come as a criterion, about 65 percent of the variance in the objective economic standing of the men in mid-career in the second sample can be accounted for by resources they accumulated at the time they began their work careers—that is, by family background and schooling.

While it is apparent that this work as a whole adds considerably to knowledge about the subjective assessment of stratification in America (the data using objective measures only replicate earlier findings), its utility is significantly decreased by its atheoretical approach. Theoretical analysis, ever since Max Weber, has distinguished between status variables and class variables. The former are anchored in the sphere of consumption and life-styles, the latter in the sphere of the market for goods and labor. The present authors, however, use class, status, and social standing interchangeably and thereby muddy the waters when constructing their hierarchical scheme of general status profiles.

Moreover, the authors cling persistently to a view of social class or social standing in which life-styles and life-chances are simple correlatives of position in a structure analogous to a simple layer cake. This obscures a central fact about systems of stratification, namely that people in the higher position have the power largely to determine the fate of those placed in lower strata. Warner's and the authors' Panglossian approach veils the central fact that in all class societies the resources and the power of the high and mighty are largely a function of the lack of power and resources of the downtrodden. One hardly needs a profound knowledge of the social sciences to realize when the Bureau of the Census informs us that in 1974 the poorest fifth of American families received 5.4 percent of national income and the top fifth received 41 percent that there is a relation between these data. But such reflections do not arise in studies of social standing that limit themselves to "what people say" or to the analysis of background variables in status attainment. As I have argued elsewhere, students of class and stratification ignore structural variables, such as class antagonisms and power relationships, at their peril. Without recourse to the theoretical formulations of Marx, Weber, and their contemporary successors, we might get, as in this case, fine descriptive findings, but we shall hardly advance a theoretical penetration of the veiled mystery of class societies.

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Niche Overlaps

Food Webs and Niche Space. JOEL E. COHEN. Princeton University Press, Princeton, N.J., 1978. xvi, 190 pp. Cloth, $14; paper, $6.95. Monographs in Population Biology, 11.

In opening up new areas for intensive study the Princeton Monographs in Population Biology have been widely influential. Cohen's monograph, like its predecessors, is the first work on a subject rather than the last. Though most ecology textbooks discuss food webs, there have been few attempts to investigate their structure and its consequences. Perhaps many have been bewildered by the apparent complexity and lack of pattern in what they observe. Cohen quickly states that his aim is not to provide "a compendium of everything worth knowing about food webs." His major contribution, rather, is to show that their complexities do not preclude the existence of interesting patterns for descriptive and theoretical study.

The pattern shown by nearly all food webs is that they can be represented by interval graphs. In interval graphs the predator's choice of prey can be expressed as intervals, possibly overlapping, along the real line. The noninterval pattern requires at least four predators (say, A, B, C, D) and occurs, for example, when the only overlaps in diet are between A and B, B and C, C and D, and D and A. Such a pattern cannot be represented in one dimension as overlapping intervals (one per species), though it can be represented in two dimensions.

That food webs are usually interval is a curious, perhaps even obscure, property to which to devote a book. Yet such properties, being unsuspected, are less likely to be artifacts of the ways in which the data were collected.

The exact definition of interval and noninterval graphs, the choice of webs from the literature, and their analysis occupy the first three chapters of the book. The most important chapters are the next two, which ask: Why are interval webs so common? The first step in dealing with this problem is to examine attributes that food webs possess other than being interval. The second involves the demonstration that random webs constrained to possess these attributes contain a larger fraction of noninterval webs than those found in the real world.

Cohen produces seven models; each has one or more attributes (for example the number of prey species for each predator) equal to those in the real web under analysis. Each model makes predictions about the expected number of niche overlaps to be found, and comparing such predictions with the observed values permits the seven models to be evaluated. For each of the models a random sample of artificial webs is produced and analyzed. Even for the samples based on the models that describe the data the best, the artificial webs have an excess of noninterval webs over what is observed in nature. Real food webs are not random structures.

This section analyzing web attributes and the models based on them is the easiest one to criticize. This comment is not meant to detract; if the criticisms are valid they are also explanations for the rarity of noninterval webs. There are at least three factors that might affect the result.

First, a property that is interesting in its own right: the 4:3 ratio of predator to prey species in community webs. Cohen groups webs into two classes, sink webs, which are portions of communities consisting of particular predators and all their prey, and community webs, which are relatively more complete, consisting of all the major species in a habitat. Sink webs have more prey species than predator species, but since these webs exclude the predators' predators the total number of predators will be too small. Sink webs are also less grouped; community webs often contain "species" that are groups of species. This grouping of species varies with trophic level as one might expect: the lower the trophic level the greater the grouping. In the literature Cohen has searched birds are usually named to species, insects and plants are usually simply categorized as such. Even when (as in the description of the willow forest community) the lower trophic levels are not lumped together, the list of vertebrates (seven in this example) would seem more complete than the list of plants (only three). These biases must surely contribute to the apparent excess of predators.

Second, in the models some features are allowed to vary that in the real world are partly fixed by a number of factors. Cohen's models permit loops of the kind A eats B eats A, A eats B eats C eats A, and so on. These do not occur in the ecological data, except through typological error, and there are many reasons why they should not. The probability that random webs will contain such loops is quite high.

Third, the models are not constrained by the number of trophic levels and so can occasionally possess many more levels than are found in the data.

How any of these three factors affects

the probability of noninterval webs is unclear. If artificial webs constrained to have any or all of these additional attributes had fewer noninterval webs, then the rarity of noninterval webs in nature might be partially explained.

