Text book of a course of lectures, on the theory and practice of physic: for the use of the medical students of Harvard University (Part 1).

TEXT BOOK

OF A

Course of Lectures,

ON THE

THEORY AND PRACTICE OF PHYSIC.

PART FIRST.

By JAMES JACKSON, M. D.

FOR THE USE OF THE MEDICAL STUDENTS

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INTRODUCTION.

THE Science and the Art of Medicine are confessedly imperfect; yet so great is the amount of knowledge possessed by the world, if we take all which could be gathered from those, who practise the art, and so numerous are the details, into which that knowledge would carry us, that probably there are very few men, who know half that is known of this science and this art. Although one man may know more than any other, yet that man is probably deficient in many points, on which others are well informed. No man then can be considered qualified to teach the whole of this science and art. But it is obvious that the fullest time usually allotted to a course of lectures must be vastly too short to communicate all, which one man of common talents and common industry, must have acquired in a few years only devoted to the study and practice of medicine. Every expedient, therefore, which can help the teacher, should be adopted.

The advantages in giving instruction by lectures on medicine and similar subjects, where there is

not any demonstration nor experiment, must consist principally in the stronger and more lasting effect produced by impressions on the mind conveyed through the ear, than by those conveyed through the eye. But these advantages cannot be secured, except great method and distinctness be observed in the oral statements. The greatest difficulty to the hearer is to keep in mind the method, which is laid down. Likewise in listening to the details of evidence in support of one proposition, the hearer is liable to forget the train of propositions, with which it is connected. To obviate these difficulties we must avail ourselves of the eye and the ear at the same time. This may be done by the use of a syllabus, or of a text book placed in the hands of the pupil.

In the year 1816 I prepared very hastily, and amidst many pressing engagements, a syllabus for my course of lectures. Imperfect as this was I have reason to believe that it has been useful to those, who have attended me. As however the edition then printed is nearly exhausted, it was proper for me to think in what way I could render this little volume more perfect. And on full consideration it has appeared to me expedient to prepare a text book in preference to a syllabus. Since the establishment of the Hospital in this place I have been able to carry my pupils to visit the patients in this excellent Institution and have there given them clinical instructions. But the pupils,

engaged in attending courses of lectures on other branches of medicine, have found it as difficult as I have to spend the time necessary to visit the Hospital, without giving up some of the hours formerly devoted to the lectures on the theory and practice of physic. Hence I have been compelled to shorten my course on this last subject. This difficulty may I conceive be diminished, if not obviated, by a text book. For not only in that much may be read, which would otherwise be stated in the lecture room in more words; but the method of the discourse and the most important propositions being always before the eye, there must be less occasion for repetition and recapitulation than there would be otherwise.

It must however be remarked that a text book, as well as a syllabus, need not be equally precise, nor equally full on all subjects. In this respect I shall be governed by considerations of expediency. Thus in the part, which relates to physiology, so far as that division of the science is discussed in my lectures, it seems to me proper that the text book should be more full than in those parts, which relate to pathology and therapeutics.

The science of medicine admits of four great divisions, *physiology*, *hygiene*, *pathology* and *therapeutics*. Each of these, in a full discussion of the

science, should be considered separately. But it is not convenient to describe each disease under pathology, and then to introduce the same again under therapeutics in order to state the mode of cure. It will be more convenient to consider the general principles of the science under these divisions, and then to describe separately diseases and the treatment adapted to them. This separate description of diseases and their treatment I shall denominate *the practice of medicine.*

As time will not permit me to treat of hygiene in my winter course, addressed to medical pupils, although it constitutes the principal subject of the lectures delivered to the under graduates of the University, I shall not at present prepare the part of my text book relating to that division of the science.

In this place I wish to make some observations on the first division, physiology, in order to show the extent of this division of the science and to show how small a part of it will be considered in this course.

In a full and systematic view of physiology the following objects should be regarded. I. The structure of the various parts of the human body; —the simple textures, the organs into which these enter, and the physical properties of the fluids. II. The chemical composition of these various

parts. III. The vital properties. IV. The functions of the various textures and organs. V. The growth of the whole body and the occasional developement of particular parts. VI. The varieties of the human race, viz. those of sex, race and temperament. VII. The relations existing between the living system and external things. VIII. Death, or the modes in which life terminates.

Some of these topics are discussed in distinct courses of lectures. The structure of the body and the functions of its various organs are the subjects of the anatomical course; and from the difficulty of obtaining a good acquaintance with these subjects, as well as from the fundamental importance of them, they well deserve to constitute a distinct branch of study. The composition of the various animal solids and fluids constitutes a part of the chemical course. The consideration of the other topics might be entered upon with sufficient propriety in the lectures on the theory and practice of physic. But the period allotted for this course will not allow full attention to these objects without a neglect of things more important. I therefore introduce under the head of physiology such topics only as are subservient to the subsequent parts of the course.

It is the especial object of the physiological part of my course to point out what pertains to the subject of vitality. As the most brief and conve-

nient way of doing this I shall describe in a general way the functions common to all organized living beings, and then the vital powers or properties, which are displayed in the performance of these functions. The same plan will then be pursued in respect to the functions and vital properties peculiar to animals. Next the mutual relations between the different organs will be stated; and afterwards the relations existing between the living human system and external things. Lastly, death, or the modes in which life terminates, will be described.

PHYSIOLOGY.

I. Every organized living being is an integral being, a whole by itself. It bears relations to things external to itself; but it does not, in its perfect state, immediately depend on any one individual external thing for the performance of its functions and the maintenance of its life. Its powers depend only on the being who gave them.

II. There are three kinds of functions, which are performed by all organized living beings. These are those of ASSIMILATION, FORMATION and EXCRETION.

III. Every organized living being requires supplies from without, although not dependant on any individual portion of matter for those supplies. Every such being receives these supplies and changes the materials to a fluid* fitted to furnish both the other fluids and the solid organs necessary to its existence. This is *assimilation.*

IV. The organization, by which the functions of assimilation are performed, is in some beings more,

* If this proposition be couched in terms too general it will at least be admitted in respect to those animals and vegetables, whose economy is best known to us.

in some less complicated. The organs, by which the food is received, perform a function subordinate to those of assimilation, and may be regarded as belonging to the organs of assimilation.

V. In plants the food is first received by *absorbing vessels*, principally in the roots. These vessels are continued into others, which pass through the leaves and returning are distributed to the various parts of the plant. The material in the vessels passing from the roots to the leaves is called sap; that in the vessels passing from the leaves is called *succus proprius*, and consists of the food now entirely assimilated. Something appears to be thrown out from the leaves; and although it is not certainly known, yet it is highly probable that something is added there to the materials in the vessels. If any thing is added, this is still derived from without by absorbing vessels, analogous in their general character to those of the roots.

VI. Hence it appears that the food is assimilated in plants while passing through vessels, which are analogous to the large blood-vessels of the human body; vessels to which may be given the general names of *carrying and distributing vessels*. Accordingly, whatever change is wrought in the food in producing the *succus proprius*, that is, in the functions of assimilation, must be attributed to the influence of the carrying and distributing vessels.

VII. In animals the organization, necessary for the functions of assimilation, appears to be more

complicated than in vegetables, or plants. In the latter the food is taken up in small particles by numerous vessels. In animals generally, if not universally, there is an organ called a *stomach.** This varies in different animals, consisting of more parts in some than in others; but it may be regarded as a large vessel, into which masses of food may be received and in which this food is partially assimilated. In the more perfect animals there are connected with the stomach certain subordinate organs, each of which prepares and pours into it a peculiar fluid, or aids it in some other way. Of the materials received into the stomach, a portion is discharged from it, without having been assimilated.

VIII. From the stomach there arise absorbing vessels analogous to those of plants, and these vessels are continued into the carrying and distributing vessels. The absorbing vessels, which arise from the stomach in the more perfect animals, are called *lacteals.* The vessels, into which they are continued, are called *blood-vessels.*

IX. That part of the food, which is taken up by the lacteals, is called *chyle.* This, after it has been received into the blood-vessels, is changed in its properties and is then called *blood.* Thus it appears that in animals assimilation is commenced in the stomach and is perfected in the blood-vessels.

*The word stomach is here used in its most extensive and general sense and is equivalent to the words *alimentary canal.*

X. The food, after assimilation, both in plants and animals, is in a fluid state. This assimilated fluid always differs in its properties from the crude food, from which it is derived. The change wrought in its assimilation cannot be attributed to any mechanical process; nor can it be attributed to any such chemical process, as can be effected out of the living body. The affinities, by which the elements of the assimilated fluid are united, are not those which operate, when the same particles are brought together out of the living body. Those affinities may therefore be called *vital affinities*, in order to distinguish them from those affinities which exist in dead matter and which are called chemical affinities. These vital affinities must be communicated by the living organs, through which the elements possessing them have passed; since these elements are exposed to no other agent.

XI. The assimilated fluid in living organized bodies is used for the *formation* of the various solid parts, or organs of such bodies, and for that of the secreted fluids employed in the various functions of the same. To this use it is applied by vessels continuous with the carrying and distributing vessels; though generally the former are of less size than the latter. The vessels employed in this application of the assimilated fluid may be called *formative vessels.*

XII. The functions of the formative vessels are exceedingly similar in their character to those of the assimilating vessels. They receive a certain

material and they discharge a material, possessing undoubtedly the same elements, but differing in composition and other properties. Whatever difference there is between the solids or liquids formed and the assimilated fluid, must be attributed to the influence of the formative vessels; for to these alone the materials in question are exposed. And this influence of the formative vessels must be owing to the vital powers of those vessels; since the effects are not consistent with any laws operating in dead matter alone.

XIII. The evidence, that the formative vessels exercise the influence attributed to them, will not probably be disputed. But it should be distinctly remembered that the kind of influence exercised is known only by the effects. The action of the vessels is not the subject of any of our senses, and there is nothing performed by one portion of dead matter on another, by which it can be illustrated. We may be able to show what the action, or influence of these vessels is not; and thereby ascertain in some measure what it is.

XIV. In the more perfect animals at least, as in man, the stomach rejects, or discharges a certain portion of the food received, without employing it in the formation of the assimilated fluid. The matter thus discharged is called an excrement and the function is denominated *excretion*. This excrement from the stomach, or first passages is, in the more perfect animals, mixed with the fluids

poured into those passages by the subordinate organs, such as the liver, and by the formative vessels, which terminate in the coats of those passages. Thus the excrement from the stomach, or alimentary canal is composed in part of materials derived from the blood, or assimilated fluid. These materials do not appear to be poured into the alimentary canal merely for the purpose of excretion, but to subserve in some way the purposes of that canal.

XV. There are other fluids discharged from every living organized body, some in a liquid and some in a gaseous state, which have previously constituted properly a part of such body, and which are at length separated for excretion alone.

XVI. It would seem that the materials, which constitute the organs of living bodies, are incapable of constituting parts of those bodies beyond a definite period; and that that period is less by much than the ordinary period of existence of such bodies themselves, as wholes. The particles of such bodies are therefore taken up by vessels very similar to those, which take up the food to be carried into the body. The name of *absorbing vessels* is therefore given to the vessels, which take up these particles. It is not improbable that in vegetables and the simplest animals these absorbing vessels connected with the excreting system terminate in other mouths, by which they discharge at once the materials they have taken up. In the more perfect animals however it is not so.

XVII. In these animals the absorbing vessels, last described, terminate in the same blood-vessels, which receive the supplies from without for distribution. Thus the blood, contained in the distributing vessels, consists of a heterogeneous mass, viz. the chyle or imperfect blood, the blood perfectly assimilated and the waste brought from the various parts for excretion.

XVIII. To relieve themselves of the waste matter thus brought into them, the blood vessels are continually pouring out excrementitious fluids through different organs, viz. the kidneys, skin and lungs. The vessels, by which these excretions are discharged from the blood, are continuous with the blood vessels, and may be called the *excreting vessels.* The materials discharged are no doubt selected by these vessels, in some mode, from the purer parts of the blood; and these materials are so acted upon by the excreting organs as to be brought into a state fitted for excretion. The excrements from the skin and from the lungs are ordinarily discharged in a gaseous and insensible form, as are those of plants.

