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MEDICINE[1]

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IT is at once a singular privilege and a heavy responsibility to address the undergraduates of Wesleyan College on the problems of a medical career, for a subject that is close to one's heart can not be discussed lightly, and he were foolhardy who would advise another concerning a life's work who had not weighed the matter judiciously and long. In the western part of the country where I was born we were taught as students that medicine and the church were the two highest callings to which a man might aspire, and if one were brought up in a doctor's family it required very little persuasion to convince one that ministering to the needs of the body was more important than caring for man's spiritual ills. Experience, however, indicates clearly that the two callings can never be wholly separated, for a man who has a true aptitude for the one generally finds himself responding to the needs of the other; and the son of a physician must be forgiven the prejudice that causes him instinctively to regard medicine as the highest of all callings.

Historically medicine and the church have been intimately related. The clergy at one time treated their devout followers for physical ills and there are many authentic records within historical times of monks and clergymen who were also doctors. Indeed, that great ecclesiastic of the eighteenth century after whom your college is named wrote one of the most popular books on medicine that was ever penned. John Wesley's "Primitive Physic; or, an Easy and Natural Method of Curing Most Diseases,"[2] which first appeared in 1747, passed through countless editions. I have here the thirty-second, which was published in London in 1828. The nature of his approach to the healing art may be gleaned by quoting a few sentences from his preface:

[1] An address to the premedical students of Wesleyan College, delivered at Middletown, Connecticut, on February 23, 1933.

[2] John Wesley, "Primitive Physic; or, an Easy and Natural Method of Curing Most Diseases." 32d edition, London, John Mason, 1828. xxiii + 162 pp.

When man came first out of the hands of the great Creator, clothed, in body as well as in soul, with immortality and incorruption, there was no place for physic, or the art of healing. As he knew no sin, so he knew no pain, no sickness, weakness or bodily disorder. . . .

But since man rebelled against the Sovereign of heaven and earth, how entirely is the scene changed! The incorruptible frame hath put on corruption, the immortal has put on mortality.

But can there nothing be found to lessen those inconveniences which can not be wholly removed, to soften the evils of life, and prevent in part the sickness and pain to which we are continually exposed?

It is probable, physic, as well as religion, was, in the first ages, chiefly traditional; every father delivering down to his sons what he had himself in like manner received, concerning the manner of healing both outward hurts, and the diseases incident to each season and climate, and the medicines which were of the greatest efficacy for the cure of each disorder. It is certain this is the method wherein the art of healing is preserved among the Americans [Indians] to this day. Their diseases, indeed, are exceedingly few; nor do they often occur, by reason of their continual exercise, and (till of late, universal) temperance. But if any are sick or bit by a serpent, or torn by a wild beast, the fathers immediately tell their children what remedy to apply. And it is rare that the patient suffers long, those medicines being quick, as well as generally infallible.

And has not the Author of nature taught us the use of many other medicines, by what is vulgarly termed *accident?* Thus, one walking some years since in a grove of pines, at a time when many in the neighboring town were afflicted with a kind of new distemper, little sores in the inside of the mouth, a drop of natural gum fell from one of the trees on the book which he was reading. This he took up, and thoughtless applied to one of those sore places. Finding the pain immediately cease, he applied it to another, which was also presently healed.

Thus far physic was wholly founded on experiment.

But he goes on to say that physicians in later days began to erect hypotheses, and simple experimental physic was no longer employed. Wesley therefore made a plea for the return to primitive pragmatic remedies—an excellent plea as far as it went, but, for obvious reasons, it would not fulfil all the needs of medicine. In 1760 Wesley also wrote an anonymous book on electricity under the title "The Desideratum: or, Electricity Made Plain and Useful."[3] This illustrates his wide interest in science and natural phenomena, and the book was frequently referred to by eighteenth century writers on electricity, including Priestley.

Within our own times there have also been distinguished examples of high officials of the church who have contributed to medical science or who have even practised the art. That versatile scholar of Baltimore, John Rathbone Oliver, priest of the Anglican church, doctor of medicine and a Greek scholar, is also a high authority on psychiatry and legal medicine. His book, "Four Square,"[4] a most remarkable human document, tells the story of his varied life in the clinic, the church, the courts and the university, and it carries this important message to any one who proposes to study medicine, that a man's success as a physician (or for that matter as a priest or minister) generally runs in proportion to his worldly experience. He must have seen life, and have seen it squarely. He should study with patience and sympathy every form of human emotion, and learn how at a glance to evaluate them. Age, sex, race and creed all bring human problems which fall within the immediate sphere of the physician. If he be Jew, let him learn to understand Gentile, if he be rich let him study the ways of the poor, if he be devout, let him inquire into the convictions of the pagan. Only through wide experience among all sorts and conditions of men can he gain that sense of security which will allow him to make those human contacts so essential for the successful practise of medicine. This, I think, is the great message that John Oliver has to offer to medical students, and I might remind you of his conviction that one of the most effective ways of increasing the intellectual horizon is by cultivating general literature. It is just as important to know how to approach the grave-digger of Hamlet as it is to "reach" Lady Macbeth or Nell Gwynne. The familiar grinning countenance of the immature, embarrassed youth bespeaks a lack of experience which counts heavily against any man who depends for his living upon an ability to inspire confidence in human beings.

