coverage of each compound, although brief, is good, but I noted important gaps. For example, the enzymatic methylation of thioinosinate and the antiviral activity of 9-β-D-arabinofuranosyladenine are not mentioned. The discussion of such subjects as selective toxicity is not very penetrating, and certain statements are actually misleading. For example, the author states that the de novo purine biosynthetic pathway appears to be operative in all organisms so far studied. It is, in fact, known that parasites in general do not have this biosynthetic capacity.

This book may be of use as an introductory text for graduate students, but it cannot compare favorably with the recent book by M. Earl Balis entitled *Antagonists and Nucleic Acid*, which covers the same subject matter more thoroughly and with more insight.

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Aquatic Pathology

Principal Diseases of Marine Fish and Shellfish. CARL J. SINDERMANN. Academic Press, New York, 1970. xii, 372 pp., illus. $17.50.

This book serves a dual purpose: as the first attempt to summarize in one volume the pertinent information on diseases of marine fish, mollusks, and crustaceans, it is a useful reference for the specialist in each of these fields; equally important, it should be read by everyone involved with marine fish and shellfish management as an introduction to the role of disease in wild and cultivated stocks. The fact that it is not exhaustively detailed may subject it to some criticism by the specialist, but the lack of detail is the very reason it will hold the attention of other readers. As the author points out in the introduction of the chapter on diseases of marine fishes, his approach is to present examples of significant diseases, concentrating on those that have received adequate attention and including a wide spectrum of pathogens and parasites. The coverage is adequate for both fish and shellfish.

Sindermann recognizes, in contrast to many authors, that such a selection process results in the omission or inadequate consideration of much literature. Further, there is a natural tendency to choose examples with which the author is best acquainted, frequently from his own or his colleagues' research. The reader, if he has published in the field, is inclined to fault the author for neglecting his (the reader's) contributions. A number of such omissions stung the reviewer as he read this volume, as they probably will other researchers. If one refrains from nitpicking and objectively considers the overall contribution, however, it is clear that the author has succeeded enviably in digesting a voluminous literature into a concise and readable summary. This is no surprise, for Sindermann has previously demonstrated an aptitude for the preparation of outstanding review papers.

The chapters on internal defense mechanisms in marine animals, the relation of human diseases to diseases of marine animals, the role of disease in marine populations, and future studies of diseases in the marine environment are particularly timely and are subjects usually ignored in books on fish disease. In these chapters Sindermann brings out important facets of the role of disease in fishery population dynamics that are not usually considered by those engaged in fishery management. The chapter on internal defense mechanisms is, again, a departure from previous texts, particularly with the inclusion of germane material not specifically related to infectious disease. Finally, attention is focused on the importance of disease studies, both diagnosis and treatment, to accompany the development of more intensive marine aquaculture.

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Organelles and Energy

Membranes of Mitochondria and Chloroplasts. EFRAIM RACKER, Ed. Van Nostrand Reinhold, New York, 1970. xiv, 322 pp., illus. $17.50. American Chemical Society Monograph No. 165.

One of the most interesting aspects of research on biological membranes involves the relationship between membrane structure and energy-trapping mechanisms of the cell. The field is particularly exciting at present because a number of alternative hypotheses of membrane structure and function are available for testing. For instance, two general models have been proposed for the organization of lipids and proteins in membranes. One suggests that most of the lipid is present as a bilayer in the center of the membranes. Protein would be attached to the membrane surface, with little interaction between protein molecules and lipid hydrocarbon chains. The other proposes that there is in fact considerable interaction between lipid chains and protein. Some of the protein would therefore be integrated into the interior structure of the membrane. A variation of the latter places most of the protein in the membrane interior in the form of functional lipoprotein subunits.

A number of alternative hypotheses are also available to account for various membrane functions, particularly transport phenomena and energy-trapping mechanisms. The central question of energy trapping concerns the manner in which synthesis of high energy chemical bonds is coupled to electron transfer events in the inner membranes of mitochondria and chloroplasts. In past years it has been thought that coupling must occur entirely through a chemical mechanism. A recent alternative, the chemiosmotic hypothesis, proposes that the initial event is the formation of an electrochemical proton gradient across the coupling membrane whose energy is utilized to drive an equilibrium toward adenosine triphosphate synthesis.

A third area of interest is the question of enzyme localization within membranes. With modern techniques of cell fractionation it is possible to ask whether specific enzymes of mitochondria are in the inner or outer membranes. Since different laboratories report different sites of localization, this has been a subject of considerable controversy. We may also ask how organelles are synthesized within cells. Are mitochondrial components under nuclear control, or do mitochondria have their own genetic information?

Membranes of Mitochondria and Chloroplasts is a collection of seven review chapters by investigators who have made significant contributions to this field. The authors address themselves directly to the questions outlined above. They attempt to evaluate the various conflicting hypotheses and to offer their own conclusions. For instance, a chapter by Efraim Racker provides a clear discussion of the limitations of the chemical and chemiosmotic coupling hypotheses, and concludes that

a compromise hypothesis might be useful. This is duly presented, with the warning that "it will undoubtedly be vigorously rejected by both opposing parties."

