in deciding what sacrifices they should bring to these new altars of the God of eternal truth.

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THE UNIVERSITY AND MEDICAL EDUCATION[1]

WITHIN a comparatively few years medical education in America has come to be commonly regarded as a function of the university, and the movement in this direction has already progressed so far as to make it unnecessary to discuss the abstract desirability of this tendency. Nor is it any longer necessary to make comparisons between the university and non-university types of medical education. I shall therefore assume that this congress is interested mainly in the use to which the university may be expected to put the rich heritage it has already received, and in the contribution to be made by the university to the improvement of the practice of medicine by improving medical education.

I do not propose to deal at length here with the much-debated question as to whether medicine is to be classified as a science or as an art. Incidentally I may remark, however, that this question is a much older one than is commonly recognized and that much that appears in the current discussions is simply a repetition of what has been actively discussed for many years. Scientific medicine first became self-conscious about the middle of the last century, or a few decades after the universities of Central Europe had consciously adopted research, or increasing the domain of knowledge, as one of their primary functions. It is therefore only natural that long ago there should have occurred, particularly in the middle European countries, active discussion as to the relationship of medicine to science, and as to the function of the universities with respect to medical education.

Naunyn[2] in his inaugural address at the University of Dorpat, in 1869, took as his central theme that "only in science lies the salvation of medicine." Billroth[3] took much the same point of view, and in his classical monograph on the medical sciences summarized most of the discussion which took place up to the beginning of the fourth quarter of the century. In view of the fact that most of what I have to say was current in Germany more than fifty years ago, and since most of it has been repeated at times by many writers during these fifty years, I wish to disclaim any pretense of originality in my remarks to-day.

The union of medical education and the university which has progressed so rapidly in America within the past two decades is in fact, although it has not always been consciously recognized as such, a tacit recognition of the scientific aspirations of American medicine. I propose, therefore, to examine into the further implications of this movement, and to see, so far as I can, what responsibilities the university has for the future, and how we may expect the university to meet them. While recognizing the great responsibility of the university for the advancement of knowledge in medicine, I propose to limit myself to its immediate concern with the education of students in candidacy for the M.D. degree.

It is clear that in taking over the affairs of medical education the university assumes a double function in education, the function of the university and the function of the medical school. The medical school, by tradition and in fact, has the responsibility of furnishing the people with well-trained physicians in sufficient numbers; the university, as such, is concerned only with research and with the conservation and propagation of knowledge, without immediate concern for the use to which its product is to be put. This is an extreme statement of the case, for the purpose of emphasis, but it is well to admit at the outset, as Billroth did,[4] that at times conflicts between these two functions will be inevitable, and that valid objection to the university's conception of its function can and will be made on the basis that "at times too much emphasis may be put on scholarship, at the expense of the practical, sound training, the actual training of the physician."

Since the American university is not a single, well-defined concept, we must expect to find among the individual universities a diversity of attitudes toward these functions. In some, particularly where the immediate responsibility toward the community is more or less fixed, we may expect to find that the attitude of the medical school will dominate. In others, free to follow the dictates of their own conceptions and with future rather than immediate needs in mind, we shall undoubtedly find that the university attitude will determine the course to be followed. I prefer to speak to-day from the standpoint of the university, which, not unmindful of the requirements of the school, will nevertheless conceive of its function in medical education in terms of the university.

This ideal and perhaps idealized university will

[1] An address delivered before the Annual Congress on Medical Education, Medical Licensure and Hospitals, Chicago, February 14, 1926.

[2] Naunyn, S. B., "Errinerungen, Gedanken und Meinungen," Munich, 1925, p. 190.

[3] Billroth, T., "The Medical Sciences in the German Universities" (English translation), New York, 1924.

