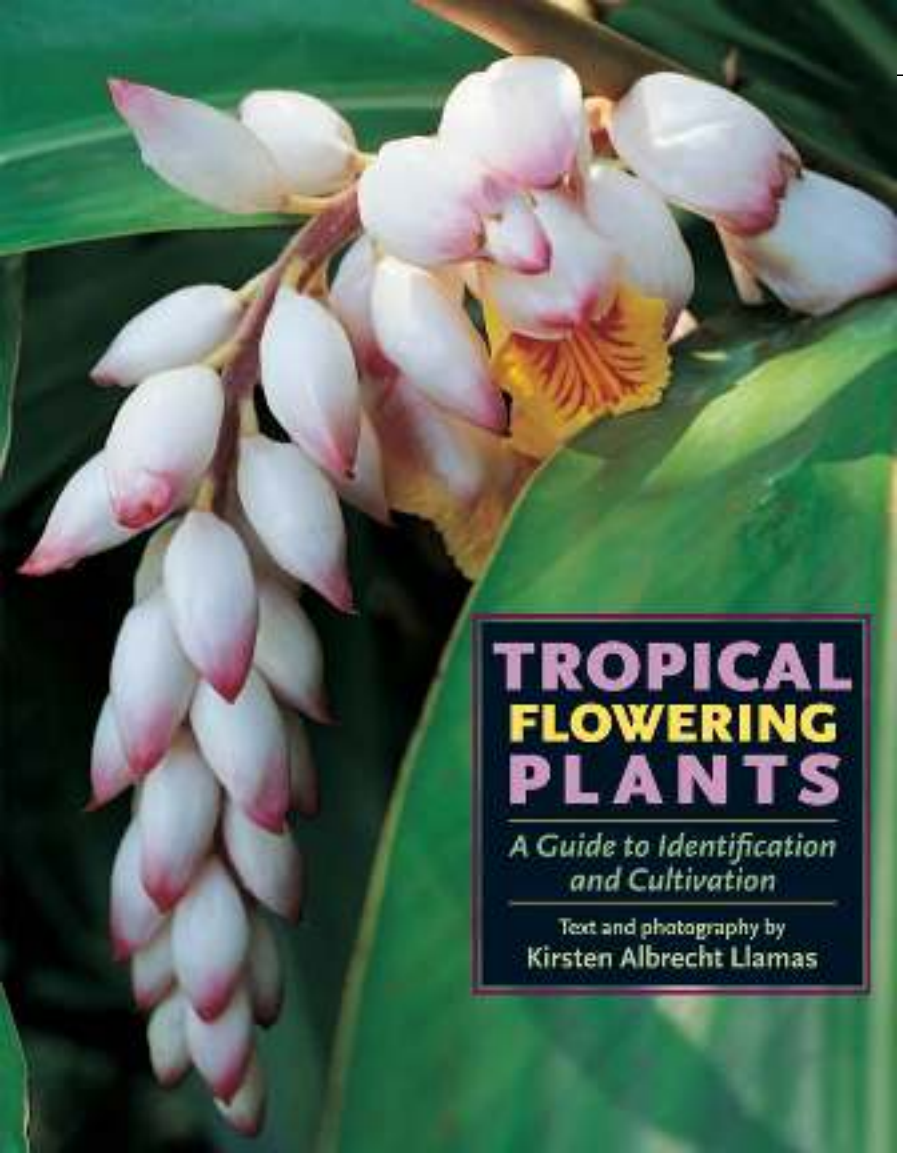
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A Guide to Identification and Cultivation
Text and photography by
Kirsten Albrecht Llamas

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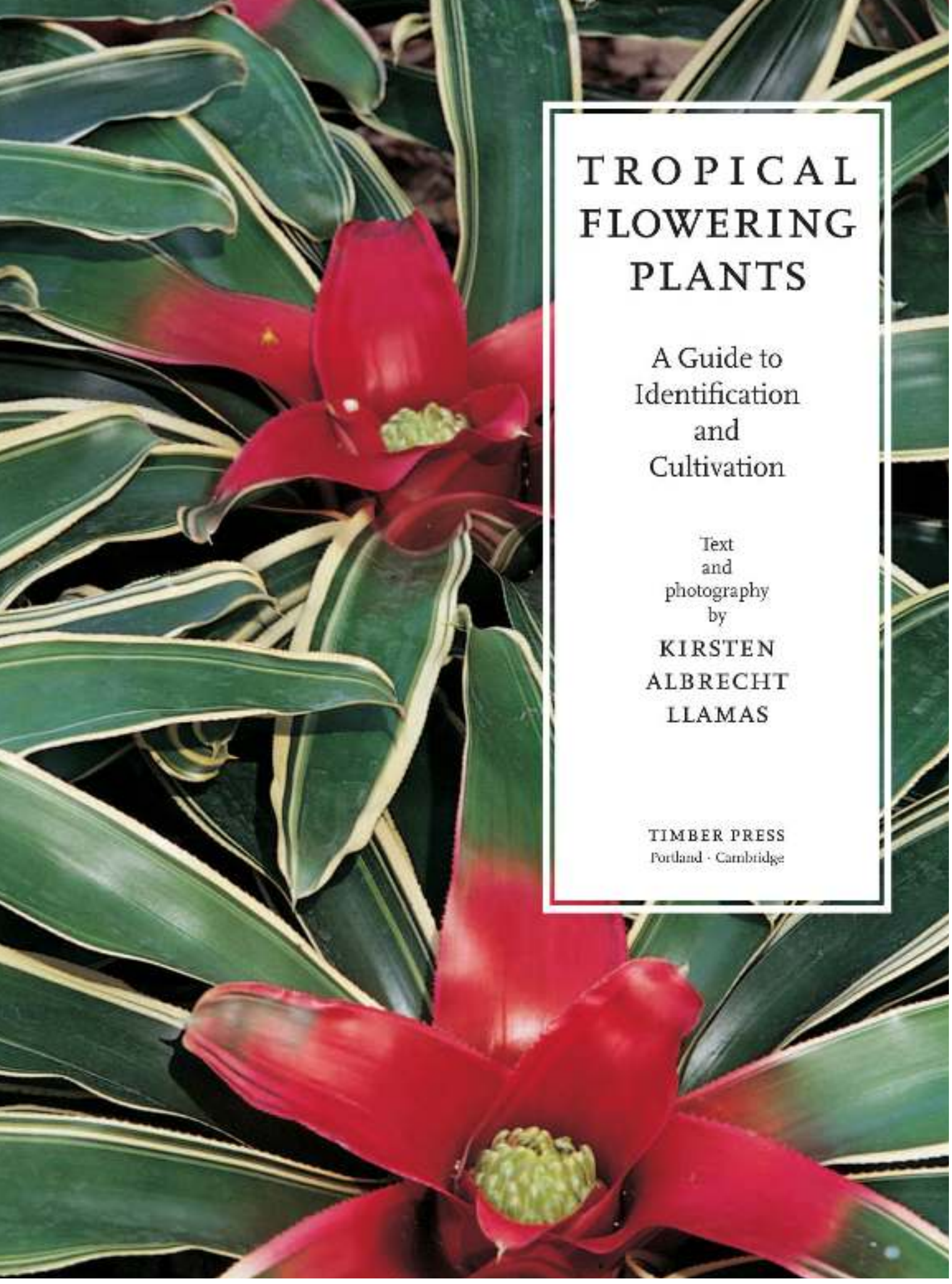

