# Not in the Books

By GEORGE W. BEADLE

SOME YEARS ago the director of a Division of one of the four Regional Research Laboratories of the U. S. Department of Agriculture was called upon to defend before a congressional committee the budget request for his laboratory. Among the items in the proposed budget was a not inconsiderable one for books and periodicals for the library. Pouncing upon this with great vigor a member of the committee pounded the table and shouted: "Doctor, I thought we were paying you fellows to put stuff in books, not to get it out!"

While it is no doubt true that the congressman responsible for this utterance underestimated the importance of a firm foundation in the knowledge of the past as a basis for future discovery, there is a certain justice in his contention. Those of us working in Biology at the Institute are more interested in "putting stuff in books" than we are in getting old stuff out of them. By this I do not mean we are in any way unappreciative of past accomplishment or that we are inclined to decry the importance of an adequate library—quite the contrary. But we do see the many unsolved problems of biology ahead of us and we are impatient to get at them.

What are these problems of biology whose answers we cannot yet find in books? There are many, some of which lie so far in the future that we perhaps cannot yet formulate them in a manner sufficiently clear to make it obvious how we should go about attacking them. Others stand out more boldly.

Many of modern biology's enigmas—some of the profoundest perhaps—center around the gene. As our knowledge of this unit of heredity increases it becomes more and more apparent that it is an irreducible and indispensable unit of all living systems. It appears to be the simplest component of the organism capable of self-duplication. In this it is like the virus. It differs from simpler non-living self-duplicating systems such as crystals in being capable of becoming permanently modified without losing the property of self-multiplication. It is this mutability that has made possible all evolutionary change in living organisms.

While we have learned a great deal about the mechanism by which higher organisms transmit genes from one generation to another with an almost uncanny precision and while much of the mystery surrounding the difference between the living and the non-living has disappeared as a result of our recently acquired knowledge of genes and viruses, there remains much to be learned. We do not know with any certainty what a gene is chemically. We do not know how it produces replicas of itself. Nor do we know how it plays its essential part in the development and functioning of a complex organism. This is a part of the knowledge that biologists will put in the books that are yet to be written.

Gene-duplication involves protein synthesis. It is therefore obvious that we cannot hope to understand this process until we know how proteins are made in the living cell. This, too, is a problem of the future although we are now getting gratifyingly close to it. We can hope soon to know how peptide linkages are formed and once we know this it should be possible to get ahead with the problem of how amino acids are combined to form the essential proteins out of which genes, enzymes and other protoplasmic constituents are built.

Just as advance in basic knowledge at the biological level depends on prior knowledge at the chemical, physical and mathematical levels, so sound medical progress can come only after problems in biology have been formulated and solved. Unfortunately much of present day medical knowledge is empirical and superficial. To illustrate, consider what we know about penicillin, one of Medicine's most remarkable recent discoveries. It is true that at the cost of tremendous labor, which probably could not have been brought to focus on the problem had it not been for the war, we know the chemical structure of the penicillin molecule. But regarding its biological action, our ignorance is indeed profound. Its action on the bacterium whose growth it so effectively stops is a complete unknown.

What is true of penicillin is equally true of most of Medicine's vast array of drugs. Almost nothing is known at a basic level about the action of these substances. Modern chemistry is just now in a position from which it can profitably tackle the problem of molecular structure and biological activity—a position from which it can hope, for example, to tell us why sulfanilamide inhibits the growth of a pathogenic bacterium but a closely related compound does not.

It may be said about the cancer problem, too, that all our knowledge lies close to the surface. Before we can hope to understand in any but a very small way a problem as complex as this, we must solve a basic biological problem about which we now know very little. This is the problem of differentiation. How is it that one group of cells forms an eye while another group, supposedly genetically identical, gives rise to a hand? If we can learn the answer to this, perhaps we will then be in a position to say why in cancer a group of cells suddenly embarks upon an uninhibited growth spree.

These examples serve as a very small sample of the vast unknown in biology. They are a little of the stuff that is not yet in books. They are a part of the challenge to this and future generations of those scientists who are interested in following all possible approaches to a more complete understanding of the ways of living things.

Maximum speed in solving these many problems depends on our bringing to bear on them as soon as we possibly can all the known techniques of the physical and biological sciences. This is exactly what the Institute is attempting to do in the long-term research program in physical chemical biology now well under way. In the Physics laboratory is a modern electron microscope available for use on materials of biological interest. In Chemistry X-ray and electron diffraction techniques determining molecular

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## The Gosney Research Fund

IN 1929 Mr. E. S. Gosney founded and endowed a non-profit organization, known at the Human Betterment Foundation, for the purpose of fostering and aiding constructive and educational forces for the protection and betterment of the human family. In collaboration with Dr. Paul Popenoe and other scientists Mr. Gosney carried on an extensive study in the field of eugenic sterilization, including particularly its medical, legal and social aspects. In 1929 and 1930 an exhaustive survey was made of 6000 cases of sterilization of eugenically unfit. Eight years later a second similar survey of 10,000 cases was made.

