



## Preface

During the past decade, advances in biology and chemistry have introduced important concepts that the student must study before taking the introductory course in botany. The new material poses questions for all botanists, but the problem of selecting the subject matter for the introductory course is a particularly vexing one. Although this fourth edition of *Botany, An Introduction to Plant Biology* is still an introductory textbook, the student reading it must know more about biological concepts than those who studied earlier editions. We still assume, however, that students have little or no knowledge about plants as living entities. The objective of the text remains unchanged: *to acquaint students with the great range of plant life that inhabits our biosphere.* With concepts of energy transfer, electron flow, and DNA replication already established, we can proceed directly to the exciting aspects of plant form—its development, its relation to function, its similarities over wide ranges of plants and, in seeming contradiction, the great diversity that allows for unique individuals within species.

To help maintain breadth of approach and to foster the ideas of younger botanists currently making the decisions on modern curricula, Professor Michael G. Barbour, who recently joined the staff of the Department of Botany of the University of California at Davis, was asked to become a third author. His interest in plants, particularly their ecology and taxonomy, his dedication to teaching and to his students, and his ability to write and to criticize have already made him an appreciated and valued co-worker.

The quality of illustrations has been greatly enhanced. Alice B. Addicott, a biologist with a master's degree in biology from Stanford University and a botanist by association, has acted as a collaborator, not only in the preparation of new illustrations that bear her signature (ABA), but also in redrawing, coloring, and rearranging figures that have been retained from earlier editions. She has been assisted in her work by Jean A. McKinnon (original figures signed JAM). Color has been added to this edition; most line drawings are shaded in greens and grays, and there are fourteen plates in full color. The majority of the halftones are new; they range from exciting micrographs from recent research papers to greatly improved views of subjects presented in earlier editions.

The choice of new subject matter and the deletion of older material reflect the advances in knowledge and the changes in thinking that have occurred over the past decade. For instance, the electron microscope has supplied significant information about the cell wall, sieve elements, food transport, the chloroplast and mitochondria, and other aspects of cell structure. The electron-scanning microscope has revealed details of leaf surfaces and the design of pollen cell walls. The chapters on cells and cell division have been

completely revised to convey this new information about the ultrastructure of plant cells.

The increased importance of ecology during the decade is indicated in the new chapters on ecology and taxonomy. The chapter on ecology now includes an analysis of many living and nonliving factors in the environment; the ecotype, community, and ecosystem concepts; a review of selected world vegetation types; and a discussion of problems related to pollution. In the taxonomy chapter, we have tried to show the great diversity of taxonomic research methods, such as biosystematics and numerical taxonomy, and have included considerable material on the history of taxonomy.

The policy in earlier editions of *Botany* has been to proceed from the known to the unknown. Although we still believe that this is the best possible approach, in the present edition we have revised the opening paragraphs of many chapters to emphasize the traits that are common to all of the plants discussed in that particular chapter. Thus we now also proceed from uniformity to diversity.

In earlier editions, problems of plant development were confined for the most part to a single chapter but, in the fourth edition, development is a continuous theme running through many chapters. The algae are used to illustrate principles in the development of form. Additional aspects of development, particularly information gained through experimentation, are brought together and discussed in Chapter 20, "Plant Growth and Development."

Thus, the chapters on morphology are more complete throughout the text because the processes of development are given parallel treatment in each of them. This approach permits a great many complementary illustrations. The stem and root chapters have complementary diagrams on development, and the illustrations of leaf and flower development relate directly to the illustrations of the shoot apex. Matching figures illustrate cross sections of the stipe of the brown algae and cross sections of the stems of the vascular plants.

The discussion of algae, here, is frankly experimental. Our aim is to tell a connected story about plant development that will be meaningful without naming particular species. Chapter 22 is a study of the *biology of the algae*. The traits that group algae together are described first, and then the diversity that separates them into phyla is considered. In the second part of the chapter we compare the plant bodies of algae by describing three lines of evolutionary development. Although the principal concepts of this story can be told without referring to particular species, examples are given, and each example is illustrated. Reproductive cycles are then discussed in terms of gametic, zygotic, and sporic life cycles. Again, the concepts involved do not require our mentioning specific algae, but each life cycle is accompanied by a diagram and examples. Because the electron microscope has so greatly increased our knowledge of algal cytology, the presentation of the structure of algae cells in the fourth and last section concentrates chiefly on ultrastructure. The material on classification and life cycles (in the first and third sections of Chapter 22) corresponds closely to similar subject matter in most introductory botany textbooks, but the treatment of the evolution of algal form and the fine structure of the algal cell is somewhat new to an elementary text.

The problem of classification has not been resolved. Our decision for this edition has been to follow, with one exception, the system adopted in a current

textbook on plant morphology, *An Evolutionary Survey of the Plant Kingdom*, by R. F. Scagel, R. J. Bandoni, G. E. Rouse, W. B. Schofield, J. R. Stein, and T. M. C. Taylor. Our exception is the retention of Sphenophyta in preference to Arthropophyta. Unquestionably the term Arthropophyta, meaning "jointed plants," better describes the horsetails than does the phrase "wedge plants," which Sphenophyta designates. But we have found the word Arthropophyta to be confusing; it is too similar to the Arthropoda of the zoologist and to Anthophyta used by Robert F. Scagel and his co-workers for the flowering plants. In adopting this classification we do not mean to express an opinion on the evolutionary development of plant phyla, although we are skeptical about the theory of a monophyletic origin of the vascular plants.

The chapter on inheritance has been revised to point out that modern plant breeding is no longer based on simple Mendelian genetics, but is complicated by polygenes, multiple alleles, heterosis, and polyploidy. Much thought was given as to whether to restate the genetic code, but we decided to mention it only briefly in the account of DNA replication, on the premise that all biology students will be subjected to it several times before obtaining a degree.

The close and frequently exciting interchanges with colleagues have been a constant source of stimulation and pleasure during the preparation of this edition. Their response to requests for illustrative material, for advice on problems such as that posed by the phylogeny of the plant kingdom, and for reviews of the manuscript has been phenomenal. The graduate students in our own department have been particularly helpful in contributing information, illustrations, and criticism. David Brown and Lewis Feldman gave willingly of their time and experience in the preparation of several excellent figures. Professors E. M. Gifford, Elizabeth Cutter, and Norma Lang provided unfailing stimulation and help. We owe a special debt to Professor Daniel Branton, who contributed very materially with a criticism of the third edition and with important suggestions for changing the fourth edition. Harold Drever, Bijan Dehgan, and Walter Russell constantly supplied fresh material for the pen or camera. Since we have received the important and willing assistance of many colleagues in the preparation of this edition, the book in a sense expresses the points of view of a wide range of botanists. However, we are responsible for its accuracy of statement, its organization, and its philosophy. The writing of this volume has been difficult and exciting—we hope it will be a genuine contribution to plant biology.

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