In the opening chapter, on ocean volume, Schopf summarizes the evidence for the proposition that degassing occurred early in the earth's history (4.6 to 2.5 billion years ago) during rapid continental and oceanic evolution and was followed by slow recycling of the earth's crust and oceans. Factors governing changes in sea level are considered and an up-to-date, if somewhat less than comprehensive, summary of the seismic stratigraphic studies by Vail and others is given.

The various factors applicable to the interpretation of (paleo)bathymetry (such as grain size distribution, lithic, biologic, geochemical, and mineralogic criteria, backtracking, and carbon compensation depth) are discussed in chapter 2. Schopf takes note of the use of backtracking and the hypsometric curve in giving paleobathymetry a firm scientific base. The chapter concludes with an interesting analysis of two contrasting models for continental platforms: epeiric seas and marginal seas.

The chapter on water studies includes a discussion of tides, currents, and (particularly well treated, I thought) circulation. The chapter concludes with the observation that no aspect of paleoceanography has as promising or immediate a future as does the determination of ancient ocean circulation, an observation with which many of us working at oceanographic institutions and engaged in historical oceanographic studies can agree.

The chapter on temperature includes a consideration of the methods—geologic, biologic (taxonomic, faunal, and floral gradients and so on), and chemical (including isotopic)—used in determining ancient temperatures. Schopf discusses the effect of changes in the sun (solar constant) and atmosphere (increase in CO_2 and H_2O) in the past and succumbs to the temptation to link decrease in temperature with increase in magnetic field intensity. Whether such a link can be made is a controversial issue among paleoclimatologists and geophysicists, but the idea of the link appears to have been essentially discredited lately.

In the chapter on chemistry Schopf treats a variety of topics ranging from salinity and methods for assessing it in ancient deposits (involving measurement of boron, interstitial fluids and porosity, sedimentary phosphates, siderite, and so on) to ocean and atmospheric chemistry (including an analysis of the earliest ocean and atmosphere, the origin of oxygen, and banded iron formation). The general picture that emerges is of an essentially steady-state oceanic and atmospheric chemistry over the past 2 billion years following an early degassing of the earth's interior, an early equilibration with volatiles, and the development of an oxidizing environment.

In the chapter on climatology Schopf covers latitudinal zonation of climatic zones, patterns of sediment yield, and storms. Latitudinal control of shelf, slope, and oceanic sediment types is adequately treated, as are the influence of topography and climate on total river runoff and the rate of mechanical denudation. Storms are shown to be of great geologic significance as major agents of short-period sediment transport.

The final chapter, on biology, considers productivity, patterns of taxonomic change, and biogeography. Various explanations (such as sampling bias, increase in diversity within an adaptive zone, and changes in biogeography) are considered in accounting for observations about species diversity. Temperature per se is shown to have played an insignificant role in faunal extinctions. Rather, density-dependent changes (in temperature, salinity, and oxygen concentration, for example) are shown to provide the background against which important causes of extinction operate.

The treatment of biogeography is concerned with the prediction of faunal equilibrium and of the number and size of faunal provinces and with relating these predictions to observed changes in faunal diversity. Changes in the diversity of a faunal province are shown to be more likely to be a function of the number of provinces than of the size of the province. The role of ocean currents in determining the boundaries of faunal provinces is important, and thus species provinciality is seen as a function of the confinement of species by currents to given regions. The delineation of past faunal provinces will hinge on the ability of paleontologists to reconstruct ancient current systems. Schopf applies the concepts developed in the chapter to an analysis of changing biotic diversity through geologic time, in particular of the Permo-Triassic extinctions and of Silurian patterns.

Schopf has covered a large amount of ground in the book, and it should serve both as an excellent textbook for a graduate course in paleoceanography and as a source of reference for those working in the field. My main, and perhaps my only, criticism of the book is the lack of a sequential narrative dealing with the history of paleocirculation, paleobiogeography, and paleogeography insofar as they relate to a true historical geology of the oceans. This type of information is dispersed (and repeated) throughout the book, with the result that a sense of the historical continuity of paleoceanography is diluted. A final chapter might have provided a synthesis of this information. The interested reader can, in fact, find a narrative approach of this sort in the recently published *Climates throughout Geologic Time* by L. A. Frakes. The two books are perfect complements in providing an overview of the rapidly developing field of paleoceanography.

