# Book Reviews

## Issues of Zonation

**Concepts and Methods of Biostratigraphy.** ERLE G. KAUFFMAN and JOSEPH E. HAZEL, Eds. Dowden, Hutchinson and Ross, Stroudsburg, Pa., 1977 (distributor, Halsted [Wiley], New York). xiv, 658 pp., illus. $35.

Biostratigraphy has to do with the classification, correlation, and interpretation of stratified rocks on the basis of the fossils they contain. Its working units are bodies of rock (stages, zones) distinguished from one another by distinctive fossils; and its methodology deals largely with the discrimination of these units and with their correlation, which involves identification of the same zones or stages in two or more places. It has long been inferred from evolutionary theory that fossil-defined biostratigraphic units accumulated within the same intervals of time wherever they are recognized and thus are fundamentally different from rock-defined lithostratigraphic units, which merely record the former existence in two or more places of the same physical conditions operating on similar materials. The principal achievement of biostratigraphers has been the development of a high-resolution framework within which to discuss diverse aspects of earth history.

*Concepts and Methods of Biostratigraphy* is not an integrated text but a collection of 25 papers by 31 authors, who were obviously given free rein in the treatment of their topics (one disdains use of "biostratigraphy," but his tongue-twisting substitute, "paleontostratigraphy," will not win many votes). The subjects included are passably well distributed stratigraphically and biologically, but the coverage, clarity, and pertinence of discussion vary greatly from one chapter to the next. The volume grew out of a 1973 Paleontological Society symposium, hence 1973 is the crystallization date of most contributions, with only a few including more recent information.

Uniquely biostratigraphic concepts are few, so they get little specific attention. Hancock gives a historical sketch of the concepts of stage and zone and, more or less incidentally, of the general matter of biostratigraphic correlation. Steininger, Surlyk and Birkelund, Berry, Mamet, Ernst and Seibertz, and Waterhouse show, largely by example, how various kinds of zonal schemes have been put together according to evidence from the fossil groups with which they are familiar. Kauffman advises how to select the groups that will give the most narrowly restricted zones, but his advice will be hard to follow until one has made several trial runs (as he has done) to discover which groups should have been selected in the first place.

Hancock questions the practical need for the several types of zones recognized and named by various national and international commissions; but Valentine argues that some of these entities may also be viewed as biogeographic units and, as such, may merit separate recognition. He suggests, for example, that assemblage zones based on marine invertebrates may be the biostratigraphic record of former provinces and thus different in biogeographic significance from range zones, concurrent-range zones, and the like. His point of view seems to be supported by Taylor's excellent report on Late Cambrian trilobite distribution in western North America, which is also the high point of the volume.

Eldredge and Gould and Sylvester-Bradley discuss evolutionary models and their significance to biostratigraphy. The former, of course, see the biostratigraphic record as confirmation of their notion of "punctuated equilibria," which is mostly how things ought to be if the processes favored by evolutionary biologists also operated in the past. Sylvester-Bradley proposes a more involved model, which gets high marks for diplomacy but rivals federal tax laws in complexity. He acknowledges the possibility of (and cites examples to support) both phyletic gradualism and punctuated equilibria, but finds a need for a third mode of speciation, which he terms "reticulate." Its results look suspiciously like those of the oscillatory fooling about that Eldredge and Gould see as predictable in intervals of stasis between major speciation events. Fortunately, as the latter point out, biostratigraphy owes little to any evolutionary model; evolutionary theory may owe more to biostratigraphy than vice versa.

Stages, which are groups of zones, and thus biostratigraphic units to most biostratigraphers, have been made into chronostratigraphic units in other taxonomies. Hancock objects to this, but his protest is based on an interpretation of d'Orbigny that seems superficial by comparison with that of Monty (*J. Paleontol.* **42**, No. 3, 689 [1968]), whose thoughtful essay on d'Orbigny's concepts of stage and zone is not even cited. Monty concluded that, to d'Orbigny, its inventor, a stage was a "paleo-today," an isochronous body of rock defined and delimited on a purely paleontologic basis. Thus it was originally both a biostratigraphic and a chronostratigraphic concept. In at least this classical sense, stages are not the same as biomeres, as Hancock asserts, for the latter may be demonstrably diachronous and are bounded by nonevolutionary changes in dominant elements of a single phylum.

Widely recognizable biostratigraphic units, however defined and named, are based mostly on representatives of mobile, primarily nektonic and planktonic organisms with preservable hard parts that are sufficiently complex morphologically to record genetic differences in some detail. Sohl, Sando, and Ernst and Seibertz show with regard to snails, corals, and echinoids, respectively, that such types of fossils may be useful biostratigraphically in limited areas, or when nothing else is available. But every schoolboy knows that trilobites, graptolites, goniatites, fusulinids, and conodonts are the basis of the primary biostratigraphic division and correlation of Paleozoic rocks; that ceratites and ammonites, with help from conodonts in the Triassic and foraminifers in the Cretaceous, have pride of place in Mesozoic biostratigraphy; and that forams and noncephalopod mollusks are most useful in the zonation and correlation of Cenozoic strata. What schoolboys may not know is why these groups are so important—and some of the mystery will linger after reading this volume.