TROPICAL FLOWERING PLANTS

A Guide to Identification and Cultivation

Text
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KIRSTEN
ALBRECHT
LLAMAS

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To
my husband, Roberto

our daughters,
Marcela Teresa Llamas Losh
Tania Cecilia Llamas Cornelison
Sasha Lenora Llamas

our grandson,
Liam Joseph Losh

and to my mother and father,
Josephine Eleanor Farmer Albrecht
Herbert Otto Albrecht
(1899–1977)

CONTENTS

FOREWORD

This book is a unique publication comprising an outstanding collection of more than 1500 color photographs of tropical and subtropical flowering plants with descriptions of the families, genera, species, and cultivars, including country or area of origin, general maintenance, propagation, and horticultural use. No other single volume is available with such appropriate application.

The descriptions are arranged alphabetically by family, genus, and species. The family groups are based on *Plant Systematics, A Phylogenetic Approach* (Judd et al. 2002). This textbook, recognizing and incorporating many of the latest studies in molecular biology, has redefined many families of flowering plants, the angiosperms, so that *Tropical Flowering Plants: A Guide to Identification and Cultivation* becomes the first volume in the field of horticulture to recognize the modern status of plant systematics.

For the treatment of genera and species Mrs. Uhamas has consulted specialists in the United States and elsewhere and has followed their published work and frequently shared their currently unpublished work in progress. Synonyms and misapplied names are also listed, greatly increasing the reference value of this book.

Many cultivars are illustrated and described in the text. In the literature of horticulture, cultivar names are indexed by name, author, or bibliographic citation only by the relatively small number of International Cultivar Registration Authorities (ICRAs) for cultivar names. Few of the cultivars treated in this book are represented by ICRAs. Thus, the cultivar names given in this volume will have increasing value in the future as the place of publication, with a colored illustration, aiding the work of the Horticultural Taxonomic Group, at the Royal Horticultural Society Wisley Garden, Woking, Surrey, United Kingdom.

The common names given in this publication are those used primarily in English- and Spanish-speaking areas. The cultural information was derived from the personal experience of the author and that shared by practitioners in other areas. The volume has immediate value to the gardener or home owner who is considering the investment of time and money in the addition of new but unusual or unknown plants to existing plantings.

Richard A. Howard
Professor emeritus at Harvard University
former director of Arnold Arboretum

PREFACE

The natural function of tropical flowers, with their luminous colors and ingenious designs, is to lure pollinators within the boundless green of the rain forest or during a brief rainy season in arid regions. We humans respond to the aesthetics and exotic allure of their fecund natural beauty. Nurseries vie for new and exotic species to quench the collectors' thirst. The floral business imports flowers from around the globe. In the United States, tropical plants are grown outdoors year-round in Hawaii, California, Florida, and along the Gulf Coast. They are grown indoors, at least in winter, from Maine to Alaska. They appear on the pages of glossy magazines, in ads, television studio sets, homes, and work places. It is evident that the pleasure derived from having tropical plants around us is a passion shared by many.

The wild habitat of tropical species is disappearing at an alarming rate. It is calculated that literally thousands of species have become extinct without our ever having had a glimpse of them, and untold thousands more seem likely to be exterminated within the next few decades. Only a relative few species make it into cultivation because of their aesthetic, medicinal, or utilitarian value. Others with unknown value are lost every day to the saw, bulldozer, and fire.

This volume illuminates many species saved through cultivation. Tropical gardens and conservatories not only exhibit but also protect plants as zoos protect animal species. It is hoped that this volume will help impart a deeper appreciation for tropical species through plants in cultivation and, by extension, the need to preserve their wild habitat. Gardeners help maintain diversity by seeking out, growing, and sharing unusual species.

When I began to study tropical botany in the 1950s, the books on tropical plants were usually densely scientific. Illustrations, if present at all, were black-and-white drawings or stylistic color paintings. For a young Northerner freshly transplanted to the subtropics, it made learning about this intriguing flora especially challenging. Dry herbarium specimens did not relate very well to the verdant green that surrounded me. Available collections were limited. Little was available on tropical plants from distant regions.

As a lifelong photographer as well as a budding botanist, I decided to create my own photo collection of the plants that caught my eye. The process of discovering an exciting species, taking its photo, finding its name, and labeling the photo made a species indelible in my memory. In 1992 after Hurricane Andrew cut a large swath across South Florida, resulting in loss of trees and cooling greenness, my photographic perspective on tropical plants took on new meaning. Stress often incites a plant to bloom. Previously out-of-reach flowers on tall trees burst forth on mangled limbs at camera level.

To file my burgeoning collection I had to identify the plants correctly, but popular literature proved contradictory and untrustworthy. During the same period diagnostic technology using DNA was providing fresh insight into plant relationships, which resulted in massive rearrangement of plant families and numerous name changes. Thus, this volume evolved out of the need for a reliable broad reference for plants in cultivation.

As the photos and accompanying information in the database grew, it became clear that the information would be valuable to others as well. As the photographer as well as the writer, I have had firsthand experience with each plant and control over the accuracy of their descriptions. References were challenged and cross-checked.

