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RESEARCH IN THE MEDICAL SCIENCES[1]

THE medical sciences may be defined as including those secondary sciences which contribute directly or indirectly to preventive and curative medicine and to public health. In common with other sciences the medical sciences have both theoretical and applied aspects, and research is the underlying principle of all knowledge and advance in both. Research and theory are interdependent, theory underlies practice, and practice at its best continues to utilize and to stimulate and accomplish research. Research after all simply reflects a state of mind; that state of mind that is not satisfied with the acceptance and application of an alleged group of facts but that insists on personal verification and extension thereof. This questioning and itching type of mind is in its highest reaches inborn, but its cultivation is not only possible in normally equipped individuals, but would seem essential for the proper fulfillment of a life on the level of a profession.

THE FIELD

The medical sciences afford fields of research which yield results comparable to those that accrue from the other sciences—happiness through intellectual gratification, opportunity for human service and a livelihood. It is true that the secondary sciences that are grouped as medical are less exact than the older fundamental sciences in the sense that they are younger, less fully formulated and more complex. The last feature alone suffices to assure an even wider range of intellectual gratification than do those sciences that enjoy greater technical accuracy. To many the prolongation of life and the mitigation and prevention of physical suffering is the highest form of human service. A livelihood is now

[1] This article is one of a series on "Opportunities for a career in science" that is being prepared for the Division of Educational Relations of the National Research Council.

assured even to the teacher and investigator of medical theory. It is a matter of pride to medical scientists that discoveries in their field which are frequently of the most far reaching human importance can never, from the ethics of the profession, be utilized for personal pecuniary gain. If one is drawn to the more practical aspects of applied medicine, whether in the laboratory or at the bedside, an often generous, though seldom large, financial return is possible, coupled with opportunity for great and personal human service. Investigation may still continue under these latter conditions, although it is less likely to flourish.

THE RELATION OF THE MEDICAL SCIENCES TO THE PRACTICE OF MEDICINE

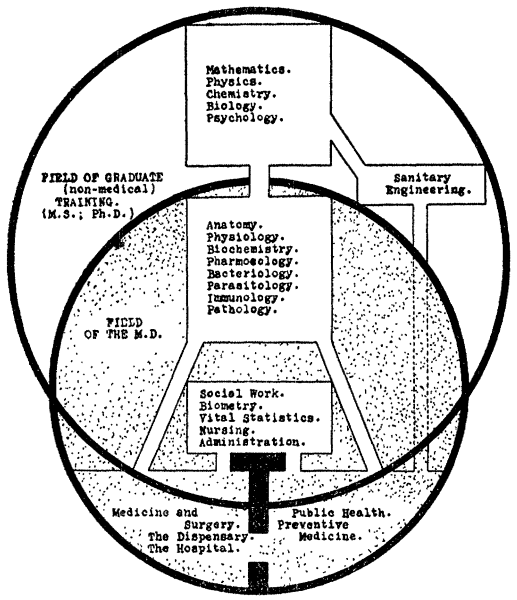
There is still a common misapprehension that the medical sciences are formulated and advanced entirely or for the most part by practitioners of medicine. In the middle ages physicians began to be dissatisfied with the explanations of the structure and function of the human body and of the nature of disease that had been handed down from Galen and Hippocrates. Certain radicals like Paracelsus began to ask themselves questions about these matters, to review the evidence in person, and to arrive at conclusions by a process of reasoning. Ratiocination in turn gave way to the methods of direct observation, and finally certain fundamental truths, as, for example, the circulation of the blood (Harvey) came to be worked out not by taking advantage of chance occurrence in the sick or well, but by deliberately planned experiments on living animals. The physician still remains the one most concerned in knowing the natural conditions of structure and function in the animal body, and particularly such modifications of them as occur in disease. Each year the physician has behind him a greater body of determined facts which enable him to understand and to modify the processes which he sees going on in his patients. Indeed, the body of facts on which his expert skill rests has become so great that his life becomes a frantic attempt to keep up with those advances which he may utilize advantageously in the treatment of disease. The increase of specialization in medicine means simply that the physician has realized that to be most effective he must focus his attention on certain types of disease or on certain localizations of disease in the body. The practitioner still sees best the gaps in present knowledge that, if filled, would enable him to understand and to counteract those manifestations of disease by which he is confronted. But the filling of these gaps with those new facts on the basis of which the practitioner acts has often been and is increasingly becoming a function of yet other groups of specialists whose interests lie in the impersonal study of animal structure and function in health and disease, apart from any practical application that may follow such information. It requires a lifetime of endeavor to acquire the technique requisite for the modern investigation of a new problem, let us say, in the normal or vitiated chemistry of the human body. This means that increasing numbers of anatomists, physiologists, biochemists, bacteriologists, parasitologists, immunologists, pathologists and others have come into being, whose daily life is occupied not with the care of the sick but with the study of conditions underlying such care. This specialization in each of the numerous medical sciences is merely a further manifestation of the advantageous division of labor.

