PREFACE

Biology encompasses a tremendous and scattered array of subdisciplines, each with its squadrons of practitioners who are bent on discovery. Discover they do, and the amount of new information to be assimilated balloons monthly. How can a survey book accurately portray this current work in addition to the heritage of biological research of past centuries?

An encyclopedic approach means covering many or most of the topics but not in any depth. This might be called Platte River writing (a mile wide and an inch deep), in that students can get to the other side without even getting their feet wet. Of course, they might not end up with much experience in self-navigation through deeper waters. Platte River writing can indeed move them quickly past ecology and molecular biology, for example. But will they, at the end, be able to separate facts from flawed logic in accounts of acid deposition, including the so-called acid rain? Will they be equipped to assess opinions about genetic engineering that might lead to improved crop yields, to genotypic cures for terrible human disorders, or, inadvertently, to a bacterial species with enhanced resistance to antibiotics? These are not esoteric issues, confined to research journals. They are being discussed repeatedly, sometimes in naïve ways, in news articles, in trade magazines, and on television. It becomes a question of obligation. Students can be left to sink or taught to swim, but there is no way to pretend that they will not be encountering deep rivers, some of which may change the course of their lives.

Somewhere between the Platte River and the Amazon lies a good river for learning. With the encouragement and proddings of about three hundred instructors and research specialists over the past seven years, we may have located it. There is agreement, more or less, that we should do the following things in a survey book:

1. State the principles that apply to all fields of biological inquiry, the most pervasive being the principles of evolution and energy flow.
2. Use those principles as a framework for presenting the material, rather than simply paying lip service to them.
3. Distill the main concepts and outline the research trends in all major fields.
4. Give enough examples of problem solving and experiments to provide familiarity with a scientific approach to interpreting the world.
5. Include enough comparative biology to convey a sense of the unity and diversity among living things.
6. Include enough human biology to enhance understanding of our evolution, behavior, and ecology as well as our body structure and functioning.
7. Be selective in developing the vocabulary necessary to comprehend what is being talked about today in each field.
8. Present the material accurately but not at a high level.
9. Write clearly, in a style that is not boring or patronizing.
10. Keep the writing free of bias and soapboxing, thereby giving students the chance to form their own opinions about the material presented.
11. Excise teleological wording.
12. Create easy-to-follow line illustrations and select photographs that are beautiful but not superfluous.
13. Make the line illustrations and photographs larger than the size of postage stamps.
14. Make the book long enough to cover all important topics but short enough so that carrying it to class does not produce hernias.

Anyone in his or her right mind would walk away at once from such an impossible order; which says something about biology writers if not their books. It took three years of obsessively full-time literature review and conceptual synthesis, writing, original art development, and revising to attempt to meet these criteria for the third edition—and still there never was enough time. Fortunately, parallel with this focused authorship, our reviewers responded to the challenge of creating a good book.

A few examples of their commitment: Along with his exquisitely detailed professional advice, James Bonner's manuscript evaluations included a treasury of personal insights into the events that shaped modern biology. John Alcock, concerned that introductory books are not keeping up with current trends in animal behavior studies, wrote the chapter on it himself. This time Cleon Ross, author of the

plant physiology chapters, reviewed in microscopic detail major sections of the book. Stephen Hedman wrote original genetics problems and detailed solutions. William Leonard and Vernon Tipton each wrote a Commentary; Professor Tipton also coordinated a major review program. Jane Taylor was her characteristically dedicated self in creating a study guide and instructor's manual for the book. Through extended conversations and correspondence, John Blamire, Leon Harris, William Harvey, Tyler Miller, Marian Reeve, and Robert Smith profoundly influenced the course of revision. And just when we thought it was safe to get out of the manuscript, David Brumagen, Lowell Diller, Thomas Hemmerly, James Howard, Jean DeSaix, Philip Mathis, David Morton, Jim Perry, John Rickett, and Wayne Yoder convinced us to go back in and revise a little more.

A list of third-edition reviewers concludes this preface. There never is enough space to acknowledge all those who help create a book. To reviewers of this and earlier efforts, thank you for your insights, your criticisms, your praise. You will know, in reading through the book, where you have left your imprint.

Some Important Content Changes

This is not a cosmetic revision; we reworked all chapters. We split many into shorter chapters that will be more manageable to study. (For example, photosynthesis and carbohydrate metabolism are now covered separately.) The splits also allow more flexibility in adapting the book to different course sequences.

In response to user requests, we made several shifts in unit organization. Evolutionary biology is treated in a separate, expanded unit before organismic diversity. A separate unit on ecology follows. All plant anatomy and physiology (including flowering plant reproduction) is now organized in one unit. This unit on plant systems now precedes that for animals.

We reorganized and rewrote all chapters to reflect current information and trends. Biology is growing so rapidly, in so many directions, that all of us working on the revision felt that we had to take the time to stand back and develop an accurate, simple picture of how the parts are fitting together.

Just a few examples of currency: Photosynthesis and aerobic respiration are not talked about in a vacuum; chemiosmotic events of ATP formation are described simply, in terms of the cell structures in which they occur. Also, we don't stop with thirty-year-old models of DNA replication and recombination, and we give a current picture of protein synthesis. By working intensively with specialists, we developed clear, accurate introductions to animal anatomy and physiology (see, for example, discussions of homeostasis, neural and endocrine functioning, and muscle functioning). We use current models in plant physiology (see the treatments of transpiration and translocation). The evolution unit has new sections on macroevolution and evolutionary trends; it includes an updated picture on research into the origin of life. In Figure 31.10, we integrate a flowchart of biological evolution with newly available paleogeographic maps. The diversity unit provides coverage of bacterial phylogeny (including the intriguing Archaebacteria). We have essentially a new ecology unit, complete with current models of population dynamics, ecosystems, nutrient cycling, and succession, to name a few.

We have three new chapters: two short, provocative chapters on human genetics and human origins, and one on animal behavior. John Alcock, author of a widely respected textbook on animal behavior, did admirably in describing current research trends with such lively, succinct prose.

We are pleased that our writing style has been well received. However, we worked at refining it further. Each sentence was evaluated for clarity and content. The outcome is greater strength and precision in the text.

A New Illustration Program

All line art is now full color to allow better tracking of information within an illustration. More outstanding micrographs have been added. Almost all other photographs are in full color, the better to convey the magnificent diversity of living organisms and their environments.

For each chapter, we developed text and art simultaneously. Where feasible, we combined visual and written summaries to make complex concepts easier to grasp. In many line illustrations, the topics are presented as a series of steps, which are less intimidating than one large, complicated illustration. For examples, see the art on carbohydrate metabolism (pages 127, 130, 131), mitosis and meiosis (pages 143, 145, 150, and 154), and protein synthesis (page 220).

Case Studies and Commentaries

Our Case Studies show how general concepts apply to specific situations. For example, after the discussion of immune systems, a case study shows students how their bodies would mount an immune response to a bacterial attack (page 396). The Commentaries are "outside readings" built