Oceanography

The Dynamics of the Upper Ocean. O. M. PHILLIPS. Cambridge University Press, New York, 1966. 269 pp., illus. $11.50.

There is a great deal of theory and information on the dynamics of the upper ocean that need to be put together, as is evidenced by the fact that all but a handful of the more than 200 references upon which this elegantly written treatise is based were published after 1950, and the majority have appeared since 1960. (The earlier references are the classics of such scientists as Fjeldstat, Kolmogorov, Lamb, Proudmann, Taylor, and Wilton.) Phillips has accomplished such an integration by combining hydrodynamics, similarity theory, tensor analysis, and time-series concepts to describe wave dynamics, ocean surface waves as generated by the wind, internal waves, and atmospheric and oceanic turbulence.

The equations governing fluid motions are expounded, at an advanced level, so as to derive the Boussinesq approximation and the Reynolds stress. There follows the description of the dynamics of surface waves, including particle motions, effects of molecular viscosity, conservation equations, wave interactions, and various applications. These results are then applied to ocean surface waves in an analysis of wave generation by wind and the coupling between wind and waves. The equilibrium range in the spectrum, spectral growth, and ripples are analyzed. Air flow over the sea in non-neutral conditions is discussed in the last part of the book. Internal waves are treated for all ranges of period and mode. The effect of a weak mean shear is discussed. The chapter on turbulence deals with all kinds: isotropic, in stably stratified media, in unstably stratified media, and entrainment. It is pointed out how much has yet to be learned.

The mathematical derivations and the results obtained in the book are not simple. The reader will be required to follow the presentation carefully and to supplement many derivations by intermediate steps, but the result will be a fuller understanding of the subject. The reader will benefit, also, from study of additional material so as to see how the "upper" ocean relates to the total ocean and the entire atmosphere and so as to acquire a more quantitative knowledge of the subject.

Work from Europe is not fully represented. Some aspects of spectral analysis are treated lightly. Finally, dissenting opinions on some of the theories presented are not mentioned. For example, the drag coefficient according to some authors has not yet been satisfactorily related to the wind speed even for neutral conditions. (Very recent Russian work is most suggestive here.) Also, it may well turn out that the section on the theory of third-order nonlinear wave interactions will need considerable revision in a few years.

WILLARD J. PIERSON, JR.
Department of Meteorology and Oceanography, New York University, New York City

Malariology

Malaria Parasites and Other Haemosporidia. P. C. C. GARNHAM. Blackwell, Oxford, England; Davis, Philadelphia, 1966. 1132 pp., illus. $35.

In spite of the vast amount of money, time, and manpower which have been directed toward eradication of malaria, the disease still exists. The recent discovery of drug-resistant parasites has called for renewed efforts in malaria research and has stimulated enthusiastic interest in the problem. P. C. C. Garnham's book therefore appears at an opportune time. It is unique in being an up-to-date morphological treatise on malaria parasites and their close relatives; it includes details of new strains, new species, and both vector and vertebrate stages of recent finding. The compilation of this material is done painstakingly and in a systematic and orderly manner.

The book covers mammalian, avian, and saurian malaria parasites (family Plasmodiidae) and even doubtful forms probably misidentified originally. The two other families of the Haemosporidiidea, Haemoproteidae and Leucocytozoidae, are also given thorough treatment. Running throughout the text is an interesting historical narrative of the discoveries and early descriptions of the organisms. Systematic classification is emphasized with great detail in a general chapter and reiterated in specific ones. Schemes of classification proposed by the author are utilized in the main, but discussion of other methods is presented. Keys and tables help with the delineations, but some confusion does result when the criteria set forth are not adhered to. The introductory chapter to the mammalian subgenera is particularly weak in this regard.

The hypothetical evolutionary patterns of malaria parasites are considered at great length. Factors involving vertebrate hosts, that is, pathology and immunology, are not stressed, but outstanding work along these lines is cited. Biochemistry and studies in vitro are also considered rather briefly. Reference is made to pertinent papers, however. A techniques chapter provides practical information on a wide range of topics from methods of constructing an insectary to use of the indirect fluorescent antibody test.

The main emphasis of the book is morphology. Colored plates, most of which are original drawings, of parasites in all stages of development are numerous. Current information allows for a more complete treatment of the life cycles with special reference to exoerythrocytic stages. The plates are spaced at intervals throughout the book in an arrangement that does not facilitate study. The paucity of electron micrographs is conspicuous and disappointing. The few that are included are generally not reproduced well and in most cases are not referred to in the general discussion on morphology and life cycle where a point of reference would be helpful.

The book is clearly written for the experienced malariologist, but a glossary of terms and diagrams of life cycles make it useful to the less sophisticated student. It serves well as a protozoological reference source on the Haemosporidia.

KAREN J. OTT
Bureau of Biological Research, Rutgers University, New Brunswick, New Jersey

Boron Compounds

Organoboron Chemistry. Vol. 2, Boron-Nitrogen and Boron-Phosphorus Compounds. HOWARD STEINBERG and ROBERT J. BROTHERTON. Interscience (Wiley), New York, 1966. 588 pp., illus. $25.

