a treatise on bacterial and algal paleobiology, it is a pity that the brown algae are omitted simply because their fossil record is not extensive. Euglenoids, whose record is minimal, are included. Charophytes receive a very thorough review. The inclusion of prokaryotes does provide a useful lead-in to a discussion of the origin of the eukaryotes, a topic that is seldom well covered in the micropaleontological literature. Here the coverage is generally good although it contains few recent references.

The literature coverage in this work as a whole is thorough only up to 1975 or 1976, depending on the chapter. This seems inevitable in view of the size of the work, but it does mean that much pertinent literature is omitted, most noticeably in the case of subjects of active research such as molecular evolution or, in the section on dinoflagellate ecology, "red tides." There is no mention of the Archaebacteria, the third major prokaryotic linkage much under discussion at present.

There are minor errors here and there in the book, but these are inevitable in such a large work. Some anomalies in the data given, however, point to problems of interpretation that should have been expounded for the benefit of students.

It is a reasonable convention to place the organic-walled microfossils of uncertain affinity in the Acritarch form-group, as Tappan and other micropaleontologists do, but this can give the impression that the forms not so placed are confidently assignable to contemporary or extinct natural groups. Though diatoms are usually clearly recognizable, other forms may be attributed to group only questionably. For example, *Eosphaera* has been placed in groups as divergent as the red algae (in this volume) and the volvocalean greens, and in Tappan's figures the same pair of cells of another organism is shown identified as a cyanobacterium, *Glenobotrydion aenigmaticus* (fig. 1.39.8), and later assigned to the green algae as *Caryosphaeroides pristina* (fig. 10.26).

Tappan, together with her husband, A. R. Loeblich, Jr., has been a pioneer in the interpretation of broad patterns of microplankton evolution and their correlation with primary production, nutrient limitation, and so on. The results of this valuable and interesting work are used frequently in the present volume, principally through diagrams, including plots of the percentages of new taxa and extinctions, that illustrate the rise and fall of taxa at various periods in the fossil record. Tappan does not caution the reader concerning the reliability of these diagrams, though one finds, for example, that in fig. 5.15 the ebridians appear to become extinct in the Pleistocene and yet reappear in the Holocene. Obviously this information cannot be intended to be precise and complete (and is contradicted by fig. 5.14, in which three genera are shown to be continuously represented from the Miocene to the Holocene), but roughly what is the expected error? Is it legitimate to compare the number of living taxa with those in the fossil record when the criteria for recognition are quite different (as in the case of dinoflagellates)?

None of this can detract from the fact that Tappan has produced a major work. It is a mine of information that should be present in every geological and biological library. However, to be usable as a textbook it should be half the size and one quarter the price, or am I out of date? Perhaps we can persuade industry to begin subsidizing textbooks in their areas of concern.

F. J. R. TAYLOR
*Departments of Oceanography and Botany, University of British Columbia, Vancouver, V6T 1W5, Canada*

## Paleoclimates

**Climates Throughout Geologic Time.** L. A. FRAKES. Elsevier, New York, 1979. xii, 310 pp., illus. Cloth, $58.50; paper, $29.95.

To attempt, as Frakes does in this book, to analyze and synthesize the great mass of data and interpretations of the earth's past climates, taking into account past continental positions, is a formidable undertaking. Frakes, who is known for his many contributions to the documentation of pre-Pleistocene glaciations, naturally relies heavily on the physical, especially lithologic, evidence. The coverage of Precambrian and Paleozoic climates is generally admirable and emphasizes the glacial intervals, which are, of course, valid evidence for a relatively cool earth. Frakes also emphasizes other lithologic evidence of paleoclimates, for instance, the latitudinal (adjusted for putative positions of the continents) distributions of evaporites, red beds, laterites, and coals. For the Cretaceous and younger periods (that is, the last 140 million years), the interpretations rely more on chemical data, particularly paleotemperatures as calculated from oxygen isotope data derived in the last decade from the Deep Sea Drilling Project.

Frakes's attempted syntheses are in many instances praiseworthy but in other instances are flawed. Certainly some of the problem derives from sometimes conflicting data, and a strong point of the book is that Frakes continually emphasizes conflicting or anomalous data and suggests needed work to resolve such conflicts. Yet his handling of some of the data that are available is unsatisfactory.

The analysis suffers from both misinterpretation and omission. Though it is true that peat (and hence coal) formation is today conspicuous in poorly drained regions glaciated during the Pleistocene, coals are not evidence of nontropical climates as Frakes implies on p. 109 and elsewhere. Some of the largest individual peat bogs are in the tropics: 70 years ago Potonié described a 10-meter-thick peat in Sumatra that covers over 700 square kilometers, and other such occurrences are known. A serious omission is that dune deposits are ignored. Such deposits—particularly abundant in the early Mesozoic—may offer incontrovertible evidence of major deserts and serve to document paleowind directions. Ancient soil types (such as caliche) indicative of particular climatic regimes are also ignored.

