Address.

METHODS IN MEDICINE. *

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It was a happy inspiration that led the Committee to Procure Scientific Papers to offer as one of the principal attractions of this meeting of The Massachusetts Medical Society a series of demonstrations exhibiting and explaining the various technical procedures pertaining to the practical part of our profession. Nothing could be more interesting or stimulating to the members of a society of busy practitioners than such an exposition of modern manipulations as, thanks to the sagacity and enterprise of your committee, and the energy and good will of the demonstrators, has been arranged for; and I can conceive of nothing more likely successfully to entice a group of men from the absorbing and exacting routine in which they are daily immersed, or more helpful and recompensive to them after they have yielded to the seduction, than an opportunity to view the illustrations, here so vividly presented, of the application of all kinds of aids to the art of making accurate observations on patients. While every one of us is doubtless familiar, in a general way, with the great progress which has been making in the modes of examining patients and of gathering data regarding the form and functions of their various organs and tissues, and the constitution of the body-juices, it will come to many of us as a surprise, I feel sure, that there is such a wealth of methods that can be and should be used to help us in our daily work. A great many more helps to diagnosis than those actually shown might have been included; many have been unavoidably omitted, but a wise selection has undoubtedly been made, and one sufficiently comprehensive, I think, to convince each of us of his shortcomings. "Knowledge of the condition of a patient is to be drawn out of the patient himself, rather than manufactured without the aid of the senses in the interior of the physician's head." It was to emphasize this fact, Dr. Councilman wrote me, that the committee planned the demonstration of methods at this meeting. The only sure way to secure what information is acquirable regarding a patient in addition to what one is told about him, is to examine him in a strictly systematic way, each part in a suitable sequence, with utilization of every aid which will reveal to our senses any deviation from the normal. There is not one of us, I venture to say, who will not return to his practice, in view of what he has here seen, more sensible of his deficiencies and more contrite of his inexactness, than before; each of us will renew his determination to perfect himself in accurate observation and to elevate to the highest level, which his powers and the exigencies of his practice will permit, the stand-

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In the preparation of this address free use has been made of the writings of Claude Bernard, J. Henle, T. H. Huxley, J. Loeb, J. S. Mill, E. Mach, W. Ostwald, K. Pearson, L. Stephen, R. Virchow, C. A. Wunderlich and W. Wundt.

ard of his routine. I may speak for myself, at any rate, in this way, and I believe that in voicing this sentiment, I give expression to the thought and feeling of many of you.

Though I have chosen "Methods in Medicine" as a title for my remarks, I shall try to make it clear that, in my opinion, all so-called methods in medicine are but parts of, or aids to, the one great method of acquiring knowledge, viz., the method of science. Science has come to be recognized as universal in its scope; it includes in its legitimate domain the acquisition of truth in every sphere; and whether it deals with the facts of mathematics, the facts of geometry, the facts of physics, the facts of chemistry, the facts of biology, the facts of psychology or the facts of sociology, it deals with them in one way, in what we call the scientific way. And that way is to collect facts carefully, to arrange them according to their likeness and sequences, and to interpret them in the simplest manner compatible with verification by healthy minds of our own grade of culture. It is in this way that knowledge in medicine, as in all sciences, has been and is being advanced; it cannot be advanced in any other way.

MEDICINE, AS IT ADVANCES, TENDS TO BECOME MORE SCIENTIFIC.

Biology, far more complicated than physics and chemistry, has, by virtue of the intricacy of its problems, necessarily lagged behind the other sciences, and medicine, the most complex and difficult branch of biology, is still in a primitive stage of evolution as compared with the sciences which deal with the phenomena of the inorganic world. Born of the fear of death, and of the sympathy of man with the sufferings of his fellows, medicine has been compelled from the earliest times to be active as an art before it developed as a science. It is the necessity of action which has always, consciously or unconsciously, led the race, however slowly, to increase its knowing; if a science of medicine is gradually becoming established, it is because in order to do what is right man must first learn to know what is true, because successfully to predict the future he must understand the present and the past. Science began in myth; it passed through dogma; the tendency to-day is to limit its meaning to verifiable truth.

Medicine, like all knowledge, began by chance observation; it has developed through reasoning and the spur to further observation which reasoning has given. But medicine, like all other sciences, and perhaps more than most, has been held back by faulty observation and imperfect reasoning. It has, in turn, been theistic, dogmatic and metaphysical; it is only very slowly becoming rational, only very gradually scientific. As it progresses, however, it tends more and more to hold to the path of science, for it is learning that in stepping off this road it is invariably led into by-paths which run backward.

The scientific habit of mind is sure to pervade medicine more and more as enlightenment spreads.

