Book Reviews

The Production of Behavior

Neuroethology. Nerve Cells and the Natural Behavior of Animals. JEFFREY M. CAMHI. Sinauer, Sunderland, Mass., 1984. xvi, 416 pp., illus. $30.

Neuroethology as a new synthesis of neurobiology and behavior has had difficulty developing a respectability and an identity of its own. In the '50's many ethologists laid the foundations for the subject by offering explanations of behavior in terms of brain mechanisms. They developed many concepts, but these always evaporated when neurophysiologists sought to follow them up. Ethologists then went their separate ways, most to behavioral ecology, leaving few interested in brain mechanisms. It was left to neurobiologists to pick up the subject, but for them relating behavior to events in the brain has rarely been a respectable pastime. Perhaps the task of explaining how the brain produces behavior has always seemed too hard to manage. But that is what must be done in order to understand the brain, for it has no other purpose than to produce behavior. Moreover, relating the activity of neurons to behavior keeps the neurophysiologist in touch with reality. For example, would long-term changes in pre- and postsynaptic potassium channels now be a subject of much interest were it not possible to relate the changes to modifications of behavior? It is because it attempts the beginning of an explanation of how the brain produces behavior that Camhi's book is a welcome addition to the neurobiological literature. It differs fundamentally from the many good textbooks on neurobiology that have recently been aimed at medical students and considerably outshines two recent books on neuroethology.

Chapters 2 and 3 trace the contributions of behavioral studies and neurobiology to the new synthesis. Basic concepts of behavior and basic properties of neurons are covered briefly and at a very elementary level. Neurons are described only in terms of their classical methods of signaling; omitted is most of our modern knowledge of channels and our burgeoning knowledge of the chemistry of neurons. These chapters appear to be an attempt to generate an all-purpose neurobiology textbook. Though they do not achieve that aim they do indicate by their juxtaposition of discussions of altruism and ion channels in membranes that a vast task of synthesis lies ahead.

The style of the book is set by chapter 4, which describes the behavior of a cockroach escaping from a toad in terms of the properties of the receptors and the giant interneurons that are partly responsible for encoding the direction of the stimulus. Evidence and methods of collecting it are afforded more space than conclusions. The approach on the whole works well and only fails when references to research papers become too numerous or when hearsay is promulgated by reference to unpublished papers.

The next two chapters deal with sensory processing. The first, on vision, describes the way bees are able to communicate the direction of food sources, birds to navigate, and toads to recognize prey. The second, on hearing, deals particularly with echolocation in bats. Both are preceded by lucid accounts of the physics of the particular sensory modality, followed by descriptions of the behavior and of some of the neural mechanisms. In general the behavioral descriptions are more satisfying than the neurobiological ones, but this is no more than a reflection of the present state of the synthesis.

The final chapters describe the way movement is produced, drawing upon examples such as the tail flip of a crayfish, the rhythmical swimming movements of a leech, and the visual stabilization of the body of a fly. They exemplify the value of the neuroethological approach by showing how the properties and connectivity of neurons have more meaning when placed in the context of what they are doing. Even behavioral experiments can be more accurately focused once some of the neural mechanisms begin to be understood.

Inevitably the coverage of the book is restrictive and not everyone will find his or her favorite topic, but the selection is representative of current research. Many of us who try to teach undergraduate courses at the boundary between neurobiology and behavior have always been frustrated by the lack of suitable textbooks; this book should go a long way toward alleviating such frustration. I am sure it will do much to rekindle interest in this vibrant and essential subject.

MALCOLM BURROWS
Department of Zoology,
University of Cambridge,
Cambridge CB2 3EJ, England

Magendie and His Milieu

Science and Medicine in France. The Emergence of Experimental Physiology, 1790–1855. JOHN E. LESCH. Harvard University Press, Cambridge, Mass., 1984. xii, 276 pp. $25.

It was in France, during the early decades of the 19th century, that physiology first developed its scientific identity as an autonomous discipline. This achievement was made possible by the work of many men, but the predominant contribution—the one that overshadowed by far any other efforts—was made by François Magendie (1783–1855). It is no accident, then, that the years covered by this book correspond almost exactly to Magendie's life-span and that five of the book's nine chapters are devoted almost exclusively to Magendie's career.

Lesch situates Magendie's work historically by opening his book with a chapter surveying the state of physiology in the 18th century and another outlining the institutional changes taking place in France during the 1790's that favored the advancement of physiology as a science. Lesch's third chapter then focuses on the work of Xavier Bichat (1771–1802), Magendie's most important predecessor in physiological research; and his final chapter symmetrically completes the picture by following the early career of Magendie's celebrated student and successor, Claude Bernard (1813–1878).

Although Magendie's physiology and its relationship with that of Bichat on the one hand, and with that of Bernard on the other, have been the subject of a number of detailed studies over the last 40 years, Lesch's book makes a significant contribution to the literature by demonstrating the central role that surgical practices, and the surgical tradition generally, played in the development of

French physiology during this period. Lesch's handling of the surgical theme is skillful, and his arguments are for the most part well documented. It is only to be regretted that he did not make some reference to the pioneering work of Owsei Temkin in this connection.