The weakest aspect of the book is the treatment of past distributions of land plants. Frakes takes the scarcity of Devonian coals as evidence of an arid period; yet this scarcity might be related to the fact that plants had just invaded land and throughout much of the Devonian were of very low stature—a low biomass is not conducive to peat formation. Frakes discusses the problem of explaining lush forests at polar latitudes (again, these are true paleolatitudes determined from paleomagnetic data), but he seems to miss the real point. He suggests the ancestors of groups such as cycads, which today are restricted to low latitudes, may have had different climatic tolerances. Yet the question that needs to be answered is what physiological process would allow such large-leaved evergreen plants to metabolize during the six-month polar night when no food could be produced. Frakes also makes an error regarding basic plant physiology when he states (p. 185) that "$CO_2$ apparently built up quickly in oceans and atmosphere, probably as a result of land plant respiration"; photosynthesizing plants consume far more $CO_2$ than they yield as metabolic by-products.

Frakes's summary of the major physical evidence bearing on paleoclimates

fills a valid need. Because of the weaknesses outlined here, however, the attempted syntheses are unsuccessful.

JACK A. WOLFE

*Branch of Paleontology and Stratigraphy, U.S. Geological Survey, Menlo Park, California 94025*

## Biomechanics

**Aspects of Animal Movement.** Papers from a symposium, Reading, England, Dec. 1978. H. Y. ELDER and E. R. TRUEMAN, Eds. Cambridge University Press, New York, 1980. x, 250 pp., illus. Cloth, $44.50; paper, $16.50. Society for Experimental Biology Seminar Series.

In the old days, most locomotion research was done by biologists who got the physics they needed either from childhood memories or from an hour with a colleague in a nearby department of mathematics, physics, or engineering. With a little effort, they could understand all the papers published on animal locomotion. Things are different now. Mathematicians and engineers are actually involved in the research, working with the biologists in their laboratories or in departments of applied mathematics or engineering. Communication between the biological and mathematical ends of the spectrum is difficult; to produce any satisfactory book with "animal locomotion" in its title has become a daunting task. The present editors started with a further disadvantage: the claim made for the volumes of the Society for Experimental Biology Seminar Series, as stated in the jacket blurb, that "together the contributions form introductory texts for the senior undergraduate, graduate student and research worker looking at the field for the first time." The editors have wisely ignored this, judiciously including the word "aspects" in their title and acknowledging in their preface that the treatment leaves gaps. In short, the book is not, and never could be, a textbook; it is no rival to Alexander and Goldspink's *Mechanics and Energetics of Animal Locomotion* (an excellent modern text) and Gray's *Animal Locomotion* (a good summary from the point of view of the old days).

How, then, are we to regard this book? I see each of its chapters as an essay reflecting the interests, approach, and idiosyncrasies of its author. One chapter is an original contribution in the style of a research paper, asking penetrating questions about locomotor efficiency (Taylor). Several are comprehensive reviews of relatively small and self-contained sections of the subject, such as structural considerations (Currey), water-beetle swimming (Nachtigall), insect jumping (Bennet-Clark), vorticity and flight (Rayner), and walking (Alexander). Other authors attempt to review much wider fields and have to spread their material correspondingly thinly. One chapter, regrettably, seems to have been assembled with scissors and paste out of two of its author's chapters in another book. Some chapters assume familiarity with much of the animal kingdom; others presuppose confidence (or at any rate, no terror) in the presence of mathematics and fluid dynamics.

Anyone claiming an interest in the whole field of animal locomotion (if there be any such persons nowadays) will need this book. Those with narrower interests may read one or two chapters but would do well to read more; they cannot fail to be fascinated and to learn something worthwhile. Certainly it will do a research worker of the mathematical sort good to read the chapters that have no equations in them. The classical biologist, more at home with description than algebra, should, however, beware when seeking to understand the more quantitative chapters: poor typesetting and proofreading, especially of mathematical material, have laid many traps for such a reader. That the highest density of infelicities, errors, and misprints is in a chapter by an author whose mother tongue is not English must lay much of the blame on the editors. Indeed, one wishes that the editors had ruled their contributors, however eminent, with a rather heavier hand; the inconsistency of symbols, units, and even spelling between chapters is disconcerting.

Every serious reader will come to regard three or four of the chapters as the most worthwhile, for a host of subjective reasons. My nomination goes to Currey's "Skeletal factors in locomotion," a lucid and readable review of natural engineering; Rayner's "Vorticity and animal flight," the first readily comprehensible review of this new approach, which was originated by Cone in 1968 but has been highly developed recently and almost independently by C. P. Ellington and Rayner himself; and finally Bennet-Clark's "Aerodynamics of insect jumping," based on experiments that were simple and elegant in conception and obviously fun to do.

K. E. MACHIN

*Department of Zoology, University of Cambridge, Cambridge CB2 3EJ, England*

### Books Received

**Ab Initio Calculations.** Methods and Applications in Chemistry. Petr Carsky and Miroslav Urban. Springer-Verlag, New York, 1980. vi, 248 pp. Paper, $21. Lecture Notes in Chemistry, vol. 16.

**Abstract Software Specifications.** D. Bjørner, Ed. Springer-Verlag, New York, 1980, xiv, 568 pp. Paper, $31. Lecture Notes in Computer Science, vol. 86.

