HERBERTIA

VOLUME 51 1996

HERBERTIA™

is the journal of the International Bulb Society and is devoted to the botany and horticulture of all geophytic (bulbous) plants. Special emphases are the taxonomy, culture, varieties, cultivars, history, discovery and conservation of petaloid monocotyledonous and dicotyledonous plants of the Amaryllidaceae, Liliaceae, Iridaceae and all other plant families with geophytic species. Articles about geophytic plants in any plant family are welcome.

VOLUME 51, 1996

Volume 51 publication date: 1 July 1996

ISSN: 8756-9418

ADDRESS FOR ALL CORRESPONDENCE

International Bulb Society
P.O. Box 92136, Pasadena CA 91109-2136
United States of America

The International Bulb Society is a nonprofit, scientific and educational organization incorporated in California in 1943. Dues and donations to the Society are tax deductible under Section 501 (c)3 of the Internal Revenue Service Code. Dues are U.S. $30.00 per year [July 1 through June 30] for U.S. addresses; yearly dues for addresses outside the U.S.A. are $40.00, payable by checks *drawn on a U.S. bank only*, international money order or U.S. dollars (currency) to the International Bulb Society, mailed to the above address only. Journal and newsletters are sent via air mail to addresses outside the United States.

Produced, formatted, edited and prepared for printing by the editor on a Power Macintosh computer with QuarkXPress publishing software.

Printed by **Kandid Litho**
Covina, California, United States of America.

BEQUEST APPEAL

Donations to the International Bulb Society may be made at any time and are tax deductible as described above.

The Board of Directors makes a special appeal to individuals and organizations who would like to promote the cause of ornamental bulbous plants. The Board asks that your last will and testament include a bequest to the International Bulb Society. There is so much more your Society could do if only the funds were available:

- collecting trips to help save rapidly disappearing plant species;
- scholarships for deserving young botanists and horticulturists;
- more color pictures in future editions of **HERBERTIA**;
- publication of a revised edition of **AMARYLLIDACEAE** and other monographs on bulbous and tuberous plant species.

These are just a few of the plans being made for the society's future. The Board is asking that you become a part of these plans with your tax deductible donation.

Please write a bequest into your will to:

International Bulb Society
P.O. Box 92136, Pasadena CA 91109-2136
United States of America

JOURNAL BACK ISSUES

Many back issues are now out of print. For an up to date list of available issues, please request a back issue order sheet, using the society's mailing address on page one. Available back issues are $10.00 per volume for 1934 to 1991 and $20.00 per volume for 1992 to 1994 (plus $4.00 per issue for additional postage on orders sent to an address outside the United States).

SEED AND BULB EXCHANGE: A SUBSCRIBER SERVICE

Members may participate in the IBS seed and bulb exchange. A moderate charge per packet of seed is used to defray mailing expenses. The next seed and bulb listing will be mailed to all subscribers with the autumn 1996 newsletter, *The Underground*, which is scheduled to be mailed in late September. This is one of the largest bulb seed lists in the world. For more information or to donate seeds or bulbs, please contact:

Charles Gorenstein
IBS Seed & Bulb Exchange Director
PO Box 92136, Pasadena CA 91109-2136
United States of America

A NOTE TO CONTRIBUTING AUTHORS

We welcome your bulb articles and manuscripts for publication. Articles must be received by IBS by January 31 to be considered for inclusion in the following HERBERTIA issue. An author of a major article will receive five copies of the HERBERTIA issue containing his or her article; additional copies can be supplied at cost if ordered when proof copy is returned. When possible, please send articles in any major word processing format on a 3½ inch floppy disk along with a hard copy.

Please submit copies of artwork, slides, transparencies and maps. Care is taken with manuscripts and illustrations, but we cannot be responsible for their return in original condition. Crisp, clear, black and white photos, color slides, line drawings or other artwork are acceptable. All Color slides and artwork used in production will be returned after the issue is printed. Donations towards the cost of color separations are encouraged.