This book is intended to be concise, detailed enough for

students and professionals, and written in language that can be understood by the average plant enthusiast. Above all, I want the reader to enjoy tropical plants and perhaps search for something a little out of the ordinary for a container on the porch or a special place in the garden.

The vast majority of the world's plant species come from the tropics, and no single volume could possibly cover even a fraction of the tropicals in cultivation. This book includes a selection of plants that demonstrate the great diversity of species in cultivation. It offers information about their native habitats and growing conditions which, in turn, suggests how they will best thrive in cultivation. Cultivated plants more commonly encountered in the garden and nurseries are presented along with rare and tantalizing plants for jaded readers. Woody plants are covered in greatest depth. A diverse selection from the very large herbaceous families provides essential information for distinguishing these groups. Particular attention has been given to the rarely published but magnificent ginger family, Zingiberaceae.

The criterion for selecting species to be included in this volume is their ability to thrive in zone 9 (with average lows between 20° and 30°F) or higher. Species with a broad temperature tolerance may also grow in temperate regions. Selections are included from moist tropical regions and seasonally moist/dry climates as well as cool montane and arid regions. A few technically nontropical species have been included that are commonly grown and thrive in tropical regions. Most annuals and species grown primarily as foliage plants are excluded.

In temperate regions many tropical species can be grown indoors in containers in winter and moved outdoors in spring. Some fast-growers are planted as summer annuals. Species from higher altitudes, deciduous shrubs, and winter-dormant herbs are often grown as perennials outdoors in mild areas with a blanket of mulch to protect the roots from freezing.

Maximum effort has been given to determining the currently accepted name for each species. Specialists in the various families have been consulted—sometimes prodded unmercifully—for details. Live scions and/or vouchers have been sent out for verification as needed. In a few cases where information is insufficient to support an identification, out-dated, or still under investigation, the best determination is given with the caveat that the identification is tentative. Uncertain determinations are clearly stated in an effort to counter any subsequent propagation of unverified names as fact in the popular literature.

Though some may dream of stability for scientific plant names, systematics is an evolving science. Naming a plant is not like giving a name to a newborn child, but rather like adopting an orphan and trying to determine its family roots and relationships after the fact. Names are based on the current understanding of the relationships among plant groups and evolutionary hierarchy. A number of different botanists may independently collect the same or very similar species, and each may have given them names based upon what information they can find. It takes considerable research, often involving international herbaria, to track down and compare collections to see which is a previously named species and which a new one. With each new study and technique, specimens are reviewed, and any new information often results in a name being revised. Inevitably, some experts will disagree on classification. The current studies using DNA have initiated a complete reevaluation of all previously named genera.

Botanical reorganization is one thing, but the most difficult task has been weeding out names that have been applied illegitimately in the trade, commonly without any regard for registration. Invalid names have become indelibly embedded in the popular literature and psyche of gardeners. For lack of understanding of what must seem like a constant stream of changes on the botanical side, the trade holds tenaciously to familiar names no matter how wrong or out of date they may be.

Growers often protect hybrid ancestry and origin for short-term commercial competition or fail to keep accurate records. This has led to considerable confusion and misinformation that distorts and quickly devalues the work of the grower. This is especially unfortunate in view of the drastic loss of biodiversity in wild habitat and the growing imperative to establish records of surviving species in cultivation and their hybrids. The Web address for the International Cultivar Registration Authorities (ICRAs), which provides information on registration of cultivar names, is given at the end of this book in the list of Web sites.

This volume is arranged alphabetically by family. This positions photos of related genera in close proximity for easy comparison. Leaf and floral size, morphology, gross size, and habit for each species are based on my original measurements with comparative figures included to show the range of natural variability. One or two field marks, or distinctive characteristics, are provided to help differentiate similar species. Botanical terminology is often used for brevity, but terms are explained in nearby family and genus headings. A glossary is also provided. Every effort has been made to enlighten while keeping this volume simple to use and pleasant to browse.

Information provided will help differentiate plants

with benign behavior from potential pests. Lists of invasive and weedy species are at the end of this book. As far as is known, only Florida actually prohibits certain species from distribution and this information is included as cautionary to other regions; however, it must be noted that a pest in one region or type of climate may be quite benign in another. Institutions such as state universities in Hawaii, Texas, and California provide lists of invasive plants in their regions on the Web. A list of Web sites can be found at the end of this book.

Be forewarned that state and county lists of restricted species do not always deter unscrupulous or unimaginative landscapers from selling undesirable species to the unwary. Anything from expensive builder-homes to subdivisions are landscaped primarily with mass-produced plants designed to sell property but without regard to how they will look in several years. Weedy species are fast-growing and cheap to produce, which means that a landscape company makes a return trip for maintenance, taking another bite out of your wallet. Checking for weedy species and size characteristics in this volume in advance will save considerable expense and regret in the future.

In our rapidly aging society, drastically reducing garden maintenance is a sound investment in the future both physically and financially. Elders can literally be driven from their homes by the cost of maintenance. Foresighted selection of plants by mature size, gradually reducing grassy areas with xeric plants, and generous mulching can make a garden practical enough to withstand extended vacations and inflation on a retirement income. Plants adapted to local growing conditions are more pest resistant and easier to maintain, reducing or eliminating the need for fertilizers and toxic chemicals. Increasing property taxes are partially related to the cost of controlling unwisely selected trees near power lines and streets.

Most small birds and butterflies are gourmands and will flock to a garden given a wide selection of local and introduced plant species. Many cultivated species are familiar to migratory birds and butterflies in distant parts of their ranges. Certain birds will visit flowering plants but not a feeder. For example, hummingbirds in South Florida are rarely interested in feeders but strongly fancy orchid trees (*Bauhinia* species), aloes, and other flowering species foreign to their ranges. It is noteworthy that the threatened swallow-tailed kite prefers a restricted species, Australian pine (*Casuarina equisetifolia*), to native Florida pine (*Pinus elliottii*) for nest building and will leave an area when Australian pines are removed. Stands of these trees, isolated from areas where they can become invasive, should be left for the benefit of this magnificent bird. The native-exotic dilemma is not black and white.

Though butterflies may dine on a wide range of introduced and local species, they are dependent upon certain host species for their larvae. Host plants will be periodically defoliated, but the larvae generally do no lasting harm to established plants. Including larval food plants (and not spraying them with pesticides) will keep the garden aflutter with butterflies. Species with special appeal to birds and butterflies are noted in this volume. Other species provide cover and nesting places. Choose a selection of species that bloom in all the seasons for year-round food for wildlife.