In his chapter on Bichat, Lesch argues for a radical distinction between the two different styles of physiological work in which Bichat engaged: a descriptive systematization of bodily processes based upon the philosophical medicine of the 18th century, and an experimental investigation of specific animal functions based upon the outlook and techniques of contemporary surgery. Lesch's insistence on the importance of surgery for Bichat's experimental work in physiology represents an advance on our previous understanding of Bichat and his career; but his conclusion that Bichat's work is therefore bifurcated into "two physiologies" having little or no connection with one another seems somewhat forced.

The lengthy treatment of Magendie in this book gives Lesch the opportunity to cover, in some detail, the main features of Magendie's career, from his doctoral thesis of 1808 to his retirement in 1852. In the chapters devoted to this material Lesch presents a fine synthesis of the interrelated elements in Magendie's development of experimental physiology, including not only the central theme of surgery but also the associated aspects of Magendie's researches on the actions of drugs and the beginnings of experimental pharmacology. In the course of his analysis, Lesch challenges the self-image of Magendie, perpetuated by Claude Bernard, as a "scavenger of facts" unconstrained by theoretical conceptions. Although it is doubtful that Magendie's scavenger image was ever wholly accepted by scholars at face value, it is nevertheless useful to have Lesch's documented rebuttal of this characterization on the record.

Having shown that Magendie was not unconcerned with the systematic relationships between experimental findings in physiology, and highlighting also the occasions when Magendie expressed his experimental goal in terms of the control of phenomena, Lesch is able to demonstrate a number of continuities between Magendie and Bernard. Some of these continuities were suggested in the 1940's by J. M. D. Olmsted, but Lesch's case is more extensive and better argued. It also helps us to understand, in the context of Lesch's argument as a whole, the ways in which Bernard moved beyond the medically oriented physiology of Magendie to become a specialist in physiological research.

As a whole, *Science and Medicine in France* is a sound and informative book that presents a coherent thesis about the early development of physiology as an experimental science. In defending this thesis, Lesch takes full account of recent research in the relevant areas, although often he seems to characterize the findings of his immediate predecessors in straw-man terms so as to maximize the novelty or distinctiveness of his own contribution. This kind of exercise, usually associated with weaker scholarship than Lesch's, is quite out of place here, since the genuine strengths of *Science and Medicine in France*, both analytic and synthetic, are a sufficient recommendation of the book.

W. R. ALBURY
School of History and Philosophy of Science, University of New South Wales, Kensington 2033, Australia

A Figure of Modern Science

A Time to Remember. The Autobiography of a Chemist. ALEXANDER TODD. Cambridge University Press, New York, 1984. viii, 257 pp. $29.95.

This is an account of the life of a remarkable man. Alexander Todd won the Nobel Prize in Chemistry in 1957 in recognition of scientific work that dominated, and indeed created, the synthetic chemistry of nucleotides and coenzymes. This work was central to our understanding of the structure and chemistry of nucleic acids and vitamins. Throughout his career Todd also has participated actively in public affairs, playing a key role in the formulation of science policy as an adviser to government and acting as a spokesman for British science in international organizations. This remarkable dual career led to other honors: a knighthood in 1954, a Life Peerage (Baron Todd of Trumpington) in 1962, and election to the presidency of the International Union of Pure and Applied Chemistry, of the British Association for the Advancement of Science, and of the Royal Society. His autobiography chronicles this career and includes insights into his ideas about science, universities, and public policy. These ideas are amplified in six appendixes, containing extracts from his presidential addresses to the British Association for the Advancement of Science and to the Royal Society.

Todd was born in Glasgow, Scotland, in 1907, in average circumstances. When he was eight or nine he received a Home Chemistry Set and augmented it with equipment and chemicals bought from a local laboratory supply house. An outstanding chemistry teacher helped inspire his interest, which led him to enter the University of Glasgow as an honors candidate in chemistry. He went off to the University of Frankfurt for graduate work, receiving a D.Phil. in 1931, and then went to Oxford to do research with Robert Robinson (Nobel Prize in Chemistry, 1947) and received a second D.Phil. in 1933. His independent career started at the medical chemistry department in Edinburgh, where he developed a good practical synthesis of vitamin B-1. In 1936 he moved to the Lister Institute in London.

Todd's work on vitamins attracted wide attention and stimulated several offers of university positions. He accepted an offer to join the University of Toronto as professor of chemistry, but shortly after his acceptance the offer was reduced to an associate professorship. After some hesitation he accepted this, whereupon the offer was reduced to an assistant professorship. Thus Canada lost an opportunity. The United States also came close. After a visit to Caltech in 1938 he received an offer of a faculty position and was about to accept it. At the last moment he was also offered the professorship of organic chemistry at Manchester; at the age of 30 Todd took up this position, one of the traditionally major posts in British chemistry. In 1944 he moved to the University of Cambridge, where he has been ever since.

It is difficult to convey the importance of the role that Todd has played at Cambridge. He inherited a dispirited department and developed it into one of the leading scientific centers. He designed and constructed the first modern university chemical laboratories in Britain, which have served as a model for others throughout the world. Todd initiated the creation of Churchill College, devoted to science and technology, and served as master of Christ's College for 15 years. He brought in strong successors and retired from the professorship at the early age of 63, determined to see his department continue to flourish under fresh leadership. I first went to Cambridge in 1955, as a postdoctoral fellow with Todd. Cambridge has established the Todd Professorship, an annual visiting post that I had the honor to hold in 1982. The new