Book Reviews

Paleobiogeography

Atlas of Palaeobiogeography. A. HALLAM, Ed. Elsevier, New York, 1973. xii, 532 pp., illus. $42.

Faunal Provinces in Space and Time. A congress, London, Dec. 1969. F. A. MIDDLEMISS, P. F. RAWSON, and G. NEWALL, Eds. Seel House Press, Liverpool, 1971. x, 236 pp., illus. £5.50. Geological Journal Special Issue No. 4, 1971.

Organisms and Continents through Time. A symposium, Cambridge, England, Dec. 1971. N. F. HUGHES, Ed. The Palaeontological Association, London, 1973. vi, 334 pp., illus. $26. Palaeontological Association Special Paper No. 12; Systematics Association Publication No. 9.

At their first annual meeting more than half a century ago, the Council of the (American) Paleontological Society designed a conference on faunal criteria for use in paleogeography. Its purpose was "for the discerning at what probable depths the Paleozoic sediments were deposited, the shorelines of such deposits, the temperature of the water, the factors indicating faunal provinces, and the effect of currents on the life assemblages." At the conference, held on 29 December 1910, papers were given by the most highly regarded men of the profession: Charles Schuchert, T. Wayland Vaughan, Stuart Weller, Rudolf Ruedemann, David White, William H. Dall, R. S. Bassler, and John M. Clarke. Now the theme of that conference is again discussed, but with a fundamentally different point of view. Whereas in 1910 certainly all participants were continental "fixists" (probably no other view was known to them), most current paleontologists seek to view distributions in terms of the Wegnerian Revolution of lithospheric drift.

If the arrangement of continents and oceans at any given time is but a passing phase, then the choice of a base map on which to plot animal and plant distributions is also free to change with the time period of interest. And even if, as Hallam claims in his introduction to the *Atlas of Palaeobiogeography*, "it will be a long time before we can reliably plot the positions of continents for all the different periods," we nevertheless know that most reconstructions are likely to be a much closer approximation to the truth "than any present-day projection," as Bulman states in *Faunal Provinces in Space and Time*. Or, as Whittington and Hughes succinctly put it in *Organisms and Continents through Time*, "Plotting early Paleozoic faunal provinces on present-day geography is not enlightening. . . ."

A map, the very heart of any biogeographic construction, predetermines the kind of organization we are likely to see in our data and thus exerts a direct but often hidden influence over our science. As an example of the kind of result that a so-called "objective" Recent map leads us to, we have the curious feature of Permanian protozoan distributions along one coast of a continent but none at all on the others (Gobbett, *Atlas*, in an otherwise valuable article). Any one of several drift reconstructions immediately demonstrates that this is the pattern of marine seas peripheral to a single large continent.

Because of the importance of appropriate base maps, I was immediately drawn to *Organisms and Continents*, which features a *new* set of Mercator and polar projections constructed by Smith, Briden, and Drewry according to paleomagnetic evidence for the Upper Cambrian–Lower Ordovician, Lower Devonian, Mississippian, Permian, Triassic, Middle Jurassic, Middle Cretaceous, and Eocene. Most of its 23 chapters use the Mercator projection with its attendant large distortion at latitudes of 60 degrees or higher. Since much of the Paleozoic featured continents at high latitudes, these charts poorly display these reconstructions. In contrast, the *Atlas* tries to standardize on a Winkel "triple projection" (essentially equal area), which, however, displays the continents only in their present positions and deletes Antarctica even from chapters on the Late Paleozoic. This map is used in almost all of the 48 chapters of the *Atlas*, no matter what period of geologic time is under discussion, although some authors also use drift reconstructions. The practice in the 13 chapters of *Faunal Provinces* is less formal, with Sylvester-Bradley (in a thoughtful chapter on dynamic factors in animal distributions), Cowie, and Bulman making extensive use of drift maps. What paleogeographers seem to be working toward is a synthesis of the best features of historical geology and cartography in a set of equal-area projections appropriate to 30- to 50-million-year intervals of the past 600 million years.

