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.

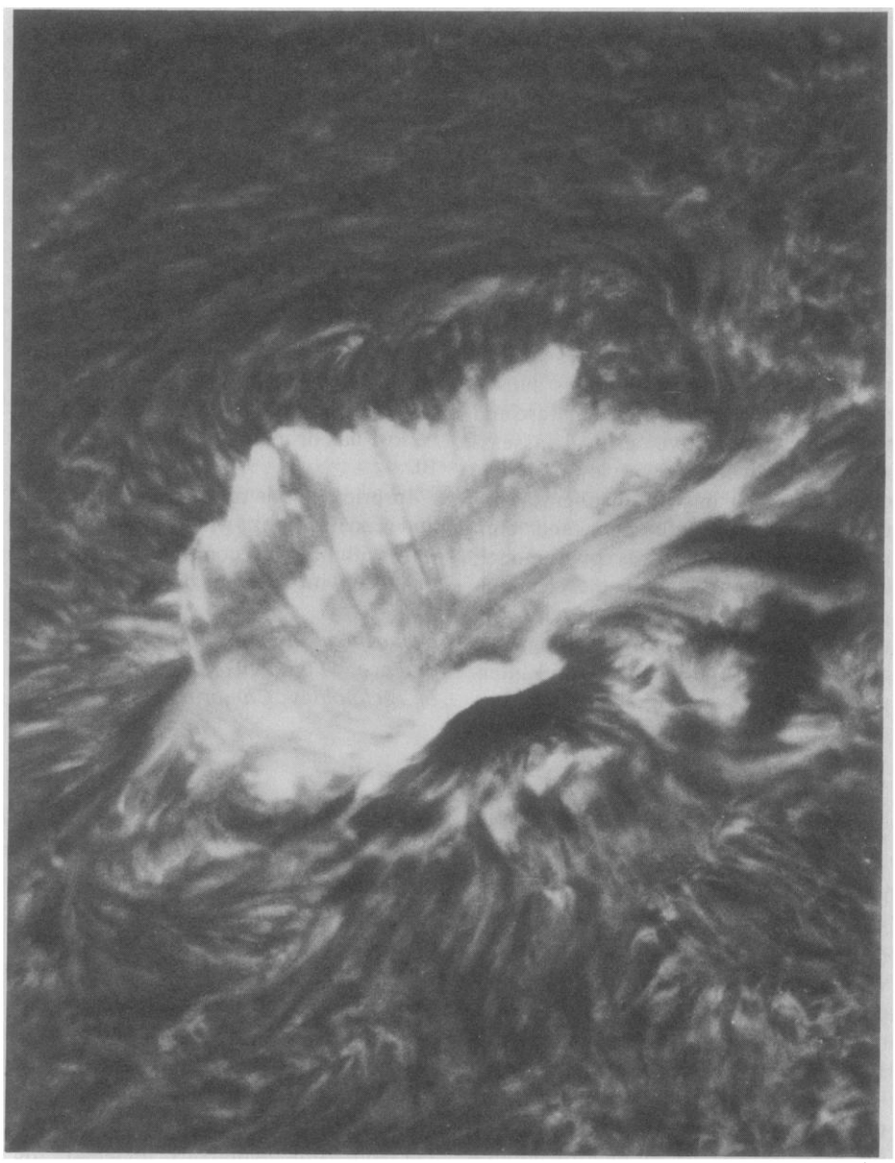
This book is the published record from Skylab Solar Workshop II held at various times from late 1976 through 1977. The first chapter, an introduction, and the last chapter, on flare models, are written by the editor. The rest of the book is written by the teams who participated in the workshop (a total 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*]

The book summarizes and enhances our knowledge of solar flares and articulates the need for the Solar Maximum Mission (launched 14 February 1980) and the Solar Optical Telescope (launch 1985?).

The various facets of solar flare research are well covered, but an overall picture combining them is left as an exercise for the reader.

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Planetary Geochemistry

Origin of the Earth and Moon. A. E. RINGWOOD. Springer-Verlag, New York, 1979. xiv, 296 pp., illus. $24.80.

