elements in metabolism. The next sequence, the endocrines, is handled well, structurally and functionally, in 160 pages. The last chapter in volume 1 reviews the prostaglandins in nonavian and avian species. Volume 2 begins with the integument, goes on to the skeletal system, and then presents a number of chapters on each of the interrelated systems, muscular, vascular, and nervous, terminating with chapters on bile formation and body temperature, including regulation. The third volume is devoted entirely to the structural and hormonal aspects of male and female reproductive systems.

Almost without exception each author has pointed out wherein the information for the chicken and other birds differs from that known and generally accepted for mammals. By this approach they have performed a signal service to students in general and relieve the neophyte in avian physiology of the necessity of seeking answers for the bird in texts and reference books based on mammals.

Sometimes scholarly publications of this magnitude are read through once and largely ignored in the years thereafter. This reviewer found that the chapters are written with the attention-holding qualities of a popular publication, that the information presented opens up whole new fields for research, and that the suggestions and critical approach make this work the kind of reference publication that will be used repeatedly, if close at hand. The volumes will be a special boon to students just entering the arena of avian anatomy and physiology and will provide material for many stimulating seminars.

Only two of the 62 chapters seem to fall somewhat short of the average high standard. Much of the chapter on the digestive tract is anatomically accurate, but the divisions of the intestine as given by the author follow mammalian rather than avian terminology as found in the ornithological literature. Also, the pancreas of the chicken differs in several important respects from those of mammals. Later chapters take up some of these differences and give them proper emphasis. The chapter introducing the vascular system has borrowed some terminology from mammalian anatomy, such as "innominate artery" for "brachiocephalic artery." Blood returning from the lungs is said to enter the left atrium rather than the left auricle.

Such minor errors are offset by the masterly handling of other topics—for example, the treatment of the respiratory system by all the authors involved is outstanding. The excretory system of birds has two kinds of tubules. The renal portal system probably plays a role in uric acid formation in the kidney, the process thereby differing from uric acid formation in the livers of mammals. The insulin content of the chicken pancreas is low, approximately one-tenth as much as in mammals. On the other hand, the glucagon content of the fowl pancreas is 10 times that of mammals. A hormone may be present in the cloacal bursa that acts upon the adrenal to maintain ascorbic acid concentration. These and many more provocative ideas, new hypotheses, and reevaluations of previously accepted facts continue through all the chapters.

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Neural Mechanisms

Neuron Structure of the Brain. G. I. POLIAKOV. Translated from the Russian. Harvard University Press, Cambridge, Mass., 1972. vi, 122 pp., illus. $5.

The English rendition of this monograph has been made possible by a special U.S. program for scientific translations. The author is a neuromorphologist who has worked extensively with the Golgi method, and his studies have included significant observations on the establishment of neuronal contacts during embryonic life. But the reader should not expect to find in this book any detailed discussion of either the anatomical or physiological aspects of synaptology. There is no attempt to correlate the Golgi picture with that obtained by the electron microscope or with degeneration studies. And since there is no index, it should also be mentioned that there is no inclusion of such timely topics as dendro-dendritic and axon-axonal connections, vesicles, axonal flow, cholinergic and aminergic systems, the glia, tight junctions, miniature and graded potentials, or lateral inhibition.

Rather, the author's purpose is to present his concepts of how progressively more complicated neural circuits make their appearance during the course of vertebrate evolution. The usual cybernetic models, he contends, are oversimplified and "represent more of the cybernetic aspect than an exact knowledge of the brain."

Claiming a somewhat novel approach, Poliakov identifies three main functions of the nervous system which he refers to as (i) "regulatory function," (ii) "control," and (iii) "direction." These are respectively subserved by (i) a "coordinating mechanism," (ii) an "analyzing-coordinating mechanism," and (iii) the "systems of analyzers." The coordinating mechanism regulates local defensive and adaptive reflexes involved in posture, locomotion, assimilation of food, and so forth. Poliakov points out that the principle of "action-counteraction" was first established by N. E. Vvedenskii and later formulated by Charles Sherrington as reciprocal innervation. The analyzing-coordinating mechanism subserves more complicated reflexes such as those involved in orientation. Finally, there are the analyzer systems, including cortical and subcortical mechanisms, that account for all psychological functions and dominate all reflex coordinations.

