emphasis on arcane economics keeps much of its work from decision-makers and the general public.

"One of the happy incidents of the Federal system," Justice Louis Brandeis once wrote, "is that a single state may, if its citizens choose, serve as a laboratory; and try novel social and economic experiments without risk to the rest of the country." Carter's book is a valuable documentation of one such set of experiments. His insights and conclusions should be of value to those facing similar growth-related problems in other states.

PETER R. JUTRO
Department of Natural Resources, Cornell University, Ithaca, New York

Species Abundance Patterns

Ecological Diversity. E. C. PIELOU. Wiley-Interscience, New York, 1975. x, 166 pp., illus. $14.95.

How many species can live together in a given place, and what are their relative abundances likely to be? Pielou's monograph (not to be confused with her textbook *Population and Community Ecology*, also just published) aims at a succinct review and synthesis of mathematical aspects of these questions.

The book opens with a survey of the often muddled literature that seeks some single number, or "index," to describe the diversity or evenness of a community. Various species-abundance distributions (lognormal, logseries, and so on) are then discussed in detail, with attention given to the relationship between the different ways in which these distributions are conventionally displayed by ecologists (for example, as rank-abundance plots). With the mathematical foundations laid, Pielou turns to statistical methods for testing hypotheses about species' abundances, and to the relations between spatial patterns and species diversity.

In discussing *local* factors that help determine diversity, Pielou gives an incisive summary of the models of Skellam and of Horn and MacArthur, which show how a competitively inferior species can persist by virtue of superior vagility if the environment is spatially heterogeneous. She also develops a suggestive new model for two-species competition, in which time delays in the growth equations and a monotonic environmental gradient can combine to produce a cyclic mosaic: zones dominated by species A alternate with zones dominated by species B, and these zones migrate up and down the gradient in cyclic fashion.

The discussion of *global* factors that bear upon species diversity includes a very crisp exposition of current notions about the relation between "stability" and "complexity," namely that a predictable or stable environment may permit the evolution of a complex community (itself usually a dynamically fragile thing). The book concludes with speculations about changes in diversity over geological time. This is a fascinating topic. How recent developments in theoretical ecology can shed light on aspects of the fossil record is illustrated by many papers in the new journal *Paleobiology* or (for a more general audience) by some of Gould's monthly essays in *Natural History*.

The emphasis in this book is primarily on lucid and rigorous mathematics, and secondarily on methods for testing hypotheses against relevant data. It is a "feet-on-the-ground" book, with a healthy distrust of grand and general theories. Pielou has wise things to say about what might be called the philosophy of model building, or even the philosophy of applied mathematics. Noting the tendency for theoretical ecology to bifurcate into mathematical ecology and statistical ecology, she cautions that "mathematicians run the risk of constructing interesting models divorced from reality; and the statisticians of providing clear answers to ecologically uninteresting questions." At times these digressions border on the epigrammatic: "models reveal possibilities but not impossibilities."

From the areas mapped out in this book, paths lead off in many directions. For example, it is frequently noted that in streams and lakes the effect of pollution is to change the patterns of species relative abundance from the relatively even lognormal distribution characteristic of the equilibrium community into a distribution where a few species are exceptionally common. It is tempting to seek some simple diversity index that reflects such changes, and to use this index in environmental impact studies. But as Patrick, Williamson, and others have observed, for polluted waters any such single number will be dominated by the handful of common species, whereas the time scale for recovery of the pristine ecosystem (and, indeed, whether it can ever recover) depends on the presence of a variety of species which are uncommon in the polluted community, and whose presence will not show up in any overall diversity index. This is one of many relevant but unresolved questions. Pielou's book stands as a signpost toward this sort of practical application.

ROBERT M. MAY
Biology Department, Princeton University, Princeton, New Jersey

Secretory Mechanism

Salt Glands in Birds and Reptiles. M. PEAKER and J. L. LINZELL. Cambridge University Press, New York, 1975. x, 308 pp., illus., + plates. $27.50. Monographs of the Physiological Society, No. 32.

There has been no other comprehensive treatment of avian and reptilian salt glands, and the appearance of this volume is most welcome. These glands, which provide an extrarenal mechanism for salt secretion, are of interest from viewpoints ranging from the molecular to the ecological. Thus, publications on salt glands have appeared in a wide variety of journals, and much of this information has not previously been brought together—much less synthesized. This is what Peaker and Linzell have attempted, rather successfully, in their monograph.