Following the death of Mr. Gosney in 1942, the Trustees of the Human Betterment Foundation agreed that the best interests of the Foundation would be served by transferring its activities to the California Institute of Technology. As a consequence in October 1943 an agreement was drawn up according to which the Human Betterment Foundation was to be dissolved as such and its assets turned over to the Institute. The Institute agreed to use these assets "and the proceeds thereof to establish the Gosney Research Fund, the income from which will be devoted in perpetuity to the promotion of research into the biological bases of human qualities and for making known the results of such research for the public interest."

At the present time the income of the Gosney Research Fund is used in support of post-doctoral fellowships in those branches of biological science basic to our understanding of human welfare. Gosney Research Fellowships are available to qualified investigators who hold the Ph.D. degree or its equivalent and who have demonstrated exceptional ability in original research. Preference is given to candidates who desire to carry on research in the general field of heredity. The Gosney Research Fund is currently administered by a Gosney Fund Committee made up of Professors A. H. Sturtevant, chairman, E. G. Anderson, Max Mason, and A. H. van Harreveld.

In effecting the transfer of the material assets of the Human Betterment Foundation to the Gosney Research Fund of the Institute special credit is due Mrs. Lois Gosney Castle, daughter of Mr. E. S. Gosney. Mrs. Castle spent approximately a year in putting the affairs of the Foundation in good order and in converting properties and other assets into fluid form. In addition she has maintained a keen interest in the research activities supported by the Gosney Research Fund.

G. W. B.

## The Hixon Fund

IN 1938 A FUND was established at the Institute by the Estate of Frank P. Hixon to support researches in science which offered promise of increased understanding of human behavior. Up to the present the income of the fund has been applied to a series of individual projects of limited duration.

In the first of these Dr. R. Larente de Nó, on leave of absence from the Rockefeller Institute of Medical Research, spent a half year at the Institute continuing his work on nerve action currents, with opportunity for consultation with the Institute staffs in physics and mathematics, and in particular with Dr. Leverett Davis of the Physics Department, who gave analytical formulation to the results. Dr. Larente is now publishing a comprehensive treatise on nerve action currents, and considers that his experience at the Institute was of primary importance for the five years of research which is being reported in the treatise.

The next project aided by the Hixon Fund was started as a cooperative study between members of the Institute staff under the leadership of Drs. Wiersma and van Harreveld and representatives of the State Department of Institutions, on the effects of electroshock as a means of psychotherapy. The work was carried on later in cooperation with the Department of Psychiatry at the Los Angeles County Hospital. Important clinical experience was obtained and reported on electronarcosis as a treatment in mental disorder.

During the war Dr. David B. Tyler, Hixon Research Fellow, at first independently, and later under O.S.R.D. auspices, made valuable studies which resulted in means of treatment for cases of battle shock, fatigue, and motion sickness.

The Hixon Fund is at present administered by a Committee consisting of Professors Max Mason, A. H. Sturtevant, Henry Borsook, and Linus Pauling.

Max Mason

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structure are focused on chemical compounds that make up living systems. Radioactive isotopes of various elements are being used to determine the fates of specific molecules in the organism. In a similar way the latest methods of electrophoresis, chromatography, and spectroscopy are being made use of. Physicists, Chemists and Biologists are pooling their knowledge and their resources to find the answers. But it is not enough that the attack be made with the techniques and skills that now exist—there must be a constant search for new and improved techniques and, even more important, for fresh imaginations to use them.

### PERSONALS

**1928**

RICHARD ARMSTRONG (Aussieker) returned to Pasadena in August after serving in the Army Medical Corps, and started medical practice limited to the eye.

**1929**

ALBERT TYLER, Ph.D., has remained at C.I.T., and is now associate professor of embryology.

**1930**

EMORY L. ELLIS, Ph.D. '34, is working at the U. S. Naval Ordnance Test Station at Inyokern, Calif. His work for the last six years has led him away from the field of his doctorate, biochemistry, as he is now chiefly concerned with physical chemistry and chemical engineering.

**1931**

RUSSELL LEE BIDDLE, Ph.D., is assistant professor of biology at the College of the City of New York. He is teaching many pre-medical and pre-dental students, and is college advisor to students majoring in pre-med and pre-dent and biology. He spends ten hours a week in this capacity, and regrets that it leaves him little time for research. Dr. Biddle lives in New Jersey with his wife, son Russel Lee, Jr., five, and two daughters, Virginia Ruth, twelve, and Valerie Ann, one.