XIX. The statements thus far made apply in some measure to the functions of assimilation, formation and excretion in all organized living beings. The organs common to all appear to be vessels absorbing at one extremity, and pouring out at the other for the purpose either of formation, or excretion; while the intermediate portion of such

vessels, by which the absorbed matter is carried and distributed to the various parts, is of various length and in some beings more, in others less complicated as to form. These vessels in every part appear to perform functions, which they are enabled to do only by vitality.

XX. It may now be well to consider somewhat more fully the system of vessels, which in man and the more perfect animals serve to carry and distribute the blood to the various parts of the body. In such animals the blood is not all used in the several parts, to which it is carried at any one time, but is returned in part for further use into the common mass. This is effected by an arrangement of the vessels, by which the blood is made continually to circulate throughout the body. This *circulation of the blood* and the changes wrought in the blood during the circulation of it will now be considered. The change of chyle into blood has already been stated, and referred to the only possible cause, viz. the vessels in which it takes place.

XXI. In the more perfect animals there is always a quantity of blood, contained in its appropriate vessels, more than is requisite for the immediate purposes of formation. This blood is made to circulate by an apparatus well known. In man the perfect blood is carried from the heart by the aorta and distributed to every part of the body. The large arteries may be called the *distributing ves-*

sels. Probably the blood is carried through the arteries principally by the power of the heart. These arteries terminate in the capillary vessels, which constitute a net-work. This net-work is found in every part of the body, and it seems destined to contain, as in a store, the materials for the use of the various parts. From this store the extreme arterial vessels derive materials, whether for formation, or excretion. What intermediate apparatus there is between the capillaries containing red blood and the extreme vessels, we do not certainly know. We have however reason to believe that by a power of selecting the materials wanted, or by a power of refusing those not wanted, and not by any mechanical arrangement, the extreme vessels of every part receive only such portions of the blood, as are fitted for their purposes respectively.

XXII. In regard to the capillary vessels, we have reason to believe that they must always be supplied with florid, or arterial blood; that, if they are not so supplied in any part, vitality soon ceases in that part; and that this happens so soon, as to exclude altogether the idea that the failure of vitality is owing to the failure of nutrition.

XXIII. We have also reason to believe that the motion of the blood in the capillaries is not entirely regulated by the motion of blood in the arterial trunks; and particularly that the degree of the fullness or enlargement of the capillaries is

referrible to their own actions, and not at all to that of the heart or arteries.

XXIV. The blood is never stagnant in the capillary net-work, but is constantly passing from that into the veins. By these it is conveyed to the right auricle, and by this to the right ventricle of the heart. Such is the general course, but we find an exception to it in the vessels of the abdomen. The veins of the abdominal viscera, with the exception of the liver, carry their blood to that organ through the *vena portæ*. This vessel appears to assume the office of an artery; and, by a new distribution of its blood, it fills those capillary vessels of the liver, which furnish the materials for the secretion of bile. The blood, which is not used for this purpose, is again collected into veins and unites with the common mass carried to the right side of the heart.

XXV. The blood, which is brought to the right side of the heart, and as it is found in all the veins of the aortal system, differs in some respects from that which is sent from the left side through the aorta. The most striking difference, though it may not be the most important, is in the colour. The blood of the right cavities of the heart, venous blood, is of a colour which has been called modena red; that of the left side, arterial blood, is of a bright scarlet. Another difference, ascertained by experiment and already referred to, is that the distention of the capillaries with the blood

of a modena red colour will not maintain the vitality of the parts, to which such capillaries belong. Other differences have been pointed out, but there are none ascertained to which much importance can be attached, either as a means of distinguishing the two kinds of blood, or as accounting for their difference. It seems certain that whatever change is wrought in converting the arterial into venous blood, must be wrought in the capillary vessels by those vessels, and by the extreme vessels connected with them.

XXVI. From the right ventricle of the heart the blood is sent through the pulmonary artery to the lungs. Here it passes through arteries, capillaries and veins, as in the aortal system, and is delivered by the pulmonary veins to the left auricle. From the left auricle it passes into the left ventricle, and thence commences anew the course already described. In passing through the lungs the blood changes its colour and other properties, and this change appears to be wrought in the capillaries. Hence the arterial blood of the lungs corresponds in its characters with the venous blood of the other parts of the body, and *vice versâ*.

XXVII. The nature of the changes wrought in the blood, while passing through the pulmonary vessels, and the mode in which these changes are effected, have been the subjects of much investigation. The investigation has not perhaps afforded entire satisfaction to any one. What is certain is

that the mucous membrane of the lungs is constantly exposed to atmospheric air; that this air, or at least air containing oxygen gas, is essential to produce the pulmonic change in the blood; that the air expired from the lungs contains less of oxygen gas than that inspired; and that carbonic acid gas appears in the air expired to have taken the place of the oxygen gas which is lost. It is then obvious that carbon is added to the air inspired. With this there is also discharged from the lungs some vapour, which is mostly, or entirely aqueous. So far the lungs are shown to be excretory organs. Whether any thing else is effected by the passage of the blood through the lungs and by the influence of the air, to which it is there exposed, is not known. How the abstraction of carbon, and the loss of water should change the colour of the blood and render it fit for the purposes of arterial blood is not known. But neither is it known that those excretions are not sufficient to effect the changes just mentioned. As the capacity for heat of carbonic acid gas is less than that of oxygen gas, it is probable that some heat is derived to the lungs in a latent state from the air.

XXVIII. The functions of assimilation, formation and excretion have been considered so far as they are essential to the preservation of individual organized beings already in existence. But such beings have the power of *reproducing their kind.* As preparatory to the consideration of this power

and the exercise of it, it may be well to remark, what otherwise deserves especial notice, viz. that the organs, performing the several functions above mentioned, those of assimilation, &c. do not act except upon the application of the appropriate stimuli, and that certain conditions are necessary in different cases, to their action even upon such application.

XXIX. The due conditions, which vary in different organized beings, being complied with, individuals of every species are capable of reproducing their kind. In so doing they exercise the formative functions. As a plant can form its branches and its leaves in the course of its development, so also can it form its flowers and its fruit. But this fruit contains the offspring of the plant in embryo; and this is capable, under proper circumstances, of being developed by its own powers and becoming a perfect plant, like that from which it was produced. In forming its fruit, the plant exercises no powers not exercised in its own growth.

XXX. When stimulated by the presence of the *succus proprius* of the plant, the formative vessels convert this, or parts of it, into solid organs and secreted fluids for the growth and support of the plant itself. In like manner do the formative vessels form the flower bud and all the parts of fructification. The several parts of fructification prepare by similar vessels the appropriate materials. The presence of these materials, or of other causes,

stimulates the proper organs to the actions necessary for effecting the ultimate purpose of their formation.

XXXI. In the more perfect animals the preparation of the organs of generation, and in the male the presence of the seminal fluid occasion peculiar sensations, desires and voluntary actions, which correspond with other sensations, &c. in the animal system hereafter to be considered. What now deserves notice, is, that there is a general analogy in the functions of reproduction in all living organized beings; that these functions, so far as they are common to such beings, are similar in their general character to those of growth and preservation, as performed by the formative vessels; and that the arcana are not more perfectly hidden in the one case than in the other. In both we may trace effects more or less minutely, but we cannot elucidate their production by any mechanical or chemical principles.

XXXII. It may be well now to consider what peculiar powers or properties are brought into exercise in the functions which have been described, as common to all living organized beings. Whatever powers or properties are found to exist in such beings, which do not exist in common or dead matter, may be called *vital powers* or *properties.* The term *vital* is here employed as descriptive and not as explanatory.

XXXIII. First, common or dead matter is intro-

duced into a living body, without possessing any vital properties, or not the same which it is afterwards endowed with. When this common matter is made to constitute a part of the solids or liquids of the living body, it acquires life and whatever properties are appropriate to such solids or liquids. But this life and these properties it must receive from the living body itself. This inference is not drawn from any fancied knowledge of the nature of vitality or life; it is drawn from the consideration that there is nothing else, to which the vivified matter has been exposed, except the living body. It is by that body then, that the matter must have been vivified. This then shows that a living body possesses one peculiar power, which may be called the power of *vivification.*

XXXIV. Second, from the consideration stated in § X., it appears that all parts of living bodies, all their elements, must become possessed of peculiar affinities, which, in contradistinction to chemical affinity, may receive the general name of *vital affinities.* The decomposition of organized bodies after death, is to be referred to the influence of chemical affinity, which operates among the elements recently united by the laws of vital affinity.

XXXV. Third, the various functions which have been described, are not performed without motion. In plants this motion is principally shown in the action of the vessels on their contained fluids. This motion cannot be attributed to any of the

attractions or causes of motion which act in common matter, such as the attractions of gravitation, electricity, magnetism, chemical affinity, and crystallization. It must be attributed to some power of originating motion which is peculiar to living beings, and may be called *vital mobility.*

XXXVI. Fourth, this mobility does not seem to operate spontaneously, but only on the application of a stimulus either to the part, which is to perform the motion, or to some other part connected with that. But the power of being impressed by a stimulus is different from, though most closely connected with mobility; and therefore the former power should have a distinct designation. That power is called *irritability* by those who make the distinction; for some physiologists employ this name for the two powers conjointly. Irritability is also shown in some organs in the performance of functions, which may or may not depend on motion, but which certainly do not depend on sensible motion. Thus an agent being applied to a secretory organ, or to parts connected with it, and its secretion being increased, we call that agent a stimulus, and consider the organ as evincing irritability. Yet it may be, that the *action* of this organ is not attended by any motion. It is in this broad sense, that Mr. John Hunter often employs the word *action*, without necessarily implying that any motion occurs.

XXXVII. Fifth, the different parts of organized

beings are found to act in connexion, so as to effect one object, which one part alone could not effect. Instances of this sort may not be obvious in all organized beings. There are however many instances in plants, especially in the parts of fructification. Such cooperation has been referred by some physiologists to a peculiar power, and this has been denominated *synergy.**

XXXVIII. These properties then, viz. vivification, vital affinity, mobility, irritability and synergy, as being common to all organized living beings, may be called *organic vital properties.* In like manner the functions, which have been described, may be called *organic functions.*

XXXIX. The functions and the properties, which have been described, are sufficient to maintain simple life in any organized being. The form, the size and the number of organs belonging to such beings may be various. The apparatus for effecting any one of the functions described, may be more or less complicated. In quadrupeds the organs for assimilation and for the distribution of the assimilated fluid are vastly more complicated than in vegetables, and in the lower order of animals. Yet in all there is, probably, a great similarity in the absorbing and formative vessels. These last most especially are common to every

* See Barthèz sur le science de l'homme.

part, and may be regarded as organs of the very first importance.*

XL. It may now be remarked that by the functions, which have been described, *other organs may also be formed* besides those destined to the organic functions themselves. Such organs may resemble those of all organized beings, so far as regards simple life; that is, they may be formed by vessels of the same character, and as their particles decay they may be removed and replaced in the same manner, as those destined for the organic functions alone. At the same time the superadded organs may possess peculiar powers, by which they may enjoy a higher species of life than that of the beings, which perform the organic functions alone.

XLI. What is stated in the preceding paragraph as possible, corresponds precisely with what actually exists in animals of the higher order. In man the superadded organs are the brain and nerves, organs of sense, of locomotion and voice. It now becomes necessary to describe the functions of these organs very briefly. These organs have been denominated the *organs of animal life*, since they are found only in animals. They are not,

* If the inquiry be made how these organs themselves are formed, a satisfactory answer may not be furnished. Perhaps the speculations and experiments, in which Sir Everard Home and Mr. Bauer have of late been engaged, will lead to a more perfect answer to this inquiry, than can at present be given.

however, all of them, found in every species of animal.

XLII. Without engaging in discussions respecting the nature of the *mind*, we may be permitted to regard the *brain as its seat*, or as the organ through which it operates. In a general view of the subject, it may be said that the integrity of the brain is necessary to the healthy exercise of the intellectual and all the mental functions, as well as to that of the other functions of the animal organs.

