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-older 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 assembling 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 That is not to say that this book is obsolete; on the contrary, it is a valuable addition to the library of anyone interested in the theory of electrode response or in the problems of practical use of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 specification 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 nonglass 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, postembryonic 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

have believed that hairs are modified scales, others have thought they are teeth that have lost their dentine and failed to become calcified, and still a third group has suggested a resemblance to the feathers of birds. Also, since mammals are thought to have evolved directly from reptilian ancestors, theories attributing a relationship of hairs to the femoral glands or to the tactile corpuscles of reptiles enjoyed support for a time. Actually it would appear from the available evidence that the hair system is uniquely a characteristic of the class Mammalia. No other class of veretebrates has anything even remotely resembling this system.

In a like vein, Gabe's discussion of the arguments advanced by certain scientists to demonstrate the superiority of one race of humans over another is both amusing and instructive. One such "scientific" argument concerned the glands of the skin. To the older mammalogists the apocrine sweat glands represented the more primitive form, the eccrine glands being the possession of mammals more evolved. One scientist then championed the superiority of the Mongol race over all others because members of this race had the fewest glands of the primitive form. The whole argument was demolished later when it was demonstrated that monotremes, considered the most primitive of mammals, were provided with both types of glands.

Cartilage, osseous tissue, and osteogenesis are also handled by Gabe in a fashion similar to that found in the standard histology text. Form and growth of bone are covered by Jacques Lessertisseur and Roger Saban, and the mammalian skull and the hyobranchial skeleton are handled by Dietrich Starck and Jean-Pierre Gasc, respectively. Lessertisseur and Saban also are responsible for a thorough study of the vertebral column and appendicular skeleton.

More than two-thirds of this book is devoted to studies of the skeleton. Every conceivable aspect of the mammalian skeleton is treated—for example, asymmetry and peculiarities of cetacean skulls, the value of the hyobranchial apparatus to the vertebrates, and the evolution of the spinal column and the "enderostes" (a French term for ectopic bony structures such as the os penis). Nearly every page contains a black-and-white drawing or diagram depicting the arrangement and form of bones in various mammals. These excellent sketches are probably the perfect way to illustrate skeletal parts.

The book will be useful to many biologists. Students and teachers alike will appreciate it because anatomy, histology, physiology, and biochemistry are all under the same cover. Comparative anatomists will find it an indispensable reference for matters pertaining to the skeleton. The section on the integument will be less valuable because of the lack of comparative material.

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Some Trees

The Genus Pinus. N. T. MIROV. Ronald, New York, 1967. 610 pp., illus. $15.

This volume covers the pines of the world, both living and fossil. Not primarily a taxonomic revision, it is much broader than the classic monograph with the same title by George Russell Shaw (1914). Mirov's experience with pines is unique, ranging from fieldwork with most species of the world to chemical studies of oleoresins. He has succeeded admirably in his objectives, stated in the preface, of assembling as much information as possible on pines, answering many questions about them, and offering some generalizations and speculations as a stimulus to more research, and this reference will be useful to many classes of readers. Certain practical aspects of pines are not included, however—for example, silviculture, forest management, insect pests and diseases, and physical properties of lumber.

The book is mainly a review of the literature, enriched with many Russian-language citations, but it also has some new material. The ten chapters are well-organized compilations of information on history, paleobotany, and paleogeography (105 pages), geography (192 pages), genetics, morphology and reproduction, physiology and ecology, chemistry, chemical geography, and taxonomy. Geographic distribution ranks first in number of pages. Material about the various species is scattered among several chapters with slight repetition, but it can be found easily with the help of the detailed index. Among the numerous illustrations is a remarkable collection of photographs of forest trees of nearly every pine species.

The taxonomic treatment, accepting 105 species (counting two varieties), and including Martinez's many Mexican pines, is not conservative but is intermediate between those of Harrison (in Dallimore and Jackson, 1966), with 80, and Gaussen (1960), with 120. Shaw's classification is followed, with the rearrangement of the subsection *Pinaster* by Duffield (1952). There are no taxonomic descriptions or drawings of each species, no taxonomic citations, and no lists of synonyms or specimens. Only under geography is each species treated separately with a map and photograph. Incidentally, the detailed distribution maps recently published by the U.S. Forest Service [*U.S. Dept. Agr. Misc. Pub. 991* (1966), 97 pp., illus.] were the result of a project begun by Mirov before his retirement in 1963.

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Books Received

The Adaptable Black Bear. J. R. Matson. Dorrance, Philadelphia, 1967. xii + 147 pp., illus. $4.

Advances in Agronomy. Vol. 19. A. G. Norman, Ed. Prepared under the auspices of the American Society of Agronomy. Academic Press, New York, 1967. xii + 370 pp., illus. $15.50.

Advances in Biological and Medical Physics. Vol. 11. John H. Lawrence and John W. Gofman, Eds. Academic Press, New York, 1967. ix + 356 pp., illus. $15.

Advances in Control Systems: Theory and Applications. Vol. 5. C. T. Leondes, Ed. Academic Press, New York, 1967. xii + 426 pp., illus. $18.50.

Advances in Immunogenetics. Tibor J. Greenwalt, Ed. Lippincott, Philadelphia, 1967. x + 223 pp., illus. $13.50.

Alcohol Problems. A Report to the Nation by the Cooperative Commission on the Study of Alcoholism. Prepared by Thomas F. A. Plaut. Oxford University Press, New York, 1967. xvi + 200 pp. $4.75.

Algebraic Theory of Particle Physics. Hadron Dynamics in Terms of Unitary Spin Currents. Yuval Ne'eman. Benjamin, New York, 1967. xvi + 334 pp., illus. Cloth, $10; paper, $5.95. Frontiers in Physics.

The Alkaloids. Chemistry and Physiology. Vol. 9. R. H. F. Manske, Ed. Academic Press, New York, 1967. xvi + 589 pp., illus. $27.

American Junior Colleges. Edmund J. Gleazer, Jr., and Paul L. Houts, Eds.

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