A theoretical treatise

Thermodynamics and Control of Biological Free-energy Transduction

by Hans V. Westerhoff and Karel van Dam, *Elsevier, 1987. Dfl 450.00/ £150.00 (xxxi + 568 pages) ISBN 0 444 80783 7*

William James wrote: 'When a thing was new, people said "It is not true". Later, when the truth became obvious, people said, "Anyway, it is not important", and when its importance could not be denied, people said, "Anyway it is not new".' In some ways, I fear that this important book may be in danger of suffering such a fate, since in 568 pages it contains no less than 1412 equations. This strike rate of almost 2.5 equations per page may have the effect of putting off many of the readers who would most benefit from a perusal of this work, such that its importance, though significant, may remain unrecognized for longer than it should. Who then are such readers, and what is the purpose of the book?

The major stated purpose of the book is to convey to advanced undergraduates and postgraduates the physicochemical basis of biochemistry, with particular reference to the areas of metabolic control and bioenergetics and with an emphasis on the 'mosaic non-equilibrium thermodynamics' (MNET) developed by the authors. The book is thus mainly a theoretical treatise, aiming to give the underlying formalisms of the subject within which the interpretation of experimental studies must perforce take place. Not least because of the general importance of an understanding of the foundations of the subject, however, and of the fact that it consists to an extent of approximately 40% of new, unpublished material, I would suggest that it is certainly suitable for research workers in virtually any area of biochemistry.

The lengthy opening chapter, which occupies more than 200 pages, covers equilibrium statistical mechanics and thermodynamics, 'classical' or phenomenological (Onsager-type) non-equilibrium thermodynamics, chemical and biochemical kinetics, stability analysis as the basis for metabolic control, and the theory of metabolic control as developed in particular by Kacser, Burns, Heinrich, Rapoport (KBHR) and others, finally outlining a few aspects of cell biology which will be necessary for the understanding of later chapters. This chapter, which is of a more pedagogic or classical character, thus forms the basis for the more detailed descriptions, and in many cases the novel material, which follow.

The second chapter describes the MNET formalism, and how it permits one to relate the thermodynamic and kinetic properties of individual reactions to each other, so as to describe how the fluxes through biological systems should (and do) depend on the thermodynamic forces across them. This leads naturally in the next chapter to a survey of some actual examples of the usefulness of the MNET formalism, concentrating on three examples from bioenergetics, namely ion movement in bacteriorhodopsin liposomes, oxidative phosphorylation, and microbial growth. In the latter case in particular, we learn that biological systems do not necessarily evolve to achieve maximum thermodynamic efficiency; most microorganisms indeed appear (perhaps because of their 'feast and famine' existence in nature) to have evolved to exhibit maximum growth *rate*, a state necessarily accompanied by a less-than-perfect (and in some cases negative!) thermodynamic efficiency. Such studies highlight the importance of having a good formal, physicochemically based scientific understanding if one wishes, for example, to exploit microorganisms for technological purposes.

Finally, the authors consider, given the relationships between thermodynamics and kinetics expounded earlier, how these relate to the *control* of metabolism, within the broad framework of the KBHR theory, and extend this theory to include the control of thermodynamic properties and compartmented systems.

Overall, this is a fundamental, important and solid overview of the physicochemical basis of biochemistry. To this end it deserves a place in every library. It is not a particularly easy read, but then neither is the subject. Nonetheless, as John Maynard Smith wrote: 'It seems to me that there is no single idea in biology which is hard to understand, in the way that ideas in physics can be hard. If biology is difficult, it is because of the bewildering number and variety of things that one must hold in one's head.' This book goes a long way to collating the basis of these ideas in a single place, and I thus recommend it warmly. Given the well-known distinction between physics and philately, it will amply repay the time spent studying its contents.

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A specialist book on *N*-substituted porphyrins

The Chemistry and Biochemistry of *N*-Substituted Porphyrins

by David K. Lavallee, *VCH Publishers, 1987. £32.75 (x + 313 pages) ISBN 0 89573 147 9*

This specialized book reviews the biochemical, chemical, and pharmacological literature concerning porphyrins substituted at a pyrroleninic nitrogen atom. The first report of *N*-substituted porphyrin was a brief mention in a paper by McEwen in 1936. Early studies focused on whether the *N*-methylporphyrin could be used as a better endopoint indicator for acid–base titration. The discovery of *N*-alkylporphyrins in biological systems and the elucidation of the mechanism of their production by hepatic cytochrome P-450 have been carried out during the last decade. Clinical symptoms caused in animals by certain drugs, closely resemble those of the porphyric diseases of man. The drug-inducing porphyric symptom caused a marked inhibition of ferrochelatase which catalyses the insertion of ferrous ion into protoporphyrin IX to form haeme. This inhibition was not due to drug itself but to a green pigment formation in the liver of drug-treated animals. By comparison of the absorption spectra of the anomalous green pigment with those of synthetic *N*-substituted porphyrin, the pigment was shown to be *N*-substituted protoporphyrin originating from the prosthetic haeme group of hepatic cytochrome P-450. *N*-substituted porphyrins are produced in the reactions of a number of xenobiotics with cytochrome P-450 in the liver microsomes. Compounds which produce *N*-substituted porphyrin include prescription drugs, anaesthetics and even such simple compounds as