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SCIENCE IN MEDICAL EDUCATION[1]

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IT is not often, I imagine, that one who is privileged to address so large and representative an audience feels impelled to speak along the lines of his own most intimate concern and belief. I trust I may convince you that the history and atmosphere of this particular university community lends the most persuasive argument that could readily be found of the influence of the scientific aspects of medicine on medicine as a whole.

Medical science and its influence on the education of practitioners of medicine is naturally not fully understood by every one and indeed not always appreciated in some of its aspects by the medical profession at large. The public has heard that medicine as it is practised is some mysterious combination of art and science, embodied in a single individual who comes to their bedside in periods of dire emergency and who may, at happy intervals, seem to work miracles. The practitioner himself realizes that when he accomplishes such gratifying results it is through application of knowledge acquired from his predecessors, through personal experience, and, he should not hesitate to confess, at times through what appears to be the inspiration of emergency.

The wise physician, even more than the public, appreciates the present-day necessity of specialization within a complex field which no one man, however wide his interest and however unflagging his energy, can fully encompass. He knows, moreover, that the life work of certain of his colleagues, on whose collaboration he increasingly depends, lies outside the care of individual sufferers from disease. The laboratory man, as he is called, has become differentiated from the clinician or bedside physician as a natural corollary to accumulating knowledge and a division of labor. His particular activities have un-

[1] An address delivered at the 111th commencement of the George Washington University, June 15, 1932.

fortunately at times seemed remote and unrelated to the immediate concerns of practical medicine.

The Medical School of George Washington University has been in existence well over one hundred years and has faithfully served the main purpose for which it was created—namely, the training of able practitioners of the healing art. I have no question that, if I were better acquainted with your history, I could recall to your minds many noble and self-sacrificing physicians who have not only endeared themselves to this community but whose skill in diagnosis and treatment has been sought from afar. Fortunately, from my view-point, you enjoy what is to me a still greater distinction in that your school has been the fostering mother of that particular science in which I am most concerned. I venture to interpret your choice of the new leader who has recently come to guide and inspire your school of medicine, not entirely in terms of a glowing, lovable and energetic personality, nor yet as due to the advantage of his scientific training and accomplishment. The manifest destiny involved in your history prescribed that you must have chosen a bacteriologist. It needs, perhaps, some one from the outside fully to appreciate and to emphasize to you how much your university is involved in this new and important science which aims to interpret the significance of living, minute, extraneous agents in the production of disease.

Theobald Smith, Walter Reed, Frederick Russell! No other medical school in this country, and I venture to say in the world, can present a professorial sequence in bacteriology that equals it. They represented the birth, adolescence and young maturity of our science which reaches back only fifty odd years and whose life history almost exactly coincides with the tenure of the chair of bacteriology here by these three unusual men. During the twenty-four years between 1886 and 1910 Smith, Reed and Russell successively inspired your students of medicine through their knowledge and contributions in a field that was only then gaining proper recognition. I wish I might recite to you in detail the service these men have rendered medical science and the world, but it is familiar to all of you in its essence and to many of you in detail. Some of us might enter into friendly controversy at to whether Theobald Smith is responsible for five or several more fundamental discoveries in bacteriology, protozoology and immunity. I challenge you to find some one else since Pasteur and Koch who is universally credited with even the smaller number! Walter Reed told us in essence nearly all we know about yellow fever to-day, notably that its living agent or virus passes through filters that withhold the ordinary bacteria and that it is transmitted not through simple contact but by the bite of a special variety of mosquito. The latter observation in particular made avoidance of this dread disease possible through screening, and finally its eradication from whole localities certain if the insect transmitter were destroyed. Russell perfected and first employed typhoid vaccination on a large scale, and the accepted results of his work rendered the world war much less terrible in those armies that rigidly followed his method.

In a way the beginnings rather than the endings of discovery count most. It requires greater intellectual acumen to formulate principles than to apply them practically, because new principles represent radical departures from orthodox opinion, mean road-breaking through apparently impenetrable forests and involve the opening of new vistas. The first experiments that underlie great practical discoveries are often aimed to gratify pure intellectual curiosity rather than to attain results that are at first unperceived. Whether or not there be an "art for art's sake," there is indeed a "science for science's sake," which, in the last analysis, is that form of endeavor that is the most rewarding. Who can question the superiority of the mind that conceives the first experiment? Who would hesitate to place Faraday's discovery of the induction current of electricity about magnets a hundred years ago ahead of the invention of various forms of electric motors that now move the world, or of the loaded telephone wire which greatly amplifies its transmission of sound? These practical results, each in itself worthy of the greatest praise, are traced by their inventors to Faraday's initial and gratified curiosity.