In addition to the recognition that a change is needed in base maps, one can sense in these books a new decisiveness in the way questions are being asked. The traditional reliance on years of experience and anecdotal information exists, of course—biogeography has been claimed to be only for the "mature" systematist. But a much more analytical approach is also used, particularly in outstanding chapters of *Organisms and Continents* by Alwyn Williams (Ordovician paleogeography), Vine (Permian paleogeography), Hughes (Mesozoic-Tertiary land-plant distributions), and Coryndon and Savage (African mammal faunas) and of the *Atlas* by Kauffman (patterns of diversity in Cretaceous bivalves) and Cox (Triassic tetrapod paleogeography). In no chapter in any of these books, however, are equilibrium models from modern biogeographic theory, which are based on events in ecologic time, applied to geologic events charted over evolutionary time.

In general, the 84 articles in these three volumes concentrate on the description of biogeographic data and derive interpretations based on the traditional three causes: climate, dispersal, and history. A higher percentage of authors are concerned with applying the distributional data to a geologic problem than with using the geologic framework to answer a biologic question. Most chapters emphasize one taxonomic group, or even a few genera, and to have five chapters of the *Atlas* on chiefly European Jurassic ammonites seems excessive. Except for the Silurian (*Faunal Provinces*: Holland), changes in "whole" faunas are not charted; the vertebrate and paleobotanical chapters have the broadest coverage. Although various authors refer to modern plant and animal distributions, only *Faunal Provinces* (Hewer) has a specific chapter on "Modern zoogeographical regions," and that barely discusses marine distri-

butions. In sum, we are presented with separate "miniatures" which taken together illustrate alternating increasing and decreasing provinciality in the biota of the past 600 million years.

Cambrian deposits with the earliest widespread metazoans of the fossil record have trilobite faunal provinces as well as faunal changes in deposits formed in water of increasing depth (*Faunal Provinces*: Cowie; *Atlas*: Palmer). Provinciality continues through the remainder of the Cambrian and becomes especially marked in the Early and Middle Ordovician (*Atlas*: Whittington on trilobites, Jaanusson on brachiopods, Skevington on graptolites, Kaljo and Klaamann on corals, Bergström on conodonts; *Organisms and Continents*: Whittington and Hughes on trilobites, Williams on brachiopods; *Faunal Provinces*: Bulman on graptolites). Provinciality during this period of time may have been developed to the same extent as during the Recent (given preservational bias), but no precise comparisons have yet been made.

During the Middle Ordovician, plate movements brought continental areas into collision, so that faunas were "cosmopolitan" during the Upper Ordovician and Silurian (*Atlas*: Berry on graptolites, Kaljo and Klaamann on corals, Boucot and Johnson on brachiopods; *Organisms and Continents*: Cocks and McKerrow on brachiopods, Holland on trilobites, graptolites, brachiopods, corals, cephalopods, crinoids, and ostracods). From the Cambrian into the Silurian, equatorial regions strike northeast across the joined North America and western Europe. This has resulted in the equatorial faunas of the Lower Paleozoic being better known than the contemporaneous higher-latitude faunas, in sharp contrast to the situation for the Recent.

In the Devonian and Lower Carboniferous, realignment of lithospheric plates led to an increase in marine provincialism for sessile groups (*Atlas*: Johnson and Boucot on brachiopods, Hill on corals, Ross on foraminifera; *Organisms and Continents*: Oliver on corals, Cocks and McKerrow on brachiopods; *Faunal Provinces*: House on corals and brachiopods) but not for highly mobile cephalopods (House in all three volumes; Hodson and Ramsbottom in *Organisms and Continents*).

On the continents during the Middle Paleozoic, Lower and Middle Devonian plants occur in two general regions, called northern and southern by Edwards in the *Atlas*. This floral distinction disappeared in a more cosmopolitan Upper Devonian and Lower Carboniferous flora (*Organisms and Continents*: Chaloner and Lacey). Also during the Carboniferous, most tetrapod deposits occur in the tropics with subsequent farther east-west migration (*Atlas*: Panchen).

With the closure of various "Hercynian" seas in the Upper Carboniferous and Permian, the wide continentality resulted in four floral regions (*Atlas*: Chaloner and Meyen). One of these, the Permian *Glossopteris* (Gondwana) region, is the largest floral realm ever in geologic history (*Atlas*: Plumstead). Lower Permian reptilian provinces exist in northern Laurasia and southern Gondwana, but by the Middle and Upper Permian the reptilian faunas of the two regions are sufficiently similar to argue for considerable interchange (*Atlas*: Romer; *Faunal Provinces*: Charig). In the epicontinental seas, the Upper Carboniferous and Permian suturing of plates resulted in latitudinally zoned faunas (*Atlas*: Ross on foraminifera, Stehli on brachiopods, Gobbett on foraminifera).

