from Royce to Mead to Blumer and to Goffman there is documented a great transformation: The singular and binding covenant of the Protestant ethicists erodes in the face of the emergence of a plurality of worldly, nonbinding situational and personal ethics [p. 276].

It is clear that Vidich and Lyman see the future in Goffman's apotheosis of the "voracious ego" (p. 306), that furiously secular creature of the Pacific frontier. But what this might mean now for sociology, or, much more important, for society at large, *American Sociology* does not say. Perhaps as one casts aside the rhetoric of moral certainty it becomes harder to say anything at all.

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Mechanisms of Migration

The Control of Fish Migration. R. J. F. SMITH. Springer-Verlag, New York, 1985. xvi, 243 pp., illus. $49.50. Zoophysiology, vol. 17.

Fish Migration. BRIAN A. MCKEOWN. Croom Helm, London, and Timber Press, Portland, Ore., 1984 (distributor, International Specialized Book Services, Portland). x, 224 pp., illus. $29.

The study of animal migration in general and fish migration in particular has produced a literature of impressive proportions. Despite the theoretical basis provided by F. R. Harden Jones in 1968 with the publication of *Fish Migration*, progress in this field has been sporadic, with little evidence of the emergence of a conceptually complete framework for the further study of fish migration. The abundant yet disparate literature has, since 1978, included a number of books reviewing the field that in general have failed to contribute more than summary of what has already been documented. Some of the exceptions to this generalization are the contributions of R. R. Baker (1978, 1982) on the general subject of animal migration and the collection of papers assembled by J. D. McCleave and coeditors (1984) concerning migratory orientation in fish. We now have two more books in what appears to be a renaissance of interest in fish migration.

Smith's *The Control of Fish Migration* is presented as a summary of representative experimental studies illustrating the mechanisms used by fish to guide and time their migrations. Studies of distribution and migratory routes and of physiological adjustments required of migrants are excluded. The author thus places little emphasis on a major contemporary issue in fish migration research, that is, the interaction between the physiological state of a migrant, its environmental preferences, and ocean dynamics as a mechanism of directional movement. Although this issue is alluded to, it is subordinated to the traditional approach of discussing migration in terms of major sign stimuli (light, odors, magnetic stimuli, and so on) and their respective sense organs. Although there is nothing wrong with this approach, the end product is a conventional and routine paper-by-paper review that repeats the same ideas and findings that have dominated our thinking over the last two decades. For the uninitiated, the book is a convenient introduction to part of the literature concerning migratory orientation. For the initiated, it provides no significant new insights or concepts.

In contrast, McKeown's *Fish Migration* presents a compact, up-to-date, overview of the field including migration patterns, mechanisms of orientation, bioenergetics, physiology, ecology, and evolution. The major contribution of this work is the author's effort to establish research in bioenergetics and physiology as equal partners of orientation research in the study of fish migration. This equilibrium is rarely achieved in collective works dealing with the proximate regulation and the ultimate causes of fish migration.

Much of the review of bioenergetics and physiology deals with fundamental principles that some physiologists might consider too basic for a specialty book. However, as a nonphysiologist in need of a review, I found these chapters informative. The only shortcoming I noted was the absence of discussion of mathematical models dealing with the hydromechanics of fish swimming. Such models provide explanations of certain behavioral and morphological adaptations based on assumptions of least costly travel strategies. Such research is worthy of consideration in any study of migratory bioenergetics.

The final chapter, dealing with the ecology and evolution of fish migration, is dominated by Baker's ideas concerning lifetime tracks. The utility of this concept is not always obvious. It is easy to state that the characteristics of an animal's lifetime track or migration are determined by its morphology, physiology, and behavior; the challenge is to define how these phenomena are related. Under what set of conditions is the optimization of physiological state sufficient to explain migratory patterns without precise orientation? Under what set of circumstances is precise orientation obligatory? What are the physiological links between bioenergetics and behavior? What is the course of ontogeny in orienting ability and to what extent can physiological events (critical periods) and learning modify it? The possibility of formulating a unifying theory of fish migration lies in the answers to these questions, and the task demands a global appreciation of all the topics touched on in McKeown's book. This book provides a readable and complete introduction for all those who wish to know why and how fish migrate. The next step is to formulate key questions and testable hypotheses concerning these diverse phenomena. What we do not need, for the time being, is another review of the subject.