**Adsorption and Ion Exchange with Synthetic Zeolites.** Principles and Practice. William H. Flank, Ed. American Chemical Society, Washington, D.C., 1980. x, 294 pp., illus. $34.25. ACS Symposium Series, 135.

**Advances in Biochemical Engineering.** Vol. 16. A. Fiechter, Ed. Springer-Verlag, New York, 1980. x, 148 pp., illus. $42.60.

**Advances in Environmental Science and Engineering.** Vol. 3. James R. Pfafflin and Edward N. Ziegler, Eds. Gordon and Breach, New York, 1980. xiv, 224 pp., illus. $59.

**Advances in Heterocyclic Chemistry.** Vol. 26. A. R. Katritzky and A. J. Boulton, Eds. Academic Press, New York, 1980. x, 248 pp., illus. $32.

**Aging—Its Chemistry.** Albert A. Dietz and Virginia S. Marcum, Eds. American Association for Clinical Chemistry, Washington, D.C., 1980. xxviii, 448 pp., illus. $33.45.

**Alchemy.** The Philosopher's Stone. Allison Coudert. Shambhala, Boulder, Colo., 1980 (distributor, Random, New York). 240 pp., illus. Cloth, $17.50; paper, $8.95.

**Alcoholic Korsakoff's Syndrome.** An Information-Processing Approach to Amnesia. Nelson Butters and Laird S. Cermak. Academic Press, New York, 1980. xvi, 188 pp., illus. $16.50.

**Algebras in Genetics.** Angelika Wörz-Busekros. Springer-Verlag, New York, 1980. vi, 238 pp. Paper, $16. Lecture Notes in Biomathematics, vol. 36.

**Algorithms for Network Programming.** Jeff L. Kennington and Richard V. Helgason. Wiley-Interscience, New York, 1980, xvi, 292 pp., illus. $23.50.

**Aminocyclitol Antibiotics.** Kenneth L. Rinehart, Jr., and Tetsuo Suami, Eds.American Chemical Society, Washington, D.C., 1980. x, 438 pp., illus. $39.50. ACS Symposium Series, 125.

**Analysis of Airborne Pollutants in Working Atmospheres.** The Welding and Surface Coatings Industries. Janet Moreton and N. A. R. Falla. The Chemical Society, London, 1980. viii, 184 pp., illus. $32.

**Ancient Lamps in the Royal Ontario Museum.** I: Greek and Roman Clay Lamps. A Catalogue. J. W. Hayes. Photographs by W. B. Robertson and others. Royal Ontario Museum, Toronto, 1980. xiv, 226 pp. $22.50.

**Annual Review of Sociology.** Vol. 6. Alex Inkeles, Neil J. Smelser, and Ralph H. Turner, Eds. Annual Reviews, Palo Alto, Calif., 1980. viii, 514 pp. $20.

**Antibiotics and Chemotherapy.** Current Topics. R. N. Grüneberg, Ed. University Park Press, Baltimore, 1980. xii, 220 pp., illus. $27.50. Current Status of Modern Therapy, vol. 4.

**Antidiuretic Hormone.** Vol. 4. Mary L. Forsling. Eden Press, St. Albans, Vt., 1980 (distributor, Pergamon, New York). viii, 166 pp. $26. Annual Research Reviews.

**Aquarium Fishes.** Dick Mills. Arco, New York, 1980. 126 pp., illus. $7.95.

**Arabia, the Gulf and the West.** J. B. Kelly. Basic Books, New York, 1980. x, 530 pp. $25.

**Archaeological Explorations in Caves of the Point of Pines Region, Arizona.** James C. Gifford. University of Arizona Press, Tucson, 1980. xiv, 218 pp., illus. Paper, $8.95. Anthropological Papers of the University of Arizona, No. 36.

**Assessment and Modification of Emotional Behavior.** Proceedings of a symposium, Mississauga, Canada, Apr. 1978. Kirk R. Blankstein, Patricia Pliner, and Janet Polivy, Eds. Plenum, New York, 1980. x, 226 pp. $25. Advances in the Study of Communication and Affect, vol. 6.

**Astrophysics from Spacelab.** Pier Luigi Bernacca and Remo Ruffini, Eds. Reidel, Boston, 1980 (distributor, Kluwer Boston, Hingham, Mass.). xii, 664 pp., illus. $47.50. Astrophysics and Space Science Library, vol. 81.

**Atom's Eve.** Ending the Nuclear Age. An Anthology. Mark Reader, Ronald A. Hardert, and Gerald L. Moulton, Eds. McGraw-Hill, New York, 1980. xii, 286 pp. Paper, $5.95.

**Basic Concepts in Quantum Mechanics.** L. V. Tarasov. Translated from the Russian edition (1978) by Ram S. Wadhwa. Mir, Moscow, 1980 (U.S. distributor, Imported Publications, Chicago). 264 pp., illus. $8.

**The Beginnings of Solid State Physics.** Royal Society, London, 1980. iv, 178 pp. £10.25. First published in *Proceedings of the Royal Society of London*, series A, vol. 371, No. 1744.

**Benefit-Cost Analysis of Data Used to Allocate**