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TWENTY-FIVE YEARS OF MEDICAL PROGRESS.

The Address in Medicine delivered at the Annual Meeting of the British Medical Association held in Bournemouth, July, 1891.

BY

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TWENTY-FIVE YEARS OF MEDICAL PROGRESS.

WHEN friends meet again after a prolonged separation they almost invariably begin to talk about the changes that have occurred since they parted. In a few weeks more it will be just a quarter of a century since the President of this Association and I occupied adjacent rooms in hospital as fellow resident physicians, but since then our spheres of work have kept us much apart. It is therefore natural that I should take as my subject of address to-day the changes that have occurred in the profession to which we both belong during the time that has elapsed since we were comrades together.

Perhaps there is no period in the whole history of medicine in which such rapid changes have taken place as in the last five-and-twenty years. It is impossible to give anything like a complete account of these in the brief space of one hour, and I shall therefore restrict myself to a few of the more prominent points, and especially those that have come directly under my personal cognisance; for, like the man who made one-half of his fortune by attending to his own affairs and the other half by leaving other people's alone, I may probably utilise the time at my disposal best by speaking of what I know myself and leaving other things out.

Advances in Knowledge and Teaching due to Experimental Method.—These changes have occurred both in the profession itself and also to some extent—in this country at least—in the education and training of the men who enter it. We notice, first, that a very great increase has occurred in the knowledge of the nature, causation, and treatment of diseases possessed by the profession as a whole, but perhaps a still greater gain is the general adoption of the experimental method by which most of our recent knowledge has been acquired, and from which we may hope for even greater advantages in the future. In correspondence with the acquirement of knowledge, we notice also a great alteration in the teaching of medicine, and especially prominent is the tendency to make such teaching practical instead of theoretical by training men to place their dependence upon objective facts, and not to receive without experimental data the theories or speculations of any master, however great he may be.

Practical Training.—Five-and-twenty years ago, not only was practical training such as we now find in the scientific departments of medicine—chemistry, physiology, pathology, and to a certain extent also pharmacology—almost entirely wanting, but even in general clinical medicine, not to mention the special departments of the throat, eye, and ear, it was very deficient as compared with what it is now.

Direction of Advance.—The greatest advance made in the last 25 years has been in the direction of the accumulation, co-ordination, and teaching of facts instead of theories, of the phenomena of Nature as opposed to the fancies of the human mind.

Co-ordination of Facts.—But the mere accumulation of facts is of little use unless they can be so arranged, compared, and grouped as to bring them into relationship with some general law, and this we find in the world's history has been done from time to time by some master-mind. In the case of medicine, this has also occurred to a great extent during the last five-and-twenty years.

Influence of Darwin.—Medicine, both in its principles and practice, is really a subdivision of biology, and this, like all other branches of knowledge, has been most profoundly modified by the general acceptance of Darwin's great thoughts—the doctrine of evolution, the struggle for existence, and the survival of the fittest. Wherever we turn we find that Darwin's influence has modified the direction of thought, and whether the study concerns the evolution of the elements, the evolution of the planetary systems, of living beings, of communities, of customs, of laws, of literature, science or art, in every department of human knowledge we find that men, consciously or unconsciously, are influenced by Darwin's work. It is with shame I confess that five-and-twenty years ago, although I had taken a university degree not only in medicine but in science, and might therefore be supposed to be acquainted with his work, I did not even know of the existence of his *Origin of Species*, and I first heard its name in Vienna from the lips of an Austrian who was speaking of it in terms of the highest praise. "What is it?" I asked, and my question then seemed to cause my foreign friend as much astonishment as it causes myself now, when the possibility of such ignorance seems to me, as it must to you, almost incredible, and yet such was the fact. The publication of Darwin's *Origin of Species*, in 1859, has done more to change the current of human thought than anything else for centuries, but while its influence is everywhere felt, biology and all its subdivisions have been more especially affected.

Changes in Medical Students.—But great as the changes have been during the last five-and-twenty years in the profession itself, they are perhaps quite as great in the men who enter it. The days when Bob Sawyer was taken as a type of a medical student have long since gone by, and I should think in all probability there is no class in which one can find so many gentlemanly, thoroughly well educated, and hard working men as amongst the medical students of the present day. The change began rather more than twenty-five years ago, for it was in 1861 that the regulation of the General Medical Council to the effect that before entering on the medical profession each student should pass a preliminary examination in general education came into force. While our President and I were at college together we had amongst our fellow-students two classes, one consisting of men who had not passed a preliminary examination, and called Old Statutes, and the other of those who had passed, called New Statutes men. The class of Old Statutes men was a very mixed one; many of them, of course, were exceedingly good, able, energetic, and industrious, but a number were also lazy and idle, while some of them were distinctly dissolute and disreputable. The New Statutes men, on the contrary, were, upon the whole, steady and hardworking. The reason of this was that under the old statutes parents frequently thought that when a boy failed to learn anything at school and was too unsteady to hope for success in commerce, he was good enough to make a medical student of. The preliminary examination at once cut out all those who, by their idleness or stupidity at school, were unable to come up to the required entrance standard. Some of the idlest of our fellow-students under the old statutes, after studying for several years and failing to pass their examinations, drifted into other occupations. Others, again, after repeated trials, managed to scrape through their examinations and entered the profession. Probably some of those who have supplied the lack of book knowledge by experience gained in practice still survive and flourish, but most of the Old Statutes men now engaged in practice belonged to the better class, and would have gained access to the profession no matter how difficult their examinations might have been. There may be a very few exceptions, but I think we may be quite sure that nearly all those who are now thriving have either thorough knowledge or much *savoir faire*, for incompetent men get weeded out in the struggle for existence, which in the medical profession is a very hard one, and of late years has been getting harder and harder.

Struggle for Existence in the Profession.—I was much struck a year or two ago with the evidence of this severity which I saw in the house of a medical man residing in the neighbourhood which had gradually deteriorated. This doctor had a large practice, and was very hardworked, but his fees were small; and in order to educate his children, some of whom were in the profession, expenses had to be greatly retrenched at home. The house was large, and at one time had been tastefully decorated, but the paint was faded on the walls, the carpets were worn threadbare, and the furniture was poor and old. The severity of this struggle is, no doubt, due to the excessive number of men who have been entering the profession notwithstanding the barriers raised by the entrance examination; for this very barrier, by raising the quality of the men, has naturally raised the estimation in which the profession is held, and has, therefore, made it more attractive. But the excessive severity of the struggle, on the other hand, has a tendency again to lower the profession by rendering it so difficult for medical men to make a bare living that they are sometimes tempted to think more of their fees than of the welfare of their patients, and occasionally to resort to such means of making money as tend to bring discredit both on themselves and on the profession to which they belong. It is possible that the new regulation of the Medical Council requiring a five years' curriculum may tend to lessen this evil by preventing so many men from entering the profession. This longer curriculum is becoming absolutely necessary on account of the rapid progress which is being made in medicine and the time required to master the increased knowledge, not only regarding the nature of disease and the means of treating it, but regarding the means of ascertaining its presence.

Long ago the doctor's means of diagnosis consisted in inspecting the tongue, feeling the skin, counting the pulse, shaking the urine, and looking at the motions and the sputum. But now, in addition to a thorough training in auscultation and percussion, students have to learn the use of the laryngoscope, ophthalmoscope, and otoscope, and the application of electricity. They have to acquire a knowledge of the chemistry of the urine and its alterations in disease, and, what takes still more time, they have to learn the microscopical appearances, not only of the tissues and excretions in health, but their alterations in disease, and must be acquainted with the methods of staining so as to detect tubercle bacilli and other disease germs.

Apparent Change in Disease.—Increased knowledge of diagnosis has led to an apparent change in the mortality from different diseases. Thus, the frequency of deaths from heart disease appears to be much greater, and that from apoplexy much smaller now than fifty years ago. In all probability this difference is not real but only apparent, and is due to the more accurate diagnosis by which the presence of cardiac disease is now ascertained. The supposed increase in the frequency of cancer is probably in great measure due to a similar cause, for I am quite certain that many cases which were formerly classed as chronic diarrhœa, dysentery, jaundice, or dropsy were really due to malignant disease of the abdomen, while others probably depended upon unrecognised disease of the kidney. For up to a recent date so little attention was paid to the condition of the urine that about fifteen years ago, when examining proposers for life assurance in place of a friend who was away on his autumn holiday, I was astonished to find that there was no apparatus at the office for examining urine, and I believe that it is only within the last ten or twelve years that an examination of the urine for life assurance has become general.

Real Changes in Disease.—But real changes as well as apparent ones have occurred in diseases. Some have become more frequent and others are rarer. Thus, typhoid fever is almost certainly more common, because the increase of our sewage system has given greater facilities for its spread. Typhus fever, on the other hand, has become comparatively rare, and the story of its extermination in Edinburgh is very interesting. Five-and-twenty years ago your President was constantly wearing a smoking-cap because his head had been shaved during an attack of typhus, and a few months later one of the physicians and two of the house physicians to the hospital in Edinburgh died of the disease, while another just escaped with his life. There were, I believe, at the end of 1867 nearly 150 typhus patients in the hospital at once. A few years later the disease was completely exterminated by the alterations in the town necessitated by the new university buildings. A certain narrow lane called Hastie's Close, which was a hotbed of typhus fever, and from which the disease used to make periodical excursions into the neighbouring districts, was pulled down, and since then typhus has almost entirely disappeared. Pyæmia is another disease which, although not totally extinct, is very greatly lessened in virulence. When I was a student it was the dread of the surgical wards, and I remember one patient dying of it who had been admitted simply for a slight injury to the finger tip, which necessitated amputation of the last phalanx. Now, thanks to the antiseptic treatment introduced by Lister, such cases are almost unknown.

Departments of Greatest Advance.—Five-and-twenty years ago we knew only too well that typhus was infectious, and that pyæmia and erysipelas were likely to spread in a ward when once they got into it, but we did not know then the causes of these diseases as we do now, nor had we the same means at our disposal wherewith to combat them. The departments in which the greatest advances have been made within the last five-and-twenty years are in those of fevers and diseases of the nervous system. A new era in the study of the latter was foreshadowed by the experiments of Fritsch and Hitzig on the brain of the dog, but it can only be said to have fairly begun with Ferrier's localisation of the cortical centres, both motor and sensory, in the brain of monkeys. For the brain of the dog was too unlike that of man for experiments upon it to be of much practical use in the diagnosis of human ailments, while the likeness in the brain of the monkey to that of man at once allowed conclusions drawn from the experiments upon the former to be transferred upon the latter. Yet if we try to describe in one word the department in which medicine has made the greatest progress within the last quarter of a century, that word must be "fevers;" for during this time we have learned to recognise fever by the use of the thermometer in a way we never did before; we have learned the dependence of the febrile process in the great majority of cases upon the presence of microbes in the organism, and we have become acquainted with an immense number of chemical substances which have the power both to destroy the microbes and to regulate the febrile process.

Introduction of the Thermometer.—It is true that the thermometer was used by Danielssen, in leprosy, before the year 1848, and its more general use began with Wunderlich's observations nearly thirty years ago, but it is only within the last five-and-twenty years that its use has become at all general. It was only during the latter period of my service as house-physician, that the clinical thermometers introduced into this country by Aitken came into use in the Edinburgh Infirmary, and cumbersome instruments they were, for they were nearly a foot long, and I used to carry them about the wards under my arm in a case big enough to have held a set of amputating instruments. Their size and brittleness combined were a complete obstacle to their general employment in practice, whereas the small, accurate and yet moderately priced thermometer is now to be found in every doctor's waistcoat pocket. During one of the last years of my student life I saw a man suffering from double pneumonia nearly die, his life being saved by the accidental presence of a Swedish doctor. The man was completely comatose, and everyone thought he would die; but the Swede, who had seen similar cases saved by bleeding and cold affusion, proceeded to apply these remedies with complete success. No one who witnessed the wonderful way in which the man was snatched from the jaws of death could fail to be deeply impressed by the scene, but no one knew then why the man was dying or how the remedial measures acted. Now the use of the thermometer enables the merest tyro to recognise such a case as one of hyperpyrexia saved by the abstraction of heat. The constant employment of the instrument shows everyone, nurses as well as doctors, when the temperature of a patient is rising so high as to be dangerous, and allows them in many, perhaps in most cases, to prevent a further rise by the use of antithermic measures, such as cradling, cold sponging, cold affusion, cold baths, or by the administration of antipyretic remedies.

Nature of Fever.—The thermometer has not only enabled us to detect the onset and to watch the progress of fever, but in conjunction with microscopical research, physiological experiment, and chemical analysis it has enabled us to gain a fuller knowledge of the nature of the febrile process itself. We know that during it the organism is consuming rapidly, or, as Dr. Donald MacAlister graphically says, it is like "a candle burning at both ends," and we have learned scientifically the reasons for the practical treatment, of which Graves was so proud that he wrote as his own epitaph "He fed fevers." We have learned also, to a great extent, the necessity for the elimination of the waste products, or ashes as we may term them, which the excessive combustion produces, and thus we know why the surgeon is so anxious regarding the result of an operation when the kidneys of his patient are inadequate. For if any febrile attack following the operation should lead to increased demands upon these secreting powers, they might fail to meet it, and the retained excreta would poison the patient.