The enormous advances in theory and practice directly attributable in our time to the application of the method of science to the study of disease and its cure will make us cling to this method as our salvation. We have been taught that there is no short and easy cut to knowledge, such as the ancients sought and hoped for; we are learning to be patient and to be willing to settle the details that are solvable, rather than fruitlessly to attempt to attack the problems of "the whole" that are for us unapproachable; we study, for instance, water as gas, as liquid and as solid rather than the origin of the universe; we inquire as to the characters of the organs and juices in health and disease rather than bother our heads about vital force and first causes. In medicine, as in other departments of knowledge, they who contribute to advance are those who make sure that their facts are well-established, that their classifications of facts are based upon fundamental similarities, that their ideas of the sequence of phenomena conform to actual experience, and that their own conceptions, inferences and interpretations have been so thoroughly criticised by themselves that they will bear the test of the fair criticism of the minds of other healthy and enlightened men.

THE METHOD OF SCIENCE.

The method of science is the only method which may be applied hopefully to the solution of the problems which we meet with as medical men, — the problems of diagnosis, of prognosis and of treatment. It is surely important, therefore, not only that we should be trained in the use of that method but that we should from time to time take stock, as it were, of our methodological practice to see in how far we are utilizing the scientific method, and in what way, if any, we may do so more perfectly. And such a stock-taking is, I imagine, in part at least, the object of this meeting.

On reviewing the development of any science, especially one which is well constituted, it is easy to recognize three phases through which it has passed: first, a phase in which facts are established and collected; second, a phase in which facts are compared and arranged according to their mutual relations and connections; and, third, a phase in which by the aid of the imagination these relations and connections are epitomized in the form of brief formulas, or so-called general laws. These three phases are not sharply separable from one another; all three may be met with at once in different parts of the same science. In medicine we are as yet largely in the first and second phases; we are busy collecting facts; we have already done something toward classifying phenomena, toward determining their order in nature, but the science is only slowly reaching the stage of development when the formation of brief laws is feasible. When we remember how greatly thought is economized by the law of gravitation, for instance, or the law of the conservation of mass, or the law of the conservation of energy, or the law of

organic evolution, how wide a range of phenomena is summed up in each, we realize the importance of the creation of scientific laws. As these fundamental laws of nature have been found to describe satisfactorily the sequences and relationships for a very large group of phenomena, so in medicine we shall gradually attain to simple statements which will satisfactorily describe succession and relation among more limited ranges of medical facts.

The method of investigation is always the same, no matter what the natural science. The material differs with the individual sciences, the aids to investigation vary, but the mind acts in one and the same way. The groups of sensory impressions which the mind receives and combines with stored sensory impressions of previous conscious states, it projects outside itself; these constitute the only "reality" of physical phenomena possible for us, the only "external world" we know. By association and abstraction these conscious states which are called percepts give rise to other states of consciousness called concepts and from them we draw inferences. These concepts and inferences together with their perceptual antecedents are the facts of science. Science has nothing to do and can have nothing to do with the "beyond" of sense-impressions; if there is anything "behind" them which is the source of them, it is unknowable to us; the "things-in-themselves" of the metaphysicians, scientists know nothing about and need not know. What we do when we acquire knowledge is to collect sense-impressions, store them, combine them, compare them, determine their relationship and order of succession, and by an act of creative imagination epitomize descriptions of them, into short statements or formulæ. The mind analyzes, synthesizes, abstracts and determines. Induction and deduction are its forms of operation. Observation, reflection, experiment and comparison are their aids. Science would be impossible if the minds of normal human beings of the same culture-grade did not act in much the same way, if the faculties of perception and reflection were not nearly identical among such beings. If the routine of sensory impressions which can be gained were suddenly to cease to be practically the same for one mind that they are for another, or the processes of association and conception to be nearly identical, there could be no agreement among men. One man would create an entirely different external world from that which another would construct, and every man would be insane to every other man. There could be no general validity for a law; there could be no extensive common knowledge. As the human race has advanced, the capacity for receiving and storing sensory impressions has increased and with it the power of reasoning has steadily developed. Through reasoning man is enabled not only to widen the range of his perceptions, but also to summarize them and the concepts derived from them in a way which tremendously economizes his thoughts. He is thus enabled when he re-

ceives new sense-impressions to respond more rapidly to them by suitable action. This largely accounts for the superior place he occupies in the struggle for existence.

SCIENTIFIC MEDICINE.

Observing facts, arranging them, and summarizing them in thought-symbols, so as to increase knowledge and economize thinking in order that suitable action may follow most surely and quickly upon impressions of sense is, then, the business of science. Making medical observations, classifying them according to resemblances and succession and epitomizing them in brief statements so as to improve our knowledge of the normal and diseased body in order that we may quickly recognize abnormal phenomena and undertake appropriate treatment is the business of scientific medicine.

Scientific medicine, like all natural science, began with simple observation, with direct sense-impression. Observation alone and unaided, however, cannot bring us very far, and the idea that it can, and that medicine is, and must remain, a purely observational science is a grave mistake. Though absurd, when one thinks other than naively about it, many medical men have fallen into this error; it has been responsible for the serious retardation of medical science. Unaided observation is bound to be very inexact; through the use of reason, scientific men have learned to experiment and through experiment to invent artificial aids which increase and render more precise the powers of their organs of sense.