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Cetaceans

Behavior of Marine Animals. Current Perspectives in Research. Vol. 3, Cetaceans. HOWARD E. WINN and BORI L. OLLA, Eds. Plenum, New York, 1979. xxii, 438 pp., illus. $37.50.

To appreciate the constraints under which students of whale behavior labor other behaviorists might try spending some time restricted to observation of the tails of the animals they study. The popularity of studies of the acoustical behavior of whales is due to the fact that this is the one kind of behavior that can be observed with comparative ease and predictability. Knowledge of other aspects of their behavior often depends on incidental observations made in the course of studies concerned with other matters or on inference from other factors.

The editors of the present volume acknowledge the difficulties of studying whale behavior and yet go bravely to the task. The papers in the volume fall into three general categories: accounts of methodologies, natural histories, and reports of work on vocalization.

The methodological papers include a good review by S. Leatherwood and W. E. Evans of radio tagging and tracking efforts. Successful radio tracking of most species appears possible, but there are no "off the shelf" systems available. Early results of efforts to identify individual humpback whales by means of fluke photographs, reported by S. Katona *et al.*, indicate that this method may be used for studying migration and social relationships in this species.

Natural history papers on the northern right whale dolphin by Leatherwood and W. A. Walker, Dall's porpoise by G. V. Morejohn, and the bottle-nosed whale by T. Benjaminsen and I. Christensen are good contributions to understanding of

the general biology of these species but have little in the way of behavioral content. Papers on social organization in humpback dolphins by G. S. Saayman and C. K. Tayler and in sperm whales by P. B. Best are excellent and illustrate well the heroic inferential efforts required to study the behavior of cetaceans.

With respect to acoustic behavior, P. Beamish reports on vocalizations in several entrapped baleen whales and remarks on the production of pulsed sounds that may be suitable for echolocation. Graded whistle repertoires of North Atlantic pilot whales are described by A. G. Taruski as varying little over several behavioral and environmental conditions. D. W. Morgan reports variable vocal and behavioral reactions by wild and captive belugas to playbacks of conspecific vocalizations. M. C. and D. K. Caldwell present a good description of the ontogeny of whistles in Atlantic bottle-nosed dolphins. Whistles in the young dolphin are variable in structure and acquire stereotyped individual features only after the first year. Finally T. J. Thompson *et al.* give a brief review of mysticete sounds and discuss the possible social and orientation functions of known vocalizations.

There is some that is new in the present volume but little that is exciting for behaviorists. The volume does not attempt to give general reviews or directions for future work and is far from a general or balanced coverage of cetacean behavior. It is a disappointment compared with earlier volumes in the series.

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Astrophysics

Nonradial Oscillations of Stars. WASABURO UNNO, YOJI OSAKI, HIROYASU ANDO, and HIROMOTO SHIBAHASHI. University of Toyko Press, Tokyo, 1979 (U.S. distributor, ISBS, Forest Grove, Ore.). x, 324 pp., illus. $32.50.

As the authors of this book point out, recent observations have revealed that nonradial oscillations "are inherent to most of the stars that are the main constituents of the universe." This is therefore a timely book.

Fundamental advances in our understanding of nonradial oscillations have in recent years been made by a number of Japanese astrophysicists (most of whom are among the authors of the book). In addition to summarizing much of the work on the subject, the book also provides information and details that usually cannot be found in research papers.

Chapter 1 is masterly and should be required reading for every astronomer or astrophysicist. In less than 20 pages, it gives a brief history of the subject, summarizes the reasons for studying nonradial oscillations in stars, discusses the kinds of objects in which nonradial oscillations are suspected and some of the physics involved, and gives some inkling of the mode classification problem and its difficulties.

Chapter 3, on adiabatic oscillations, gives an excellent and thorough discussion of "trapping" of nonradial oscillations in certain portions of a stellar interior. The concept of trapping is relatively new and was first applied to nonradial oscillations in stellar interiors by Unno and Osaki. The chapter also contains a good, thorough discussion of boundary conditions; surface boundary conditions are also considered in chapter 4.