XLIII. The brain, or encephalon is of itself a very complicated organ, but the distinct functions and purposes of its several parts are unknown.* It communicates either directly, or through its continuation, the *medulla spinalis*, with every part of the body by means of *nerves*. The nerves terminate for the most part in extremities too fine to be demonstrated by the anatomist. It is in these extremities that the most important offices of the nerves are performed. The intermediate trunks appear to serve only as *internuncii* between those extremities and the brain.

* Different functions have indeed been assigned fancifully to different parts of the brain, both in former and in later times; and recently some experiments have been made, from which inferences in respect to the distinct uses of the various parts of the brain have been drawn. (See Edin. Med. and Surg. Jour. for Jan. 1824.) But the subject has not yet been so investigated, as to authorize us to say we have any knowledge in respect to it.

XLIV. The *functions*, which the nerves are *known* to perform, are *of two kinds;* but there are functions of a *third kind* also, which may be attributed to them with a great degree of probability. These functions are, first, those of *sensation;* second, that of *producing voluntary motion;* and third, those of *sympathy.*

XLV. It is not necessary here to describe the several organs of *sensation* and the different offices they perform. It may be stated generally that an organ of sense consists of such parts, as will favour the action of the object of sense on its nerve. The nerve being acted upon, the impression is conveyed with the greatest rapidity along the trunk of the nerve to the brain. This trunk is incapable, in any of its parts, of being acted upon by the object of sense, although it can convey the impression derived from it. This is true at least so far as regards any specific sensation; for the feeling of pain may be derived from the action of a foreign body on the trunk of a nerve. It is then in the extremity of a nerve in an organ of sense and in the extremity in the brain that its most important powers appear to be placed. *Sensation* may be said to take place *in the organ of sense;* while *perception takes place in the mind*, in consequence of the effect propagated to the cerebral extremity of the nerve.

XLVI. In the production of *voluntary motion* the nerves serve only to convey the commands of

the mind from the brain to the muscles; these last are the immediate organs of motion. In thus conveying the commands of the mind, as well as in the function of sensation, the extremities of the nerves are the most important agents. The extremity in the brain may be considered as acted upon by the mind, and the other extremity as acting upon the muscle. The muscle may be regarded as having a power of motion similar to that of the organs of motion in all organized beings. The only peculiarity of an animal, or voluntary muscle is that it is susceptible of the stimulus of volition. The phenomena are volition in the mind to perform a certain motion, and the performance of the motion. But the volition is not followed by the motion, if the nerve be compressed, or cut off in any part of its course, or if the muscle be not in a sound state. The trunk or body of the nerve serves only to make the communication from one extremity to the other.

XLVII. It appears by the observations of Mr. Charles Bell* that there are distinct nerves for the different functions of parts performing more than one office; and that the nerves of motion supplying different parts are in some way connected, so far as they are destined to excite motions in reference to the same objects. Thus by the

* See Phil. Trans. of the Roy. Soc. of Lond. for the year 1821.

arrangement of certain nerves all the muscles, in any way subservient to respiration, are classed together. Those nerves are called by Mr. B. the *respiratory nerves.* The very same parts, to which these nerves go, are furnished with other nerves for the purposes of sensation and for common voluntary motion; for which purposes the respiratory nerves are inefficient. These respiratory nerves may be regarded as *sympathetic.* That is, they serve to keep up a communication between organs, which are distinct, but which are often to act in unison in consequence of impressions made in one point. By a division of any one branch of these nerves the muscles supplied by that branch will be prevented from acting in unison with the other muscles of the same class.

XLVIII. In the case last supposed, in which one branch of the respiratory nerves is divided, the muscles supplied by that branch do not lose in any measure their mobility. Accordingly they may be excited to motion for other purposes, through a distinct set of nerves. This is shown very clearly, when the *portio dura* of the seventh pair of nerves is divided. Hence it is evident, among other things, that the *power of motion* in muscles is *not derived from the nerves.*

XLIX. It seems certain that the functions of assimilation and formation cannot be performed by powers derived from the nerves; since these functions are performed in vegetables, which are

destitute of nerves.* Yet these functions are undoubtedly influenced by the nerves, and some physiologists of the present day have attempted to show by experiments on brute animals, that digestion and secretion are performed by some immediate influence of the nerves. The true explanation of those experiments may however be found in considering the nerves as organs of sympathy between the different parts of the organic system.

L. In tracing living beings from those, who are the most simple, to those, who are more complicated in their organization, we can perceive the advantage, if not the necessity of a sympathetic connexion between the different parts, performing the organic functions, in those who are more complicated. In the vegetable there is an immediate continuation of vessels from the roots to the various branches, to the leaves and to the parts of fructification. But if a part of the root is injured, the rest of it may continue to perform its functions as before. One branch may be lopped off and the others will not have their vigour impaired. There is not any central organ, or organs, whose functions are essential to the rest. Each part above the ground is dependent on some part of the root;

* It has indeed been suspected that vegetable beings have nerves; but this suspicion has arisen only from a theory, which requires them, and is not supported by any anatomical observations.

but the integrity of the whole root is not essential to any one part.

LI. On the contrary in the more perfect animals there are several organs, the integrity of which is more or less essential to the life and health of the whole body. Thus the stomach and the other organs subservient to digestion labour for the whole body and are essential to it. So too the heart is essential, though it does nothing probably in the work of assimilation, and though it possesses nothing more of vitality than other organs and is not a source of vital power to the other organs. It is however essential to the whole, because without its aid the constant want of fresh blood in every part cannot be satisfied. In like manner are the lungs essential.

LII. But not only are the different organs essential to each other, it seems necessary that they should have some correspondence; that they may have, if the expression can be allowed, a feeling of each other's wants. The stomach, even if its vitality could be maintained, would not labour, if it were insulated and were not acted upon by the parts, which require the supplies prepared by it. It must feel the stimulus of necessity; to adopt an expression of Mr. Hunter's, which has been unjustly criticised. This feeling is indeed without any distinct perception by the mind; and if it is said that the term *feeling* is not properly used in such a case, then let some other term be

employed. The opinion intended to be expressed, and which is rendered intelligible probably to every one by the language employed, is not to be confuted by showing that a word has been employed in too limited a sense.

LIII. If this doctrine be admitted, it will probably be allowed that the intercourse, or sympathy between the different organs is more likely to be maintained through the nervous system than in any other mode. But this likelihood may be tested by cutting off the nervous communication between any one of the great organic viscera and the rest of the body. Now this is what has been done by various experimental physiologists and it appears that, when thus insulated, the great organic viscera fail at once to perform their functions. The muscles of inspiration will not act, if they have not a nervous communication with the lungs, for which they act. The stomach will not digest food, and the liver will not secrete bile, if they be not connected by the nerves with the other parts of the body.

LIV. On the other hand it is not essential to the extreme vessels, which perform nutrition, that they should be connected with other parts. If the organs, to which they belong, are duly exercised, these vessels will perform their functions. Thus a paralytic limb fails to be nourished, only in proportion as it ceases to be exercised. This is shown by the fact, frequently observed, that a

disuse of a limb from any cause diminishes the nutrition of it; as much when it is not palsied, as when it is. In neither case does the nutrition fail entirely. But if every part except the stomach were truly palsied, then would the stomach cease to act; for it would be in the same state, as when the nerves, which go to it, are divided.

LV. The *sympathetic influence* of the various organs on each other is *not commonly noticed in health*, because its only effects are to maintain every part in the easy and regular performance of its functions. But *under disease* this influence *is* constantly manifested and recognized; and the only difficulty in many cases is to trace to their origin the complicated effects produced by it. Thus a disease, not violent in its character and not attended by pain, may be going on in some part of the body comparatively unimportant. This may occasion a derangement in the functions of the stomach; this derangement may soon cause an irregularity in the hepatic functions; and the disorder in the stomach or liver, or in both may occasion affections of the head, or of the heart, or of the muscular system; and thus may be produced a series of complicated symptoms, under which it may be exceedingly difficult to detect the original seat of mischief. It is only when a knowledge of the remote cause shows what part was first affected, or where the disease is situated in some part which is exposed to view, or when some other

peculiar circumstances demonstrate the first seat of disease, that we can certainly trace to their source such a series of symptoms, as has been described above.

LVI. It is then to be remembered that sympathy may be constantly operating in health and its effects may not be noticed, because they serve only to maintain order; and that, although its effects are more obvious in disease, yet they may be overlooked in disease also, when the original affection occasioning them is not distinctly manifested. But that in all cases, where nervous influence is demonstrated,* and where that influence does not consist in sensation, nor in the communication of volition, we are authorized to regard it, as an influence by which a correspondence is maintained in the organic functions. This correspondence it is, which is denominated sympathy.

LVII. It is next to be observed that by sympathy the extreme vessels, which perform the formative and excretory functions, operate on the great central organs, of which the heart and the stomach are the most important, much more powerfully than these great organs operate on those extreme vessels. This is peculiarly true as respects the heart; for the stomach does operate by sympathy very powerfully on all the other organs. If however the instances of a sympathe-

* As in the experiments of Dr. Philip on the stomach.

tic influence originating in the stomach are very frequent, it is to be remembered that this organ is more frequently exposed to causes of offence than any other part of the body. In a healthy and vigorous state of the system however it will bear very great derangement without a disturbance of any other part; while the same is not true of the organs of formation and vascular excretion. These remarks seem to be true in point of fact; and the final cause of the laws of sympathy, which they point out, is sufficiently obvious.

LVIII. To understand this final cause it is to be considered that, when the functions of the extreme vessels are deranged, it may be very necessary that the heart, which labours for them, should have its actions in some measure modified. If we cannot tell how this happens, that is, if we cannot see how the change in the functions of the heart may aid the diseased vessels in a given case, yet we can see that some change may be requisite. On the other hand we do not see any advantage in a change, or modification of the functions of the extreme vessels under a disease of the heart. The heart bears a mechanical relation to those vessels, by which it influences them; but it need not call for their aid, when it is diseased, and therefore does not require in them any peculiar sympathy. The same considerations do not apply with equal force to the stomach, as related to the extreme vessels; and accordingly we

find the sympathy between those vessels and the stomach to be more nearly mutual, than between the same vessels and the heart.

LIX. The *functions of the nerves*, sensation, and its transmission, the transmitting of volition and sympathy, are *not* to be *explained on mechanical principles.* At least they never have been so explained in a satisfactory manner, though the attempt has often been made. Nor are they to be explained on any physical principles, with which we become acquainted by the investigation of common dead matter. *The properties of the nerves are strictly vital.* The functions they perform, occur only in living beings, only in animals; and we ascertain their properties only by ascertaining their functions. Seeing what these functions are, we say they have the powers, or properties of performing those functions. Thus we say they possess sensibility, and the power of transmitting sensations so as to produce perception in the mind, the power of transmitting volition and the power of producing sympathy. These may be called *animal vital properties;* and under the same name may be included the properties of the mind.

LX. *Sensibility* is of various kinds. It is *specific* in the various organs of sense. The sensibility of the optic nerve is evidently different from that of the auditory nerve. There is also a *common* sensibility, by which we become susceptible of corporeal pain, or pleasure. Even in this respect we

find that parts of different texture, and that different organs have in some measure peculiar kinds of sensation, when in pain; whence perhaps some specific modification of sensibility may be inferred. Whether the power of transmission is just the same in all nerves we do not know.

LXI. There are not any observations, which show any specific modifications in the powers of nerves transmitting *volition.* The same may be said in respect to the nerves, by which sympathy is maintained. This subject however may be considered as *sub judice.* Mr. C. Bell and his disciples are engaged in collecting the evidence. After they have presented this, a decision may be had. In respect to the power of *sympathy* it must be added that its efforts are sometimes *active* and sometimes *passive;* that they may be either *local* or *general;* and that, when local, they may be manifested in parts, which are *continuous*, or *contiguous*, or *remote.* Likewise what is called general, or constitutional sympathy is not commonly shown in the whole system strictly speaking; but in some one of the subordinate systems. Thus we call the sympathy general, if it is shown in the circulating system, or in the system of extreme vessels, or in the muscular system, &c.

