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