Volume 1 of this treatise [reviewed in *Science* **145**, 477 (1964)] covered the boron-oxygen and boron-sulfur compounds, and volume 3 will treat boron-carbon compounds. In volume 2, the authors deal, in 12 chapters, with all aspects of boron-nitrogen compounds in which (with the exceptions of some borazine and pseudohalogen derivatives) there are no boron-carbon or boron-silicon bonds present. The literature is covered up to September

1964, and the thoroughness of coverage is demonstrated by the approximately 950 references cited. The two major subjects treated in this book are trigonal boron compounds containing at least one boron-nitrogen bond, and borazines. Compounds with boron-boron bonds have been excluded from the series. Other classes of compounds covered are heterocyclic boron-nitrogen compounds other than the borazines, tetrahedral boron-nitrogen compounds, boron-nitrogen polymers, and boron-phosphorus compounds. Though ignored in the title, boron-arsenic and boron-antimony compounds are also included. Nomenclature is discussed in each of the chapters, whereas in volume 1 this was done in a separate chapter near the beginning of the book.

Since boron-nitrogen compounds do not occur in nature, a book on these compounds must necessarily be an account of their preparation and reactions. The authors have provided excellent coverage of both. In addition, they have included an impressive quantity of data on physical constants. In the literature there are a number of reviews that deal with some classes of compounds, such as borazines, covered in this book, and there are also general reviews with a less restricted coverage of boron-nitrogen chemistry. But this book is nevertheless highly recommended as an excellent detailed reference work for those interested in this fascinating and rapidly growing field of synthetic chemistry.

KURT L. LOENING
Chemical Abstracts Service,
Ohio State University, Columbus

Letters of Priestley

A Scientific Autobiography of Joseph Priestley (1733–1804). Selected scientific correspondence, edited, with a commentary, by ROBERT E. SCHOFIELD. M.I.T. Press, Cambridge, Mass., 1967. 431 pp., illus. $13.50.

Joseph Priestley was one of the most prolific writers in an age noted for its prolific writers. One thinks immediately of the massive volumes of Edward Gibbon's *Decline and Fall* and of Dr. Samuel Johnson's dictionary, but these pale into insignificance (quantitatively) beside the theological, polemical, political, historical, and scientific writings of Priestley. It was Priestley's proud boast that he never revised but published everything at the white heat with which it left his pen. The result is a forbidding pile of material upon which the historian of science must look with some degree of apprehension, for the scientific nuggets are often buried in a veritable mountain of other matters. From this mountain, Robert E. Schofield has extracted the essence (he feels) of Priestley's scientific thought. His edition is a model for future editors of scientific correspondence. From it there emerges what the title describes as a scientific autobiography, for Priestley was a frank man and his ideas and his opinions are clearly expressed in his letters.

Here are to be found many of the more important controversies of the 18th century. There is Priestley's caustic letter to Father R. J. Boscovich on the application of Boscovich's theory of point atoms to what Boscovich thought to be the cause of materialism. One can also read Priestley's reaction to the new chemistry which dispensed with phlogiston in favor of the new French essence of combustion, oxygen. And there is much more. Interspersed throughout are commentaries by Schofield which add materially to the value of the letters.

I have only two criticisms to direct at this work. The first is the failure of the editor to identify people mentioned in the body of the letters. There is an excellent biographical appendix which gives short sketches of the recipients of Priestley's pen, but the reader is left to fend for himself with those people mentioned by Priestley. Thus, on pages 205, 208, 215, and 261, for example, a Mr. William Russell is mentioned but, in spite of the terms of familiarity with which Priestley speaks of him, we are given no clue as to his identity. The second criticism is one the justice of which only Schofield can decide, for only he knows the Priestley material thoroughly. He has restricted this volume to the "scientific" correspondence of Priestley but he has also noted that Priestley's "science" was, in many cases, subordinate to his larger vision of reality. The question is, where has Schofield drawn the line? Do we lack some essential documents here because they were not "scientific" as Schofield understands the term? Fortunately, the answer will soon be forthcoming, for Schofield's biography of Priestley will, undoubtedly, be the definitive life. In the meantime, I can only recommend this volume strongly as a work which sheds great light upon the career of Joseph Priestley in particular and upon the life of science in the 18th century in general.

L. PEARCE WILLIAMS
Department of History,
Cornell University,
Ithaca, New York

Mathematics of Systems

Modern Foundations of Systems Engineering. WILLIAM A. PORTER. Macmillan, New York, 1966. 501 pp., illus. $14.95.

Techniques for the analysis and design of engineering systems are undergoing major revision, largely because of the availability of the digital computer for the simulation and realization of complex systems. Whereas classical approaches are directed toward closed-form analytical descriptions of system behavior and performance, the more recent techniques lead to algorithmic descriptions. The tools and notation for this kind of description have been found in matrix algebra and in the more abstract framework of functional analysis. These techniques have not yet been fully established or refined to the point where intuition and insight are easily conveyed.

Porter's book is another step in the direction of these goals. It is oriented toward providing a mathematical basis of modern system theory rather than a detailed account of the applications. While the book is written in a mathematical style, the author has made an effort to motivate the development. He has been particularly successful in the first two chapters, which deal with the definitions and properties of function spaces and with transformations between spaces. The material in these chapters is presented with enough informality to make the reader comfortable while maintaining the precision and elegance of the ideas. The remaining two chapters investigate the structure of linear systems and the application to a class of problems in optimal control. The nine appendices provide supplementary material both on functional analysis and on the optimal control problem considered in chapter 4.

This book is somewhat of a departure from other recent texts in its use of the more general and abstract function space notation, and it is characterized primarily by the generality of the approach. As the author says: ". . . the basic problem is com-