Although the title of this book implies that mitochondria and chloroplasts will be equally represented, chloroplasts are considered only briefly in a single chapter. Also, much of the work is unavoidably at least two years old and the material of several chapters has since appeared elsewhere in revised form.

All in all, the book will be a useful reference for several years. It bears the clear stamp of a unifying editorial effort. The chapters are organized along similar lines of presentation, and the electron micrographs and illustrations are for the most part quite clear. The present utility of the book is suggested by the fact that this reviewer had to retrieve his copy several times from graduate students and colleagues who found it to be a highly readable current review of the field.

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Terpenoid Biochemistry

Natural Substances Formed Biologically from Mevalonic Acid. Biochemical Society Symposium No. 29, Liverpool, April 1969. T. W. GOODWIN, Ed. Academic Press, New York, 1970. viii, 186 pp., illus. $8.

This symposium brought to Liverpool a small group of major contributors to areas of the terpenoid field which have seen important recent progress. The meeting was therefore timely, and the resulting volume, though selective, encompasses some of the most significant current topics in terpenoid biochemistry.

Several contributions illustrate the extensive recent use of stereospecifically labeled mevalonic acids in studies of isoprenoid biosynthesis, and, appropriately, the Cornforths review their original work on labeling methods which provided the impetus for this approach. Unfortunately, its application, together with nuclear magnetic resonance spectroscopy, mass spectrometry, and expert enzymology, to the enigmatic C_{30} precursor of squalene, as recounted by Popják, has so far failed to give an unequivocal answer to this challenging structural problem.

The stereospecific labeling approach is exemplified in Hemming's account of the polyprenols and in Goad's survey of advances in sterol biosynthesis. The latter author performs sterling service in summarizing a literature which is confusing, not so much for its biochemical complexities as because of the considerable overlap of recent efforts by different workers, all riding the stereochemical wave.

The enzymology of the separate processes of squalene oxidation and cyclization to lanosterol is discussed by Yamamoto and Bloch. Their efforts and those of others notwithstanding, the mechanisms of these transformations of squalene remain elusive. So also does the precise mechanism of participation of terpenoid quinones in oxidative phosphorylation, despite the accumulation of an impressive body of detailed knowledge presented by Brodie and co-workers. The distribution and comparative utilization of quinones (Wiss and Gloor) and their biosynthesis (Rudney) are also authoritatively surveyed. The book is therefore a valuable comprehensive source of recent information on these compounds.

Karlson reviews the biochemistry of the ecdysones, juvenile hormones, and the terpenoid pheromones and defensive substances of insects and touches upon the intriguing discovery, by Schildknecht and collaborators, of defensive steroids of the mammalian hormone type in water beetles. Since comparative biochemical knowledge in this area is sparse, Karlson's view that these insects have "invented" the route to these compounds quite independently of mammals seems less obvious than he asserts. Indeed, an additional contribution to this symposium might profitably have come from a steroid phytochemist, who would have shown that such steroids participate in many biogenetic sequences in plants.

The final paper, by Battersby, deals with his biogenetic studies of indole alkaloids, in which the pivotal intermediary role of loganin has recently been established and exploited. This elegant blend of organic chemical and biochemical intuition and expertise is in the best traditions of the field and well illustrates its interdisciplinary character as expressed in Morton's opening remarks.

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Optical Systems

Geometrical Optics. HANS-GEORG ZIMMER. Translated from the German edition by Raymond Wilson. Springer-Verlag, New York, 1970. viii, 172 pp., illus. $9.40. Applied Physics and Engineering, vol. 9.

The author begins with a theory of geometrical optics based upon a law for the conservation of energy passing through the optical system rather than upon the law of refraction. Since both are consequences of minimal principles, the resulting conclusions are of course the same. The interesting point is that the development in this book bridges a gap that is perhaps even unanticipated by the author. In the design of energy-collecting and image-detecting instruments, principally in the infrared region, the "throughput" has come to be used to characterize the overall light-collecting efficiency of a lens system. This "throughput" turns out to be a general form of the Lagrange invariant familiar to all optical designers. This is identical to the "linear conductivity" used by the author in this book as the basis for his development of geometrical optics. All the usual paraxial laws are easily derived, and the author includes a useful observation on the comparison of his linear conductivity with the wavelength to describe the extent to which a system can be described on a geometrical rather than physical basis.

The author provides some examples of magnitude of the linear conductivity of energy and applies his approach to some common systems. He also shows how his approach is a generalization of the y-$\bar{y}$ approach to system analysis proposed by Delano. This closes part 1 of the book, which is quite useful and instructive.

Part 2, on aberrations, begins well with a discussion of optical materials and chromatic errors, but is burdened with an awkward, unconventional notation that becomes increasingly difficult to follow. The various chapters on aberration are laced with descriptions of actual problems in design that are quite worth reading, but the formulas developed are cumbersome to work with.

In total, this book is a useful contribution to the literature. Part 1 is suggested for general interest, part 2 for the specialist. The book is not a manual for design, nor did the author intend it to be so.

It is unfortunate that the translator did not take the opportunity to insert a preface relating some of the concepts and notation to forms familar to Eng-