LXII. *Perception* and *volition* are the functions of mind most distinctly connected with the functions of the nerves. These functions certainly show distinct powers in the mind; powers obvious-

ly different from those of memory, judgment, &c. This doctrine is not, and cannot fairly be regarded as inconsistent with that of the unity of the mind. Nor is it inconsistent with the doctrine of the immateriality of the mind. If these propositions be denied, the burden of proof must rest on those, who deny them. The powers, or properties of the mind are obviously to be included among the animal vital properties.

LXIII. The various functions of the human body having now been stated in general terms, it may be convenient to notice more distinctly the *relations*, which are maintained *between the different organs* performing these functions. These organs are related to each other in two modes, which may be denominated *mechanical* and *vital*. The mechanical relations depend on causes similar to those by which the different parts of an inanimate machine may be connected with each other. The vital relations are such as belong only to living bodies, depending on the vital properties. These two kinds of relation may be illustrated by a few instances.

LXIV. When the stomach propels its contents into the *duodenum*, its influence upon that intestine is similar to that of one part of a machine delivering its contents to another part of the same, in order to produce some action in that. Similar to this is the influence of the heart upon the arteries, when the former pours out its blood into the latter.

Such too is the influence which the diaphragm exercises in its motions upon the viscera of the two cavities, which it divides. That is to say, in each of these cases the relation of the one organ to the other is mechanical, although the moving organ acts by a vital power.

LXV. When a nerve, being acted upon by a foreign body, propagates the effects to the brain, the influence is such as is exercised only in living bodies. There is not any evidence that in this case matter, or even motion is propagated along the nerve. The same is true in respect to the propagation of volition; so that the relation of the brain to the voluntary muscles may be called vital. The same is true in respect to organs, which exercise a sympathetic influence upon each other.

LXVI. There remains to be noticed certain effects resulting from the relation of the body to the mind. The mind is affected by the body not only from causes operating on, or in the body, which occasion distinct sensations. The mind has also the emotions of pleasure or pain from states of the body, of which states, however, it does not take any distinct cognizance. There is a feeling of vigour, of satisfaction, of comfort, or of hilarity, which arises from the full possession of all the powers, and the easy performance of all the functions of the body. Opposite feelings result from an embarrassment of the functions, or a failure in the powers, which do not necessarily acquaint the

mind with the difficulty which exists, nor even with the situation of the difficulty. Certain states occasion those desires called appetites, in which the mind is influenced by the changes in the body, as positively as in common sensations; but without any definite perceptions of those changes in the body. We discover by observation that the appetite for meat and drink arises in us when empty, or after fasting, while the desire for Venus arises in us when in a certain sense full; and that both are much influenced by the presence, or by the thoughts of its object. But the sensations accompanying, or exciting the desire or appetite in these cases, are neither definite nor exactly local.

LXVII. On the other hand, the mind acts upon the body in modes, which may be called sympathetic. Certain thoughts being present to the mind, the heart beats with more frequency and greater force; the respiration becomes deep and hurried; there is an uneasiness in the muscles, which prevents rest, or which seems to demand violent efforts; the countenance is distorted and becomes alternately pale and red, while the eye fixed on one object seems not to be acted on by common things. Some of these effects are entirely involuntary, and all of them in a measure so. They denote the passion of anger, which has its seat certainly in the mind, though its effects are manifested by affections of the body. Analogous manifestations of the other passions are also well

known. In all these cases the affection of the body may be said to result from sympathy with the mind; and there is discovered a vital relation between the mind and body.

LXVIII. It may next be considered what are the *physiological relations* maintained between the living body and external things. These relations must depend on the properties of the body, which enable it to act upon external things, or to be acted upon by them, and on those of external things capable of acting on it. The properties of the living body, which enable it to act or to be acted upon, are of two descriptions, physical and vital; the physical properties being such as it has in common with other matter; the vital properties such as have been already described.

LXIX. The living body is subject to gravitation in common with other matter. It is also subject to the action of mechanical powers. By the influence of these its structure may be injured. The injury, or imperfection thus produced, is followed by actions in the parts injured, the tendency of which is to restore those parts to a sound state. The living body may be acted upon, in any of its parts, by substances having a strong chemical affinity for those parts. In this case vitality is destroyed before, or as soon as the chemical affinities operate. If agents capable of so acting have their strength diminished below a certain point, their effect is to produce a sudden inflammation. This

is seen in the influence of heat. When a chemical action does take place, the part acted upon becomes a foreign body, and there ensues the process of restoration, as where a mechanical injury has been inflicted, and the dead matter is at the same time thrown off. The living body, by its power of motion, may act mechanically on external things. There may also be some other physical relations between the living body and external things.

LXX. The vital properties, which enable the living body to be acted upon by external things, are two. These are irritability and sensibility. A foreign substance applied to, or introduced into the body, will induce either sensation or action, or both, in the part to which it is applied. A local effect having thus been produced, further effects may ensue in consequence of the relations between different parts of the body. Thus, in consequence of the mechanical relations, such substance may be removed from the part to which it is first applied, and may be made to act successively on various parts of the body. Or, either sensation or action may be induced in various parts of the body in consequence of the vital relation of sympathy existing between such parts and the part first affected. But in every case the foreign substance acts primarily and directly upon either the irritability or sensibility.

LXXI. The particular effects of substances acting on the vital properties will depend on the character of those substances. It is only by experi-

ment on the living body, that this character can be ascertained. We do not learn it by ascertaining the physical, or chemical properties of the foreign substance. This is shown most distinctly in the influence of substances used as medicines. But it is shown in other cases. For instance, our knowledge of the chemical properties of acids would never lead us to a knowledge of their taste.

LXXII. The following may be taken as an exception to the remarks in § lxx—lxxi. Besides inducing sensation and action, it is probable that foreign substances may in some instances operate directly to diminish or suspend a vital power. It is not easy to explain the effects of narcotic substances upon any other principle. Such substances have been called stimuli; and this upon the ground that they first excite action before they produce sedative effects. It does not appear, however, that they do, all of them, excite action; nor in any case does there appear such a proportion between their stimulant and sedative effects, as that the latter can be regarded as consequences of the former.

LXXIII. The *conditions necessary to the maintenance of life* may next be considered, and thus its termination or death will be brought readily into view. In order to determine what are the conditions necessary to the maintenance of life, it is proper to fix with some precision *what we mean by life* and living beings, referring of course to such living beings as we discover on our globe. It

might have seemed proper to have given an earlier attention to this point; but it was believed that it could be done with the greatest advantage after the statements which have preceded.

LXXIV. Living beings are those which are capable of growing by intussusception, and for this purpose of assimilating foreign matter to themselves; and which, when perfect of their kind, are capable of perpetuating their species. By this definition, we may at least distinguish living beings from common matter in all ordinary cases. Such beings possess certain properties, which have been described, and which they are capable of communicating to the materials they assimilate to themselves, and of transmitting to their offspring. The possession of any one of these properties by any substance, if at the same time it be capable of being excited to its proper functions, is an evidence of life in that substance. Thus a seed, or an egg, are possessed of life; but a piece of wood, though its elements continue to be united by vital affinity, is not possessed of life. The same may be said of the flesh of an animal preserved by art. The wood and the flesh do indeed exhibit one of the properties of life, but they are not capable of being excited to perform any of the functions of life, which the egg and the seed are capable of. The vital property they exhibit is vital affinity. It is at least so far manifested as this; that the particles of the wood and flesh continue to be

united apparently in the same manner as during life.

LXXV. The conditions, necessary to the maintenance of life, are not the same in cases where there is simple vitality with a capacity of performing the functions of life as in the egg, and where those functions have once commenced as in the animal. To the egg and the seed it is necessary that their texture should be uninjured; and in all instances, perhaps, there are certain degrees of temperature necessary to them. Thus an egg will be frozen in a certain temperature, and then vitality is lost. This temperature is below that at which water freezes. An egg is also coagulated at a certain elevation of temperature, and then also vitality ceases. Seeds may likewise lose their vitality by a certain elevation of temperature; and probably there is a point, below which no seed can retain life. But the range of temperature consistent with life is very considerable in both these cases.

LXXVI. In regard to both vegetable and animal beings in the more perfect state, that is, when performing the functions of life, a temperature of a more limited range is requisite to vitality. Below a certain temperature some become torpid, and they are revived when placed in a proper medium of a higher temperature. Others, animals at least, are incapable of passing to the torpid state, in which most of the functions are arrested;

and they cannot live at all, except within certain limits, as to temperature. In the more perfect animals, there is a power of maintaining a certain fixed temperature under great variations of the surrounding medium; but this power has its limits. Those limits vary according to the habits of individuals. This is true, in respect to man, most especially. Thus man can live, where mercury freezes, provided he guard his body by such clothing as is a sufficiently slow conductor of heat; so that the warmth generated in his own body may not be too rapidly dissipated. Likewise man can live in a temperature of the atmosphere much above that, at which dead animal substances are coagulated. But life could not, probably, be maintained for a long time in so high a temperature. Probably all living beings possess, in some measure, the power of regulating their own temperature; although it is in the warm blooded animals that this power exists in the most eminent degree.

LXXVII. A supply of atmospheric air, or of some air containing oxygen, is also requisite to the maintenance of the functions of life, at least in all warm-blooded animals. Without this the venous, or black blood, is not changed to the arterial. (See § xxv.) A third requisite is the supply of food. Although this supply may be wanting, without the loss of life, for a time much longer than that for which atmospheric air can be dispensed with; yet, beyond a certain time, life cannot be maintained without food.

LXXVIII. Of the articles of food water is that, of which the most constant supply seems necessary. Indeed, as this does not undergo changes in the living body so much as other articles, it may be doubted whether it should be called an article of food. The presence of water appears to be as essential to certain microscopic animals, as that of air to man, &c.; and life may apparently be suspended and revived by the alternate removal and supply of this fluid. (See Spallanzani on resurrection of animals.) But to all living organized bodies water seems to be essential; though some can imbibe it in sufficient quantities from the atmosphere, while others can live only where it is furnished in most abundant quantity.

LXXIX. The necessity of substantial food is less urgent, for a limited time, than that of water. Yet beyond a certain time life cannot be preserved without other food than that article. The quantity of such food absolutely requisite for life is much less than that ordinarily taken. Habit has a great influence in this respect. By degrees man may become able to support life on an exceedingly small quantity of food. The exercise taken has a great influence also as to the quantity of food required.

LXXX. The conditions mentioned (§ lxxiii—lxxix) relate to external things. It is lastly necessary to the maintenance of life in man, &c. that the organization of the great central organs be entire, or

nearly so; and that the vital powers or properties exist in due degree.

LXXXI. From what has been stated, it may be learnt *how death takes place.* In the first place, if the circulation of the blood be suspended, all the organs die. This happens because the blood does not distend the capillary system. In the second place, if the respiration fails, death ensues. This happens because the blood, sent from the heart through the aorta, has not undergone the proper changes. In the third place, an injury of the brain may cause immediate death. It has been shewn by M. Le Gallois, that the whole *cerebrum* and the whole *cerebellum* may be removed, and yet life is not immediately destroyed, while the *medulla oblongata* remains entire. But the injury of the *medulla oblongata*, or a division of the *medulla spinalis* at its upper part, instantly destroys life. It has been clearly proved by experiment, that such injury destroys life by stopping respiration. This it does by destroying the communication between the *par vagum* and the intercostal nerves.

LXXXII. When life is destroyed in either of the three modes mentioned, (§ lxxxi.) the patient may be said *to expire* at once; but absolute death does not take place instantly in every part. The muscles contract after expiration, and the vital properties are lost more or less gradually. But in some instances absolute death takes place instantly, and then the muscles do not contract, but remain flaccid, and

the vital properties are all lost at once; so that putrefaction ensues immediately. When *death* takes place *under disease*, it happens sometimes from a failure of the heart, lungs, or brain, in the performance of their functions, in consequence of a local affection of one of those organs. But more commonly the powers of life are slowly exhausted, so as to cause a gradual failure of respiration and a subsequent gradual loss of all vitality after expiration. This exhaustion of the powers of life may arise in consequence of long continued local irritation, or in consequence of some cause directly destructive of those powers.

