

local legends. "This living reef," 19 pages, is an essay by the author, his considerably dramatized conception of the background natural history, geological and biological, and a brief descriptive presentation of the topography as dealt with in the following section. "Illustrations" is the collection of plates, arranged very effectively in four sections: the outer reefs; the passes; the lagoons; the coves and marine lakes. The first three start with general views of the areas, then proceed to portraits of organisms.

A substantial part of the contribution to biologists is the section "Commentary," p. 153-179, presenting the 107 captions for the plates. An imposing list of professional biologists is cited as assisting in the identifications. About 140 organisms are designated, roughly 125 of them by full scientific names: 75 invertebrates, 30-odd fish, and a dozen plants. The author coined some of his own common names, more or less aptly descriptive.

A handsome 2-page map of Belau concludes the volume. With reference to it the author states "The reader will not find Belauan names on any other maps . . . the people of Belau did not have a part of making them."

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HICKLING, C. F., AND P. LANCASTER BROWN. 1974. **The sea and oceans in color.** Macmillan Co., New York. x + 249 p. \$5.95.

This book gets off to a bad start but eventually gets over many of its problems. The first two problems are probably really out of the authors' hands. Somehow, the title hints of lavish color photographs of or about the oceans. While this image is partly true, most of the "in color" proves to be maps, diagrams, and drawings—well executed, but hardly what I expected. Nowhere do the authors or the publisher specify explicitly their intended audience. Perhaps that is somehow implicit. I take the book to be an adequate but hardly profound general survey of oceanography, particularly applied aspects thereof, for the non-scientist (including high-school students).

Some of the early material on the chemistry of the oceans is a bit confused. The authors imply by means of a footnote, for example, that the ionic composition of seawater can be equated with the hydrogen ion concentration! A summary of the properties of water is a jumble of technical and nontechnical terms; the intended audience may get lost.

The decision to give both metric and English units throughout may have some educational merit. However, as is so often the case, the blind reporting of the dual notation for approximate values is frequently (but not consistently) carried to logi-

cal extremes. There are also a few typographical errors, most of them minor. South America is incorrectly labeled on figure 26. Similarly, there are a few minor inconsistencies, such as the oceanic deposition rates given on p. 56 and 66. Other examples of both problems can be found.

Despite the objections raised, I found the book a readable account about the oceans. Part 2 deals with man and the ocean, from the standpoint of the history of oceanography, various aspects of ocean technology, resource utilization, and the law of the sea. Man's roles in fouling the ocean are also discussed. The information throughout this anthropocentric part of the book remains simplified, and the errors persist—but the coverage of the subjects treated was generally adequate.

In sum, the book is perfectly acceptable as a volume to be read casually by someone with a passing curiosity about the ocean. It probably does not really have a great deal of potential as a textbook or a reference book for most readers of this review.

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JERLOV, N. G., AND E. STEEMANN NIELSEN [EDS.] 1974. **Optical aspects of oceanography.** Academic Press, London and New York. xv + 494 p. £10.50.

Ocean optics, or hydro-optics, is a newly emerging discipline melding the interests of biologists and physical oceanographers. *Optical aspects of oceanography* exemplifies this collaboration and offers a review of the present state of the art concerning the various optical properties of the ocean. It is a collection of 19 invited papers prepared for a symposium sponsored by the International Association for the Physical Sciences of the Ocean and held in Copenhagen, Denmark, in June 1972. The authors, representing seven countries, are the most prominent physical oceanographers and marine biologists in this rapidly expanding, though still somewhat limited, field of hydro-optics.

The papers are arranged as chapters. Some are modern reviews of basic optical physics, supplemented by the authors' first-hand experiments: "Optical properties of pure water and pure sea water" and "Significant relationships between optical properties of the sea." Others present recent advances in ocean optics: "New developments of the theory of radiative transfer in the ocean." In the chapter titled "Underwater visibility and photography," it is pointed out that particulate matter and salt crystals do not harm imagery as much as was previously thought and that imagery can be enhanced by proper techniques. Another relatively recent discovery is "Polarization measurement [of light] in the sea," a subject that still needs more investigation. Several chapters, among them "Light

and primary productivity" and "Light and photosynthesis of different marine algal groups," relate optical studies to biological activity—a primary objective of the book.

