cludes an essay by Eliot Chapple on his quarter century of research on the mathematical theory of interaction. Chapple cannot yet provide full results, but he shows some of the difficulty in the use of classical mathematics which has led him to suggest that the complex problems he is dealing with may require recourse to the general theory of relaxation oscillators.

The last section, Probabilistic Methods, contains new solutions to three important anthropological problems: (i) the problem of the conditions for cultural stability, (ii) the problems of measuring endogamy and exogamy, and (iii) the problem of the degree to which culture is shared within and between groups. Hans Hoffmann studies the age grading system of the Galla in Ethiopia and suggests that the limiting vector of a Markov process might represent the structure of the system better than do the distributions observed by the ethnographer at any one time (for anthropologists the work of Asmaram Legesse supersedes this effort). Kimball Romney has devised an iterative procedure for the measurement of endogamy and exogamy that is both intuitively satisfying and gives promise of resolving many problems in the conceptualization of empirical models of systems of symmetric and asymmetric exchange (a task which has been undertaken by Alice K. Adams). He has solved the problem of measuring endogamy rates for populations of unequal size, which had resisted previous investigators. John Roberts and his colleagues have worked out a method of defining the degree of sharedness of culture within a single group, using a new measure of concordance (with Robert Kozelka), as well as a way of using preference mappings to show both similarity and contrast between cultures in their attitude toward systemic cultural patterns (here using clothing, but elsewhere using family size and composition). Two last essays, by Peggy Sanday and her associates, take first a logical and then a statistical approach to the problems of understanding correlation matrices generated by Murdock's cross-cultural sample.

For social scientists interested in the diversity of interests that mathematical anthropologists hold, or for anthropologists who have been hearing about their results and wondering where they came from, this book will be most useful. It is a shame that it took so long in publication, because some of the results may seem old hat to the cognoscenti, but for the reviewer, at least, it is extremely helpful to have them all together in one volume.

HENRY SELBY
Department of Anthropology, University of Texas, Austin

Data and Models

Systems Analysis and Simulation in Ecology. Vol. 1. BERNARD C. PATTEN, Ed. Academic Press, New York, 1971. xvi, 608 pp., illus. $27.50.

This book, the first volume of two, seeks to convince us that a new science of *systems ecology* is born, and documents, according to the editor, "a move away from the explanatory or cognitive criterion of truth, a soft criterion . . . toward . . . a hard one with the potential of leading ultimately to optimal design and control of ecosystems." The parents of systems ecology, sire and dam respectively, are the hardware and brute force tactics of engineering and the esthetic patterns and properties of nature as revealed by ecologists. This volume begins by detailing the contribution of engineering, but contains no similar primer of ecological fundamentals and is therefore intended to recruit from the ecological rather than the engineering field.

The book is divided into three parts: an introductory section on modeling, a section on single species models, and a group of chapters on many-species systems. The introduction consists of the editor's summary of the practicalities of computer use in ecology, a thorough and lucid "how-to" lesson later exemplified in chapter 9, and a chapter by N. E. Kowal on the philosophy of the modeling approach. Together these take up one third of the book; their content is good, basic information for one starting on the systems ecology path (even though the essence of the second chapter was given in a couple of pages by R. Levins five years ago) and is worth digesting. In part 2 F. M. Williams, S. P. Hubbell, and N. R. Glass give their algal growth, isopod energetics, and fish predation models respectively, in the most ecologically interesting chapters of the book. Part 3 comprises a general "ecosystem" model—actually limited to six hypothetical species—by R. R. Lassiter and D. W. Hayne, a model by R. V. O'Neill of radiocesium movement through forest floor arthropod populations, and three attempts to model field data published by other ecologists: two old-field succession studies, the moose-wolf interaction on Isle Royale, and R. Lindeman's Cedar Bog Lake data.

After reading the book, I think I have a good idea of what the contributors are trying to do. In some cases the stated aims are quite modest, being no more than to gain insight into the construction of the models themselves (rather than the ecological patterns they are supposed to imitate). Another gain might be to reveal where ecological studies are deficient in information. That is one goal of chapter 6, but the gaps (for the modelers) are ubiquitous and general, even obvious, and no useful specification results. The predictive properties of the models might be chief assets, but, at least at the ecosystem level, the obvious tests are either impossible or impractical, especially when the input is 30-year-old data. Certainly some ecological insights are gained, however, among which F. M. Williams's remarks on coexistence in the phytoplankton and the properties of the secondary succession model could be mentioned.

Most models have to do with energy fluxes between compartments and deal with calories per unit time, weight, or area or some combination thereof. It would be gratifying indeed if the 40-odd years of such accumulated ecological data were finally to prove useful. But the use of existing data and of supposed relationships is dubious indeed, for numerous of the relationships that may be important are not yet known and must be guessed, and others (such as Holling's predator-prey functions cited in several chapters) lack confirmation of a broad applicability. The lesson seems to be, particularly if real prediction and testing are planned, that model-builders must collect their own data. Ecology will always need people with ideas and imagination, insight and intuition. To solve its complex numerical interactions, it may also need the services of computers and people who can program them with facility, although this at present remains to be demonstrated. If we have both sets of talents in one "systems ecologist," progress is all the more likely.

MARTIN CODY
Department of Zoology, University of California, Los Angeles