PATHOLOGY.

LXXXIII. This division of the science of medicine relates to the doctrine of diseases. Disease can be defined only by contrasting it with health. There is much more difficulty in defining the terms *health* and *disease*, than in the practical distinction of the states, which they designate.

LXXXIV. In *health* every organ is ready to perform its proper functions under the appropriate circumstances, and some of the organs are continually engaged in the performance of their functions, others are occasionally so engaged. The whole body is at ease; the discharges from the body have respectively certain appropriate characters, and the alternate states of sleep and watching can be fully enjoyed. What are the proper functions, &c. &c. it is the business of physiology to teach.

LXXXV. Strictly, every departure from the state of perfect health is a *disease;* but slight deviations from that state would not be practically regarded as such. A disease may be defined to be a state, in which we experience pain or suffering; or in which there may be discovered some change from a healthy state in the composition, structure, or

functions of some part, or in some one of the natural appetites.*

LXXXVI. In the study of diseases we have to attend to their phenomena, or *symptoms*, and their *causes*.

LXXXVII. We may regard each departure from health, or each symptom as a distinct disease. But a very little attention to the subject suffices to show that a single morbid affection may give rise to two, or more symptoms. Hence, when several symptoms are present, we are ordinarily lead to refer them to a single morbid affection as their immediate, or *proximate cause*. Other notions respecting a proximate cause may at some times have prevailed; but the expression is now used in the sense here referred to.

LXXXVIII. It is by the symptoms that a disease must be described; because by these alone it can be demonstrated. The proximate cause may be disputed, and must often be a matter of doubt. It is not possible to dispute about that which is demonstrated; but men will never agree in respect to that which is hidden, and which is matter of inference.

LXXXIX. In ascertaining the proximate cause of a disease, or that which may be regarded philosophically as the disease, aid is derived from an

* For distinguishing disease from health in practice, it is quite essential to be familiar with the phenomena of health. On this subject see Hall on Diagnosis.

examination of the body in the fatal cases of that disease. But, in considering only what happens in the living body, this cause must be learnt by attending to the symptoms in the order of their occurrence; by noting at what intervals they follow each other; and by considering, in respect to each symptom to what organ it is to be referred, and of what function it denotes a derangement; and finally, by inquiring how far one of these derangements has an influence in producing another. On these points physiology affords material aid.

XC. It must be obvious that the expression, *proximate cause*, is relative. The symptoms may all be traced to one local affection; and this is the proximate cause of those symptoms. But the question may then arise, on what particular changes or actions of the part this local affection depends. Thus, if the symptoms be traced to an inflammation of any part, it will be asked in what does inflammation consist, and what is its proximate cause.

XCI. When the symptoms and their proximate cause are ascertained, an inquiry must arise how the original affection denominated proximate cause has been produced. The causes of this original affection are called *remote causes*. Of these, there are said to be two kinds.

XCII. There are many circumstances, such as exposure to vicissitudes of weather, great fatigue, errors of diet, watching, &c. which are often fol-

lowed immediately by disease. But of many persons exposed in the same way at the same time, all are not affected with disease; and among those affected different diseases are produced. The inference is then that some are predisposed to disease generally, while others are not so; and that some are predisposed to particular diseases. Hence it appears that the circumstances, such as are above mentioned, operate only to excite disease in those, who are predisposed to be diseased. Those circumstances, then, are called *exciting* or *occasional causes.*

XCIII. But the predisposition to disease must also have a cause. This is called the *predisposing cause.* Both this and the exciting cause having an influence in producing the proximate cause, they are called by way of distinction the remote causes.

XCIV. It does not always happen, that two remote causes act. One is sometimes sufficient, either from its peculiar nature, or character; or from its acting with great force, or for a considerable length of time. In some instances one only of the remote causes is known, and yet it is known that the other has existed and operated.

XCV. It is always satisfactory, if possible, to ascertain the mode in which the remote causes operate on the body, how they produce the first morbid changes, as well as in what those changes consist. Respecting their mode of operation, however, our knowledge is often deficient, even when the influence of the remote causes is indisputable.

XCVI. Our knowledge of the symptoms of a disease is obtained in different modes. Some of them we learn by our own observation and examination of the patient; others we learn from the account which the patient gives of himself. In general, those which are learnt in the first mode deserve to be relied on more than the others; and that from various considerations.

XCVII. The symptoms which arise in the various morbid states of the human system, are numerous. Most of these symptoms are capable of existing in various degrees, and are liable to some modifications. They may also be variously combined. Hence the great variety, the almost endless variety in the diseases, which the physician is called to see.

XCVIII. In examining a patient, whose system presents many marks of disease, in order to be assured that all the symptoms are noticed, it is convenient to adopt some method. For this purpose it may be well, first, to attend to the organic functions in their order, viz.; those of assimilation, formation and excretion. Then to examine respecting the animal functions, viz.; those of sensation, the intellectual or mental functions, and those of locomotion and voice. Lastly, to observe any deviations from health, as manifested in the countenance and figure, which result from the combination of derangements in the organic and animal systems. The order, in which the symptoms have occurred; the severity of each; their constancy,

or inconstancy; the regular, or irregular recurrence of any of them; and all their mutual relations must be ascertained in order to a due understanding of the case.

XCIX. The proximate cause, as has already been stated, is the primary morbid affection, which gives rise to all the symptoms in a disease, and which may be regarded philosophically as the disease itself. Regarding the proximate cause in this way, it may easily be shewn that it undergoes changes in the progress of what must practically be called the same disease.

C. It may now be useful to consider, in a general way, those states of the body which have been regarded as the primary morbid affections or proximate causes of diseases. In this way some general principles may be ascertained, or approximations may be made to some such principles, as will be useful in the subsequent examination of particular diseases. The different medical theories which have prevailed, have been founded on the general principles, which have been adopted by their authors on this subject.

CI. All the opinions which have been adopted in reference to the proximate causes of diseases, numerous as they are, may be referred to four heads. First, those which place those causes in the fluids, i. e. in a redundancy or deficiency of some of the fluids, often connected with some change in their composition; or in some change in

composition alone. Second, those which place them in some change in the structure of some part of the solid organs. Third, those which place them in some change in the vital properties. Fourth, those which place them in some change in the functions. Of course, the different opinions here adverted to have in some instances been combined.

CII. First, *of causes in the fluids.* Under disease there appears in some cases to be a redundancy, in others to be a deficiency of blood. The redundancy appears sometimes in an increased fullness of the arteries, sometimes in distention of the cutaneous capillaries, sometimes in an enlargement of the superficial veins. It appears also in an enlargement, or in a sense of fullness of some organ, accompanied by circumstances, which show that the increase of bulk arises from increased distention of the blood-vessels of such organ. Likewise, a spontaneous discharge, or an artificial evacuation of blood often gives such immediate relief, as to occasion the belief that a sanguineous plethora, either general or local, had been a cause of disease. Circumstances, generally the opposite of those here described, may seem to evince a deficiency of blood; as shrinking, deficiency in the secretions, paleness, and smallness of the arteries and veins.

CIII. In other cases of disease, a redundancy of watery fluid, or of mucus, and sometimes a defi-

ciency of these will appear in the discharges. Likewise bile is sometimes poured forth in disease in great abundance; in other cases it is deficient.

CIV. It has also been supposed that all the fluids of the body are occasionally in a morbid state; that is, that their composition is varied from that of health. Thus, the blood is thought sometimes to be too thick, at others too thin; and its different proximate elements are suspected to vary from the due proportions of health. It has been thought, too, that the composition of this fluid may be varied by substances introduced into it, and sometimes by intestine changes, by which its elements may be degenerated.

CV. Undoubtedly there is some foundation for these various opinions respecting morbid changes in the blood. But observations in respect to that fluid in diseased subjects, comparing it with the blood of health, have not been made with sufficient accuracy to determine just how far any of these opinions can be supported. The subject is attended with great difficulty. One circumstance, which deserves especial attention, is that the blood-vessels may sometimes contain other materials besides the blood, so that a cause of disease may perhaps be in the blood-vessels, and not in the blood. Various substances received from without, are detected in the evacuations unchanged, or nearly so; and some of these have even been detected in the blood. But the nutriment, which is changed into

blood, has its properties changed. There arises then a strong probability, that the substances which pass through the vessels without losing their properties, never constitute, strictly speaking, a part of the blood; that is, that they are *mixed* with the lymph, albumen, &c., without *combining* with either of them.

CVI. The blood itself is formed from the nutriment by the influence or action of certain living organs. It is consumed by other living organs in the various processes of formation and excretion. Any redundancy or deficiency of the blood is then to be attributed to a want of due proportion in the functions of supply and of waste. If the blood be not perfect in its composition in any case, this must be attributed to some failure in the performance of the functions of some of the organs above referred to. In that case, the change in the blood is not a primary affection; the primary affection taking place in the functions of one or more of the organs. If, however, there be a want of nutriment, there may be a consequent want of blood, and only excrementitious matter may be supplied to the vessels. But if the difficulty be referred to some foreign substance mixed with the blood in its vessels, it is to be observed that this substance, should it be a cause of disease, must be regarded as a remote cause. The proximate cause will be the change, which this foreign substance produces, in the powers or functions of the living organs.

CVII. Arguments of the same kind may be adduced to show that all changes in the other fluids, either in their quantity or quality, must be referred to some change in the organic functions, as the primary affection.

CVIII. The importance of these views will be obvious, if we anticipate the remark that our remedies should be such as to correct the first evil, before we can look for a lasting cure of a disease. It is in this mode of regarding it that a consideration of the proximate cause becomes most interesting.

CIX. Second, *of causes in the structure.* Changes of structure have not often been regarded as constituting the proximate causes of disease. Unless we take into view injuries of structure produced by mechanical violence, or by chemical means, changes of structure must be referred to some imperfection in the formative functions. In this case the change of structure is secondary, not primary. But there are some cases, in which we may be excused, if, practically, we regard the change of structure as the proximate cause of disease. Thus in organic diseases, where the first change of structure derives all its importance from that of the part in which it has occurred, and where we may not be able to ascertain the nature of that first change during life, we have to look to the organic change as the proximate cause. But, strictly, we should look to the disease

by which the change of structure is produced, as the proximate cause; and if this first disease can be ascertained, we must inquire how far this can be relieved. The organic diseases referred to in this section constitute a natural tribe of great importance.

CX. Third, *of causes in the vital properties.* How far a change, a diminution, or an exaltation of one or more of the vital properties may be the primary change produced by the action of the remote cause of disease in any case, is a question not very easily decided. There does certainly appear to be reason for the opinion that the substances, which we call narcotics, operate directly to diminish sensibility and irritability, independently of any influence those substances may exercise in changing the functions. It is not improbable, that in other cases the vital properties are immediately affected by the remote causes of disease. But in a large proportion of cases, we may regard the subject practically in the same light, whether we do or do not admit this direct influence of foreign agents on the vital properties. For the effect of any change in the properties will be manifested by a change in the functions; and a restoration of the properties to a healthy state is to be learnt only by a restoration of the functions; and what remedies, or mode of treatment, will effect such salutary change is learnt only by experience.

CXI. Fourth, *of causes in the functions.* In the majority of diseases, then, we look for the proximate

cause in the functions. Under disease, the functions of some part are interrupted, or so excited or modified, as to differ from those of health. Very commonly, the changes produced have the effect to remove the remote cause of disease if present, or to obviate and remedy any evil consequences it may have produced. In consequence of the relations existing between the different parts of the human system, the disease is propagated to parts not originally affected. It is in this way often the numerous symptoms are produced in what is practically regarded as a single disease.

CXII. To form an acquaintance with diseases we should observe the phenomena they present, and trace them to their causes. But it may be of some use to bring into review the different functions, and to consider, briefly in what way they may be diseased, stopping to notice more particularly such diseases of them, as we believe actually to occur. In so doing we shall proceed from causes to effects. To a certain extent, this method has its advantages in communicating knowledge, though not the proper one for the acquisition of it.