New Methods.—The rapid increase in our knowledge has been due not merely to the constant use of old methods, but to the introduction of new ones, and more especially to the general recognition of the fact that the same strategy which has often proved so successful in war is to be applied in attacking complex problems. They are to be separated as far as possible into their several components and each of these is to be overcome in detail. As presented to us by observation at the bedside, the problems of disease are too complex for us to solve, and we are only succeeding in doing it by examining the various factors one by one in the laboratory. The greatly increased powers of the microscope and the better methods of illumination have been of the greatest service, but their utility would be very much less than it is had it not been for the general introduction of the microtome and the invention of new methods of staining. When I was a student the microtome was only used for cutting sections of wood in the class of practical botany. About that time it was employed by Mr. Stirling, Professor Goodsir's assistant, in the preparation of animal tissues, but I believe that we owe its general introduction to Professor Rutherford. The facility with which sections are made by it has made microscopical research much less tedious, and has enabled trained histologists to do more work in a given time, and medical students to acquire knowledge more rapidly. But without the method of staining introduced by Weigert and Ehrlich, we should, even with the best microscopes, be unable to recognise most of the microbes which are so important in the causation of disease.

Good Out of Evil.—It is very interesting to see how good may come out of evil, and a striking illustration of this is afforded by the history of medicine in the period we are now considering. For it seems to me that we can trace a great part of our knowledge of disease germs and of the antiseptic remedies we use in treatment to the cupidity and stupidity of the Spaniards of the Cordilleras. Their cupidity led them to cut down the cinchona trees of the Andes in order to fill their pockets with the gold they received in exchange for the precious bark, while their stupidity prevented them from planting new trees to replace those which they felled. The consequence of this was that quinine became so dear that it was evident that anyone who could produce it artificially would make his fortune. Amongst others Perkins tried to do this, and, although he failed, yet in the attempt he discovered the anilin dyes, whose staining powers have not only helped us so much in ordinary histological research, but have made it possible to distinguish disease germs which without them would have been invisible. But the discovery of the anilin colours was only one outcome of the attempt to make quinine synthetically, for the impulse which it gave to the study of aromatic compounds has led to the production of salicylic acid and acetanilide, antipyrin, phenacetin and all the other antipyretic remedies whose number is probably legion, and whose names already have become so numerous as to be troublesome. Here we see good has arisen out of evil; for if the price of quinine had not been so high, the researches which have proved so useful might not have been begun even yet.

Small and Great, Foolish and Wise.—In looking at another of the greatest advances which medicine has made—namely, the knowledge of infective disease—we can see how enormous results can arise out of very small beginnings, and the safety of nations may be consequent upon a research which many men would have termed useless or even frivolous. I can hardly fancy any better illustration of St. Paul's observation about the foolish things of this world confounding the wise than Pasteur's researches on tartaric acid; for what could seem more foolish to the so-called practical man than the question, "Why does a crystal of tartaric acid sometimes take one shape and sometimes another?" Yet from an attempt to answer this question has arisen the whole of Pasteur's work on fermentation in general, and on that of wine, beer, and vinegar in particular, whereby he has been able to save millions to his country by accelerating the production of vinegar and preventing the souring of wine and beer. His observation that tartaric acid sometimes turned the ray of polarisation to the right, sometimes to the left; that, indeed, there were two crystals apparently alike, but really different; and that these could be combined so as to form a symmetrical crystal having no power of rotation, led him to look to life and living beings as the source of asymmetry. He tried to produce this asymmetry in salts of tartaric acid by fermentation, and found that during the process an organism developed which eats up the dextro-tartaric acid, and leaves the lævo-tartaric acid behind. This led him to investigate such minute organisms, and, by simplifying the soil in which they grew, and separating the organisms one from another, he learned the conditions of their growth, and showed that most processes of fermentation were due to the presence of living organisms. It is true that while Pasteur was still a boy at school, Peyen and Persoz had shown that the liquefaction of starch and its conversion into sugar was due to diastase, and that Dumas in a report on a paper by Guérin-Varry had pointed out that, although unlike diastase, the active principle of the gastric juice had not been isolated, it was probably a ferment of a somewhat similar kind. Dumas classed yeast as a ferment along with diastase, and the fact that such a process as conversion of starch into sugar could be effected without a living organism naturally rendered it all the more difficult for Pasteur to prove his thesis that most fermentations were due to living organisms.

Chemical and Biological Views of Fermentation.—The two views of the action of ferments—namely, the chemical and the biological—may, I think, fitly be likened to Pasteur's two kinds of tartaric acid, each by itself being lopsided and incomplete, forming a symmetrical whole only when united. There can be no doubt of the truth of the chemical view that diastase is not a living organism, and yet converts starch into sugar. There can be as little doubt of the biological view that yeast and other organisms which cause fermentation are living bodies, and that without the presence of these living bodies alcoholic, acetic, and other forms of fermentation would not exist.

Microbes and Enzymes.—But recently we have come to recognise that these living organisms may produce their effect by manufacturing chemical ferments, and that these ferments may occasionally do the work, although the organisms which form them may be absent. It is quite true that it is difficult—perhaps impossible—to get fermentation from the dead yeast plant, but we may find a parallel for this in the fact that the pancreas of the higher animals sometimes yields an active ferment and sometimes not. Nor need we wonder that the ferments produced by microbes have but a slight action compared with those of the microbes themselves, if we remember how very little power of digestion a dead pig's stomach has as compared with the amount which can be digested not by the live animal itself only, but by the herds of swine consisting of its "fathers and mothers, its brothers and sisters, its cousins and its aunts," during all the term of their natural lives; for in the process of fermentation microbes are growing, fermenting, and dying with great rapidity, and many generations occur in a fermenting fluid in the space of a few hours, so that the total effect they produce will be out of all proportion to any which can be got from the microbes themselves at a single instant.

Microbes and Disease.—From organisms as a cause of fermentation and of the diseases of wine and beer, Pasteur went on to investigate their action as causes of disease in living beings—first in the silkworm, next in the lower animals, and, lastly, in man. He established the dependence of the silkworm disease and of anthrax upon the presence of specific microbes which could be transmitted and communicate the disease, and by destroying the infected eggs of the silkworm he eradicated the disease and restored the silk industry to France.

Weakening of Disease Germs.—But while this investigation is interesting to us as illustrating the probable cause of the disappearance of typhus fever, to which I have already alluded, Pasteur's researches on anthrax are still more important as bearing upon the question of protective inoculation; for he found that the disease germ could be cultivated outside the living body and grown in flasks under varying conditions, some of which were favourable and others unfavourable to its growth. High temperature enfeebled the virus, so that it no longer killed an animal with the same certainty, and by inoculating first with a weak virus and then with one successively stronger and stronger, he found that animals could be completely protected either from inoculation by the strongest virus or by infection from other animals suffering from the actual disease.

Increase in Virulence of Disease Germs.—Another extraordinary fact which he made out was that the virus thus weakened so that it will not kill a guinea-pig a year old, and still less a sheep or ox, may again be rendered most potent by inoculating a feeble animal, such as a guinea-pig a day or two old, from this older and stronger guinea-pig's, the strength of the disease germs increasing with every inoculation, until finally sheep and cows may be killed by it. We can thus see how an epidemic of disease beginning sporadically and attacking weak individuals may gradually acquire such strength as to attack and carry off the strongest.

Pure Cultures.—Pasteur's plan of growing disease germs outside the body in broth, although of the utmost value, did not allow a convenient separation of different germs; but this can now readily be done by Koch's plan of sowing them, not in a liquid medium but on solid gelatine spread on glass plates, so that the growth of the germs can be daily watched under the microscope and inoculations made from single colonies on other plates until pure cultures have been obtained. By thus isolating the different microbes we learn their life-history, the mode in which their growth is influenced by differences of soil, of temperature, of moisture, by the addition of various substances which either favour or retard their growth, and, last but not least, the effect which one microbe has upon another when they are grown together at the same time.

Struggle for Existence amongst Microbes.—For even amongst these minute organisms the struggle for existence and the survival of the fittest exists, like that which Darwin pointed out so clearly in the case of higher plants and animals. When two microbes are growing together, one may choke or destroy the other, just as weeds in a garden may choke the flowers, or, on the other hand, successive generations of one microbe may render the soil suitable for another, just as decaying algæ and mosses may furnish mould in which higher plants can grow.

Struggle for Existence between Microbes and the Organism.—But it is not merely between different species of microbes or different cells in an organism that this struggle occurs. It takes place also between the disease germs and the cells of the organism which they invade, and the result of the struggle may be determined, not by some powerful agency which weakens or destroys either the organism or the microbe, but by some little thing which simply inclines the scale in favour of one or the other. Thus, in the potato disease the victory of the invading microbe and the destruction of the potato, or the death of the microbe and the health of the tuber, may depend upon some condition of moisture or possibly of electrical change in the atmosphere which aids the growth of the microbe disproportionately to that of the potato. These atmospheric conditions need not necessarily be antagonistic to the potato, they may even in themselves be advantageous to it; but if they help the microbe more than the plant, the microbe will gain the victory and the plant be destroyed.

Fight between Cells in Higher Organisms.—The fight between the organs which Æsop describes in his fables actually occurs between the cells in some vertebrate animals, and the schism predicted by St. Paul as the result of such a fight actually takes place. For in the tadpole, at one stage of its existence some of the cells at the base of the tail begin to eat up others, with the result that schism occurs and the tail falls off.

Phagocytosis.—This struggle for existence between the cells of an organism and microbes has been beautifully shown by Metschnikoff in the daphne or water flea, where the process of the cells eating up the microbes or the microbes destroying the cells can be actually observed under the microscope. This process of phagocytosis is now regarded by many as only a small part of the struggle between an organism and a microbe, but it is impossible to see one part of a microbe half digested by the cell in which it is imbedded, while the part outside part remains unaltered, without believing that the process is one of great importance. At the same time, it seems that the process of phagocytosis, where the microbe and the cells meet in close conflict, bears about the same relationship to the total struggle that a bayonet charge bears to a modern battle. The main part of the fight is really carried on at some distance by deadly weapons, by bullets in the case of the soldier, and by ferments, poisonous albumoses, and alkaloids on the part of the cells and the microbes. In some of Metschnikoff's observations we can almost see this process, for he has figured leucocytes dead, and apparently burst by the action of conidia, lying close to but yet outside them, as if these conidia, like the dragons of fable, had spit out some venom which had destroyed them.

Venom of Microbes.—Within the last few years attention has been gradually becoming directed less to microscopical examination of the microbes themselves and more to chemical investigation of the ferments and poisons which they produce; yet, strangely enough, the very moment when chemistry is becoming more important than ever has been chosen to minimise the teaching of it in medical schools, and examination in it by licensing bodies. It is now possible to separate the albumoses and poisons from the microbes which produce them either by filtration, or by destroying the microbes by graduated heat; for, as a rule, they are destroyed by a lower temperature than the albumose or poisons which they form.

Microbes and Enzymes.—As the albumoses produced by microbes are nearly allied, chemically and physiologically, to those formed in the alimentary canal of the higher animals by digestive ferments, it is natural to suppose that microbes, like the higher animals, split up proteids, starches, and sugars by enzymes, which they secrete, and which in both cases may be obtained apart from the living organisms which produce them; that, in fact, we should be able to isolate from microbes bodies which correspond to pepsin or trypsin, just as we can isolate these from the stomach or pancreas of an animal. In some, although not in all cases, this attempt has succeeded.[1]

Poisonous Albumoses.—The albumoses produced by microbes resemble those formed during normal digestion in being poisonous when injected directly into the circulation, although they may not be so greatly absorbed from the intestinal canal. One of the most remarkable discoveries in regard to albuminous bodies is the fact that some of them which are perfectly innocuous, and, indeed, probably advantageous to the organism in their own place, become most deadly poisons when they get out of it. Thus the thyroid and thymus glands, which are perfectly harmless and probably useful, were found by Wooldridge when broken up in water to yield a proteid which instantaneously coagulated the blood if injected into a vein, so that the animal died as if struck by lightning, while Schmidt-Mühlheim, under Ludwig's direction, found that peptones had an exactly opposite effect, and prevented coagulation altogether.

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[1] *Vide* Brunton and Macfadyen, Croonian Lectures on Chemical Structure and Physiological Action, BRITISH MEDICAL JOURNAL, June 15th, 1889, p. 1336.