All this is merely another way of stating that a man who wishes to prepare himself for medicine must become an active student of human nature. He must develop a degree of poise and reserve which will allow him to feel as much at home in a tenement as in a palace, and to be at ease with all the various groups and gatherings that constitute human society—Masons and Rotarians, trade unions and churches, senior proms and prize fights, fraternities and night clubs, etc. The instinctive poise so essential for meeting difficult social situations is most appropriately described by the Latin term *Aequanimitas,* and Osler,[5] who resurrected the word, was, like Dr. Oliver, never

[3] John Wesley, "The Desideratum: or, Electricity Made Plain and Useful. By a Lover of Mankind, and of Common Sense." London, W. Flexney, 1760. viii + 72 pp.

[4] John Rathbone Oliver, "Four Square." New York, The Macmillan Company, 1931. x + 305 pp.

[5] William Osler, "Aequanimitas. With Other Addresses to Medical Students, Nurses and Practitioners of Medicine." London, H. K. Lewis, 1904. vii + 389 pp.

weary of emphasizing that a knowledge of history, art and literature was the invariable touchstone that gave a man breadth of vision, human understanding and maturity of thought and action. For those who propose to go into medicine a little Greek tragedy, a few books of Rabelais, some Restoration drama, several good biographies, the "Ode to the Nightingale" and "David Copperfield" are as essential to sound preparation as text-books of chemistry, physics and zoology and the languages. In any medical school catalogue you will find bare requirements stated in terms of the biological and physical sciences, etc., but I would ask you to believe me when I say that these are probably not the most important requirements for a successful career in medicine. If these disciplines have trained you to observe accurately, to describe clearly and objectively the things you have seen, and finally to draw logical inferences on the basis of closely reasoned arguments, your physics and chemistry will have been of some use. A careful training in mathematics, geology or astronomy or, even in economics, might enable you to do the same thing, and they would fit you almost as well for the study of medicine. No medical school catalogue that I know of emphasizes the value of general literature and worldly experience as a prerequisite for medical students. But in my opinion these broader disciplines transcend in importance the stated requirements in languages and the sciences. I can perhaps make this point clearer by describing more specifically certain aspects of the training of a physician which I propose to do under the headings of "The Art" and "The Science."

I. THE ART

In the year 1543 an indefatigable, black-haired man of 28 years of age published a book which marks the dawn of modern medicine. In the preface of the book he made the pregnant remark that training of the hand is the most important part of the training of a physician. Taken out of its context the statement may seem bald and meaningless, but it contains a truth as important to-day as it was in the time of Andreas Vesalius, who first gave utterance to it. Vesalius protested that physicians of his day had forgotten how to use their hands, that they had refused to dissect the human body and had relegated to ignorant and artless barbers the operations of surgery and to others, still more ignorant, the task of dispensing drugs. Vesalius felt in his soul that this was wrong, and to prove his point he began at the early age of 21 to rob graves, unstring criminals from the gallows, that he might determine for himself the structures of the human body. Hitherto such dissections as had been performed were carried out by servants at the behest of a professor who declined to soil his fingers by touching decaying human flesh. Within a few years Vesalius had dissected all parts of the human body with his own hands and had written his great book, "De Humani Corporis Fabrica."[6] Quite apart from the gigantic character of his labor and the fact that the book created human anatomy as we now know it, it had a subtle influence which gradually permeated the whole field of medicine. It was an influence which emanated, not from any new truth that he propounded in the book itself, but from the example he had set. Great teaching comes not from lectures or from books, but from example, and that a man of 28 could have achieved what Vesalius achieved, through industry and training his hand to obey his will, has given inspiration to all students of medicine since his time.