CXIII. First, then, of the functions of assimilation. While the organs, which perform these functions, retain their powers sufficiently, and materials are furnished in due quantity and quality and at proper intervals, and no noxious cause operates, we must presume that the functions will be duly performed. But a failure in these conditions

may cause a diseased performance of those functions.

CXIV. The powers, and consequently the functions, of the organs of assimilation may be impaired in various modes; as, first, by an excess or defect of nutriment; or by substances which are not nutritious, whether mixt with those which are nutritious, or not so; or, second, by affections of other parts inducing sympathetically a loss of power in those organs; or, third, by the mere decay of powers by age.

CXV. The causes enumerated will produce various derangements in the alimentary canal. Every organ is fitted to bear the stimulus of certain substances adapted to it, and the effect of such stimulus is to promote the easy performance of its proper functions. But other substances operate as an unnatural and offensive stimulus, and derange the functions. Thus, undigested food is a natural stimulus to the stomach; but it is an unnatural stimulus to the intestines, and is liable to derange their functions. These remarks lead to an explanation of many of the derangements which occur, when, from any cause, the stomach protrudes into the duodenum any thing else than chyme. The secretions of the mucous coat of the canal will be affected, as well as the actions of the muscular coat; and the subordinate organs will also be affected in their secretions. The undigested mass may be expelled by the efforts to which the canal is excited by the offence of this mass. But

this does not always happen in season to prevent further evils. Sometimes the stomach, sometimes the intestines or some portion of them appear to become torpid, and then the materials retained undergo decomposition. In this way flatus is generated, and various acrimonious matters are produced in like manner.

CXVI. In the next place, it may happen that the lacteals and bloodvessels will be offended by the matters received into them, or may suffer from the want of due supplies. That the lacteals may take up other articles besides perfect chyle will scarcely be doubted at the present time. These articles may not be combined with the chyle, and may never be combined with the blood; yet the presence of them in the lacteals, lacteal glands and bloodvessels may offend and injure those organs, or derange their functions. Likewise the want of chyle to form new blood may give occasion for various affections of the bloodvessels, and, especially, may diminish their power. The powers of these vessels may also be injured in other ways, as well as those of the stomach. The derangements, however, of the bloodvessels, considered as organs of assimilation, are probably much less frequent, and certainly are less easily detected than those of the alimentary canal. The effect of such a derangement of the bloodvessels probably must be general weakness, and especially a failure in the processes of formation and in those of vas-

cular excretion. Possibly other effects, such as inflammation in various parts, and perhaps dropsy may ensue from the same cause. May not scurvy be referred to the same cause?

CXVII. There are certain derangements of the sanguiferous organs, considered as constituting the circulating system, which may be properly noticed in this place. These consist in an unequal or disproportionate distribution of blood. An increased determination of blood to a particular part takes place in many cases in consequence of an irritation of such part. Such an increased determination is an ordinary concomitant of inflammation; but it does not constitute inflammation. In the cases here referred to, it is in the capillary vessels principally that the accumulation of blood takes place. The immediate cause of this accumulation appears to be an enlargement or dilatation of those vessels. In this dilatation those vessels may be either active or passive; but probably they are in most cases active. In the cases referred to, the dilatation sometimes extends to the arterial trunks, or larger vessels leading to the part, and sometimes it would seem that all the arteries are dilated or enlarged. When this happens, the increased fulness of the arteries must be at the expense of the veins. In other cases, this fulness of the arterial trunks occurs without an enlargement of any portion of the capillary vessels. Again, there are cases in which

both the arteries and capillaries are unusually contracted for a longer or shorter time; in which cases, the accumulation is ordinarily in the veins. But if the accumulation is in the veins, it may be in some portion of them only. Probably, indeed, almost certainly in some cases, where the arteries are contracted, the accumulation takes place principally about the right side of the heart and large venous trunks. In other instances, the pulmonary vessels are distended, while the whole aortal system has less than its proportion of blood. In the instances of increased fulness in any part of the venous system, the immediate cause is most probably a passive dilatation of that system. The undue accumulation in the lungs, probably, takes place from different causes, and may sometimes be most in the arteries, at other times in the veins, &c. as happens in the aortal system. Now all this irregularity in the distribution of the blood requires to be much regarded in a practical view—since it is a circumstance on which the importance and danger of a disease may depend, though not the proximate cause.

CXVIII. Next of the functions of formation. These are liable to be diseased in various ways, and from various causes. First, any want of supply, or the supply of materials not of good quality by the blood-vessels, or the presence of any offensive materials in these vessels mixed with the blood, may occasion some change in the actions of the for-

mative vessels. In such cases, the original fault may be in the assimilating organs, and in consequence of the mechanical relations of these to the formative vessels, the offensive materials are brought to these vessels.

CXIX. Second, a mechanical or chemical injury of any part will induce new and extraordinary actions of the formative vessels for the restoration of the part injured. Wherever an irritation exists, a flow of blood takes place. This flow of blood is generally accompanied by an increase of both sensibility and irritability in the part. This flow of blood is to be referred, not to a *vis a tergo*, but to an active dilatation of the capillaries of the part.

CXX. Third, an irritation excited in other parts of the body may be extended or communicated by sympathy to the formative vessels, and induce in them a diseased action.

CXXI. Fourth, by sympathy likewise the actions of the formative vessels may be diminished, or even arrested.

CXXII. In these, and perhaps other ways, the formative vessels may have their functions arrested, or diminished, or increased, or modified. Of the affections thus induced, the various processes of inflammation are the most remarkable. These are processes, in some of which the parts are enlarged by a deposition of various matters, by the enlargement of its vessels, and by the

formation of new vessels; and in which also various fluids are under different circumstances secreted. In these processes, the absorbent vessels sometimes act a part; and in the termination of them new parts are often formed.

CXXIII. As inflammation is an affection, to which all the organized parts of the body are liable, and as it is, under some of its modifications, the primary affection in a very large proportion of all the diseases to which the body is liable, it may be well to give in this place some general account of its processes. Five principal processes may be distinguished in inflammation, though they do not all occur in each case of that disease. They may be denominated the formative, adhesive, suppurative, ulcerative and restorative processes. In a regular inflammation of the mucous membrane only the formative, suppurative and restorative processes occur. In a regular inflammation of the cellular membrane, or of any circumscribed cavity, the formative and adhesive processes at least occur; very commonly the suppurative process follows, and then the ulcerative and restorative ensue.

CXXIV. The formative process appears to consist only in an enlargement of the capillary vessels so far as can be seen; but it is highly probable that there also takes place some new arrangement, or other change in the formative vessels themselves, by which they are fitted to perform the subsequent

processes. It is certain that some little time elapses after the commencement of the process, more than seems necessary, merely for the enlargement of the vessels. Likewise, in specific inflammations, the diseased part exhibits a peculiarity of form in this stage.

CXXV. The adhesive process consists, first, in the effusion from the formative vessels of coagulating lymph, or of some other fluid which almost immediately undergoes coagulation, by which the parts opposed to each other, may become glued together; and afterwards, in the extension of vessels or formation of new ones, by the action of which the matter thus first effused becomes replaced by organized parts.

CXXVI. The suppurative process consists in the secretion by the formative vessels of a peculiar fluid, called pus, differing in its characters according to the texture of the parts affected, and according to the character of the inflammation, and perhaps according to other circumstances. Occasionally, however, instead of pus, other fluids more or less widely differing from it, are effused or secreted by inflamed parts.

CXXVII. The ulcerative process is performed by absorbent vessels, under various circumstances; but most especially for opening a passage for pus, when this is formed on any part not having a natural outlet. When other fluids are effused or secreted instead of pus, the ulcerative process rarely, if ever, takes place.

CXXVIII. The restorative process varies according to circumstances. In some cases, as in inflammations of the mucous membrane, it seems to be little else than a contraction of the vessels which had been dilated, and a renewal of the usual secretions. In this case, the secretion is gradually changed from that of pus to that of mucus. But in cases, where, from any cause, a division has taken place between parts ordinarily united, the restorative process brings the parts again into union. This appears to be effected through the agency of the formative vessels, by a process analogous to that, by which the growth of the solid organs is originally effected.

CXXIX. In all these processes various irregularities arise, which will be more discussed when treating of the subject hereafter. One of the principal of these is the effusion of a watery fluid instead of pus. This happens in the early stage of inflammation on the mucous membrane in some cases. It happens also on the serous and cellular membranes, when the inflammation is of a very low and slight kind. It then constitutes a dropsy.

CXXX. In most inflammations the disease is circumscribed within limits, which bear a relation to the magnitude and violence of the central part. It is in this central part that the most important processes are performed. But in some inflammations, the disease gradually leaves the part first affected, while it extends to the adjoining parts of

the same texture. Also, in consequence of accidental causes, there sometimes occurs a sudden extension of inflammation beyond its natural or original bounds.

CXXXI. The processes of inflammation cannot be explained upon the supposition of either an increase, or a decrease in the momentum of the blood. The most essential part of those processes appears to be performed by the same extreme vessels, by which the formative functions are conducted. Whether the mechanical actions of the vessels in either case determine the result, may well be made a matter of doubt.

CXXXII. In some cases of inflammation, a constitutional affection is induced, and this is varied by many circumstances. But this subject will be more conveniently discussed in another place.

CXXXIII. There are other morbid affections besides inflammation, which belong to the formative functions, among which are hæmorrhage, vitiated secretions and tumours of various kinds. These, so far as they call for attention in this course, will be noticed at other times.

CXXXIV. The diseases of the *excretory functions* are seldom strictly primary; they are so when any cause acting primarily on the excretory organs derange those functions. In the excretory functions we can see that many diseases may arise analogous to those of the formative functions. It has already been suggested, that if the stomach protrude into

the intestinal canal any substance, other than chyme, such substance being an unnatural stimulus to that canal, will occasion a derangement of its functions. These functions are partly those of assimilation, partly those of excretion. As an excretory organ, this canal may have its motions diminished or increased, directly or indirectly, by the substances received into it. But independently of any effect on its motions, the materials brought into it may be such as cannot be reduced to the state of ordinary and healthy alvine feces. Likewise, the alvine discharges may be changed by the secretions, occasioned by the unnatural stimulus. Hence we may trace deviations from health in the *frequency*, the *quality*, and the *quantity* of the *alvine excretions.*

CXXXV. The alvine discharges may also be altered by affections of the secretory organs appertaining to the alimentary canal. This will happen, whatever may be the cause of such affections of the secretory organs, but will be modified according as that cause operates on the secretory organs alone, or at the same time on the alimentary canal.

CXXXVI. The frequency of the alvine discharges will be diminished by causes of four descriptions, viz. by a diminution of stimulus, as to quantity or quality; by causes which lessen the irritability of that canal; by such as lessen the secretions, which are poured into that canal; and by such as constitute mechanical obstacles to the passage through

the canal. The frequency of these discharges will be increased by causes of an opposite character.

CXXXVII. The quality of the alvine discharges depends on that of the *ingesta*, directly and indirectly. Directly, in cases where the articles received retain any of their characters unchanged, or undergo fermentation instead of digestion. Indirectly, where the articles received induce any change in the secretions of the abdominal organs. Some articles increase the watery secretions only, as the neutral salts. Others induce an increase in the secretion of mucus; others in that of bile.

CXXXVIII. The quantity of the alvine discharges must ordinarily depend on the quantity of food undigested, and on that of the secretions. The quantity at a single evacuation will be influenced by the frequency, and by the energy with which the large intestines act in discharging the load accumulated in them.