Neutralisation of Poisonous Albumoses.—Perhaps the analogy is too vague, but we seem to find here something very like Pasteur's two kinds of tartaric acid, one rotating polarised light to the right, the other to the left, but, when united together, having no action at all, for here we have two bodies, one of which destroys coagulability entirely, the other increases it enormously; while many albuminous bodies have no action upon coagulation whatever. This view would lead us to suppose that one form of albumose may neutralise the action of another, thus rendering them both completely innocuous, whilst either one or other alone might be a deadly poison. The albumoses formed by microbes appear frequently, if not always, to have a double action, destructive and protective on the higher animals. Pasteur's treatment of hydrophobia is based on the idea that the spinal cord of rabid animals contains a virus, and its antidote—Koch's tuberculin—may be similar in this respect, and may yet, by suitable alterations, fulfil the hopes of its able and single-minded discoverer.

Zymogens and Enzymes.—Perhaps a similar process of splitting up and recombination may explain the formation and disappearance of the enzymes, such as pepsin and trypsin, by which digestion is carried on. The pancreas of a fasting animal will not digest albuminous bodies like fibrin, while the pancreas of an animal killed during full digestion will do so rapidly. Yet the fasting pancreas contains the zymogen, or mother substance, which yields the digestive ferment, and, as Kühne has shown, by treating it first with acid and then with alkali, it becomes active. Again, to recur to the analogy of Pasteur's tartaric acid, we seem to find that the inactive, and possibly symmetrical, albuminous substance of the fasting pancreas is split up by this treatment after death or during the process of digestion in life, and yields the lopsided and active pancreatic ferment. But, if this be so, what becomes of the other half which has been split off? We do not at present know, but curiously enough Lépine has lately shown that while the pancreas is pouring into the digestive canal a ferment which will form sugar, it is at the same time pouring into the circulation another ferment which will destroy sugar.

Immunity.—We must be very careful in our speculations and test them by experiment, but such observations as these may tend to throw some light upon the nature of immunity. Immunity is probably a very complex condition, and is not dependent altogether upon any single factor, but we can now understand that if a microbe has gained an entrance into an organism, and produces a proteid or an albumose poisonous to the organism which it enters, it may grow, thrive, and destroy that organism, while the injection of some other proteid which would neutralise the poison might save the animal while the microbe would perish.

Cure of Anthrax.—Thus Hankin has found that while a mouse inoculated with anthrax will die within twenty-four hours, a rat resists the poison altogether; but if the mouse after being inoculated with the disease has a few drops of rat's serum injected into it, instead of dying, as it would otherwise certainly do, it survives just like the rat, and from the spleen of the rat Hankin has isolated a proteid which has a similar protective action to that of the serum.

Cure for Tubercle.—Working on similar lines, Bernheim and Lépine used the injection of goat's blood in phthisis so as to stop, if possible, the progress of tubercle, and Richet has used the serum of dog's blood, for the goat is quite immune, and the dog is to a great extent, though not entirely, immune from attacks of tuberculosis. The injection of goat's blood in somewhat large quantities has been given up, while dog's and goat's serum in small quantities of 15 to 20 minims at intervals of several days is still under trial.

Action of Blisters.—But if immunity can be insured by such slight changes in the organism as a few drops of serum from a rat will produce in the body of a mouse, it is natural to suppose that a similar change might possibly be effected by removing the albuminous substance from one part of the body and introducing it perhaps after it has undergone slight change, into another. As I have already mentioned, the albumoses of ordinary digestion are poisonous when they are injected into the circulation, and so are the proteid substances obtained from the thyroid and thymus glands. Why then may not the serum of one's own blood, withdrawn from the vessels by a blister and reabsorbed again, not to be as good as the serum obtained from the blood of an animal? We all know that in many diseases, such as inflammation of the lungs either pneumonic or tuberculous, in inflammation of serous cavities such as the pleura, pericardium, and arachnoid, and of solid organs like the liver, or of nerves like the sciatic, the application of blisters is one of the most useful therapeutic means we can employ. In spite of all the changes in medical theory, blisters have always maintained an important place in practice. We have hitherto been in the habit of explaining their action by supposing that they caused derivation of blood from the inflamed part or reflexly caused the vessels to contract, and lessened the pressure upon the nerves of the inflamed tissues. But it is quite possible that this may be only a part of the truth, and that the good derived from blisters may be due to this form of treatment being really a form of endermic administration of proteid matters derived, no doubt from the blood, but altered in their passage from the vessels to the surface of the skin, and thus having an effect upon the body entirely different from what they would have had if they had remained in their ordinary place. It might form an interesting point for investigation how far the beneficial action of blisters is increased or diminished by leaving the bleb untouched so that the serum may be reabsorbed, or opening it and allowing the serum to drain away.

Bleeding.—It is quite possible, too, that the good effects of bleeding may be due to a similar cause. There can be no doubt that this practice has fallen much into disuse, and I think there can be as little doubt that those who used it in former times were not fools, but were led to use it by the marked relief which in many cases it afforded. Experiments upon animals have shown that withdrawal of blood from the veins causes absorption of proteid matters from the tissues, and these may have an action of their own upon the blood and tissues generally with which they are thus brought into contact. Indeed it is possible that free purgation may be partly due to a similar action.

Speculation and Experiment.—The human body is a most complex piece of mechanism. We learn its action bit by bit very slowly indeed, and we are only too apt to regard the little piece which attracts attention at the moment as all-important and to leave the other parts out of sight. But this is not true of our study of the body only, for the same tendency manifests itself in the pursuit of knowledge of all kinds, yet it is in medicine more especially that this tendency comes to be a matter of life or death, for upon the medical view prevailing at the moment medical practice is apt to depend and erroneous views may lead to the death of many patients. So long as practice depends upon theories, unchecked by experiment, so long will medical practice prove fluctuating, uncertain, and dangerous. One of the greatest gains of the last five-and-twenty years is the general introduction of the experimental method and the habit which has been growing up during it of accepting no statement unless based upon experimental data. Speculations such as those in which I have been indulging in regard to blisters and blood-letting are useful as indicating lines of experimental research, but until these have been thus tested it is foolish and may be dangerous either to accept and act upon them as true or to scout them entirely as false and absurd. Imperfect knowledge is almost sure to lead to one-sided practice, and thus diverging further and further from the truth, ends at last in falsehood and folly.

Antisepsis.—Perhaps no better example of this can be found than antiseptic surgery, from the time of the good Samaritan down to Ambroise Paré and Sir Joseph Lister. The good Samaritan bound up the wounds of the poor traveller, pouring in oil and wine, which, only a few years ago, was recommended in an Italian journal as an excellent antiseptic. Ambroise Paré, when his ointments ran out, could not sleep for thinking of the miserable soldiers to whom they had not been applied, and was greatly astonished to find in the morning that these wretched neglected ones were better and happier than their comrades who had been treated *secundum artem.* I have no doubt that Paré's predecessors in trying to improve upon the methods of the good Samaritan and upon the still useful friars' balsam, which is a powerful antiseptic but stings the wound or sore, had tried to make their applications more and more irritating, not knowing that it was the antiseptic power and not the irritant qualities which were desired. Paré abolished the ointments with the irritation they caused, and thus did great service to surgery. But a greater one yet was rendered by Lister when he recognised that the danger of operations was due to the entrance of germs, and by preventing this has completely revolutionised surgical practice; nay, more, he has to a great extent revolutionised medicine, for the diseases of the internal organs, which were formerly entirely under the physician's care, are now becoming amenable to surgical treatment, and diseases of the stomach, intestine, liver, kidney, and lungs, and even of the brain and spinal cord, are now successfully treated by surgery when medicines are powerless to help. The most remarkable of all the recent triumphs of surgical operations upon the brain in which Mr. Horsley has gained such well-deserved fame, would have been impossible without Ferrier's localisation of cortical centres, and would have been equally impossible but for Lister's antiseptic method.

Disinfection.—But it is not only in surgery that recognition of diseased germs as a source of danger to the organism has led to their destruction outside the body, and insured safety from their attack. This occurs in all infective diseases, and this term now includes many which were not formerly regarded as such, for neither consumption nor pneumonia was formerly regarded in this light; but just about twenty-five years ago tubercle was shown to be inoculable, and since then the discovery of the bacillus of tubercle by Koch, and of pneumonia by Friedländer, has caused us to class both these diseases as not only infective, but as caused by definite organisms.

Prevention of Epidemic Diseases.—So long as people were ignorant of the causes of epidemic diseases, they were utterly unable to combat them, and they either in fury slew defenceless people for poisoning the wells, as in the Middle Ages, or appointed days of fasting and prayer, as in our own times. But once an epidemic is known to depend upon the presence of a certain organism, precautions can be taken for destroying the organism outside the body by means of disinfectants, or for lessening the susceptibility of the organism to its ravages inside the body by inoculation, or combating its effects by means of antipyretics. A knowledge of the life-history of microbes has enabled us to ascertain the power of different substances, either to destroy them completely, or to arrest or retard their germination and growth, and in this way to prevent the occurrence of the diseases which these microbes might otherwise produce.

Old and New Remedies.—In comparing the drugs at our disposal now with those we possessed twenty-five years ago, we are at once struck by two facts, namely, that we not only have a very much larger number of powerful remedies than before, but that we also know better how to use the old ones. Both of these gains we owe to experimental pharmacology, to the testing of drugs upon the lower animals.

Antivivisection.—Every now and again a loud outcry is raised against this method, partly from ignorance and partly from prejudice. Many—probably most—of the opponents of experiments on animals are good, honest, kind-hearted people, who mean well, but either forget that man has rights against animals as well as animals against man, or are misled by the false statements of the other class. These are persons who, blinded by prejudice, regard human life and human suffering as of small importance compared with those of animals, who deny that a man is better than many sparrows, and who, to the question that was put of old, "How much then is a man better than a sheep?" would return the reply, "He is no better at all." Such people bring unfounded charges of cruelty against those who are striving, to the best of their ability, to lessen the pains of disease both in man and also in animals, for they, like us, are liable to disease, and, like us, they suffer from it. I may perhaps be allowed to quote two sentences from a paper which I wrote twenty-four years ago, and therefore a considerable time before any antivivisection agitation had arisen, for they expressed then and they express now the objects of experimental pharmacology. [2] "Few things are more distressing to a physician than to stand beside a suffering patient who is anxiously looking to him for that relief from pain which he feels himself utterly unable to afford. His sympathy for the sufferer, and the regret he feels for the impotence of his art, engrave the picture indelibly on his mind, and serve as a constant and urgent stimulus in his search after the causes of the pain, and the means by which it may be alleviated."

Gains by Experiment on Animals.—It is said that our mouths are full of promises, but our hands are empty of results. The answer to this is that anyone who doubts the utility of experimentation upon animals should compare the *Pharmacopœia* of

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[2] *Lancet*, July 27th, 1867.

1867 with our present one. To it we owe, in great measure, our power to lower temperature, for to it is due not only the introduction of new antipyretics such as salicylate of soda, antipyrin, antifebrin, and phenacetin, but the extension of the use of quinine from a particular kind of fever—malaria—to other febrile conditions. To it also we owe our greatly increased power to lessen pain by the substances just mentioned, which have not only an antipyretic but an analgesic action, and give relief in the torturing pains of neuralgia and locomotor ataxy when even morphine fails to ease, unless pushed to complete narcosis. The sleeplessness, too, which is such a frightful complication in some fevers can now be combated by other remedies than opium and antimony; and we have the bromides, chloral, sulphonal, paraldehyde, urethane, chloralamide, and others which, either by themselves or added to opium, enable us to quiet the brain instead of exciting it to further action, as opium alone so frequently does. Our whole ideas regarding cardiac tonics also have undergone a complete revolution within the last quarter of a century, for I was told when a student that digitalis was a cardiac sedative, and was apt to depress the heart, whereas now we know that it and its congeners—strophanthus and erythrophlœum and spartein—increase the heart's strength, raise the vascular tension, and are useful not only in sustaining the circulation, but in aiding elimination. This view of the action of cardiac tonics, which has revolutionised the treatment of heart disease, we owe chiefly to the experiments of Traube, although my own experiments, made in the laboratory of Sir Douglas Maclagan under the direction and by the help of my teacher and friend, Dr. Arthur Gamgee, may have helped towards its general acceptance in this country.

Future of Pharmacology.—But perhaps the most promising thing about pharmacology is that we are now just beginning to gain such a knowledge of the relationship between chemical structure and physiological action that we can, to a certain extent, predict the action of a drug from its chemical structure, and are able to produce new chemical compounds having a general action such as we desire, for example, anæsthetics, soporifics, antipyretics, and analgesics, although we have not yet arrived at the point of giving to each one the precise action which would make it most suitable in any particular case. Even when we do not know the chemical structure of a drug we may be able, from noticing one of its actions, to infer that it possesses others. We are, indeed, getting a knowledge of the action of drugs both of known and unknown chemical structure and a power of making new remedies which will, I believe, enable us within the next five-and-twenty years to cure our patients in a way that at present we hardly think.

