Book Reviews

Prospectuses of Neurobiology

From Neuron to Brain. A Cellular Approach to the Function of the Nervous System. STEPHEN W. KUFFLER and JOHN G. NICHOLLS. Sinauer, Sunderland, Mass., 1976. xiv, 490 pp., illus. Cloth, $18; paper, $12.

The Cellular Basis of Behavior. An Introduction to Behavioral Neurobiology. ERIC R. KANDEL. Freeman, San Francisco, 1976. xxii, 728 pp., illus. Cloth, $45; paper, $19.95.

Some authors of textbooks try to present standard subject matter with improvements over previous such efforts; if all goes well the writing is clearer, the references more recent and complete, the presentation more up to date, the book more scholarly or pedagogically more nearly perfect. Other authors depart from the standard and define, or redefine, a field, eliminating many topics that might ordinarily be considered important in order to make room for the nonstandard.

We of course need all sorts of textbooks, but those in the second category can play an especially important role in the dialectic of scientific ideas. These three authors have given us a pair of textbooks firmly in that category. In both cases the books are avowedly nonstandard, and to a significant extent they are statements of their authors' personal achievements, both direct and indirect.

The Kuffler and Nicholls book is divided into six parts. Part 1, Neural Organization for Perception, concentrates on information gained from studies of single cells in the mammalian visual system, much of it from the laboratory of Hubel and Wiesel. To get the novice reader started, the authors give preliminary definitions of the necessary terms ("synapse," "dendrite," "action potential," and so on). They then plunge directly into questions of visual information processing. Almost half of the book is taken up with part 2, Mechanisms for Neuronal Signaling. Here the ionic basis of the resting potential, the nerve impulse, synaptic potentials, neurotransmitter release mechanisms, neurotransmitter biochemistry, and active transport are dealt with. Part 3 treats the physiology of glia and the cerebrospinal fluid, and part 4 surveys sensory receptor mechanisms, with emphasis on stretch receptors. The methods used by nerve cells to integrate information are presented in part 5, with examples drawn from studies on Mauthner cells and the spinal reflex. This part concludes with a chapter on the leech that illustrates the advantages of using a simple nervous system and gives a succinct summary of studies on this preparation. The last part, entitled Nature and Nurture, considers, by reference to studies on denervation and reinnervation and on development of the visual system (Hubel and Wiesel again), interesting questions of growth and specificity of neuronal connections.

This book deals throughout with cellular mechanisms, and nearly all the examples emphasize studies from the Harvard neurobiology department, although other contributions to the literature are not neglected. The authors have made significant research contributions to the areas covered in each chapter, so the treatment has the authority only an insider can give, except perhaps where the more quantitative aspects of the subject are encountered. The style is clear and interesting, and the presentation gives historical perspective to the development of the subject, but with a thoroughly modern outlook: gating currents, freeze-fractured synapses, and orientation and ocular dominance columns are here together with photographs of Adrian and Cajal and on p. 150 a nice picture of Kuffler with two of his early collaborators who later made it.

The writing makes this a good book to learn from, and so does the overall production. The illustrations are clear and appropriate, the margins of the pages have brief indications of the major topics discussed, and various pedagogic aids such as good summary tables, a glossary of technical terms, and an appendix on electrical circuits have been included.

Kandel has divided his book into three parts. Part 1 is Strategies in the Study of Behavior, part 2 Strategies in the Study of Nerve Cells, and part 3 Nerve Cells and Behavior.

The first part begins with a brief history of experimental and ethological approaches to behavior and argues for a convergence of those traditions with modern cellular approaches to nervous system function. Further, it advocates the systematic and logical approach of selecting a favorable preparation with simple physiology and behavior as a model system and using the model to work out answers to questions of general importance. Although generalizations to other preparations, and to man, will not be immediate, both experience and evolutionary theory support the idea that understanding behavioral mechanisms in one organism will, at the very least, be a great aid for approaching the same questions in other forms. The sea hare *Aplysia* is then introduced as a suitable simple animal to serve as the model preparation. After a description of the animal itself, Kandel presents the structure of its beautiful nervous system and compares it with the mammalian plan. *Aplysia* exhibits behaviors that range in complexity from simple reflexes through fixed action patterns characteristic of "instinct" to more complicated chains articulated by complex discriminative stimuli (feeding and mating). The strategy, then, is to exploit simplicities in neuronal and behavioral structure to discover the neural mechanisms that underlie instances of behavior in various categories (reflex, fixed action pattern, and so on) and its plasticity.

Part 2 describes the neuronal properties and mechanisms that will be needed for the third part. Here we are introduced to the mechanisms of the action potential and of pacemaker activity and to synaptic mechanisms. The subject of identifiable single neurons is presented and some brain maps are given, together with a discussion of similarities and distinctive differences between various identified nerve cells. This part concludes with a treatment of the richness exhibited by neuronal circuits in *Aplysia*: here are revealed the electrical synapses, the dual excitatory-inhibitory synapses, the multiaction neurons (those that mediate both inhibition and excitation), and the variety of mechanisms and neurotransmitters used to achieve excitation and inhibition in this nervous system (as in others).

In part 3, almost half the book, Kandel turns to his main task, presenting the neuronal mechanisms responsible for specific behaviors. Half a dozen behaviors, from a simple reflex withdrawal of

the mantle to more complicated circulatory control and feeding, are treated in detail. In each case, the emphasis is on properties of nerve cells and circuits that account for special aspects of the behavior. For example, defensive inking has a high threshold and a very nearly all-or-none character, and these properties can be traced to electrical connections between the controlling neurons and to their special properties and pattern of synaptic connections.

