The writers review current knowledge of their respective specialties and incorporate new and unpublished material of their own.

The essays range widely over topics important in physiology. There is something for the molecular, the developmental, the environmental, and the behavioral physiologist. I found the eight essays on morphogenesis and neurosecretion particularly interesting. These show that the insect is unrivaled as an experimental animal for the elucidation of the hormonal control of cellular mechanisms. The recent identification and synthesis of the growth hormones of insects will provide the molecular and developmental physiologist with a most powerful tool for rapidly gaining an insight into how a living organism is built.

The essays also provide an overview of other aspects of insect physiology such as the integument, flight, the central nervous system, the sensory organs, reproduction, behavior, and membrane permeability. I have a limited knowledge of behavioral physiology and ion and water transport. Thus it was pleasing to find the essays on these subjects to be relatively easy to read, interesting, and informative.

This volume will be useful to the researcher, the teacher, and the advanced graduate student.

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Antiviral Substances

The Interferons. A symposium, Siena, Italy, 1967. GEO RITA, Ed. Academic Press, New York, 1968. xviii + 269 pp., illus. $12.50.

This book contains the 21 papers presented at an international symposium on interferon held at the Aula Magna of the University of Siena in June 1967. Many of the scientists actively working with this natural antiviral substance participated in this symposium as well as in a Ciba Foundation symposium on interferon held two months earlier in London (*Interferon,* G. E. W. Wolstenholme and M. O'Connor, Eds., Little, Brown, Boston). Consequently there is a certain amount of duplication in the resulting publications. Indeed, some authors gave essentially the same paper at both meetings.

The first eight papers in this volume are concerned mostly with the induction or release of interferon in in vitro and in vivo systems. In the first paper, Merigan reviews his own extensive work with viral and nonviral inducers of interferon. He discusses his studies showing that mice respond with circulating interferon after injection with synthetic copolymers of maleic acid anhydride and derivatives. The point is made that nonviral inducers appear preferable to live agents for induction of endogenous interferon in man for prophylactic and therapeutic purposes, since it is difficult to rule out the presence of adventitious contaminants in biological preparations or to be sure that such preparations will behave benignly in all individuals. In this regard also, V. D. Soloviev of the Academy of Medical Sciences of the U.S.S.R. discusses in a later paper the two approaches to interferon therapy, the stimulation of endogenous interferon and the administration of purified interferon. Other workers in the early chapters review and describe various other nonviral agents which stimulate the appearance of interferon-like substances. Unfortunately, there is no mention of the exciting findings of Hilleman's group that double-stranded ribonucleic acid molecules (natural or synthetic) from a number of sources are efficient inducers of interferon and of resistance to viral infections in vivo and in vitro. Other studies are concerned with the distribution and subsequent fate of interferon in the animal and with the influence of physiologic factors and stress on the enhancement or inhibition of interferon production.

Several papers are concerned with the mechanism of action of interferon. Two papers, one by Levy and Carter and the other by Marcus and Salb, review work done by these authors which indicates that the action of interferon occurs at the ribosomal level. Ribosomes and ribosomal subunits formed in the interferon-treated cell are capable of forming apparently normal polysomes with cellular messenger RNA but bind to virus RNA poorly and translate the polysomes into protein even more poorly.

Other papers presented at this important symposium are concerned with interferon assays, purification, physicochemical properties, and treatment of viral disease with interferon.

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The State University

Higher Education: Who Pays? Who Gains? Financing Education beyond the High School. M. M. CHAMBERS. Interstate, Danville, Ill., 1968. xvi + 304 pp. $6.95.

Author of numerous monographs about higher education, and a long-time student of the subject, M. M. Chambers, who currently is attached to the School of Education at Indiana University, deserves and enjoys widespread respect among administrators of colleges and universities. Indeed, singlehandedly and with considerable success, Chambers each year collects and distributes timely data on state government appropriations in support of higher education, a task which the Office of Education in the U.S. Department of Health, Education, and Welfare has found beyond its capabilities.

The author in his epilogue describes the present volume as a "subjective essay dealing with comprehensive concepts." No reviewer could improve upon this statement. Certainly this book is highly subjective. Chambers has some definite points of view about higher education, and once again he sets them forth with his usual vigor. His impressions may and sometimes do depart from a considerable array of facts which might warrant a different opinion. This circumstance doesn't bother Chambers.

The volume serves a dual purpose. It is a convenient handbook of observations about financing colleges and universities in the United States. In this respect, the author does not explore any new ideas, but he provides a useful summary of current practice and present issues. But the book is even more, as I have suggested, a vehicle for a restatement of personal positions.

First of all, Chambers is a strong defender of the state university and of the state government role in supporting higher education. In all the furor about federal government financing of higher education, there is a tendency to forget that our state governments provide the bulk of available funds for the current operation of higher education in the United States and that state government appropriations in support of higher education have crossed the $5-billion mark in the current fiscal year. Chambers thinks state governments can and will do still more. Those of us who labor in this vineyard hope that 1969 will prove him correct.