Training of Medical Students.—But the excessively rapid development of medicine and medical sciences requires that men who are entering the profession should not only be taught the things that we know now, but should be so trained as to enable them to keep abreast more or less with medical progress. This, I believe, can only be done by giving them a thorough grounding in chemistry, physiology, general pathology, and pharmacology; and this training must be essentially of a practical nature, not only in the way of demonstrations, but of actual work on the part of the student himself. It is, as I have already said, most extraordinary to find that at the time when chemistry is becoming most essential to medicine, some medical boards should so reduce their requirements in the examination on this subject as to render the student's knowledge of it both limited and superficial. But while chemistry may be regarded as at present badly treated, the same cannot be said of histology, and while five-and-twenty years ago comparatively few students possessed a microscope, there is hardly one now who has not only got one at his disposal, but is also able to use it.

The introduction of training in practical physiology, which we owe in great measure to Professors Burdon Sanderson and Michael Foster, has given to the student a basis for his medical studies, such as practical anatomy affords surgery. When I took my degree in medicine I had never looked into an eye or an ear or down a throat; but now we have departments for these specialities, and for others, such as skin and electrical treatment, at most hospitals. I am, unfortunately, unable to give an account of the development of special departments in different hospitals throughout the country, but at St. Bartholomew's there was none for the throat until 1874, when I went to Vienna for six weeks to learn the laryngoscope, and, by the kindness of the Governors, on my return I was provided with everything requisite for opening a special department. But this department, while I held it, was used almost entirely for the simple treatment of patients; whereas, by my successor, Mr. Butlin, it has been converted into a means for the instruction of students. It is not, however, in this department only that the cases at hospitals are better utilised for instruction. The same thing has gone on in all departments both general and special, and the change in this respect which I have noticed in the twenty years during which I have seen out-patients at St. Bartholomew's has been very great. Everywhere we find men eager to learn, and the desire for knowledge which they show as students they carry with them into practice, where they read and work in a way that makes one frequently astonished that men, the greater part of whose time is taken up in seeing their patients, can manage to keep themselves so well abreast of all the new discoveries. In doing this, great aid has been afforded to men unacquainted with French and German, by the abstracts of foreign papers published in medical journals and yearbooks, and especially, perhaps, by the *Medical Record*, now unfortunately defunct. Its place, however, has been already filled, and shortly, we hope, will be much more than filled by the SUPPLEMENT to the BRITISH MEDICAL JOURNAL. Nor is it only in supplying the members of this Association with an epitome of current literature that the Council have shown both wisdom and liberality, for, by granting aid to scientific research and to the investigation of therapeutic questions the British Medical Association has shown a farsighted policy and a most praiseworthy desire not to be content with merely keeping abreast with medical progress, but to push onward in the van and further by every means in its power the rapid advance of medical knowledge, which is practically the power of rendering aid to suffering humanity. Nor are the periodical meetings of the members of this Association without advantage, for journals may remain unread or be laid aside for a convenient season which never comes, but the stimulus of personal contact and interchange of ideas tends greatly to further the object which we all have at heart, the prolongation of life, the preservation of health, the alleviation of pains and the cure of disease.

23.

An Address

ON THE

METHOD OF ZADIG IN MEDICINE.

DELIVERED AT THE INAUGURAL MEETING OF THE NORTH LONDON MEDICO-CHIRURGICAL SOCIETY, ON THURSDAY, DEC. 17TH, 1891.

BY

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AN ADDRESS

ON THE

METHOD OF ZADIG IN MEDICINE.

Mr. President and Gentlemen,—Allow me, first of all, to thank you for the great honour you have done me in asking me to address you to-night. The choice of a subject has not been easy, and, in trying to select one, it occurred to me that perhaps no animal gets to its goal more quickly or more surely than the carrier pigeon; yet, when started on its homeward journey, it does not fly directly onwards, but first of all takes two or three preliminary circles, in order to ascertain its whereabouts and the direction in which to direct its flight. The time spent in doing this is very far from lost, and what occurs in the case of the carrier pigeon appears to happen also in the conduct of human affairs. A little while ago I was down in the country, and a nurseryman, a most intelligent and able man, gave me a few lessons on pruning. He told me first of all what to avoid, and then what to do. "Some people," he said, "when they want to prune a tree begin with the knife at once, and cut here and there, without having a definite idea of what they are to do. Now the proper way is to put your hands in your pockets, stand a little distance off, look at your tree, see what you want to do, and then set to work." In laboratory researches we find the same thing, and a few preliminary experiments are often very advantageous in learning the methods of work, so that an apparent loss of time at the beginning is often a real saving both of time and trouble in the end. Now, as this is a new Society, it seemed to me that perhaps it might be better, instead of beginning with a definite medical subject, such as the pathology and treatment of some disease, to ask you rather to direct your thoughts to some general methods of investigation. Now one of the greatest losses in medicine is the loss of individual experience. We find that men most able and successful in the practice of their profession, in the recognition and treatment of disease, die and carry their knowledge away with them. Some men may record the cases they have seen, but comparatively few are able to record their experience in such a way as to make it thoroughly available for others. Various attempts have been made at different times to collect the experiences of medical men, especially those in general practice, and to put it in such a form as to be available for their colleagues.

In the years 1874-77,[1] in my capacity of editor of the *Practitioner*, I made an attempt to collect the experiences of practitioners by issuing a circular and asking for returns regarding the treatment of quinsy and sciatica. Answers were returned from all parts of the world, and these were collated and published. The advantage which was thus gained, however, seemed hardly enough to repay the time, trouble, and expense which these questions and returns necessitated, and the attempt was discontinued. A few years later another attempt was made on a very much larger scale by the Collective Investigation Committee of the British Medical Association, but after this had been continued for awhile it was also dropped. The same desire for the collection of information is shown, however, in the union

[1] Practitioner, Nov. 1874, vol. xiii., p. 308; vol. xvi., p. 41; vol. xviii., p. 107.

of medical men to form societies in which everyone shall profit by the experience of his neighbours. The formation of the present Society is another indication of the value of this form of collective investigation, and it seems to me rather important that at its commencement we should pause a while and take a glance round before proceeding with what one may term its proper work, the considera-tion of diseases and their treatment. The failure of collective investigation to bring out any great amount of information from the profession as a whole shows that the task is no easy one; and if I fail to trace out for you a complete course by which our end may be attained you will not, I am sure, blame me, but will rather sympathise with my attempt, and will each and all of you endeavour to carry out further than I may be able to do the search for such methods as will enable us to attain the end we all desire. It seems to me that one cause of failure is a want of exact analysis, which leads to a want of exact synthesis. I may illustrate this by the common observa-tion that, when we wish to describe the face of someone, all we are able to recollect, or at least to put into words, are the general facts that the individual has two eyes, a nose, and a mouth, with hair of a more or less pronounced colour. If we try to describe him more accurately, we may possibly recollect that his eyes are sleepy or bright, that his face is stout or thin, that his nose is long or short, that his chin is projecting or not. But here most of us would have ex-hausted our stock of reminiscences. Now, it is frequently very important that a face should be so exactly described that the owner of it may be at once recognised, and for this purpose a plan has been adopted in France of photographing the front face and the profile. The enormous number of photographs which are thus accu-mulated, of criminals and others in whom the officers of the law take an interest, is so great that it would be impossible either to pitch upon the particular photograph that was wanted or to recognise the individual if it were not for a system of arrangement. All profiles may be at once divided into three classes, according as the base line of the nose is ascending, horizontal, or drooping—and each of these may be further subdivided according as the bridge is convex, straight, or concave. When to these are added similar subdivisions, according to the shape of the eye and the ear, we see at once that the whole of the photographs may be readily classified, and any individual one that is wanted may be picked out from amongst thousands of others at a moment's notice. Many people remember faces sufficiently well to recognise them when they see them again, but not to describe them, much less draw a portrait from memory; yet it is by teaching the law officers to describe portraits from memory that they are trained to recognise from the photographs the people who may be "wanted." It appears to me that one of the kinds of training that is needed by medical men is this power of learning to differentiate the characteristics of a patient, the symptoms he presents, and the effects of treatment upon him in such a way as to render any case presenting similar features readily recognisable by a fellow practitioner.

But it is not only the outward signs that we have to differentiate in this way. We are obliged in medicine to judge of the unseen from the seen, and from the objective data which are presented to our senses we must draw conclusions regarding the processes which are going on, or have already gone on, in the persons of our patients. We must, in fact, track symptoms which we see back to their causes. Now this process of "tracking" appears to me to be a fundamental one in man, and one which seems really to be a remnant of the qualities possessed by our pre-historic ancestors. According to Haeckel, man runs through in his embryonic condition the history of the development of the race from a simple uni-cellular organism up to the human being. But even after birth traces of simian ancestry still appear. We have all noticed that when an infant is warming its feet before a fire the soles are not held straight forwards like those of an adult, but are turned in towards one another, and the great toes are drawn apart from the others in very much the same position as the feet of a monkey. Lately, too, Dr. Louis Robinson has shown that the arms of infants have an extra-ordinary power of supporting the weight of the body, and in this characteristic also an infant resembles the monkey. Even in adult life the position of the feet which we notice so easily in infants is retained by many, and we often find that the soles of people's boots are worn more on the outer than on the inner edge, the feet still tending to turn inwards, though only to a slight extent. The same tendency to reversion which we notice in the feet may be observed, I think, also in the faculties of the mind; and the keen interest in tracking game by which prehistoric man was enabled to exist still evidences itself in the intense eagerness with which boys will read in Cooper's novels about Indians following a trail, or adults will pore over Gaboriau's stories of the police on the track of a criminal. There can be little doubt, I think, that the profession of medicine is a most intensely interesting one, and I am inclined to think that its special charm is, to some extent at least, due to the fact that it is constantly demanding the exercise of those qualities of tracking which we find in Cooper's Indian heroes. I know of no better example of the exercise of those faculties than that narrated by Voltaire in his story of Zadig. I thought it was an original idea of my own to point out the application of this method to medicine, but I find that I am only a humble follower of Professor Huxley, who has already written upon the applications of the method of Zadig to biology and palæontology.[2]

Zadig was a young man who, disgusted with life, retired from Babylon to a lonely place on the banks of the Euphrates, and there studied animals and plants until he saw a thousand differences where others could only see uniformity. One day one of the Queen's eunuchs, followed by a band of officials, came hastening past and asked Zadig: "Have you seen the Queen's dog?" Zadig modestly answered, "A bitch, I think; not a dog." "Quite right," said the eunuch; and Zadig continued, "A very small spaniel, has lately had puppies, limps with the left fore foot, and has very long ears." "You have seen her, then," said the eunuch. "No," said Zadig, "I have never seen her, and did not even know that the Queen had a dog at all." At the same time the finest horse in the King's stables ran away, and the chief huntsman, when seeking it, also made inquiries of Zadig, who said: "A first-rate galloper, five feet high, small hoofed, tail three feet and a half long, cheek-pieces of the bit are of twenty-three-carat gold and the shoes silver." "Where is he?" cried the chief huntsman. "I have not seen him and never heard of him before," said Zadig. Naturally enough he was suspected of having stolen both the spaniel and the horse, and was tried and condemned; but no sooner was sentence pronounced than both the missing animals were found. Zadig was then asked to explain how he knew so much about them without having seen them, and this, he said, was the way. He noticed one day in the sand the tracks of an animal, which he easily recognised as those of a small dog. Long

[2] On the Method of Zadig. Nineteenth Century, 1880. Reprinted in Science and Culture.

faint streaks on the ridges of sand between the footprints indicated that it was a bitch with pendent dugs, showing that she had had puppies shortly before. Other marks on the surface of the sand close to the prints of the forefeet indicated that she had very long ears, and one of the footprints being fainter than the others showed that she was slightly lame. As for the horse, the marks of his hoofs were all equi distant, showing that he was a famous galloper. In a narrow alley the dust on the trunks of the trees was disturbed at three feet and a half from the middle of the path. This showed the length of his tail, which had swept the trees as he lashed it from side to side. Branches of the trees met overhead at a height of five feet, and under them were some newly fallen leaves, showing that the horse had brushed against them, and was therefore five feet high. As to his bit, he had rubbed it against a stone, which Zadig recognised as a touchstone, and his shoes had left such marks on pebbles of another kind as showed they were made of fine silver.

A story very like that of Zadig's is told of an old fakir in the Syrian desert. He was one day visited by several Arabs, who asked him whether he had seen their lost camel. "It was very tall," said the fakir, "it was blind of the right eye, it had lost one of its front teeth, and it was laden on the one side with honey and on the other with corn." "Yes," said the Arabs, "that is exactly the camel; you have mentioned every point about it. Where is it?" "I have never seen your camel," said the fakir. "But if you have not seen it," said the Arabs, "how can you know all about it?" "I knew that it was a very tall camel because the tracks of its steps in the sand were further apart than those of an ordinary-sized camel. I knew it was blind of the right eye because it had cropped the herbage only on its left side, and I knew that it had lost one of its front teeth because in the middle of every bite that it had taken there was a small uncut part corresponding to where the tooth ought to have been. I knew that it had been loaded with honey on the one side and with corn on the other because I saw flies buzzing round one side of the track and ants busy on the other carrying away grains of corn that had fallen from the load."