The first 70 pages would seem to be a sketchy and sparsely documented account leading up to detailed consideration of Poliakov's major interest in the fine structure of the analyzers and their interactions. One finds, however, that although the "grid" drawings showing interconnections become more complicated, the supporting evidence remains flimsy. (Two short legends provide the only explanation of one model, illustrating how impulses, given 10^{200} possible routes, might take a direct course to a given locus.)

Were it not for the references in the footnotes, some as recent as 1964, one would infer from the language and diagrams that the book was written in the early 1950's, when cybernetic modeling relied heavily on Lorente de No's neuroanatomical schemes of self-exciting chains of neurons and Forbes's physiological evidence of the reverberating circuits. Two more examples will serve to reflect the style of Poliakov's analysis. In discussing cortical connections, he states, "The main function of tangential contacts of axonal ramifications of lateral dendritic outgrowths is apparently the establishment of indirect tangential effects of some neurons on others." After a cursory presentation of one set of diagrams he concludes, "The above-described structure of interconnections in the highest

cerebral endings of the analyzer systems represents a physical basis of the diverse grades of transfer from actual sensory perception and impressions to abstract-logical forms of concepts of reality and behavior patterns." Such are the phrases that allegedly bring us "closer to the solution of the cardinal question posed by Pavlov: what is the fine structure of the analyzers, and how do their various components interact?"

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Morphogenesis in Insects

Biochemical Aspects of Insect Development. P. S. CHEN. Karger, Basel, 1971 (U.S. distributor, Phiebig, White Plains, N.Y.). viii, 230 pp., illus. $17.30. Monographs in Developmental Biology, vol. 3.

Recently developmental biologists have increasingly recognized the opportunities for genetic analysis of development afforded by that genetically best-known of all animals, *Drosophila*. At the same time, research on endocrine aspects of insect development has burgeoned, spurred in part by the encouraging possibility that hormone mimics may be valuable in the selective control of insects. A book on the biochemistry of insect development is therefore welcome, and P. S. Chen, an active contributor to this field for the past two decades, is well qualified to provide it. This concise volume takes up insect development stage by stage—embryo, larva, metamorphosis, adult—reviewing the biochemical knowledge of each, and concludes with a chapter on genetically based studies. The book is generally up to date and, with a bibliography of more than 900 titles, is a valuable source for the literature of the field. Endocrine aspects receive little emphasis, which is appropriate in view of the existence of several current reviews on insect hormones, and genetic aspects, in which the author has special interest, are emphasized. Although in this field of research, as in others, many investigations have suffered from technical inadequacy, many premature conclusions have been drawn, and many inferences have been legitimately revised in the light of new discovery, Chen studiously refrains from criticism and value judgment. This seems a pity—some guidance through the jungle of papers, and personal opinion from an experienced worker, would have been welcome. Also a little disappointing is the limited amount of new interpretation and synthesis. Perhaps the boldest broad conclusion is the rejection of any massive alteration of the protein pattern at metamorphosis. Chen does not accept the concept, put forth by others, of gene-set switchover at metamorphosis. "Even in the higher Diptera, which have the most complete metamorphosis, the data do not imply a switchover from a larval set of genes to an adult set" (p. 96). Changing gene expression during development could be called the theme of this book, but Chen believes that the evidence indicates a less extensive and more gradual change in pattern of gene expression than has sometimes been assumed. This reviewer found the final chapter, on biochemical analysis of developmental mutants (chiefly *Drosophila*), the most interesting. Modern methods of nucleic acid and protein research are now being applied to this material, and significant results for developmental biology are to be expected.

The volume is regrettably expensive for its size, and would have benefited from better proofreading.

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