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BOOK REVIEWS

Transport and Diffusion Across Cell Membranes, Wilfred D. Stein. Academic Press, San Diego CA, U.S.A. 1986. U.S.$38.50 (paper), 685 pp.

In the preface the author tells us the book deals with molecular and kinetic aspects of the movement of molecules and ions across cell membranes, that he wants to show that the same kinetic equations, appropriately modified, serve to describe all of the various transport systems, and that the exposition is data-based.

The material is organized into six chapters. Chapter 1, "Physical Basis of Movement Across Cell Membranes", discusses structure and physical chemistry of the cell membrane and then introduces thermodynamics and kinetics and the methods of measurement of membrane permeability. The central section on thermodynamics and kinetics is a short introductory treatment and could well be deeper for a graduate level book. Chapter 2, "Simple Diffusion Across the Membrane Bilayer", gives a good, physically intuitive and data-based discussion of the effects of partition coefficient and molecular volume on permeability. The order of the argument in Section 2.1 seems to be inverted in that the author starts with a plot of $\log P$ vs $\log K_{\text{hexadecane}}$ (Fig. 2.1) in which he fits a straight line to a set of points that obviously do not fit a straight line, without motivation. The motivation appears two pages later in the derivation of the relation $P = K\,D_{\text{mem}}/\lambda$. Chapter 3, "Channels Across the Cell Membrane", starts with data on single channel conductances, discusses channels for different substrates, gives a uniform kinetic treatment for 1-site, 2-site and multisite channels, and covers channel specificity and regulation of channel opening. Chapter 4, "Facilitated Diffusion: The Simple Carrier", starts with the experimental definition of facilitated diffusion and the kinetic treatment of the simple carrier model and proceeds to a discussion of a series of systems, interpretation of transport parameters, counter-flow, different types of inhibition, and a comparison of properties of carriers and enzymes and the question whether the conformational shifts of the carrier or the substrate-carrier dissociation steps are rate limiting. Chapter 5, "The Cosubstrate Systems: Two Substrates That are Carried on a Single Transporter", is concerned with the cotransport systems and the nature of gradient-coupling, the question of effective design for tight coupling and the effect of the membrane potential. Figure 5.9 on p. 388, from one of my papers, is mislabelled as being from an infinite-trans experiment; it was a zero-trans experiment. Chapter 6, "Primary Active Transport Systems: Chemiosmosis", goes into the Na^+K^+ pump in great detail and then covers some of the other active transport systems that are linked to the splitting of ATP. Finally, there are two brief appendices, one on the kinetics of the carrier model for facilitated diffusion, the other on the kinetics of the carrier model of cotransport.

Does the author accomplish what he set out to do? To a great extent, yes, but the book deals primarily with kinetic aspects and what can be learned from the various experiments on kinetics. At a couple of places in the book we are promised another volume that will deal with molecular structure and regulation. The interplay between data analysis, the kinetics derived from the major models and physicochemical interpretations of mechanism is very good. The author takes the standard experiments, zero-trans, infinite-trans, exchange equilibration, etc., and asks what combinations of the basic kinetic parameters of the models can be estimated and how can one use them to test various hypotheses about mechanism. This is in the spirit of modern studies of identifiability of parameters of models, although the author does not use the term identifiability and does not refer to the now extensive literature on identifiability of parameters of models in biology.

This book comes at the right time in the development of transport studies. The late 1950s to early 1960s saw the start of the kinetics phase of transport studies. From that time up to the early 1980s the major models were developed, as were the kinetic analyses and the experimental methods for kinetic studies. By the early 1980s this "kinetics" phase was over and the emphasis had clearly switched to the molecular structure of transporters and their genetics. Stein's book shows us what we have learned from this "kinetics" phase and summarizes where we are now. The techniques of kinetic analysis, experimental and theoretical, have become part of the standard methods used in transport studies! Many contributed to the development of the kinetics phase in the 1960s. The book is not an historical review and the author has limited the references, but I missed references to a couple of my early papers that I thought made contributions; probably others will feel the same.

The book is good and will serve as an excellent text or reference for first year graduate courses in cell physiology and membrane transport. Besides the slips already covered, there are few minor errors and typos.

What of the mathematical modeler and biomathematician, will this be useful to her/him? Definitely. For the modeler who wants to work in this field it provides detailed background on kinetic mechanisms and the standard set of models now used in the transport field. Don't expect the formal mathematical approach in which assumptions are listed formally, the model equations presented and properties of the solutions worked out; the presentation is more informal, but it does the job.

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Photosynthesis: Metabolism, Control and Physiology, D. W. Lawlor. Longman Scientific & Technical, Harlow, U.K. (copublished in U.S.A. by John Wiley, New York), 1987. U.S.$39.95 (paper), 262 pp.

This book provides a qualitative description of photosynthesis at the molecular, organelle, cell and organ levels of organization, intended for undergraduate and graduate study in plant biology courses, and for other non-specialists interested in photosynthesis. There are twelve chapters, followed by an index. After an introductory chapter, there are chapters on light and the light reactions. After describing the architecture of the photosynthetic apparatus, the author continues with the splitting of water, the electron transport chain, and photophosphorylation. Next, he deals with the biochemistry of photosynthesis, and the metabolism of photosynthetic products. C4 photosynthesis and crassulacean acid metabolism are the subjects of the ninth chapter, with the final three chapters covering the topics of CO_2 supply for photosynthesis, leaf photosynthesis, and photosynthesis in relation to plant production and yield. There is no appreciable mathematical content.

Lawlor's text is generally well-written, accurate, and there are many helpful diagrams and tables. However, I cannot recommend the book without reservation, even as a qualitative account of photosynthesis, since there are errors and obscurities, some of which could seriously mislead. For example, the author seems confused about the differences between flux and flux density; in one table some of the numbers are inconsistent; I was frustrated by missing references or references not supplied; two sentences that made me pause were: "Sunlight is the only form of energy which adds to the total energy supply of the earth . . . ", and "Assimilation rate is governed by the slowest, or rate-limiting step . . . ".

It has been said that we are now living in a scientific era where the convergence of the sciences and the integration of disciplines and theories are important if not dominant processes in many researches, from particle physics and cosmology to brain research and ecology. While the outcome of our investigations can never be predictable, it seems that the passage of time is