Book Reviews

Broader Themes in Paleoecology

Structure and Classification of Paleocommunities. Papers from a symposium, Miami Beach, Fla., 1974. ROBERT W. SCOTT and RONALD R. WEST, Eds. Dowden, Hutchinson and Ross, Stroudsburg, Pa., 1976 (distributor, Halsted [Wiley], New York). xii, 292 pp., illus. $25.

From an evolutionary point of view, the disadvantage of studying present-day communities of plants and animals is that they represent only a single slice in time: although evolutionary relationships can be inferred, the characteristic time scale for actual evolutionary change is far longer than human lives, not to mention tenure decisions. One important aspect of the study of the fossil remains of past communities is, therefore, that they can exhibit the dynamical workings of evolutionary processes. One can glimpse the movie, albeit jerkily and fuzzily, as opposed to examining the last frame with a hand lens.

Earlier paleoecology was primarily a tool for refining stratigraphic analysis, with consequential practical applications (such as petroleum location). Rocks of the same age can record different environments, and those fossils which are restricted to environments rather than time planes can be a misleading guide to the temporal organization of strata. An appreciation of the autecology of fossilized species can help unravel these complications. More recent paleoecological studies have addressed broader themes. In a pioneering paper, Bretsky and Lorenz (*1*) argued that Paleozoic nearshore communities are typically less diverse, but geologically more persistent, than offshore communities, and that this accords with current ecological notions about stability and diversity. Valentine (*2*) has integrated contemporary ecological theory with paleoecological data to give an account of the evolution of the marine biosphere (*3*). The book under review is a mixture of the old and the new.

The chief difficulty in using paleontology as a time machine to study past communities is the differential preservation of different taxa. Even for organisms that are not soft-bodied, some shells (for example) fossilize better than others. Many of the papers address this problem, at the community level. The techniques used include statistical cluster analyses and a new classification in terms of feeding habit and substrate niche diagrams (Scott). Broadly, they suggest that qualitative community attributes such as species presence-absence data (and thence species richness) or taxonomic composition are likely to be more reliably indicated by the fossil record than are quantities such as diversity or trophic structure.

Two interesting papers deal with communities of ostracods, one set from the late Paleozoic (Brondos and Kaesler) and the other from the Pleistocene (Lister). The species in these guilds of filter-feeding zooplankton fossilize similarly, presenting relatively few problems of differential preservability. Lister shows the community patterns of species relative abundance (as measured by diversity indices, equitability, or just number of species) change in a regular and predictable way with time. The changes seem to be governed by climatic conditions. A beautiful figure (p. 202) shows the correlation between a diversity index (the Brillouin index) and the curve of marine paleotemperatures for this 700,000-year sweep.

In a similar vein, Scott (pp. 46–51) uses his feeding habit-substrate niche methods to analyze the changes in community structure from stable, predictable environments (carbonate shelf below normal wave base) to unstable, unpredictable environments (carbonate sands within the zone of wave action). The "coincidence between facies patterns, petrographic trends, diversity patterns and community feeding habit-substrate niche structure supports the conclusion that environmental stability and predictability, among other factors, influence the complexity of community structure."

One of the prevailing sins in contemporary ecology is a tendency to extravagant generalization, based on particular taxa or particular situations. Paleoecologists are apparently not immune to this temptation. "Of all aquatic communities, freshwater communities are the simplest, least diversified, and support the lowest number of organisms" (p. 84). What about Lake Baikal? "Environments having stable and relatively low amounts of resources sustain the most diverse, highly specialized communities" (p. 41). Does this include tropical rain forests? Such overly simple generalizations are the exuberance of a young and growing subject. I think that as the subject matures a more complex—but still manageable—theoretical framework will emerge. This book is a step toward that happy day.

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References and Notes

1. P. W. Bretsky and D. M. Lorenz, *Proc. North Am. Paleontol. Conv.* (Part E), 522 (1970).
2. J. W. Valentine, *Evolutionary Paleoecology of the Marine Biosphere* (Prentice-Hall, Englewood Cliffs, N.J., 1973).
3. For other recent reviews bearing on the reciprocal interactions between paleontology and theoretical ecology, see S. J. Gould, in *Theoretical Ecology: Principles and Applications*, R. M. May, Ed. (Saunders, Philadelphia, 1976), chapter 12, and E. C. Pielou, *Ecological Diversity* (Wiley, New York, 1975), chapter 8.

Pollen and Spore Evolution

The Evolutionary Significance of the Exine. Papers from a symposium, London, Sept. 1974. I. K. FERGUSON and J. MULLER, Eds. Published for the Linnean Society of London by Academic Press, New York, 1976. xii, 592 pp., illus. $71. Linnean Society Symposium Series, No. 1.

This book includes 23 papers presented at a symposium organized by Ferguson and Muller on the implications of the structure of the exine—the resistant, fossilizable wall of spores and pollen grains—for plant evolution. Although two-thirds of the book consists of papers that exemplify the conventional emphasis on comparative morphology of spores and pollen of modern plants, "pollen types" and "trends," and their relation to the established taxonomy of particular groups, the effects of recent advances are evident throughout. Most strikingly, all the taxonomic papers illustrate how electron microscopy has become an indispensable part of modern palynological studies. Developmental research on patterns of deposition of exine material (discussed most specifically by Rowley, Dickinson, Meyer and Yaroshevskaya, Denizot, and Lugardon) has also had significant impact on evolutionary dis-