You may recall that I neglected to specify the particular discoveries of Theobald Smith, to which I applied the term of "fundamental." It would take more time than I have at my disposal to explain in logical detail the importance of his recognition that the bacillus of cattle tuberculosis differs in certain unmistakable particulars from its relative that causes the same disease in man, a differentiation which alone is making it possible for us to arrive at a decision as to relative danger of milk from tuberculous cows and contact with tuberculous parents in causing the disease in children—Smith's demonstration that the colon bacillus forms two common kinds of gas in a definite and unmistakable ratio when allowed to act on sugar enables us to differentiate it from another organism that it closely resembles but which is not so characteristic an inhabitant of the human intestinal canal. The whole story of water pollution is bound up in this apparently remote observation.

These and other facts that he and many others have recorded happen to have led within a reasonable lapse of time to a sequence of discoveries that are trans-

lated in terms of obvious usefulness. But for every one of these rapid dividend-paying facts there are multitudes that have as yet no practical significance but which are equally fundamental in the scheme of nature. Those of us who are familiar with the history of scientific discovery know that the bizarre and remote phenomenon which seems to-day unrelated to any human concern may lead to-morrow to inventions of great practical usefulness. We should, each one of us, like to discover at once a cure for cancer, or for tuberculosis, but I venture to say that the final determining step that will lead to either one will be made by some one who is concerned with the orderly development of some obscure and apparently unrelated branch of science as such, rather than with direct attainment of the great objective.

Education, etymologically and in fact, is a process of intellectual self-development. It may be enormously facilitated by instruction, whether by example or didactically, from those who know a little more than the pupil. In medicine Imhotep, Aesculapius, Hippocrates and Galen told their disciples what they believed to be true. In spite of implications that we read into the written fragments they have left us and their subsequent influence on medical thought, I do not believe that any really great teacher ever has believed that he knew it all. Galen, at least, of those that I have mentioned, continually questioned the remote causes of such phenomena as paralysis, and tried to answer his own questions by experimentation. His experiments marked the end of simple observation and pure speculation, and represented the beginning of medical science. Since that time medicine has advanced, intermittently at first, but now swept rapidly on by the stream of medical science. The development and the teaching of this science has until very recently been due to those whose formal education and whose practical service has been the care of the sick. Paracelsus, Harvey and Jenner, to mention only a few, were practitioners of medicine.

Those two of the medical sciences that have interested me most, bacteriology and immunology, carry a new implication as to present methods of growth of medical science in general. They were essentially launched by two men who not only were not medical practitioners, but who had no formal education in medicine—by Pasteur and by Metchnikoff, respectively a chemist and a zoologist. At the present time over half of the professors of the medical sciences in this country, and a still larger percentage of the essential contributors to them, are not medical men in the strict and old-fashioned sense. This shift in personnel means to me two things, namely, that these sciences are becoming increasingly autonomous and important in their general relations, and that they are becoming "purer," by which we mean that their main objectives are theoretical and fundamental rather than practical and applied. These medical sciences, anattomy, physiology, bacteriology and biochemistry, have widely assumed general university importance as educational disciplines, alongside physics, chemistry, zoology and botany, and are no longer simple handmaidens of clinical medicine.

You are all familiar with the development of specialties in medicine and surgery and probably accept it as wise on the whole; personally, you would rather be treated by the man who has had the greatest experience in your particular malady. But the public is largely unaware, and the practical medical men often unconvinced as to necessity of an equally essential specialization in the medical sciences, and at what seems at times their divorce from the concerns of clinical medicine. Practitioners are glad to have us devise and apply the practical tests and specific remedies for the diseases with which they are daily concerned, but can not always understand why we are given quite so much time to demonstrate to students of the healing art certain unpractical phenomena.

It is indeed true that in a school of medicine we are concerned mainly in the education of those whose proper and worthy concern will be the care of the individual patient. The majority of our graduates will never attempt again to tell the true diphtheria bacillus from its harmless relative that is frequently encountered in the healthy throat, or to do a Wassermann reaction; he is, indeed, not fully competent, and from the standpoint of economy of effort as well, should leave these matters to his laboratory colleague. He must know, however, when and how to obtain materials for such tests, to know the causes of error inherent in them, the necessary controls and to appreciate what the results mean. This can only be learned by some knowledge of the principles as well as the technique of our science.

