soup" include relative abundances of common cations (Co^{2+}, Mg^{2+}, Na^{+}, K^{+}) that are closer to those of animals than are those in seawater, the similarity of Precambrian microfossils to modern soil microbes, and the presence of very ancient soils that are more oxidized than one would expect. In addition, the presence of clays to act as catalysts and templates for complexing reactions and the greater protection from ultraviolet radiation also favor soils.

Retallack also thoroughly reviews the sequence of soil types in the geologic record. Although some paleosols may represent extinct kinds of soil, it appears that the increase of soil types with time is the result of addition of new types rather than replacement of earlier types. Paleosols can be considered as trace fossils of ecosystems because of the importance of organisms to the formation of soils. The increase in soil types and soil features results from a diversification of life with time; therefore, soils can provide evidence of former ecosystems independent of other fossils.

In chapter 4, Francis describes the formation of a series of paleosols, the Jurassic Dirt Beds, on the margin of the Purbeck Basin. The intertidal zone algal sediments were periodically exposed for varying lengths of time, which resulted in the development of several soils. Francis's suggestion that similar algal horizons in other basin margin sequences might contain paleosols should stimulate investigators to look for them and use them to recognize environmental fluctuations.

In chapter 5, Atkinson presents an insightful discussion of paleosols in the Eocene Capella Formation of northern Spain. An alluvial fan model is used to explain the sedimentation in the basin, and soil-forming factors are evaluated in that context. The lateral variations of the soils across the area are interpreted as a "catena" produced by the relief implied by the fan model and modified by preferential eastern upthrow on fault zones. Interpretations of these soils have contributed to an understanding of basin tectonics.

Sedimentologists, particularly those working in alluvial sequences, will find Kraus and Bown's chapter 6 on paleosols and time resolution in alluvial stratigraphy most interesting. Floodplain environments are dominated by long intervals of stasis during which soil formation occurs, rather than by periods of deposition or erosion. Careful investigation of soils present in the fluvial sequences of the Eocene Willwood Formation of Wyoming and the Upper Triassic Chinle Formation of Arizona enabled the authors to draw conclusions on sedimentation rates, episodic base-level fluctuations, and evolutionary rates of fossil organisms. They contend that most ancient successions of overbank deposits are very complete with only minor local time gaps and that fossils in paleosols are scavenged time-lag accumulations that represent longer spans of time than the enclosing sediments.

The book has a few shortcomings. Several photographs are too dark or have been reduced too much to effectively illustrate the features depicted. In one instance, figure 14, the photo is misoriented. The glossary is helpful, but many technical terms specific to the British literature or soil sciences are not defined.

The book achieves the goals stated in the preface: to provide a focus for interest, a database, and a stimulus for future work. Scientists with various specific interests will find many ideas to apply or test in their own research. In addition to furnishing examples of methods to follow and techniques to use, these papers are certain to spur creative thinking and new approaches.

RONALD D. STIEGLITZ
College of Environmental Science, University of Wisconsin, Green Bay, WI 54302

"The Pinnacles area, Badlands National Park, South Dakota, USA. Above the weathered Cretaceous marine shale (lower foreground) are 87 superimposed paleosols of Late Eocene and Oligocene age within 143 m of alluvial deposits." [From G. J. Retallack's chapter in *Paleosols*]

Ion Transport

Proteins of Excitable Membranes. BERTIL HILLE and DOUGLAS M. FAMBROUGH, Eds. Wiley-Interscience, New York, 1987. xvi, 331 pp., illus. $59.95. Society of General Physiologists Series, vol. 41. Based on a symposium, 1985.

The study of electrically excitable membranes is much wider and deeper than it was 15 years ago, when ion pumps and ion channels had yet to be directly observed as macromolecules. The membrane physiologists are still busy providing fundamental information about the functions of ion pumps and channels, now with enhanced, high-resolution techniques (such as single-channel recording and rapid quench-flow methods). But now the proteins responsible for these functions are falling, one by one, to the assaults of membrane biochemists and molecular biologists. The adenosine triphosphate–powered pumps for Ca^{2+} and for Na^{+} and K^{+} have been purified, reconstituted, and cloned, as have several of the physiologically important ion channels. So now, while looking closely at the ion-moving functions of these membrane proteins, we can begin to base our dreams about their molecular structures on real, experimental results.

In this volume, B. Hille and D. M. Fambrough (who weigh in as heavies on ion channels and ion pumps, respectively) bring together practitioners of this newly broadened field of excitable membranes by collecting 17 contributions from a symposium held in September 1985. Chapters focus on five key transport proteins: the Ca^{2+}-adenosine triphosphatase of sarcoplasmic reticulum, its plasma membrane cousin the Na^{+}, K^{+}-adenosine triphosphatase, the acetylcholine receptor, and the Na^{+} and Ca^{2+} channels. These five proteins are all crucially involved in making excitable membranes

excitable, and so the subject matter is well chosen.

The stated intention of this book's source symposium was to introduce workers in different parts of the excitable membrane field to each other, and the book remains true to this purpose. This is not, therefore, a place for the novice to learn about the subject. (Try Hille's *Ionic Channels of Excitable Membranes* [Sinauer, 1984] for that.) The chapters are pitched well to the intended audience; each provides an overview of a problem in a specific domain of the field to workers in the other domains. Thus, by reading G. Inesi's excellent chapter on rapid quench-flow studies in sarcoplasmic reticulum, electrophysiologists will see why biochemists need to measure fast ion fluxes into membrane vesicles. Likewise, J. H. Steinbach and S. H. Sine's contribution on the interpretation of single-channel kinetics can be read by biochemists who want to comprehend the flavor of this subject, which is arcane but essential for understanding what ion channels actually do. Numerous other chapters will similarly facilitate the transfer of information within this multidisciplinary field, chapters on cloning of genes for very large membrane proteins, physical structures of channels and pumps, labeling of functional sites on channels, and the cell biology of multi-subunit membrane protein assembly, to list a few examples.

There is a price to be paid for covering a broad area in a rather thin, multi-author volume: most chapters are quite short, and some tend toward superficiality. So while this is not a book to use to find out the latest in your own area of excitable membranes, it is an excellent place to be reminded of recent advances in those areas of the subject that you should know about, but don't. My only scolding is directed at a few authors whose papers are blatantly perfunctory. The editors should have resisted the forces of collegial *politesse* (which are indeed strong in this traditionally friendly field) and refused to include these few chapters.

CHRISTOPHER MILLER
Graduate Department of Biochemistry, Brandeis University, Waltham, MA 02254

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