HERBERTIA™
volume 51, 1996

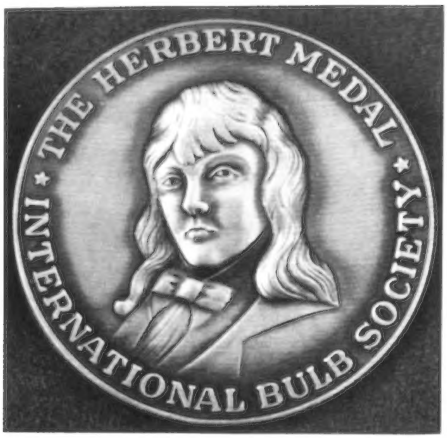
TABLE OF CONTENTS

Introduction—Volume 51

This issue of **HERBERTIA** covers a large and diverse group of geophytic plants from *Alstroemeria* to *Zephyranthes*. Included are wonderful old standbys and interesting new species. Three groups of geophytic plants are included for the first time—*Kniphofia*, *Pelargonium* and *Disa*. We hope we have a good balance on observations of plants in habitat, cultivation, new species, research, hybridizing and ecology.

We are excited about the new E-mail Bulb Robin. In a world that changes entirely too fast and is constantly adding huge volumes of information, we will be able to learn of new plants, research, cultivation methods and, of course, new problems and answers much more quickly.

Cover Photo: *Nerine platypetala*. Painting by Gillian Condy of plants from the Wakkerstroom locality from **The Flowering Plants of Africa**. Reproduced courtesy of the National Botanical Institute, Republic of South Africa.



THE HERBERT MEDAL

The Herbert Medal is the highest honor the International Bulb Society can bestow upon a person for meritorious achievement in advancing the knowledge of bulbous plants. The medal is named for William Herbert (1778-1847), son of Henry Herbert, Earl of Carnarvon. William Herbert had a prediliction for amaryllids and achieved success in their hybridization and published his research findings in several monumental works. His contributions as a pioneer geneticist and plant breeder, and his arrangement of the Amaryllidaceae, helped set the stage upon which other workers, both amateur and professional, have been able to advance.

The award includes honorary life membership in the society.

The Herbert Medal may be awarded annually or on special occasions by the Board of Directors of the Society. Medalists need not be members of the Society.