As the Mesozoic begins, shelf faunas occur in an equatorial Tethys zone (extensively discussed in Systematics Association Publication No. 7, "Aspects of Tethyan Biogeography," 1967), and along the Pacific margin of the Americas, later connecting in a circum-Arctic route (*Atlas*: Kummel on cephalopods and bivalves, Westermann on bivalves). By the Jurassic, a third general realm is easily differentiated: Atlantic boreal (with an Upper Jurassic Arctic province) (*Atlas*: cephalopod chapters by Stevens, Howarth, Dietl, Cariou, Enay, Wiedmann, and Matsumoto). This pattern persisted for approximately 100 million years into the Upper Cretaceous, with increasing partitioning of the equatorial seas as the Atlantic Ocean became wider (*Atlas*: Stevens on cephalopods, Dilley on foraminifera, Ager on brachiopods; *Organisms and Continents*: Dilley on foraminifera, Coates on corals; *Faunal Provinces*: Casey on cephalopods). The hypothesis that the boreal-vs.-tropical differentiation was caused by salinity or local paleogeographic conditions (*Faunal Provinces*: Hallam) is rejected in favor of the influence of climatic zonation (*Atlas*: Stevens, Cariou, Beauvais, Wiedmann).

Cretaceous bivalves display diversity patterns, noted in earlier periods (but not well documented), corresponding to cycles of transgression and regression. Increase in endemism in the mid-Cretaceous of North America "is coincident with the first widespread flooding of the craton since the Jurassic, and drift isolation from Europe, creating a new area of marine bivalve radiation" (*Atlas*: Kauffman). Among the deep-water deposits, planktonic foraminifera and organic siliceous sediments display a latitudinal zonation from the Cretaceous (and earlier for siliceous sediments) (*Faunal Provinces*: Dilley; *Organisms and Continents*: Ramsay).

On Mesozoic continents, "The Triassic is the only [Phanerozoic] Period during which terrestrial vertebrates show clearly that land connections existed between every one of today's continents" (*Atlas*: Cox). Jurassic and Cretaceous dinosaurs are also very widespread (*Atlas*: Charig). Triassic plants are less diverse than those of the Permo-Carboniferous, but southern Gondwana, north temperate Euramerican, and northern Angaran provinces remain (*Organisms and Continents*: Barnard). The Jurassic and Cretaceous are also characterized by low-latitude and adjacent higher-latitude floras within which additional endemism may occur (*Atlas*: Wesley; *Organisms and Continents*: Barnard, Hughes).

Paleobiogeographic trends during the Tertiary include additional endemism and latitudinal zonation as faunas became separated (*Atlas*: foraminifera treated by Hottinger, Adams, Funnell, and Ramsay; ostracods by McKenzie [also in *Organisms and Continents*]; *Faunal Provinces*: Funnell on plankton). Perhaps marine species with Recent widespread distributions (and no prominent means of dispersal) are a relic of the pre-Miocene, when equatorial currents circumnavigated the globe (*Atlas*: Lagaaij and Cook for bryozoa). Endemism on continents during the Tertiary (including the Pleistocene effects) has also increased for vertebrates (*Atlas*: Kurtén on mammals) and plants (*Atlas*: Tralau). The development of placental and marsupial mammals in South America but only marsupials in Australia is best explained by the existence of a selective barrier to migration across Antarctica in the early Tertiary (*Organisms and Continents*: Cox). Increasing endemism in Africa through the Tertiary has resulted from the development of the climate that led to the Sahara (*Organisms and Continents*: Coryndon and Savage).

With respect to matters of convenience, the *Atlas* has an index of genera and of people, but none for places, and there are no abstracts to articles. *Organisms and Continents* lacks an index altogether, but each article has an abstract. *Faunal Provinces* has both author and subject indexes, and all but one chapter has an abstract.

In general outlook, the *Atlas*, with its emphasis on the present distribution of continents, is the most traditional of the three books, but it has 60 percent of the articles and the most complete coverage. The *Atlas* marks the end of a long era of biogeographical charting on Recent maps. The organizers of *Organisms and Continents* (with its new maps) and *Faunal Provinces* have consciously incorporated lithospheric drift into the subject of geological biogeography. Virtually every paleontologist will need to consult these books for at least a few chapters concerned with his taxonomic or stratigraphic specialty. Thus they are of inestimable value to those concerned with the distribution of plants and animals of the past and, through the new set of paleogeographic maps, to those concerned with general geologic history.

