Biochemical and biophysical aspects of photosynthesis

Bioenergetics of Photosynthesis. (Cell Biology: A Series of Monographs.) Edited by Govindjee. Pp. xiv+698. (Academic: New York and London, April 1975.) £20.65.

OFTEN books born of long gestation periods are disappointing when they finally arrive. That is definitely not the case with this well edited volume, which should have a very useful life in the library and on the desk.

The book comprises 12 chapters by selected authors who cover the general biochemical and biophysical aspects of photosynthesis in plant and (to a lesser extent) bacterial systems. The way in which this is related to bioenergetic conversion is dealt with from several points of view: membrane structure related to pigments and energy conversion; chloroplast structure; the primary events of photosynthesis including luminescence and fluorescence; oxygen evolution; electron transport; phosphorylation; and ion movements. Each chapter has been externally reviewed and the editor has inserted useful cross references. This, combined with the extensive references, the list of abbreviations and the tables, ensure that each chapter, though complete in itself, is also relevant to other chapters.

The subject index and author index are excellent—necessarily so in a book which claims to "serve as a reference source for researchers but also as an introductory work for graduate students"—and, consequently, the book is more useful than volumes of proceedings and monographs which lack such indexes. It is a pity that more publishers do not insist on the inclusion of extensive indexes even though the resulting books may be more expensive than otherwise—in the long run readers would find the extra expense well worthwhile.

Since the practical use of photosynthesis based on both the improvement of its natural efficiency and the construction of artificial systems are so in vogue now (for food and/or energy) it is a pity that a chapter on this important topic was not included.

An understanding of the biochemical and biophysical mechanisms of photosynthesis seems crucial to its future exploitation and this is where this book will provide the source of background information for present and future investigations—whether scientific, administrative or commercial. **D. O. Hall**

Magnetic oxides

Magnetic Oxides. Edited by D. J. Craik. Part 1: Pp. xxi+482. Part 2: Pp. xix+483–798. (Wiley: London and New York, 1975.) £15.00 each.

THESE two volumes cover various aspects of the theory, properties and uses of magnetic oxides. The 13 chapters are written by 20 authors and cover an extremely wide range, from the practical arts of crystal growing to the theoretical intricacies of crystal fields and exchange. The versatility of magnetic oxides as recording media is also well covered in chapters ranging from the recently utilised bubble domains to the recording over geological times of past terrestrial magnetic fields in the oxides which occur naturally in rocks. There are also chapters on such topics as anisotropy, magnetostriction, optical properties, electrical properties, domains and microwave resonance. Experimental techniques such as neutron diffraction and nuclear magnetic resonance are, of necessity, mentioned here and there but are not discussed fully.

The question of units in a multiple author book on magnetism is bound to present an initial problem, at least, and it has been solved in this case using e.m.u. throughout, in line with most of the literature. It is, perhaps, not surprising in view of the wide field that the treatment of many of the topics is not detailed enough to be followed by the reader without frequent recourse to references, and in that respect the book tends to be a rather thorough review of the current state of knowledge. That is, however, the major strength of the work and each chapter is well provided with a comprehensive list of references, there being something like 1,700 in the whole book.

Although the individual chapters are to a large extent independent of each other, the work as a whole is well integrated by frequent cross-referencing where interaction of subject matter does occur. The book is perhaps most likely to appeal to the specialist who wishes to extend his knowledge of other aspects of magnetic oxides, and for that purpose it is of considerable value in view of its logical presentation and comprehensive referencing. **A. Stephenson**

Kets, bras and boson variables

Spinors in Hilbert Space. By P. A. M. Dirac. Pp. vi+91. (Plenum: New York and London, 1974.) $14.50.

ON reading this volume, I had at once an impression of *déjà vu*, hearing again the logical, elegant and irresistible exposition so well known to us from Professor Dirac's classic work *The Principles of Quantum Mechanics*. This book differs from the latter, however, in being primarily mathematical in character. Its relevance to the physics of the real world is mentioned in only a few of its 35 sections. The book is based on a series of lectures which the author gave at the University of Miami in 1969. Although self-contained, it is not really intended for the beginner; for example, familiarity with the notion of a spinor and its properties and uses is very much taken for granted, although it is true that four lines in Section 2 do give a complete characterisation for a spinor quantity.

Dirac begins by developing the theory of vectors and operators in a real Hilbert space with $2N$ dimensions, in which there exists the concept of perpendicularity (as opposed to orthogonality, which concept also exists). He then introduces the operation of rotation and distinguishes spinors from tensors by the reversal of sign experienced by the former for a complete rotation. In this space, the vectors, termed kets, and their duals, termed bras, are the most elementary spinors, and Dirac confines his attention to them, since more complicated spinors can be constructed from them by multiplications, as done by van der Waerden in his lectures on spinors some decades ago. Their possible application to physical problems is not discussed in detail here, although Dirac does comment briefly about this at several points in the lectures, identifying, for example, the operators for the creation and destruction of fermions.

Dirac then approaches the case of special interest for him, the case of a Hilbert space with an infinite number of dimensions, by taking the limit $N \to \infty$. For this, the operators of interest are those whose matrix is bounded, so that the operations of multiplication and division are defined for them. This limit leads Dirac to a new class of operators, which do not commute with each other nor obey the associative law of multiplication. He terms these as 'boson variables' and they come in two types, identified by Dirac as creation and destruction operators. In the closing section, Dirac emphasises that these boson variables appear automatically in infinite-dimensional theories which start with only fermion variables, provided that the latter are infinite in number. Dirac observes, "There must be such boson operators connected with electrons. Their physical presence is a subject for further investigation. They have a negative energy . . ."

This book is very much for the specialist, and one may expect it to have much value and influence in suggesting new extensions from the physical theories which we now know. We must note, however, that this little book costs 15 cents per page, which, even given the circumstances, does seem unnecessarily high.

R. H. Dalitz