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.