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Genetic Interactions

Hybridization of Somatic Cells. BORIS EPHRUSSI. Princeton University Press, Princeton, N.J., 1972. xii, 176 pp., illus. Cloth, $9.50; paper, $4.95.

The observation made by Barski and colleagues in 1960 that mammalian cells in culture occasionally fuse and give rise to viable hybrid lines removed the major obstacle to the development of somatic cell genetics: the lack of a mating system. The author of this book was among the first to appreciate the scope and potentialities of Barski's discovery. What might have appeared to be just a laboratory "freak" became, in his hands, a reliable technique for directly testing genetic interactions between somatic cells of vertebrates. In this book, which contains essentially the text of a series of honorary lectures he gave at Princeton University in January 1971, Ephrussi describes the contributions of cell hybridization to the study of mammalian genetics, cell differentiation, and cancer. It is not the first book to be written on the subject. Harris's *Cell Fusion*, published two years earlier, covers to a similar extent the same general topic. The scope of Ephrussi's book is different, however. Essentially, it reflects the geneticist's approach to the problems of cell differentiation and cell multiplication. Cell hybridization is looked upon as the method of choice for testing somatic cell phenotypes for the sort of interactions which in other systems define specific functional relationships between genes—dominance and recessiveness, complementation, suppression and induction, recombination, and so on. Work related to cell differentiation—the author's major interest—is given priority. Critical experiments are described in detail and with sufficient clarity to be comprehensible to the nonspecialist. The different behavior following hybridization justifies the distinction, underlined by the author, between "household" and "luxury" functions in cells, and supports the interpretation of the latter as epigenetic rather than genetic changes. The author is careful in avoiding farfetched interpretations of data (the word "extinction" rather than "suppression" is used to describe the disappearance of characters following hybridization with negative cells). This conservative attitude does not detract from the author's witty style and critical, highly opinionated approach to problems.

Perhaps some of the present limitations of this method in analyzing genetically epigenetic changes should have been pointed out more explicitly. The main one stems from the very property of hybrid cells which has made them useful in the formal genetics of man: their chromosomal instability. As a result of this, most hybrid cell populations are intrinsically heterogeneous, and karyotypic characterization of them is based on mean or modal values. This limitation becomes obvious in the chapter devoted to the study of cancer. It strikes one as somewhat surprising that a debate over such a fundamental question as that of dominance versus recessiveness of malignancy could be based entirely on statistical evaluations of chromosome numbers. It should be added that, although he claims to have "little taste for formal genetics in general," the author stresses, in a different chapter, that "formal genetics is beyond any possible doubt an absolutely essential prerequisite to the attack of any other problem involving genetic mechanisms."

Finally, in the chapter devoted to a historical survey of the major contributions to the field, the author's careful assessment of priorities will not go unnoticed. It can hardly be found inappropriate. It adds, however, a flavor of contest between *prime donne* which many readers may find unnecessary.

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The Order Carnivora

The Carnivores. R. F. EWER. Cornell University Press, Ithaca, N.Y., 1973. xvi, 494 pp., illus., + plates. $21.50.

Mention such animals as mongoose, otter, raccoon, hyena, tiger, grizzly bear, and wolf, and each person will conjure up mental images which engender emotions ranging from delight and exultation to fear and loathing. Man has for centuries been fascinated by members of the order Carnivora; he feels an emotional kinship to them, particularly to such large social ones as the lion and the wolf, perhaps because he, too, has evolved psychologically as a hunter. Whatever the reason, Ewer's book, the only available one devoted to the carnivores, is certain to interest a wide audience.

The book can be read at several levels, and the satisfaction it provides will to some extent depend on the depth of one's interest. I find it a useful reference on various topics. One chapter lists all species and their distribution, another discusses fossil carnivores. To someone like myself who knows little about anatomy, the first few chapters, comprising about one-third of the text, provide a useful summary of skeletal structure, anatomy of the soft parts, and a description of the capacities of the senses, including evidence for color vision and the upper limits of hearing. Should one want to know the diploid chromosome number of the coati, the composition of cheetah milk, or the gestation period of the polar bear, there are tables that give the answers.

About half of the text is devoted to natural history, primarily to food habits, land tenure systems, social organization, and reproduction. To present information on the ecology and behavior of nearly 250 species fully would