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.

JOHN S. EDWARDS
Department of Zoology, University of Washington, Seattle 98195

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.

S. D. ERULKAR
Department of Pharmacology, University of Pennsylvania Medical School, Philadelphia 19104

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-