An admirable example of the application to medicine of this method of tracking used to be told with great gusto by my late friend, Dr. Milner Fothergill, and I regret greatly that I cannot tell it with the same power and vividness that he did. In the town of Leeds there once lived a quack who had received no professional instruction whatever, but was known far and wide for his wonderful cures, and especially for his power of diagnosing the diseases of patients whom he had never seen, by simply examining their urine. A celebrated surgeon, Mr. X——, wishing to see his method of working, desired to be present one day, and the quack readily acceded to his request, feeling much flattered that so great a man should patronise him. Shortly after Mr. X—— had taken his seat a woman came in with a bottle of urine, which she handed to the quack. He looked at her, then at the bottle, held it up between him and the light, shook it, and said: "Your husband's?" "Yes, sir." "He is a good deal older than you." "Yes, sir." "He is a tailor?" "Yes, sir." "He lives at Scarcroft?" "Yes, sir" "His bowels are obstinate?" "Yes, sir." "Here," he said handing her a box of pills, "tell him to take one of these pills every night for a week, and a big drink of cold water every morning, and he will soon be all right." No sooner had the woman gone out than Mr. X—— turned to the quack, curious to know how he had made out all this. "Well, you see," said the quack, "she was a young woman, and looked well and strong, and I guessed the water was not here. As I saw she had a wedding ring on her finger, I knew she was married, and I thought the chances were it was her husband's water. If he had been about the same age as she it was hardly likely that he was going to be ill either, so I guessed he was older. I knew he was a tailor because the bottle was not stopped with a cork, but with a bit of paper rolled up and tied round with a thread in a way that no one but a tailor could have done it. Tailors get no exercise, and consequently they are all very apt to be constipated. I was quite sure that he would be no exception to the rule, and so I gave him opening pills." "But how did you know she came from Scarcroft?" "Oh, Mr. X——, have you lived so long in Leeds and you don't know the colour of Scarcroft clay? It was the first thing I saw on her boots the moment she came in."

Now, of late years we have got so many new methods of investigation that we are sometimes apt to forget the old habits of close observation by which this quack made out so much, and proved himself, although without any diploma, a worthy descendant of the water doctor whose picture by Gerard Dow occupies such a distinguished place in the gallery of the Louvre. Without resorting to the plan of testing the urine, by which that water doctor and his brethren of the craft no doubt recognised the presence of sugar, he could learn a great deal from its simple appearance.

Some years ago, when staying in the country with a medical friend whose wife was boiling some eggs in the dining-room for breakfast, I said to her from the other side of the room, "You have cracked one of those eggs now." She said, "I don't think I have." On taking them out of the pan, however, she found that one of them was cracked. She wondered how I knew, but the explanation was simple enough. The pan had boiled over, but water would not have held the steam long enough to boil over, unless there had been something in it to make the bubbles tenacious, and this could hardly be anything else but albumen which had escaped from a crack. In the same way, although the water doctor did not know about albumen, he probably recognised that the persistence of froth on the urine after shaking it was of somewhat ominous import, and that would lead him to give a guarded prognosis, just as one nowadays sometimes pities an old gentleman who unconsciously proclaims his precarious tenure of life by the froth he leaves behind him in a public urinal.

The water doctor may even have learned to associate this frothiness with nervous symptoms, such as restlessness, irritability of temper, and sudden outbursts of passion quite out of proportion to the amount of offence. I well remember an incident some fifteen years ago where an apparently causeless outburst of fury on the part of an ordinarily quiet man completely astonished all his friends, who only understood it when his subsequent illness and death showed that his sudden passion was but an indication of unsuspected disease. The steward of St. Bartholomew's Hospital, Mr. Mark Morris, a man of very keen observation, has told me that whenever a patient comes down to the office at 11 o'clock at night and wants to be discharged there and then, they know that he is suffering from cardiac disease. Perhaps the outburst of fury in the Emperor Theodosius,[3] which resulted in the massacre of Thessalonica, was only an indication of the disease which later on resulted in dropsy and death.

The water doctor would be sure to divide his frothy urines into pale and dark, and he would know that these two corresponded to quite different types. The dark urine was probably passed by an individual who was short of breath, disposed to rest, and frequently drowsy. The pale urine

[3] Gibbon's Decline and Fall of the Roman Empire, chap. xxvii.

would be passed either by an individual who rose in the morning with his eyelids swollen and puffy, and who was probably drooping and languid during the day, or by a person of quite a different stamp, energetic, irritable, restless, sleepless, always on the move, and driving on like a high-pressure engine. Further than that, perhaps, the water doctor might not go, but we know now that the dark, frothy urine has probably been passed by a man suffering from cardiac disease, while the pale urine is due to renal mischief; and the classical researches of Bright and others have shown us that the man with big eyelids has probably tubular nephritis, while one who drives himself and his neighbours without intermission suffers from contracting kidney. Nay more, physiological and pathological researches have taught us that the dark urine of cardiac disease is due to low tension in the arterial system in general and in the renal arteries in particular, so that the excretion of water is diminished, while the pale urine is due either to high tension in the arterial system, as in cases of gouty kidney, or to diminished power of excreting solids in chronic nephritis.

But there are other indications of disease which may sometimes be recognised without examining the urine, and I was greatly astonished by a man diagnosing albuminuria from the photograph of a patient, although there was no swelling whatever visible in the face. On inquiry afterwards I learned that the diagnosis was made from the glistening of the eye. A tendency to œdema had caused a reflection of light along the sclerotic, and this made the eye appear more brilliant than usual. We get a similar glistening of the eye as an effect of the emotion of compassion, in which the increased secretion of tears moistens the eyeball more than usual. An entirely different effect is produced by the emotion of anger, where the eye does not glisten, but glitters, or by great grief, which renders the eye-ball dull and lustreless. If we try to follow these appearances back to their physiological cause, we may find our attempt helped by considering a typical lack-lustre eye, such as that of a dead cod-fish. We see at once that the eyeball here is flaccid and its surface perhaps indented, instead of being tense, as it ought to be, and its surface smooth. We may imitate this condition very readily upon a child's indiarubber balloon. If we let the air out it at once becomes limp. If we blow it out it begins to shine, and the tighter we blow it the more does it reflect the light. The tension in the eye-ball under ordinary conditions has a relation to the tension of the blood, and the bright eye indicates the stout heart which may win the fair lady, while the lack-lustre eye is associated with a feeble circulation, which frequently has its origin in the depressing emotions of sorrow or fear. The glittering which occurs in anger is, I think, part of the same physiological process by which the face in great anger becomes pale, and the blood becomes concentrated internally, ready to supply force to the muscles in a sudden attack upon the enemy. It has always seemed to me that Orchardson's wonderful picture of Voltaire complaining of the insult that had been offered to him would have been rendered still finer by a very minute touch of white upon the eyeball, to indicate the glitter of anger. The bright eye of consumption is familiar to us all, the high temperature so common in the disease tending to make the circulation more than usually rapid, the intellect often more keen, and the hopes more bright than in health, though the face may be emaciated and the body reduced almost to a skeleton. But if we find in a thin person a languid instead of a bright eye, we are led to look for the cause of the patient's leanness rather in want of food than in rapid combustion, and not unfrequently, if inquiry teaches us that the patient is able to obtain food, we may diagnose either that he cannot eat or cannot digest.

Now it does not do to make one's diagnosis too rapidly, for otherwise one may fall into grievous error. I remember once a whole class of students standing round a man with a loud cardiac murmur, and one of his pupils much dilated. After many learned opinions had been expressed regarding his case, the man informed us that the eye over which we had been having such an animated discussion was a glass one. A similar occurrence happened to a learned professor. He was telling his students that he was able to discover this, that, and the other thing from the appearance of his patient's teeth. The woman took them out, and said, "Please, sir, I will hand them round; they might like to look at them closer." Yet, in spite of these risks incidental to all hasty observation, the habit of close attention to minute detail which this professor tried to inculcate was a most useful one, and many of those who scoffed at him five-and-twenty years ago have learned to respect and admire him.

The process of tracking disease to its cause will often help us greatly in treatment, for unless we can remove the cause all therapeutic measures may be useless. I remember on one occasion being consulted by a gentleman who was second in command in a department involving not only heavy work, but great worry. He was suffering from dyspepsia, and looked thin and worn. I examined him most carefully, and could find absolutely no cause for his symptoms. Knowing, however, the conditions under which he was working, I said to him, "How is your chief?" "He is not well." "Is he irritable?" "Yes, very." "Who is physicking him?" "Dr. So-and-so." I returned him his fee, and said, "Go to Dr. So-and-so and tell him to physic your chief; it is of no use for me to try to cure you with medicine." I met my patient some time afterwards, who, with a sly glance at his chief, whispered to me, "Your prescription was very efficacious."

One of the best examples that I know of tracing symptoms to their cause is afforded by Weir Mitchell's observations on chorea and on neuralgic pains. During the American War he took great interest in cases of gunshot wounds, and especially those involving injury to nerves. After the war was over his patients were scattered far and wide over the continent of America. He was struck by the curious coincidence in the reports which he got from them, and observed that one day (to put it roughly) he might get letters from San Francisco, saying that his patients in that district were suffering from pains in their scars; next day he might get a packet from the neighbourhood of Denver, next day from Chicago, and next day from New York. He thus noticed that a wave of pain was passing across the country. He next obtained the meteorological records, and found that a wave of rain was passing across the country at the same time and with the same speed. By comparing the pain-area with the rain-area he noticed that the two were concentric, but that the pain-area had a much larger radius than the rain-area. Thus all the patients in the rain-area, when they felt twinges in their limbs, looking up at the sky, would say, "It is raining to-day, and that is the cause of my pains." But those in the part of the pain-area outside the rain-area, when they looked up, saw that the weather was fine, and could thus discover no cause for their sufferings, although these were due to meteorological disturbances just as much as those of their fellow-sufferers in the rain-area. The way in which Weir Mitchell showed the dependence of chorea on meteorological changes was almost as interesting as the relationship between pain and weather. He tabulated all the cases of chorea occurring in Philadelphia, and drew out a chart to show them diagrammatically. He then got the meteorological records and tried to find what conditions caused an increase in the cases of chorea. He tried the mean daily range of the thermometer, the average temperature, the average barometric pressure, the relative humidity of the air, but little or no correspondence could be traced between the curves representing these different factors and the curve of chorea. The curve showing the amount of rain and snow in inches showed a slight general resemblance to that of chorea, the curve showing the days on which the rain or snow fell came still nearer, but the curve showing the number of storm centres passing within 400 miles of Philadelphia showed a likeness to the curve of chorea which was very remarkable. In the same way he showed that the curve of infantile palsy closely corresponded with the curve of temperature, though not precisely so. We now constantly receive from America telegraphic information of the approach of storms, and we may well fancy that the day is not far distant when warnings will be published in the newspapers, not only to seamen of approaching storms, but to invalids and people in general of the meteorological changes which will induce pain in some and nervous excitability in others, with perhaps an added hint that extra flannel should be worn by the former, and bromide of potassium or some other nervine sedative taken freely by the latter.

One of the commonest observations in medicine is that cases come in a run. In hospital practice this is very striking. On one day you will see a great number of cases of bronchitis, another day cases of diarrhœa, another day cases of rheumatism, and so on. It has seemed to me, for a good many years back, that a most useful study would be the connexion between such runs of cases of disease and meteorological conditions. I may, perhaps, be allowed to suggest that such a society as the present might find this a useful branch of work, and one which would not entail a great deal of labour if it were properly done. Each week, or each fortnight perhaps, the members might jot down in one word the kind of cases of which they had seen most, and their individual notes might be classified, so as to give the general results, by some member chosen for the purpose. He would then be able readily to get the meteorological records, and by comparing these with the cases which had come in a run a relationship might be traced between the condition of the weather and the class of patients most affected. We are accustomed to warn patients suffering from pulmonary diseases, either phthisis or bronchitis, or from albuminuria, to avoid chills; but I do not think that the meteorological factors which give rise to exacerbation of symptoms in all these diseases have been at all satisfactorily determined as yet. The process of tracking might thus be advantageously followed, in regard to the external conditions giving rise to disease, by this Society, but the process ought not to end here; it ought to be followed onwards to the internal constitution of the patient. You will often hear people who do not believe much in doctors still say that they are unwilling to go to anyone else than the man who has attended them and their families for a long time, "because," they say, "he knows my constitution." If we try to analyse what they mean by this, I think we will find that "the constitution" implies the kind of reaction which occurs on the application of any external stimulus. Take three men belonging to different families, for example. Put them on the top of an omnibus and let them drive out on a rainy day, and with a cold wind blowing. One man comes home and has a bad bronchitis, the second an attack of sickness and diarrhœa, and the third gets an attack of rheumatic pains. The meteorological conditions to which each man has been exposed were the same, but the results have been quite different, the difference depending upon the constitutions of the individuals. But people belonging to different families do not only react differently to meteorological conditions or to other causes of disease, they are also differently affected by remedies. One of these three men, for example, might tolerate with impunity, and indeed derive benefit from, large doses of arsenic which would cause sickness and diarrhœa in another; while a second might get headache, deafness, and possibly a cutaneous rash from a quantity of quinine which would only produce a feeling of strength and well-being in another. It is the knowledge of the way in which different families will react to drugs that constitutes the most important part of the experience of an old practitioner, and which forms one of the greatest difficulties in the way of a medical man treating strangers satisfactorily and certainly. When a stranger comes before him presenting certain symptoms, he can only deal with the disease according to average rules, and yet this individual patient may present the exception to these rules, and consequently the treatment fails.