The latest horticultural advice strongly discourages the use of toxic chemicals in the garden. Healthy plants usually adapt to periodic infestations. Birds and insect predators of plant pests are killed by spraying. The use of pesticides is only a temporary solution because it produces pests with greater resistance to these chemicals. Pesticides also are toxic to humans, especially children, and pets. Choosing resistant plants and thinning to allow air to circulate reduces the likelihood and severity of infestations.

Temperate climate immigrants to the tropics at first may long for temperate species but usually find they demand too much care, pesticide, and fungicide, or fail to thrive in tropical conditions. Though the tropics are inhospitable to dogwoods and apples, this volume provides many beguiling substitutes.

As the backbone of the landscape, using xeric species that require little or no added moisture once established reduces the need for irrigation and saves precious water. Keep thirsty species well mulched and within easy reach of a sprinkler, and plant xeric species around the perimeter. Reduce grassy areas to the minimum. It is unnecessary to irrigate the entire property. Avoid planting moisture-loving herbs and annuals near the roots of trees that need a seasonally dry dormant period. An efficient garden is a less perishable garden but no less beautiful with the choices provided in this book.

ACKNOWLEDGMENTS

During the current era of dynamic changes in plant systematics a book such as this one could not have been accomplished without the assistance of numerous experts who provided information about arrangements and current names of plant genera and families. The generosity of authorities who contributed information based upon their lifetimes of experience is overwhelming. I am deeply honored and gratified.

Some more recent updates in this volume were provided through personal communications and, as far as possible, are noted in the text. Personal contributions, however, are by no means limited to individual notations.

Who knows if this project would have come to fruition but for the persuasive and unflagging support of my good friend, the preeminent pied piper of tropical flowers, Larry Schokman. Larry is director of the Kampong of the National Tropical Botanical Garden near Miami, in Coconut Grove, Florida. The Kampong is the former home and garden of America's plant collector extraordinaire, David Fairchild, who introduced winter wheat and many other important food crops. More than a few of the flowering plants and fruits in this book were photographed there. Larry's war chest of anecdotes freshes out many of the descriptions. His obvious delight in what he does captivates everyone he encounters.

It has been my great privilege to have three distinguished authorities on tropical flora and systematics review the manuscript. A list of their qualifications would go far beyond the space allotted. I pay them tribute and thank them fervently for their time and suggestions. I have felt a heavy responsibility to produce a book worthy of their confidence.

Richard Howard, professor emeritus at Harvard University, former director of the Arnold Arboretum, and principal author of the *Flora of the Lesser Antilles* among many other technical works, provided his experience and invaluable guidance under the most difficult of personal circumstances. I am especially grateful to Dick for writing the foreword for this book. He is a highly esteemed authority on tropical flora and I am honored by his support.

Derek Burch, with an unusually broad perspective as both a botanist and horticultural consultant with wide-ranging experience in the field and laboratory, helped sort out numerous identification problems and was especially helpful with the horticultural information. His British exactitude on the fine points of the English language, botanical terminology, and editing experience have been invaluable.

Walter Judd, an extraordinarily busy professor at the University of Florida and the lead author of the state-of-the-art textbook on plant systematics, astounded me by actually offering to read the manuscript. The arrangement of plant families and genera in this book is based on his text, which uses DNA analysis to determine natural order. Walt provided guidance and helped me extract key characteristics on many new and redistributed groups.

Numerous authorities gave generously of their expertise on plant families in the manuscript. I particularly want to thank Dieter Wasshausen (Smithsonian Herbarium, Washington, D.C.), who went out of his way, quite literally, to help with identifications on troublesome Acanthaceae. Peter Gibbs (University of St. Andrews, Scotland) provided extensive background analysis and interesting discussion on his ongoing research on the extraordinary *Ceiba*/*Chorisia* species. Peter Boyce and Simon Mayo (both of the Royal Botanic Gardens, Kew, England)

and Tom Croat (Missouri Botanical Garden, St. Louis) took time during a busy meeting to look over slides of the Araceae, answered numerous follow-up questions, and Tom and Peter later reviewed the whole section. Chuck Hubbuch (former director of plant collections at Fairchild Tropical Garden, Coral Gables, Florida, now curator of horticulture, Jacksonville Zoo, Florida) looked over the section on palms and fielded frequent questions concerning the garden collections. While working on his Ph.D. thesis at the University of Florida or on his way to a sale towing a trailer of gorgeous gingers, Tom Wood provided extensive unpublished technical detail and checked the identifications on the Zingiberaceae. I am especially fortunate that, before his death, noted *Heliconia* authority Fred Berry reviewed the collection of *Heliconia* photos and provided firsthand information.

Special thanks go to Shirley Graham (Kent State University, Ohio) who assisted with Lythraceae identifications (including vouchers on highly ornamental but still unsettled species of *Lagerstroemia*. It would have been impossible to unravel unfamiliar species of Agavaceae without the very generous and friendly guidance of Mary Irish (former director of public horticulture, Desert Botanical Garden, Phoenix). Lucia Lohmann (Missouri Botanical Garden) took precious time from her Ph.D. studies at the University of Missouri, St. Louis, to confirm *Tabebuia* vouchers and provide diagnostics on other species of Bignoniaceae. Harry Luther (director, Bromeliad Identification Center, Marie Selby Garden, Sarasota, Florida) and Donna Atwood (formerly of Marie Selby Garden) helped with Bromeliaceae and Gesneriaceae identifications and provided valuable reference material. Roger Hammer (naturalist and director of Castellow Hammock Park, Homestead, Florida) knows the location of practically every weed and benign ornamental in South Florida and is a respected authority on local species. His own garden is a showplace of local and introduced species working together in harmony, confirmed by the plethora of butterflies and birds dancing among the blossoms. Many unusual species were photographed there.

Alan Meerow (curator ARS-SHRS, USDA, Chapman Field, Miami) was consulted on identifications of bulbous herbs. Editor and author of recent authoritative succulent volumes Urs Eggli (Sukkulenten-Sammlung, Zürich, Switzerland) and co-author Bernard Descoings (Museum of Natural History, France) helped with Crassulaceae identifications. Richard Olmstead (University of Washington) provided the updated list of revisions for Lamiales.