Also presented are new techniques for ascertaining the optical properties of the sea from both below and above the sea surface: "The remote sensing of spectral radiance from below the sea surface" and "Remote optical sensing in oceanography utilizing satellite sensors." The latter presents an initial breakthrough in real-time, large-area studies revealing useful oceanographic parameters such as sea surface temperature, current boundaries, eddy patterns, ice coverage, waves, etc. Although cloud cover limits the effective use of satellite techniques, cloud patterns may in themselves reveal water temperature boundaries. Other chapters deal with the techniques of using optical properties of the water to ascertain water motion: "Some applications of the optical tracer method" and "The use of fluorescent dyes for turbulence studies in the sea."

The final chapter deals with "Bioluminescence." The authors summarize what is known of light production by marine animals, including the anatomical devices employed by various phyla, the distribution of light, and the advantages of bioluminescence to the animals themselves.

Each chapter is outlined in the table of contents and contains an abundance of black and white photographs and line drawings. A most helpful feature is the unusually large number of references, as many as 100, concluding each chapter. As might be expected, all authors include a generous listing of their own works.

Author and subject indexes conclude the book.

Although not especially suitable as a textbook, it is the most modern and comprehensive reference on the subject of ocean optics and should prove very useful to physical oceanographers and marine biologists alike, be they students or specialists.

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TASCH, P. 1973. Paleobiology of the invertebrates. Data retrieval from the fossil record. Wiley and Sons, New York. 946 p.

Books this ambitious in coverage are certainly best evaluated by classes, not reviewers. Is it possible to teach the basics of invertebrate zoology, invertebrate paleontology, and the essential points of population biology simultaneously? This volume convinces me that it isn't. For instance, it is taxonomically complex from the outset and there is an aura of pseudo-genetics that characterizes many of the discussions of group evolution. I couldn't find a complete geological time scale and, unfortunately, the book's timing seems to have precluded substantial discussion of plate tectonics.

On the other hand minor or enigmatic fossil groups are dealt with in some detail, and there are ample references to permit the more advanced student to continue working independently. Because the book does not radiate with the potential benefits of academic hybrid vigor, I retain my somewhat conservative beliefs: the most effective and constructive entrée to paleobiology will continue to be rigorous, independent coursework in modern population ecology and invertebrate biology.

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MARISCAL, R. N. [Ed.] 1974. Experimental marine biology. Academic Press, New York. x + 373 p. \$18.50.

I do not believe that this attractively prepared volume, consisting of eight contributed chapters, will be of substantial utility to biological oceanographers at large. That is, most will find the lengthy chapters on developmental biology, toxicology, endocrinology, and physiology, albeit devoted to marine organisms, too specialized, remote, or lacking in relevancy to their subject. This is not to state that these chapters will not repay careful reading.

The remaining four chapters contain information of potential interest. The chapter by Spotte is a compendium of techniques for the salt water aquarist and offers substantial hope that many delicate species can be maintained adequately for experimental purposes. Kittredge's contribution—marine biochemistry—contains many interesting facts and speculations and clearly has benefited from the personal touch added to all the chapters in which the authors have discussed their own research.

I found it most rewarding to contrast the contributions of Hernkind (behavior) and Connell (ecology). Both authors deal with techniques of investigating natural animal populations. Their subject matters overlap to some degree, and a comparison of their evaluations of the state of the art and success in posing, and answering, questions is both intriguing and revealing. Seemingly, there is an inverse correlation between the development of realistic and testable hypotheses (essentially what experimental marine biology should be about) and the degree to which practitioners have come to rely on sophisticated mechanical contraptions. Hernkind writes optimistically of an increased role for advanced technology; Connell, on the other hand, makes a convincing case for the strength of manipulative natural experiments utilizing common hardware store items. Perhaps there is an ecological generality here.

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