The section on avian salt glands makes up over 80 percent of the text. Following an overview of the morphology of the gland, this section proceeds into chapters focusing on the various physiological and biochemical mechanisms involved in salt gland function (for example nervous control, blood flow, secretory mechanisms, role of hormones, adaptation) and ends with two chapters dealing with salt glands in the perspective of the whole animal and its environment. The chapter topics are highly interdependent, yet the authors have tried to make the chapters comprehensible as units to enable readers "to find what they require without having to plough through the whole work!" Extensive cross-referencing is employed to this end, but those plowing through still encounter considerable repetition. The section on reptiles is divided taxonomically and treats sea turtles, terrapins, sea snakes, the Galápagos marine iguana, and terrestrial lizards. Insofar as is possible, matters of morphology, control mechanisms, adaptation, and so on are dealt with for each group, with frequent comparison with the avian glands.

This book provides a complete and detailed accounting of research on salt glands such as is not possible in review articles. Reference is made in the text to virtually every publication on salt glands appearing prior to 1973, and to many that appeared in that year. An addendum lists more recent publications relevant to each chapter. Liberal use of tables and figures from primary sources also enhances the reference value of the book. Although the authors occasionally become bogged down in attempts to reconcile conflicting data, they usually manage to emerge with testable hypotheses. In addition, they provide thoughtful criticism of the methods employed in studies of salt glands.

The book is at its best when dealing with the authors' own considerable research, much of it in collaboration with Ann Hanwell, on control of avian salt gland secretion. Their description of attempts to locate the osmoreceptors responsible for initiation of salt gland secretion is a case in point. As with most topics, they take a historical approach and trace the search for osmoreceptors through its various convolutions. They then describe elegant experiments demonstrating that the receptors are not located in the head, but rather in or near the heart. Also in typical fashion, they evaluate the prospects for further discoveries in this area.

There are still many unanswered questions concerning salt glands, and some of them are rather fundamental. Upon seeing such chapter titles as "The mechanism of secretion" and "The evolution of salt glands," the reader may get his hopes up only to find that firm conclusions are not forthcoming. This is not to suggest that the book is premature or that the authors have been negligent. Rather, it is to be hoped that it will soon be possible to write an even more definitive treatise on this challenging subject. Indeed, Peaker and Linzell's book should hasten that day.

VAUGHAN H. SHOEMAKER
Department of Biology,
University of California, Riverside

Electrophysiology

Electric Current Flow in Excitable Cells. J. J. B. JACK, D. NOBLE, and R. W. TSIEN. Clarendon (Oxford University Press), New York, 1975. xvi, 502 pp., illus. $45.

Books in an experimental science like physiology are usually elementary texts, collections of reviews, or compilations of previously published results. It is not common for a book to be a significant contribution to current research. It is almost unprecedented for a single book to be simultaneously a useful text, a significant review, and an original contribution to research. This "monograph" by Jack, Noble, and Tsien is remarkable in that it succeeds in each of these respects. It is a superb advanced text, presenting difficult material in a lucid form understandable to all who read it with care; it is a useful review of several developing fields; and it makes a number of original contributions. This combination of attributes suggests that the book will have a decisive effect on the development of electrophysiology: it may well serve as a dictionary of paradigms for future work in the field.

The book starts with a discussion of linear cable theory. The necessary mathematical apparatus is presented in an appendix, but in the absence of problems it is doubtful that a neophyte will develop enough facility from the appendix to master the rest of the book. One can criticize this initial section on a number of other grounds—particularly its failure to use two-port theory to describe the properties of finite cables. But such criticisms miss the essential point: these chapters represent an important synthesis of widely known but rarely published results, and they present the results in a form easily accessible to scientists without an outstanding mathematical background. The section illustrates the utility of linear analysis with brilliant reviews of two areas of considerable research activity: the use of linear circuit analysis to determine the pathways for current flow in striated muscle, and mathematical modeling of nerve cells. The review of the former is unfortunately already out of date. The review on mathematical modeling is a most useful synthesis, but implicitly shows the need for more experimental work designed to falsify one or the other of the theoretical models.