CXXXIX. But, the ingesta being the same, the evacuations will vary according to the state of the stomach and intestines. Thus, proper vigour or the want of it in the alimentary canal, must have a great influence. Also, if from inflammation, or any other cause, the canal be rendered unusually irritable, a common stimulus will produce all the effects of a great or extraordinary stimulus on the healthy canal. Hence the evacuations will vary in frequency, quantity and quality. The secretions produced by the inflammation will of course be

discharged, either by themselves or in mixture with the other contents of the canal. In some cases blood may be discharged from the part diseased. The effects of inflammation in the alimentary canal are greatly varied by the violence, extent and seat of the disease, and by the texture affected. There are some peculiarities in the alvine discharges, in a diseased state of the canal, which might not at first be anticipated. Thus, while the canal is loaded with feces, the discharge will consist of blood, or bile, or mucus unmixed with fecal matter. When the discharge is blood or mucus, it may be supposed that it is derived from the rectum, or from the lower part of the colon, where there may not be any feces at the time. But sometimes these fluids are derived from a higher part of the intestine. In the case of bile, it must always be derived from the small intestines. That the bile should not be mixed with the fecal matter can be explained only on the supposition, that the fecal matter is in a state in which it will not readily permit the mixture of any fluid with it; and that at the same time the bile is so acrid as to occasion rapid and violent contractions of the intestines to propel it.

CXL. In the excretion of *urine*, deviations from perfect health may arise from various remote causes, viz. from variations in the *ingesta*, from imperfect assimilation, from a morbid state of the kidneys, or of the other organs belonging to the uri-

nary apparatus, or of organs closely connected with those, or lastly from sympathy.

CXLI. From these several causes singly, or acting in conjunction, the urine itself may be increased or decreased in quantity, may have its colour changed may be turbid when discharged, or become so after standing a short time, and the matter separated may form a sediment or remain suspended in the urine.

CXLII. The urine is increased in quantity by taking into the stomach an unusual quantity of liquid, or certain substances which act especially on the kidneys, such as vegetable acids; by a diminution of the evacuations from the skin; by certain passions of the mind; and in certain diseases, by causes not satisfactorily ascertained.

CXLIII. The urine is diminished in quantity by some causes the opposite of those which increase it; such as diminution in the quantity of liquids swallowed, by increased discharge from the skin, &c. Likewise it is diminished under certain diseases, as by inflammation either chronic or acute; especially by that inflammatory affection which occasions dropsy; and by diseases affecting the kidneys themselves.

CXLIV. The colour of the urine depends on the greater or less quantity of water, and on that of certain ingredients which naturally belong to it, or which are formed under disease. But the consideration of this subject in detail would lead us too far.

CXLV. The matters separated from the urine, whether mucus alone, or the saline contents of the excretion, remain suspended or form a sediment according to the specific gravity of the fluid. The red sediment, so common in inflammation, consists principally of the lithates of ammonia and of soda, with a large proportion of the colouring matter of the urine. The white sediment consists principally of the ammoniaco-magnesian phosphate.

CXLVI. Respecting the changes in the evacuations from the skin and lungs under disease, our knowledge is not very precise. The sensible perspiration is diminished under exposure to cold and when at rest, and increased under the opposite circumstances; and similar changes take place under disease. The changes which occur under disease may be referred, in many instances, to sympathy of the skin with the diseased organ; but in some cases, probably the cause may be a failure in the functions of assimilation, whence a change in the composition of the blood is produced. In all cases the immediate cause is a change in the actions of the excretory vessels. A fulness of the cutaneous capillaries is not immediately followed by increased sensible perspiration; but is so ultimately in most instances.

CXLVII. The morbid changes, to which the animal functions are liable, must next be examined. It has already been stated that the vital properties, and especially the irritability and sensibility, may

be temporarily increased or diminished by the direct agency of foreign substances. Moral causes, or causes operating on the mind directly, may affect the animal powers. A change in these powers may of course occasion a change in the functions which depend on them.

CXLVIII. But in a large proportion of cases, we must refer the diseases of the animal system to primary changes in the organic functions. It is most especially to changes in the state of the vessels, which belong to the animal organs, that we must attribute most of the grave diseases of the animal system. But in some cases these diseases appear to arise solely from sympathy with the organic system.

CXLIX. In whatever mode a primary disease is produced in any one part of the animal system, the other parts of the same are liable to be affected so far as their functions are connected. It is especially when the brain is the seat of disease that such secondary affections are produced.

CL. Diseases of the mind are in many cases manifestly referrible to affections of the body; but there are cases, in which such a reference cannot be made with confidence. In such cases there must be a doubt, whether the disease of the mind is original, or whether it is occasioned by a disease of the body, which we cannot detect.

CLI. In those affections of the animal system, which depend on the state of the vessels belong-

ing to the animal organs, two opposite states of that system are produced by the diseased state of those vessels. This is most remarkable, where the vessels of the brain are affected. First, an increased determination of blood to the brain, and especially when the small vessels are particularly affected, occasions pain, or distress, or a sense of confusion in the brain, accompanied often by increased sensibility in the organs of sense, and a tendency to violent, irregular, and often involuntary actions in the animal muscles. Secondly, when the quantity of blood accumulated in the brain is greatly increased, or when the increased vascular fulness has been followed by effusion of any kind from the vessels, then the brain becomes compressed, and effects of a different kind ensue. These are a diminution, or loss of sensibility in one or more parts, and a suspension of all actions, voluntary or involuntary, in the animal muscles. It frequently happens that a suspension of action takes place in one part, as on one side, while involuntary actions take place in another part. This arises from a compression of one part of the brain and an irritation of another part.

CLII. The suspension of sensation and voluntary motion may arise from pressure on the brain, however induced. It does not appear that a certain amount of pressure will always produce the same effects. This may be explained by considering, first, that something will depend on the part

of the brain particularly compressed; and second, that, so far as the pressure operates on the whole brain, its effects will be greater or less, as the compression takes place more or less suddenly. When the pressure is produced very gradually, the brain becomes accommodated to it, either by the absorption of some part, or in some other way.

CLIII. The consequences of pressure on the *medulla spinalis*, or on the nerves, are somewhat similar to those of pressure on the brain. In regard to the nerves, however, it must be noticed that they are less liable to compression than either the brain or spinal marrow; sinces these last are inclosed within cases of bone, while the nerves generally lie among the soft parts, which yield somewhat to pressure. The nerves are, however, liable to be compressed against a bone by tumors, and likewise to be compressed by the effusion of coagulable lymph around them, as in the adhesive process of inflammation.

CLIV. The nerves of sensation are subject to a certain affection, which is manifested only by pain. This affection has received the name of *neuralgia*. In many cases it has the appearance of an idiopathic disease of one or more of the nerves. In some cases it is a symptomatic affection; and, generally, pain is symptomatic. Neuralgia may be directly produced by some inflammatory or other vascular affection of the nervous trunk or twigs. But there is not any evidence that this is the case.

CLV. Increase and diminution of sensibility in particular nerves, and also its abolition, arise from various local effections in the organs to which the affected nerves belong; and likewise by sympathy from the affections of distant organs. Pain and increased sensibility often occur together; but they are not inseparably united.

CLVI. The muscles, as well as all other organs, are diseased in consequence of affections of the blood-vessels, which belong to him. But in some cases there appears also to be an original affection of the muscles. At least the power of contraction is impaired, or the contractions take place irregularly, without any evident agency of either the vessels belonging to the organic system, or of the brain or nerves. Use and disuse of the muscles, especially the latter when long continued, have a direct effect in occasioning disease in those organs. It would seem, also, that the long continued internal use of alcohol, and that some mineral substances, long applied to the body, occasion directly some change in the power of motion in the muscles.

CLVII. Voluntary motion, or the action of the muscles under the influence of the will, is arrested or modified by diseases of the brain, or of the organs intermediate between the brain and muscles. Voluntary motion is also prevented in particular muscles by sympathy with distant organs, without any obvious affection of the nervous system.

CLVIII. Involuntary motion, viz. in the organic system, is no doubt affected by the original diseases of the muscles, just as voluntary motion is. But the dependence of the involuntary or organic muscles on the nervous system is not the same as that of the voluntary or animal muscles. Yet the injury or division of nerves supplying the organic muscles will influence such muscles, inasmuch as such injury deprives them of the salutary influence of sympathy with other organs. There may also be a direct effect from the injury of the nerves of such muscles, as from the injury of any part with which they are connected.

CLIX. The functions of the voice, dependant on the vigour and integrity of many parts, are liable to be affected by various causes. Among these are organic affections of the nose, mouth, fauces, larynx, &c.; affections of the nerves of the larynx; and sympathy both with the whole system and with particular parts. From these causes the voice may be affected in its tones, volume, and strength, and the articulation in its distinctness.

CLX. The various appetites, inasmuch as they are dependant at once on the organic and animal systems, are influenced by changes in each of those systems.

CLXI. We have been engaged in reviewing the different functions, and considering in what ways they may be most remarkably diseased. It is probable that they are susceptible of other dis-

eases, of which we have not any just conceptions. Let us now pursue a different course, and inquire what are the diseases, which are known to occur in the human subject, and which have been distinguished by clinical practitioners. These are numerous, and yet they probably may be reduced, with the consent of all, to a few classes.

CLXII. In distinguishing and naming diseases men would first have reference to symptoms, and would afterwards learn to attribute these to the several primary affections; and then they would think only of distinguishing these primary affections from each other. Thus, headach would be called a disease, vomiting another, diarrhœa another. But it might be presently discovered, that all these originate in an affection of the stomach; and then that affection would be regarded as the disease, and the headach, &c. as symptoms.

CLXIII. The different primary affections, to which the human body is subject, may all probably be included in the following classes, and perhaps some of these may be unnecessary; viz.

Phlegmasiæ.
Hemorrhagiæ.
Profluvia.
Febres.
Dolores.
Spasmi.
Dysorexiæ.
Vesaniæ.
Adynamia.

CLXIV. But from a regard to convenience, it may be well to add the following classes, viz.

Morbi organici.
Morbi ex adventitiis in corpore inclusis.
Mimoses.

CLXV. But it is not possible to prove that this, or any other number of classes, will properly include all the diseases of mankind. The opinions formed by different persons on this subject will be founded on the different pathological principles they may adopt. While it is impossible to demonstrate the truth of any system of pathology, it will be impossible to make men agree on any system which is proposed.

CLXVI. A methodical arrangement of diseases, founded on any such principles, will not meet with universal approbation. Is there not then any ground on which a nosological system can be founded, analogous to the methodical systems adopted in the various branches of natural history? So long as we confine ourselves to the objects which can be demonstrated or pointed out, we may adopt such a system. Symptoms are the immediate objects of our knowledge, and they will admit of a systematic arrangement.

CLXVII. Among the many nosological systems which have been published, that by the learned John M. Good seems entitled to a preference, among other reasons, for this; that the arrangement has a reference to the actual phenomena of diseases, or to symptoms, more than that of any other similar work. In the practical part of this course, Good's system will be followed, and then some evidence will be offered in support of the remark last made.

THERAPEUTICS.

CLXVIII. This division of the science of medicine relates to the treatment of diseases; or, more strictly, to the treatment of persons under disease. Its ultimate objects are three; of which sometimes one only is regarded; sometimes two, and sometimes all three are regarded at the same time. To effect its objects, two different methods may be pursued; of which one is called active, the other watching, or *expectante*. There is likewise another distinction in respect to the method of treating diseases, which relates to the considerations which determine the physician in his choice of remedies. The distinction here referred to is that of the rational and the empirical modes. The former mode is preferable; but when our knowledge does not enable us to apply it, we must avail ourselves of any resources offered by the latter.

CLXIX. Whatever mode is pursued, it will be done to more or less advantage precisely as our knowledge of the pathology of the disease under care is more or less perfect. For rational practice especially, it is requisite to distinguish in every case the symptoms, the proximate cause and the remote causes; and especially to be able to anticipate the

probable course and event of the disease. From a consideration of these circumstances, the *rational* practitioner adopts certain *intentions* in his treatment, by which he hopes and designs to afford relief to the patient. Or it may be said, that a consideration of these circumstances furnishes an *indication* of the course to be pursued. The empirical practitioner does not adopt any *intention* in the technical sense, except the general one of relieving the patient by means, which have been thought beneficial in cases apparently similar.

CLXX. Although *indications* may be derived from different sources, they are not equally satisfactory from them all. They are least satisfactory when *derived from the symptoms* only, as these may often be salutary in their tendency, however troublesome they may be at the moment. On this point we cannot judge correctly, when the causes are unknown to us. Yet, when symptoms are very distressing, and still more if they be attended with apparent danger, we follow the indications they furnish, though with all possible caution. In some diseases experience will justify such a course.