THE TRAINING OF MEDICAL RESEARCH WORKERS

Workers in these underlying and more theoretical fields of medicine are engaged in increasing numbers not alone in eliciting new facts of eventual value in the progress to medicine but in carrying out for practitioners those diagnostic procedures which their particular branch of science has developed. The career of these workers in the laboratory sciences, therefore, include not only research and teaching but routine practice. The question now arises as to how those who choose careers in the medical sciences are actually being trained for their work and, indeed, what method of training is the best. The profession of medicine is at least moderately endowed with guild consciousness. The physician has at times been somewhat disturbed to find that the problems on the solution of which his art depends are being solved by those who have failed to follow in his footsteps through a course in medicine and through contact with the sick. The physicians of France at first vigorously re-

sented the fact that Pasteur, a mere chemist, offered certain indisputable proofs of the parasitic nature of the infectious diseases in man and animals. Even Koch, who with Pasteur founded the modern sciences of bacteriology, and himself a practitioner of medicine, made vigorous strictures on Pasteur's claim to have succeeded in preventing splenic fever (anthrax) in cattle, in view of the latter's lack of training in comparative pathology and veterinary medicine. But, fortunately, advance in science is not dependent on a pattern of training. The prepared and particular mind at work on a given problem remains the essential element in its solution. The chemist continues to be the man best fitted to attack a problem of chemistry, whether that particular problem in chemistry relates to structure of the atom or the metabolism of the diseased human body. A physician may, to be sure, be somewhat of a chemist, but it has become increasingly more difficult for one to remain an essential contributor in several scientific fields.

An attempt is made in the accompanying diagram to show the relations of the fundamental sciences of curative and preventive medicine and of public health to the medical sciences. The two enclosing circles show the respective fields for which graduate training as exemplified in higher degrees fits a prospective student. The difference in size of the circles is designed to indicate the fact that there are actually more scientific subjects of direct or indirect value to medicine for which a Ph. D. degree can and does fit a student than does the regulation medical training. Even in the practical fields of curative and preventive medicine the non-medical graduate is gradually bearing more and more of the burden, here subordinate, to be sure, to the predominating care of the sick.



THE MEDICAL SCIENCES.
Relations --- Approaches.

To be concrete, the Doctor of Philosophy in the appropriate field may be and actually does become the Professor of Anatomy, Physiology, Biochemistry, Bacteriology, Pharmacology and probably in the near future Pathology. It is needless to say that he makes contributions to each of these subjects and even with less advanced training (M. S.). In the practical fields we have, in addition to non-medical social workers, statisticians and nurses, non-medical administrators of hospital and public health enterprises, at least in lesser positions. No one would dream of looking for a sanitary engineer among medical graduates, and even non-medical epidemiologists have been utilized.

