Preface

We wrote this book because we believed that there was a need for an explanation of plant systematics (or taxonomy) that can be used in undergraduate courses and that incorporates current exciting developments in the field. In the past two decades abundant new systematic data, especially from DNA sequences, have come forth, and a rigorous phylogenetic approach has established novel ways of analyzing data and practicing systematics.

The first edition of this book was well received by many students and other botanists. It has been translated into French and Italian, and the authors of the first edition (Walter S. Judd, Christopher S. Campbell, Elizabeth A. Kellogg, and Peter F. Stevens) received the 1999 Engler Silver Award, an annual award of the International Association of Plant Systematists for the most outstanding book or monograph in plant systematics. Encouraged by this positive reception, we prepared a second edition (which was translated into Korean), and now this third edition, in order to keep the book as up-to-date as possible.

The basis for this book is the tree of life—the idea that all life is interrelated, like branches on a tree. We deal with the part of this tree occupied by the vascular plants or tracheophytes, and focus on the flowering plants, an important group that dominates most of Earth's terrestrial ecosystems and provides us with medicines, beautiful ornamentals, construction materials, fiber for paper and clothing, and most of our food. Historically, information about these and other attributes of vascular plants was essential to the development of human civilization. Survival rested upon knowing which plants were poisonous or were good to eat; which were potential food for animals; which were good for tools and weapons; which might cure ailments; and which might be useful in many other ways. Systematics as a science grew out of such interests in organisms and evolved from systems of information about the uses of different organisms to a broader understanding of biodiversity. To this end, plant systematists ask questions such as, How should the tremendous diversity of legumes be partitioned or classified into genera and then into species? What are the relationships among the major groups of grasses? How do we know whether or not a plant is a member of the orchid family? This text deals with how these and thousands of similar questions are answered; the final two chapters present some current answers to questions about evolutionary relationships among the major groups of tracheophytes.

Charles Darwin led the way in establishing the evolutionary perspective of modern biology. One impact of this view of life was to make it a major goal of systematics to uncover the evolutionary history—or phylogeny—of groups of organisms. Willi Hennig and W. H. Wagner, along with many others, developed explicit methods of hypothesizing and testing phylogenetic relationships and reflecting these in classifications. We follow a phylogenetic approach throughout this book.

Chapter 1 introduces and explains the concept of phylogeny, and outlines why systematics is important in biological investigations and to society. Chapter 2 explains how phylogenies are reconstructed from systematic evidence. The process of transforming evidence into a representation of phylogenetic relationships in an evolutionary tree is first presented using simple hypothetical data and then extended to complex real situations. This "primer of phylogeny" also incorporates the conversion of phylogenetic hypotheses into a classification.

The central position of phylogeny in classification has emerged only recently, but many groups of plants, such as legumes, grasses, and orchids, have long been recognized. Chapter 3 outlines how systematists perceived groups in the past, how higher taxa were formed, the historical background of phylogeny, and provides an explanation of plant groupings over the years. The information on which phylogenies and classifications are based, comes from a wide array of sources, including structural aspects of organisms, especially morphology, anatomy and secondary chemistry (Chapter 4), and DNA features, especially nucleotide sequences (Chapter 5). These chapters on phylogeny, classification, and taxonomic evidence provide essential information for understanding the vascular plant groups covered in this book.

Diversification and the evolution of plant species—how plant species form, how they interact, and how we define them, including a presentation of the effects of hybridization—are the fascinating and challenging topics of Chapter 6. Chapter 7 presents an overview of the phylogenetic history of green plants, especially tracheophytes, explains the origin of many of the important features used to identify