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A CONSIDERATION OF THE CLINICAL AND DIDACTIC METHODS OF TEACHING MEDICINE

BEFORE undertaking to expatiate upon the main thesis of this essay, it might be well to explain briefly what is meant by the term "the teaching of medicine." Broadly speaking, what is understood by this term is the application of the science of biology, anatomy, physics and physiology, chemistry and biochemistry, pathology and bacteriology, to the study of disease as presented by the patient. It is the correlation of the sciences related to medicine, to the art of achieving a diagnosis of the morbid process from which the patient suffers and to the art of relieving the patient after the presenting symptoms and signs have been interpreted properly. Medicine as distinguished nowadays is further delineated by the adjective "internal," implying that the disease to be recognized and treated lies within the three larger cavities of the body, the cranium, thorax and abdomen, in contradistinction to some of the smaller offshoots from the main stem of medicine which are recognized as the specialties and which deal with lesions of the skin, the nerves or the special senses.

Having defined what is the usual conception of medicine in its broad sense, it should now be possible to trace the development that has taken place in the methods of teaching students in the undergraduate medical schools within the past few years. In the United States, a hundred years ago, the teaching was almost entirely individualistic. A student attached himself to a preceptor, who in theory at least was qualified to guide the neophyte through the intricacies of a medical training. On the one hand, such a method of training had the advantage of permitting the student to come into intimate contact with disease from the start of his training; on the other hand, the great bulk of the preceptors were little qualified to teach and to instruct. In the beginning of the past century such a method of training gradually was succeeded and replaced by the springing into being of more or less inadequate medical schools whose training of the student was almost entirely dogmatic and didactic and who depended for their very existence upon the fees that were collected from the students. Towards the end of the nineteenth century at Harvard, Johns Hopkins and the University of Pennsylvania, as Garrison relates, "medical teaching began to be true university teaching, in the sense of

training a student to make use of his own mind as a substitute for blind acceptance of dogma." Despite these beginnings, we find that at the beginning of the present century there were hosts of medical schools of low standards, with insufficient clinical facilities, teaching almost entirely didactically large numbers of medical students. So great had been the increase in medical schools and students that we find in 1904, when the American Medical Association began its campaign to elevate the standards of medical education in the United States, that there were in existence 162 medical schools with an enrollment of 28,142 students. As a result of improved standards of medical education, the number of schools teaching medicine and fulfilling the requirements satisfactorily has fallen to 55, with a student enrollment approximately one third smaller than in the peak year, 1904. The quantitative fall in number of students has been accomplished by qualitative betterment in the type of the student body and a corresponding improvement in the medical graduate. The explanation of the better grade of practitioners now being turned out by the medical schools is that, with the decrease in number of students, greater opportunity has been afforded those in the school to study at first hand disease as it was presented by the patient. The advantages of this type of teaching, the so-called clinical teaching, are so obvious that they hardly need to be reiterated, but for the purpose of review they will be briefly enumerated.

In the first place, such a method of teaching permits the student to see and to follow up the usual run of cases as occur in the in- and out-patient department of a hospital. He is thrown into intimate contact with such types of cases as he will meet in his postgraduate work and in his practice. He learns the life cycle of disease at first hand and he learns how to diagnose and treat the disease from personal observation of the patient. The unusual, abstruse and difficult cases are not picked out for him to study and are not accentuated as they were in the old days when the teacher would select such cases for the purpose of delivering a brilliant lecture. On the contrary, he sees patients as they come into a service and only occasionally meets a case of some exotic disease. Secondly, the protagonists of clinical teaching maintain that the time spent in lectures is time wasted. Much better would it be were the student to employ the lecture hour in reading or in the objective study of a patient than, parrot-like, to copy the words of one who has prepared his lecture largely from a text-book. On the other hand, in a clinical talk with the patient before him, in contradistinction to the formal lecture, the teacher is enabled from a concrete example to enter into a full discussion of the disease as presented by that patient, as seen by him in other patients and as studied in various phases and in minute detail by investigators throughout the world.

Another advantage of clinical teaching lies in the fact that it is more thorough. It is an inherent characteristic of the great body of mankind that they are better able to remember what they have seen than what they have heard. And this faculty of remembering is greatly enhanced because the student is given the opportunity of not briefly seeing the case, passing in review as it were, but of actually spending hours and even days studying the various manifestations of the disease.

Lastly, and probably more important than all the other advantages of clinical teaching, is the training it gives the student in the use of his eyes and his ears and his sense of touch. He learns to use his senses, to make proper deductions from what he has observed and then he learns to cultivate his mind; he learns the art of reasoning and he trains himself, he becomes experienced—factors which are of prime importance in learning any science.