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Developmental Neurobiology

Molecular Bases of Neural Development. GERALD M. EDELMAN, W. EINAR GALL, and W. MAXWELL COWAN, Eds. Wiley, New York, 1985. x, 606 pp., illus. $85. A Neurosciences Institute Publication.

Recent advances in molecular biology, immunology, and biophysics have provided tools adequate for addressing in molecular terms some of the most interesting issues in developmental neurobiology. The influx into neuroscience research of a new generation of scientists trained in these molecular techniques has brought neuroscience back into the mainstream of biology. Biologists who want to see how both classical and modern approaches are being used to address previously unapproachable questions, or simply to learn what some of the most interesting issues are in this transformed field, should find *Molecular Bases of Neural Development* interesting reading.

The book contains reports from a conference sponsored by the Neuroscience Institute. The objective of the organizers appears to have been to provide in-depth samplings of the finest research being done on a few selected subjects and not to provide a comprehensive overview of developmental neurobiology.

Overall the quality of the chapters is quite high. The authors are an outstanding set of scientists, and the book contains the best overviews of recent work by many of them. Only a few papers repeat recent reviews or are out-of-date.

The best section of the book describes

the development of the map in the retinotectal system. Cowan and Hunt provide a lucid and intellectually rigorous review of past theories and experiments concerning this system. Similar chapters in the other sections would have added depth. Fraser provides a clear model for explaining the development of the map with only four proposed interactions between retinal and tectal cells—three adhesive and one repulsive. This chapter illustrates the potential strength of a theoretical approach to developmental neurobiology. Even if one suspects that theory must be far from reality when so little is known about a system, one should enjoy Fraser's provocative thrust. Finally, chapters by Easter and Schmidt deal thoroughly with experimental results. Easter shows convincingly that retinotectal maps are plastic in the goldfish. Retinal fibers continually shift positions on the tectum as it grows asymmetrically throughout life. Schmidt presents evidence that production of the final map requires activity-dependent stabilization of synapses as well as adhesive interactions.

A section on the neural crest and the development of the periphery contains an elegant brief description of the development of neural crest progeny by Le Douarin. Though not a substitute for her recent monograph on the neural crest, Le Douarin's chapter presents a substantial revision of a major theme of that book—the pluripotency of crest cells. Some developmental capacities of early crest cells now appear to be restricted to subpopulations at earlier times than was previously appreciated. A chapter by Thiery and colleagues is a clear summary of their important work on the roles of cell adhesion and extracellular matrix molecules in directing crest cell behavior. Unfortunately, the chapter does not summarize Thiery's recent experiments in which crest cell migation in vivo has been inhibited by a synthetic peptide that blocks fibronectin function. A chapter by Gershon and Rothman provides the best introduction that this reviewer has seen to the development of the enteric nervous system, a fascinating but frequently ignored subject.

A section on the formation of neurites and synapses contains elegant papers by Letourneau and by Goodman and associates. The first describes extrinsic factors, such as adhesive molecules, electric fields, and trophic molecules, that direct the movements of neuronal growth cones in vitro. The second illustrates the power of invertebrate systems for analyzing the growth of identified neurons in vivo and the potentials of modern immunology and molecular biology for investigating the molecules that direct the growth. A paper by Hollyday in another section argues persuasively that the development of motor innervation in vertebrates proceeds with equally exquisite precision, probably using similar cues.

Some sections of the book are not well organized. The papers in the sections not discussed here are often tenuously related, and several papers would have been better placed in different sections. Inevitably, some papers are dated. For example, a paper by Edelman on cell adhesion molecules deals with only three such molecules, although recent work from his and several other laboratories makes it clear that many more adhesion molecules exist and are used by individual cells in ways that are just beginning to be appreciated. A paper by Warner on early development of the nervous system does not cover her dramatic studies with Guthrie and Gilula on the role of gap junctions. Overall, though, these are minor criticisms of an exciting and very readable book.

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Books Received

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