HERBERT MEDALISTS

Mr. Henry P. Nehrling, Florida, 1937
Mr. Theodore L. Mead, Florida, 1937
Mr. Arthington Worsley, England, 1937
Mr. Ernst H. Krelage, Holland, 1938
Mr. Cecil Houdyshel, California, 1938
Maj. Albert Pam, England, 1938
Mr. Pierre S. duPont, Delaware, 1938
Mr. Jan de Graff, Oregon, 1938
Mr. Fred H. Howard, California, 1939
Mr. Sydney Percy-Lancaster, India, 1939
Dr. J. Hutchinson, England, 1939
Mr. Carl Purdy, California, 1939
Dr. A. B. Stout, New York, 1939
Mr. H. W. Pugsley, England, 1940
Mr. W. M. James, California, 1941
Prof. Dr A. Fernandes, Portugal, 1942
Miss. Elizabeth Lawrence, N. Carolina, 1943
Dr. Henry A. Jones, Maryland, 1944
Mr. R. G. Huey, Kentucky, 1945
Mr. Guy L. Wilson, Northern Ireland, 1946
Mr. R. W. Wheeler, Florida, 1947
Dr. R. A. Dyer, South Africa, 1948
Capt. C. O. Fairbairn, Australia, 1949
Mrs. Mary G. Henry, Pennsylvania, 1950
M. Mulford B. Foster, Florida, 1951
Dr. J. C. Th. Uphof, Florida, 1952
Mr. E. A. Bowles, England, 1953
Mr. Thomas R. Manley, Pennsylvania, 1954
Dr. Robert F. Hoover, California, 1955
Mr. E. O. Orpet, California, 1956
Mrs. Morris W. Clint, Texas, 1957
Mr. Wyndham Hayward, Flirida, 1958
Dr. Robert G. Thornburgh, California, 1959
Prof. Ira S. Nelson, Louisiana, 1960
Mr. Frederick B. Jones, Texas, 1961
Dr. Floyd F. Smith, Maryland, 1962
Mr. W. D. Morton, Jr, Louisiana, 1963
Mr. S. Y. Caldwell, Tennessee, 1964
Mr. Robert D. Goedert, Florida, 1965
Mr. Leion Boshoff-Mostert, S Africa, 1966
Dr. Marton Cardenas Hermosa, Bolivia, 1967
Dr. Robert P. Kahn, Maryland, 1968
Mr. W. Quinn Buck, California, 1969
Dr. Thad M. Howard, Texas, 1970
Dr. C. G. Ruppel, Argentina, 1971
Mr. J. L. Doran, California, 1972
Dr. Cesar Vargas, Peru, 1973
Sr. Pierfelice Ravenna, Chile 1974
Dr. John M. Cage, California, 1975
Mr. Floor Barnhoorn, South Africa, 1976
Mrs. Emma D. Menninger, California, 1977
Dr. W. S. Flory, Jr, North Carolina, 1978
Mr. Harry Blossfeld, Brazil, 1979
Mr. Charles D. Cothran, California, 1980
Mr. W. L. Tjaden, England, 1981
Walter & Hilda Latapie, Louisiana, 1982
Mrs. A. C. Pickard. Texas, 1982
Mrs. Marcia C. Wilson, Texas, 1983
Dr. Hamilton P. Traub, California, 1985
Dr. Thomas W. Whitaker, California, 1988
Mr. Grant E. Mitsch, Oregon, 1988
Mr. L. S. Hannibal, California, 1988
Dr. H. Shuichi Hirao, Japan, 1990
Dr. Kenneth E. Mann, California, 1991
Mr. Brian Mathew, England, 1992
Dr. Maurice Boussard, France, 1996

1996 HERBERT MEDALIST

MAURICE BOUSSARD

AN AUTOBIOGRAPHY

I was born March 13, 1933 in Nancy, a city of 320,000 inhabitants which lies in the northeast corner of France 60 miles (96km) south of Verdun. My father was Pascal Boussard who worked as an accountant. He married Mary Heintz and together they produced two sons and two daughters. I am the eldest.

From the age of fifteen I began to take an interest in nature, especially iris and lilies. I remember being particularly impressed by clumps of *Iris germanica* and *Lilium candidum*—the Madonna lily, growing in my grandmother's garden in a suburb of Nancy. I was also attracted by our lovely native *Orchis* and *Ophrys* terrestrial orchid species.

School in Nancy began for me in 1940. My later studies were at the Faculty of Pharmacy, University of Nancy. My thesis, written in 1959, was on bacteriological biochemistry.

My career included a stay as a pathologist at the Hospices Civila in Nancy and in 1962 I was appointed to the position of Chief Pathologist at St. Nicola Hospital in Verdun. I remained in this position from 1962 to 1995 and retired on April 1, 1995.

In 1953 I met Suzanne Monet and we married in 1955. We have six children: François, born in 1956, now an engineer at the Commissasiat Energie Atomique (CEA is the French nuclear board); Noël, born in 1957, a physician in the Intensive Care Unit at the Hospital of Nancy; Michael, born in 1959, a supervisor in a fast food CY (Quick, the European competitor of MeDo); Hèlène, born in 1961, who followed in her father's footsteps and is now a pathologist; Ètiènne, born in 1962, a professor of philosophy; and Jean-Yves, born in 1964, who followed in his grandfather's footsteps to become an accountant.

