Preface

The continuing humanization of the earth, and the consequent loss of natural habitats and the germplasm in them, gives urgency to studies concerned with the diversity, workings, preservation, and utilization of the plants and animals that compose our living world. It is imperative that we continue to increase and refine our total knowledge of the biota and that we apply this knowledge, in relevant ways, to better the state of humanity and the earth's environment. In the Cucurbitaceae, popularly known as the gourd family or simply as the cucurbits, the nature and extent of problems and opportunities facing humankind are exemplified, and the ultimate inter-relatedness of the pure and applied aspects of science is demonstrated.

The cucurbits are widely distributed through tropical and warm-temperate regions of the world, being represented by some 118 extant genera and 825 species. Most species are components of native ecosystems and often are little known beyond basic descriptive taxonomic accounts. A few species are cultigens of major economic importance. They serve as sources of human nutrition or useful products and have been studied from many perspectives.

For much of humanity, the fruits of cultivated cucurbits characterize the family. Their remarkable variation in size, shape, and color patterning is a notable familial feature, although equally impressive is the prodigious growth of the herbaceous, vining stems of some species. The flesh of the fruits of many species, most notably those of the genera *Cucurbita* (squash, pumpkin), *Cucumis* (cucumber, melon), and *Citrullus* (watermelon), is eaten. Seeds, rich in oils and proteins, are important foods as well. Also sometimes eaten are leaves or shoots (for instance, those of the bitter melon, *Momordica charantia* L.), roots (for example, those of chayote, *Sechium edule* (Jacq.) Swartz), and flowers (commonly of *Cucurbita* species). Edible

and industrial oils can be extracted from the seeds. The mature fruits of the calabash, *Lagenaria siceraria* (Mol.) Standl., which ranks among the world's oldest cultigens, provide humans with an enormous array of goods, ranging from containers to musical instruments, while the gourds of *Cucurbita pepo* L. are strikingly ornamental. The fibers of the fruits of *Luffa aegyptiaca* Mill. are vegetable sponges, which even today remain popular bath items. Many cucurbits are important elements of traditional medicine and enter the pharmacopoeias of Old and New World societies.

A striking feature of cultivated cucurbits is their adaptation to a wide variety of agricultural environments. They can be grown in extensive monocultures, typical of crop production in technological societies, but are equally at home in kitchen gardens and in traditional systems characterized by low energy requirements. Many cucurbits are adapted to environments considered marginal for agriculture. Some are gathered in the wild as food sources, for example, the fruits of *Acanthosicyos horridus* Welw. ex Hook. f. or the roots of *Coccinia rehmannii* Cogn., both of southern Africa; others are collected for medicinal uses.

From both biological and agricultural perspectives, the cucurbits present an array of intriguing problems. The widespread occurrence of bitter tetracyclic triterpenoids, known as cucurbitacins, provides a basis for studies of coevolution with insects. An ability to control the presence or absence of these compounds has implications for the biological control of insect pests, and their elimination or reduction in harvested parts is a critical step in the development of edible crops. Understanding the underlying controls of unisexuality, ubiquitous among cucurbits and expressed through both monoecy and dioecy, is another intriguing field for investigation. Its relevance to agriculture is seen in the potential to increase fruit production by eliminating dioecy, improving the ratio of female to male flowers, and facilitating the production of F_1 hybrid seed. Questions of broad concern and application can be addressed in studies of reproductive biology, of the genetic basis of character trait expression, and of the physiological nature of adaptations. Systematic investigations of taxa at all hierarchical levels remain intellectually stimulating, and many present added complexity and fascination because they deal with the origin of domesticated species and synergistic relationships with early agriculturists. Such studies draw on a wide range of data and a variety of analytical methods, thereby providing baseline information about phylogenetic relationships and germplasm resources—a necessary prerequisite for the identification of sources of resistance to pathogens, agronomically desirable characteristics, or even new species of economic potential.

As is so often the case with interdisciplinary publications, the genesis for this book was a conference, which in this instance dealt with various aspects of the biology, chemistry, and utilization of the Cucurbitaceae. The confer-

ence was held on the campuses of Cornell University, Ithaca, New York, and the New York State Agricultural Experiment Station, Geneva, New York, on August 3–6, 1980. During the conference, plans were made for publishing the proceedings of what was a productive and stimulating meeting of cucurbit specialists. Manuscripts were solicited and submitted, yet for unanticipated and unavoidable reasons, the project did not go forward until late 1985 when plans for the book were revived.

In its rebirth, the book has taken on a somewhat different character from that originally proposed. Because of the time that had elapsed since the conference, we recognized that most of the papers submitted would require revision. Furthermore, we thought that papers sampling recent work should be included in the volume if it was to represent the current state of knowledge and activity in the family. Toward these ends, most individuals who had participated in the conference graciously agreed to revise and update their manuscripts; others, nonparticipants, were invited to prepare papers outlining their research. The result is a book whose contents have remained timely yet have matured through the revision of manuscripts and the addition of new materials.

The contents of the book progress through five loosely defined parts, the first dealing with systematics and evolution, the last with approaches relevant to understanding and improving agricultural productivity. The purpose of this arrangement is to cluster related subjects. In whatever sequence they are read, the chapters demonstrate the interrelatedness of studies on the biology and utilization of cucurbits. They provide a sample of the kinds of problems existing in the family, a survey of the techniques and approaches used to seek solutions, and a sense of the extent of research still to be undertaken.

