Brain Development

Studies in Developmental Neurobiology. Essays in Honor of Viktor Hamburger. W. MAXWELL COWAN, Ed. Oxford University Press, New York, 1981. xvi, 454 pp., illus. $45.

Viktor Hamburger laid the groundwork for what we currently know of the general rules of vertebrate brain development. First and foremost is that there is no precise predetermination of the role to be played by each individual component. The prudent gardener plants many seeds and later thins the seedlings. In the same way, neurons of each general class are formed in a generous surplus and are endowed with a set of general rules that they must follow in order to achieve their proper pattern of interconnection. This is not to say that there are no limitations on what each cell may do; in fact, the delineation of these limitations is the topic of many of the chapters in this book honoring Hamburger.

Neurons are determined to be of a particular class at an early stage in their generation, perhaps during final mitosis. Lynn Landmesser addresses the question of how particular this determination is by studying the ability of motoneurons to innervate inappropriate groups of muscles. In the book she notes a distinction between classes of motoneuron that normally innervate dorsal limb muscle masses and those that innervate ventral limb muscle masses and suggests that motoneurons may even be determined to contact particular muscles within one of these muscle masses. The experimental construction of aberrant patterns of innervation may reflect a capacity to accept second best within a hierarchy of possibilities, rather than an absence of an affinity for particular end organs. The theory of chemoaffinity was formulated by J. N. Langley in 1895 to explain his observations of orderly reinnervation of autonomic ganglion cells, and its current status is here reviewed in chapters by Dale Purves, on synaptic specificity, David Gottleib and Luis Glaser, on cellular regulation during neural development, and Margaret Hollyday and Paul Grobstein, on myoneural specificity and the patterning of connections in the retinotectal system. That more than half the neurons developing in some parts of the brain should be destined to die is difficult to accept. This part of Hamburger's scientific legacy provides many puzzles, not the least being that development may be quite normal until the time of death. Neuronal death is the subject of a timely and comprehensive review by Robert Oppenheim.

With customary lucidity and rigor, Gunther Stent makes it clear that to speak of a "genetic program" for development may lead to more than merely semantic confusion. No "plan" for the final complex pattern of the nervous system exists within the genome, although presumptive neurons are endowed with a set of rules for their development. The rules include instructions on how to migrate to the right place, how to extend an axon in the proper direction, how to accept synaptic inputs from appropriate sources, and so on. In addition, as E. G. Jones's elegant experiments demonstrate, axon terminals may pause in the vicinity of their presumptive targets for days or weeks (depending on species) until the appropriate time to form synapses.

The book is more than a collection of essays. Cowan has organized a coherent and progressive account of current knowledge of neuroembryology that will interest the general reader as well as the specialist. It is not fully comprehensive; for example, there is little consideration of the role of feedback from the environment or of the "critical periods" when fine tuning of various aspects of brain development may occur. Nevertheless, it is of sufficient stature to supplement Jacobson's *Developmental Neurobiology* and Lund's *Development and Plasticity of the Brain* in graduate courses.

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Marine Ecology for Students

Marine Ecology. JEFFREY S. LEVINTON. Prentice-Hall, Englewood Cliffs, N.J., 1982. xviii, 526 pp., illus. $35.95.

Judged by any number of criteria, the field of marine ecology has burgeoned in the last few decades. Keeping abreast of developments in the field is becoming increasingly difficult. There has never been a textbook that adequately guided students through the maze of information. Several marine biology texts provide beginning students with a general introduction to the oceanic realm, but they deal inadequately with the questions addressed by studies in modern marine ecology.

