

cally examined by H. A. Bern. R. B. Clark presents a rather comprehensive survey of studies on integration in the brain of polychaete worms, including aspects of neurosecretion, hormone action, habituation, learning, and memory. W. Loher and F. Huber describe old as well as new experiments on nervous and endocrine control of sexual behavior in a grasshopper, and R. A. Hinde and E. Steel describe the integration of external and internal (hormonal) stimuli in the control of reproductive behavior in female canaries; B. Baggerman takes a similar approach in a study of reproductive behavior of the three-spined stickleback. J. Bruner and L. Tauc attempt to explain learning processes and "plastic changes" in the central nervous system on the basis of modifications of transmitter production at synapses and "episynapses." Intensive research on learning in the octopus is beautifully reviewed by M. J. Wells. Short-term and long-term plastic changes in the mammalian nervous system are discussed by W. Kozak and R. Westerman.

This carefully edited and beautifully produced volume has an assured place on the bookshelves of comparative physiologists and neurophysiologists. Like the 16-year-old proceedings of the fourth Symposium of the Society for Experimental Biology, *Physiological Mechanisms in Animal Behavior*, it can be regarded as a landmark and will be of value for many years to come.

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Research Tools

Glass Electrodes for Hydrogen and Other Cations. Principles and Practice. GEORGE EISENMAN, Ed. Dekker, New York, 1967. 594 pp., illus. \$24.75.

With the commercial introduction in recent years of many highly specific electrodes for both cations and anions, and with the improvement of electrometers for measurement of electromotive force, there has been much increase in the use of electrodes in various analytical situations. Electrodes have the advantages of being relatively inexpensive, nondestructive, and, in the case of highly specific ones, relatively easy to apply. This is a kind of research that is developing rapidly, and unfortunately the time involved in as-

sembling and publishing a book like this one seems to mean that the book is two or three years old when published. That is not to say that this book is obsolete; on the contrary, it is a valuable addition to the library of anyone interested in the theory of electrode response or in the problems of practical use of electrodes in inorganic or biological research. It deals, however, almost entirely with silicate-glass electrodes, and as readers of *Science* know, there are now available specific-ion electrodes whose sensitive membrane is an organic liquid, or, as in the case of the fluoride electrode, a crystal.

The glass-electrode potential and, by inference, an organic-liquid potential, or a crystal-electrode potential, is now generally accepted as being the sum of two potentials: the boundary potential, which arises from exchange equilibrium between the electrode and the solution, and a diffusion potential, arising from interdiffusion of ions in the membrane. Empirical electrode equations and equations stemming from solid solution theory have been derived to aid in understanding the potential changes of an electrode sensitive to more than one ion, and these equations may be applied to any ion-sensitive electrodes. No doubt the increased understanding of the sources of glass-electrode potentials has aided in the development of the newer non-glass electrodes. In practical applications, however, it is best not to assume that any electrode will respond ideally for very long; one should recalibrate frequently, with standard solutions as much as possible like the unknowns.

George Eisenman has compiled, edited, and contributed to a book that contains chapters by many different authors, who represent many if not most of those involved in current research on glass-electrode theory and applications. The first seven chapters deal with theory; there follow 12 chapters of a practical nature, describing techniques of construction and of measurement in inorganic solutions, in soil studies, and in biological applications, both in vitro and in vivo. Glass electrodes are especially useful in biological research because the glass can be formed into microelectrodes for intracellular ion analyses. The practical section will be welcomed by those who struggle with the mundane problems of experimental arrangements and interpretations of measurements. Because each chapter has many references, the book amounts

to a review of the literature of glass-electrode technology up to early 1965 and constitutes a convenient source of recent experience with glass electrodes.

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Mammalian Anatomy

Traité de Zoologie: Anatomie, Systématique, Biologie. Vol. 16, Mammifères, fascicule 1, Téguments et Squelette. Pierre-P. Grassé, Ed. Masson, Paris, 1967. 1170 pp., illus. F. 255.

The comprehensiveness of the treatment of the mammalian integument and skeleton in the first installment of volume 16 of the *Traité de Zoologie* will be no surprise to those who have read or consulted previous volumes in this series. The mammals as a class take up two volumes (16 and 17), which are divided into seven installments. Installments 2 through 4 of volume 16, covering other aspects of mammalian anatomy and reproduction, are in press, and installment 5, which will contain notes on embryology, post-embryonic growth, and taxonomy, is in preparation. Volume 17, in two installments dealing with taxonomy and ethology of mammals, has already been published.

The first 233 pages of the present book are devoted to the skin and its accessory structures. This section, which is written by Manfred Gabe, director of research at the National Center of Scientific Research in Paris, includes a large amount of factual material gleaned from the literature on morphology, histology, histochemistry, histophysiology, cytology, general physiology, vascularization, innervation, lymphatics, and embryology. Most of the information about the structure and function of skin comes from studies of man and the common laboratory animals. For this reason, a truly comparative treatment of the subject was not possible, and discussions of morphology and physiology relative to environmental adaptation are limited.

The author adds interest to his presentation of facts by including a history of ideas and a list of unsolved problems. For example, the covering of hair is one of the important distinctive characteristics of mammals, and many theories have been advanced to explain its evolution. Certain mammalogists