The unaided eye can collect only a limited number of sense-impressions regarding the body of healthy and diseased persons, but with the aid of the microscope, the spectroscope, the polariscope, the fluoroscope, the ophthalmoscope, the laryngoscope, the bronchoscope, the cystoscope, and a host of other implements, as well as through the use of chemical reagents and the inoculations of bacteriological culture media, the number of visual impressions can be multiplied more than a thousandfold. The unaided ear can collect only a few sensory impressions directly from the body, but through the mediation of the stethoscope and by the experimental production of sounds by percussion, the number of auditory impressions which can be gathered from a patient is augmented. The sense organs of the physicians' skin gave unaided to the earliest doctors and give to doctors to-day valuable information concerning pressures, pain, coolness, warmth and the like, but that information is minimal in amount and vague in character contrasted with the wealth and exactness of phenomena revealed to us by the instruments which the modern medical man uses as his aids. The sensory impressions, gatherable by the unaided sense organs, which lead to the conceptions of size, shape, position, weight, movement, time and rhythm are few and futile in comparison with the sensory data furnished us by the rule, the caliper, the balance, the chronometer, the ophthalmometer, and the graphic recording machines which medi-

cal science has applied. The tendency is to pass from the vague to the exact; to replace crude estimation by quantitative measurement expressed in terms of standard units. Medicine has here felt the influence of the physical sciences; it is beginning to be shame-faced when it says "a little" or "a good deal," and is laudably ambitious to express itself in centigrade degrees, in centimeters, grams, and seconds, in dynes, ergs, coulombs and watts.

This tendency to rigid exactness results in the challenging of every alleged medical fact to make sure that it is a real truth, for medical science has chafed under the particular disrepute into which "medical facts" have somehow fallen, it having before now been sarcastically remarked that "nothing can be less deserving of credit than medical theories, except medical facts." The precision which characterizes the observation of the best modern medical observers would have been impossible had medicine been content to remain an observational science; it has been brought about by reasoning, by the formation of hypotheses and by the subjection of these hypotheses to the control of experiment. The elaborate aids to observation used to-day by the diagnostician are the applied results of physical, chemical and biological experimentation; and further, every time a physician listens to the sounds of the heart through a stethoscope, every time he tests the knee kick, every time he measures the blood pressure, every time he makes a Widal test, he performs an experiment in order to extend his observation or make it more accurate. Observation and experiment overlap; to increase his powers of observation, the observer uses implements derived from experimental investigation; these new aids make him observe with greater precision.

An experiment is really an observation provoked at the will of the experimenter; the observation is made then under peculiarly favorable circumstances, for the attention of the observer is prepared and his interest is sharpened by the question he is putting to nature. The experimenter commands the phenomenon to appear in circumstances which he has modified; by isolating or varying the circumstances he is able gradually to decide as to the relative importance of each, and in many instances he can determine the conditioning circumstance, that is, the one which is invariably antecedent to the phenomenon, or what is called its "cause."

Unfortunately, in medical science, observers on account of the complexity of the phenomena and their apparent inaccessibility to experiment have been slow in applying the experimental method to medical investigations. As soon as it began to be systematically applied, however, and especially after the recognition of the fact that judicious experimentation on animals permits an actual alteration of the phenomena of life and yields observations which are largely applicable in human physiology, pathology and therapy, medicine began to make progress at an unprecedented speed. Knowledge made so fast

that special branches of medicine became established and observers, advantageously to themselves and to medical science, began to specialize, to limit their observations and experiments to particular fields. Experimental morphology, experimental physiology, experimental pathology, and experimental therapy are the most helpfully productive sciences in medicine to-day; in them lies our main hope for the progress of medicine in the future.

Next in importance to the help which experiment affords to the scientific method in medicine and really inseparable from it is the aid which comes from comparison. It is this aid which lies at the foundation of various logical methods of procedure, of analysis, of synthesis, of abstraction and of determination. It is the implement which is used in arranging medical facts according to their mutual relations and connections. Phenomena in physiology, pathology and therapy which resemble one another are graded according to their agreements and differences. As a result of the classifications thus established arise our conceptions of physiological processes, of disease phenomena, and of the effects of treatment. We all know how the older ideas of the effects of various forms of treatment of pneumonia and of typhoid fever have been rendered ludicrous by the application of the comparative method.

The statistical method, made popular especially by Louis, is an important application of the comparative method; it helped to clear up the vexed questions concerning the continued fevers, and is to-day a prevalent method among medical men. It has its own drawbacks, however, and these too often go unrecognized. To be of value the statistical method must be discriminating; even epidemic diseases vary in intensity in different outbreaks, so that observations made in one epidemic may lead to conclusions very different from those in another. In the use of the statistical method, there are so many pitfalls for the unwary that the taunting remark is sometimes heard that statistics can be made to prove anything in medicine. Unless statistics deal with observations made by one man, at about the same time and upon patients in similar circumstances, the physician who employs them is but too prone to become the victim of many illusions. I am inclined to think that a part of the energy now devoted by hospital physicians to the compiling of statistics could be more profitably employed in the application of the experimental method to the many problems which clamor for solution and are solvable by it. I would not be misunderstood as decrying the legitimate and appropriate use of the statistical method. Far from it; as a part of the comparative method it is a valuable helpmeet to the experimental method in scientific medicine. It is only the imperfect application and exaggerated use of this method to the exclusion or complete subordination of the more important experimental method against which I would register a protest. Comparison is far inferior to experiment, especially for settling questions of cause. A

few experiments will often settle a question of causal relation definitively, where thousands of the most laboriously compiled statistics would throw no light upon conditioning sequence.

