intensification of marine resource utilization and access to coastal regional and long-distance trade patterns were probably important factors in influencing coastal settlement. Some of the clearest contrasts between the Atlantic and Pacific coasts come during this period; maize is still not in use in some areas of the former by A.D. 600, whereas it has been in use in some parts of the Pacific by at least 300 B.C. and probably much earlier. Linares suggests that a pattern of generalized resource exploitation impedes or delays the evolution of centralized polities, and this inference is borne out by the data.

The analyses in the book show a variety of approaches to archeological interpretation. The excavation methods are generally carefully described, and one is reminded of the particular difficulties of archeology in the tropics; all archeologists suffer under sometimes burdensome field conditions, but few have had a site literally wash away during a 70-hour deluge. Central America lacks any monumental domestic or public architecture, and features at the sites described in this book are limited to living floors, burial pits, caches, and other minor remains. Analytical emphasis is placed on settlement data, ceramics, lithics, and faunal and floral remains. Burial contexts are described when found, but additional information regarding age, sex, pathologies, dental conditions, and so on would have been welcome.

In this book ceramics are utilized to contrast inter- and intra-site relationships, to create part of the chronological framework, and to detect past movements and contacts of peoples and goods. Linares and the computer consultants with whom she worked at the University of Pennsylvania concluded that, for the ceramic problems she was approaching, comparable results could be achieved by hand-sorting and by computer and that hand-sorting was faster and more economical.

The book contains a wealth of data of relevance to other archeological work in Central America and the Intermediate Area. Although it is not possible in a single publication both to present a great deal of data and to compare them extensively with others' materials, more comparative material would have helped make many of the points advanced. Of closest geographical relevance, I question the lack of more detailed reference to Cooke's Central Panamanian data, Snarskis's Atlantic coastal Costa Rican material, and northwestern Pacific coastal Costa Rican material generated by myself and others. This lack of comparative data also affects the conclusions regarding some aspects of the research; although clearly presented, they are sometimes brief relative to the quantity of research that was done.

The book is a collaborative effort among 18 persons who participated in various phases of the research. In order to "maintain continuity in the discussion and presentation of ideas, but also . . . to make documentation easily available" the reports of the data are separated from and placed after the general interpretative chapters.

The first half of the book is better polished than the reports, which are of variable quality. It would have been helpful to have introductions to the individual reports, which would have helped provide continuity among them. Moreover, it is more difficult than the authors perhaps anticipated to go from chapter to report and back again to determine which cultural materials were associated in which contexts. There are occasional lapses in cross-referencing, but the absence of an index is the prime impediment. The lack of indexes in this monograph series, as well as in recent publications from other presses, is a serious slippage in standards of scholarly publishing. If extensive data are going to be published, then a basic aid for locating them must be included.

The quality of the printing and binding is commendable, and the illustrations are generally of good quality and show desired details. However, many of the illustrations, particularly of ceramics, lack scales or other pertinent information. Except in the soil profile of Report No. 17, no Munsell or other color notations are used in the book.

I reemphasize the importance of the data and ideas presented in this publication. Students of Central American prehistory and tropical cultural development will want to refer to it frequently.

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Micropaleontology

The Paleobiology of Plant Protists. HELEN TAPPAN. Freeman, San Francisco, 1980. xxiv, 1028 pp., illus. $95.

For a long time the focus in micropaleontology was on groups, such as the foraminiferans and radiolarians, that attract little interest among neontologists. Recently, however, there has been a broadening of focus to include the photosynthetic groups, about which a great deal more is known by neontologists. For example, much use is being made of diatoms and coccolithophorids in the Deep Sea Drilling Project, and palynologists are paying more attention to the nonpollen components in their preparations of organic-walled microfossils, such as the dinoflagellates, some of which seem to be particularly useful in petroleum geology.

There have been many books on nonphotosynthetic microfossil groups, but the photosynthetic forms have had to be studied from volumes that are either strong on fossils and weak on biology or vice versa. Helen Tappan has attempted to remedy the situation with the present massive volume.

The book is a compilation of information group by group. There are extensive accounts of the general biology of each group, not limited to features of paleontological interest. There are summaries of ecological information that are more extensive than in many other publications, although still superficial. There is an outline of the factors thought to be important in the deposition and preservation of each group. The fossil record and apparent evolutionary trends are concisely summarized. Although the book is not intended to be taxonomic, it contains substantial "tables," some running to 70 pages, outlining the classification of each group. There are extensive reference lists at the end of each chapter. The depth of treatment is indicated by the fact that the chapter on dinoflagellates runs to 237 pages, with over 100 illustrations, many of them composites. This is the most extensive biological treatment of the group available. The same applies to the chapter on coccolithophores. Many of the chapters could serve in a course on living algae.

The fact that one author has handled all this with a high degree of competence is sufficient grounds for admiration. Add to this the clarity of writing and the wealth of illustration, particularly photographic, and the success of the volume should be assured. What, then, are its shortcomings?

The groups covered in the text are not those that might be expected from the title. Although "protist" is not defined in the otherwise extensive glossary, it is evidently used here in the earliest Haeckelian sense to include both bacteria and "lower" eukaryotes, and not in the more widely used sense that excludes prokaryotes. The "Plant" of the title does not include fungi.

Given the decision to produce in effect

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.

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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