Douglass includes enough basic information about fusulinids to make the rationale of fusulinid biostratigraphy obvious; Rhodes and Austin do a creditable job for conodonts; and Berry gives reasonably adequate information for graptolites. Ammonoids, however, get short shrift. Goniatites are not mentioned, even though they are primary indexes to standard stages and zones from the Devonian through the Permian. Ceratites

are neglected; and Jurassic ammonites are included only as isolated examples of evolutionary mode by Sylvester-Bradley, even though biostratigraphy, based on ammonites, grew up in the Jurassic and that system is often hailed as the one in which the science has reached peak development. The problems that beset ammonite biostratigraphers in the Cretaceous are tersely summarized by Kennedy and Cobban, but they say little about the nature of ammonite-based zones and shed little light on the rationale of the ammonite biostratigrapher. In fact, one gets the impression that too much homage may have been paid the cephalopods, at least those of the Cretaceous.

To most contributors to this volume, the development of a zonal scheme for the interval of their principal interest seems to be the ultimate goal, rather than just a means to some other end. Consequently, the important business of biostratigraphic correlation is largely ignored—and therein lies the principal weakness of the volume. Correlation, although mentioned, is not discussed adequately in 16 of the 25 papers in the volume. Miller does deal specifically and effectively with the graphic-correlation method introduced by Shaw in 1964, but the power of this procedure is apparently not recognized by other authors (compare, for example, the results Miller achieves with those of Doyle). Hazel discusses various quantitative techniques for assemblage-zone discrimination. Zonal schemes discussed by others, however, seem to have been pieced together mostly by qualitative stacking of biostratigraphic units from various sections without much consideration of the methods of correlation implicit in this procedure. The schemes outlined by Steininger and by Surlyk and Birkelund are admittedly put together from composite sections "correlated" lithostratigraphically.

*Concepts and Methods of Biostratigraphy*, despite its unevenness, is a valuable collection of papers, which serve in the aggregate as a reasonably inclusive state-of-the-art summary of biostratigraphy. Like most state-of-the-art volumes, this one contains little that is new; but that does not detract from its potential usefulness as a companion to available American stratigraphy texts, in which biostratigraphic aspects of the science take a distant second place to lithostratigraphic ones.

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## Lunar Research

**The Moon—A New Appraisal from Space Missions and Laboratory Analyses**. Papers from a meeting, June 1975. The Royal Society, London, 1977. vi, 606 pp., illus. £38.95. Also published as *Philosophical Transactions of the Royal Society*, Series A, vol. 285.

This collection of 66 papers summarizes recent findings in essentially all the significant areas of current lunar research. With hardly an exception the authors are scientists actively engaged in lunar studies; most of them are working with samples of the moon returned by the Apollo and Luna missions. For the most part, the contributions represent a high level of scholarship and deserve the attention of anyone interested in keeping abreast of current research in this field.

An unusually high proportion of the authors are from abroad; all the European and Commonwealth laboratories that have worked on lunar rocks are represented. This does not affect the flavor of the book significantly. The discipline and standards set by the NASA lunar program have so effectively established common sets of attitudes and values that national differences have become irrelevant.

Almost all the results presented here can be found elsewhere, particularly in the proceedings of the lunar science conferences held annually in Houston, but most of the present authors have taken a broader perspective than is commonly found in those more specialized papers. Nevertheless, reading through a major portion of this book will be hard work for those who have not followed the subject closely. In this regard the organizers of the conference, Harrie Massey, G. M. Brown, G. Eglington, S. K. Runcorn, and H. C. Urey, have done the reader a service by outlining in the preface a tentative consensus concerning the main advances in our understanding of the moon that have been made during the 10 years since the Royal Society was last host to a lunar meeting, and the advances have indeed been considerable. Without the outline, it might prove difficult to know that the authors are writing about the same moon, so diverse are their assumptions, interpretations, and conclusions. To a large extent this is the way it must be in a frontier field of science. For the most part, the data are of very high quality and in good agreement, and the differences arise primarily because authors with various scientific backgrounds treat results with which they are familiar differently from those with which they are not. Also, there is considerable tossing about of the burden of proof on matters about which present evidence is inconclusive. In a number of cases, one gets the impression that a serious and respectful effort to understand why others draw differing inferences from essentially the same data would reduce the number of conflicting conclusions.

But that won't be the entire answer, for there are signs that matters will become more obscure before they are clarified. Most of the authors explicitly or implicitly accept a scenario for the earliest history of the moon that involves equilibrium condensation of minerals from a hot solar nebula and the rapid accumulation of this material into the moon and planets. It is possible that this is more or less what actually occurred, but the present consensus is more a convention than a compelling consequence of the data. As our knowledge of the formation of stellar and planetary systems advances, this simple picture is bound to suffer, and some of the present scanty agreement will be lost with it. It will be interesting to compare the present book with the one that will probably appear in 1987.

The book is beautifully printed; the size of the pages, the margins, and the type are from a different epoch. One cannot escape the thought that the physical volume may prove less perishable than many of the conclusions to be found on its pages.

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## Primate Evolution

**Molecular Anthropology**. Genes and Proteins in the Evolutionary Ascent of the Primates. Papers from a symposium, Burg Wartenstein, Austria, July 1975. MORRIS GOODMAN, RICHARD E. TASHIAN, and JEANNE H. TASHIAN, Eds. Plenum, New York, 1976. xiv, 466 pp., illus. $35. Advances in Primatology.

Although this book has some of the deficiencies characteristic of symposium volumes, many of the papers it contains are excellent reviews, apparently more fully developed than the original presentations. The subjects that are well covered are: primate phylogeny as deduced from the fossil record (discussed by Simons and by Walker); albumin and transferrin relationships among primates (Sarich and Cronin); immunodiffusion (Dene, Goodman, and Prychodko); and amino acid sequences for individual proteins of primates (presented in a number of papers).

The book is not simply a presentation