This growing importance of non-medical scientists in more or less purely medical subjects is in part due to the law of supply and demand. Doctors of Medicine are too few, their training too long and expensive, to expect that many of them will fill the less remunerative positions which theory affords as compared with practice. And apart from pecuniary regard, the personal human touch, the joy of direct human service which fortunately appeals to the majority of mankind, leads most graduates in medicine into the practical field. And, then, it must be confessed that in some respects the non-medically trained man is often better fitted both as a teacher and investigator than the medical graduate to forward the medical sciences.

To be specific, what course would we lay out for a recent graduate of a university (A. B.) who had taken a course in general bacteriology in his sophomore year, had later been permitted to take the regular course in medical bacteriology and who now plans to make bacteriology in its medical aspects his life's work? Should he proceed through the regular medical course for a period of five years to the medical

degree, or should he proceed through a shorter period of from three to four years to the Ph. D. in Bacteriology? If he is so advised and follows the first plan he will on graduation in medicine, and after a required interne service in medicine and surgery, have a general idea of human disease problems and the general relations of bacteriology to them; he will thereafter, however theoretical he may become, be able to stand unabashed in the presence of a patient and discuss symptoms with his clinical colleague, but he will be but little better as a bacteriologist than he was four years before, and, unfortunately for his first love, he will in all probability have long since ceased to wish to become one. As a successful Ph. D. on the other hand, our student will have demonstrated two years earlier his ability as an independent research worker in bacteriology, he will have made the first steps in a teaching career and he will have added something to the sum of human knowledge in his field. For better or worse the latter man is a recruit to the science he has chosen, but from the personal standpoint he is a recruit with a handicap in the eyes of his henceforth medical colleagues which he can live down only by superior ability. Such choices must after all remain for the individual to make and should and will be made in the light of what he insists on doing. At least it should be clear that a research career in the medical sciences is open both to medical and non-medical graduates.

OPPORTUNITIES FOR RESEARCH

The opportunities for these research careers in medical science are now present in many places, admixed with more or less responsibilities of a more defined or routine sort, as teaching, which is a stimulus to research, diagnosis, which by the clever mind in its most routine forms takes an investigative trend, and administrative duties. Research institutions exist for the pure investigation of any or of some particular medical problem. The universities, fortunately for their teaching, remain the fostering places of pure research while affording the constant human stimulus of contact with fresh young minds. Public health laboratories, municipal, state and federal, while largely administrative in function, always under wise guidance, afford research opportunities and, indeed, present the latest, most urgent, and, frequently, most interesting problems. Even hospital laboratories with predominating routine duties are recognizing the need of including research possibilities in order to secure a really competent personnel.

Repetition of a procedure that has been mastered is the path of least resistance, and when followed by more and more flattering administrative responsibilities with opportunity for human contact, leads in the career of many to a languishing of research. Research is recognized as a stepping stone to preferment and is frequently utilized for this purpose alone; something is accomplished even in this way to the benefit of the individual and the science. The greatest investigators are probably seldom lost in spite of difficulties that are put in their way and the seductive paths that lure them, but the rank and file of minor contributors is essential. A determination to start a career which shall include research and opportunity for its accomplishment do not suffice. An encouraging and never-failing belief in the essential necessity for research, a scholarly atmosphere, should surround the majority of beginners. Such an atmosphere usually occurs in the universities and in research institutions and only occasionally elsewhere.

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"THE FRIENDLY ARCTIC"

THERE appeared in SCIENCE for July 7, 1922, an article by Diamond Jenness, entitled "The Friendly Arctic." In this article Mr. Jenness is spokesman for those members of one of the subdivisions of my 1913-1918 expedition who caused the disturbance which in newspaper controversy has since come to be known as "the Collinson Point Mutiny" and which is described in Chapter XIII of my book, "The Friendly Arctic." I am informed that a reply to Mr. Jenness will be published in SCIENCE by two of the loyal members of the expedition, Burt M. McConnell, now one of the editors of the *Literary Digest,* and Harold Noice, who is now in New York work-