[4] Billroth, T., *l.c.*, p. 28, p. 92.

adopt Naunyn's belief that "only in science lies the salvation of medicine." And as a corollary it will adopt Mr. Flexner's[5] principle that "if medicine accepts as its goal—however remote that goal may be—scientific standards alike in research and in practice, medical education must be conceived as primarily the effort to train students in the intellectual technique of inductive science." It will follow the dictum of John Stuart Mill[6] who said that "the logic of science is the universal logic, applicable to all inquiries in which men engage." And it will believe with Carlson[7] that the scientific method should, as a conditioned reflex, become a part of the daily thinking and behavior of the student of medicine.

The university will feel that the adoption of these principles will not only be best for the future of medicine, but that in the long run they furnish the soundest basis for the practice of medicine and that the level of practice will consequently be improved. If some of its students are stimulated to enter careers of research, so much the better, but this can not be stated as a primary object of the university in setting its standards. The university will believe, with Billroth[8] that "he (the young doctor) can acquire a sense for scientific training only during his student days, but unfortunately this newly born scientific spirit is often killed outright by the premature development of medical routine. The degree of scientific training and interest imparted to the young man at the university determines his intellectual level for the rest of his life. . . . In the face of these great, culturally invaluable assets it amounts to a mere bagatelle if a young disciple of Aesculapius, confronted with a case which he has properly diagnosed, can not at once recall the formula for the prescription he wished to write, but must look it up in his note book."

But these are merely abstract statements of aims in education. We must know how to attain these aims. How is the method of procedure to differ from that already in use, and if emphasis is to be changed, how is this to be accomplished? How much of that which has been brought into our universities by the formerly independent or loosely affiliated medical schools is being carried on by force of tradition only and should be revised to correspond to university standards in higher education? These are very practical questions to which answers may very properly be demanded.

It is but natural that the first concern of medical education has always been with the teaching of accumulated experience, consisting of facts and theories, or in short the subject-matter of medicine. About this aspect of the teaching of medicine has centered most of the current discussion of the curriculum, and in the presence of an overabundance of subject-matter, which has always confronted medical education, and always will, it is manifestly impossible to determine the ideal subject-matter content of a medical education. That no single formula is universally acceptable is abundantly shown by the diversity of the curricula in various schools—and by the growing tendency to abandon the secondary school type of fixed curriculum which has been brought by the medical schools into the universities.

So far as subject-matter is concerned we need not so much a new curriculum as we need a new attitude towards the curriculum. Whether or not you agree with the German professors who, more than fifty years ago,[9] argued that it is not necessary to cover the entire subject-matter in lectures and that it is sufficient to stimulate the students to pursue his studies independently, it should be apparent that the fixed curriculum is contrary to all principles of higher education and that a freedom of election within the individual university comparable at least with the diversity of subject-matter taught in various medical schools, and by various instructors in the same subject, could be adopted by any university without endangering the structure of medical education. The present system approaches an absurdity when a new course is offered within a medical school, and attendance upon this course is immediately required of all students.

The quiz compend and the recitation course have been prominent in medical education. They are disappearing, but they still exist. They are pernicious and subversive to the achievement of the aim we have stated, and their only object is to cram facts into students. They have no place in the university school of medicine. But the quiz compend and the recitation course are only examples of the overemphasis on subject-matter which is characteristic of our medical schools. The first duty of the university is to shift the emphasis from subject-matter to the intellectual processes of the student. In the words of William Stokes[10] "let us labor to place the teaching of medicine in its true position. Let us emancipate the student, and give him time and opportunity for the cultivation of his mind, so that in his pupilage he shall not be a puppet in the hands of others, but rather a self-relying and reflecting being. Let us ever foster the general education in preference to

[5] Flexner, A., "Medical Education," New York, 1925.

[6] Mill, John Stuart, "System of Logic," Book III, Chapter I.

[7] Carlson, A. J., "Research as a Method of Education," SCIENCE, 1927, lxv, 125–128.

[8] Billroth, T., *l.c.*, p. 92.

[9] Quoted by Billroth, T., *l.c.*, p. 43.

