Principles and Models of Biological Transport, by Morton H. Friedman, Springer-Verlag, 1986, 260 pp. 106 Figures.

REVIEWED BY A. S. POPEL

Biological transport has been a subject of interest and curiosity for engineers for some time. This interest has already resulted in several important textbooks, most notably S. Middleman, "Transport Phenomena in the Cardiovascular System," 1972, E. N. Lightfoot, "Transport Phenomena and Living Systems," 1974, M. M. Lih, "Transport Phenomena in Medicine and Biology," 1975, and D. O. Cooney "Biomedical Engineering Principles," 1976. These were written as traditional textbooks on chemical engineering transport phenomena: the fundamental principles and equations of mass, momentum, and energy balance were presented first, and subsequently applied to physiological transport phenomena. The approach was phenomenological, with relatively little emphasis on molecular mechanisms of transport phenomena. Indeed, browsing through these texts, one would find no mention of many concepts that dominate modern cell biology: receptors, the mosaic model of cell membrane, or microscopic models of ion-specific channels. Of course, many important results have been obtained in the last decade, after the above texts appeared.

A new textbook by Morton H. Friedman approaches the subject in a very different manner, and is complementary to the previous texts. The approach is best defined by the author in the Preface: "What distinguishes biological transport from other mass transfer processes is the fact that biological transport is biological. Thus, we do not start with the engineering principles of mass transport (which are well presented elsewhere) and then seek biological applications of these principles; rather, we begin with the biological processes themselves, and then develop the tools that are needed to describe them. As a result, more physiology is presented in this text than is often found in books dealing with engineering applications in the life sciences." This approach makes the book unique in the world literature—its content places it in the category of biophysical and physiological literature, yet it is quantitative and, where possible, uses methods of engineering analysis. It is, thus, a valuable addition to biomedical engineering literature.

There are nine chapters. The first five are devoted to fundamental principles of biological transport, the sixth analyzes general features of membrane transport, and the last three chapters consider particular examples of physiological transport systems. Although it is assumed that the reader has a "limited familiarity" with thermodynamics, the author attempts to make the material self-contained and introduces, at least briefly, all necessary concepts.

In teaching biological transport to undergraduate and graduate engineering students, until now one has immediately encountered a problem: no textbook existed that clearly explained transport mechanisms at the molecular level and that was, on the one hand, quantitative, and, on the other hand, not based on deep knowledge of biochemistry and cell biology that engineering students are normally lacking. The book reviewed here fills this gap. It is an excellent introduction to biological transport phenomena that should give the conscientious reader enough background to comprehend the results of current research in the field. In teaching engineering students, it would probably be best to combine the material in the book with a more conventional mathematical approach to transport phenomena developed in previous texts.

In recent years, applications of engineering methods in biology have been extended to include anaylses of cellular and subcellular systems and processes. These studies are sometimes referred to as "Cellular Engineering." If this term is defined as the area of cell biology studied by engineering methods, then we can certainly regard the book as an excellent text in this new area.

Microvascular Networks: Experimental and Theoretical Studies, *Proceeding of the Symposium on Microvascular Networks: Experimental and Theoretical Studies*, Tucson, Arizona, 1985, Editors: A. S. Popel and P. C. Johnson, Karger, 1986, 226 pp. 90 Figures

In order to study the morphological and hemorrheological complexity of the microcirculatory network, more sophisticated theoretical and experimental methods of analysis of network architecture and flow properties have been developed. Methods of analysis originally used in geomorphology have been adapted and extended to the biological sciences, such as neuroscience and pulmonary science, and, recently, to microvascular research. This volume, based on an international meeting, describes new methods of microvascular network analysis. Its unique coverage combines the description of quantitative studies of architectural, hemodynamic and regulatory aspects of microvascular network structure and function. It systematically presents the methodology of network analysis, and describes the state of the art in experimental and theoretical methods of analysis of microvasclar networks.

Eighteen papers are grouped into five sections. In the first section, important fundamental questions are addressed relative to the formulation of models of the microcirculation, areas of uncertainty are point out. Models of network analysis is geographical research relevant to the study of microcirculatory networks are reviewed. Papers in the second section describe methods for the topological analysis of microvascular networks. The following section contains studies on capillary erythrocyte flow distribution, in which questions of microvascular geometry, blood flow variables and capillary perfusion heterogeneity are examined. The fourth section describes experiments on blood flow modulation and considers such factors as vasomotion, myogenic autoregulation, microvascular pressure distribution, and effects of angiotensin II. The book's final part discusses network models which can be used to study the heterogeneity of the microcirculatory network, blood flow through bifurcations, network hemodynamics and variation of viscosity, the hemodynamic significance of arteriolar anastomoses, and the effect of network geometry on flow heterogeneity.

As an accumulation of results of recent studies of microvascular networks and as a description of new experimental and theoretical methods of microvascular network analysis, this volume will be useful to microcirculatory and cardiovascular physiologists, and to biomedical engineers and clinical researchers interested in circulation.

From the jacket cover.