Jeffrey Levinton has bravely attempted to fill this growing void. *Marine Ecology* is intended to serve as a textbook or as background reading for junior and senior undergraduate and first-year graduate courses in marine ecology and biological oceanography. The book consists of 21 chapters divided among the following six sections: The Ocean and the Effects of Its Properties on Marine Organisms; Some Models and Principles of Populations in Marine Ecology; Reproduction, Dispersal and Larval Ecology; Plankton and Productivity in the Oceans; Substrata and Life Habits of Benthic Organisms; and Coastal and Benthic Habitats. The material is drawn from original literature, which is liberally cited throughout the text, the aim being to give the student "a strong sense of current research in marine ecology." A glossary is also provided.

The book emphasizes patterns and processes related to the distributions and abundances of marine organisms, including interactions among species within communities. Processes of nutrient cycling and energy flow are treated in less detail, as is the ecology of marine vertebrates. There is almost no treatment of applied marine ecology; three pages are devoted to marine fisheries and none to oceanic pollution or mariculture.

Compiling a textbook for the field of marine ecology is an awesome task made all the more difficult by the absence of predecessors. In some respects, Levinton's book is quite successful. It provides a sound but not overly detailed background in physical and chemical oceanography (though it overlooks the effects of small-scale phenomena such as boundary layers) and introduces the reader to the incredible variety of phenomena studied by scientists who identify themselves as marine ecologists. All of the major marine environments and their more common inhabitants are discussed and often illustrated with photographs or with excellent line drawings. Biological processes ranging from physiology to community evolution are discussed and a wide variety of techniques are described.

Unfortunately, Levinton's book lacks the cohesion and balance required of a successful textbook. The organization of the material is often cumbersome and in some places repetitive. The text reads like an extended review rather than a textbook. The author seems not to have stepped back from his nine years of accumulated lecture notes to perceive the field as a whole before starting to write. As a result, the weighting given to the material is often unbalanced. Some subjects (for example community evolution) are treated in such detail as to obscure the main points whereas others are treated only superficially (demography, predatory behavior, modes of evo-

lution, nonequilibrium views of community structure, and succession). Contributing to these problems, the text is not particularly well written: it is sometimes ungrammatical, and the presentation of a number of the arguments is convoluted or vague. The author uses technical terms (for example, "clastic," "lithified," "adaptive radiation," "reproductive value," "amphi-Atlantic," "endemism," "state variable") that are defined neither in the text nor in the glossary. The same is true of key terms that appear in some of the figures reproduced without revision from the original sources (for example "appetitive behavior" in fig. 8-8).

Much of the discussion of major topics in ecology (for example, Lotka-Volterra competition equations, life history strategies, particularly r and K selection, succession, niche differentiation, and character displacement) seems naïve and uncritical. Important critical reviews of these subjects that had been published at the time the text was being written are neither cited nor discussed. Students sorely need to learn critical skills, especially when reading the results of original research. This book does little to develop them. Philosophically, Levinton seems to favor equilibrium explanations of community structure, particularly those involving competition for limiting resources.

The discussions of evolutionary processes are often unclear. For example, the presentation of theories concerning long-distance dispersal in marine invertebrates and supporting examples are likely to leave the reader confused about the level at which Levinton believes selection to be operating. Modes of selection above the level of the individual (about which there is an abundance of recent theory) are not discussed explicitly, though their operation is implicit in many of Levinton's arguments.

It is commendable that Levinton has drawn his information from original sources. The list of references is impressive, numbering about 900. However, the citations in some areas are much more up-to-date than in others. Papers dealing with soft-sediment habitats published as recently as 1981 are included, whereas important contributions from the 1970's on the ecology of assemblages on hard substrata are not. The most blatant omissions occur in the accounts of island biogeography, predatory behavior, the role of disturbance in community structure, and succession.

In summary, *Marine Ecology* contains more than enough of the raw material needed for a first-rate textbook. In fact, most workers in applied and basic marine ecology will find it to be a valuable reference book and will want to own copies. However, for classroom use it is too detailed and provides little synthesis. One comes away from the book with little sense of what the author feels to be important directions for future research. A rigorous revision could correct these problems. In the meantime, my own students will continue to be held responsible only for the half-truths I tell in lecture.

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