The comparative method has been of especial value in the study of symptomatology. The comparison of individual medical cases with all their phenomena led to descriptive or systematic zoölogy and systematic botany. As medicine has become more scientific, the mind has ceased to be satisfied with such descriptive classifications as the clinical symptoms and syndromes represent, and with the "clinical types" set up, and it is ever on the alert to replace them by classifications of a developmental or genetic character. Just as systematic zoölogy and systematic botany have had to give way to general morphology, so the older nosologies in clinical medicine and surgery are gradually being supplanted by new ones based on etiology and pathogenesis. In the newer classification, generic rather than individual comparison is made. It was experiment that brought about the revolution in classification in zoology and botany; it is the application of the experimental method that is reforming medicine to-day and making generic comparison so much more useful than the old individual comparison. White swelling of the knee, *malum coxæ*, *scrofula*, pulmonary consumption, Pott's disease of the spine, *tabes mesenterica*, renal phthisis, cold abscess, lupus, — terms referable to individual comparison, — are all joined together in and subordinated to the one term of generic comparison, — tuberculosis. Both individual and generic comparison are necessary; the application of the former precedes the application of the latter, but the latter makes more use of induction, is more satisfying to the mind and is sure to come into greater use as medicine becomes more scientific. Even the term tuberculosis will some day — indeed, may now — be regarded as tintured in many respects with older ontological conceptions of disease, and the time will come, if it be not already here, when we shall have, based on the functional conception of pathology, a still more general grouping of which the function deviations of tuberculosis will be but special instances. The notion of disease as an entity, of the personification of maladies, will be replaced ultimately by descriptions of the links in the chains of invariable sequences of functional phenomena. In the construction of these higher and more useful thought symbols, comparison will, however, be less effective than experiment.

Scientific medicine has a great advantage over philosophical or scholastic systems of medicine in that it is independent of personal authority. It demands that its facts and its principles be not contingent upon the decisions of any individual thinker. The successions maintained by it to exist among phenomena and the laws which condense them into brief formulæ must leave no liberty and room for individual fancy. Scientific medicine, using the method of science, contains within itself its own criterion by which

its facts, its propositions and its opinions can be tested. A thing is not so any longer because Hippocrates said so, or Galen, or Sydenham. Because Darwin, Virchow or Pasteur held an opinion in their time does not necessarily make that opinion valid in the century in which we live. Knowledge is but relative; it takes new forms as science advances. As the province of experience is enlarged or hitherto disconnected territories become united the older conceptions become inadequate and no longer tenable and must be replaced by new symbols. Verification by experience, not justification by faith, as Huxley was wont to put it, is the touchstone of science. The control of conception by perception, the trial by experience, is the true Ithuriel's spear by means of which we distinguish what is true from what is false in our ideas of disease and of the treatment of the sick. It would be as wrong for us to-day to accept unchallenged the statements of the great scientists of the nineteenth century as it was for the followers of Galen to accept his writings as of supreme authority for more than a thousand years. We may admire Virchow, we may venerate the memory of Pasteur, but we shall act best if we do as they did and preserve only those ideas and theories of our predecessors which agree with the collective state of knowledge in our time. There are truths which we can see to-day which were invisible to Virchow. There are errors in the opinions of Pasteur which were inherent to his time and which the scientists of this century must try to recognize and destroy. Non-submission to his authority is, in a sense, one of the highest tributes succeeding generations of scientific medical men can pay to the memory of a medical genius.

This devotion to doubt, this consecration of distrust, this systematic questioning of results, is the safeguard of method in medicine as it is in all sciences. Though the medical man must believe in an invariable order in nature, since all progress in medicine is based upon this belief, still he should always be hesitatingly apprehensive lest he has failed to discover the invariable order in a given case, lest he has confounded a mere coincidence with an inevitable sequence; too often he will find that in with his fact he has unwittingly mixed some purely hypothetical ingredient. The observation that a pneumonia patient recovers after the application of a clay poultice, that a man with disturbed digestion seems to improve on lithia water, or that a leukemic spleen diminishes in size under the influence of x-rays, will not justify far-reaching conclusions concerning the treatment of pneumonia, the effect of the alkali metal-ions on a "uric-acid diathesis," or the curability of leukemia. The scientific medical man, though often compelled to act without full knowledge, will always be aware of his ignorance, and will ever be tormented by the craving for more precise knowledge. He is forced to act as yet largely empirically, but he will *desire* to act rationally. In his hands the health and the life of a patient will surely be safer than in the hands of the cocksure healer

who knows (*sic*) that he can cure, and is content to be ignorant as to how he does it, or in those of the proud-spirited enthusiast who founds his opinions upon so-called medical tact, upon vague medical intuition or upon some inspired "medical mode of thought" which, in his phantasy, transcends the thinking of science.