CLXXI. *Indications derived from the remote causes* will be more safe than those derived from symptoms. But they cannot always be fulfilled; nor, when fulfilled, does relief always follow. In some diseases relief cannot be obtained until the remote causes are removed; but in others a train of consequences follows them, which is not arrested by their removal.

CLXXII. *Indications from the proximate cause* are the most safe and satisfactory. In some cases this cause may be removed; in others, where this cause may be said to consist in a succession of processes, these may be interrupted. But even these indications cannot always be fulfilled with impunity; and in some cases the means are wanting. The indications may be clear, but our power may be limited.

CLXXIII. The *means* employed for the cure of diseases are various. They consist in the removal of some material from the body, or in some operation on the body, by surgery; or in the application of some medicinal agent to the body; or in some operation on the mind; or in the regulation of the functions by diet and regimen. The principal surgical remedies employed in the practice of the physician, as distinguished from surgery in the familiar sense of the term, are *blood-letting* and *friction.*

CLXXIV. The mode in which *blood-letting* operates to relieve disease has never been well ascertained. There cannot be any opinion generally received on this subject, while the mode, in which the circulation is maintained, continues to be a matter of dispute. Without referring to the various opinions entertained on these points, the following remarks will be offered as an attempt to explain the effects of blood-letting.

CLXXV. First, the effect of the operation on the

mind will often for a short time, and in some instances for a long time, modify the effects of the loss of blood. Second, the effects of bleeding are in some considerable measure modified by the rapidity or slowness, with which a given quantity of blood is taken away. Third, when blood is taken from a person in health, the effects will be different from those on a person under disease; and especially if the disease be one, in which there is an unequal distribution of blood in the sanguiferous system. Fourth, both in health and disease the effects will no doubt vary somewhat in different individuals; as in one the heart may be proportionally more or less vigorous; and so in respect to the other organs of the sanguiferous system. Fifth, when blood is taken from a large vein in health, there will be produced different effects on the heart and on the bloodvessels; effects modified, as above suggested, by the constitution of the subject. The heart will receive less blood at each diastole, or else will have the diastole lengthened. So far as regards the heart, therefore, bleeding will diminish stimulus. Meanwhile the arteries and veins will contract; inasmuch as these vessels are always precisely full. This contraction, as respects the arteries, will probably be effected by an elastic power to a certain extent; but, when the loss of blood is very great, the contraction will be effected by a vital power. As the veins do not appear to possess any elasticity, their contraction

must probably be effected by a vital power. The capillaries appear not to contract so rapidly as the larger vessels; but eventually they contract in their proportion, so that the blood becomes equally diffused throughout the sanguiferous system; and, consequently, the loss operates equally on every part of that system. Sixth, in general, when the blood is distributed unequally, or in undue proportions, the ultimate effect in bleeding will be to lessen the proportion of blood in those parts, where it is accumulated more than in other parts; or in other words, to restore the balance of the circulation. This appears to accord with facts often observed, even though the mode, in which the effect is produced, may not admit of a satisfactory explanation. The especial effects last noticed may be explained in cases of active dilatation of the vessels in this way. The bloodvessels always contract exactly upon their contents. When they enlarge preternaturally in any part, and thus are enabled to contain more blood, they gain this blood at the expense of some other part. This rarely happens to a considerable extent, when the quantity of blood in the body is much less than is natural. If it has happened, when the blood was in due quantity, and the quantity of blood be afterwards much diminished, there may be supposed to be a contest between the vessels performing healthy functions and those performing morbid processes, which shall yield the greatest proportion of

blood. It may be, that it will suffice if they yield their blood in due proportion. But if this be not sufficient to keep the vessels, which are engaged in the necessary and healthy operations of the system duly supplied, the vessels engaged in the morbid process will yield their blood, or contract in greater proportion than the other vessels; because their actions are not governed by so strong a necessity, as those of the other vessels. The only exceptions will be in the case of such debility in the vessels of the diseased part as to prevent their contracting; or in the case of so strong an irritation from the influence of some morbid cause in the diseased part, as to be equal to the natural tendencies, or necessity for action in the vessels of the healthy parts. Seventh, in cases where the dilatation is passive, as commonly, if not always, happens when the blood is accumulated in the veins, the diminution of the mass of blood lessens the resistance to action; and then the dilated vessels are commonly able to contract and propel their contents, so as to reduce themselves to their ordinary size. In such cases the arteries may become more full after bleeding.

CLXXVI. The effects of *local bleeding*, or of bleeding from the small vessels, as *by leeches, or cupping*, are generally thought to be much greater in the vicinity of the part operated on than upon the whole system. This has been denied by some persons; but more on the ground of a difficulty in ex-

plaining such local effects, than on that of observation. If the effects be admitted, the explanation must probably be found in the partial independence of the capillary system. That there is often a local turgescence in the capillaries appears to be certain; and it is manifest that no local turgescence can arise from the influence of the heart. It may well happen, then, that a local bleeding may diminish the blood in the capillary vessels acted upon, and on those in their vicinity, more than in any other part of the body. In the case of spontaneous local bleeding, the effects are often very great from a small evacuation. This is best explained on the supposition, that there exists an erethism in the part, which is removed by the spontaneous bleeding, just as the erethism of the mamma is relieved by the discharge of milk, and that of some other organs, in a mode obviously analogous.

CLXXVII. *Friction*, pressure, beating, shampooing, &c. have often been highly lauded, as remedies, by those who have employed them fully, and have been more or less valued by most practitioners of medicine and surgery; yet their modes of operation have not been very well ascertained. Probably these different operations do all produce the same effects. Some share of the influence they produce, is probably effected through the medium of the sensations and that of the mind. These will vary according to the kind of operation, and

according to the character and circumstances of the patient. The direct effects on the body will no doubt in some cases be limited to the skin, as where gentle friction only is employed; in others, extend to the muscles or other subjacent parts. The effects of gentle friction on the skin are, probably, to solicit more blood to that organ, and to promote the healthy action of its vessels; and thus to induce an increase in its warmth and in its secretions. Analogous effects may be produced on the subjacent parts by hard rubbing, and thus may be derived benefits similar to those of muscular exercise.

CLXXVIII. The *medicinal agents* applied to the body operate upon the principles stated in the physiological part of this course. From a regard to their apparent operation on the diseased body, these agents are conveniently distinguished under the following, or similar names, viz. *stimulants*, *sedatives*, *narcotics*, *antispasmodics*, *refrigerants*, *alteratives*, *astringents*, *tonics*, *emetics*, *cathartics*, *diuretics*, *diaphoretics*, *emmenagogues*, *expectorants*, *sialogogues*, *errhines*, *epispastics*, *escaharotics*, *antacids*, *antilithics*, *anthelmintics*, *demulcents*, and *emollients*.* There will

* This list is adopted from Dr Bigelow's Sequel to the Pharm. of the U. S. pp. 18—25. The terms are employed by me, as by him, from a regard to convenience; and the list may be diminished or increased without any difference of opinion as to the real mode of operation of the remedies referred to.

be some convenience in considering remedies under these general names; but a useful knowledge of the powers of medicinal substances cannot be attained without attending to the peculiar properties of the individual articles employed. But a particular consideration of this branch of the subject is unnecessary, as it is the peculiar business of the Professor of *materia medica.*

CLXXIX. It is sometimes possible to cure diseases, and often to mitigate them, by *operations on the mind.* Every sagacious and humane physician avails himself of this power, and that, sometimes, without any very precise and settled plan. This object will be more certainly attained, when we act upon principles previously considered and settled. The common empirics avail themselves of this power to great advantage in many cases. It is no doubt true, that they often abuse the power, and that they resort to methods unworthy men of pure and elevated characters; of methods, the benefit of which is often transient, though brilliant. But, on the other hand, the regular practitioner often fails to derive the fair and proper advantage, which he might obtain by an influence on the mind of the sick.

CLXXX. Under this head it may be stated briefly: 1. It is proper to remove all undue and unfounded fears, whether they arise from the apprehension of improbable evils, or from magnifying such as are inevitable; 2. It is proper to encourage the

fortitude of the sick and suffering, and to suggest all the motives to patience. 3. It is proper to assume a cheerful air in all cases, avoiding however all levity, and especially in cases of danger, or of great suffering. 4. It is of the utmost consequence to satisfy the patient that you are desirous to understand his case, to show a proper sympathy in his sufferings, and without ostentation to evince a sincere desire to afford him relief. 5. It is often proper to make such arrangements as will occupy the patient's mind, so as to divert his thoughts and to remove anxiety and despondence. 6. It is proper to employ trivial remedies, on the direct effects of which no reliance can be placed, when these can be employed so as to sustain the patient's hopes, and thus to promote his recovery;—or when they will induce him to make exertions, salutary in their nature, but to which he cannot be prompted by more rational methods.

CLXXXI. The influence of *diet and regimen* in regulating the health is in many instances more important than that of the common medicinal agents. Some general remarks only will be made on these as on other subjects. First, of diet. The influence of articles of diet, whether they be nutritious, or cordials, or condiments, will be manifested in the alimentary canal, in the general system, and occasionally in some particular parts other than the alimentary canal.

CLXXXII. As respects the alimentary canal, ar-

ticles differ as they are more or less easily digested, as they are more or less stimulating to the stomach and organs of digestions, and as they exercise directly or indirectly more or less influence in promoting the alvine discharges.

CLXXXIII. All arrangements of the articles of food as being more or less easy of digestion, are fallacious, unless due attention be paid to the age, constitution, habits, state of health, &c. of the individual concerned. But in all cases it is important, that such food be taken as can be digested, and that the quantity be not greater than can be digested; for any article may be the cause of great derangement in the alimentary canal and elsewhere, if not digested. This is peculiarly true when any part of the intestines is in a state of disease, or is unusually irritable. For food, though the natural stimulus to the stomach, is not so to the intestines; and will, therefore, act on them somewhat as a foreign substance does in the cellular membrane.

CLXXXIV. In acute diseases, and in other cases where the powers of digestion are temporarily suspended, either nearly or entirely, it appears to be best to administer food only in a liquid form, and of such kind as is least stimulating. The advantage of the form appears to be, that the articles may be easily propelled, if not digested; and that they may not be injurious to the intestines. It is for this last reason, in part, that the food, which

is least stimulating is preferred. This circumstance, however, is likewise important in respect to the whole system in acute diseases.

CLXXXV. On the contrary in dyspepsia, whether existing alone, or in connexion with a chronic disease, it is often important to administer food in a solid form, and of a character somewhat stimulating. This would be useless, if the powers of digestion were entirely lost; but if not, such food is found by experience to be most digestible. It may then happen that in a chronic disease, in respect to which, considered alone, we should prefer the least stimulating food, we may be obliged by the state of the digestive powers to exhibit food of the most stimulating character.

CLXXXVI. It happens in many cases of disease, that it is very important to diminish the excitement of the vascular system; and on that account very little food should be allowed, and that should be of the least stimulating kind. This will happen, when the heart itself or any of the large vessels is the seat of any organic affection; likewise, when an active inflammation exists in any part of the body. Under the same circumstances condiments and cordials, especially the latter, are commonly to be avoided.

CLXXXVII. On the contrary, in many cases of exhaustion and debility, where none of the circumstances above-mentioned exist, it is important to replenish the vessels, and to sustain their actions until

they are replenished. In these cases, the most nutritious food, rendered grateful by condiments and the best cordials, are very usefully employed. The cordials are also useful in instances where there is a great temporary depression of the vital powers without any local affection.

CLXXXVIII. Secondly, of regimen. In a large proportion of cases, other circumstances must be regarded besides medicine and diet, if we would make our cure certain, safe and speedy. The evacuations are often controlled by a proper government of the patient's conduct. His place of residence, his clothing, his exercise and rest, his sleeping and watching, and the passions and emotions of the mind will all of them call for the attention of the physician, and should, as far as possible, be directed by him. All these circumstances must be determined by the general principles of physiology and of hygiene, modified in each case by a consideration of the previous habits and present state of the patient.