But it is not only in different families that we find drugs having a different action; different individuals in the same family will not react always in the same way, either to the cause of disease or to the mode of treatment. Nay more, a further complexity is introduced by the fact that the same person will react differently in youth, manhood, and age to causes of disease and to remedies. We not infrequently find, for example, that a youth who has been liable to bronchitis presents symptoms of dyspepsia in middle age, and may again have a pulmonary affection in old age. If these variations in families and individuals could be traced to their origin the benefit conferred on practical medicine would be immense. We should then be able to overcome satisfactorily one of the great difficulties which constantly meet us at the present time, and instead of simply *trying* our remedies, choosing first one and then another amongst those most likely to suit, we should then be able to select the drug most suited to any individual case with certainty, and treat the disease with success. In this attempt I think we may be greatly helped by the law of heredity. At present we acknowledge it to a certain extent. If a man's grandfather has been gouty we are not at all astonished at the reappearance of the gouty symptoms in the grandchild. If either the father or the mother has been consumptive we dread the same disease in their progeny; but if one child should resemble the consumptive mother and the other the hale and hearty father, we should use special care to guard against colds in the former, and have very much less fear of any tubercular tendency in the latter. We acknowledge, in fact, that the members of one family throw back to different ancestral strains either on the father's or the mother's side, and that they do this not only in external appearance, but in tendencies to disease, and this is still one of the points which wants close and careful investigation. The different tendencies of an individual in either childhood or age may be regarded as a kind of reversion to different ancestors at various periods of life. This has been beautifully put by Oliver Wendell Holmes in his novel "The Guardian Angel." The heroine of this story, Myrtle Hazard, runs away from home, and, floating down the river in a boat, sees at dusk, in an old Indian burying place, a curious vision. Around the burial mound various figures seem to flit, some thin and shadowy, others more substantial, but still misty; while others again appear almost as distinct as living men and women. She recognises, as one does in a dream, that these are her ancestors, the solid ones closely related to her in blood, while the thin and shadowy are far removed. Each ancestor has an existence in herself more or less definite according to the nearness or remoteness of blood. It is not necessary to trace our heroine through her various adventures; but at one time she develops suddenly and unexpectedly, under provocation, the character of an Indian squaw from whom she is descended, and nearly slays a schoolfellow while they are acting together. Later on another ancestress, who was a famous beauty, appears in a dream, and for some time afterwards the heroine feels this beauty living within her and directing her actions; while later still another ancestress, who has been a great saint, drives the capricious beauty out and leads the heroine in the way she should go.

As I have already said, Haeckel believes that during intra-uterine life the fœtus rapidly runs through the development of the race up to mankind, and I think we may in after life trace the progress of the individual through various ancestors more and more slowly as he advances in years. In infancy and childhood we frequently notice how rapidly the features change, and friends will say at one visit how like the child is to some member of his father's family, while a week or two after they will notice a resemblance to someone of his mother's family. If this Society can gather together notes as to whether an individual presenting an unwonted reaction to medicine happens to resemble at the time someone either of his father's or his mother's family who had a similar peculiarity, a great step might be made.

This, however, is not all. We have next to try to trace why medicines act differently upon different families. It is just possible that this also is a case of reversion to a very far-off period; indeed, before mankind had even reached the level of the monkey. Some years ago it occurred to me that one might possibly gain some information regarding the peculiar differences in the action of drugs on gouty and other individuals by comparing the effects of certain poisons or remedies upon such animals as rabbits, which excrete their nitrogenous waste in the form of urea, and pigeons, which excrete it in the form of solid urates. Now Weir Mitchell had shown that pigeons had a singular power of resistance to the action of opium, and can take large quantities of it without presenting any symptoms of narcosis. Dr. Cash and I made some experiments upon the subject, and we found that opium in moderate doses appeared to have almost no action upon pigeons, yet on examining more closely we found that it had a very marked action, only it did not produce sopor, but caused the temperature to fall greatly. Instead of acting as a narcotic it acted as an antipyretic. We did not try the converse of this by giving antipyretics such as antipyrin to pigeons and seeing whether they acted as soporifics, but in patients we certainly do find that occasionally, as in acute inflammation, opium seems to have an antipyretic action, whereas antipyrin certainly acts at other times like a soporific. In order to track these actions further back still and find out what changes in the circulation, blood, nerve cells, and nerve fibres the action of these various drugs depends, a large amount of experimental work in laboratories is required.

Until lately there has been no opportunity for young men generally to do such work in this country, and those who wished to undertake it were obliged to go abroad. Now, however, owing to the wise action of the Colleges of Physicians and Surgeons, opportunities are being afforded for such investigations ; but all such researches will give only one side of the subject, and will remain valueless unless clinical observation can be brought to bear at the same time on therapeutic studies. The members of this Society, by the fact that they have founded it, have shown their desire to forward the progress of medicine. I have to-night tried, in a very imperfect way indeed, to consider some of the methods by which I have thought their objects might be to some extent attained ; and even if I should have failed to show you how to work, this evening may not have been uselessly spent if I have succeeded in directing your attention to the search after methods of attaining the objects which we all have at heart—that of securing health and ease to our patients with quickness and certainty.

24.

ON THE

SCIENCE OF EASY CHAIRS

Reprinted from "NATURE," Oct. 17, 1878.

ON POSTURE

AND ITS INDICATIONS

Reprinted from "THE LANCET," July 2, 1892.

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ON

THE SCIENCE OF EASY CHAIRS.

BY T. LAUDER BRUNTON, M.D., F.R.S.

Reprinted from "NATURE," October 17, 1878.

THERE is a reason for everything, if we can only find it out, but it is sometimes very hard to discover the reasons of even the very simplest things. Every one who has travelled much, and even those who have merely looked through books of travels, must have been struck by the variety of attitudes assumed by the people of different countries. The Hindoo sits down on the ground with his knees drawn up close to his body, so that his chin will almost rest upon them ; the Turk squats down cross-legged ; the European sits on a chair ; while the American often raises his legs to a level with his head. Nor are the postures assumed by the same people under varying circumstances less diverse. Climate or season, for example, will cause considerable alteration in the posture assumed, as was well shown by Alma Tadema, in his pictures of the four seasons exhibited in the Academy a year ago. In his representation of summer he painted a woman leaning backwards on a ledge, with one leg loosely hanging down, while the other was drawn up so that the foot was on a level with the body. In the picture of Winter, on the other hand, we saw a figure with the legs drawn up in front of the belly. The reason for these different postures has been explained by Rosenthal. The temperature of the body, as is well known, is kept up and regulated by the circulation of the blood through it, and a great proportion of the blood contained in the whole body circulates in the vessels of the intestines Now the intestines are only separated from the external air by the thin abdominal walls, and therefore any change of temperature in the atmosphere will readily act upon them unless they be guarded by some additional protection. The Hindoos are well aware of this, and they habitually protect the belly by means of a thick shawl or cummerbund, thus guarding themselves against any sudden change of temperature. This precaution is also frequently adopted by Europeans resident in hot climates, and is even retained by them after returning to England. But the function of the cummerbund may, to a certain extent, be fulfilled by change of posture alone. When the legs are drawn up, as in the picture of Winter already referred to, the thighs partially cover the abdomen, and taking the place of additional clothing, aid the abdominal walls in protecting the intestines and the blood they contain from the cooling influence of the external air.

Thus it is that in cold weather, when the quantity of covering in bed is insufficient, persons naturally draw up their legs towards the abdomen, so as to retain as much heat as possible before going to sleep. In hot weather, on the contrary, they wish to expose the abdomen as much as possible to the cooling influence of the atmosphere. The posture depicted by Alma Tadema is the most efficient for this purpose. It no doubt answers the purpose to lie down flat on one's back, but in this position the abdominal walls are more or less tight, whereas, when one of the legs is drawn up as in the painting just alluded to, the walls are relaxed, and the intestines not being subject to any pressure, the blood in them will circulate more rapidly, and the cooling process be carried on more effectually. In this attitude also the thighs are completely separated, and loss of heat allowed from their whole surface.

Varying conditions of fatigue also alter the postures which people assume. When slightly tired one is content to sit down in an ordinary chair in the position of the letter N with the middle limb horizontal. As we get more and more fatigued we usually assume positions in which the limbs of the N become more and more oblique, the trunk leaning backwards and the legs extending forwards. If we lie down in bed on our back the legs will probably become straight, but if we rest upon our side they will be more or less bent. The straightness of the legs in the supine position is simply due to their weight, which is then supported at every point by the bed, but when we lie on our sides the genuflexion of the legs is most agreeable, because not only are the muscles more perfectly relaxed, but, as the late Prof. Goodsir pointed out, the bones which form the knee-joint are slightly removed one from another, and thus the joint itself, as well as the muscles, passes into a state of rest. Some of the bamboo easy chairs manufactured in India allow us to obtain the advantages of both positions. These chairs are made in the form of a somewhat irregular straggling W, and in them one can lie on one's back with every part of the body thoroughly supported, and the knees bent in the same way as they would be if one lay upon one's side.

Thus simple inaction, the relaxation of muscles, and the laxity of joints, are some of the factors necessary for complete rest, and an easy chair, to be perfect, must secure them all.

But it is possible for an easy chair to secure all these, and yet be imperfect. We have just said that usually, as the fatigue becomes greater and greater, the tendency is to assume the position of the N with the limbs at a more or less obtuse angle, but when sitting in an ordinary chair we find relief from raising the feet by means of a foot-stool, although this tends to make the angles of the N more acute instead of more obtuse. Still more relief, however, do we obtain when the legs are raised up on a level with the body by being placed upon another chair, or by being rested on the Indian bamboo seat already described. If, in addition to this, the legs are gently shampooed upwards, the sensation is perfectly delightful, and the feelings of fatigue are greatly lessened. To understand how this can be, it is necessary for us to have some idea as to the cause of fatigue. Any muscular exertion can be performed for a considerable time by a man in average health, without the least feeling of fatigue, but by and by the muscles become weary, and do not respond to the will of their owner so rapidly as before ; and if the exertion be too great, or be continued for too long a time, they will ultimately entirely refuse to perform their functions. The muscle, like a steam-engine, derives the energy which it expends in mechanical work from the combustion going on within it, and this combustion, in both cases would come to a standstill if its waste products or ashes were not removed. It is these waste products of the muscle which, accumulating within it, cause fatigue, and ultimately paralyse it. This has been very neatly shown by Kronecker, who caused a frog's muscle, separated from the body, to contract until it entirely ceased to respond to a stimulus. He then washed out the waste products from it by means of a little salt and water, and found that its contractile power again returned, just as the power of the steam-engine would be increased by raking the ashes which were blocking up the furnace and putting out the fire. These waste products are partly removed from the muscles by the blood which flows through them, and are carried by the veins into the general circulation. There they undergo more complete combustion, and tend to keep up the temperature of the body. At the same time, however, according to Preyer, they lessen the activity of the nervous system, producing a tendency to sleep, and in this way he would, at least to some extent, explain the agreeable drowsiness which comes on after muscular exertion. It would seem, however, that the circulation of the blood is insufficient to remove all the waste products from the muscles, for we find that they are supplied with a special apparatus for this purpose. Each muscle is generally ensheathed in a thin membrane, or fascia, and besides these we have thicker fasciæ ensheathing whole limbs. These fasciæ act as a pumping apparatus, by which the products of waste may be removed from the muscles which they invest. They consist of two layers, with spaces between. When the muscle is at rest these layers separate and the spaces become filled with fluid derived from the muscle, and when the muscle contracts it presses the two layers of its investing sheath together, and drives out the fluid contained between them. This passes onwards into the lymphatics, where a series of valves prevent its return, and allow it only to move onwards, till at last it is emptied into the general circulation.