In evolutionary history the cultivation of the hand in dextrous performance has undoubtedly been one of the chief stimuli for the development of the brain. The animal which was quick and alert, using all its motor cells to fullest capacity, was more likely to survive than the animal who allowed these cells to retrogress through inactivity. And I have always had the belief, but of course it can not be proved, that in the development of the individual, constant use of the hands in skilful maneuvers is a great stimulus to intellectual activity. When, therefore, I tell you that a large part of the training of a physician consists in teaching him to use his hands, I do so believing that this is one of the chief factors underlying intellectual development. The student is given the opportunity to perform many of the classical experiments in physiology, all of which involve delicate manipulation. He is also called upon to dissect the human body, following nerves and vessels to their finest ultimate ramifications, an enterprise that calls for patience, delicacy of movement and indeed a degree of manual skill considerably more precise than is commonly appreciated. The hands are further trained in the wards and the surgical amphitheater. The tips of the fingers come to appreciate the physical signs of disease in chest and abdomen, the delicate variations of the pulse and many other things peculiar to the practise of internal medicine. Similarly, surgery is essentially a field involving the skilled eye and the trained hand, which, closely interacting with one another, allow the development of that most precious of all attributes, sound surgical judgment.

I do not wish to belabor the Vesalian aphorism concerning the training of the hand, for it means very little in the absence of the other great parts of the art of medicine alluded to in my introductory re-

[6] Andreas Vesalius, "De humani corporis fabrica." Bale, 1543. 6 11. 660 pp. 17 11.

marks. In a rapidly changing world one dislikes to commit oneself concerning the future of a great profession, but certain trends are already clear. One is that in America medicine has been divided into too many unintegrated specialties. Vesalius believed that a man whose hand is trained can practise the whole art of medicine; he can diagnose, he can treat (surgically, if necessary) and he can make his own drugs. In most large cities at the present time the heart specialist refuses to see anything but cardiac cases, and is quite unable to cope, for example, with an acute infection. The general public have already rebelled at this state of affairs and are looking more and more for the man who will assume responsibility for their general health, in short, for the old-time general practitioner, or perhaps one should say, for the "new-time" general practitioner. This feeling of dissatisfaction in the present status of medical care has become acutely evident in the recent and much discussed report on "The Costs of Medical Care."[7] The distinguished committee responsible for this report have made certain recommendations concerning socialization of medicine with which many conservative people do not agree. They have nevertheless put their finger on one crucial difficulty, namely, that well-trained general practitioners have become too few. Upon this point all, or practically all, are in agreement, but it is very difficult to attract well-trained men into general practise, for the specialties have tended in the recent past to be more lucrative and more satisfying to those whose minds have been trained in a strictly scientific mould. Furthermore, many schools have experienced difficulty in giving the student contact with the vital social, economic and family problems which form an essential background for general practise. Since in the past many of the weaker students have entered general practise the quality of medical care has tended to be inferior. General practise requires men who, as my colleague Dr. Blake has aptly put it, are "sympathetic, scientific, skilled and studious," and one might add that a man who is not studious by nature is certain to fall behind in the rapidly advancing front of medicine.

The Science

As my own sphere of work lies primarily in the laboratory it might be expected that I would speak more enthusiastically of the science of medicine than of the art, but this is not quite the case, for I firmly believe that real success comes only through union of the two. A student may ultimately settle down primarily in the one atmosphere or in the other: he may practise or he may investigate, but to do either one effectively requires the broadest possible comprehension of what constitutes science, and of what men live by.

The science of medicine has reference to the analysis and interpretation of normal and pathological processes of the body in terms of physical and chemical laws (in so far as this is possible) with the end in view of instituting sound therapy. Physiology embraces the scientific study of the normal functions of the body. The term "physiology" is derived from a Greek root with the Latin equivalent *Physiologia*.[8] The word was used in classical times to signify all natural knowledge, *i.e.*, physics, zoology, astronomy, etc., but towards the end of the eighteenth century the Latin word and the English equivalent came to be restricted to include only biological knowledge, and in the nineteenth century physiology was defined as that branch of science which treats of the application of the laws of physics and chemistry in the study of living things. To understand the way in which oxygen passes from the inspired air into the blood, one must be familiar with the gas laws, especially in relation to the principle of partial pressure; similarly, a knowledge of osmotic pressure is essential for an understanding of the functions of the kidney. In clinical medicine, where the attempt is made to analyze and correct the derangements of function, the physico-chemical interpretation of bodily activities is tacitly accepted. The physician, on being confronted by signs of derangement, attempts to analyze them in the simple terms, in order to arrive at a diagnosis. The symptoms of the disturbance constitute his evidence, and after they are fully described, he attempts by a careful process of logical analysis, similar to that used in the solution of any scientific problem, to reach a conclusion as to what organ or what system of organs is functionally deranged. He has finally to institute methods which will, if possible, restore the body to its normal state. Every stage in the process of making the diagnosis, and of prescribing therapy can be regarded as a strictly scientific procedure. Indeed, the patient can with some justification be looked upon as a more or less complex machine with some parts broken that must be repaired. The chief task of a physiologist, therefore, is to train students during the first years of medicine to think clearly and logically, and the more training they have in this direction before they come the more rapid will be their progress.

