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Molecular and Cell Biophysics

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Calif., 1991. 387 pp. \$49.25 hc
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Biophysics is a most exciting, if somewhat ill-defined, subject. On the one hand, the field can be described in terms of important biological problems that have been attacked by physicists. The studies by Max Delbruck and his colleagues on genetic recombination in phages, first published nearly 50 years ago, provide an oft-cited and inspiring example. On the other hand, one can define biophysics in terms of topics in which, to quote Nossal and Lecar, "physical reasoning is needed to comprehend biological processes." This definition portends to guide the choice of material selected for their textbook and in principle, is quite reasonable. Unfortunately, it appears that the choice of topics was largely dictated by the authors' desire to decorate biology with equations. With a few notable exceptions, some of which are discussed below, I find little physical insight and insufficient clarity in the authors' presentation.

The initial part of the book concerns the structure and dynamics of macromolecules. Nossal and Lecar first review the nature of atomic interactions, with an emphasis on the weak forces that act between molecules in solution. This is followed by chapters on the structure of proteins and on the structure and dynamics of nucleic acids. The discussion on supercoiling in DNA marks their first provocative presentation. The authors clearly present the experimental evidence that indicates how a long chain of DNA twists, writhes and winds on itself to form a relatively compact structure. They then summarize statistical arguments for the

distribution of these topological features. Refreshingly, the authors pose a set of open questions within this topic, particularly with regard to the action of topoisomerases, a fascinating class of proteins that modify the extent of supercoiling in DNA.

The presentation on self-assembly provides a logical bridge that connects the study of individual molecules with that of the extended molecular assemblies that make up cells. It also allows the authors to discuss topics, such as how the shapes of cells depend on the intrinsic properties of their membranes, in which "physical reasoning" actually has led to comprehension of biological processes. Subsequent chapters discuss issues in membrane biophysics, such as the transport of ions across membranes and the basis for the generation of electrical impulses, or action potentials, in nerve cells. The discussion in all of these chapters is useful, although dated. I was bothered by the paucity of material on bioenergetics, particularly on electron-transfer reactions in photosynthetic systems. Furthermore, the discussion on nerve cells does not include any mention of ionic currents beyond those first described in 1952 by Alan Hodgkin and Andrew Huxley. This leaves the reader with little notion of the rich patterns of electrical activity that regularly occur in nerve cells and nervous systems.

The high point of the book is the chapter on mobility. There is an excellent description of chemotaxis in bacteria, primarily a summary of work by Howard Berg and Edward Purcell and by Daniel Koshland. The authors clearly delineate how the scales of length and concentration relevant to the search strategy of bacteria are determined. In general, the issues that the authors touch on relate directly to pattern formation within biological systems, an open and exciting area of biophysics.

It may be best to consider alternative texts as source books for biophysics. There are a number of "biochemistry" textbooks that provide a marvelous overview of biology, from molecules through simple organisms, with an emphasis on physical aspects of the subject. Two excellent examples are *Molecular Biology of the Cell*, by Bruce Albers, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts and James D. Watson (second edition, Garland, New York, 1989) and *Biochemistry* by J. David Rawn (Neil, Burlington, North Carolina, 1989). These books contain illuminating illustrations and, like the text by Nossal and Lecar, include references to

original papers. Although the descriptions in these biochemistry texts are qualitative, they impart a strong sense of intuition for the material they cover and will fill any reader with a sense of wonder.

At the specialized level, the three-part series *Biophysical Chemistry* by Charles R. Cantor and Paul R. Schimmel (Freeman, New York, 1980) is an excellent although slightly dated text on molecular biophysics. The biophysics of nerve cells is beautifully discussed by Bertil Hille in *Ionic Channels of Excitable Membranes* (second edition, Sinauer, Sunderland, Mass., 1991). I would select the text by Albers and coauthors for use in an undergraduate course on biophysics, and I would present more specialized and quantitative material through classroom lectures.

It may well be that the range of topics that falls under the rubric of biophysics is too diverse to be properly covered in a single text. Perhaps what is called for is an inspired set of lecture notes on selected topics in this area. Erwin Schrödinger's *What is Life? The Physical Aspects of the Living Cell* (Cambridge U. P., Cambridge, England, 1944) and Salvadore Luria's *36 Lectures in Biology* (MIT P., Cambridge, Mass., 1974) immediately jump to mind. Now, who will attempt this challenge?

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