I gratefully acknowledge the help provided by Richard Wunderlin (University of South Florida, Tampa). Dick fielded questions on Florida native and naturalized species as well as identifications of *Bauhinia* species. The late Ed Anderson (Desert Botanical Garden, Phoenix) helped with desert Cactaceae identifications. Myron Kimnach (former director Huntington Botanical Gardens, California, and editor of the *U.S. Cactus and Succulent Journal*) helped with identifications of tropical Cactaceae; Steve Hammer (Bolus Herbarium, Cape Town, South Africa) provided identifications on Aizoaceae. Identifications of *Tradescantia* and other species of Melastomataceae were graciously provided by Frank Almeda (California Academy of Sciences) and Jacinto Regalado (Field Museum of Natural History, Chicago). Suzanne Mace (Mesemb Study Group, England) put me in contact with various succulent authorities; Nat Deleon and Moira Prince (Bromeliad Society, Miami) provided expertise and subject matter for Bromeliaceae; Reto Nyffeler (University of Zürich) helped with Crassulaceae; Allen Paton (Royal Botanic Gardens, Kew, England) helped with Lamiaceae; George Staples (Bishop Museum, Hawaii) provided information on cultivated species in Hawaii.

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Jim Solomon (curator of the herbarium, Missouri Botanical Garden) and John Wiersema (taxonomist, USDA, ARS, Systematic Botany and Mycology Laboratory, Beltsville, Maryland) directed me to authorities and references and provided generous assistance concerning information on their respective Web sites.

I owe special gratitude to the late Monroe Birdsey, my taxonomy professor at the University of Miami and latter-day mentor. He will be remembered for his great fondness for bad puns and unusual plants, in which order I am not certain. The word play was intended to "impress unfamiliar Latin and Greek names on budding botanists" (Polygonaceae will forever be the "family of the departed parrot" to me). His eccentric individualism, incorrigible mispronunciations, and malapropos left indelible marks for better or worse. Many photos were made in his private jungle, especially those of his beloved aroids and water-lilies.

I particularly want to salute the staff at Fairchild Tropical Garden, Coral Gables, Florida, who collect and nurture new and exciting species. Without their often unheralded efforts—and those of similar folks at other botanical gardens—these lovely plants would not be available for us to enjoy. For their exceptional patience and assistance I want to thank Craig Allen, David Barzvi, Mary Collins, Don Evans, Jack Fisher, Dena Garvac, Marilyn Griffiths, Gerald "Stinger" Guala, Benoit Jonckheere, Mike McLaughlin and his trusty cherry picker, Ken Nougent, board member and collector Lester Pancoast, Scott Zona, and the late Bert Zuckerman. Special thanks go to Susan Knorr and Nick Cockshutt of the publications department who were among the first to encourage my efforts.

The botanical garden and conservatory at Balboa Park is located in San Diego and includes numerous succulent species from arid regions of the Americas, Africa, and Australia. Horticulturist Kathy Puplava has been most helpful providing information on plants in that collection. Burt O'Brien of Rancho Santa Ana Botanical Garden in Claremont, California, provided information on the introduction of ×*Chitalpa*. Quail Botanical Garden in Encinitas, California, has an excellent collection of threatened Canary Islands plants as well as many succulents and xerophytes.

It would be impossible to acknowledge all the members and presenters at the Miami Chapter of the Tropical Flowering Tree Society for tips from their firsthand horticultural experience covering hundreds of tropical species. Members pride themselves on introducing new and unusual species. Their motto is "Color the Horizon," promoting and planting ornamental flowering plants in public landscaping. I especially want to thank Mark Stebbins for his generosity in sharing his research on identifications; Bob McMillan for information on plant diseases and pests; and propagation expert and migratory species, Grafton Clift, a storehouse of revelations on untold numbers of plants and grafting. Photos were made at the homes and nurseries of many members including Tropical Colors Nursery, Luc and Carol Vanmoerbeeck, Homestead, Florida, specialists in *Hibiscus* and *Plumeria*; Tropical Paradise Nursery, Joe Fondeur, Davie, Florida, home of the ravishing *Warszewiczia* and other uncommon beauties; Bloomin' Good Nursery, Dolores Fugina, Homestead, Florida, specializing in unusual flowering trees; Ernesto's Nursery, Ernesto Rodriguez and Dimitris Petropoulos, Miami, Florida, renowned for its pampered *Amherstia* and other rarities; Darlene Mann, home to a fast-growing *Ochroma*; Rob and Cindy Bobson, Biospheric Engineering, Homestead, Florida; Paradise Found, Lee Cicchella, Davie, Florida, ardent Bombacaceae hybridizer; Jesse Durko's Nursery, Davie, Florida; Richard Lyon's Nursery, Perrine, Florida; Maurice Kong, whose garden is a demonstration of how to grow hundreds of unusual tropical fruit trees within the confines and regulations of a subdivision lot; and Willis Harding and the neighborhood park he filled with stunning *Ceiba*/*Chorisia* hybrids in northwestern Miami-Dade County, Florida.

I always enjoy the ebullient Aussie repartee of Mike

Ferrero, curator of palms and flowering trees at Nong Nooch Tropical Garden, Thailand. He has generously shared his experience, grapevine of authorities in Australia, and references on Asian species. Wilhelmina "Willy" Wasik, plant recorder, spent an afternoon with me digging through old plant records of the USDA Subtropical Horticulture Research Station and National Germplasm Repository, Chapman Field, Miami, for information on *Dombeya burgessiae* 'Seminole' revealing for the first time its full identity. Steve Jankalski shared his trials and tribulations with the often obscure history of *Euphorbia* cultivars.

Information and photos were gathered from innumerable sources including public and private gardens. For graciously giving permission to photograph the collections, I would like to thank Terrence Walters, executive director of the Montgomery Botanical Center, Coral Gables, Florida, which specializes in the study of cycads and palms; the late Frank Smathers and Four Fillies Farm, Coral Gables, Florida, his home garden and mango collection; and Eric Eimstad of the Parrot Jungle and Gardens, Pinecrest, Florida. Numerous tropical fruits and flowers were photographed at Miami-Dade County Fruit and Spice Park, where Cluis Rollins is director.

