Pre-Medical Training at the Institute

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THE IMPACT OF PHYSICS AND CHEMISTRY ON MEDICINE

THE DISCOVERIES of Pasteur, Koch and Bernard turned Medicine to view health and disease as physico-chemical biological phenomena. Bacterial invasion and resistance to it are described in chemical terms, an interplay of antigen and antibody. Diabetes means a lack of the specific protein substance, insulin. Viruses, the causes of, for example, influenza, infantile paralysis, some forms of experimental cancer, are complex but nevertheless well defined chemical entities. Similarly the course of a disease process is described, whenever possible, in chemical terms—as a change in hydrogen ion concentration (acidosis), or, in the case of sugar in the blood (diabetes), as too little production of acetylcholine at the locus between the end of a nerve and the muscle fibre it innervates (myastheniargravis). Food is considered as a source of essential nutrients—calories, special nitrogenous substances, minerals and vitamins, and not simply as fuel. Immunological research led to the discovery of the blood groups, and thereby greatly reduced deaths and sickness after transfusions. The blood type of a person was shown to be hereditary. It was then found that one of the causes of death of the new-born is a genetical immunological phenomenon; when the cause was recognized, means were found to avert it.

The great contributions of Physics to Medicine are commonplace. Everybody knows of the medical uses of X-rays and radium. A technician makes a diagnosis of tuberculosis today in a few minutes in cases where 40 years ago the skill, experience and judgment of an Osler were required. Isotopes and the electron microscope are powerful new tools for the study of disease as of other biological processes.

Mathematics, especially statistics, is indispensable to the Public Health officer, epidemiologist, geneticist, and in the anthropological study of populations.

The foregoings were some of the considerations which led to the establishment in 1928 of a Division of Biology at the California Institute of Technology. They were not, of course, the only considerations. The elucidation of biological phenomena, wherever possible in physico-chemical terms and by physico-chemical means, is important in itself; and as appropriate at the Institute as Physics and Chemistry and their applications.

THE BIOLOGY OPTION AS A PRE-MEDICAL COURSE

The Biology Division offers an undergraduate course designated Biology Option. It begins in the last semester of the sophomore year and continues through the remaining two and a quarter years to the B.S. degree. The subjects taught are physics, chemistry, mathematics, zoology, botany, embryology, comparative anatomy, genetics, animal and plant physiology and biochemistry, immunology, English literature, American and European history, and foreign languages.

A relatively advanced knowledge of the basic sciences of Physics, Chemistry, and Mathematics is essential for the student of modern Biology. In the biological courses the point of view is toward the fundamentals; emphasis is on general unifying principles. Applications to Medicine, Agriculture and Industry may be cited as illustrative examples, but they are not taught as subjects in themselves. In a word the objective is to teach Biology and not Medicine, Agriculture or Technology. Students who wish to become proficient in one of the latter subjects are recommended to attend, after they have had a thorough grounding in the basic sciences of Physics, Chemistry, Mathematics and Biology, schools especially devoted to that purpose.

The undergraduate Biology Option serves well as a pre-medical course. It is acceptable to leading medican schools. About half the students who have taken our Biology Option have later studied Medicine. Most have gone into medical practice, the others into academic work, medical, biological, biochemical and industrial research work. The reports we have received from our students and their teachers in medical schools testify to the value of an intensive premedical training in the fundamental Physical and Biological Sciences.

The first impact in the applications of Physics and Chemistry to Medicine is, of course, in research. It could be said that abnormal physiology, much of modern pathology and bacteriology, chemotherapy, medical radiology, to name only some of the fields in which important advances are being made now, are essentially extensions of Chemistry and Physics fusing with Biology. The great new powers at our disposal through advances in these basic sciences may be likened to the bow of Ulysses. The strength to bend it comes from a sound working knowledge of the ideas and methods of the basic sciences. A research worker in Medicine today is at a disadvantage without it.

The practising physician and surgeon needs to know the basic sciences in order to apprehend the significance of new advances in medical research and to use them intelligently. Otherwise, he is likely to be slow in taking them up or uncritical in their use. He is dependent on other better trained doctors in their use, and then can use them only in a routine manner as a technician. The advances to be made by their proper, critical use and in extending their usefulness he must leave to colleagues. Leadership in medical practice as in research is taken by doctors better trained in Medicine and in the basic sciences.