Book Reviews

Physiologists' Recollections

The Pursuit of Nature. Informal Essays on the History of Physiology. A. L. HODGKIN, A. F. HUXLEY, W. FELDBERG, W. A. H. RUSHTON, R. A GREGORY, and R. A. MCCANCE. Cambridge University Press, New York, 1977. vi, 180 pp., illus. $15.95.

This collection of "informal essays on the history of physiology" was written as part of the celebrations of the centenary of the Physiological Society in 1976. The authors were not only eyewitnesses of major developments in their respective fields but key contributors to them. Their approaches and styles of writing are quite varied, ranging from the rather straight historical reviews of the development of research (R. A. Gregory on secretory hormones and R. A. McCance on perinatal physiology) through personal and anecdotal accounts (W. H. A. Rushton on vision and M. Feldberg on acetylcholine transmission) to a more global view of how the direction of research is influenced by available instrumentation and by the interactions of people (A. H. Hodgkin on nerve and A. F. Huxley on muscle).

McCance organizes his description of developments in perinatal physiology along different avenues of scientific approach or states of fetal development. His own work is referred to mostly in the third person. His final section, entitled "The Future," acidly attacks committees on ethics for their restrictions on fetal research.

Gregory gives an interesting account of the development of research on gastrointestinal hormones, which was started by a single afternoon's experiment by Baylin and Starling. Gregory's style is to mention his own work only by citing his review articles.

Feldberg writes a very personal and anecdotal account of the brief and exciting period of his work with Sir Henry Dale on acetylcholine transmission and of the struggle to obtain recognition and acceptance of their work by electrophysiologists (at whom he launches a few arrows).

In his inimitable style, Rushton presents some personal and vivid memories of his vision research over the past 50 years. His essay appears to make no attempt to be systematic or to give a uniform treatment of the whole field (for example, he gives only a few lines to Hubel and Wiesel), but his account is rich with his own pithy recollections of striking or unusual demonstrations and lectures.

In his essay, entitled "Chance and design in electrophysiology," Hodgkin sets out to correct the impression of directness and logical planning that characterizes so many scientific papers (including his own, which often have been held up as models of systematic and logical research). Hodgkin gives a number of examples of the part chance and good fortune played in his ground-breaking experiments with nerve, carried out over two decades and culminating in his 1952 series of papers with Huxley. He makes a strong case for knowing the right people at the right time, both for scientific and for financial aid. Nor does he neglect the role that development of instrumentation and methods played. His essay is a delightful mixture of description of experiments and of his interactions with many persons whose names are familiar in the field and to whom he gives much credit for helping him on his way.

Huxley, "Looking back on muscle" in his usual scholarly way, describes the development of interference microscopes (including his own) and how their images overturned the existing ideas about muscle ultrastructure. Huxley relates that, when he found new experimental results that conflicted with the then-current texts in physiology, he delved into the history of striated-muscle research, starting in mid-19-century microscopy. He traces the changes in ideas of how muscle contracts; the description accepted today was established in the 1870's but questioned in the 1880's, contradicted on the basis of observation by new methods in the 1900's, and forgotten until rediscovered with the interference microscope in the 1950's. Huxley makes an excellent case for his conjecture that this sequence of events occurred not only because the microscope had gone out of style, but, especially, because of the ascendancy of the principle of "uniformity of nature."

Huxley raises the question whether such unjustified tides in the acceptance and rejection of observations and hypotheses occur in other areas of biology. He gives an affirmative answer with examples familiar to him from neurophysiology and the development of microscopes. He concludes with a chilling warning: "I think it is clear that there are at least two places in the story where a theory was accepted with such enthusiasm that it influenced the observations that were reported. I sometimes wonder whether the danger of this kind of error may be increased by the numerous symposia and conferences that are held nowadays. The same story is told at each, usually by the same people, until on the Bellman's principle ('what I tell you three times is true') it becomes impossible even to contemplate any alternative." Huxley's provocative ideas invite us to join him in his contemplation of possible self-deception, questioning his own work by wondering whether "we are all busy reinforcing each other in our belief in the present day cross-bridge story."

This book is provocative, enjoyable, and useful for students of all seasons.

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Insect Physiology

The Circulatory System of Insects. JACK COLVARD JONES. Thomas, Springfield, Ill., 1977. xvi, 256 pp., illus. $24.50.

"More information exists on the circulatory system of more species of insects than for any other single group of animals, including the vertebrates." So states the preface, and the 50-page bibliography that makes up one-fifth of this book would seem to bear that claim out. There is indeed much material, extending back to the observations of William Harvey and Swammerdam, on the structure and function of the insect heart and associated organs, and these data are comprehensively cataloged to provide a useful handbook of facts and references. But the comparison with vertebrate studies raises a question about the relative significance of all this knowledge. So much of the information on insect hearts stems from the sheer diversity of the group. Pulse rates for over a hundred species are listed together with hemo-

lymph volumes and hemocyte counts for half that number, and yet no significant conclusions can be drawn from these compilations except that the insect circulatory system is diverse in its characteristics. No models or generalities regarding the regulation of pulse rate emerge from the many cited studies on the action of a wide spectrum of salines, drugs, and tissue homogenates. Resolution of the longstanding question of neurogenic versus myogenic origin of the pulse rests almost entirely on Miller's excellent work with one species, the cockroach *Periplaneta americana*. The heart rhythm is myogenic, but the heart is richly innervated for reasons that seem yet to be little understood.