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I greatly appreciate the gracious home owners who opened their garden gates, delighted to exchange information and allow me to photograph their prized tropical specimens.

Enduring gratitude goes to my dear husband, Roberto, for his unqualified love, trust, and steadfast support. No institution would have granted such unfettered freedom over so many years, and without such freedom this book would not have been possible. His personal contribution goes far beyond Spanish consultant, sharp-eyed flower scout, equipment bearer, and abiding companion on many a photo safari.

INTRODUCTION

Over many years of researching identifications of plants, I have been impressed by the value of good photographs in my quests. While photos do not always serve as definitive identification of very similar species, their value in quickly narrowing down the possibilities is immeasurable. While keys are standard in botany, they can be time-consuming or bewildering to all but the experts and often useless for plants in cultivation.

Because detail is paramount, a good botanical photo should maintain high photographic quality including proper exposure. Plants should appear in natural position without artiness or artifice, and the photographs should reveal as many unique characteristics of each species as possible. This does not, however, preclude the photographer from translating the aesthetic beauty of even the most humble blossom. That this collection of photos is successful can be measured by the frequency with which experts have been able to make valid identifications based upon scanned photos—of great importance when one is working with experts from around the globe.

Ideally one would prefer a number of photos for each plant but this would be at the expense of the number of species that could be published. For readers of this volume, a broader understanding of a particular plant group can be found by perusing information on related species as well as the genera and family headings.

Scientific Names

Every attempt has been made to locate the current accepted name for each species. A number of on-line databases made this task easier. Where the literature is out of date or insufficient evidence is available to support an identification, a specialist working with a particular group has been consulted. Live scans and specimens, where necessary, of the photographed plant have been provided for verification.

Scientific names are not simply tags but imply relationships and the hierarchy among family groups. If new information about a species indicates its previous placement in a group was incorrect, the name must be changed in agreement with the *International Code of Botanical Nomenclature*. Outdated or incorrect names are listed as synonyms and may be of value when referring to older publications. In scientific works, author's names—the person who published the name of a species—follow the scientific name in roman type. They are not used here for brevity. Authors' names, however, are readily available on the Web sites listed at the back of this book.

Common Names

Common names are often treated disdainfully by scientists because they are highly variable from region to region and not universally recognized. Some less familiar species have not acquired a common name in English. To some, however, common names feel more comfortable, less formal than words with Roman and Greek roots. They might seem easier to remember or pronounce. This is, however, just a lack of familiarity considering how we routinely rattle off medical Latin or Greek—cardiologist, dentist, rubella, influenza—and myriad foreign-language proper names such as Philadelphia or Los Angeles. If we can say Massachusetts, then *Megaskepasma* shouldn't stick in the throat.

Thanks to the busy nursery trade in tropical plants, many cultivated species have acquired universal names in English. Since birds have standardized common names in English, there is no reason that plants couldn't

have them also. As a first step toward standardization, this volume lists the preferred common name first. Inaccurate names and those likely to produce confusion have usually been excluded, with a few exceptions where usage is common or no other choice is available. Many tropical species in cultivation come from Latin America, so widely recognized common names in Spanish have been provided after the English names wherever possible. Names from other countries of origin are sometimes added at the end. These may be colorful in themselves or they might be handy for travelers who wish to look up an interesting species in its home territory.

Names that originated in horticulture but have no botanical merit are listed as "hort." This is indicated in some references as "of gardens." When a grower or nursery is not sure of or cannot find the correct scientific name, it is tempting to invent a name or mistakenly apply one that belongs to a similar species. Growers should use a common name until a botanist positively identifies a species. When a grower has produced a cultivar or hybrid, he or she must register the name to conserve it and preserve his or her rights over someone who might come up with a similar cross later. A committee is currently working on registration of cultivars and hybrids. At this time, it covers many but not all plant groups. Registration information is provided on the Web site listed at the end of this book.

Origin

The origin or native range of each species is provided. Origins were cross-checked against information from herbaria and actual collection sites listed on on-line databases. Though a plant may be listed as having a native range in a particular region, this does not imply that a particular species is native to all parts of that region. The misapplication of the term *native* often leads to confusion. Plants are only native within the confines of a particular habitat within a region such as seaside forest, wetlands, seasonally moist/dry hardwood forest, low/high elevation, desert, savanna, grasslands, and so forth. Some species, often rare, may have their habitat restricted to a specific locale. Knowing the native range, in combination with growing conditions, indicates where and under what conditions a plant is likely to thrive in cultivation. Origin is also important for identifying species.

Habit

A general description of each species is followed by a range of size. The first figure is the average size of species seen in cultivation. The second figure includes information from reliable sources that suggests the potential mature size of a species in its native habitat or under optimum conditions. This does not indicate that an individual plant will necessarily reach this size or that it might not grow larger under certain circumstances. A plus sign indicates an indeterminate growth potential, such as a vine, a rare plant with little experience in cultivation to rely on, or when a larger size seems probable under optimum circumstances. Health, climate, genetics, and growing conditions influence the growth potential of individual plants. In hurricane-prone areas, few large trees reach their full potential.

Landscapers and gardeners are advised to seriously consider potential size and spread when deciding where to locate large trees in the vicinity of buildings, streets, or power lines. Some trees grow extremely rapidly in the tropics, reaching 30 feet or more in as little as 3–5 years. If possible, move species with inappropriate growth potential while young and replace them with compact species. Inappropriately sized landscape trees usually are at the mercy of unskilled maintenance crews who destroy their shape and health, chopping off branches and flowers in an attempt to fit an oversized plant into a bad location. Also, consider the spread of roots. A carefully planned landscape remains elegant for years and has considerable influence on maintenance costs, future home value, utility bills, and security in windstorms.

Hardiness Zones

A USDA hardiness zone map is provided to indicate the general range within which a plant is likely to thrive. Most plants in this volume originate in tropical or subtropical regions. All thrive in zone 9 (average winter lows between 20° and 30°F) or higher. Some tropical plants, especially those from higher altitudes, may tolerate brief freezing temperatures, while ultra-tropical species, often from moist lowlands, may need extra protection from even mild chills. The total number of days above or below average temperatures annually plays a significant role in a particular species's ability to thrive and bloom. Conditions may vary from one side of a hill to the other, on the north or south, windy or leeward sides of a structure, or from the coast to a few miles inland. Sheltering trees or proximity to a warming body of water will raise local temperature a few degrees over those of surrounding areas. The southwestern states and Hawaii are notorious for their myriad microclimates. Wise selections take advantage of local conditions.