The book then proceeds to discuss the nonlinear properties of excitable cells, the properties most directly involved in the function of the cells. The review sections of these chapters necessarily are both more descriptive and more speculative than the earlier parts of the book. Such is the lack of knowledge of molecular processes in biological membranes that more rigorous analysis does not seem possible. In this area the authors make their largest number of original contributions. While many of the contributions represent the beginning rather than the summation of lines of research, they seem no less valuable for that.

It is in this regard, though, that a defect of the book becomes apparent. The extensions of these new lines of research, and much other work in electrophysiology, clearly would benefit by contributions from physical and mathematical scientists with a knowledge of electrical phenomena. Such colleagues, however, often have some difficulty in identifying important biological problems, both because of the novelty of the design of the systems (the designer being an illogical evolutionary process) and because of the novelty of the field. Much of the novelty of electrophysiology stems from its proprietary language developed in isolation from other fields. The authors define and develop the language of electrophysiology well, but they make little attempt to make it more palatable to the physical or mathematical scientist. It would be a particular shame if this one defect prevented physical scientists from taking advantage of the greatest single attribute of the book, its identification of a wealth of important problems waiting to be solved.

For the biologist interested in the electrical properties of cells, excitable or not, this book is indispensable. Let us hope that a number of physical and mathematical scientists will find it as valuable.

ROBERT S. EISENBERG
Department of Physiology,
University of California, Los Angeles

Books Received

Advances in Food Research. Vol. 21. C. O. Chichester, E. M. Mrak, and G. F. Stewart, Eds. Academic Press, New York, 1975. viii, 358 pp., illus. $23.

Advances in Molten Salt Chemistry. Vol. 3. J. Braunstein, Gleb Mamantov, and G. P. Smith, Eds. Plenum, New York, 1975. xii, 458 pp., illus. $38.50.

Africa, the Devastated Continent? Man's Impact on the Ecology of Africa. Antoon de Vos. Junk, The Hague, 1975. 236 pp., illus. Dfl. 65. Monographiae Biologicae, vol. 26.

Anatomy of the Guinea Pig. Gale Cooper and Alan L. Schiller. Harvard University Press, Cambridge, Mass., 1975. xiv, 418 pp., illus. $40.

Ants, Indians, and Little Dinosaurs. Alan Ternes, Ed. Scribner, New York, 1975. vi, 392 pp. $8.95. Reprinted from *Natural History*.

APL. The Language and Its Usage. Raymond P. Polivka and Sandra Pakin. Prentice-Hall, Englewood Cliffs, N.J., 1975. xxvi, 580 pp. $17.95. Prentice-Hall Series in Automatic Computation.

Archaeoastronomy in Pre-Columbian America. Papers from a meeting, Mexico City, June 1973. Anthony F. Aveni, Ed. University of Texas Press, Austin, 1975. xvi, 436 pp., illus. $16.50.

Arms Uncontrolled. Stockholm International Peace Research Institute (SIPRI). Prepared by Frank Barnaby and Ronald Huisken. Harvard University Press, Cambridge, Mass., 1975. xiv, 232 pp. + plates. $12.50.

Basic Functions of Cations in Myocardial Activity. Proceedings of a meeting, Freiburg, Germany, Sept. 1973. Albrecht Fleckenstein and Naranjan S. Dhalla, Eds. University Park Press, Baltimore, 1975. xiv, 530 pp., illus. $39.50. Recent Advances in Studies on Cardiac Structure and Metabolism, vol. 5.

Biochemistry. The Molecular Basis of Cell Structure and Function. Albert L. Lehninger. Worth, New York, ed. 2, 1975. xxiv, 1104 pp., illus. $22.95.

Biochemistry of Cell Walls and Membranes. C. F. Fox, Ed. Butterworths, London, and University Park Press, Baltimore, 1975. xii, 316 pp., illus. $19.50. MTP International Review of Science. Biochemistry, Series One, vol. 2.

Biocontrol of Rodents. Papers from a symposium, Lammi, Finland, May 1974. Lennart Hansson and Bo Nilsson, Eds. Swedish Natural Science Research Council, Stockholm, 1975. 306 pp., illus. Paper, 45 Sw. Kr. Ecological Bulletins No. 19.

The Brain and Reward. E. T. Rolls. Pergamon, New York, 1975. viii, 116 pp., illus. Paper, $7.

(Continued on page 1124)