Book Review

Energy Transduction in Biological Membranes: A Textbook of Bioenergetics by William A. Cramer and David B. Knaff

Springer-Verlag, New York, 1991. 579 pages. Paperback. $39.00

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Energy Transduction in Biological Membranes is a volume in the series *Springer Advanced Texts in Chemistry* (ed. Charles R. Cantor), which is targeted at areas of chemistry that are underrepresented in traditional texts. *Energy Transduction in Biological Membranes* is an introduction to the field of bioenergetics and is designed for a one quarter graduate course in chemistry or biochemistry. A new text on bioenergetics is particularly timely, since this field has been revolutionized in the last few years by the application of molecular genetic techniques and by the availability of protein structures. This research area is quite eclectic and broad, since it encompasses research in the fields of respiration, photosynthesis, and membrane transport.

The basic question of bioenergetics is: How is biological energy coupling carried out at the molecular level? The fundamental principles underlying electron and proton transfer lie at the heart of these processes. The strength of modern bioenergetics is in the multidisciplinary approach that is being used to address this central question. However, this multidisciplinary approach can make the field seem opaque and a bit inaccessible to the beginning student. For example, many areas of bioenergetics rely on spectroscopy as their foundation. An understanding of spectroscopic subtleties is thus required to appreciate the literature in these areas. In addition, of course, the central underpinning of the entire field is thermodynamics, an area in which many new graduate students need a refresher. Also, the use of molecular genetics is now so widespread that a familiarity with these techniques and ideas is also of tremendous value.

This is an ambitious range of topics for any textbook to cover. *Energy Transduction in Biological Membranes* does a superb job of rising to the challenge. The first part of the book presents basic principles, including a review of thermodynamics, oxidation and reduction, and the chemiosmotic hypothesis. The chapters on thermodynamics have the advantage that biological examples are often given. It is characteristic of the up-to-date style of the text that Chapter 2 contains a description of electron transfer theory. The following chapters on cytochromes and iron sulfur proteins, on quinones, and on proton translocation emphasize the common themes in energy coupling in a variety of systems. For example, the section titled "The Q cycle and H^+ Translocation" describes (or speculates concerning) proton pumping mechanisms in bacteriorhodopsin, cytochrome oxidase, and bc complexes. A chapter on photosynthesis is an extremely clear and comprehensive treatment of the field. This section discusses resonance energy transfer and light-harvesting proteins, in addition to reaction centers from bacteria and plants. The remaining two chapters describe the current state of knowledge concerning ATP synthesis and active transport. Throughout the text, the authors integrate biophysical, biochemical, and molecular biological information in a seamless way, which demonstrates the interdisciplinary nature of modern research in bioenergetics.

One strong point of this book is that it contains a description of experimental instrumentation and techniques. For example, the chapter on the chemiosmotic hypothesis discusses experimental tests of the hypothesis and finishes with an appendix on ionophores. When oxidation-reduction is discussed, the experimental determination of redox potential is described. The section on metalloproteins has an appendix on EPR that can be used as a starting point for a discussion of this spectroscopic technique. The illustrations, which are abundant throughout the text, provide details on how actual measurements are made and show representative data from important experiments.

In summary, the Cramer and Knaff text introduces an exciting area of biological chemistry. The exposition is clear, and the emphasis on the use of problems as teaching aids is particularly apt, because the recent paperback edition of the book includes a detailed solution set. The extensive presentation of data makes this book a useful text for beginning graduate students, since it spans the gap between interpretation and practice. Because the reference lists are comprehensive and up to date, *Energy Transduction in Biological Membranes* is also an excellent reference work and provides a starting place from which graduate students can begin a study of the literature.