psychology, neurochemistry has taught us much about "the brain" at one level or from one point of view. But none of these disciplines can tell us how the brain works or account for or encapsulate the excitement and successes of contemporary neuroscience.

The modern era in neuroscience began in the 1950's when, inspired by visionaries like the late Stephen Kuffler, cellular neurophysiologists joined forces with neurochemists and morphologists for truly multidisciplinary explorations of neural function, development, and disease. Equipped with powerful new techniques such as intracellular recording, ultracentrifugal tissue fractionation, electron microscopy, radioisotopic tracer methods, and microanalytical chemical procedures, these "neurobiologists" sought cellular and molecular mechanisms. They charted an approach that has been fruitful and clearly fostered the subsequent explosive growth and flourishing of neurobiology.

Thus it is in a multidisciplinary, neurobiological context that neurochemistry makes its important contributions to understanding of the nervous system. For this reason, introduction of the subject to students or to investigators from other fields is perhaps best done by integrating biochemical and molecular biological reasoning and findings with those of cell biology, physiology, and anatomy.

In *Chemical Neurobiology* Bradford follows a purer neurochemical tradition, presenting a topical, detailed account of neurochemistry as a branch of biochemistry. His book offers lots of information about brain metabolism, neurotransmitters and their receptors, neuropeptides, and membranes. An excellent chapter on synaptosomes stands out as timely and informative. Overall, however, the book fails because it does not deal with neurochemistry as one of the powerful approaches to an understanding of mechanisms of neural function and development. I fear that students, who want to learn how the nervous system works and how investigators combine experimental tools to answer mechanistic questions, will find Bradford's treatment unsatisfying.

Most important neurochemical topics are included, but not with equal effectiveness. For example, although more balanced than the accounts given in some other contemporary textbooks, Bradford's discussion of vesicular and nonvesicular release of neurotransmitters is confusing. Students not familiar with the physiology of release may not appreciate the functional implications of the findings Bradford describes. In sections dealing with amino acid neurotransmitters, glutamate and aspartate are classified (at the level of section headings) as excitatory and GABA and glycine as inhibitory transmitters. This presentation seems to endow the neurotransmitter itself with excitatory or inhibitory character and is likely to be misleading to students who do not already know that the receptor mechanisms (and not the transmitters themselves) determine whether a transmitter mediates synaptic excitation or inhibition and that a given transmitter may be excitatory or inhibitory at different synapses.

Even for a textbook of modest dimensions, Bradford's book has some serious gaps, as illustrated by three examples. First, much historically and currently important work on invertebrates is not mentioned. Thus, the discovery that GABA is a neurotransmitter and much important work on its metabolism, inactivation, and synaptic mechanisms, all accomplished in Crustacea, are omitted. And important studies of cholinergic receptors and voltage-sensitive ion channels in *Drosophila* and other insects are not included. Second, the discussion of second-messenger systems is not up-to-date and neglects or fails to clarify the likely roles of those systems in synaptic mechanisms. Finally, the advances enabled recently by recombinant DNA and molecular genetic technology, immunological procedures such as hybridoma methodology, and in vitro cell culture techniques get scant attention if any. These shortcomings are sure to disappoint readers and dissuade many instructors from adopting this textbook.

The successes of modern neurobiology have stimulated much interest in the field and attracted talented students with varied scientific backgrounds. To meet their needs, courses and training programs have been mounted, stimulating the production of numerous introductory and advanced textbooks and monographs. All this activity notwithstanding, certain key areas have been left inadequately covered. None has been more seriously neglected in textbooks than that encompassing traditional neurochemistry and modern molecular neurobiology, and we sorely need an authoritative, coherent, functionally oriented, and up-to-date basic textbook presenting this important material. Bradford has given us a useful book that is a welcome addition to the introductory literature of neuroscience, but it does not fill the greater need. Perhaps even more than a good five-cent cigar, what the world needs is a really good "neurochemistry" textbook.

JOHN G. HILDEBRAND
Arizona Research Laboratories, Division of Neurobiology, University of Arizona, Tucson, AZ 85721

Edentates

The Evolution and Ecology of Armadillos, Sloths, and Vermilinguas. G. GENE MONTGOMERY, Ed. Smithsonian Institution Press, Washington, DC, 1985. xii, 451 pp., illus. Paper, $45. From a symposium, 1979.