The bulk of part 3 concerns the plasticity of the nervous system and its cellular mechanisms. After a survey of the classes of mechanisms that have been proposed to account for plasticity, Kandel describes the recent experiments from his laboratory on the cellular basis for habituation and dishabituation. The part concludes with a brief and brave discussion of possible implications of what has been learned from invertebrates for abnormal behavior in man.

This book is clearly written and provides a valuable introduction to cellular neurobiology (part 2) as well as a comprehensive treatment of the insights provided by *Aplysia* and other invertebrates into how the nervous system relates to behavior (part 3). Each chapter concludes with a "summary and perspective" that lets the reader get a clear idea, in only a couple of pages, of what happened in chapters he or she chose not to read. The equations in part 2 are developed lucidly, and the most important ones are given with examples, a great aid to understanding. It is a pity, however, that the action of magnesium at synapses is not more thoroughly explained in part 2, for magnesium block is used in a number of the experiments described in later sections. The book is attractively produced with many clear illustrations upon which thought and care have obviously been lavished.

Judged on their own terms, these are certainly successful books; they both do exactly what they set out to and do it well. What they present is accurate and authoritative, as well as lucid. The Kuffler and Nicholls book is already popular with students learning about neurobiology (Common conversation: Me to student, "And what do you know about neurobiology?" Student, "Well I read Kuffler and Nicholls"), and I suspect also with professionals who are not quite up to date on one or another aspect of nerve cellular mechanisms. Kandel's book will be an indispensable reference for anyone using *Aplysia*, and will be widely read by all who are interested in the relation between nervous system and behavior. Further, professionals will read part 2 in particular to catch up on the richness and diversity of the cellular properties described there. Both books would serve nicely as the basis for interesting courses.

The authors of these books know their business thoroughly. They are scholarly and good writers and could have produced exemplary standard texts. How then are we to view the decidedly nonstandard selection of material in both books?

Kuffler could well be called the father of modern neurobiology, and his many and classic contributions to various areas are well known. Nicholls, one of Kuffler's scientific sons, has also made important research contributions and has a comprehensive knowledge of neurobiology. Kandel is trained as a psychiatrist, has done first-rank work with both vertebrate and invertebrate nervous systems, and is the leading investigator of the cellular basis of functional plasticity. What such people choose to write, even the intentionally blatant malacomorphism of Kandel's final chapter, must be taken seriously. These texts can be read as historical documents that tell where leaders in the field think neurobiology stands and indicate where they think it is going.

The ultimate impact of such books is hard to predict, but I think these will play an important role in the evolution of the concepts of neurobiology and in the definition of the field itself. They document a trend toward explanations in terms of cellular and subcellular mechanisms, and they will, I think, help set the standard for the level of acceptable questions in neurobiology. Also, both books insist that one should strive to investigate cell properties that help to explain function, and they reject the sort of electrographic, morphologic, and biochemical taxonomy that was once usual and still occurs. It is more important to be systematic and to have observations make sense, they say, than it is to be exhaustive and collect information, without clear purpose, that fails to enhance understanding. The authors have not included all of neurobiology that makes sense—and would not claim to have done so—but by virtue of the meaningfulness and quality of the material presented their books will serve as models for future books and for research in the field.

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Cognitive Psychology

Cognition and Reality. Principles and Implications of Cognitive Psychology. ULRIC NEISSER. Freeman, San Francisco, 1976. xvi, 230 pp. Cloth, $12.50; paper, $4.95.

In 1967 Neisser's seminal book *Cognitive Psychology* exploded on the psychological scene. The book was instrumental in establishing cognitive psychology as a respectable field of scientific research, and it moved Neisser to the front and center of a new and powerful movement in psychology. His name has been synonymous with cognitive psychology in the minds of students for nearly a decade. Thus it is not surprising that his new book has been avidly awaited by psychologists.

Alas, *Cognition and Reality* is pale by contrast to Neisser's earlier work. He has abandoned the scholarly, tightly reasoned, and information-packed format of his previous book and has opted instead for a conversational, redundant, often rambling style. As a result of this change, the book is more accessible to readers outside the psychological community, but it is substantially less convincing than his earlier work. The important arguments of the book, put forth in the first 78 pages, have to do with theories of perception, ordinary seeing, and cognitive structures (what Neisser calls "schemata").

Two themes recur throughout the book: (i) Too much work in modern cognitive psychology is grounded in artificial laboratory settings. Cognitive psychologists must move out of narrow laboratory situations and study people engaged in natural activity in the real world. (ii) The theories of J. J. Gibson have more merit than they have generally been given credit for by cognitive psychologists. (The book is dedicated to J. J. and E. J. Gibson, Neisser's colleagues at Cornell.)

The point concerning the relevance, or, as Neisser calls it, the "ecological validity," of psychological research is clearly worth attention. Cognitive psychologists as a whole do spend too much energy pursuing narrow, artificial problems, and pressure toward more generality is to be commended. Neisser's argument is vitiated, however, by the fact that the two pieces of his own research reported in the book are a study of a person trying to watch one or both of two video films played simultaneously over the same TV monitor and a study of people learning to read for full comprehension while writing down a list of ran-