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.

CHARLES L. HYDER
High Altitude Observatory, Boulder, Colorado 80303

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.

J. S. LEWIS
Department of Earth and Planetary Science, Massachusetts Institute of Technology, Cambridge 02139

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

conifer forests, the vegetation of coastal southeastern America, or regional monographic synthesis will need. It is one thing to comment on what the authors might have done for the Pine Barrens; it is another to do it if the necessary research has not yet been done, as appears to be the case here. The volume implicitly identifies the unique opportunities that remain for work on the Pine Barrens of New Jersey.

ORIE L. LOUCKS
Institute of Ecology, Indianapolis, Indiana 46208

Developmental Biology

Determinants of Spatial Organization. Papers from a symposium, Madison, Wis., June 1978. STEPHEN SUBTELNY and IRWIN R. KONIGSBERG, Eds. Academic Press, New York, 1979, xxiv, 334 pp., illus. $24.

This volume is the proceedings of a symposium that focused on cytoplasmic localization of determinative factors in early embryonic development, maternal-effect mutants of development, and pattern formation and regulation in later stages of development. The book has a good balance between data and theory and covers a spectrum of topics of sufficient maturity and relatedness to be coherent. The contributions are in general well conceived and clearly presented. Too few concentrate on each of the three major topics to provide a truly thorough picture of the current state of each, but sufficient material on each topic is presented to make this a useful volume.

A scholarly review by Frankel is pivotal. Frankel discusses pattern regulation in *Tetrahymena* and demonstrates convincingly that both global long-range ordering and short-range inductive phenomena can be found in single-cell ciliates and directly parallel pattern regulation in multicellular developmental fields. Thus similar principles of pattern regulation may apply to the single-cell egg. Wolk describes the phenomenology and cellular physiology underlying heterocyst pattern formation in filamentous blue-green algae such as *Anabaena*. Campbell has recently succeeded with hydra in forming clones of organisms comprised solely of epithelial cells. Such epithelial hydra undergo essentially normal growth, budding, and pattern regulation after surgical intervention, a finding that suggests to Campbell that pattern control rests primarily in epithelial cells and may often be regulated by mechanical attributes rather than chemical gradients. Lawrence and Morata provide a brief description of the effects of homoeotic mutants in *Drosophila* in relation to the compartmental hypothesis.

Bryant reviews the data on the imaginal disks of *Drosophila* that support the hypothesis that positional information is supplied by an identical polar coordinate system in each disk. This model has been used with considerable success in interpreting pattern regulation in insects and secondary developmental fields in amphibians, but it has not been applied to primary positional information in the egg itself. The alternative hypothesis, that positional information in the *Drosophila* egg is supplied by monotonic gradients in a Cartesian coordinate system, is discussed by Nüsslein-Volhard using evidence from the maternal mutants *bicaudal* and *dorsal*. In *bicaudal*, most embryos are normal, that is, have a mirror-symmetric double abdomen. Nüsslein-Volhard suggests that a normal anterior-posterior monotonic gradient has a second stable symmetrical shape with two peaks. Kalthoff has induced a similar double abdomen in *Smittia* by ultraviolet irradiation of the anterior egg pole and suggests in his paper an independent anterior-posterior decision process and a metamerization process.

Thoughtful papers by Dohmen and Verdonk, Whittaker, Freeman, Quantrano *et al.*, Hirsh, and Mahowald *et al.* discuss the localization of cytoplasmic or cortical determinants in eggs and how the determinants might arise. Dohmen and Verdonk describe dorsal determinants in molluscan eggs. Whittaker reviews the evidence for determinants in ascidian eggs, in particular experiments in which early cleavage planes are altered, leading specific blastomeres to incorporate cytoplasm usually segregated elsewhere. Freeman describes data showing that various determinants are progressively localized during the early cleavage divisions of *Cerebratulus* eggs rather than being definitively prelocalized by fertilization. Quantrano and colleagues discuss axis fixation in *Fucus* in terms of electrical potential gradients or contractile mechanisms to move macromolecular determinants. Hirsh has collected temperature-sensitive maternal mutants of *Caenorhabditis elegans* that disrupt the geometry of early cleavage but has not yet found evidence that resulting cell linkages are altered. A paper by Mahowald and colleagues summarizes the efforts to find the molecular basis of localized pole cell determinants in *Drosophila*.

Among the most provocative papers is that by Brothers, who has analyzed the recessive maternal-effect *o* mutant of axolotl. Female homozygotes produce eggs that block during gastrulation. Exposure of mutant o^- nuclei to wild-type egg cytoplasm or nucleoplasm corrects the defect. Such o^- nuclei can sustain normal development in back transplantations to enucleate mutant o^- eggs for over 30 divisions. Brothers's results establish that o^- nuclei can be rescued to a stably heritable o^+ state despite repeated exposure to o^- cytoplasm. The analysis of cytoplasmic determinants has generally assumed that nuclei remain fully responsive to cytoplasmic factors. In many species, nuclei do remain totipotent after transplantation to enucleate eggs. However, totipotency may require features of early cleavage divisions. Progressive determination may be associated with the assumption of progressively more stable nuclear states that, once established, are resistant to signals for a wide variety of alternative developmental pathways. Such phenomena would be of deep interest in their own right and would complicate the analysis of localized determinants.

The volume is well produced, with extensive references for each paper and a clear subject index. Despite the limitations of the symposium format, this is a sound and useful book.

STUART A. KAUFFMAN
Department of Biochemistry and Biophysics, University of Pennsylvania School of Medicine, Philadelphia 19104

Books Received

Agricultural Ecology. An Analysis of World Food Production Systems. George W. Cox and Michael D. Atkins. Freeman, San Francisco, 1979. x, 722 pp., illus. $25.

Air Pollution Chemistry. J. D. Butler. Academic Press, New York, 1979. viii, 408 pp., illus. $52.50.

The Amateur Astronomer. Antonín Rükl. Translated from the Czech edition. John Gribbin, Consultant Editor. Octopus Books, London, 1979 (U.S. distributor, Mayflower Books, New York). 184 pp., illus. $9.95.

Beryllium Science and Technology. Vol. 1. Donald Webster and Gilbert J. London, Eds. Plenum, New York, 1979. xiv, 334 pp., illus. $35.

The Biological Basis of Schizophrenia. Gwynneth Hemmings and W. A. Hemmings, Eds. University Park Press, Baltimore, 1979. xii, 272 pp., illus. $29.50.

Biological Identification. Richard J. Pankhurst. University Park Press, Baltimore, 1978. viii, 104 pp., illus. Paper, $9.95.

Complex Carbohydrates of Nervous Tissue. Richard U. Margolis and Renée K. Margolis, Eds. Plenum, New York, 1979. xviii, 402 pp., illus. $39.50.

A Complex Variable Approach to the Analy-

(Continued on page 521)