In strong and healthy people the veins and lymphatics together are quite able to take up all the fluid which the arteries have supplied to the muscles, and thus prevent any accumulation from taking place either in them or in the cellular tissue adjoining them, or at least prevent any such accumulation as might become evident to the eye. In delicate, weakly persons, or in those who suffer from certain diseases of the vascular system, this is not the case; and after standing or walking for a long time the legs become swollen, so that the boots feel tight, and sometimes even a distinct impression may be remarked at that part of the ankle which was uncovered by the boot. In such persons we can actually see the swelling disappear after the feet have been kept rested for some time on a level with the body, and it may be removed more quickly still by gently and steadily rubbing the limbs in one direction from below upwards. It is almost certain that what we thus see in weakly persons occurs to a slighter extent in all, and that even in the most healthy person after a long walk a slight accumulation of fluid, laden with the products of muscular waste, occurs both in the muscles themselves, and in the cellular tissue around them, even although we cannot detect it by simple inspection. So long as the limbs of such a person hang down, the force of gravity retards the return both of blood through the veins and of lymph through the fasciæ and lymphatics, and thus hinders the muscles from getting rid of those waste products which caused the fatigue. When the legs are raised, this hindrance is at once removed, both blood and lymph return more readily from the muscles, carrying with them those substances which had been formed by the muscles of the limbs during the exertions which they had undergone when carrying the body about. So long as these substances remained where they had been formed, they might cause in the muscles of the legs an undue amount of fatigue, although when distributed over the body generally, they may produce only a pleasing languor. When the legs are long, the obstruction to the return of blood and lymph is of course greater than when they are short, and this return will take place more readily when the legs are raised above the body than when they are only on a level with it. This may be one of the reasons why some of our long-legged American cousins are so fond of raising their feet to a level with their heads, or even higher, although it is very probable that there are reasons still more powerful, which we may discuss at a future time.

It has already been mentioned that the lymph is propelled along the interstices of the fasciæ into the lymphatic vessels by the intermittent pressure which the muscle exerts upon them from within, and it seems natural to suppose that the flow may also be aided by a pressure from without, in the form of shampooing. Even when the hand is rubbed backwards and forwards upon the leg it will relieve fatigue, but the relief is greater when the leg is firmly grasped and the hand moved gently upwards so as to drive onwards as much as possible any fluid which may have accumulated in the limb, and the grasp being then relaxed, the same process should be repeated.

But while the lymph is thus most readily removed by the pumping action of intermittent pressure either of the hand without or of the muscles alternately contracting and relaxing within, it seems to us probable that this process may also be aided by steady, constant pressure from without. No doubt it is impossible for such a steady pressure to take the place of the regular pumping actión produced by the alternate contraction and relaxation of the muscles when in action, yet it will have a somewhat similar action, though to a very much less extent. For at each beat of the heart, as Mosso shows, the entire limb is distended by the blood driven into the vessels, and during the pauses between the beats it again becomes smaller. Each pulse, therefore, by distending the whole limb and each individual muscle will press out a little of the fluid contained in the fasciæ in the same way as the contractions of the muscles themselves, and it seems to us probable that it is the aid which is afforded to this process by the gentle pressure exerted on the outside of the legs by a seat which supports them along their whole extent, that renders such a seat so peculiarly restful and agreeable. For an easy chair to be perfect, therefore, it ought not only to provide for complete relaxation of the muscles, for flexion and consequent laxity of the joints, but also for the easy return of blood and lymph not merely by the posture of the limbs themselves, but by equable support and pressure against as great a surface of the limbs as possible.

Such are the theoretical demands, and it is interesting to notice how they are all fulfilled by the afore-mentioned chair in the shape of a straggling W, which the languor consequent upon a relaxing climate has taught the natives of India to make, and which is known all over the world.

ON

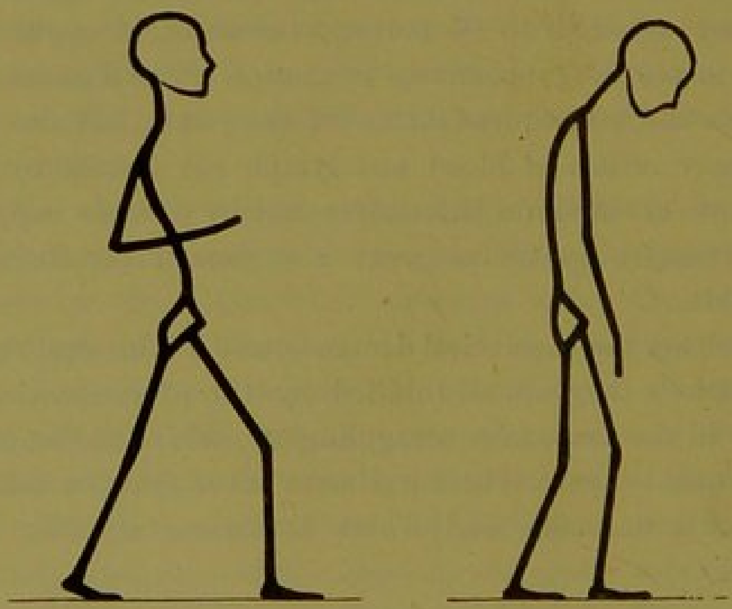
POSTURE AND ITS INDICATIONS

BY T. LAUDER BRUNTON, M.D., F.R.S.

Reprinted from "THE LANCET," July 2, 1892.

In a former paper[1] I observed that I thought medicine lost a great deal by its practitioners either not recording their experience at all, or not recording it in such a form as to be readily available for their fellow practitioners, or with sufficient precision to be really useful. As examples of vagueness and precision I instanced a verbal description of a face as commonly given, and a sketch containing all the features more or less precisely drawn. In the present paper I have tried in a very imperfect way to indicate the common postures which one meets with daily, either in patients or others, and

FIG. 1. FIG. 2.



to discover the reason why those postures are assumed. I have not attempted to draw the figures, for this would have been beyond my powers, and probably also beyond the powers of many medical men. I have simply indicated the position

[1] On the Method of Zadig in Medicine, THE LANCET, Jan. 2nd, 1892.

by a few simple lines such as anyone can draw. This method is one which was employed with great success by the late Professor Goodsir more than thirty years ago in illustrating his lectures on anatomy. In a few lines he conveyed the impression of the agility of the cat as compared with the heavy movements of the ox or of the elephant, and the absence of detail fixed the minds of his students all the more firmly on the main facts which he wished them to carry away. As we walk along the streets and notice the difference of attitude in the passers-by,

FIG. 3.

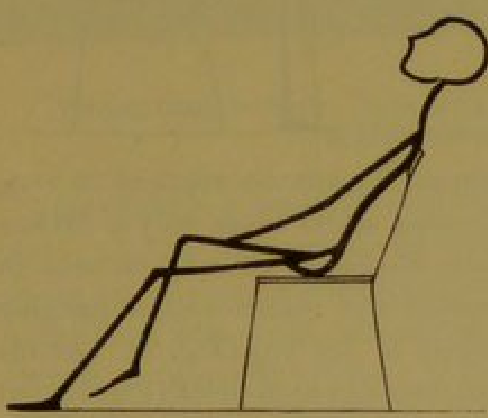


FIG. 4.

some with head erect and agile steps convey to us at once the idea of energy and activity (Fig. 1), while others with hanging heads and bended knees suggest the ideas of languor, weakness and depression (Fig. 2). It is a matter of ancient observation that such an attitude as this is associated with weak circulation, and it is probably more than three thousand years ago that the injunction was given: "Strengthen ye the weak hands and confirm the feeble knees; say to them that are of a fearful heart, Be strong, fear not." Is. xxxv., 3, 4.[2] When the heart is stimulated by joy or hope the attitude again becomes erect and the gait brisk and elastic. It is by no means easy to distinguish exactly between the part played in this change by the motor cells of the nerve centres and by the circulatory apparatus, for the activity of the motor

[2] Also, "Lift up the hands which hang down, and the feeble knees, and make straight paths for your feet." Heb. xii., 12.

cells on which muscular action depends is itself influenced to an enormous extent by the circulation of blood through the nerve centres. We find an example of this in the

Fig. 5.

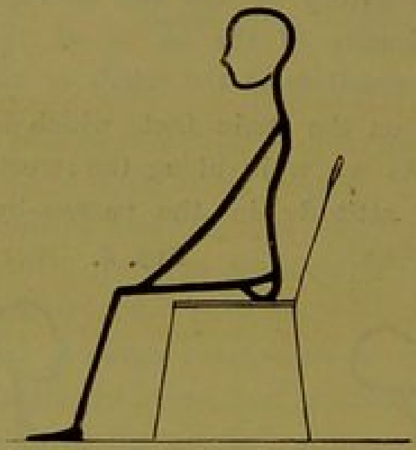
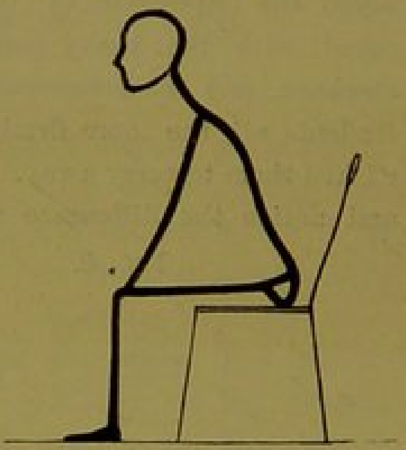
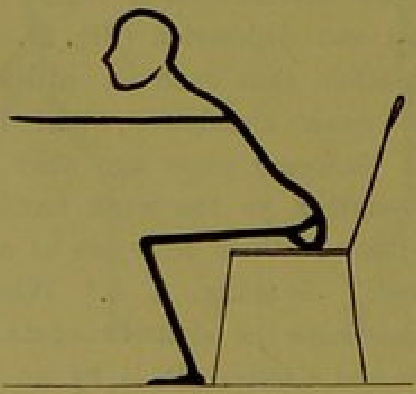


Fig. 6.



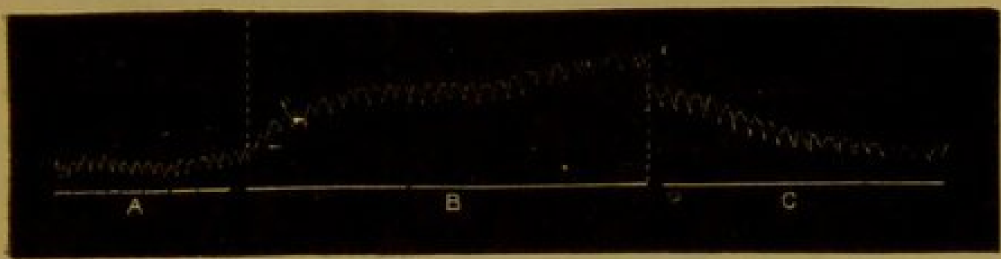
attitude unconsciously assumed by anyone engaged in conversation or argument So long as he takes only a listless interest in the subject under discussion he may lie back in the chair with his legs crossed and his arms either hanging down or his hands laid loosely in his lap (Fig. 3). As his interest increases his attitude becomes more erect (Fig. 4), and he sits straight up with his hands folded or laid upon his knees instead of hanging listlessly down (Fig. 5). As the interest

Fig. 7.



increases still further the body is bent forwards at an angle and the hand is very probably placed firmly on the thigh (Fig. 6). If he becomes excited in the heat of argument the body is bent forwards at a somewhat acute angle and the hand is stretched out in front and somewhat upwards as if to help the words whi flow from his lips to drive the thoughts which are rapidly evolved from his brain into his opponent's mind. (Fig. 7.) In this position the flow of blood through the arterial system onwards to the brain as well as its return backwards through the veins seems to be particularly easy (Fig. 8).

FIG. 8.



Tracing from the brain. A, in upright position ; B, with head inclined forwards.

This position is not only assumed during the heat of argument, whether the speaker be sitting or standing, but when one is led to assume it unconsciously it seems to give rise to a rapid and sometimes almost uncontrollable flow of ideas. Thus it occasionally becomes a cause of remorse to devout souls, who during the attempt to pray in church in this attitude are sadly distracted by crowds of ideas which at once disappear on the assumption of an easy sitting posture. The circulation in the cerebral vessels and the current of ideas in the brain are very delicate things and may be modified by very slight causes; thus an attitude with the head drooping slightly more than that indicated in Fig. 6, and with the chin supported upon the hand is the one frequently assumed in deep thought, with concentration of ideas upon a single subject and no desire for immediate expression (Fig. 9). The touch of the hand upon the head seems to have a directing power over the thoughts which one would formerly have been inclined to deny, but such experiments as those of Tesla and Crookes with electric currents of very high tension give a visible illustration of phenomena previously unknown and seemingly incredible. For in these experiments a person who has put himself into the electric field renders vacuum tubes containing various substances fluorescent and fills them with a glow of coloured light by simply waving his hands over them. The tubes, which were previously dark, owe their luminosity only to the approximation of his hand, yet he himself does not feel that any special power has gone out of him. The contact of the hand with the temples seems as if it could hardly by any possibility modify the circulation in the brain or the feelings of the individual, and yet it appears to have an actually soothing effect and to be a real physical solace in cases of grief and depression (Fig. 10). At the same

FIG. 9.

