

topics, such as lipid polymorphism, membrane elasticity, and liquid crystalline structure of the membranes, which have been reviewed and discussed in various contexts and by various authors through the years. These earlier works include: Derek Marsh and Gregor Cevc's *Phospholipid Bilayers: Physical Principles and Models* (Wiley, 1987) and Reinhard Lipowsky and Erich Sackmann's *Structure and Dynamics of Membranes/Vol 1, Parts A & B* (Elsevier, 1995). The table of contents of the present work is very much in line with those of the earlier books, except that Petrov has added some less-well known topics on which he has worked: molecular asymmetry of lyotropic mesogens and an incredibly detailed and exhaustive account of the theoretical and experimental underpinnings of flexoelectricity, a membrane analogy to piezoelectricity.

The theory of elasticity of layered structures probably represents the heart of our understanding of the amphiphilic—or more specifically lipid—polymorphism. Petrov introduces the reader to this subject in an extremely thorough and detailed way. The Helfrich–Canham–Evans hamiltonian serves as the point of departure that leads to nonlinear elasticity, elasticity of lipid mono- and bilayers, microscopic nature of the elastic moduli, computer modelling of membrane elasticity, and experimental determination of the relevant elastic moduli. The theory of membrane elasticity can also be straightforwardly applied to the problem of defects in the layered structure and, most notably, to the problem of the membrane pore formation. Apart from the fundamental membrane issues, pore formation is related to various important and relevant biological problems, to say nothing of the potential or presumed applications in gene therapy. I find the two chapters on membrane elasticity and pore formation to be the best in this book. The subject matter is thoroughly researched and readable, the list of references is exhaustive, and the development of concepts is logical and fluent.

Self-assembly of amphiphilic molecules, or lipids, represents without doubt one of the more carefully studied cases of lyotropic liquid crystals. Depending on the density (or, more appropriately, chemical potential) of the amphiphilic molecules in a solution, one can observe in them different types of ordered structures. These structures have been studied by various methods that the field of lyotropic

liquid crystals shares with the more well-known field of thermotropics. Many of these structures are believed to be adequate models for ordered structures observed in living organisms. Petrov constantly stresses this well-established relationship between lyotropic liquid crystals and membranes *in vivo*.

How the mesoscopic ordering of amphiphiles relates to their microscopic molecular properties is, however, still a more or less open question. It is related to a more general and fundamental problem of statistical mechanics: how the microscopic interaction potentials translate into appropriate phenomenological constants of the mesoscopic liquid crystalline physics. Petrov and others have proposed various quantitative measures of molecular asymmetry that relate to electric, steric, biphilic, and flexible molecular properties. Petrov also details this approach, although here his treatment adds to a clearer systematics of lyotropic polymorphism by circumventing the standard drawbacks of direct but very difficult statistical mechanics calculations.

The greatest disappointment of this book is that we do not get much else besides membrane physics, despite the promised lyotropic state of matter in the title. Where are the lyotropic polymers with their plethora of exotic phase diagrams and their own elasticity theory with its various consequences? Where are the lyotropic colloids, colloidal crystals, and the like? If the author really intended to give an overview of the lyotropic state of matter, these are all-too-serious omissions. If we are, on the other hand, dealing with a membrane physics in disguise, then the title of the book is most inappropriate and misleading. Lyotropic is not and should not become synonymous with membrane.

The style of the book is generally clear and fluent. What I nevertheless miss is some type of gradation of the material. Because of the book's broad and detailed sweeps over whole research topics, I believe a careful reader would appreciate a delineation of the relative importance of different topics. Also the style of the book sometimes becomes too much like that of a review article, in the sense that it inappropriately includes too many of the technical minutiae.

With the above caveats I find the book well written and informative. For the sheer number of topics discussed and the incredibly detailed presentation, *The Lyotropic State of Matter* will and should certainly find

its way to the shelves of researchers in the field of membrane physics.

RUDI PODGORNIK
National Institutes of Health
Bethesda, Maryland and
University of Ljubljana
Ljubljana, Slovenia

Biology in Physics: Is Life Matter?

▶ Konstantin Bogdanov
Academic Press, San Diego, Calif.,
2000. 237 pp. \$69.95 hc
ISBN 0-12-109840-0

Konstantin Bogdanov's *Biology in Physics: Is Life Matter?* is not about biology in physics, but rather about physics in biology (classical physics applied to organismic biology). It does not deal at all with the question "Is life matter?" except in the foreword, in which Vitaliy L. Ginsberg wonders whether there is a connection between basic biology and physics. This book certainly is not what the back cover claims: "a radical new book which bridges the gap between biology and physics." It is neither radical nor radically new: I dealt with such a book more than 40 years ago, while taking a course in medical physiology. Nor, as is claimed on the back cover, does it treat "all the important topics in modern biophysics." Nothing is said about DNA and RNA, and relatively little is said about proteins.

The book does have its charm and uses. It gives a relatively simple, nonsense introduction to topics of interest in general biology to which introductory physics can be applied. Topics include properties of nerve and bone, of the vascular system, kidneys and lungs, and of eyes and ears (including those of insects). Topics not treated in my physiology text but treated here include manipulation of cells with electric fields and navigation by electric or magnetic fields. For most topics, the early history is mentioned, and reference is made to recent work. So if these subjects are new to you, here is a palatable introduction.

But, like my old course in physiology, essentially nothing is deduced from first principles. Equations are pulled out of the air and said to be well known or readily derived. So you will not learn much physics from this book, either. However, it might be useful in a course on widely applied physics, as an introduction to topics about which students could think more deeply on their own.

HOWARD C. BERG
Harvard University
Cambridge, Massachusetts