Though efforts have been made to produce more precise climate maps, there are so many local variables and so many species that any climate map must be taken only as a general guide. Within reasonable limits, the best way

to determine if a newly introduced species will thrive in a particular location is to compare species from the same or similar regions known to thrive in the area. Many avid gardeners pride themselves on their ability to push zone limits though this is generally not a low-maintenance approach. The simplest device is to keep tender plants in containers that can be moved as necessary.

Evergreen, Deciduous, Seasonally Dormant

Deciduous trees, shrubs, and perennials become dormant seasonally and lose all their leaves. In the tropics this is usually in response to dry and/or cooler seasons. Some herbaceous tropical species die back to the ground in dry seasons and others stop growing and bloom but retain all or some foliage. These species are listed as seasonally dormant. The roots or rhizomes of seasonally dormant tropicals may survive in mild temperate areas in the ground if protected from freezing temperatures by a thick layer of mulch; otherwise, it is best to dig them up and overwinter indoors.

Evergreen trees also shed leaves but gradually or partially while remaining mostly green. They may or may not become semidormant seasonally. In temperate areas the term evergreen is often applied loosely to conifers (gymnosperms), though some other temperate species such as hollies remain evergreen in winter.

Semideciduous species may lose their leaves in dry or chilly conditions or behave as perennials in mild temperate areas but usually remain evergreen in warmer and/or moister conditions.

Bloom Season

Time of flowering is listed by season rather than by month to be applicable in both the Northern and Southern Hemispheres. Gardeners can mark their calendars by the date some species bloom, while others may vary considerably from year to year and location to location. Many factors determine when, how prolifically, or if a plant will bloom at all. Some species bloom during a dry season or when the rainy season begins regardless of the time of year. In areas with 2 dry seasons, for instance, jacarandas often bloom twice a year. Artificial irrigation during the dry season will disrupt this cycle and often results in poorer or no bloom. Many plants will not thrive or may even die if kept excessively moist when dormant.

Poinsettias and holiday cactus are sensitive to decreasing periods of light; they begin to bloom when daylight hours shorten and will fail to bloom when darkness is interrupted by artificial light. Other species rely on increasing hours of daylight in spring, moisture, and/or warmth to initiate bloom. Some herbs, such as alpinias, which bloom on second-year growth, usually do not flower in areas where the tops are killed back annually although they produce plentiful new foliage each year.

Moisture

Moisture requirement is an important consideration in deciding the conditions where a particular species will thrive. A preference for species from a radically different climate than the local one must be balanced against cost of special maintenance and the time one is prepared to provide, how reliable the source of water is, and other requirements.

The level of moisture needed by a species is predetermined by the conditions to which a plant is adapted in its native habitat. This may be a narrow range. Other species may be quite adaptable. The amount of irrigation needed is influenced by how long the soil remains moist, which in turn depends on other conditions such as heat or cold, rate of evaporation, and soil porosity. Mulch and other organic matter greatly reduce the loss of moisture from the soil among other benefits. All plants except those that require dry conditions benefit from at least 3 inches of mulch covering the root area to just beyond the edge of the canopy with a clear area around the trunk. Excess water is just as bad for a plant as not enough. This volume presents general guidelines. Advice on particular groups of plants can often be found in specialty books or through local plant societies.

"Moist" conditions refer to soil that remains slightly damp at all time around the plant roots. Candidates suitable for moist conditions are often tender plants of rainforest understory that grow in filtered light. They require frequent irrigation and additional misting when the humidity is low. Though these plants like moisture, their roots should not remain wet and the soil should drain off any excess water quickly. The soil should contain considerable organic matter such as peat moss or humus that maintains even moisture between applications of water or rain. Top-dress the soil with mulch or humus to slow evaporation.

"Regular moisture" indicates a plant needs watering at regular intervals so that soil around the finer roots never dries out although the soil surface may become almost dry. Plants in this group usually tolerate somewhat more sunlight or wind as long as the moisture level is adjusted accordingly. They tolerate somewhat longer intervals between watering depending on local conditions including temperatures.

"Moderate moisture" is used for a plant that can tolerate extended intervals between waterings but whose roots should never become completely dry during active

growth. Such plants tolerate brief periods without irrigation when the weather is cool and growth is slow. They are often xerophytic in areas with seasonally dry winters. In Mediterranean-type climates with hot, dry summers, irrigation will more likely be needed in summer than winter.

"Dry" conditions apply to plants that usually do not require supplementary irrigation except during extended hot, dry periods. In seasonally moist climates these species often thrive without additional irrigation if provided porous soils that drain off very rapidly. They should not have large amounts of organic materials around the roots. Most of these plants thrive in Mediterranean-type climates such as southern California and parts of Hawaii.

"Arid" plants tolerate bone-dry conditions for long periods in the wild, often depending on brief seasonal showers to bloom. Arid-growing plants differ from dry-growing plants by having special adaptations for storing moisture and preventing evaporation. In cultivation, however, even arid-growing plants may need weekly irrigation in extreme heat and/or drought. If soil becomes completely dry, it will be resistant to rewetting—like a dry sponge—and it may take several applications, or several hours of trickle irrigation, to moisten the soil down to the root system. Arid conditions are typical of the desert Southwest, higher elevations, and down wind of the mountains in Hawaii.

"Seasonally moist/dry" conditions suit plants from forests with distinct wet and dry seasons. These plants grow actively in rainy months but slow or become dormant in dry seasons. Such conditions are typical of regions with monsoons such as Southeast Asia as well as areas of the Americas. These species require regular moisture during active growth, usually summer, but little when dormant.

All moisture recommendations apply to plants in containers as well as in the ground; however, the porosity of a container, its size, and the potting medium must be taken into consideration. Containers have a significant influence on the frequency with which moisture will need to be applied. Plastic pots are not porous and permit less evaporation than with clay pots. Adjusting the type of container and potting soil mix to suit the watering schedule is usually more practical than attempting to water individual plants on different schedules. This is especially important where container-grown plants are kept outdoors, exposed to rain. Moisture should be reduced in cooler seasons when a plant slows its growth or goes dormant; more is needed in hot or windy conditions. Good drainage will save many plants from heavy-handed watering or those times when it rains for days on end.