Scientific medicine can never be content until it has thoroughly marshalled the facts concerning the body in health and disease, until by observation and experiment and by induction and deduction it has recognized the relationships of these facts to one another, or until it has formulated general laws which conceptionally symbolize in brief form their regular sequences. A taste of this scientific method and an experience that this method, though dedicated to the principles of "doubt," brings the only "certainty" worthy of the name, should be obtained if possible by every physician early in his career. For the more rapidly the medical profession becomes imbued with the scientific spirit, the more quickly will medicine become physiological, rational and precise, the sooner will therapy cease to be occult, expectant, nihilistic or merely empirical in order to become judiciously active and definite. The therapy of scientific medicine will not simply avoid hindering the "healing power of Nature"; on the contrary, it will in many cases become able aggressively to interfere with pathological processes and compel the return of normal function.

THE METHOD OF SCIENCE AND MEDICAL PRACTICE.

It has been too much the tendency to separate sharply medical science from the medical art, to contrast knowledge and action as widely divided things in medicine. Too much stress has been laid upon *science* as the mere satisfaction of intelligent curiosity, and upon *art* as mere manipulative skill, largely independent of thought and of systematized knowledge. Convictions concerning the science of medicine and the art of medicine are changing; it is becoming ever clearer that while medicine has two aspects, the so-called theoretical side and the so-called practical side, scientific medicine includes both. On the theoretical side scientific medicine deals, as we have seen, with the search for facts, the arrangement and co-ordination of facts and the establishment of short generalizations recapitulating the facts and their sequences; on the practical side it deals with the rules and methods for facilitating the performance of the work to be done in making diagnoses and instituting treatments and with the acquisition of skill in the work itself, that is to say in the carrying out of these rules and methods. While it is true that science often makes greatest progress through the efforts of men who avowedly seek truth for truth's sake, independent of any practical application of the truth, and, further, that too great an insistence upon an immediate practical aim in scientific research results very frequently in total sterility of production, an unprejudiced survey of the history of knowledge and action will reveal the fact that the cravings of mankind

for brief descriptions and for interpretations, or in other words, for *knowledge*, are the impulses which in the long run, through their effects, account for that *action* which has permitted the race to hold its own in the struggle of life; in other words, better *knowing* has always resulted ultimately in better *doing*, the art of making the exertion more fitting has been preceded by progress in the conceptual symbolization of an ever-expanding body of perceptual experience. The race constantly tends to rid itself, even if slowly, of false observations, reasonings and imaginations, for they are bound to impede its progress and not to favor its work; it conserves tenaciously the true observations, conceptions and inferences made by it, for they have contributed to the improvement of its comportment in the past, they are its only guide to safe conduct in the present, and they, together with similar ones to be created by the same method later, form the sole hope for suitable behavior in the future. The two aspects of scientific medicine, the theoretical and the practical, the knowledge side and the art side, ought not to be divorced from one another; if attempts to abrogate the close relation which should exist between them were at any time successful, medical art would be sure to fail to progress, and if the medical art did not advance, it would be bound to deteriorate. Medical science and medical art should live in a state of wedlock. Their conjugal harmony should never be disturbed by lack of appreciation of one for the other.

The objection is often made that medical science being inexact, the practitioner cannot be guided by it, but must rely upon his own practical experience in the treatment of the sick. The so-called "practical" man, especially, tends to regard theory and practice as incompatible, to deny science and to regard its contributions as useless ballast not needed by the practitioner. I have heard, and doubtless some of you may have heard, physicians of long experience meet the enthusiasms of the medical student regarding progress in scientific medical investigation with the discouraging remark: "The quicker you forget such nonsense the better off you will be. Discard theory; be practical. Do not be a scientist; be a physician." The man who makes such a comment intends to do his young friend a good turn; but he overlooks the fact that scientific medicine includes the results of the observations and experiments of the most skilled members of the profession for centuries, and does not realize that he is recommending the limited personal experience of one man as its substitute; in opposing theory he forgets that every practitioner, even the crudest empiricist, unconsciously forms hypotheses as to what he sees, and uses these as a guide in his treatment, no matter how non-speculative he may think himself to be; he neglects to consider that, instead of the activity of the disciplined mind utilizing the accumulated wisdom of the past, he is advising blind experiment based on instinct and the illogical vagaries of an untrained imagination.

