Paleobiogeography: Current Concerns

Historical Biogeography, Plate Tectonics, and the Changing Environment. JANE GRAY and ARTHUR J. BOUCOT, Eds. Oregon State University Press, Corvallis, 1979. xii, 502 pp., illus. $59.75.

With the discovery of plate tectonics in the 1960's it became apparent that constant change in geography is the background against which the evolution of life has taken place and that paleobiogeography must become a central subject in the field of paleontology. *Historical Biogeography, Plate Tectonics, and the Changing Environment* is an excellent review of the state of paleobiogeographic study.

The book includes 16 papers from a colloquium held at Oregon State University in 1976 and 22 supplied by other contributors. Although the book appears three and a half years after the original symposium, the reference lists include citations extending into 1978 and the work is generally up to date. As one would expect from a symposium volume, the book is not an attempt at a complete compilation of distributions throughout the Phanerozoic, nor are the papers uniform in scope. Instead, they range from specific studies of the paleobiogeographic implications of single occurrences (examples are Ormiston and R. J. Ross on an Ordovician-age trilobite, *Monorakos*, in Alaska and Zinsmeister on Early Tertiary Mollusca from Seymour Island, Antarctica) to worldwide summaries of major groups (such as C. A. Ross on fusulinids in the Late Paleozoic) to presentations of theoretical models (T. J. M. Schopf on the relationship between provinciality and diversity).

The book contains few papers on general biogeographic theory in historical perspective. This reflects the state of the field. The differences in the constraints and possibilities associated with the study of different parts of the geologic time scale leave us with few unifying concepts, and without much prospect of generating many until common goals of investigation appear.

The papers in the book reveal the general ideas that seem significant to specialists who concentrate on different portions of geologic time. The 18 contributions about organisms of Paleozoic age are generally concerned with either recognizing biogeographic regions or using biogeographic distribution to define ancient geography. Because pre-Mesozoic geographic configurations are not preserved but must be interpreted from secondary data these goals are understandable for studies of Paleozoic biogeography. The four contributions on Mesozoic distributions concentrate on the influence of the breakup of the supercontinent of Pangaea. This geography is assumed by the contributors. The six papers on Cenozoic distributions focus on the impact of climatic change on organisms and on the changes in distribution that led to modern biogeographic patterns. Because the global geographic situation during the Cenozoic was fairly close to the modern situation physical geographic features per se are not at issue. Instead, relatively subtle changes that affected particular areas are emphasized. Biogeographers dealing with Recent distributions (six papers) tend to reach back into time looking for specific geographic changes that would help explain the anomalous aspects of those distributions. They seek more direct cause-effect explanations than do the authors of the strictly paleontologic studies, probably because in the case of living organisms observation of responses to particular changes is possible.

The contributions that I found particularly useful include several on groups not previously summarized in paleobiogeographic studies, a series of papers on detailed relationships during Devonian time, and several on Cenozoic phenomena. The papers by Pojeta on rostroconch mollusks and by Beauvais on Middle Jurassic corals are examples of those that add new data for comparison with better-known or more widely studied groups. The studies of North American rugose corals by Oliver and Peddler, of trilobites in the Malvinokaffric Realm by Eldredge and Ormiston, and of brachiopods by Savage, Perry, and Boucot present both detailed data and rigorous analysis that clarify and refine several regional patterns for the Devonian. Repenning, Roy, and Grigorescu provide intriguing documentation of the changing distribution of seals and walrus through the Cenozoic. Benson's study of ostracods and the development of the psychrosphere is incisive in its reasoning and delightfully written. The account of the biogeography of barnacles in the Californian transition zone presented by Newman should help all biogeographers and paleobiogeographers understand how much species ranges can change over short intervals, often for reasons that may be hard to document in the geologic record.