Part I begins with an overview of the state of systematics in the family. This is followed by surveys of cytology, amino acids, isozymes, and seed oils, each of which has implications for classification. Otherwise, focus is primarily on *Cucurbita* and *Cucumis*, although studies of *Luffa* and *Sechium* are also included. Two chapters, cast in a coevolutionary vein, complete the section. One deals with reproductive biology and natural history of the New World genera *Gurania* and *Psiguria*; the other with cucurbitacins and rootworm beetles, as viewed from both evolutionary and agricultural perspectives.

The second part includes comparative, familywide morphological and anatomical studies of embryos, pollen, trichomes, stomata, and seed coats, as well as a study concerned with adaptive anatomical features of xerophytic Madagascan genera. Although the systematic implications at the generic level and above are stressed, the chapters have a morphological theme that brings them together as a unit.

Four chapters concerned with sex expression in the family constitute Part

III. Genetic and hormonal determinants are discussed, and the ontogeny of male and female flowers in the cucumber is described and interpreted.

The fourth part is concerned with utilization of cucurbits, primarily those species with potential to be used more widely or even brought into cultivation. The focus of the first chapter is on the use of biodynamic compounds in traditional medicine in the American tropics and is illustrative of medicinal uses in other regions of the world. Succeeding chapters emphasize the use of cucurbits as sources of food or energy in low-energetic agricultural settings. Among food plants are the !nara (*Acanthosicyos horridus*) of the Namib Desert, the oyster nut (*Telfaria pedata* (Sims) Hook.) of Africa, and the Chinese lard fruit (*Hodgsonia macrocarpa* (Blume) Cogn.) of Asia. The buffalo gourd (*Cucurbita foetidissima* HBK) of North American deserts merits attention as a source of oil, starch, and, ultimately, energy in xeric regions of the world.

Chapters of the closing part are concerned with improvement and protection of cucurbits as crop plants. They introduce relevant propagation, agronomic, and breeding techniques and effectively illustrate the extent to which basic research on genetics, chemistry, physiology, ecology, and systematics, among other subject areas, not only enhances crop productivity, but also provides fundamental data about the biology of cucurbit crops and their relatives.

In books drawn from the contributions of authors of different specialties and perspectives, consistent application of scientific names throughout the text is seldom possible. In this volume, however, generic names and those at the subfamilial, tribal, and subtribal levels are in accord with Jeffrey's classification of the family, presented in the Appendix. Unfortunately, scientific names at the specific and infraspecific levels have no such universal guide.

Difficulties at the species level and below largely reflect an absence of modern revisions for many genera or honest disagreement among authors concerning species boundaries or the rules governing the application of names. For example, both *Cucurbita* and *Cucumis* are subjects of active systematic investigation, yet there is no modern comprehensive monograph of either to which research workers may refer. Hence, in this book different names are sometimes applied to the same taxon of a genus—for instance, the cushaw appears either as *Cucurbita mixta* Pang. or *C. argyrosperma* subsp. *callicarpa* Merrick & Bates. The application of some names appearing in this book is uncertain. Laura Merrick, for instance, points out that *C. radicans* L. H. Bailey (syn. *C. gracilior* L. H. Bailey) is a distinct species, but in the literature both it and the synonym are widely applied to what is now recognized as *C. argyrosperma* subsp. *sororia* (L. H. Bailey) Merrick & Bates (syn. *C. sororia* L. H. Bailey). When problems with names could be resolved with certainty, we have done so by indicating the accepted name. Such resolution was not always possible, however, nor was it always edi-

torially acceptable to alter the taxonomic concepts and nomenclature of individual contributors. Eventually, these problems will be resolved with the preparation of systematic accounts.

Bringing together the work of scientists with wide-ranging interests serves to heighten both historical awareness and anticipation of the future. While each presentation owes its being to the author or authors who prepared it and who provide new data about and insights into long-standing or newly emerging questions, it also reflects the labor and ideas of the individuals whose work has gone before. Through the collective nature and historical continuity of its contents, the pages of this book summarize what we have learned about cucurbits. But, as neither science nor society as a whole can remain static, these pages are equally a foundation on which future studies can be built.

With a base of knowledge in place and significant new methods available for gathering and analyzing data, the stage is set for an expansion of studies in the pure and applied aspects of cucurbit biology. Just as these approaches are now complementary and interrelated, we suggest that in the future they will become less and less distinguishable. Expanded efforts in systematics and evolution will draw on increasingly refined knowledge of the biochemistry, genetics, ecology, physiology, morphogenesis, and other attributes of the family, much of which will be derived from applied research programs. Similarly, research designed to increase the use and productivity of cucurbits in a broad range of agroecosystems will depend not only on the application of findings from traditional agricultural and horticultural approaches and the rapidly developing field of biotechnology, but also on a detailed understanding of the nature and extent of the cucurbit germplasm, which owes its characterization to genetics and systematics. The prospects for future research on the Cucurbitaceae remain exciting and stimulating and promise both intellectual challenges and benefit to humankind.

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