diagrams to clarify the discussion of relationships. The narrative is usefully interrupted with summaries and conclusions of a theme or with suggestions for and indications of the direction of future research. The author's own research has been with unicellular and multicellular organisms and with the retrieval of the latter from ocean depths. This experience has given him an intuition for the problems of life in the oceans.

The chapter on deep-sea nutrition is perhaps singularly significant. The variety of food available to deep-sea animals is characterized and the problem of a limited food supply is defined. One result of adaptations for existing with little food is thought to be a low rate of oxygen consumption. Researchers thus often have difficulty knowing whether to attribute a given adaptation to a limited food supply or to an increased hydrostatic pressure or to both. This chapter lucidly shows, moreover, that there are additional difficulties that hinder the posing and answering of physiological questions. For example, the determination of the standing stock of marine microbes remains refractory. Thus we can only inadequately estimate the value of these organisms as a food source and only awkwardly use them in studies of microbial physiology.

The author notes the meagerness of the research effort on the physiology of deep-sea organisms. The research this book itself will stimulate should augment our knowledge considerably. Students in the field as well as those already doing research in it will profit from reading the book. It is sufficiently well written to be read in two or three sittings, yet the detail in which the problems of deep-sea life are presented is conducive to lingering for hours on a page.

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Neurobiology

'Simple' Nervous Systems. An International Symposium. Glasgow and Edinburgh, Apr. 1973. P. N. R. USHERWOOD and D. R. NEWTH, Eds. Arnold, London, and Crane, Russak, New York, 1975. xviii, 490 pp., illus. $35.

I have mixed feelings about this symposium volume. In some respects it is unusually good: the editors and authors have made an obvious effort to review their subject matter thoroughly and to eschew own-laboratory chauvinism; the topic is, to the biased eye of this reviewer, a significant one; and some novel approaches to it are included in the form of papers on developing systems and the seldom-reviewed lower invertebrate groups. Yet the book exhibits both major defects of symposium proceedings: there is little relationship among the contributions, and the authors have been handicapped by the way in which topics have been divided. Moreover, it is an abominable job of book production. The bibliographies following the individual articles are inconsistent, and several use the annoying no-titles format; there is no index; and the half-tones (especially the electron micrographs) are muddy.

There is much to praise about certain of the papers. Anne E. Warner presents an excellent account of the origin of electrical differentiation in the nervous system, and A. Roberts then supplies a scholarly and thorough treatment of the development of electrical responses and synaptic connections in amphibian embryos. The review of coelenterate neurobiology by Elaine A. Robson moves from an intriguing historical view to a very complete summary of contemporary work. P. J. Mill and D. A. Dorsett do very well with annelids and mollusks, respectively. These papers all have the advantage of a fresh approach; all were written by English workers from whom less has been heard than from their American counterparts.

The treatment of arthropods is much less successful. Here the level of research activity is high enough to have forced a topical division into small taxa, and the result is a trio of papers that confine themselves either to Crustacea or to insects. Even though all three of the authors have worthwhile things to say, their ability to focus on process is severely compromised. W. J. P. Barnes, writing on crustacean locomotion, cannot make as much use as he should of the excellent work on bilateral interaction and intersegmental coordination in insect walking. F. Huber, who is responsible for the chapter on cyclically recurring behavior in insects, carries self-denial much further: he refers to no work on Crustacea at all, though he makes extensive use of concepts (such as command interneurons) that were developed in studies of crustaceans. The result is an artificial separation that handicaps both papers. M. Burrows's excellent account of motoneurons in insects suffers less, because his own work provides such a complete view of the subject.

The opportunity to deal with subject matter defined functionally rather than taxonomically was not well used by two of the authors who had it. D. M. Guthrie, who covers the fascinating subject of regeneration and neural specificity in invertebrates, has produced a long and occasionally interesting paper that unfortunately misinterprets work on axonal degeneration and its sequelae, fails to discuss the important effect of axotomy on electrical excitability, and overstates the present evidence for specificity of regenerated connections in arthropod ganglia. E. Florey, discussing chemical neuromuscular transmission in arthropods, begins with an account of tension control by inhibitory junctional potentials that offers no really new insights; this is followed by a typically provocative hypothesis about cotransmitters.

At the end, the volume includes two papers about unambiguously complex systems. That by M. J. Wells on the evolution of learning in mollusks is thoughtful and interesting, though it did not persuade me that we have yet learned much from all the work on octopus brains. That by D. Michie and colleagues is about a machine named Freddy that can classify shapes in a way that seems octopuslike to its owners. The less said about Freddy the better.

Should there be a moratorium on symposia on this subject? Some of us, overexposers and overexposed alike, have thought there should be: One more leech ganglion, one more crayfish junction, one more *Tritonia* brain, or one more locust leap seems almost too much. The present volume, at least, has avoided the fate of staleness by including new material and new investigators worth hearing.

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Interactions of Polypeptides

Subunit Enzymes. Biochemistry and Functions. KURT E. EBNER, Ed. Dekker, New York, 1975. xii, 332 pp., illus. $24.50. Enzymology, vol. 2.

This book is a group of independent essays with no cross-referencing or explicit interrelationships. Unlike most such collections, however, this one justifies itself by the implicit relationships between the subjects treated. In contrast to most compendiums of this type, it can actually be read with profit as a book. The topics are well selected to illustrate diverse aspects of interactions between proteins or among protein subunits, and anyone interested in this field will find it valuable.

The first chapter, by Levitzki, deals with subunit interactions in terms of the formal "concerted" or Monod-Wyman-Changeux model and the "sequential" or Koshland-Némethy-Filmer model. The material has been discussed in much this way several times before, and it is not obvious why this chapter, which presents no new insights or approaches, is included. The last chapter, by Dempsey, is a well-done description of squalene and sterol carrier proteins. These are very interesting systems but, in view of the present level of information about their functions, inclusion of the chapter may have been premature. There also seems to be no evidence for subunit interaction, although the complex must interact functionally with a number of enzymes of lipid metabolism.

The other five chapters make up the core of the book. Ginsburg and Stadtman provide a characteristically lucid account of highly complex results obtained with the fascinating glutamine synthetase system from *Escherichia coli*. Interactions between proteins and among subunits at several levels are illustrated. Gabriel, Kalckar, and Darrow discuss uridine diphosphogalactose-4-epimerase from various organisms. The lactose synthetase system, described by Ebner and Magee, may not illustrate subunit interaction in the strict sense; α-lactalbumin and the galactosyltransferase may better be considered two proteins. Nevertheless, the interaction between them, with a consequent change in acceptor specificity, is interesting and important in terms both of enzymic function and of comparative molecular evolution. Unfortunately this chapter is carelessly written, with much unnecessary repetition, and the syntax sometimes renders the meaning ambiguous or obscure. The extensive polymerization of acetyl coenzyme A carboxylases, with concomitant effects on function, is clearly and interestingly discussed by Lane, Polakis, and Moss. Finally, Crawford's chapter on tryptophan synthetases is a superior review of the catalytic interactions and the immunological, genetic, and evolutionary aspects of a highly interesting system.

This book can be recommended especially to students as a means of obtaining a general background, through consideration of well-chosen specific systems, on the kinds of interactions between polypeptides that underlie much of the versatility of protein function.

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