The regulation of hemolymph volume is another topic of fundamental importance to insect physiology on which an array of observations has accumulated. Endocrine effects on diuresis have been widely reported, but a coherent picture of either short-term regulation or the basis for the marked developmental changes in hemolymph volume has yet to emerge. It seems, too, that such basic properties of the circulatory system as hemolymph viscosity and fluid dynamics in relation to pump design are quite unknown. On the other hand, several special features of the insect system are well studied, for example the occurrence of accessory pulsatile organs that insure circulation in elongate appendages, although even here nothing seems to be known of circulation in orthopteroid cerci; are they circulatory dead spaces?

Some other physiological aspects of great intrinsic interest are given brief and rather superficial treatment. Thermoregulation, for example, is a function of the insect circulation that, although long suspected, has been subjected to serious evaluation only in this decade. The air-cooled thoracic flight motor proves also to be cooled or warmed, according to requirement, by blood. Another special function of the insect circulatory system is the provision of localized hydrostatic pressure that inflates and expands body parts at the molt. Many examples of this process are cited, but detailed quantitative studies such as Cottrell's on the passage from pupa to adult of the blowfly are barely noticed.

What is known about blood cells in insects, the subject of the author's own principal research, is presented here in some detail. It is a complicated story with much yet to be told. A comprehensive account of the chemical composition of the hemolymph, in particular its diverse enzymatic components, its rich amino acid content, and its carbohydrates, both those of intermediary metabolism and those of cryoprotection, is unaccountably absent from the book. This is a surprising omission considering the physiological and developmental importance of the fluid that bathes all organs of the insect body.

An account of the origin and function of hemocytes and a brief look at immunity conclude the book.

On the basis of the material assembled in this volume, one is forced to the conclusion that, despite the vast literature, there is much yet to be done before it can be truly claimed that there is more significant information about the insect circulatory system than about that of the vertebrates.

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Amphibian Nervous System

Frog Neurobiology. A Handbook. R. LLINÁS and W. PRECHT, Eds. Springer-Verlag, New York, 1976. xvi, 1048 pp., illus. $184.50.

This book gives due recognition to the contributions the frog has made to our understanding of neurobiology. The editors state that their goal was "to assemble as much as possible of the information available on frog neurobiology," and in this they have largely succeeded. The book ranges from membrane biophysics to neuroendocrinology and includes sections on the skin, autonomic nervous system, sensory systems, and central nervous system of the frog. Each topic is covered in depth, and a comprehensive summary is provided at the end of each chapter. No restriction appears to have been placed on the number of figures in the book (one chapter contains 83), and reproduction of the figures, especially of the electron micrographs, is excellent.

The value of the book is not limited to its usefulness to investigators of amphibian morphology and physiology, for, as the editors point out, "much of the now classical knowledge in neurobiology was originally obtained and elaborated in depth in this vertebrate." The comparative aspects of both morphology and physiology are rightly emphasized, especially in the chapter on muscle spindles (Ottoson). The use of the amphibian in studies of development and regeneration is well described in chapters on the lateral line receptors (Russell) and the development of the prosencephalon (Clairambault). A useful chapter on the frog as an experimental animal (Müller) describes habitat, maintenance techniques, diseases, and experimental techniques.

Each author apparently has been allowed free rein, and little attention has been paid to avoiding overlap. For example, in the section on vision, pathways from the retina to the tectum are covered in three separate chapters. Although the chapter on the cellular and synaptic architecture of the optic tectum (Székely and Lázár) supplements that on the nuclear organization and connections of the optic pathway (Scalia), with reference made in each chapter to the other, it is unclear why the chapters, each excellent in its own right, could not have been condensed and combined. In the section on the spinal cord, the subject of electrical interactions between motoneurons has extensive coverage in two chapters and slightly less coverage in two others. Some overlap is unavoidable, but much of that in this book could have been avoided by the editors, shortening the book and (one hopes) reducing the price, which will severely restrict its availability. As it is, I can only urge medical and scientific libraries to obtain the book so that as many students and investigators as possible can take advantage of it.

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Protein Synthesis

Molecular Mechanisms of Protein Biosynthesis. HERBERT WEISSBACH and SIDNEY PESTKA, Eds. Academic Press, New York, 1977. xiv, 722 pp., illus. $55. Molecular Biology.

In the decade and a half since the genetic code was deciphered, we have been learning a remarkable amount about the way ribosomes synthesize proteins. All the ribosomal components have now been purified and RNA and protein sequence studies are well advanced. The arena has shifted from topics that occupied the field a decade ago, such as ribosomal assembly and protein chemistry, to investigations of ribosomal function, ribosomal genetics and regulation, and, perhaps most important, their relation to ribosomal structure. The cutting edge of ribosome research is currently the integration of functional studies with structural information, combining our detailed knowledge of the locations of individual ribosomal pro-