All these statements are well recognized. The increase in the length of the curriculum that has come about in the past thirty years is merely recognition of the fact that a student must dissect, must use his microscope, must titrate his specimens and must work on the patient. The increased hours the student spends in his learning of medicine are not devoted to new subjects as much as they are given over to the individual doing and seeing, deducting and reasoning, rather than merely hearing and copying.

But the question comes up: Are we not allowing the student to spend too much time in practice and are not his efforts, particularly in internal medicine, likely to be too unsystematic? Didactic teaching has many advantages, in spite of the fact that the pendulum has swung far away from it and that in many universities in the teaching of medicine it has been done away with almost entirely. Among the advantages that it presents, when used in moderation, is that it affords opportunity for the arrangement of a systematic course in medicine. One disease after another can be taken up in a definite and fixed order and the clinical teaching can be so correlated with the didactic that greater interest is aroused in the student when he sees what he has been recently told than when he is thrown precipitately into the study of a new case. The reading of the student can also be better correlated than when he is presumed to be following a course of reading and studying without definite guidance. This is supposedly obviated

by conducting classes and quizzes in some systematic manner, but such a method of teaching is only a variation and not a difference in didacticism. Unless there is some such definite guide, practically a student does not follow any comprehensive plan in his studying.

From the pedagogic standpoint, we may assume that the clinical or practical method of teaching is the ideal, but from the point of view of a practical educator there is always before the student various examinations which he will have to take after he has left the medical school and before he becomes a qualified physician. It is all right to say that, if a student learns to study one type of case thoroughly and properly, when he sees an unusual type of case which he has never seen in his student days (and no hospital can show in two years every type of disease and disorder), he will be able to study this new case in a suitable and proper manner. But hospital examining boards and state boards do not know this nor do they know what diseases a student has seen or has not seen. Therefore it behooves the student, if he is to pass examining boards not connected with his university, to learn more or less about every disease and it behooves the instructor so to teach the student. Much as the necessity of this is to be regretted, it is not a theory and must be faced. A medical school must not only train the mind and the intellect of its students, but it must also give them such instruction as will permit of their being allowed by state authorities to exercise their presumably well-trained abilities.

Lastly, one of the very real advantages of a course of didactic lectures lies in the inherent value of the first-hand opinions and ideas which the head of a department is enabled to give his teachers and his students. In no other way is the man who is presumed to be best acquainted with the theory and practice of medicine able to get together as one group all those associated with him and to tell them what he feels and thinks and knows about disease and so to correlate the teaching in his department that it may be a cohesive whole. The leader should lead. This he can not do, at least in purely physical teaching, even if we presume that he has great abilities as an executive, as a stimulator of research or as a leader of men, if his energies are devoted only to such small groups of men that many in the class never have the opportunity of seeing his methods or attaining his point of view.

The objections to and disadvantages attributed to didacticism are numerous, but the chief criticism of those who believe in the clinical methods of teaching is that it abolishes or at least minimizes the advantages inherent in this, the clinical, method of instruction. By this rather paradoxical statement I mean to imply that education, without training of the student's mind to deduce facts from observations, without allowing for the development of his initiative and without giving him opportunity of developing his reasoning power, is in no sense real education and that without these attributes a man may mimic a medical education but he is not an educated, trained physician. Minor points of attack in the didactic method of teaching include waste of time to the head of a department and to the student. In the case of the first individual it is said that the preparation and delivery of a lecture is time-consuming without compensatory advantages. The hour that is spent in delivering a lecture is preceded by many long hours of preparation, for a good lecture is not a spontaneous outburst of oratory, but a prepared, systematic marshalling of facts, from personal knowledge, from text-books and from current medical literature in an orderly fashion so that the whole subject is discussed *in toto* thoroughly. For the second individual, the student, the waste of his time lies in the knowledge that the greater part of what is said in the lecture can be read in a text-book, and read repeatedly in a time equivalent to that devoted to listening to a lecture.