It might be assumed, and indeed it often is assumed, that the science of medicine is the only thing that matters, and that when the laws of physics and chem-

[7] Committee on the Costs of Medical Care. "Medical Care for the American People. The Final Report of the Committee on the Costs of Medical Care." Chicago, University of Chicago Press, 1932. xvi + 213 pp.

[8] J. F. Fulton, "A Note on the Origin of the Term 'Physiology.'" *Yale Jour. Biol. Med.*, 3: 59–62, 1930.

istry as applied to the body come to be more clearly understood, the human element in medicine will become less and less important. To a certain extent this is true, but so long as human beings are what they are, the need for the art coupled with the science is only too manifest, especially when one is called upon to deal with spiritual and mental ills.

From the point of view of a prospective medical student it is desirable to consider what medicine has to offer, on the one hand, to a man who wishes to devote himself purely to research, *i.e.*, to academic medicine, and, on the other, to a man who wishes to practise and hopes nevertheless to advance his chosen profession.

For the laboratory investigator there are three chief openings, (1) study of normal form and function, (2) the causes and characteristics of specific disease entities, and (3) the means by which diseases may be prevented, ameliorated or cured. It is unnecessary to discuss all three in detail, but I can perhaps give you some idea of the scope of the first by describing the work now going on in my own department (physiology), for of this I can speak at first hand. My colleague, Professor Hitchcock, a pupil of Jacques Loeb, who acts as head of a division of the laboratory known as general physiology, concerns himself with the study of the physicochemical properties of protein solutions and with the principles of physical chemistry. Dr. Himwich is in charge of another separate division in which the blood gases are studied as well as the mode of utilization by the body of its various foodstuffs (metabolism). Associated with Dr. Himwich is a former Wesleyan man, Nathan Rakieten, who has made a series of interesting studies on the effect of alcohol on metabolism. The other members of the laboratory are studying the comparative physiology of monkeys and the higher apes. Many have been conscious of the fact that it is impossible to infer from studies of the lower forms of animals, such as cats and rabbits, the functions of higher forms. Much is to be gained from the analysis of homologous functions in animals representing various stages of evolution; thus the stomach or the brain of the cat is quite different from that of a monkey, and in a monkey different from that of man, but the chimpanzee closely approaches the human being in every faculty except that of speech, and it is obvious that physiological studies carried out upon the chimpanzee carry much greater significance than corresponding studies made upon lower forms. We are therefore working intensively with chimpanzees, training them to perform various highly complicated manipulations—much as we do our medical students—and we then proceed to study the effect on the animal's memory of the skilled acts of removal of various parts of the brain.

I would like to remind those who propose to practise medicine of one important fact, that they may advance scientific medicine as effectively, and perhaps even more effectively, than a laboratory monk, such as I am, who devotes his attention wholly to animals and first-year medical students. Some years ago I had occasion to edit a volume of "Readings in the History of Physiology,"[9] in which the attempt was made to bring together the original description of the great discoveries in the history of our science. About 75 selections were made, and it was very surprising to discover, on analyzing the materials, that 14 of the discoveries were based upon human experimentation—in most cases upon experiments carried out upon the discoverer himself. Spallanzani, for example, swallowed perforated metal pellets containing food and on ultimately recovering them observed to what extent the food had been digested; Haldane and Priestley discovered on themselves how the gas, carbon dioxide, stimulates the breathing center in the medulla. These instances might be multiplied. Any student who observes his patient carefully, keeping detailed records of what he sees, and who ultimately analyzes his observations in a scientific spirit, is likely at any time to make an important contribution to scientific medicine. Indeed, there are many instances in the recent annals of medicine of men who have made their contributions solely from the study of patients. One might cite, for example, the great French neurologist, Joseph Babinski, who died only a few months ago. In describing his career to a group of medical students in New York I pointed out that it had this message to offer:[10]

> He gave himself the broadest possible training in general medicine before he came to specialize. He chose as his mentors the best clinical teachers then to be found in France and he remained loyal to them until his death. His scientific achievements were based entirely upon the study of clinical material. Painstaking observation and study, coupled with an alertness of mind that allowed nothing to escape him caused Babinski to see far more deeply into the mysteries of the nervous system than most men who have had the advantage of the experimental approach to the subject. And it is a curious fact that in most of his papers Babinski was silent about relevant work from physiological laboratories. There is, of course, ample evidence that he was familiar with the experimental literature, but he clearly did not regard laboratory experimentation as essential for a career as a scientific clinician. Had he been an experimentalist he might have gone even further, but those who wish to

[9] J. F. Fulton, "Selected Readings in the History of Physiology." Springfield, Ill., Charles C. Thomas, 1930. xx + 317 pp.

