Book Reviews

Life, Electricity, and the Relations between Them

Membranes, Ions and Impulses. A Chapter of Classical Biophysics. KENNETH S. COLE. University of California, Berkeley, 1968. x + 572 pp., illus. $15. Biophysics Series, vol. 1.

This book, by the acknowledged "father of biophysics," K. S. Cole, has been long awaited by his many friends and colleagues. He fully repays their patience.

Over several decades, Cole has made many and important contributions to our understanding of the electrical properties of membranes. Among the better known of these are the measurement of the capacitance of several types of membranes; the description of the impedance change associated with a nerve impulse (the famous and beautiful figure showing this graces the jacket of this book); the observation of the "overshoot" or reversed potential at the peak of the action potential; and the concept and development of the voltage clamp method.

The book opens with the statement: "Life, electricity, and the relations between them have long been subjects of intense curiosity and often of acrimonious speculation." Although the reader will have difficulty in finding anything in the book about "acrimonious speculation," his curiosity will be richly rewarded by Cole's account, which gives the only complete and authoritative history of the developments in this field. Whereas Hodgkin's book [*The Conduction of the Nervous Impulse* (1964)] is relatively nontechnical, Cole's is thoroughly technical, going into great detail, and is full of mathematical analyses and reproductions of many figures, others' as well as his own.

Cole starts with the older measurements of the linear and passive properties of cell membranes, showing the difficulties of working with cell suspensions and the problems of extracellular measurement techniques. He moves to impulse excitation and propagation in nerve, showing how a number of models of nonlinear membrane behavior were developed. This is followed by an excellent account of how he developed the concept and implementation of the powerful voltage clamp method. Cole recalls Hodgkin's visit to him to learn the voltage clamp and goes on to tell about Hodgkin's improvement and use of this very powerful method with Huxley. He gives a brief description of their well-known monumental work, and then proceeds to assemble an impressive array of tests of the Hodgkin-Huxley model axon carried out in his own and other laboratories. This is followed by a section on the application of the voltage clamp method to other membranes, including recent data and some new techniques.

This book should be and is a type of scientific autobiography. It is almost the complete antithesis of James Watson's recent volume *The Double Helix*. The reader will look in vain for discussions of personal relations among the scientists involved or for morsels of gossip about how one scientist feels about others with whom he is working or competing. On the contrary, Cole usually refers to his collaborators by their last names only. As far as I can tell, he has not identified persons with any laboratories. Indeed, a reader who is unfamiliar with the people in the field may only learn the names of a few who worked in Cole's own laboratory by such passing references as "with the collaboration of ———."

Furthermore, Cole handles the one major scientific confrontation (between his laboratory and that of Tasaki) in a matter-of-fact manner and shows how it proved to be a stimulus for a significant advance in the understanding of the limitations of an experimental method. Nonconventional observations in voltage clamp experiments in Tasaki's laboratory led Tasaki to imply that the voltage clamp concept was worthless and that the mathematical formulations developed from voltage clamp experiments were therefore inappropriate. Cole says that this made him realize that, in fact, he could not write voltage clamp specifications or check performance against them. This realization became a stimulus for a long series of papers directed toward developing such specifications and comparing them with actual voltage clamp performance. He records his reactions by saying, " . . . in spite of considerable provocation I think we were usually able to keep our efforts within the framework of 'what is right?' rather than 'who is wrong?' "

The book will be a splendid resource for those who are doing research in membrane physiology and those who want to study it in depth. The level and complexity of the analysis are such that a student new to the field would probably do best to read Hodgkin first. Perhaps the most balanced perspective comes from the responses of more than a dozen of Cole's colleagues who read the manuscript and gave him the benefit of their comments and criticisms. He summarizes them in his acknowledgment: "Most interestingly, I have been both criticized and applauded on numerous aspects of the book. Suggestions for more elementary and complete discussions on physics and mathematics have come from those with the most biological background and experience. Pleas for more biological information and discussion along with condensations and consolidation of most of the analysis were made by the more physical scientists."

Cole's sense of humor shows through in the way he sometimes chides himself, but I would have liked readers to share more of the delightful anecdotes which he frequently told about himself to those in his own laboratory.

Without doubt this book *is* "Kacy" Cole doing "his own thing" on a grand scale.

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Closeups of the Nervous System

The Neuron. HOLGER HYDÉN. Elsevier, New York, 1967. viii + 393 pp., illus. $19.