[10] Quoted by Cole, R., SCIENCE, 1920, li, 329–340.

the special training, not ignoring the latter, but seeing that it be not thrust upon a mind uncultivated or degraded. Let us strive to encourage every means of large and liberal education in the true sense of the term and so help to place and sustain our noble profession in the position which it ought to occupy."

I am not speaking against the acquisition of facts, for only with knowledge can the intellectual processes act, and the practice of a profession is impossible without a body of knowledge. That within a university school of medicine there should be conserved and taught the whole subject-matter of medicine goes, perhaps, without saying. But that this can all be condensed to fit into a four years' curriculum is manifestly impossible. Further, I submit that the body of knowledge in use by any practitioner is a constantly shifting structure, and that such knowledge as is acquired or can be acquired by the student during his medical course bears only a slight relationship to that which he acquires and puts to use in later life.

As an extreme example of the opposite point of view I shall relate the following incident. The one thing I recall of a certain lecture course I attended on Saturday afternoons during my third year in medical school is a statement made by the instructor to the remainder of his class on an occasion when the majority had deserted in favor of a football game. More in sorrow than in anger he related that he owed his helplessness in a constantly recurring emergency to the fact that when a student in medical school, some thirty years before, he had unavoidably missed the lecture given on this subject and that he had never been able to repair the resulting deficiency in his knowledge. That I remember this, and do not remember one more thing that was told us in that same course is perhaps not without significance.

My ideal university would drop the attempt to establish a fixed curriculum and would eliminate or bring to a minimum all required courses. It would recognize the fact that the subject-matter necessary for the practice of medicine may be acquired in any of a great number of ways, and within certain very wide limits it would allow the student freedom of election of courses in the belief that he will develop both his intellectual powers and his knowledge of medicine more rapidly if allowed to select courses which arouse his curiosity and interest, instead of being forced to learn facts in a predetermined order. In the interest of the public it would naturally safeguard the M.D. degree, which has come to mean fitness for the practice of medicine, but it would design safeguards to operate at the time the degree is to be conferred, rather than to depend on the results of examinations given so long before the degree that they no longer serve as an indication of the qualifications of the student.

But a change in attitude toward subject-matter meets only in part the problems we face. I have already indicated that the primary concern of the university is with the intellectual processes of the student. To an important extent this has to do with the processes of reasoning, and unless the university can train students to think logically it has failed at the outset. But the matter goes even deeper than that, for logical reasoning in itself is not sufficient in a subject so complicated as medicine, for the reason that in a subject where so many assumptions have to be made, conclusions reached on the basis of reasoning alone are more than apt to be fallacious.

The physician must compare and weigh evidence, and if possible must submit his tentative conclusions to critical tests and be ready to start anew if the evidence be against them. These are the methods of science, and either in practice or in research they must be used by the student of medicine. And the obvious way in which a student can acquire the methods of science, by which I mean not the technique of complicated laboratory methods but the intellectual technique of science, is by taking part in scientific investigations. This thesis has recently been advanced and elaborated by Carlson[11] in his address on "Research as a Method of Education," and it has been advocated by President Mason as "education by participation in research." The student may gain some insight into the scientific method by repeating, as Cole[12] suggests, the important steps which have led to the present knowledge of at least one disease. But this method will at the best acquaint him only with the successes in investigation, and not with the failures and disappointments. How much better it would be to have him take some part, however small, in new investigations actually in progress. This will give him insight into the methods and intellectual processes involved in arriving at the truth, and will give him first-hand contact with the difficulties and pitfalls inherent in the attempt to advance knowledge.

This method of education, which to be successful should be practiced as early and as continuously as possible during the student's progress through his courses in medicine, will also give him one other asset of first importance to him in his later life—a sense of the sources and limits of error in the methods of medicine, without which he can not expect to use these methods fruitfully and intelligently either in practice or in research. Just as the student of chemistry can not become a good analytical chemist

[11] Carlson, A. J., *l.c.*

[12] Cole, R., *l.c.*

until he has learned from his own experience the sources and limits of error in the methods he is to use, just so the student of medicine can not become a good physician until his consciousness is fully awakened to the limitations of the methods he is to use in diagnosis, prognosis and treatment, and to the steps necessary for the safeguarding of the accuracy and the validity of his conclusions.

