

lymphocyte markers as a probe in disease (Strickland and others), immunosuppression (Yu and others) and antilymphocytic antibodies (Messner; Kunkel and others). To biochemists, these topics perhaps represent fields to keep an eye on for future considera-

tion rather than immediate inclusion in the mainstream of the discipline.

D. S. O'Dell

### *Protein-Metal Interactions*

Edited by Mendel Friedman  
Plenum Press Inc.; New York and London, 1974  
x + 692 pages. £24.89, \$ 47.40

Over the past decade studies on the rôle of metal ions in biological systems have benefitted from the increasing application of sophisticated physico-chemical techniques to biological problems. Protein-metal interactions have been a particular beneficiary of this development and, in consequence, new information has accumulated at a rapid rate. It is, therefore, inevitable that several treatises devoted to this topic have appeared recently, including *Inorganic Biochemistry* (edited by G. Eichhorn), and *Volume 5 of The Proteins*, which is devoted entirely to a discussion of metalloproteins. The book reviewed here contains the proceedings of a symposium organised by Dr Friedman for the Division of Agricultural and Food Chemistry of the American Chemical Society and held in Chicago in August, 1973. It consists of 22 articles derived from the symposium presentations, together with an additional five invited contributions. In general, the articles are longer and more detailed than would be expected for reports of symposium proceedings, but no record was apparently kept of discussions involving the participants and/or the audience. The published proceedings, therefore, read more like a multi-author volume of specialised reviews on aspects of protein-metal interactions and lack the insights which can be gained by incisive and directed discussion between workers having a wide spectrum of interests centered around the general topic of the symposium. Thus, while the symposium itself may have fulfilled Dr Friedman's objective of generation of new ideas

and approaches by such cross-fertilisation, no trace of this aspect remains in the resulting publication.

It is difficult to detect any overriding theme within the area of protein-metal interactions which links the constituent articles in this book, although one does note that 12 of the contributions emanate in toto or in part from the laboratories of the US Agricultural Research Service, and that three of these are co-authored by Dr Friedman himself. However, in a very general way one can discern three topic groups. Ten of the articles describe studies on the interaction of purified proteins with ligands, using more or less sophisticated physicochemical techniques. These contributions include an article or articles on the rôle of metals in metallo-enzymes (Vallee) which appears to be an obligatory feature of such symposia; on the interaction of ligands with metalloproteins, e.g.  $^{13}\text{CO}_2$  with haemoglobin and carbonic anhydrase (Gurd), anions with transferrin (Aisen) and esters with carboxypeptidase A (Kaiser); and on the interaction of metals with proteins, e.g.  $\text{Ca}^{2+}$  with elastin (Rucker), with carp muscle binding proteins (Bradshaw) or with antibody-antigen complexes (Maurer), and transition metal ions with lactoferrin (Brown). Allied with this group are the three articles which consider applications of new techniques to studies on protein-metal interactions, including X-ray photoelectron and energy dispersive fluorescence spectroscopy.

A second group of three articles, which are the most interesting to this reviewer, consider the biological rôle of some metallo-enzymes, including the oxidases and reductases involved in iron metabolism (Frieden) and the oxidases implicated in cross-linking of collagen (O'Dell). Also in this group is an article by Frieden on the evolution of metal ions as essential elements, which contains some very interesting ideas, especially in regard to the relationship between copper and iron. Since these topics are seldom treated in any detail in discussions of metallo-enzymes or metalloproteins, their inclusion is a welcome feature of this volume.

The third group may generally be described as biological and clinical studies on protein-metal interactions, and the physiological role of some essential metal ions. In this group one finds articles on metal binding components in serum (Henkin) and intestine (Evans), on the biological consequences of zinc and nickel deficiency (Sanstead et al.) and on the basis of toxicity to lead and mercury. These articles are representative of the classical approach to metallo-biology and owe nothing to the impact of physical techniques on this field.

I suspect that the very breath of the approach taken in this volume will ensure that it appeals to a very limited audience. Many workers in the field may wish to refer to one or two of the articles, but it is hard to imagine that any one individual will find sufficient pertinent material to justify inclusion in their library.

M. C. Scrutton

*Chemical Microbiology: An introduction to microbial physiology (3rd edition)*

by A. H. Rose

Butterworths; London Boston, Sydney, Wellington, Durban, Toronto, 1976

x + 469 pages. £7.75

'Chemical Microbiology' appears in a third edition after eight years and has increased in size by about half, in price by more than three-fold, and changed in form by becoming paper-backed and typewriter-set. However, the basic content is the same but updated and with only minor changes to the ten chapter headings.

The book presupposes some knowledge of microbiology and biochemistry and begins with a chapter on 'Molecular Architecture' which includes brief mention of methods of preparation as well as anatomy and chemistry. Walls, membranes and organelles such as cilia, flagella, mitochondria, photosynthetic apparatus, genomes and ribosomes are included and reference is made to algae and fungi as well as to bacteria. Over fifty classified references are given and they include titles which is helpful.

'The Environment' embraces chemical and physical factors and the responses to them – growth, inhibition, movement – and leads to a short chapter on transport. Then follow sixty pages on 'Energy-yielding Metabolism' and eighty on 'Energy Expenditure: Biosyntheses'. The former covers the standard pathways of catabolism including various fermentations, and electron

transport and phosphorylation in both heterotrophs and lithotrophs. In the chapter on biosynthesis, assimilation of one- and two-carbon compounds and inorganic nitrogen leads to a consideration of amino acid and nucleotide synthesis and then their polymerisation to proteins and nucleic acids. Peptidoglycans, teichoic acids, and lipopolysaccharides are also dealt with in sections on carbohydrates and lipids. However, there are only six references at the end of this chapter to protein and nucleic acid synthesis – one each from 1969 and 1973 and two each from 1971 and 1972.

'Regulation of Metabolism' begins with the genetic code, mutation, and transfer of genetic material, and goes on to inhibition and repression of enzymes. The treatment of genetics in a textbook which now has the additional sub-title 'An Introduction to Microbial Physiology' is cursory to say the least and the only three references to the genetic code are to the out-of-date 1970 edition of Watson and to a book and a paper by Woese (1967 and 1970).

The penultimate chapter, entitled 'Growth and Survival' deals with replication of organelles, individuals and populations, while the last is called 'Differen-