BOOK REVIEWS

Allen, T. F. H. and T. B. Starr: *Hierarchy: Perspectives for Ecological Complexity.* Chicago: University of Chicago Press, 1982, 310 pp.

THE BOOK *Hierarachy: Perspectives for Ecological Complexity* could become a major work for ecologists and other systems scientists. Allen and Starr have taken hierarchical concepts from various disciplines and integrated them into a theory which can be applied by both field researchers as well as theoreticians.

Although hierarchical concepts have been utilized in many disciplines, ecology is ideal for their application. Ecological phenomena can usually be described at a number of levels of resolution with different spatial and temporal scales. These levels of resolution encompass middle-number systems which are intermediate between small-number systems such as studied those in particle physics and large number systems such as those studied in statistical mechanics. Middle-number systems are the domain of general systems theory; many of the ideas in *Hierarchy* can be applied to other areas sucb as psychology, sociology, and economics. Indeed, because of its range of applicability, hierarchy theory could be regarded as being coextensive with systems theory.

Classic ideas about hierarchy theory of Simon, Pattee, Weinberg, Ashby, Margalef, von Bertalanffy, and Bunge are used throughout *Hierarchy.* This book is one of the few places where these ideas have been put together and actually applied to real world problems. Some notable work done with hierarchy and living systems theory such as that by Miller (1978) are not mentioned in this book; admittedly, Miller's work has not related directly to ecology until recently (Miller & Miller, 1982), but profitable interaction might have resulted from its consideration.

The use of complementary models for describing a system is a keystone in the work. Systems can be described from different levels of resolution and provide alternative view points. Many complex systems can be represented by rate-dependent laws at one level that generate dynamics and rate independent rules that provide constraints at a higher level. The existence of such complementary models helps to explain the seeming paradox of being able to validly describe the same phenomena by both discrete and continuous representations. Such paradoxical arguments have been important in a number of fields such as physics and ecology. In physics, for example, matter can be viewed as being wave-like or being particle-like, while in ecology, ecosystems can be viewed as being either continuous units or discrete units.

Allen and Starr avoid the issue of whether or not hierarchies have ontological status or not by taking the position that hierarchies are epistemological and are observer determined. Their approach, therefore, tends to emphasize more operational than conceptual concerns. A rich body of ecological research is used to illustrate their ideas, although in many cases the hierarchical framework was imposed after the research was done, rather than before it was started. The point is made that scientists should use hierarchical concerns to organize their research from the beginning. Results may have little or no meaning if measurements and modes of analysis are not appropriately scaled or viewed from a well-defined observer perspective. Perspective and scale can be powerful tools for gaining new understanding of real phenomena.

This hierarchical framework helps to relate aspects of ecology that have seemed tenuously related in the past. For example, concepts of connectivity, diversity, and stability fit together more completely when systems are viewed from a hierarchical perspective. A system which is exhibiting different modes of stability may, in fact, be experiencing changing patterns of connectivity and diversity at a more detailed level of resolution. Connectivity is treated as

being dynamic rather than static, which is in contrast to the way that most ecologists have worked with connectivity.

Multivariate analysis is suggested as a tool for identifying hierarchical structures in ecological data sets. Allen and Starr use a number of examples in which multivariate analyses have identified ecological phenomena that occur at different scales and frequencies. Such techniques are useful in ecology and other middle-number disciplines. I have some reservations about the indiscriminate application of multivariate analysis. Such analyses have often been used without the proper understanding of the assumptions behind the methods. Such abuses have become more common with the prevalent use of computer statistical packages. Improper use of multivariate techniques can easily lead to interpretations that are invalid. As with the most powerful tools, they can generate either fruitful or harmful consequences. Allen and Star demonstrate how multivariate analyses can be used as a powerful ecological method for reducing large data sets.

In the last chapter, the authors apologize for making the book hard to read. The book is hard to read in places, because of the use of unfamiliar terminology and ideas, but many parts of the book are a delight to read because of the clear and clever use of examples. Sometimes, the examples appear to be trivial and one feels that hierarchy theory does not have too much to offer those examples. The last chapter may be the most useful because it deals with the way the hierarchy theory applies to field research and emphasizes the fact that scale and observer perspective are important in addressing any scientific question. With many researchers such considerations are more intuitively than explicitly recognized.

I hope that the book will generate the type of fruitful discussion that Allen and Starr desire. The topics that they discuss are central to the design of scientific experiments and results, especially in disciplines that deal with complex systems.

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Miller, J. G. *Living systems.* New York: McGraw Hill, 1976.

Miller, J. G. & J. L. Miller. The earth as a system. *Behavioral Science,* 1982, 27, 303–322.

C. C. Park: *Ecology and Environmental Management, A Geographical Perspective.* Boulder, Colorado: Westview Press, 1980, 272 pp.

THIS BOOK is designed as an introduction to ecology and environmental management for students of geography or environmental science, and is also suitable for landscape architects and regional planners. Park has organized the book well. He begins with a chapter on the problems of environmental management. His discussion of the history of the "environmental crisis" is very good. The relationship between humankind and the environment, and between geography and ecology is also discussed.

Park then devotes four chapters to ecological theory *per se.* First, the biosphere is examined from a systems point of view, although only two or three pages are allotted to the explanation of systems concepts. Global cycles of energy, water, chemical elements, and sediments are discussed in sufficient detail, although the nitrogen cycle is oversimplified. Next, the ecosystem concept is addressed. Park examines food webs, trophic dynamics, niche, energy, nutrients, productivity, and ecosystem analysis.

He then discusses variations in ecosystems with a standard chapter on ecological changes through time (evolution and succession), and a more unusual chapter on ecological changes in space. Spatial distributions of ecological characteristics are discussed on a global and a regional scale. Although some mention is made of animal distribution, the chapter is primarily concerned with the distribution of plants.

The final three chapters deal directly with environmental management issues. He first deals with society's use of environmental resources, and the resulting pressures on those resources. The next chapter addresses society's abuse of the environ-