cussions—as is exemplified by the intriguing hints given by Denizot and Lugardon for a homology between the centripetally deposited laminated layer that makes up the bulk of the exine (minus perispore) in many bryophytes and pteridophytes and the inner exine layer (endexine) of gymnosperms and angiosperms. Similarly, Huynh's careful analysis of developmental relationships between positions of apertures and tetrad symmetry in angiosperms belongs to a tradition that has had generally recognized evolutionary implications. On the other hand, although Laing summarizes recent studies on Cretaceous fossil pollen that provide important evidence concerning early evolutionary trends in angiosperms, and Chaloner and Heslop-Harrison present arguments about the functional significance of characters in fossil and modern spores and pollen that promise to help explain exine evolution as one facet of the evolution of more basic reproductive adaptations, the dearth of references to the fossil record and the adaptive bases of trends elsewhere in the book (partial exceptions being papers by Köhler, Walker, and Muller and Leenhouts) suggests that these new aspects of palynology have not yet attracted the attention they deserve from systematic palynologists.

Some of the systematically oriented papers are rather narrow in focus and will be of interest primarily to taxonomic specialists. Many, however, are of considerable general interest because they discuss trends in large or phylogenetically important groups (for example, Lugardon on exine structure in pteridophytes, Walker on living "primitive" angiosperms, Hideux and Ferguson on the Saxifragaceae sensu lato, Van Campo on patterns of aperture and symmetry variation within angiosperm taxa) or because they illustrate especially well trends or methodological approaches that are relevant to other groups (for example, Köhler on pollen dimorphism in Sterculiaceae, Le Thomas and Lugardon on exine structure in Annonaceae, Muller and Leenhouts on Sapindaceae). The paper by Hideux and Ferguson, though too preliminary to do full justice to the subject, is of special interest not only because of the key phylogenetic position of the Saxifragaceae, but also for its pioneering attempts to systematize exine structure and sculpture features as seen with the scanning electron microscope and to apply multivariate techniques to analysis of pollen morphological variation and trends. Also of broad evolutionary interest is evidence presented by Walker and by Le Thomas and Lugardon that stages in the origin of the typical "columellar" exine structure of most angiosperms are preserved within living primitive dicots. In the light of comparative and fossil evidence that nonalveolar exines in modern gymnosperms are more advanced than alveolar ones, however, I find Walker's hypothesis that the columellar structure of angiosperms and the "alveolar" structure of many gymnosperms arose as divergent specializations from a homogeneous "atectate" exine of the sort seen in some modern Magnoliales unconvincing. The lack of critical discussion of evolution in gymnosperm pollen is indeed one of the most conspicuous lacunae in this book as a whole.

Although usually plausible and internally consistent, many of the evolutionary schemes proposed by the contributors suffer somewhat from the widespread tendencies toward insufficient justification of assumptions about directions of evolutionary trends and toward "one-character phylogeny" based on the stringing together of modern pollen types without enough consideration of the fossil record, correlation with characters of other organs, or alternative schemes (for example, Chanda and Ghosh's suggestion of a relationship between the dicot family Berberidaceae and the monocot family Xanthorrhoeaceae). Methodological assumptions used in reconstructing evolutionary history are most clearly stated by Muller and Leenhouts, who are refreshingly candid in their emphasis on the limitations of arguments based on comparative morphology, where ambiguities often arise owing to parallelism or mosaic evolution. The repetition of similar series of pollen morphological types in different groups gives the impression that it may sometimes be better to consider groups as characterized by particular "patterns of variation" defined by a limited number of geometric rules, as is argued by Van Campo and illustrated by cases of pollen dimorphism (Köhler, Mattsson) than to search for irreversible, unidirectional "trends."

In sum, *The Evolutionary Significance of the Exine* is an excellent introduction to the successes, limitations, and potential of research on pollen and spore morphology and evolution, and an essential reference for students of pollen morphology and plant systematics.

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Surfaces and Catalysis

The Physical Basis for Heterogeneous Catalysis. Proceedings of a colloquium, Gstaad, Switzerland, Sept. 1974. EDMUND DRAUGLIS and ROBERT I. JAFFEE, Eds. Plenum, New York, 1975. xxvi, 596 pp., illus. $45. Battelle Institute Materials Science Colloquia.

This book is the report of a meeting of 53 persons classifiable into three groups: chemists concerned with heterogeneous catalysis, experimental chemists or physicists working in surface chemical physics, and theoreticians, mainly solid state theoreticians. The second group predominated. The object of the meeting was to evaluate what the last two groups had done and could do for the first. Since the last two groups have only recently interested themselves in applications to heterogeneous catalysis, the meeting was a timely one.

In order to make the colloquium "narrow enough that all the viewpoints could be brought together" it was restricted to catalysis on group VIII metals. Necessarily, then, there are only occasional references to coordination chemistry and organometallic chemistry, which so far have contributed more to the understanding of heterogeneous catalysis than has surface chemical physics. But, the restriction was a wise one because it is in studies of group VIII metals that surface chemical physics has made contributions and has the prospect of making important contributions.

Most of the 26 papers in the volume are related to the core problem of the meeting, but some are rather removed from it. The surface chemical physicists talked to each other and respectfully posed questions to the theoreticians. The theoreticians seemed to try to talk to all groups. On the evidence of the discussion sections, the seven papers on catalysis had little impact, perhaps because most of the surface chemical physicists and the theoreticians are studying chemisorption and do not yet feel ready to go very far into reactions among chemisorbed species.

The concerns of surface chemical physicists reflect the fact that historically their discipline evolved from research in ultrahigh vacua (the U.S. club of the surface chemical physicists is the American Vacuum Society). In their research they employ ultrahigh vacua and probes nec-