

Biophysical Science—A Study Program

Physical and chemical approaches to problems in biology have become increasingly productive in recent years. Major advances in the understanding of life processes have been made through research in such specialties as biophysical chemistry, molecular biology, biophysics, and electrophysiology. Continuing progress will require an ever more perceptive study of the interactions of matter, energy, and information in biological systems.

This publication grew out of a special activity, designed to aid and stimulate the further blending of the concepts and methods of physics and chemistry with those of the life sciences in the study of biological problems. The papers in this volume were presented in the Study Program in Biophysical Science, held in Boulder, Colorado, during the summer of 1958.

A living system is a self-perpetuating combination of atoms, organized in a highly specific manner and interacting with its environment in such a way as to metabolize, reproduce, grow, and adapt. The Study Program was designed to present biological problems as "viewed through physical spectacles and investigated by physical ideas and methods."* Biological processes can be examined, for example, in terms of atomic structures, energy levels, and binding forces. The engineer might prefer to specify the design and operation in terms of components and "black boxes." The chemist discusses molecular configurations and kinetic and thermodynamic details of biochemical reactions. These and other modes for describing biological processes are found in this volume.

The Study Program included a number of "case studies" in which topics were chosen to point up the need and value of physical approaches at all levels of biological organization. Particular emphasis centered upon muscle and nerve, where considerable information is available at many of these levels. The series of papers related to nerve, for example, encompasses the molecular organization of the nerve fiber, the nature of the nerve impulse, nerve metabolism, sensory performance of organisms, receptor mechanisms, and integrated responses of higher neural centers. Another series deals with genetics, replication, and synthesis of nucleic-acid and protein macromolecules. Here again, the topics range from descriptions of the biological processes of replication, through physical and biochemical details

of relevant structures, to mathematical considerations in the coding of information.

The subjects were selected with emphasis on fundamental concepts, to broaden the base of common language and understanding among a heterogeneous group of biologists, physicists, and chemists. This emphasis restricted the range of topics that could be presented within the limited duration of the Study Program. Also, the interests of those who organized the program are unavoidably reflected in its contents.

This particular choice of topics is not intended to define or delimit the field of biophysics, but, rather, to illustrate the power and success of the integrated physical-biological approach. Future conferences and publications of this kind will undoubtedly emphasize alternative subjects such as, for example, those at higher levels of biological complexity.

The arrangement of the material presented in the Study Program was chosen to provide a logical unfolding of the selected subjects, along with a continuous injection of background material. The initial chapters give many of the fundamental concepts, whereas the later chapters make use of developments introduced in the intervening chapters. Since references may be needed to supplement the necessarily abridged discussions in the papers, a Selected General Bibliography is given on pages 2 to 4. The entries are divided into 10 subject categories, together with a designation of those papers that are most closely related to each category.

Biophysics and Biophysical Chemistry Study Section

P. H. Abelson
J. W. Beams
R. H. Bolt
J. D. Ferry
I. Fuhr
D. E. Goldman
I. Gray
J. D. Hardy
H. K. Hartline
J. G. Kirkwood
H. Neurath
J. L. Oncley
M. D. Rosenberg
H. A. Sober
R. C. Williams
F. O. Schmitt,
Chairman

October, 1958
Cambridge, Massachusetts

* A. V. Hill, "Why Biophysics?" *Lectures on the Scientific Basis of Medicine* (Athlone Press, London, 1956), Vol. IV, p. 1. Reprinted in *Science* 124, 1233 (1956).