Armadillos (Cingulata) and sloths and anteaters (Pilosa) are living representatives of an early radiation of placental mammals that took place in isolation in South America. These living groups and their fossil relatives belong to the order Edentata, which is sometimes also called Paratheria or, as in this book, Xenarthra. The word "edentate" is of course technically a misnomer for all but the anteaters, which now lack teeth, but the name has long been in use and is likely to stick. Like the Marsupialia, edentates display enough anatomical diversity to warrant creation of several mammalian orders to receive them, but till now authors dealing with edentates have resisted such taxonomic inflation.

As a natural taxonomic group, the Edentata are held together by shared-derived characters, such as possession of extra articulations of the lumbar vertebrae (xenarthry), development of a synsacrum, and possession (later lost in some forms) of dermal ossicles. Edentates also retain some primitive characters, such as the shape of the stapes bone in the auditory apparatus and in some forms retention of a poorly differentiated uterus and vagina. Within the Edentata, anteaters and sloths share additional derived characters and therefore for more than 100 years have been merged as the taxon Pilosa, sister group of the Cingulata.

The origin of edentates as a major division of placental mammals is shrouded in mystery, but, on anatomical as well as biochemical grounds, their last genetic connection with other placentals is considered remote. This view is confirmed by a long and isolated edentate fossil record in South America, known to reach well down into the Paleocene. Recent discoveries by Bonaparte in Argentina suggest that the edentate record may even extend further, to the Campanaian Stage of the Late Cretaceous. How the edentates got to South America originally is unknown, but both Africa and North America seem to have had some kind of land connection with South America in at least part of the Late Cretaceous. Details are still murky. However, the present Panamanian isthmus was almost certainly not involved, because reconstructions of the Caribbean area suggest that Central America in Cretaceous times was situated well to the northwest of South America. Possibly, there was some sort of stepping-stone route between North and South America in the eastern

Caribbean, or perhaps resemblances between North and South American biotas resulted from a distribution that extended the long way around, via Africa, Europe, and the north shore of the North Atlantic Ocean. No one really knows.

Complicating matters, edentate-like fossils occur in early Cenozoic formations of eastern Asia, western North America, and Europe. Just as aardvarks and pangolins once were, these fossils have been referred to the true edentates by their describers. However, others have suggested that these supposed early northern edentates are really just palaeanodonts, a diverse fossil group allied more closely to pangolins than to true edentates. Thus, a North American origin of the Edentata from "insectivores" via Cenozoic northern palaeanodonts is currently questioned.

Whatever their origin, edentates have always been primarily South American. But in the late Cenozoic, several kinds of each of their major taxonomic divisions colonized southern North America from the south, beginning with several separate sloth invasions even before the Panamanian isthmus completely formed. One kind of sloth nearly reached the Bering Straits by the Pleistocene, but apparently no edentate crossed to Asia by that route in the late Cenozoic. Fossil edentates are known from the Greater Antilles as well as from the two main American continents, but the Antillean edentates are all representatives of a single sloth subdivision, the Megalonychoidea.

This book deals with unquestioned edentates, mainly living ones. It is a very instructive compendium, organized into sections dealing with identification and classification, phylogeny, anatomy and physiology, reproduction, diseases and parasites, and facets of ecology. I found the chapters on phylogeny by George Engelmann and by Wilfried de Jong *et al.* especially thought-provoking, as were Brian McNab's on energetics, population biology, and distribution and Kent Redford's on the food habits of armadillos. Most of the other papers, though fact-filled and interesting, are definitely for the files rather than for impassioned immediate discussion, but they are nonetheless well done. Moreover, the paper by the late Ralph M. Wetzel on the characteristics of the various kinds of armadillos is an especially useful summary. Wetzel's scholarship is inspiring; we shall miss him.

This book has been long in gestation. It therefore unavoidably contains some out-of-date ideas and contradictions, but it is generally well done. It has a good balance of descriptive chapters with think-pieces. The book is well illustrated, both in the individual chapters and also by some wonderful interspersed drawings by an unidentified artist whose initials are L. R. They add charm and fascination.

MALCOLM C. MCKENNA
Department of Vertebrate Paleontology, American Museum of Natural History, New York, NY 10024

Some Other Books of Interest

Inorganic Reactions and Methods. J. J. ZUCKERMAN, Ed. Vol. 1, The Formation of Bonds to Hydrogen (Part 1). VCH, Deerfield Beach, FL, 1986. xxvi, 326 pp., illus. $92.

