

tered references to studies of social behavior and these relate to bees, fish, and birds. Neither author claims to provide a compendium for the animal behavior field. Rather each ranges selectively across a broad and diverse literature. Teachers should find good use for these as textbooks or as supplementary reading, depending upon the background of the student. They are intermediate in difficulty, each one presupposing as a minimum some introductory work in zoology, physiology, and psychology.

The seriously interested student will find himself impelled to go to original sources. Space did not permit these writers to present full details of many, or even of the majority, of the studies that supply the basis for their principles of animal behavior.

AUSTIN H. RIESEN

*Department of Psychology,
University of California, Riverside*

Regulatory Biology

Control Theory and Biological Systems.

Fred S. Grodins. Columbia University Press, New York, 1963. xii + 205 pp. Illus. \$8.50.

Regulatory and adaptive processes have long been central subjects in biology. The principle of homeostasis, detailed knowledge about several control mechanisms, and, to a limited extent, an understanding of the interactions and integration through which orderly and stable function is achieved in the whole organism are in hand. Although there are many significant questions that remain unanswered, the time is ripe for a synthesis—for the establishment of generalizations which may ultimately become biological laws—and for a formal treatment that facilitates understanding and suggests predictions which could be tested experimentally. It was, however, less the present state of physiological knowledge and more the recent, well-developed analytical treatment of control systems by engineers that led Grodins to write this book. Since the last war, “feedback control,” “servoregulator,” “transfer function,” and other bits of engineering jargon have come to be used by the biologist almost as commonly as by the engineer, but more often than not the biologist is still unaware of the rigorous foundation, or the complex ramifica-

tions of modern control theory. Clearly it is important that he catch up with more than the words, for despite the fact that engineers treat the nonliving world, there are close analogies between their models and many systems in the living animal. And in abstraction, all the differences should disappear. Although the biologist may eventually have to go beyond the point where the engineer stops, it is important that he start at the beginning and assimilate the concepts and the formalisms of modern physical control theory.

In the first six chapters of this book, Grodins summarizes the salient features of systems behavior, drawing exclusively on physical examples. Some of the important mathematical techniques, including the Laplace transform, are introduced very simply, and the usefulness of analog computers is repeatedly emphasized. Concepts, both intuitive and rigorous, of transient and steady state response are clearly set forth, and the problem of stability is introduced. Such a compressed digest will leave many readers dangling, for the treatment is not complete in either scope or depth. Almost certainly it was not meant to be. This is an introduction for biologists—far from exhaustive, but not too gentle either. It is not a condescending survey. Selected references are provided for the reader who seeks more. With or without the extra reading, it is a safe prediction that any biologist who grasps these six chapters will have acquired new and deeper insights into general aspects of control, whether in living, or nonliving things.

The next two chapters examine two well-studied physiological control systems, the respiratory and the cardiovascular, from the standpoint of the principles and methodology set forth earlier. At this point most physiologists are likely to feel somewhat let down. These chapters are inconclusive, but perhaps for good reason. Not only do the problems immediately take form as nonlinear differential equations which lie outside the scope of the introductory principles, but also some of the elementary experimental data are still too incompletely understood. Nonetheless, the reader has been led to expect more than he gets when the theory of control is focused on these physiological problems. The final chapter is devoted to a summing up and a discussion of prospects for the future.

For the biologist in general, and the physiologist in particular, Grodins’

book can be recommended as a clearly written introduction to control system theory. In contrast to other books on the subject, this one is written by a physiologist for the use of physiologists. It signals an important step in the development of regulatory biology.

S. M. TENNEY

*Department of Physiology,
Dartmouth Medical School*

Permian System

Standard Wolfcampian Series (Permian), Glass Mountains, Texas.

Charles A. Ross. Geological Society of America, New York, 1963. viii + 205 pp. Illus. \$7.50.

Although the type section of the Permian System is in Russia, North American geologists generally look to the Permian sequence of the Trans-Pecos region in Texas as a continental standard of reference. In this book, Charles Ross describes the stratigraphy and paleontology of the standard American section for the Wolfcampian, the oldest Permian series.

Perhaps the principal contribution here is the definition of stratigraphic ranges, for different species of fusulinid Foraminifera, within a complex sequence of strata that cross the boundary between the Pennsylvanian and Permian systems. More than half the book is devoted to systematic descriptions of the fusulinids, 50 species of which are represented. The ample and quantitative descriptions are illustrated by 248 enlarged photographs that show the diagnostic internal structures of the shells. The stratigraphic horizons of the fusulinids were determined by reference to 43 detailed sections. These, in turn, form the basis for a restored section of the Upper Pennsylvanian and Lower Permian rocks along the southern front of the Glass Mountains.

The Wolfcampian emerges from Ross’s reconstruction as a time-stratigraphic unit, physically represented by two mutually unconformable formations, each of which rests locally upon Pennsylvanian or older rocks, and the younger of which is overlain unconformably by the Leonard Formation. Thus defined, the Wolfcampian has been taken to correspond essentially with the ranges of *Pseudoschwagerina* and *Paraschwagerina*. This has called

for upward readjustment of both the lower and the upper boundaries of the Wolfcampian.