The only consistently dissatisfying aspect of the book is the presentation of maps and paleogeographic reconstructions. Latitude and longitude are omitted from about half the modern maps and two-thirds of the paleogeographic reconstructions. Because a variety of projections are used, the actual geographic grid is not always obvious, even for maps of the Recent. If geographic distributions are to be dealt with in a precise way they must be shown in a format that permits accurate comparisons.

The preliminary and incomplete nature of available reconstruction seems to have irritated the editors. In the "epilogue," Boucot and Gray present generalized biogeographic patterns for each period of the Paleozoic entirely on a Pangaea geographic base. They claim they are showing that the data are so ambiguous that they fit any reconstruction. Boucot and Gray seem to have missed, or chosen to ignore, the point that the distribution of organisms at all times in the Paleozoic was in some real geography that almost certainly was not Pangaean. They explicitly exclude paleomagnetic information because it conflicts with apparent biogeographic similarities, even though it is now quite well established that paleogeographic configurations were closely related to paleomagnetic positions and that paleogeography and history determine paleobiogeographic relationships and not the reverse. This paper seems flawed not only in numerous technical details but also in general concept.

The book leaves the reader with some definite impressions. We get a picture of the variation in the distribution of organisms through time. A relationship between plate tectonics and associated phenomena such as climatic change and biogeographic distribution is apparent. Biogeographic distributions are dynamic and some changes take place so rapidly

they cannot be followed with the stratigraphic resolution available. As one goes back in time the loss of data makes the resolution of detail permanently imperfect, and many attempts at explanation end up in the realm of speculation. The most pressing need for paleobiogeography is reliable and relatively detailed paleogeographic reconstructions, as several contributors note. Otherwise we can make only continued vague generalizations. Adequate reconstructions will be necessary before a better survey of paleobiogeographic concepts can be compiled than is presented in this book.

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Space Physics

Solar Flares. A Monograph from Skylab Solar Workshop II. PETER A. STURROCK, Ed. Colorado Associated University Press, Boulder, 1980. x, 514 pp., illus. $17.50.