This volume inaugurates "a closed-end series of books designed to present the state of the art of synthetic inorganic chemistry in an unprecedented manner," that is, according to bond formation and type of reaction rather than by way of elements or classes of compounds. The principles that underlie the form of presentation are explained in detail in a section headed "How to Use This Book" and in the series preface. In brief, the material is arranged according to a decimal scheme ("1.2. The Formation of Hydrogen," "1.2.1. Introduction," "1.2.2. by Reactions of Hydride Ions," "1.2.2.1. with Hydrogen Halides," and so on) and has, according to the editor, been edited in order to "homogenize" the individual contributions and to "provide the highest practicable density of information." Names of people have been confined to the reference lists that conclude each subsection, symbols and formulas are used in preference to element and compound names, and SI equivalents are included for older data. In addition to an editorial advisory board of 11 persons, 26 editorial consultants are listed for the series. Volume 1, which has ten contributors, proceeds from the formation of H_2 to the formation of bonds between hydrogen and elements of group VIB, with the treatment of bonds to hydrogen to be completed in volume 2 of the series. At the end of the volume 90 pages are devoted to author, compound, and subject indexes keyed to section rather than page numbers. The endpapers include abbreviated tables of contents for the 17 further volumes projected.—K.L.

Ionic Currents in Development. RICHARD NUCCITELLI, Ed. Liss, New York, 1986. xxxviii, 375 pp., illus. $64. Progress in Clinical and Biological Research, vol. 210. From a meeting, Los Angeles, Aug. 1985.

The development of the vibrating probe, a technique for measuring steady or slowly changing extracellular electric currents, has given rise to "impressive advances" in the study of the role of transcellular ionic currents in development, writes the editor of this volume. The technique, he reports, is now used in some 30 laboratories around the world. The meeting from which this volume stems (a satellite meeting of the 10th international congress of the International Society of Development) brought together many of the investigators using it. Nuccitelli's introduction, which includes a brief history of the study of bioelectrical phenomena, is followed by a "tutorial" on the vibrating probe by Carl Scheffey. The main text of the volume consists of four sections: Technical Advances, divided into subsections on the detection of extracellular currents (five papers) and of intracellular calcium (three papers); Transcellular Ionic Currents and Cell Polarity, dealing with both plant (eight papers) and animal (nine papers) systems; Transembryonic Ionic Currents and Regeneration (four papers); and Galvanotropism and Galvanotaxis in Development (ten papers). The volume concludes with a Roundtable Discussion consisting of two papers, "Ionic currents: an overview" by Lionel F. Jaffe and "Transcellular ion currents in tip-growing organisms: where are they taking us?" by Franklin M. Harold. It also includes a subject index.—K.L.

Books Received

Cholinesterase. Mary Whittaker. Karger, Basel, 1986. x, 132 pp., illus. $55.50. Monographs in Human Genetics, vol. 11.

A Complete Cosmology. The Cyclic Universe. L. R. Holdridge. Vantage, New York, 1986. xiv, 179 pp., illus. $11.95.

Computational Methods for Integral Equations. L. M. Delves and J. L. Mohamed. Cambridge University Press, New York, 1985. xii, 376 pp., illus. $69.50.

Computational Methods for Kinetic Models of Magnetically Confined Plasmas. J. Killeen *et al.* Springer-Verlag, New York, 1986. viii. 199 pp., illus. $38. Springer Series in Computational Physics.

A Course in Mathematical Physics. 2, Classical Field Theory. Walter Thirring. 2nd ed. Springer-Verlag, New York, 1986. x, 261 pp., illus. $35. Translated from the German edition (Vienna, 1978) by Evans M. Harrell.

The Dream of Reality. Heinz von Foerster's Constructivism. Lynn Segal. Norton, New York, 1986. xxii, 184 pp., illus. $22.95. A Norton Professional Book.

Ecology. Paul Colinvaux. Wiley, New York, 1986. x, 725 pp., illus. $32.95. A successor to the author's *Introduction to Ecology*.

Economic Aspects of Biotechnology. Andrew J. Hacking. Cambridge University Press, New York, 1986. x, 306 pp., illus. $59.50. Cambridge Studies in Biotechnology, 3.

An Invitation to Law and Social Science. Desert, Disputes, and Distribution. Richard Lempert and Joseph Sanders. Longman, New York, 1986. xvi, 528 pp., illus. $39.50; paper, $21.95.

Kinetic Theory of Particles and Photons. Theoretical Foundations of Non-LTE Plasma Spectroscopy. Joachim Oxenius. Springer-Verlag, New York, 1986. xii, 353 pp., illus. $49. Springer Series in Electrophysics, vol. 20.

Kingdom of the Ice Bear. A Portrait of the Arctic. Hugh Miles and Mike Salisbury. Published by arrange-

(*Continued on page 1105*)