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THE MEDICAL SCIENCES[1]

YOU have probably been told that in this new field of endeavor on which you are entering you will learn at once a science and an art. An art is defined as "skill in applying knowledge or ability to the accomplishment of a concrete purpose." But the art of medicine includes a skill not required in the fine arts or in engineering; namely, the skill in human contact in its most intimate and revealing complexities. It is precisely this relationship with other human beings, and particularly in its helpful aspects, that has, I imagine, attracted most of you to the study of medicine.

But the successful practice of any profession depends on knowledge of the theoretical principles that underlie it. The earlier practitioners of the healing art were not long satisfied with mere empiricism, the simple method of trial and error; they began to theorize as to how the human body is constituted and how it functions. They speculated on the nature of disease processes and soon sought for causations in external agencies. They philosophized in an abstract fashion concerning the functional turmoil that leads to the subjective and objective symptoms of disease.

This form of explanation by pure reason soon showed the lack of sufficient information on which to base a logical hypothesis and led to the development of the more purely observational sciences of anatomy and pathology.

The understanding of normal and disorganized function, that is, of physiology under natural and abnormal conditions, required the additional aid of experimentation, and, with the firm adoption of this most revealing method of biology, the gateways were opened into the far-reaching and highly specialized fields of the sciences of medicine as we have them to-day.

The problems of medicine still arise at the bedside, but they are now answered in large part in the laboratory. Experimentation, and not merely increasing acuteness in observation, accounts for our progress to-day. The stored-up knowledge and the experimental skill necessary to forward any one of our present medical sciences is so great that it can be compassed only by a lifetime of endeavor. It is a rare practitioner, indeed, to-day, who can hope to heal the sick and at the same time contribute significantly

[1] The opening address before the entering class of the College of Physicians and Surgeons, September 22, 1926.

to the science that underlies his art. Hence has come increasing specialization, which is merely a reasonable division of labor.

We are still obliged from time to time to defend specialization, and, in regard to the practice of medicine at least, the wail has gone up that we are losing the general practitioner, the family physician. Goodness knows, in the usual complaints of life he is still more than friend. But both he and we, if we are wise, will wish to turn in difficult occasion to that particular specialist who has made a life study of our individual malady. But I am speaking here rather of the teacher and contributor to some branch of medicine which some of you, I hope, are ambitious to become. The days of the man who taught natural philosophy, of even of the man like the late Professor Chandler who taught chemistry in the university at large, in the school of mines and in the medical school, are gone. There were indeed giants in those days, but there are still; the division of labor lies not in the smaller intellectual stature of the professor but in the greater bulk of the science. All this is merely from the teaching angle. It is still less possible that a Leonardo da Vinci should leave his mark on several sciences to-day, as did the great Florentine in engineering, painting, sculpture, anatomy and mathematics. The fact is that the easy, though important, discoveries in these subjects have been made and those who come after must dig deep through facts that are known, to unearth gems that are new.

And among those whose endeavor lies in one of the medical sciences we find in increasing numbers not only those who have eschewed practice, but many who have even had no orthodox medical training. We have no more reason to demand that the present-day contributor and teacher of anatomy, biochemistry or physiology should have a medical degree than we should expect it in the physicist or chemist who is making even more fundamental contributions to medicine. These trends simply indicate that the medical sciences are coming of age and are taking their places among the more exact and more fully elaborated sciences.

Just where do these medical sciences of ours stand in the greater hierarchy? Most of us biologists have, I imagine, suffered acute attacks of the inferiority complex as we mingled with mathematicians, astronomers, physicists and chemists, feeling as we do that our methods, as compared with those of the older sciences, are still crude and our information decidedly sketchy. A refreshing breeze of self-esteem will come to many of us when we read the recent Silliman lectures delivered last year in Yale University by Gilbert N. Lewis, himself a distinguished contributor to three of these purer or more exact sciences. Lewis has the distinct impression that no science gains through mere aping of another science. Biology will become no more exact by attempting a purely mechanistic concept. He says: "In the snobbery of science each branch attempts to rise in the social scale by imitating the methods of the next higher (or more exact) science and by ignoring the sciences beneath." He feels no shame in exposing himself to the charge of vitalism when he gives the following illuminating conception of biological phenomena.

> Borel [he writes], in his "Elements of the Theories of Probability," makes the amusing supposition of a million monkeys allowed to play on the keys of a million typewriters. What is the chance that this wanton activity should reproduce exactly all of the volumes which are contained in the library of the British Museum? It certainly is not a large chance but it may be roughly calculated and proves in fact to be considerably larger than the chance that a mixture of oxygen and nitrogen will separate into its two pure constituents. But all such chances, small as they are, seem enormous compared with the chance that a living cell could result from the random arrangement and rearrangement of its atoms.
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> Here we are beyond the help of mathematical calculations. But the observation of animate nature leads to the almost irresistible conviction that here emerges in our preception a new element, alien to the randomness that characterizes the physical sciences; indeed that living creatures are *cheats* in the game of physics and chemistry. It seems that animate creatures alone are striving for *distinction* in the midst of the almost overwhelming levelling forces in the great democracy of atoms.