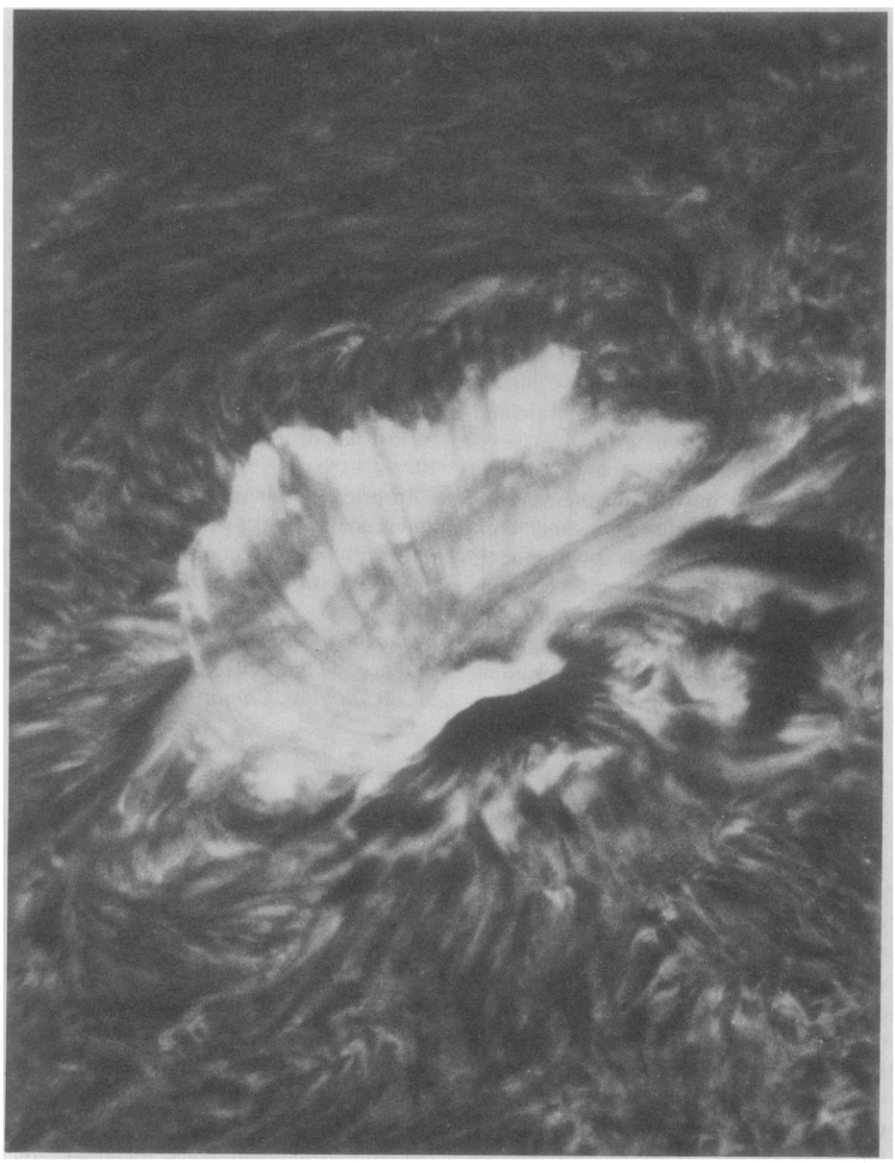
This book is the published record from Skylab Solar Workshop II held at various times from late 1976 through 1977. The first chapter, an introduction, and the last chapter, on flare models, are written by the editor. The rest of the book is written by the teams who participated in the workshop (a total of 82 people). The other chapters are on the preflare state, primary energy release, energetic particles in solar flares, impulsive phase of solar flares, the chromosphere and transition region, mass ejections, and the thermal x-ray flare plasma. Two appendixes show how two workshop teams estimated the radiative and mechanical energy output of the 5 September 1973 flare. The mechanical output exceeded the radiative by 100 times or more.

The book is primarily for solar and astrophysical researchers and those familiar with the jargon and methods used by those groups. It allows such readers to share in the most recent observational and theoretical developments regarding solar flares and related phenomena. The workshop was the vehicle for many of those developments. The last paragraph of the chapter on the preflare state expresses well what the book brings to the reader:

> That the results of the Preflare Study were not exactly as planned was probably inevitable. A great deal of fruitful collaboration occurred, particularly among the experimenters, as a direct result of the Workshop. The theoreticians also made considerable progress, not the least of which was to properly understand the physical conditions in the solar corona, and what can be learned about them. The observers discovered, at a basic level, what theorists need to know to be able to build models of solar-activity structures. This intensive mutual knowledge may be the most important long-term outcome of such workshop studies.

The various chapters bring diverse messages to the reader, ranging from the need for new kinds of space observations (such as magnetometry and polarimetry) to the need for dramatically improved spatial, temporal, and spectral resolutions to the sore need for theoretical modeling. With respect to primary energy release, for example, the theories are much more definitive than the observations. On the other hand, knowledge of mass ejections is characterized by copious observational detail for which we have little or no relevant theoretical information.

From another point of view, it is satisfying to see in the chapter on the chromosphere and transition region how a century of ground-based research on the quiet solar photosphere and chromosphere has led to diagnostic tools and model atmospheres that permit us to discriminate between basic flare processes and models by studying their expected and observed impacts on photospheric and chromospheric line profiles. Throughout the book it is made abundantly clear that the traditional photospheric and chromospheric "flares" are only target areas for the variety of energy flows that emerge from the primary energy release sites in hot coronal arches.



"A large two-ribbon flare with post-flare loops. Viewed at the centerline of Hα. Big Bear Solar Observatory, 10 September 1974 2302:55 UT." [From *Solar Flares*]