Perhaps it is the financial plight of

the private colleges and private universities which results in the focus of so much attention upon the federal government as a source of financial support. Few state governments appropriate funds for other than the current operations of state-government-sponsored and local-government-sponsored institutions of higher education.

Although he holds his baccalaureate from a private, liberal arts college—his doctorate is from a state university—Chambers is critical of private institutions for their attitude toward the public institutions, and especially for the belief that low tuition charges at public colleges and universities have caused their financial difficulties. He urges private colleges and universities to emphasize their unique attributes and not to worry about competing with the public institutions.

Second, Chambers is an advocate of low tuition for the public colleges and universities. He insists that higher education is principally a benefit to the whole society, not just to the individual who attends and graduates, and so he argues that higher education is an "ideal object of productive public investment." Although he seems to have no objection to federal and state programs of student assistance, these are no substitute in his view for low tuition charges at the public institutions.

In the third place, Chambers argues forcibly against student loans, tax deductions and tax credits for higher-educational expenses, and such proposals as that of the Zacharias Panel of the President's Science Advisory Committee. He notes that the benefits of such proposals may fall primarily to higher-income families, that "back-door" expenditures by the federal government are still expenditures, and that loan arrangements might indenture a student for life.

Finally, I must note that Chambers has no love for statewide "coordination" in higher education. He favors constitutional autonomy for public colleges and universities, institutional competition for funds, development by each institution of any academic program it wishes to undertake, and such voluntary cooperation as public institutions may care to enter into one with another. He recognizes the coordinating authority of governor and state legislature, but sees no good argument for placing any administrator between individual institutions and the policy-making organs of state government.

As usual, administrators, government officials, and faculty members (I would like to include students as well) interested in the financial operations of higher education will be interested in what Chambers has to say, whether or not they agree with all his points of view.

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Vertebrate Biology

Animal Function. Principles and Adaptations. MALCOLM S. GORDON, in collaboration with GEORGE A. BARTHOLOMEW, ALAN D. GRINNELL, C. BARKER JØRGENSEN, and FRED N. WHITE. Macmillan, New York; Collier-Macmillan, London, 1968. xvi + 560 pp., illus. $12.95. Macmillan Core Series in Biology.

One needs only to read the introductory chapter to realize that *Animal Function* is not just another physiology textbook, but one that fills the major need for an ecological approach to physiology with emphasis on the organ, organ-system, and whole-animal levels of organization. Some of the important tenets of this approach are that no logical basis exists for the claim that understanding of the nature of life is more fundamental at one level of organization than any other, that traditional divisions in biology, such as morphology, physiology, behavior, and ecology, disappear in the attempt to comprehend fully the nature of the living world, and that the concepts of evolutionary biology (in its broadest sense) are indispensable to all phases of this approach. The authors conclude their general comments with the statement (p. 2), "The living world is an object of study of a complexity and diversity not even remotely approached by the subject matter of any other field of science. . . . To most fully appreciate the nature of the living world, one must approach it with an open mind and a broad perspective. We hope this book will aid students to make such an approach—and, perhaps, eventually to contribute to what we might call the new natural history." This goal is substantially and elegantly furthered by the material covered and mode of presentation in the rest of the book. Of particular significance is that many of the questions about the adaptation and modification of features in vertebrate phylogeny that might be raised from a morphological point of view are discussed by the authors of *Animal Function* from a physiological viewpoint. That the same questions about vertebrate features arise in different fields of biology suggests that the new natural history may soon become a reality.

The scope of *Animal Function* is restricted essentially to vertebrates and to selected phases of their physiology. The topics covered can be grouped under three main headings: (i) how animals obtain and make available the energy necessary for all activities and how most of this energy is utilized for movement by muscle contraction; (ii) the maintenance of an internal environment by the mechanisms of respiration, circulation, water and solute metabolism, and body temperature and energy metabolism; and (iii) how animals obtain, integrate, and respond to information about the world outside and inside themselves. The decision to select certain topics has resulted in the omission of or in inadequate treatment of many topics of current interest, such as circadian rhythms, yearly cycles, migration, orientation, and navigation.

A serious omission lies in the lack of definition and discussion of many concepts such as "function," "adaptation," and "teleological grounds," which are essential to the goals of this book. Moreover, the general excellence of the text is marred by several weaknesses of organization. No unified discussion exists of general topics such as countercurrent mechanisms, relative size (especially the volume/area relationship), type of epithelium as related to type of transport of materials across it, and physiological adaptation (somatic modifications following environmental changes). Some of these topics are covered, but references to them are scattered throughout the book, and an understanding of their general aspects is therefore not readily obtainable. Some difficulty exists in finding answers to, or even suggestions and references to pertinent literature on, many questions about vertebrate features. As a means of ascertaining the depth of coverage I formulated a number of comparative questions about vertebrate features covered in this book. Typical questions concerned the modifications between crossopterygian fishes and their tetrapod descendants, in hemoglobin and its ability to transport oxygen, or modifications in fetal hemoglobins in those nonmammalian vertebrates that bear live young, or the relationship between blood pres-