A number of specific features of the book are attractive. Particularly welcome to this reviewer were three helpful drawings illustrating spherical harmonics for various values of ℓ and m, a detailed application of perturbation theory to slow rotation and a weak magnetic field, the application of perturbation theory to a general small perturbing force, a detailed and careful treatment of the ϵ-mechanism, and an analysis of the one-zone model of fully nonadiabatic oscillations. This reviewer also found useful the physical derivation of an equation expressing the growth rate of the most unstable modes as a function of surface gravity and effective temperature and discussions of the stability of rotating stars and of tidal forced oscillations in stars. There are even brief discussions of the Lin-Shu density wave theory of spiral galaxies and of toroidal modes.

There appears to be little on the debit side. However, a few criticisms should be mentioned. Perhaps of most importance is the attempt to include a discussion of the interaction between pulsation and convection. The subject is discussed at some length, but the conclusions and equations derived are not especially convincing. Our theoretical understanding of convection (particularly time-dependent convection) is in a rudimentary state, as the authors admit. One therefore wonders about the advisability of trying to discuss the subject in detail. There is little in the book about either nonlinear effects in general or about mode coupling in particular.

The book is an excellent complement to the encyclopedia article written in 1958 by Ledoux and Walraven and should become a standard reference on nonradial oscillations in stars.

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Books Received

Accessory Glands of the Male Reproductive Tract. E. S. E. Hafez and Elinor Spring-Mills, Eds. Ann Arbor Science, Ann Arbor, Mich., 1979. xii, 304 pp., illus. $30. Perspectives in Human Reproduction, vol. 6.

The Acquisition of Reading. Cognitive, Linguistic, and Perceptual Prerequisites. Papers from a symposium, Newark, Del., June 1975. Frank B. Murray and John J. Pikulski, Eds. University Park Press, Baltimore, 1979. xiv, 178 pp. $14.50.

Basic Electronics. Devices, Circuits and Systems. Michael M. Cirovic. Reston (Prentice-Hall), Reston, Va., ed. 2, 1979. xviii, 568 pp., illus. $19.95.

Basic Set Theory. Azriel Levy. Springer-Verlag, New York, 1979. xiv, 394 pp. $24.90. Perspectives in Mathematical Logic.

Computer Graphics in Archaeology. Statistical Cartographic Applications to Spatial Analysis in Archaeological Contests. Steadman Upham, Ed. Arizona State University Department of Anthropology, Tempe, 1979. vi, 156 pp., illus. Paper, $8.50. Arizona State University Anthropological Research Papers No. 15.

Convex Analysis and Mathematical Economics. Proceedings of a symposium. Tilburg, The Netherlands. Feb. 1978. Jacobus Kriens, Ed. Springer-Verlag, New York, 1979. vi, 138 pp., illus. Paper, $9. Lecture Notes in Economics and Mathematical Systems, vol. 168.

Countertransference and Related Subjects. Selected Papers. Harold F. Searles. International Universities Press, New York, 1979. xii, 626 pp. $27.50.

The Coyote. Defiant Songdog of the West. François Leydet. University of Oklahoma Press, Norman, 1979. 224 pp., illus. Paper, $5.95. Reprint of the 1977 edition.

A Cross-Cultural Study of Cognitive Development. Jerome Kagan, Robert E. Klein, Gordon E. Finley, Barbara Rogoff, and Elizabeth Nolan. Published for the Society for Research in Child Development by University of Chicago Press, Chicago, 1979. iv, 84 pp. Paper, $4.50. Monographs of the Society for Research in Child Development, vol. 44, No. 5, Serial No. 180.

Energy. The Countdown. A Report to the Club of Rome. Thierry de Montbrial with recommendations by Robert Lattés and Carroll Wilson. Pergamon, New York, 1979. xiv, 256 pp. Cloth, $30; paper, $10. Pergamon International Library.

The Energy Controversy. Soft Path Questions and Answers. Amory Lovins and his critics. Hugh Nash, Ed. Friends of the Earth, San Francisco, 1979. vi, 450 pp. Cloth, $12.50; paper, $6.95.

Energy in America's Future. The Choices

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