But there are other things far more important than the facts and the specialized technique which we can teach our students, as embryo practitioners of medicine. We can give them, through historical interpretation and personal example, some inkling of the technique of discovery in medicine; they will thereby better understand their heritage in a noble profession and be more capable of dealing with the research problem which each new instance of disease in reality presents.

I have attempted at the beginning to indicate to you that your school of medicine has long been dedicated to the gaining of new information as well as to handing it on. In my own field, no school has a more illustrious record. Every teacher who is worth

his salt remains a student, constantly questions the ever residual unknown, and attempts to elicit the answer from reluctant nature. I know you will continue to encourage him here through an adequate competence and more important still through opportunity to follow his destiny to the limit of his capacity. He may wander into fields that appear remote from present concern, but it is certain that in such wandering and exploration lies future knowledge and the practical accomplishment of to-morrow.

THE SOLAR ECLIPSE

THE LICK OBSERVATORY-CROCKER ECLIPSE EXPEDITION TO FRYEBURG, MAINE

THE assembling and adjustment of instruments to be used in observations of the total eclipse of the sun on August 31, 1932, by members of the Lick Observatory-Crocker Eclipse Expedition to Fryeburg, Maine, have been completed, and the entire equipment, weighing approximately four tons, boxed and shipped to the station. The shipment reached Fryeburg early in August, and the members of the expedition will be very busy there for the four weeks to follow in erecting the instruments, making final tests of all adjustments and rehearsing the program to be carried out in the critical 99 seconds during which the moon cuts off completely the light from the sun's photosphere.

This program includes both photographic and spectrographic observations. To photograph the corona, three telescopes will be set up. Two of these have Ross lenses of five inches aperture and 15 feet focal length and are provided with magazine plate holders to permit making the exposures in quick succession. The third has a Ross lens of four inches aperture and five feet focal length. This will be used to secure photographs of the corona in light of four distinct colors, violet, yellow, red and infra-red.

Four spectrographs are provided for the study of the flash spectrum of the sun. Two of these, fixed in position, will receive light from a coelostat mirror and will make continuous records of the flash spectrum from the point of appearance of the lines of lowest level to the point of disappearance of those of highest level. This is accomplished by having the plates move at a uniform rate in the focal plane of the instruments, which are therefore commonly designated as moving-plate spectrographs. One of these will record the spectrum from the K line to $\lambda 4700$, with a dispersion of 3.5 Angstrom units to the millimeter, the other, the spectrum from $H\beta$ to $H\alpha$ (dispersion, 7.5 A. per mm). Two other spectrographs, mounted on a polar axis and pointed directly toward the sun, are of the slitless type and will record on fixed plates the crescent-shaped lines, as they are usually observed. Both are equipped with magnetic shutters operated by clock-work, and special plate holders to permit obtaining exposures on moving-picture film at the rate of one every other second. One of these, equipped with a Michelson grating and a Ross camera lens of five-foot focus, will record the spectral region from $\lambda 3800$ to $\lambda 7000$; the other one, provided with two prisms and a camera lens (72 inches focal length) of ultra-violet glass, the region from $\lambda 3200$ to $\lambda 4700$.

Another polar axis will carry three spectrographs to secure plates from which the wave-lengths of the emission lines in the inner corona may be measured. One of these, provided with an etalon, is designed to measure, with the highest degree of accuracy, the wave-length of the well-known green line at approximately $\lambda 5303$. The same axis will carry two other spectrographs specially designed for speed in recording faint spectra. With these it is hoped that further data may be obtained concerning the motion of material in the outer corona.

Astronomer J. H. Moore will be in charge of the expedition, and will have as his associate observers Astronomer W. H. Wright and Assistant Astronomer D. H. Menzel, of the Lick Observatory staff, and Associate Professor C. D. Shane, of the astronomical department of the University of California, Berkeley. Mr. Ben Osen, foreman and carpenter, and Mr. J. F. Chappell, photographer, at the Lick Observatory, will assist the observers, and it is probable that one or two astronomers from other institutions will be associated with the party.

Regent William H. Crocker, who financed expeditions sent out by the Lick Observatory to observe the eclipses of 1900, Georgia; 1901, Sumatra; 1905, Spain, Egypt and Labrador; 1908, Flint Island; 1914, Russia; 1918, Goldendale, Washington; 1922, Wallal, Australia; 1923, Lower California; and 1930, Camptonville, California, is the generous patron of the present expedition also. We most gratefully acknowledge our indebtedness to him for the contributions to knowledge it has been possible to make through the successful observations of eclipses in seven of the earlier years, and for giving us the opportunity of adding to them at the coming eclipse.

R. G. AITKEN,
Director, Lick Observatory