The men who offer such advice look askance at the training given at present by some seven or eight of the better medical schools in this country. A criticism current is that these schools are "making scientists, not practitioners." Let us examine this criticism and see if it be well-worded. If the fact be that these medical schools are turning out graduates who know a great deal about anatomy, physiology, pathological anatomy, physiological chemistry and bacteriology, and nothing or very little about the available methods of diagnosis of disease and the best methods of treating it, I should agree with the critics that the training of the schools was insufficient, but not in their phrasing of the criticism; the criticism should read, "Such schools are educating men in some parts of medical science and not in others, which are equally or even more important for the medical practitioner." But if the fact be that there are medical schools, which are producing, as well as can be done at present, graduates who are versed in the diagnostic and therapeutic knowledge which has thus far been gained either empirically or rationally, and are trained in the application of it, and are, in addition, imbued with the desire to replace empiricism by rationalism as speedily as possible in every part of the subject; who have learned how to appreciate evidence, and to form judgments independent of personal bias, who have come to distrust personal authority, and to subject the observations and opinions of themselves and others to the rigid criticism of experience; who have realized that to predict the future accurately and to control phenomena necessitates a foreknowledge of the invariable sequence of events in the domain concerned; in other words, graduates who have learned what the method of science is and how to use it, then the statement that such schools are "making scientists, not practitioners," is mere stultiloquy, for the schools would be making at once scientists and practitioners, *i. e.*, scientific practitioners, rather than merely scientists or merely practitioners. We do not want medical schools to turn out only scientists who cannot be practitioners in the best sense, nor do we desire them to give us practitioners who have no adequate knowledge of science. If medical schools were to try to graduate merely empirical practitioners and not scientific physicians, the inevitable result would be a generation of healers who would be largely charlatans and quacks—a group of self-confident pretenders to medical skill, indolent, ignorant and incompetent. What has always been needed and is surely most helpful to-day is the scientific practitioner who recognizes the possibilities on the one hand and the limitations on the other of medical science and the medical art in their present state, who knows that it is necessary to act empirically where reason does not yet guide, but who will abstain from an action which experience has proven to be harmful and will do all that is in his power by observation and by judicious experiment to advance medical knowledge. We cannot do without the well-trained medical practitioner,

who, even if he have but little time to experiment, will be a contributor to medical science, by noting exactly and discriminatingly the phenomena presented by the cases he sees, and who will understand which of them can yield profit to science.

The empirical or preliminary period has lasted longer in medical science than in the sciences of inorganic nature, owing partly to the far greater complexity of the problems of medicine, and partly to the antiscientific tendency to rely upon "tact" or "intuition," or the belief that men learn medicine in some way without knowing how, the inclination unduly to exalt the personality of the physician and to diminish the importance of science. Medicine, however, gradually, and more or less unconsciously, entered upon an experimental stage. Physicians early experimented with drugs, but at first they did so very injudiciously, and a Hippocrates was needed to point out the blindness of the early experimentations and to show the value of more thorough observation. By the expectant method Hippocrates proved that many patients suffering from diseases in which cure was attributed to drugs, got well if left to themselves. Mere observation and classification as urged by Hippocrates are not, however, permanently satisfying to either patient or physician, nor should they be. Experiment again had to be resorted to, and gradually experimentation has found profitable directions. It is now clear to scientific medical men that a scientific therapy must be based ultimately upon physiology and that the cultivation and expansion of physiological science is essential if the development of a rational, physiological therapy is to be favored.

While scientific therapy adopts the Hippocratic doctrine of taking advantage of the happy tendencies of nature, it rejects it in as far as it tries to dominate nature in her bad tendencies by actual interferences with processes. It does not wait for the tissues and juices of a child to build an antidote for the poison of the diphtheria bacillus; it hunts for a means of artificially preparing an antidote, secures it, injects it and the child gets well. If the doctrine of expectancy and nihilism had been applied in physics we should have had no ocean greyhound, no electric light, no wireless message. We shall miss entirely, or for a long time be deprived of, as great or greater achievements in medical science if we do not push it forward along experimental lines.

Scientific medicine does not undervalue observation or good clinical work; it does not maintain that the laboratories of the auxiliary sciences are the only places whence illumination comes. On the contrary, scientific medicine is more cognizant to-day than ever before that the ideas which stimulate that experimental work which will be fruitful for diagnosis and treatment must come in part, at least, from sick people themselves; it sees a great danger in the almost total separation of the clinic from the experimental laboratories, and is discontent with a condition in which only a very few clinicians are well-trained experi-

menters and only a very few experimenters are well-trained clinicians. The scientific physician should have a large bedside experience, should be familiar through personal observation on human beings with the forms of disease upon which he is working, should be able to make accurate diagnoses and true prognoses and have a knowledge of the various remedies which empiricism has recommended, and he should possess real skill in applying them. But he will be more than an observer and more than an empirical therapist; he will try to penetrate by the aid of experimentation into the mysteries of disease phenomena in order to untangle them, to understand their proximate causes and to control them. Expectancy and empiricism must for him be supplanted by reflection and experimentation. It is not enough for the scientific physician that mercury and iodide of potassium will cause the changes produced by the virus of syphilis to disappear; he is tormented by the need to know what the virus of syphilis is and to find out how the cure occurs; though he has not yet found out, he will not be content until he does. Nor is it enough for him that diphtheria has been practically robbed of its terrors by the introduction of the serum treatment; he will be restless until he has isolated from the antitoxic serum the actual antitoxic substance in a pure condition, for the injection of horse's serum into babies, while a great advance on any previous treatment of diphtheria, still reminds him too forcibly of the witch's cauldron.