On the evidence of these detailed studies, the author offers correlations between the American standard for the Wolfcampian and sequences of Lower Permian strata elsewhere. In future writings he may wish to resolve a discrepancy between his Fig. 11 and the accompanying text, and thus to clarify his position with respect to correlation between the American and Russian standard sections.

CLAUDE C. ALBRITTON, JR.
*Department of Geology and Geophysics,
Southern Methodist University*

Political Science

The Political Role of Labor in Developing Countries. Bruce H. Millen. Brookings Institution, Washington, D.C., 1963. xii + 148 pp. \$3.50.

In considerable sections of the contemporary world, historical sequences in the development of labor unions appear to be reversed. Unions in the now-industrialized countries were organized and expanded, with some delay, consequent on the spread of industrial modes of production. In many of the newly developing areas, labor unions are stronger than the meager industrialization would lead one to expect, and in some instances their membership is larger than the entire industrial labor force.

The explanation of this anomaly (or anachronism), Millen argues, is to be found essentially in the political role played by unions in the formation of new nations. The author's concern for the new nations, particularly of Africa and Asia, means that his title is somewhat misleading. Latin America, for example, gets virtually no attention, though Mexico and perhaps several other countries would have fortified his case for the importance of unions in mobilizing populations for social change.

The author correctly notes that, in the developing areas, it is chiefly the "precocious" character of unions, not their political involvement, that distinguishes them from historic precedents. The primarily "private," economic focus of union activity is virtually unique to the United States. In comparative perspective, the American experience may be viewed as an historical accident, since neither nation-building nor the establish-

ment of an essentially democratic polity were problematical by the time industrialization became extensive. In Europe the radicalism of labor movements has been a function of the intransigence of a governing elite, with "evolutionary" programs of social reform appearing in countries where aristocracies have compromised with new political forces. In the developing countries to which Millen attends, the course of radicalism has also been the course of nationalism (often under a "socialist" banner for planned rapid growth). It remains to be seen how tolerant new states will be of continued labor protest, once independence, possibly accompanied by extensive nationalization of production, has been achieved. Extensive pluralism, permitting the formation of partially divisive interest groups and parties, does not appear to be an immediate prospect in most of the new states.

The author's aim appears to have been somewhat more didactic than analytical; he seems especially concerned to instruct American labor attachés and the like that they should not expect American-style unionism in exotic countries. From a social-scientific point of view, the presentation would have benefited from the type of comparative generalization about stages in labor protest that was formulated by Clark Kerr and his associates in *Industrialism and Industrial Man* (Harvard University Press, 1960). This book is listed in Millen's bibliography, but there is no reference to it in the text. As it stands, Millen's book will be of value as a source for the "political sociology of development," a subject of growing interest but challenging in its complexity.

WILBERT E. MOORE
*Department of Sociology and
Anthropology, Princeton University*

Cell Biology

Symposia of the International Society for Cell Biology. vols. 1 and 2. vol. 1, *The Interpretation of Ultrastructure* (1962, 448 pp. \$14); vol. 2, *Cell Growth and Cell Division* (1963, 352 pp. \$13). R. J. C. Harris, Ed. Academic Press, New York. Illus.

These volumes are the first two in a new series of annual symposia sponsored by the International Society for Cell Biology. The stated purpose of this series is to "deal with subjects in which new information has become available

but in which definite new viewpoints have not been established. . . . [and] to assist . . . in the development and re-assessment of knowledge in these fields by the broad exchange of data." It is generally agreed that symposia on a specific subject, with the participants limited to a small number who are actively engaged in the field, are the most fruitful meetings. In order to make these available to a larger audience, an increasing number are appearing in print. Not all symposia, however, are suitable for publication, especially if the purpose was mainly to stimulate a free flow of ideas and contact between investigators of different backgrounds. In published symposia, there is too much repetition with respect to authors and to material presented.

The first volume in this new series is devoted to a topic of interest to many biologists, biochemists, and biophysicists: what does the electron microscope tell us about the structure of viruses and cells, and how much of this can we believe or take seriously. The topic is clearly defined and of current interest; the collection of articles gives a good idea of the present state of the art, its successes, and the pitfalls. The volume deals with problems of fixation; the correlation of electron microscopy with other techniques such as x-ray diffraction; methods for localization of enzymes, nucleic acids, and proteins with the electron microscope; quantitative electron microscopy; autoradiography; the application of the negative staining technique; and the organization of the cell nucleus and cytoplasmic membrane systems. Even though more than a year elapsed between the symposium and its publication, and the field has advanced rapidly in the meantime, this volume will be very useful to anyone interested in the applications of electron microscopy in biology.

The second volume deals with a less well-defined area and is, thus, less unified. Some articles are simple reviews of published material, without much relevance to the other topics; others are progress reports on material that will be published in detail shortly. While such progress reports and speculations are the very meat of a symposium, they are not well suited for publication. It is interesting that the concepts and ideas which give vague direction to the studies reported here, of growth and its control in a variety of organisms, were borrowed from modern