

Animal Physiology

PRINCIPLES AND ADAPTATIONS

FOURTH EDITION

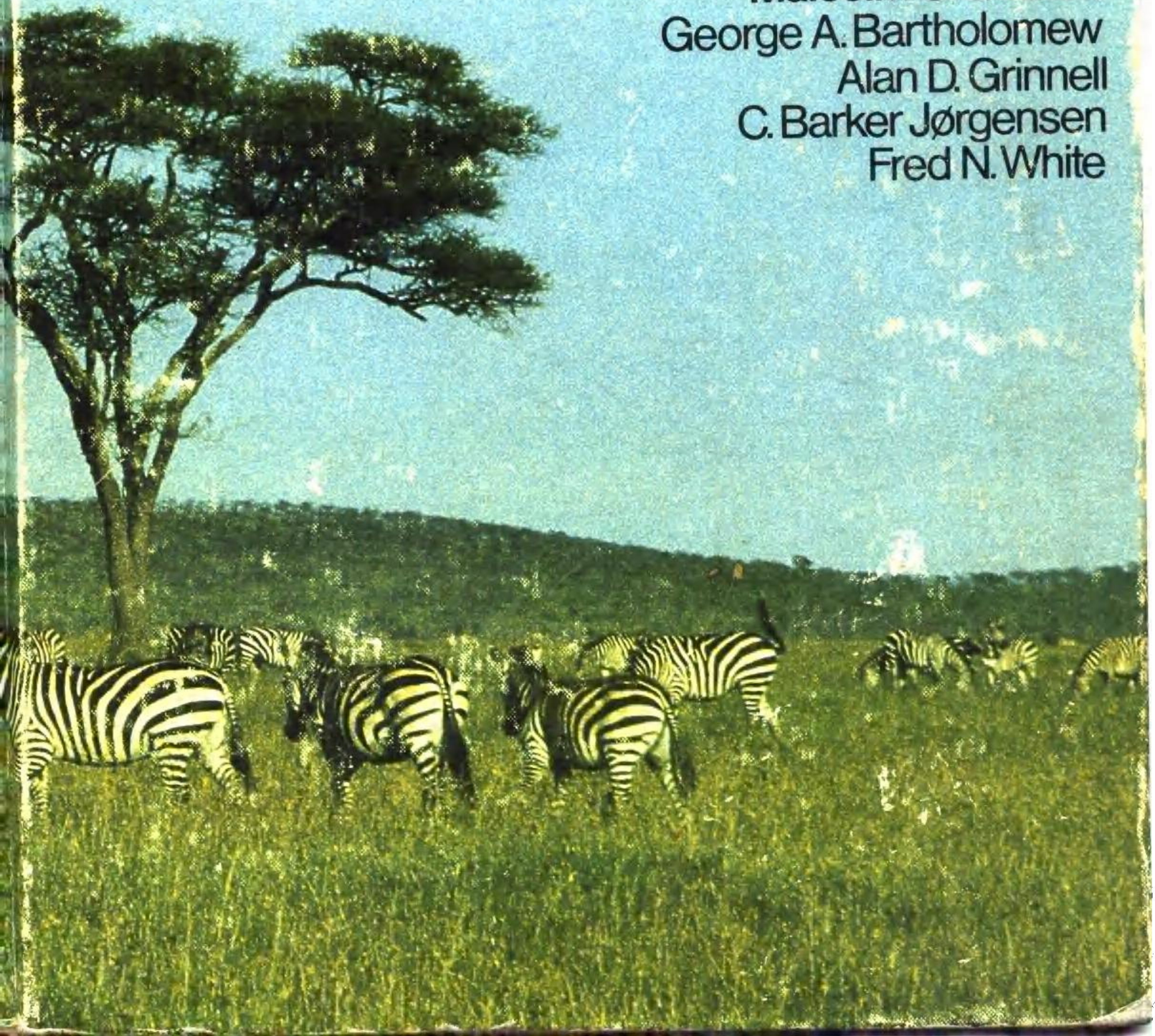
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Physiology:

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Animal

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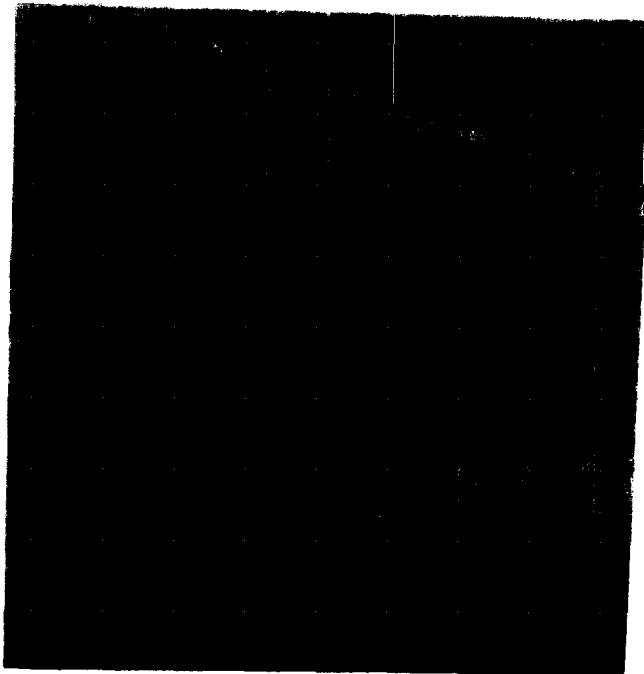
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Animal Physiology

**A cautious man should above all be on
his guard against resemblances; they
are a very slippery sort of thing.**

—Plato, "The Sophist," translated by F. M. Cornford (*Plato's Theory of Knowledge*, London, 1935, p. 180).