The scientific physician will not be the victim of any illusion that he himself is to settle experimentally all or even many of the problems which confront him and cry for solution; but he will try to settle at least some of them by experiment himself, and above all he will, under the influence of the scientific spirit which animates him, stimulate his colleagues and pupils to similar work, and support and encourage in every way possible all efforts to make the science of medicine more exact through the application of the experimental method.

It has sometimes been argued that the scientific physician is more at a loss what to do at the bedside of a patient than is the empirical physician. The empiricist is never embarrassed; if one remedy doesn't work, he tries another, and so on. He is often very popular with his patients, for the belief is very common among the laity that medicine has a remedy for every ailment, and that the only difficulty is to lay hands on the right one; a patient will often prefer almost anything to nothing in the way of treatment, and the empiricist has always something to recommend. A scientific physiologist or pathologist, who is not also trained as a clinician, would undoubtedly be embarrassed at the bedside of a patient both in making a diagnosis and in advising treatment. The scientific physician must, therefore, be as well educated on the clinical side as he is in physiology and pathology. Though he sets up as his ideal the establishment of a therapy based on physiology, he will not, when the

physiological basis is wanting, withhold a remedy which empirical experience has proven useful. In every science parts remain in the empirical state, while other parts become well founded through experiment. In medicine most of our therapeutic measures are as yet empirical, and only a few have a physiological or well-grounded experimental basis. Scientific medicine includes empirical medicine as well as experimental medicine, and the scientific physician differs from the empiricist, not in any limitation of resource, but in that he is unwilling to work without continually struggling to pass out of the obscurities of empiricism into light.

An unintentional obstacle to the advance of the scientific method in medicine is to be found I believe in the attitude of some of the representatives of the fundamental sciences of anatomy, physiology and pathology. They sometimes express the opinion that diagnosis, prognosis and therapy are not sciences, but only applications of science, by which they mean that all the clinical man can do is to make applications to his work of the sciences of anatomy, physiology and pathology. This is an old fallacy and it has many analogies. The fallacy lies in the definition of science. The physiologists and anatomists who exclude diagnosis and therapy from the list of sciences would, to be consistent, have to exclude physiology and anatomy also, for physiology, is in the same sense, largely applied anatomy, applied physics and applied chemistry; similarly, chemistry is largely applied physics, and physics, in turn, largely applied mathematics. As a matter of fact all science which deals with concrete phenomena is "applied" science; the only "pure" science is mathematics. This denial of the rank of science to diagnosis and therapy, while physiology and anatomy are accepted as sciences, is an invidious distinction which smacks of the old aristocracy of learning. The sciences which are more precise are not prone to grant many concessions in the way of recognition to the sciences which are slowly becoming precise. The "pure" chemist shrugs his shoulders when physiological chemistry is mentioned; the physicist used to be shocked to hear engineering called a science, just as the physiologist is, to hear pathology and therapeutics referred to as sciences. But science has turned democratic. She welcomes as her own child every domain in which facts are marshalled, arranged and epitomized. Diagnosis has its own group of facts which are gradually being classified according to their complex mutual relations, and expressed in shorthand; so has therapy. Diagnosis and therapy may be subdivisions of physiology if the latter subject be taken in a very broad sense; but then physiology may be regarded also as a branch of physics taken in a very broad sense. The laws of physics do not include, however, all that is known about physiological phenomena, nor do the laws of physiology exhaust everything that can be said about pathology and therapeutics. Pathology and therapeutics are far more complex sciences than physiology and anat-

omy; the former have new kinds of manifold characters which are not present in the latter. Anatomists and physiologists really wish to see physicians become more scientific; it behooves them, then, to grant that diagnosis and therapy are sciences in the "process of becoming," for by so doing they range themselves on the side of the scientific method in clinical work and not on the side of medical tact, medical intuition, the medical mode of thought, medical inspiration, medical personality, and those other antiscientific, undefinable and non-examinable Divine gifts which the enemies of science find it so convenient to fall back upon.

The method of science, then, is the best method the medical practitioner can use; investigations made in diagnosing disease and in ordering treatment differ from all other investigations in the materials worked upon, but not in the method employed. There is only one good method of investigation and it is applicable to all kinds of material. It is the method which makes sure of its facts, which establishes invariable sequences and which summarizes its results in brief statements which economize thought and facilitate prompt and suitable action. It is the method which eliminates personal prejudice so that its results are equally valid for all the normally constituted and adequately disciplined intelligences of the time. Diagnosis and therapy cannot do without this method; it is the sole method of progress.

An attentive examination of the various supports to the scientific method in medicine, demonstrated at this meeting, will reveal the fact that the aids selected are almost entirely concerned with multiplying the possibilities of gaining percepts and of making those percepts definite — in other words, with the increase of the number and accuracy of observations of patients.

It is clear that the committee in charge is of the belief that those of us who attend this meeting can be helped most by being encouraged to collect facts in as great variety, and as exact in character, as is possible through the objective examination of the patient himself.

Other things are of enormous importance, of course, in medical practice; the arrangement of the facts after they are collected is one, the formation of hypotheses regarding them (to be tested by collecting more facts) is another, the drawing of conclusions based upon comparison with other cases in our experience or in the experience of others, and, where possible, upon experiment, is still another, and, finally, there is the "fitting exertion," — the therapeutic management of the case. These other things, though, are all dependent upon the primary collection of facts in sufficient number and variety, accurately determined. If the data of departure be false or incomplete, the whole course of the subsequent procedure will be vitiated.