In the later chapters of the book Cohen explores the significance of the rarity of noninterval webs. If a predator's choice of prey can be expressed along a single dimension, what is that dimension? Does it represent an obvious physical or biological parameter, or is it abstract? In most cases the data available are insufficient to answer this question. Cohen defends his results against any circularities and points out that if there is an identifiable physical or biological dimension its occurrence does not explain why only one dimension predominates.

Other explanations for the excess of interval webs are discussed, and none of them are found to be totally acceptable. One explanation Cohen considers is that noninterval webs might be dynamically unstable. This explanation is rejected on the grounds that both interval and noninterval webs modeled by linear interactions can be shown to be stable. However, though the number of interactions in the model webs is similar to the number in the real web being analyzed, the distributions of interactions within the model and the real webs may be very different. Models may produce webs with blocks of highly interconnected species balanced by a paucity of interactions between blocks. Blocks of this type might be dynamically unstable and not persist in the real world. This would leave webs with interactions more uniformly distributed. Because of their complexity the blocks would also be more likely to be noninterval, and if any subset of a web is noninterval the entire web is noninterval. For example, a block of species consisting of two carnivores, two herbivores, and two plants requires at least eight pairs of predator-prey interactions (including two between the carnivores and the plants) before it can be noninterval. Linear models of such a noninterval system have a very small range of parameters consistent with dynamic stability, and indeed Cohen's data do not include many such blocks. In short, if the real world has fewer complex blocks than the models this also might explain the rarity of noninterval webs.

Cohen concludes with a critique of both the data and the methods used to analyze them. His attention, throughout, to detail makes this book particularly convincing. It is clearly written and each step of the argument is well illustrated with examples or analogies. The mathematics (which is generally easy to follow) is innovative, and in lacking envy of the physicists' techniques (such as differential equations) Cohen has broadened the mathematical base for theoretical ecology. Moreover, though taking a theoretical approach to his subject Cohen does not become mesmerized by the wealth of possible behaviors shown by model systems and then look to nature for examples. Rather he seeks out those patterns that are widespread in nature, carefully excludes trivial explanations, and then explores possible causes. Many ecological phenomena are complex, and how they should behave under a statistical null hypothesis may also be complex. One could wish that other ecologists were as careful as Cohen has been to distinguish patterns from statistical artifacts. More studies using methods similar to his would greatly improve our understanding of ecological communities.

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Quantum Theory

Mathematical Foundations of Quantum Theory. Papers from a meeting, New Orleans, June 1977. A. R. MARLOW, Ed. Academic Press, New York, 1978. x, 372 pp., illus. $22.

In his opening essay, "The mathematical foundations of quantum theory," P. A. M. Dirac says, "One should keep the need for a sound mathematical basis dominating one's search for a new theory. Any physical or philosophical ideas that one has must be adjusted to fit the mathematics. Not the other way around. Too many physicists are inclined to start from preconceived physical ideas and then to try to develop them and find a mathematical scheme that incorporates them. Such a line of attack is unlikely to lead to success." Most of the other 18 contributors to this volume of conference proceedings have followed the line advocated by Dirac. As a result, the book presents a reasonable sample of current efforts to learn the lesson of quantum mechanics by identifying its mathematical structure in a general framework of physical theory.

I will mention a small but, I hope, representative subset of the contributions. John Wheeler discusses a family of "delayed choice" experiments in which the observation made on a system is delayed until after the system has completed its essential interactions. Thus, the outcome of the interactions apparently depends on the observer's later choice. Wheeler's detailed and instructive analysis supports the statement he quotes from Niels Bohr, "No phenomenon is a phenomenon until it is an observed phenomenon." Experiments of the type discussed by Wheeler have only recently become practical possibilities in the laboratory, and it is to be hoped that quantum mechanics will soon be given yet another subtle and significant test by experiments now under way. Andrew Vogt gives a family of examples of pairs of distinct nonrelativistic wave functions that have identical probability distributions in both coordinate space and momentum space. He notes that the first examples of this kind appear to have been given by Hans Reichenbach and Valentine Bargmann in 1948 and that there are still plenty of associated open problems, such as to determine classes, C, of self-adjoint operators with the property that if two wave functions have the same distributions with respect to operators of C they differ by a constant phase factor. Franklin Schroeck, Jr., studies the idea of a measure with minimum uncertainty on a noncommutative algebra with an eye to the idea of "fuzzy observable" in quantum mechanics. Thurlow Cook shows how a classical theorem of commutative measure theory, the Vitali-Hahn-Saks theorem, can be extended to (noncommutative) quantum logics. Roughly, the result is that a sequence of states that converges on each proposition defines a limiting state. This is a basic technical result in the theory of quantum logics. A considerable portion of the volume (315 pages) is devoted to the general theories of quantum logics and of manuals—the authors here include A. R. Marlow, Richard Greechie, S. Gudder, D. J. Foulis and C. H. Randall, Hans Fischer and Gottfried Rüttimann, and Ron Wright. This subject has by now achieved maturity, and there is a considerable mathematical theory associated with it, as well as a fund of unsolved problems. Both are well described here.

Since it is not unlikely that at least a century will be necessary for the assimilation of the ideas of quantum mechanics, it is probably too much to expect that a book of this kind written after 50 years should be more than a modest progress report. It is just that and, as such, will no doubt prove useful for all those who interest themselves in the mathematical aspect of the assimilation process.

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