To those who hold that a certain number of didactic lectures are necessary in teaching internal medicine, certain basic faults of clinical teaching present themselves. The lack of system is the first. It has been discussed sufficiently. Another difficulty is that a large amount of clinical material is necessary to give the student opportunity of studying many cases and such material is not always available without very extensive hospital facilities. More teachers are required, because a group of students can not be turned loose in a ward or clinic without the guidance of some one properly qualified to aid them. The need of much material and a large number of instructors is a very real difficulty to those schools which are not heavily endowed and whose budgetary troubles are ever-present. Lastly, it frequently happens that to one student there may be assigned in his two years of practical work a series of patients who present almost identical diseases. One man may have the misfortune to see only heart cases; another, patients with metabolic disturbances only, while a third may have the ill luck to work with a group of unusual cases which he will rarely if ever see in his subsequent career. Nor can this difficulty be avoided. Because of the need of a large number of patients it is impossible for one man to assign to the students each case and to keep track of those diseases which

have been assigned to each man. The assignments are made by many men. Furthermore, it is usually the custom to have the patients assigned to a student in rotation as they enter the ward or clinic, disregarding the relationship of the type of case to the need of the student.

In summarizing the arguments, pro and con, of the several methods of teaching medicine, it is hoped that the reader will appreciate that there is no desire on the part of the writer to quarrel with the protagonists of either form of teaching. Purely didactic, dogmatic methods of teaching have been so completely eliminated from the curriculum of medical schools that such methods will probably never be resurrected. The disadvantages of such a type of teaching are so obvious that no one ever considers nowadays the possibility of relapsing into the scheme of teaching employed thirty and more years ago. There does seem, however, room for the scheduled didactic lecture on the roster of the medical student and it should not be abolished without due thought simply because it is the pedagogic style to do away with it. The ideal arrangement would appear to be a major portion of the student's time devoted to clinical study of his patients combined with a minor portion of the time devoted to didactic lectures in which the head of the medical department could dwell upon the broad and fundamental principles of medicine and at the same time present his subject in a systematic, orderly fashion.

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ON CYTOMORPHOSIS IN BACTERIA[1]

BACTERIOLOGISTS have been divided in opinion regarding variations in the morphological characters of bacteria. The most generally accepted teaching has been that these characters are invariable except for such pathological changes as may be brought about by an unfavorable environment. But a not inconsiderable minority have maintained that bacteria exhibit a complex "life cycle" similar to that of protozoa or higher fungi, the various stages of which may be found only in varying media. This view has been most elaborately presented in the recent monograph of Löhnis.[2] That the first theory is untenable must be apparent to any one who will patiently apply his eye to the microscope; on the other hand most bacteriologists are not inclined to accept as proven that bacteria show sexual reproduction, alternations of generation, or in general such a complex structure as is implied in the term "life cycle."

I believe that the error in both of these teachings is due to insufficient consideration of the element of time. The first school has been satisfied with its standardized observation of a twenty-four hour culture; the second has tried to patch together a complete picture from isolated observations on widely differing media, both favorable and unfavorable to growth, generally without regard to the phase of growth of the culture. If we are to understand clearly the life cycle of an organism we must observe consecutively all stages in its development. This we may do, with bacteria, either by continuous observation of the growing organisms in the agar hanging block or by removing samples from a growing culture at frequent intervals. The former method yields only a limited amount of information, for after a few cell divisions the cells become so numerous and closely packed together that nothing can be clearly seen. The latter procedure, involving the construction of a picture of the whole from samples, requires the use of statistical methods.

I have been carrying on such quantitative studies of the morphological characters of several species of bacteria and have arrived at a theory different from either of those mentioned. It is, briefly, that the cells of bacteria undergo a regular metamorphosis during the growth of a culture similar to the metamorphosis exhibited by the cells of a multicellular organism during its development, each species presenting three types of cells, a young form, an adult form and a senescent form; and that these variations are dependent on the metabolic rate, as Child[3] has found them to be in multicellular organisms, the change from one type to another occurring at the points of inflection in the growth curve. The young or embryonic type is maintained during the period of accelerating growth, the adult form appears with the phase of negative acceleration, and the senescent cells develop at the beginning of the death phase. Minot[4] has coined the word "cytomorphosis" to designate such progressive changes in the cells of multicellular organisms, and I believe that this term more clearly expresses the real nature of the morphological variations in bacteria than does "life cycle."

This idea is not entirely new. It has been implied in much of the bacteriological literature, but as far as

[1] From the Department of Bacteriology and Immunology, University of Minnesota, Minneapolis, Minnesota. Read before the Society of American Bacteriologists, Washington, D. C., December 30, 1924.

[2] Löhnis, F., "Memoirs of the National Academy of Sciences," Vol. XVI, 1921.

[3] Child, C. M., "Individuality in Organisms." Univ. of Chicago Press, Chicago, 1915.

[4] Minot, C. S., "Modern Problems of Biology." P. Blakiston's Son, Philadelphia, 1913.