Preface

This book is an effort to bring to undergraduate students an awareness of major features of the current state of animal biology at the level of the functional features of whole organisms and their component organs and organ systems. Emphasis is on function as it is related to the survival of organisms in their natural environments. The book might well be called a textbook of comparative ecological physiology. Phenomena at the submolecular to tissue levels are discussed only as they are needed to provide perspective at the organ to whole-animal levels. It is assumed that students will have additional exposure in their curriculum to courses in cellular or general physiology, as well as to anatomy (from ultrastructure to gross) and embryology.

Emphasis throughout is on the vertebrates, the fundamental approaches being zoological, comparative, and evolutionary. Material on ontogeny of functions is considered wherever possible. Material on invertebrates is discussed where it contributes to an appreciation of the diversity of functional adaptations shown by organisms, or where such examples will clarify the situation. The level of discussion presumes a basic familiarity, such as would be obtained from a good college level introductory biology or zoology course.

Comments we have received from some users of the previous editions make it seem worthwhile to include here a short statement giving the reasons for our strong belief that beginning students of

physiology, whatever may be their personal career goals, should start with a broad zoologically based, comparative approach. We feel that it does a serious disservice to students to start them out with concentration on only mammalian, especially human, physiology.

Our reasons involve both theoretical considerations and also the realities of present-day university and professional school curricula. (1) A large part of new medical and veterinary practice derives originally from studies on other kinds of animals. A lack of understanding of the important ways in which other animals resemble or differ from the forms of direct concern to humans will make it difficult to evaluate the significance or relevance of such studies. (2) Present-day concerns with important issues such as the ecological bases for the food webs supporting animals of direct importance to humans, the indirect effects of environmental pollution, the control of destructive pest species, and the need for maximizing sustained yields of valuable animal species, all require for their solution detailed knowledge of the physiological properties of many other kinds of animals. (3) Students intending to go on to professional schools, if they succeed in obtaining entrance, will be required to take physiology courses strongly focused upon the aspects of physiology of greatest relevance to their curricula. Many of these courses are likely to be relatively intensive and short. We know from expe-

rience that a prior solid basis of understanding of principles will make these later courses both more meaningful and easier.

We have tried to make this book as complete as possible in terms of physiological principles and orientations, but it is purposely designed not to be exhaustive in terms of facts. Its field is so large and diverse that a choice had to be made between trying to cover all major topics and selecting for discussion only the most significant (to the authors) of the major topics. The latter has been the choice. The effort is made, in discussing each subject area, to give an understanding not only of the important facts but also of the experimental basis for these facts and, wherever possible, some of the reasoning that led to the performance of the experiments. We hope in this way to provide some feeling for the nature of biological enquiry along with a fundamental theoretical orientation in the given subfield that will permit independent study with comprehension of related topics not specifically considered here. To ease the process of independent study, each chapter concludes with a list of relevant recent books and review articles. These relate not only to the topics considered in the chapter but also to associated areas not adequately covered.

We hope that courses in which this text will be used will make use of additional reading materials, especially on the invertebrates. Laboratory exercises using invertebrate materials are suggested as other means for expanding the range of factual coverage.

The organization of this book emphasizes physiological processes. The introduction provides necessary theoretical, philosophical, evolutionary, and taxonomic background. The energy animals use, where they get it, and how they make it available for use in their own tissues are discussed in the first two chapters—on nutrition and metabolism. The use of the greatest part of this energy to produce movement is considered next. This is followed by descriptions of the processes producing the internal environments within organisms: respiration,

circulation, water and solute metabolism, and temperature adaptation and regulation. The final five chapters consider how animals obtain necessary information about the world both outside and inside themselves, how they correlate and control their activities in the light of this information (both neurophysiologically and endocrinologically), and how they reproduce themselves.

The first three editions of this book have been sufficiently widely used that both the authors and the publisher felt it important to try to keep the contents reasonably up-to-date. This edition involves both an updating and some expansion of coverage.

All the authors are only too aware of many limitations, shortcomings, and problems relating to their contributions. We hope, however, that despite these we have produced a text that will be useful, informative, and stimulating for students and other interested readers. We earnestly solicit any comments and suggestions for future improvements.

All of the authors have profited greatly from comments and suggestions relating to the previous editions. These comments have been generated by colleagues, friends, and students in many places. We wish to particularly thank the following: Drs. G. C. Grigg, L. O. Larsen, J. E. Minnich, L. C. Oglesby, C. R. Tracy, and P. Rosenkilde. Once again, we earnestly solicit any comments and suggestions for further improvements.

Wherever previously published photographs have been used for illustrations, the authors cited in the figure captions have kindly provided original prints. The cooperation of the many authors and publishers who have given permission to reproduce copyright material is gratefully acknowledged. Finally, the revision of the book would not have been possible without the assistance of a number of people, especially Christine Kulia, Thomas Haglund, Dana Gordon, and Alexandra Zaugg-Haglund.

M.S.G.

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