Could any biologist justify his science and his present inadequacy in explanation more fully? Need you, embarking on the study of medicine, feel that you will step down intellectually in leaving your studies in chemistry and physics which are pursued by more accurate and well-aged methods? I hope you will conclude, as I do, that these new sciences with which you are to come in contact are less well formulated, not simply because they are younger, but because they are actually far more difficult.

If these remarks of Lewis and of mine have raised in your minds the fascinating but at present baffling complexity of the living cell or of those congeries of cells we call an organism—think further for a moment of the attempt to understand what happens when such a living organism is invaded by a wholly different and hostile foreign cell, as is the case in the infectious diseases.

I hope that some of these fascinating complexities will so appeal to a few of you that you will be glad

to devote your lives to their unraveling, but I realize that most of you are correctly destined to the more immediate task of protection and life-saving of the human individual or group. Your rewards in this case are more certain and immediate. I do not refer here to the financial rewards, which beyond a certain irreducible minimum are the least important elements of life, but to the rewards of grateful human response, of satisfaction from a life of unselfish and useful service.

In view of the manifest and worthy destiny of most of you there are many who in the next year and a half will question the wisdom of the course that is prepared for you. You will at times grow impatient at being held back from access to patients, which contact is certainly the lure that has brought you this far. You will wonder at the insistence on matters that, although in themselves of scientific interest to the specialist, have no obvious connection with the understanding and care of the sick human being. Why should you not immediately be ushered into the operating room and absorb gradually the modicum of science that is recognized as of purely practical value in your ultimate activity? You need have no hesitancy in asking yourselves or us this question, for it is one of the perennial ones in medical education and has recently been raised again with vehemence by certain clinical teachers. The answer, however, seems clear to most of us.

There are no doubts in the mind of any serious educator that, in preparation for the study of medicine, you should be required to know certain of the general principles of physics, chemistry and biology. You will recall that you learned chemistry, for example, as a self-sufficient science and not simply those parts of it that have to do with the compounding of drugs. In the same way the medical sciences should, and will be presented to you, as sciences complete and compelling enough so that those of us who present them to you are contented to devote ourselves wholeheartedly to their furtherance. There are none of us blind to the applicability of many of the phenomena which we demonstrate to you in the laboratory, in the elucidation, prevention and cure of disease, and we are proud so to designate them. But you will be struck to learn how many of these phenomena seemed at their discovery of purely theoretical interest. It is true that some of our most striking experimental results have so far remained merely curious scientific facts, but any one of you by examining one of these curious facts from a new angle of vision may turn it into a direct contribution to human welfare. In such a state of affairs who of us would venture to tell you what part of our science is purely useful and all that you need know to outfit you as useful practitioners of medicine?

Again it is not the facts and theories, with which you will be inundated from this day forth, that are primarily useful. The one thing we should like most to inculcate is a point of view: to teach the method of reasoning, first from cause to effect so that later, when you are called to deal with a sorry result, you can apply the reverse process and find and remove the cause.

We should like to teach you something of the processes of reasoning by which the great scientific discoveries have been made, to surround you with an atmosphere in which at least some, it may be faltering, progress of a similar sort is going on.

The word "research" is such an overworked one, used, as some one has recently expressed it, "by many professors for the purpose of reducing university authorities to submission," that one hesitates to use it. But research is simply experience, experiment and fact in the process of formulation. All that text-books hold and all that teachers talk about is somebody's researches in the past. But the research we shall talk to you about as you go on is the past experience lived over or amplified in work of the individual who brings it to you in a fresh and vital form. It is now an accepted truism that no one can teach inspiringly without himself having participated first hand in the evidence which he transmits. And I believe it is almost equally true that no one can investigate to the best advantage without reporting his results to others at intervals; in other words, without teaching.

We hope you will leave us with a better standard of measuring the value of the medical discoveries that are destined to come in your lifetime, with an understanding of how to apply them, and best of all with an ambition to have in some way your part in them.

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THE VIRTUE OF MEDICINE AS A PROFESSION[1]

IF I could have my wish, the welcome which I this day accord to you as you enter the study of your life work in medicine would remain in your memories as the morning star of your lives. I should fill your hearts with an enthusiasm that time itself could not efface, and to the end of your days you would remember with a thrill of delight the moment when you first fully realized the glory that awaits you, the joys that

[1] The opening address before the entering class of Cornell University Medical College, September, 1926.