the most part, seem legitimate devices: an emphasis on a family temperament, and on a similarity in problems attacked. Artistic considerations have no doubt caused some bias in the selection of subjects limned and anecdotes retold; but in a world overloaded with information-inputs some bias is defensible. As an introduction to further study of members of this remarkable family this book has no equal. It is thoroughly enjoyable to read.

To those of us who are—like many of the Huxleys themselves—interested in the heredity versus environment problem, the story of this family is fascinating, though inconclusive. The biographer understandably has come to see hereditary ability everywhere, though he recognizes that on a straight probability basis members of the present generation must inherit only about one-fourth to one-eighth of their genes from T. H. Huxley, depending on whether they are his grandchildren or his great-grandchildren. Selective mating has increased the proportion of hereditary excellence, no doubt: the mother of Aldous and Julian was an Arnold, for example. Even so, one must on a priori grounds grant considerable importance to environment, that is, to the microenvironment of a Huxley household permeated by traditions of independent thinking and witty conversation. There is much concern today about the necessity of enriching the lives of children raised in disadvantaged homes. The term "disadvantaged" is surely a relative one. Reading of the upbringing of the Huxleys one cannot help feeling that almost all children are raised in disadvantaged homes. To makers of Utopias (a truly Huxleyan occupation) this fact poses problems with no easy solutions.

GARRETT HARDIN
Department of Biological Sciences, University of California, Santa Barbara

Biological Membranes

The Movement of Molecules across Cell Membranes. W. D. STEIN. Academic Press, New York, 1967. xviii + 369 pp., illus. $17.50. Theoretical and Experimental Biology, vol. 6.

In his foreword to the first edition of *The Permeability of Natural Membranes* by H. Davson and J. F. Danielli, E. Newton Harvey wrote, "It can truly be said of living cells, that by their membranes ye shall know them." A quarter of a century has elapsed since these words were written, and developments of this period have added validity to Harvey's prophetic insight. In the past decade numerous monographs, reviews, and symposia dealing with various aspects of membrane structure and function have appeared. However, there are relatively few published works that provide a comprehensive, sophisticated, and up-to-date account of the molecular aspects of membrane structure and function that is suitable as an introductory text at the graduate and postgraduate levels. Wilfred Stein's monograph goes a long way toward filling this need.

The central theme of the monograph is an analysis of the various physical and chemical processes that appear to be involved in the transport of molecules across biological membranes. Although data and examples are drawn from studies on a wide variety of cells and tissues, the emphasis is on the interaction between molecules and membranes rather than on the functional role of transport processes. The development of the central theme is logical and well organized, beginning with a brief presentation of current concepts of membrane composition and structure and concluding with a critical, albeit speculative, examination of several model systems for mediated transport processes. The inadequacies of a simple, passive barrier and the need to invoke more complex, carrier-like mechanisms and coupling with energy-yielding metabolic processes are expounded clearly and logically.

The highlights of this monograph are in those areas that have been the focus of much of Stein's research effort. These include: a critical analysis of the mechanism of diffusion of nonelectrolytes across biological membranes; a detailed kinetic treatment of carrier-mediated facilitated diffusion; and a comprehensive survey of the molecular properties of transport mechanisms that includes a discussion of the recent attempts to isolate components of carrier systems. The chapter on the molecular basis of diffusion across cell membranes is perhaps the most intriguing from the point of view of the research worker in this field. In this chapter, Stein extends Danielli's "potential energy barrier" model by incorporating the formal contributions from the theory of absolute reaction rates. By a process of data-fitting Stein arrives at a simple set of rules that adequately accounts for the permeability of several plant cells to a wide variety of nonelectrolytes. The alternative model, namely, that many small nonelectrolytes cross biological membranes by movement through aqueous channels or pores, is subjected to a critical analysis from which the author concludes that "No single value of the radius of the pore can adequately account for the data on the nonspecific systems . . . ." Since the data used by Stein to test the pore hypothesis are admittedly qualitative estimates of the true permeabilities, the rejection of the pore hypothesis is, in the opinion of this reviewer, at best premature. Nevertheless, Stein's provocative analysis brings the issue into sharp focus and points to the need for additional data that would permit an unequivocal evaluation of these alternative views.

Unfortunately, this monograph contains several shortcomings and errors that detract from its overall high quality and could prove to be sources of confusion for the student. For example, in section 2.8, the interpretations of deviations from the predictions of the Ussing flux-ratio equation are erroneous and the formulation of Kedem's general flow equation (equations 2.33 and 6.1) is formally incorrect. Further, in a chapter dealing with the interaction between sodium and the transport of sugars and amino acids, there are serious shortcomings related to the kinetic model for "co-transport" proposed by Stein. Stein's model makes no provision for the carrier-mediated transport of sugars or amino acids in the absence of sodium. The predictions of this model are, contrary to what is stated by the author, inconsistent with some of the "supporting data" (fig. 5.9) referred to. Finally, it is disappointing that the subject of ion transport across membranes, particularly excitable membranes, is not afforded the same incisive consideration given the transport of nonelectrolytes. It is hoped that these and other shortcomings will be remedied in future editions.

All in all, Stein's monograph is a well-written, remarkably current and provocative analysis of several aspects of membrane transport. It is not solely a factual account but is, in addition, a critical review containing many of the author's personal interpretations and speculations, which are worthy of serious consideration by students and researchers alike.

STANLEY G. SCHULTZ
Department of Physiology, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania