structure in the mass of observational data. These 37 sections contain at least as much as one wants to know about statistics and n-point correlation functions. Chapter 4 discusses the dynamics of these statistics, primarily in terms of the BBGKY hierarchy of moment equations. These chapters are not for the beginner or the statistics-scarred. One is expected to be familiar with autocorrelation functions, power spectrum analysis, and the BBGKY hierarchy.

The author shows remarkable restraint in his choice of topics, making no mention of the current speculations of grand unified theories of the early universe. Nor do we find much attention to computer simulations of n-body dynamics. The emphasis is on analytic solutions. There is surprisingly little discussion of the universe itself, and there is no critical discussion of the galaxy catalogs, or even much discussion of the results of applying all of this machinery to the catalogs of data. Observations are mentioned in only a half-dozen of the sections.

The book has been carefully prepared. The writing is excellent, and the author has taken pains to give proper credit for ideas. This scholarly monograph is a pleasure to read, as well as scientifically valuable, a Rolls-Royce version of a review article. It will be indispensable for the specialist in the field, and every student of the universe should at least browse through it.

WILLIAM L. BURKE
Boards of Studies in Astronomy and Astrophysics and in Physics, Lick Observatory, University of California, Santa Cruz 95064

Wintering Birds

Migrant Birds in the Neotropics. Ecology, Behavior, Distribution, and Conservation. Papers from a symposium, Front Royal, Va., Oct. 1977. ALLEN KEAST and EUGENE S. MORTON, Eds. Smithsonian Institution Press, Washington, D.C., 1980. 576 pp., illus. Cloth, $27.50; paper, $15.

Much of ornithologists' early understanding of the life histories and ecology of birds was based on studies of birds in the temperate zone in Europe and North America. This "temperate zone bias" led many investigators to interpret the adaptations associated with both intraspecific and interspecific interactions as primarily reflecting selective pressures during the temperate breeding season.

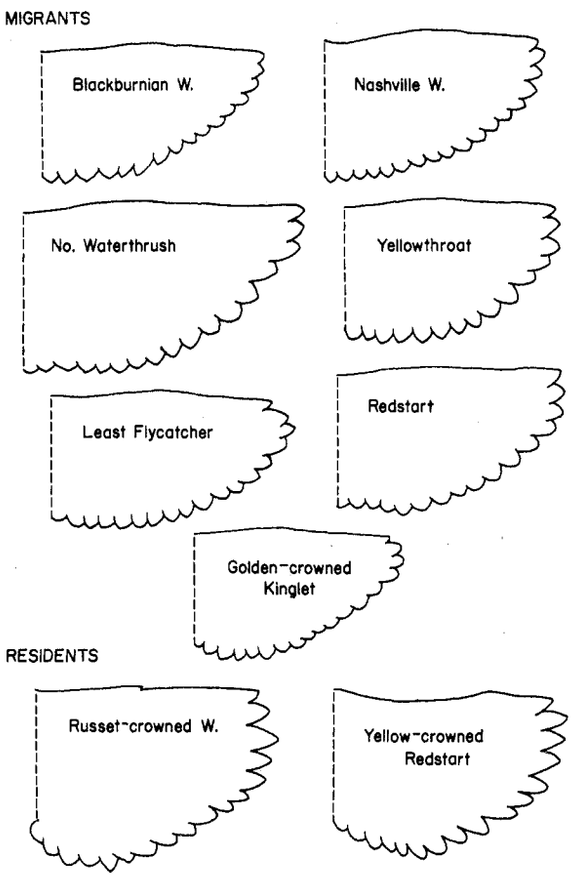
Two-thirds of the individuals of many North American bird communities migrate to Mexico, the Bahamas, Cuba, Hispanola, Central America, and even into South America. They are away from their temperate-zone breeding sites for over half the year, yet there have been few studies evaluating their behavior during their migrations or, especially, on their tropical wintering grounds. The low number of studies is attributed to the difficulty of access to many of the wintering areas, especially early in the century, and more recently to the tremendous diversity of resident tropical birds that has occupied the attention of ornithologists working in the neotropics.

As access to the neotropics has become easier and as ornithologists have, with the help of pioneering investigators such as Alexander Wetmore and Alexander Skutch, learned more about the natural histories of neotropical birds, interest in the activities of migrants has increased. The symposium that resulted in this publication came at an opportune time, for it caught the beginning of what appears to be a surge in interest in neotropical migrants. The 40 contributors include over a dozen recent Ph.D.'s as well as long-term students of tropical ornithology.

The authors have only scratched the surface of this neglected aspect of ornithology. Water birds are found in only one paper, and less conspicuous species like thrushes are conspicuously absent. This type of initial compilation of studies makes a valuable contribution, however, for the juxtaposition of such a large number of studies allows one to sort out patterns, or their lack, from a broad range of treatments. As with any symposium, the papers are variable, with some offering sound, unambiguous data to support clear hypotheses and others offering a great deal of speculation with little firm support. It is not useful, however, to discuss the merits and defects of the individual contributions, because the importance of the volume lies in the questions that are raised by the collection as a whole and the directions for research that are indicated.

The generally accepted view of the behavior and ecology of North American migrants in the tropics has been that migrants concentrate at mid-elevations and reside primarily in disturbed habitats. Some investigators present evidence here to support these hypotheses and others present evidence that is contrary. The result that emerges, and that is hinted at or stated by several authors, is that the North American migrants do not

"Wing shape of 5 migratory warblers and 2 resident Santa Marta species compared. Wings of the Least Flycatcher (*Empidonax minimus*), Tyrannidae, and Golden-crowned Kinglet (*Regulus calendula*) are included for comparison." Examination of wing length and area (relative to weight) and shape as related to migration distance has led to the conclusions that "1) there is a basic 'migratory parulid' wing type; 2) this does not differ to any extent between long- and short-distance migrants; 3) in terrestrial and thicket-dwelling migrants, where the vertical takeoff component is important, the wing is shorter relative to body weight; 4) in neotropical resident species, which undertake no seasonal movements and live in the middle sections of the forest, the wing is shorter, broader and more rounded than in the migrant species. Thus the wing . . . varies somewhat with the demands placed upon it. Within the migratory species there are no differences, however, that 'predispose' species to winter in different areas." [From a paper by A. Keast in *Migrant Birds in the Neotropics*]



conform to either of these generalizations. They are an integral part of the tropical communities in which, for many, the majority of their lives are spent, and their relationships with resident members of tropical bird communities are not restricted to mid-elevations or to disturbed habitats. The relationships of migrants in tropical communities may be even more complex than those in temperate communities, with climate, temporal variations in food availability, close competitors, and vegetation structure all influencing the ways a migrant species interacts with residents. Some species choose similar habitats and use similar foraging repertoires in breeding and in wintering areas, whereas others adopt different sets of habitats and behaviors in the two areas. The comparisons of behaviors of summering and wintering individuals of the same species in several papers are excellent. Such comparisons will provide a basis for studying the adaptations of migrants and residents and the strengths of selective pressures in different communities of competitors. The volume is an illustration that we have only opened the door to sets of interactions that deserve as much attention as the breeding communities in the United States and Canada. The annual return of migrants to their tropical wintering areas creates complex communities throughout the neotropics the nature of which will only be understood by thorough studies.

Emanating from these papers also is a sense of urgency. The majority of North American migrants winter in tropical forest and second-growth habitats that are rapidly disappearing through the activities of humans. There is a need to learn the nature of the interacting species in their tropical wintering grounds before the forests have been converted to agricultural land. Also, with the disappearance of these forests, bird communities in the temperate zone will change as habitat-specific species are selectively eliminated through destruction of their wintering habitats.

The editors have done a fine job with this rather diverse set of papers. The papers are organized in a logical series of blocks dealing with specific groups, specific regions, and behavioral ecology and evolutionary implications. The format is clear and the illustrations are well done. This is a valuable addition to the library of anyone studying birds in the New World.

EDMUND W. STILES
Department of Zoology and *Bureau of Biological Research, Rutgers University, Piscataway, New Jersey 08854*

Populations in Motion

Population Dynamics. Papers from a symposium, London, 1978. R. M. ANDERSON, B. D. TURNER, and L. R. TAYLOR, Eds. Blackwell Scientific, Oxford, 1979 (U.S. distributor, Halsted [Wiley], New York). x, 434 pp., illus. $69.95.

The 18 papers that make up this symposium volume cover the full range of possible topics in ecology: from natural history to abstract modeling, from aphids to whales, from age-specific fecundity to species diversity. If there is a general theme, it is that all aspects of populations and communities are dynamic and fluid.

Taylor and Taylor open the volume with a report on ten years of painstaking censuses of moths and aphids all over Great Britain. With sequential displays of local abundances, they show that each generation has a unique spatial distribution that is not predictable from the pattern of its resources or previous history. Not all the motion in Taylor and Taylor's aphid populations is protean. According to Dixon's summary of 15 years of data on sycamore aphids, short-term catastrophes can have long-term and density-dependent consequences. The important message in these papers is the iconoclastic suggestion that long-term "adaptive zones" rarely exist for species and investigators with research programs scheduled for anything less than many generations cannot possibly construct legitimate, predictive models of population or community-wide dynamics.

Harper and Bell's captivating paper presents strikingly realistic computer-drawn illustrations of colonial organisms, such as trees and coelenterates. Harper and Bell do not present the algorithm of simple rules of growth by modular units, but their diagrams convince this reader of the usefulness of the modular concept of "individual." Two other botanical papers deal with the interactions between plants and their herbivores. Lawton and McNeill present a convincing argument for a multifactorial answer to the question What controls the abundance of herbivores? They suggest that the effect of predators and parasitoids is to depress the survivorship schedule, whereas the general effect of hostile plant chemistry is to reduce the r of herbivores. Whittaker observes that herbivore damage universally retards root growth but often enhances aboveground growth. Herbivores can also reverse the outcome of competition between plants.

In the only paper dealing with behavior, Cowie and Krebs circumspectly support the premises of optimal foraging theory. Case histories show that predators do use simple behavioral mechanisms to gain a meal. For example, great tits search a new area first, learn where the current productive spots are in the boom-or-bust habitat, and exploit the booms. It remains an open question whether predators can optimally forage in the fluid worlds the Taylors depict.

One disappointing paper in this volume is that by Diamond. For several years Diamond has been the foremost exponent of MacArthurian biogeographical theory, defending it with his own observations of island bird faunas. Recently, his propositions that insular distributions of birds are not random and that interspecific competition is a primary force structuring bird communities have been subject to much criticism. From the title of Diamond's paper in this volume ("Community structure: is it random, or is it shaped by species differences and competition?") one would expect a judicious rebuttal. Diamond, however, neither refers to the criticism nor defends himself, but rather develops another series of snapshots of bird distributions on Indo-Pacific and North Atlantic islands. It is noteworthy that many of Diamond's own analyses show patterns indistinguishable from random null hypotheses (the statistical distributions of which are never explicit), and only one pair of flycatchers is presented as evidence of possible competition. The weakness of such reasoning is that no legitimate inferences about the dynamics of a system can be drawn from a unique observation. It is long overdue that those who claim the importance of island biogeographic theory design and perform perturbation experiments that test its tenets.

The two mathematical papers of particular interest are those by Peterman *et al.* and the peripatetic May. By developing graphical models with multiple domains of attraction, Peterman *et al.* suggest that a common dynamical model may underlie such apparently unrelated phenomena as spruce budworm outbreaks and collapses in the Pacific salmon stocks. The novel mathematical feature of the models is that the state variables themselves as well as the exogenous variables may move the boundary that separates the equilibria. May's enthusiastic paper concludes the volume. Primarily written to delineate the major ecological puzzles of today and chart the course for promising research, the paper sparkles with esoteric and sometimes risqué innuendo.