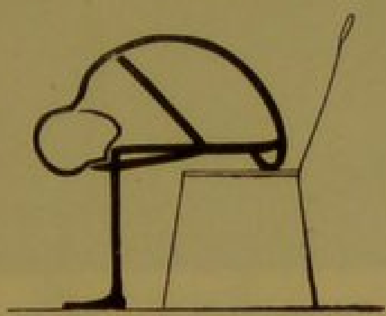
FIG. 10.

time the greater droop of the head possibly provides for a better supply of blood to the sensory parts of the brain in the posterior part of the head and thus to a certain extent counteracts the general weakness of the circulation. In the case of excitement (Fig. 7), the head being more raised, if a straight line were drawn through the axis of the body so as to represent the line of the aorta and carotid arteries, it would come out at the anterior part of the head ; and blood driven onwards in this line would supply nutriment rather to the motor than to the sensory centres.

In cases where the circulation is exceedingly weak and syncope is threatened, a most useful plan is to make the patient put his head down between his knees (Fig. 11), so that an ample supply of blood shall reach the cerebral centres. Long ago, before the introduction of anæsthetics, a common plan of rendering patients senseless previously to the performance of an operation was to lay the patient flat upon his back and then suddenly hoist him to a standing posture by six strong men who held him by the arms, three on one side and three on the other. The brain being thus, as it were lifted away from the blood, became so anæmic that it ceased to act before the circulation could adapt itself to the new posture.

An experience of my own once showed me how very dependent the brain is upon the supply of blood. I was called upon one night after a long day's work to write an article immediately. I sat down with pen, ink and paper before me, but not a single idea came into my head, not a single word could I write. Lying back I solilo-

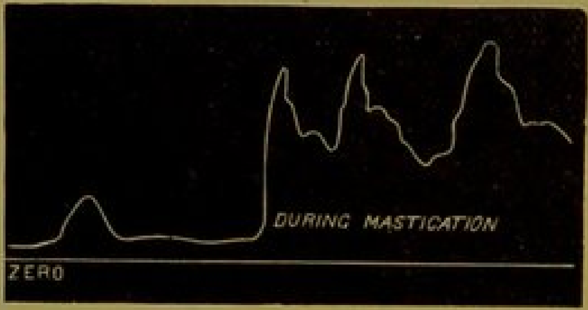
FIG. 11



quised: "The brain is the same as it was yesterday and it worked then, why will it not work to-day?" Then it occurred to me that the day before I was not so tired and probably the circulation was a little brisker than to-day. I next thought of the various experiments on the connexion between cerebral circulation and mental activity and I concluded that if the blood would not come to the brain the best thing would be to bring the brain down to the blood. I laid my head flat upon the table and at once my ideas began to flow and my pen began to run across the paper. I thought "I am getting on so well I may sit up now," but the moment I raised the head my mind became an utter blank, so I put my head down again flat upon the table and finished my article in that position.

Stimulation of some branch or other of the fifth nerve seems to increase the circulation in the brain and those who are making their utmost calls upon their mental powers are accustomed to stimulate this nerve in one way or another. The late Lord Derby used to eat brandied cherries, and an experiment of Marey's (Fig. 12) proves that mastication will accelerate the flow of blood through the carotid artery, and serves to show the wisdom of an editor whom I knew who used to eat figs while writing a leading article and even of those who indulge in the practice so disagreeable to their neighbours of chewing tobacco. Others stimulate the gustatory branches of the fifth nerve by the sweets which they suck or by the smoke of a cigar or cigarette; while a rustic called upon suddenly to answer a question will probably

Fig. 12.



Tracing of the rate of circulation in the carotid. After Marey.

excite the cutaneous branches of this nerve by scratching his head, and a man of more culture may stroke his moustache or beard, press his forehead or eyes, or, like many Germans, smite his nose with the forefinger.

A similar reason may be given to explain the habit of snuffing formerly so much in vogue. The gentle titillation of the nasal mucous membrane by the snuff probably serves to stimulate the cerebral circulation and the increased arterial tension due to the efforts of sneezing so increases the cerebral nutrition that difficulties seem at once to disappear and obscurities of mental vision are so rapidly removed that snuff is said in popular language to "clear the head." The practice of snuffing has fallen to a great extent into disuse, but it may still be occasionally employed with advantage in cases of severe and persistent headache where other remedies fail to relieve. Even where such a strong irritant as snuff is not resorted to, smelling salts (sal volatile) or aromatic vinegar may give considerable relief in headache if frequently inhaled.

While stimulation of the fifth nerve as just described tends to keep people awake and increase their mental activity, gentle, rhythmical stroking of the head tends, on the contrary, to make them fall asleep, and brushing the hair has this effect on many people to such an extent that the movements of the hairdresser's fingers over the scalp and rhythmical click of the shears will send some people to sleep, even at the risk of having their hair shorn to a much greater extent than would be at all pleasing to them on awakening. A gentle rubbing of the scalp, as if to loosen it upon the skull, also tends not only to sooth irritability, but to relieve and to prevent headaches.

External temperature has a powerful effect in determining posture. On a hot summer's day the natural ten-

Fig. 13.

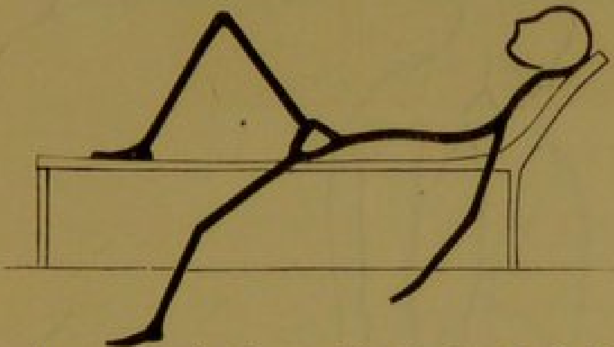


Fig. 14.

dency is to lie down with the head slightly raised, the arms hanging loose and one leg extended, while the other perhaps is drawn up, as in Fig. 13. The physiological reason for this posture is that in it the greatest extent of cooling is attained, for it ensures the greatest possible exposure of the largest vascular district in the body—viz., the intestinal vessels—to the cooling influence of the external air. This is aided by the loss of heat due to the evaporation of sweat. By the slight raising of the head and the drawing up of one leg the abdominal parietes are rendered loose and the intestines tend to fall sideways and the abdomen tends to become flattened from before backwards. The greatest extent of cooling surface is thus obtained and the temperature of the body is kept as low as possible.

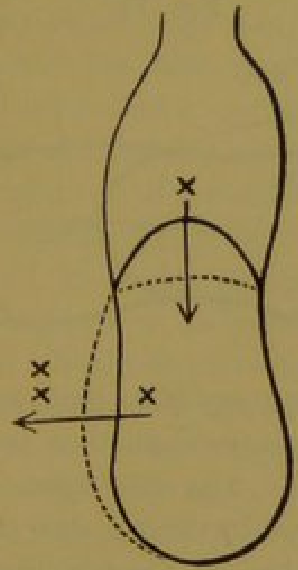
An entirely opposite attitude is assumed when the external air is cold (Fig. 14). The thin abdominal walls being insufficient to protect the intestinal vessels from the cooling influence of the external air, the legs are drawn up until the thick muscles of the thigh form a warm covering to the abdomen and thus prevent loss of heat from the intestinal vessels. Many people are unable to get to sleep when they are at all cold, and Rosenthal has shown that this attitude is commonly adopted by men, dogs and other animals when preparing to sleep so as not only to maintain the bodily temperature during sleep, but to allow the intestinal vessels to dilate and accommodate a mass of blood which would otherwise be driven into the cerebral circulation, stimulating it to functional activity and keeping the person or animal awake.

FIG. 15.

The attitude of the body may be altered permanently by occupation or disease in such a way that one accustomed to pay attention to this subject can frequently make out with a little trouble a good deal regarding the patient's history and illnesses. Thus a chronic cough has the effect of inflating the chest and rounding the back, so that one might almost guess from the figure (15) that the person so shaped was liable to chronic bronchitis. The more tightly a bladder is blown up with air the more tense does it become and the more does it take a circular form. In the same way the more an alveolus of the lung is blown up by the efforts of coughing the more does it resemble the inflated bladder. What is true of a single alveolus is true of the chest as a whole. It tends as nearly as possible to become globular, with a circular outline not only in the transverse, but in the longitudinal direction. The sternum and vertebræ prevent it from becoming completely globular, notwithstanding all efforts, and it thus assumes the barrel shape so characteristic of emphysema, as being the nearest possible approach to a globe. In going through a hospital ward one sees here and there patients who are constantly sitting up in bed and do not lie down at all ; these are for the most part people who have great difficulty of breathing. The reason for this position has no doubt been often given, but I do not recollect coming across it in print and I cannot say whether the reason that I now give has been evolved from my own brain or whether I have learned it from others.

When a man is sitting upright the diaphragm moves up and down during respiration. (Fig. 16.) At each inspiration it descends and displaces the intestines and the abdominal walls

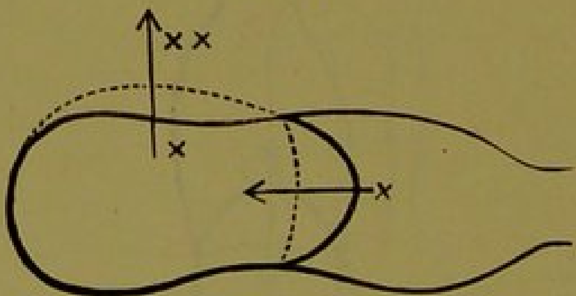
Fig. 16.



outwards. During each expiration the diaphragm ascends and the intestines and abdominal wall return back to their former position. In the upright posture the diaphragm moves vertically, but the abdominal walls and intestines move in a horizontal plane and there is no lifting work for the diaphragm to do. The case is quite different when a man is lying on his back, for then the diaphragm moves in a horizontal plane and the abdominal walls and intestines in a vertical one During inspiration as the diaphragm encroaches on the abdomen for the purpose of enlarging the thorax (Fig. 17) it has actually to raise the intestines and the abdominal walls instead of merely moving them in a horizontal plane. As the diaphragm returns into the thorax during inspiration its progress will be accelerated by the weight of the descending intestines, and thus the recumbent posture may be sometimes useful in cases of bronchitis with emphysema, and so such cases may be seen sometimes lying down although there is considerable interference with the aeration of the blood. In cases of cardiac disease no benefit of this kind is obtained, and therefore we find that a large proportion of those whom we see sitting upright in bed in a hospital ward are suffering from disease of the heart.

When a patient lies upon his side the intestines also move in a horizontal plane, and this is the position usually assumed during healthy sleep, for in it there is no inter-

Fig. 17.



ference with expiration any more than when the patient is sitting upright, while at the same time the rest obtained is much more complete. The side upon which one lies is immaterial to most healthy persons and they frequently lie first upon one and then on another, turning over perhaps several times in the course of the night; but in cardiac disease or cardiac irritability without organic disease patients frequently are unable to lie upon the left side because the heart beats against the ribs with such force as to cause physical discomfort. At the same time the heart itself appears to be stimulated by the blows which it gives itself against the thoracic walls and to palpitate more violently than before. The patient is therefore obliged to lie upon the right side. A similar result may occur if the liver is enlarged or congested, for then it seems to drag upon the suspensory ligaments when the patient lies upon the left side and thus he is obliged to turn round that the liver may be supported by the ribs. If a heavy meal has been taken shortly before retiring to rest the person may be unable to lie upon his left side because the stomach drags upon its pyloric end. On the other hand, if the stomach is distended by flatulence the gases sometimes will not escape while the patient is lying on his left side and he must either be raised into the sitting posture or be turned on his left side to allow the gas to eructate by the œsophagus and the tension in the stomach to be relieved,[2] for the œsophagus joins the stomach at such an angle that when the patient is on his left side the gases appear to accumulate and not to find an exit through the œsophagus, but when he is on his left side they pass upwards with comparative ease. This of course is a matter of very slight moment to patients who are able to move readily, because they adjust their own position at will and soon find out which is the most easy one for them. But when a patient is so weak that he is unable to move himself he is frequently allowed to lie flat on his back and to suffer much from abdominal distension and even from difficulty of breathing, due to the diaphragm being pushed upwards when he might be relieved by simply sitting him up for a few minutes or turning him over on his left side.

In this short paper I have made no reference to many other postures in disease, neither have I attempted to discuss the postures due to trade, nor have I attempted to make the paper complete. I have merely tried to give an illustration of an easy method of recording posture in a tolerably precise and easily understood way and have attempted to connect external signs with physiological conditions as an illustration of the method of tracking which I mentioned in a former paper in the hope of inducing others to prosecute the same line of work.

[2] I have found this practice useful. The explanation I have given of its utility was, I think, suggested to me several years ago by John Haddon, M.A., M.D.

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