Despite the beautiful simplicity of the title, this book is not, and is not intended to be, a compendium of present knowledge of the nerve cell. It is, rather, a collection of profusely illustrated essays dealing largely with ultrastructural investigations of limited aspects of the nervous system. If a common thread runs through chapters

by A. B. Novikoff on enzyme localization in the dorsal cord of the rat and on lysosomes, by J. Taxi on the ultrastructure of amphibian ganglion synapses, and by T. W. Blackstad on cerebral cortex, it is the correlation of light and electron microscopy of the regions or structures studied. In *The Cell* (vol. 4, Brachet and Mirsky, Eds., Academic Press, 1960), Hydén summarized in a 100-page chapter the cytochemical, ultrastructural, and microchemical knowledge of the neuron at that time. He included considerable speculation on the function of macromolecules in the nervous system. Some seven years later, in the present volume, Hydén reviews various experiments on isolated neurons and their surrounding glia which support the hypothesis of a reciprocal relationship. The chapter in the present volume is a convenient summary of his microanalytic studies on brain RNA. Experiments involving elegant microtechniques have led Hydén to conclude that there is an actual passage of RNA from glia to neuron and that characteristic changes in amount of RNA in selected neurons or glia can occur under the influence of drugs, exercise, change in state of consciousness, and learning. More recent studies on changes in protein observed in Hydén's laboratory are not reported in this volume. While Hydén maintains that there is a characteristic shift in the amount or in the base ratios of RNA, he has grown more cautious in the interpretation of his results. He points out the need to do confirmatory studies with isotopes. Since his studies involve selected neurons and their surrounding glia from specific brain regions, the various new techniques for the separation of neurons and glia from large amounts of brain tissue cannot be expected to shed additional light on his approach. It will probably remain for investigators trained in microtechniques to elucidate further the significance of these findings.

The free use of photographic plates throughout the book might seem extravagant. A pleasant exception is a chapter by the late C. M. Pomerat and coworkers in which frames from time-lapse cinematographs illustrate the dynamic nature of neurons in culture. If the chapter encourages those who have not already done so to view the films of Pomerat, of Paul Weiss, and of others, it will have served a good purpose.

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Overview of Animal Virology

The Biology of Animal Viruses. FRANK FENNER. Vol. 1, Molecular and Cellular Biology (xvi + 501 pp., illus.). Vol. 2, The Pathogenesis and Ecology of Viral Infections (xvi + 879 pp., illus.). Academic Press, New York, 1968. $18.50 each vol.

The study of viruses began, of necessity, with their role as agents of disease. Fenner in this new two-volume study looks beyond this aspect to consider the comparative biology of avian and mammalian viruses. He is well qualified to attempt this task, for his own contributions encompass the whole of virology, from ecology to molecular biology.

The first volume reviews what has been learned through the application of the methods of molecular biology to animal viruses and the cells they infect. Avoiding the one-virus-to-a-chapter approach that would be employed by a series of specialists, Fenner skillfully guides the reader through the various stages of viral growth from adsorption of the infecting particle to the release of progeny. Each of these stages is illustrated with data drawn from the whole spectrum of animal viruses. Where studies of related viruses have yielded similar results, Fenner discusses in detail only the clearest example, simply supplying references for the others. The resulting cross-sections of knowledge exhibit both the diversity and the unifying concepts of the subject. In the second volume Fenner uses the same plan to consider the interactions of viruses with whole animals and populations of animals. Here again the experimental models are clearly described and the schematic drawings—for example, one of the reproductive tract showing possible routes of infection of the embryo—give the reader a graphic sense of processes involved.

We live in an age in which data are accumulating ever more rapidly, the product of what, for the most part, are laboratory scientists, highly competent in technical aspects of their subjects but often unable to simplify, generalize, or interpret their material in a way that might make for greater meaning and usefulness. It is here that Fenner makes possibly his greatest contribution. Whether he is discussing the synthesis of viral nucleic acid, the pathogenesis of viral diseases in relation to such things as the immune response and the spread of virus through the host organism, or the ecology of animal viruses as related to spread in vertebrate populations with changes in virus and host, he draws his material, like a true biologist, from all sources, the field as well as laboratory, animals as well as man, and thus achieves an exemplary point of view which should be welcome to anyone who wishes to see the wood rather than merely the trees.

These well-documented volumes provide a reliable entry into the current literature and should be the delight of graduate students. A specialist who might be tempted to use only the particular volume that touches his interest should also avail himself of an unexcelled opportunity to view the whole of animal virology.

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Interactions

Low-Energy Neutron Physics. I. I. GUREVICH and L. V. TARASOVA. Translated from the Russian by Scripta Technica. R. I. Sharp and S. Chomet, Eds. North-Holland, Amsterdam; Interscience (Wiley), New York, 1968. xiv + 608 pp., illus. $28.

Many of the recent books in physics have been written by committees; that is, they are compendia of individual papers collected by someone or some group. It is extremely pleasant to encounter a book which is clear, comprehensive, and reasonably up-to-date and reflects the work of one or two individuals. The excellent book by I. I. Gurevich and L. V. Tarasova is such a volume.

Displaying a breadth of understanding that is increasingly rare, the authors tie together the theoretical and experimental bases of the interaction of neutrons with nuclei. They consider both macroscopic and microscopic interactions of neutrons. For example, there is an elementary discussion of the neutron dipole moment. There is a rather complete treatment of the macroscopic nuclear and electromagnetic interaction of neutrons with nuclei, atoms, crystals, and liquids. At all points the authors clearly bring out the basic relationship of the *S*-wave nuclear scattering amplitude for low energy neutrons to macroscopic phenomena such as the scattering from crystals and liquids.

The comprehensive nature of the