[10] J. F. Fulton, "Science in the Clinic as Exemplified by the Life and Work of Joseph Babinski." *Jour. Nerv. Ment. Dis.*, 77: 121–133, 1933.

emulate him in the field of medicine will do well if they achieve as much as he, and for them Babinski leaves the memory of a great name and the inspiration of a great example.

CONCLUSIONS

If those who propose to study medicine have not yet decided whether research or practise attracts them most it is well to realize that scientific medicine in this country has been made attractive by a number of unusual, and probably artificial, circumstances. The munificence of certain individuals and of scientific foundations has made it possible for large numbers of men to devote their lives purely to biological science. For reasons which are only too obvious to any one who has studied the present world situation it is unlikely that the numbers of those who are able to pursue such research will increase; indeed, their numbers are likely to diminish sharply. There is no doubt, furthermore, that schools and universities of this country have trained far too many men who intend to devote their lives to research alone. Unless a man's aptitudes are of a very extraordinary character, or unless he is financially independent, it is far wiser for him to begin the study of medicine with the intention of entering practise, if possible, general practise. In so doing he will be in daily contact with the major problems of disease and if he brings to this task a well-trained mind, as well as broad and sympathetic understanding of human problems, he will be able to make, as other illustrious physicians have made before him, discoveries and contributions which will advance our common science. If, like John Wesley, he is a pragmatist, willing to try anything within reason, and holding fast only to that which is good, he may make discoveries which in the present state of knowledge he can not explain, but he will at least have the satisfaction of realizing that he has benefited one and perhaps many suffering human beings, and he may take even greater satisfaction in knowing that he has handed to his intellectual descendants of the next generation the stimulus of his achievement.

Finally, medicine has a good deal of the spirit of the guild with a strong tradition and consciousness of its continuity with the past. Many therefore resent the tendency among writers of the present generation to make light of the foibles of the men who early attempted to cope with disease. Kipling, with characteristic insight, sums up the spirit of medical tradition in his poem "Our Fathers of Old,"[11] which incidentally offers a healthy corrective for those who have not caught the spirit of continuity and loyalty that characterizes medicine.

OUR FATHERS OF OLD

Wonderful little, when all is said,
  Wonderful little our fathers knew.
Half their remedies cured you dead—
  Most of their teaching was quite untrue—
"Look at the stars when a patient is ill,
  (Dirt has nothing to do with disease,)
Bleed and blister him as oft as you please."
    Whence enormous and manifold
    Errors were made by our fathers of old.

Yet when sickness was sore in the land,
  And neither planet nor herb assuaged,
They took their lives in their lancet-hand
  And, oh, what a wonderful war they waged!
Yes, when the crosses were chalked on the door—
  Yes, when the terrible dead-cart rolled,
Excellent courage our fathers bore—
  Excellent heart had our fathers of old,
    None too learned, but nobly bold
    Into the fight went our fathers of old.

If it be certain, as Galen says,
  And sage Hippocrates holds as much—
"That those afflicted by doubts and dismays
  Are mightily helped by a dead man's touch,"
Then, be good to us, stars above!
  Then, be good to us, herbs below!
We are afflicted by what we can prove;
  We are distracted by what we know—
    So—ah so!
    Down from your heaven or up from your mould
    Send us the hearts of our fathers of old!

—*"Rewards and Fairies."*

EURYPTERID INFLUENCE ON VERTEBRATE HISTORY

By Professor ALFRED S. ROMER
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THE general history of skeletal development in vertebrates was assumed until recent years to be a simple one. Since cartilage develops before bone in the embryo, and since the most primitive of living vertebrates have no bony tissues, it was believed that the phylogenetic story was similar—that the main line of early vertebrate evolution, as far as the stage represented by the highly developed bony fish, lay through a series of forms possessing a purely cartilaginous skeleton and lacking dermal defenses other than the shark type of denticles. The lamprey and

[11] Rudyard Kipling, "Rewards and Fairies." New York, Doubleday, Page and Company. 1925. xii + 344 pp.