The range of scientific speculation about the origin of the planets has narrowed markedly in recent years, owing both to the expansion of the scope of chemical and physical spacecraft investigations of the moon and other planets and to the great recent progress in understanding mineral stability relations at high pressures by means of the diamond-anvil press. Ringwood, as one of the most vigorous and vocal of the disputants in this arena, has now collected and updated his arguments in one accessible source. The book provides at least mention of competing theories but is most valuable in presenting a mature and refreshingly objective critical assessment of Ringwood's own views. He has clearly taken pains to distinguish between evidence, inference, and conjecture in describing his own model; however, one is left with the clear impression that all *other* work is pure conjecture. The debate between Ringwood and Edward Anders over the interpretation of observed siderophile element abundances in the lunar highlands, which is of great importance in constraining the history of the moon, is described by Ringwood as follows: "At the Ninth Lunar Science Meeting in March 1978, [my] conclusions were contested by Anders on behalf of the Chicago School. I believe that the Chicago position on this issue is incorrect." Ringwood then refers the reader to the "comprehensive account of the reasons for this opinion" in an article by himself and J. W. Delano. Those who find this unenlightening as an account of the debate are presumably at liberty to find (and read) the Anders reference on their own initiative.

The detailed discussions of the composition of Earth's mantle and core are most useful, but, again, when Ringwood offers crucial conclusions of great genetic significance one may wish to have the conclusions of others for comparison. With respect to the lower mantle, Ringwood concludes, "There seems little doubt that material of pyrolite composition, occurring in a mineral assemblage a few percent denser than isochemical mixed oxides, is capable of explaining the density and seismic distributions observed throughout most of the lower mantle." For comparison, a recent review (T. J. Ahrens, *Science* **207**, 1035 [1980]) concludes, "If a lower mantle composition similar to Ringwood's pyrolite model . . . is assumed, the shock wave data yield a density of 5.31 g/cm^3 at 120 GPa, which is considerably lower than the value of 5.42 g/cm^3 for the mantle."

Ringwood's discussion also gives less attention to the rare gas data for meteorites, Earth, Venus, and Mars than would be desirable. As for the core, much has changed in Ringwood's model. Many readers may recall his model for Earth as starting with highly volatile-rich oxidized carbonaceous chondrite material, which somehow lost a mass of volatiles greater than the mass of Mars into space and produced a metallic core rich in elemental silicon. They may be relieved to know that the elemental silicon has vanished from the core, to be replaced by geochemically plausible sulfur and oxygen, and that the mass of volatiles that must be lost has dropped by about a factor of 10.

In brief, this is an interesting, useful, and readable book, which should be read only with liberal recourse to the writings of those with different opinions.

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Ecological Mosaic

Pine Barrens. Ecosystem and Landscape. RICHARD T. T. FORMAN, Ed. Academic Press, New York, 1979. xlii, 602 pp., illus. $39.50.

Pine Barrens: Ecosystem and Landscape is a collection of papers by various authors, intended as a memorial to Murray F. Buell, late professor of botany at Rutgers University. Though a few papers on Long Island are included, the book deals mainly with the Pine Barrens of New Jersey. Extensive information was available to the authors because the area has been interesting to biologists (including Buell) for decades. This interest seems to stem from the paradox that the Barrens have an unusual simplicity of structure but unusual extremes in the evolution and adaptation of the rare as well as the common species. Among these are 71 endangered and threatened plant species (12 percent of the Pine Barrens flora), many of them representative of an Upper Cretaceous ecosystem type that is maintained today as an unusual remnant of the pre-Pleistocene coastal plain.

The 33 papers in the volume are grouped into seven major sections: People (including history); Geology and Soils; Climate, Water, and Aquatic Ecosystems; Vegetation Patterns; Plants; Animals and Animal Communities; and Conclusion.

Many of the papers are devoted to compilations of species, their distribution, and biotic communities and classifications thereof, thus providing a handbook of environmental and biological data on the New Jersey Pine Barrens. They will be valuable to readers from many disciplines, but they do not contribute appreciably to providing the kind of synthesis one finds in such regional monographs as Curtis's *The Vegetation of Wisconsin* or the recent series on the Hubbard Brook ecosystem by Bormann, Likens, *et al.* Synthesis is approached only in the final paper, by the editor. This paper presents a useful overview of the relationships within the mosaic making up the Barrens and can profitably be read first. The most significant contribution here is the idea that the biota of the Barrens is maintained in an ancient equilibrium of age states following fire or hurricanes, and that the flora with its unique adaptations to arid soils and high frequency of fire was preadapted to the early human interventions.

Notably absent from the book is comment on what it is about evergreen pine and heath species that makes them adapted to this environment when other ecosystems in the area have deciduous species. It has been suggested that the conifer-form and evergreen microphylls represent adaptations to extreme shortage of nutrients. Has there been no significant work on this question in a system so evidently poor in nutrients? There exists here a unique opportunity to test hypotheses about nutrient control of ecosystem form and advance the theory of selection and adaptation in the evolution of regional diversity.

On the whole, this is a volume that all who wish to be knowledgeable about