We have already indicated that the processes of thought needed by the physician in his daily life, *i.e.*, in the diagnosis, prognosis and treatment of disease, are the same processes involved in what we have called the scientific method. As a corollary of this it follows that it should be possible to teach the methods and the limitations of medicine on the basis of clinical problems—problems which are not new but which are new to the student. This is undoubtedly true, but it is a matter which requires conscious effort on the part of the teachers. If the student enters the clinic and finds the same attitude toward the problems of medicine which he has heretofore encountered with respect to the problems of physiology; if he finds conclusions arrived at as carefully and as guardedly as in chemistry; if he finds the same attention to the submission of conclusions to critical tests, and to control at autopsy, there is no reason, except the necessity inherent in clinical medicine for frequent immediate action on the basis of rules formulated on the basis of experience, why his clinical training should not give him the same point of view and the same critique which he would acquire through scientific experimentation.

John Stuart Mill, in his "System of Logic,"[13] in speaking of the rules of art in general says:

> By a wise practitioner rules of conduct will only be considered as provisional. Being made for the most numerous cases, or for those of most ordinary occurrence, they point out the manner in which it will be least perilous to act, where time or means do not exist for analyzing the actual circumstances of the case, or where we can not trust our judgment in estimating them. But they do not at all supersede the propriety of going through (when circumstances permit) the scientific process requisite for framing a rule from the data of the particular case before us.

If the student, on beginning his study of clinical medicine, finds that his teachers, no matter how expert they may be in the art of diagnosis, do, when circumstances permit, go through the scientific process requisite for framing rules from the data of the particular cases before them, he will have the beginning of a sound basis for his career in practice. It is therefore extremely important that the student should have his first contacts with clinical work under auspices where the principles which he has been taught are carried into practice. One of the real weaknesses of medical education has been the carrying on of slipshod methods in dispensaries, and bringing students into their first contact with clinical work in such an atmosphere. As Billroth says:[14]

> The hasty diagnoses and prescriptions in a dispensary furnish the student an opportunity to develop a certain skill in diagnosis and to learn how to make rapid examinations. But this medical routine, which greatly impresses the public and at first the student as well, is only of relative value, and, as the student is sure to learn later, has little worth as scientific training, even though it may make the task of the young doctor easier at the beginning of his practice. Most doctors learn routine all too quickly in the course of their practice; he who begins to acquire it as a student becomes so accustomed to superficial examinations, superficial thinking and superficial treatment, that he is easily spoiled for all serious and penetrative research into a diseased condition. Any quick-thinking person can acquire routine easily and rapidly if he so desires, whereas most persons must be painstakingly trained to careful, meditative, searching thought on the more difficult processes.

The same principle applies of course to the work of the student in the hospital, but fortunately our hospitals have been as a rule much better conducted than our dispensaries. The university's responsibility in this matter, for the dispensaries and hospitals under its control, is clear. The university can go no further with the art of the practice of medicine than to introduce the student to clinical work in order to give him what Cole calls "a final polish by a preceptor system correctly applied." That the preceptor system be correctly applied is of vital importance.

It may appear that the goal in medical education which I have outlined is an impossible one. This is certainly true to the extent that it will, in practice, never be quite attained either by the university or by the student. The success of the university in securing a teaching staff with the requisite vision, energy and patience will be variable, and as to the students, only a few will be able to reap the maximum benefits. But with the goal clearly before it the university should be able to move forward with greater certainty and speed. It should produce better equipped doctors and a greater number of physicians who have their potential capabilities fully developed and who in turn will hasten the conquest of ignorance and superstition.

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[13] Mill, John Stuart, "System of Logic," Book VI, Chapter XII.

[14] Billroth, T., *l.c.*, p. 31.