Anyone who takes long trips or is inclined to forget to water should select species that can tolerate brief to moderate dry spells. Look for xeric (or xerophytic) plants, which tolerate local climate and growing conditions and thrive without supplemental care once established. Such plants will not tolerate any set of conditions or every location. The term is sometimes erroneously used to indicate "native" species though introduced species often meet the requirements perfectly. Remember that native species are local species from specific habitats. A pinelands species is not native to seaside communities or grassy lowlands although it comes from the general region and growing conditions will vary. A species will only be xeric in cultivated situations that resemble its natural habitat. Conversely, any species will thrive as if xeric under local conditions that resemble its natural growing conditions.

Soil

Certain species will adapt to a variety of soils. Others are quite particular. Those that do not adapt well to local soil either need a specially prepared hole or should be grown in containers. The information provided in this volume is based on observations of species in cultivation, usually in the ground, and by people growing them successfully.

Except for aquatic plants, water should drain quickly, allowing air to reach the roots. The coarser the soil particles, the faster water will drain away. Fine particles, particularly clay and marl, retain moisture a long time and need coarser particles for aeration. Sand has a larger grain size that drains quickly and is used to break up fine soil. Coarser materials are added when moisture must drain particularly rapidly. Organic materials open the soil to air and retain moisture like a sponge. Organic and inorganic materials can easily be adjusted to fit the moisture requirements for each plant. Potting soil products are usually not suitable to use alone and need to be amended according to local conditions. Larry Schokman's favorite advice to gardeners (Larry is director of the Kampong of the National Tropical Botanical Garden) is this: "Never plant a ten-dollar tree in a ten-cent hole."

Mulch

Larry's other recipe for success is to "mulch, mulch, mulch." A doughnut-shaped layer of mulch, to at least 3 inches deep, should be maintained over the root area of all but arid plants, leaving a foot of clear space around the trunk to avoid rot. It is impossible to overstate the beneficial properties of mulch. Try it in a small area if you need proof. Many gardeners are finding extensive lawns expensive to maintain, often reaching a crisis dur-

ing a drought with water restrictions. Reduce lawn areas by gradually extending beds of xeric plants and extend mulched areas at least to the drip line of large trees. Fresh chipped garden debris is fine, no need for bins and laborious turning. Yard maintenance companies are usually happy to dump a load of chips instead of hauling it to overflowing dumps. Decorative mulches have been found to contain harmful chemicals and have already lost most nutrients. Cypress mulch, from a threatened species, should be avoided. Mulch from invasive species should never be used unless treated to kill seeds.

As mulch breaks down it releases nutrients into the soil slowly and the need for additional fertilizers is greatly reduced or sometimes unnecessary. In poor soil mulch gradually builds up layers of topsoil. Some home owners laboriously fertilize their lawn and in a few weeks time blow it all away with the clippings.

Among the greatest attributes of mulch is that of maintaining even moisture. Irrigation can often be reduced from 2 or 3 times a week to once or even less. Mulch is especially important during a drought to prevent rapid drying of the soil. Mulched areas can be edged with cut limbs or decorative borders. Small plants such as bromeliads and aroids can be planted over the top of the mulch if desired.

Mulch discourages weeds and serves as a barrier to protect trunks from string trimmer wounds that invite infection. It may discourage nematodes and helps maintain plant health. Thirsty, heavy feeders such as bananas and heliconias need far less water and fertilizer in deeply mulched beds, and mulch protects tender roots in winter. The only time organic mulch is not advised is for arid species. The ground should be covered with river gravel or other rocks with neutral pH.

Sun

The hours of sun a plant receives each day and its intensity are specific for each species and greatly influence the quality and quantity of bloom and plant health. Select plants for the garden by the light conditions in the places they will be planted. A successful gardener looks to see which conditions can be controlled and which can't and selects plants accordingly. The position of the house or large tree on a property may determine which side of the house to plant particular species. If a property lacks shade, first consider some larger trees that partially filter the light. After a few years more sensitive plants can be added.

"Full sun" indicates direct sunlight at least 6 hours a day. The plant must be positioned away from the shade of larger plants and structures. This might be almost impossible to achieve in gardens on the east or west sides of buildings, which are shaded for half the day, or where fog commonly filters the sun for part of the morning.

"Part sun" indicates at least 3 hours of direct sun preferably in the morning. Such conditions are typical of plants that grow under a deciduous tree with small leaves and a high canopy that provides shade in summer at midday. These plants usually tolerate more sun in winter when the light is less intense. This conveniently coincides with the time deciduous trees lose their leaves.

"Bright filtered light" indicates light that is diffused (but not heavily shaded) throughout the sunniest hours of the day. A tree with a canopy of small leaves provides this type of light to understory plants. A patio with 30–50% shade screen should provide similar light.

"Bright broken light" is similar to bright filtered light but bright sunlight breaks through the canopy intermittently. This light is similar to that under a tall large-leafed tree during the hottest part of the day. A slat house sometimes simulates these conditions. Plants requiring bright broken light tolerate bright early morning and late afternoon sun.

"Shade" refers only to indirect or strongly diffused light. The term is rarely used in this volume because it is interpreted variously by different people. Few flowering plants bloom in even bright shady conditions. Nonflowering plants such as ferns are usually best for shady locations. Too much shade is usually indicated by plants leaning strongly toward the light source, often developing long weak stems.

Too much sun, especially if it occurs suddenly, results in burned leaves and possibly death. Move a plant gradually over 2–3 weeks from low to higher light intensity to allow it to adjust. However, do not expect a plant that naturally grows in filtered light to adjust to full sun. If a shading tree has to be trimmed, spread an old sheet or doubled piece of screening (never plastic) over the plant temporarily. Better yet, trim trees when the sun is weaker in winter or early spring.

Flower and Leaf Descriptions

Descriptions of flowers and leaves in the popular literature are commonly derived from other references, which themselves derived information from another reference leading to the common perpetuation of mistakes. A wag once referred to this phenomenon as the "fossilization of misinformation." Descriptions in this volume are original, taken from the plants themselves, and not derivative. Be aware, however, that plants can exhibit considerable natural variation and the figures given here should be used as a general guide. Beryl cubense has large leaves