

PREFACE

Biology of Animals originated as a textbook intended for the beginning college student, regardless of background, seeking a general knowledge of the nature and functioning of animals and of the biosphere in which they live. It was an offspring of the senior author's fourth edition of *Integrated Principles of Zoology*, in part an abridgement of its parent and in part a new approach to animal biology. Despite the success of the first edition of *Biology of Animals*, we felt the need of an extensive revision to accomplish two ends: (1) to seat the entire presentation more firmly into an evolutionary theme and (2) to expand the survey of the animal kingdom, which many readers felt had been trimmed with too sharp a scalpel during its original condensation from the parent book.

We soon discovered that these aims could not be accomplished by simply rearranging and updating the material. We had to rewrite virtually all of the book. Although past readers may be discomfited to find little in the present book that resembles the first edition, we believe this approach is pedagogically more effective and we trust that teachers and students alike will find it stimulating, intellectually lively, and absorbing.

Because the evolutionary process pervades biology, the principles of evolution and the way in which they work form the central theme of the first six chapters of the book. Our treatment begins with an analysis of the earth's remarkable environment and the ecoevolutionary interactions that permitted the evolution of life as

we know it. The concepts of ecosystem, biotic community, and population are considered in detail, and examples emphasize the reciprocal relationship between human existence and ecosystem structure. The second chapter traces the evolution of life on earth from its primitive beginning some 3 billion years ago to the appearance of the eukaryotes toward the end of the Precambrian. The chemistry of life's basic molecules—proteins and nucleic acids—is also treated in this chapter. Chapter 3 moves to the organization of the eukaryotic cell, including such topics as cell division, chromosome structure, and membrane function. We progress then to a detailed consideration of the genetic mechanisms that underlie evolution, with special consideration of mendelian genetics and the chromosomal theory of inheritance. The mechanisms of evolutionary change and speciation are then treated in detail, with due consideration given to the historical evidences of evolution. The final chapter in this section deals with the evolution of behavior in animals. Stereotyped and social behavior are discussed with numerous examples to clarify the topics of instinct and learning, aggression, dominance, territoriality, and communication. Although we think Part one can be approached most effectively if all six chapters are considered in order, instructors should find the treatment sufficiently flexible to permit some other order or the use of certain chapters apart from the rest.

Part two deals with animal form and function and shows how the different functional systems are coordinated to serve animals as they interact with their environment. The scope and emphasis of this part remain unchanged from the first edition, in which this material appeared as Part three. However, the text has been updated throughout, and we have made several shifts in placement of material. The most important of these are the expansion of the nutrition chapter to include enzyme physiology and cellular metabolism and the inclusion of a single chapter on reproduction and development, representing the combination of material that appeared in two chapters in Part five of the first edition.

Parts three and four center on the living animal and its activities and on the diversity of animal life. In this systematic consideration of the animal kingdom, all of the invertebrate and vertebrate groups are treated in considerably greater depth than in the first edition of *Biology of Animals*. We have placed greater emphasis on animal diversity and on the evolution, adaptations,

and natural history of each group and less emphasis on the anatomy of representative types. The introductory chapter to Part three, on animal phylogeny, has been rewritten, and a new chapter on chordate ancestry and evolution introduces Part four.

The recent, and we think justified, general acceptance of the five-kingdom system creates a pedagogic problem for the zoologist, since in this scheme the protozoans have been removed from the animal kingdom and included with other single-celled eukaryotic organisms in the kingdom Protista. Yet the protozoans share so many clearly animal-like characteristics that their evolutionary affinity to multicellular animals can hardly be disputed. Thus it is for more than traditional reasons that we retain the protozoans in this treatment of the animal kingdom. The five-kingdom system and the fluid nature of classifications within the kingdoms of life are discussed in Chapter 14.

Perhaps a more relentless problem that we must face with each edition is when to incorporate new taxonomic revisions within the animal phyla. We, of course, always attempt to use the most modern classification available *that has gained general acceptance*. On the other hand, we can think of nothing more provoking to the instructor than to encounter a completely remodeled classification every time a new edition appears. Consequently, in the levels of synthesis through which new concepts and schemes pass—from research report to review article to textbook—we prefer to allow new taxonomic revisions to weather the scrutiny of more than one reviewer before incorporating them in our textbooks.

The instructor and student will find several aids to their study of animal biology. Lists of suggested readings to supplement the text material now follow each chapter. Both the general references and the *Scientific American* articles (which are listed separately) have for the most part been annotated to assist readers. The glossary has been completely revised and expanded. Many new illustrations have been added or replace old ones. The front endpaper bears a complete family tree of the animal kingdom showing supposed group relationships, temporal diversity, and the relative success of the groups in terms of numbers of species as suggested by the size of the ovals. The back endpaper provides a geologic time table and pictorial scheme of the supposed origins and spatial diversity of the kingdoms of life. Both instructor and student

should find these highly accessible diagrams useful for repeated reference.

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on the entire manuscript, correcting syntax and exposition, querying us on logic, and saving us from numerous future embarrassments.

William C. Ober of Crozet, Virginia, prepared numerous excellent new line drawings and paintings for this edition. The fine pencil renderings of animals that introduce many of the chapters were executed by David Hunter of Lexington, Virginia.

Finally, we thank the many teachers who wrote us about the first edition of *Biology of Animals*. Their suggestions and criticisms were of great assistance to us in preparing this edition. We hope they will continue to help us, for there is no one whose guidance we value more.

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