The validity of our conceptions and inferences, once the facts are established, will depend upon our powers of reasoning, and our ability to compare and to experiment, but there can be but

little hope for valid conception and justifiable inference where the perceptive power is deficient or has been inadequately applied.

It has taken thousands of years to elaborate the methods of clinical examination which are here demonstrated; what strikes one forcibly is the very large proportion of them which have been worked out in the recent past, the direct consequence of the application of the experimental method to clinical science. The results which have been achieved will surely give us increased confidence in man's powers in medicine. As the percepts which can be gained concerning patients grow ever more numerous and complex and our intellectual grasp of physiological function and pathological disturbance becomes continually greater, who will dare to place a limit to the physician's capacity to understand and to master phenomena? I, for one, am unwilling to set one; on the contrary, the history of medicine, especially in the decades just behind us, gives us every reason for assurance that problems of life and mind, of health and disease, of diagnosis and cure, now so dark and so intricate that in many they awaken only despair, will ultimately be solved by scientific physicians. If the past is, as we think it, an index to the future, we need not hesitate to assert with regard to medicine, that, in time, through the further application of the scientific method, *We shall know; we shall be able to predict; we shall gain the power to control.*

Original Articles.

THE MEDICAL TREATMENT OF GASTRIC ULCER AND HYPERCHLORHYDRIA.*

BY FREDERICK C. SHATTUCK, M.D., BOSTON.

WITHIN the last few years I have modified my treatment of gastric ulcer. For some fifteen years before that it was my rule to starve every case in which the diagnosis was clear, for at least fourteen days if possible. In one case of apparent duodenal ulcer in a man of middle age, seen with Dr. C. E. Stedman, rectal feeding was so well borne that stomach rest was carried on for upwards of thirty days. The symptoms never recurred. The principle is, of course, simply that of rest, peristalsis and acid secretion both ceasing, certainly in great measure, in the empty stomach.

I underwent the treatment myself seven years ago, my fast being limited to thirteen days, as rectal feeding produced so much discomfort that I was allowed to give it up. Several years later more or less constant misery from hyperchlorhydria, without bleeding or any other positive sign of ulceration, drove me again to take advice from my brother, Dr. G. B. Shattuck, and Dr. F. Forchheimer of Cincinnati. The experience gained by following their wise counsel has, I know, been of much service to me, and I think I have been able to make it so to others.

Hyperchlorhydria is very common, greater or less in degree, intermittent, or more or less con-

stant; far more, as I believe, an expression of faulty innervation, the result of worry or fatigue, than of mechanical irritation or stimulation of the mucous membrane. Diagnosis does not need the stomach tube.

The temporary relief of symptoms by food alone in the milder cases, the prompt relief even in severe cases which follow sodic bicarbonate in sufficiently large doses, one or two teaspoonfuls, clinch the diagnosis. Gastric flatulence, more or less general depression, sometimes very great, with sensitiveness to cold, are suggestive symptoms. Pyloric spasm, as characteristic as it is uncomfortable or even painful, — I have known it to start the sweat like angina, — is fortunately not very common. It receives scant or no mention in most of the books, possibly because patients cannot accurately describe it without help. As I have experienced it the sequence of events is as follows:

Usually when comfortable, perhaps asleep, largely irrespective of meal time, an uneasy sensation at the epigastrium suggesting distention of the stomach appears suddenly. This sensation increases in intensity, saliva begins to flow, the face and ears feel flushed, yawning and a feeling approaching nausea are also common. Within one or, at the most, three to five minutes, these symptoms recede again. Wind usually escapes from the stomach upward, and relative, more often absolute, comfort returns. Attacks vary in severity.

Experience with patients leads me to believe that pyloric spasm is more common than mere reading would lead one to expect. I crave your pardon for so far indulging in seeming egotism. It is a safe rule to avoid inflicting one's infirmities on others, — "to suffer and be still." But the physician who suffers from a malady ought to learn something from his personal experience and be willing to sacrifice his privacy for the sake of benefiting others. Hyde Salter, Morrill Wyman, Oertel and Ralph are names which occur to me in this connection.

There are few conditions more gratifying to treat than hyperchlorhydria. An alkali, only palliative in the more severe and persistent cases, is practically curative in those which are more transitory, relieving the distress while the nervous system recovers from its fatigue or otherwise rights itself.

Soda mint tablets, I believe, would be better without the mint, and must be taken by the dozen, save in the mildest degrees. It is therefore better to take plain bicarbonate of soda dissolved in plenty of water.

Magnesia, either in powder form or the so-called milk of magnesia, is excellent if there be constipation. But in the higher degrees of hyperchlorhydria the large quantity of magnesia required as an antacid is apt to act too freely on the bowels.

The diet should largely exclude salt, the source of HCl. Condiments should be absolutely excluded. Milk, pure or in combination, or prepared in various ways, is practically always

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