I became interested in the Iridaceae and started a collection in 1957, almost 40 years ago. To begin my collection, I ordered seeds through the Index Seminum of various botanic gardens. I received the Index through the kindness of the Curator of the Botanic Garden of Nancy. I have to confess there were many "bugs" and mistakes in the way of nomenclature problems among the seed I received from the various gardens.

In the years following the start of my interest in the Iridaceae, I became a member of various societies involved in iridaceous matters: the British Iris Society; SIGNA (Species Iris Group of North

America) of the American Iris Society, the Botanical Society of South Africa, Indigenous Bulb Growers Association of South Africa and the International Bulb Society.

It was my honor to serve as president of the Société Française Iris et Bulbeuses, the French Iris Society, for six years from 1968 to 1974. Since 1993, I have, once again, had the privilege of serving another term as the society's president.

Over the years I also became acquainted with correspondents who were interested in bulbs: Georges Delpierre in South Africa, Niel du Plessis in South Africa, Peter Goldblatt (first in South Africa and later in the United States), P.F. Ravenna in Argentina and later Chile, Alberto Castillo in Latin America, Brian Mathew in England, G. Rodionenko in Russia, Charles Hardman in the United States, the late G.J. Lewis in South Africa, and the late Elwood Molseed who was associated with the University of California, Berkeley, USA, to mention a few. While at first these people were only correspondents, they later turned out to be good friends.

I traveled to Africa for collecting trips on three different occasions, in 1984 and 1985 visiting the Cameroons, then again in 1991, visiting the Republic of South Africa. All three trips were quite rewarding. Another journey is planned for Brasil in 1997.

My collection now includes 750 species distributed through about 65 genera. At the moment my collection is increasing slowly, sometimes barely at all. To a large degree this is due to a lack of any reliable sources in some of the world's remote areas, particularly in tropical and South America. Throughout certain of the world's prime rare species habitats or botanically unexplored areas, distances are huge and local politics often place even seed and plant collectors in jeopardy.

However, I am pleased to report that the extensive seed exchange lists of some plant societies—and especially, recently, the Seed Exchange of the International Bulb Society—are bringing some valuable additions to my own species collection as well as to the collections of other interested species plant growers.

In addition to my Iridaceae, I grow a few other plants, and of these I have a special interest in orchids. Some of the "bulbous" or tuberous orchids I grow include *Barlia, Bletia, Bletilla, Bomatea, Calanthe, Disa, Eulophia, Gymnadenia, Himanthoglossum, Ophrys, Orchis, Pleione, Satyrium, Serapias, Spathoglottis* and *Spiranthes.*

I grow bulbous plants for the sheer pleasure of it and for the rewards it brings in growing them to the best of my—and their—abilities. That in itself is sufficient justification for my years of

work with my plant collection.

If I have aided even one other person in a similar endeavour, that is, of course, an added benefit.

However, if, as a result of my work with rare and endangered plant species, I have helped save from extinction even one among the many I have grown, then my satisfaction is complete and my lifelong devotion to the plants in my collection is more than justified. This "task" I assigned myself so long ago has made me happy and thereby turned its toil into fun.

Maurice Boussard

1996 Herbert Medalist—Maurice Boussard

COMMENTS FROM THE EXECUTIVE DIRECTOR

Charles Hardman

Last year, in **HERBERTIA** Volume 50, I wrote a brief history of the first sixty-two years of the International Bulb Society. This year, I want to tell you about the Society's present and your Board of Director's plans for the Society's future.

PRESENT: Since **HERBERTIA** 50 was published in July, 1995, a large cache of back issues of **HERBERTIA** and **PLANT LIFE** was discovered and added to our back issues list. We're grateful to be able to offer these back issues again. The treasures that lie hidden waiting to be discovered within the pages of these back issues are truly wonderful. In their pages you'll find habitat tips, culture guides, plant exploration adventures, science, history and much more written about bulbs, corms, rhizomes and tubers.

In October, 1995, we launched a much-anticipated newsletter, *The Underground*. We hope all of you enjoyed the Autumn 1995 and the Spring 1996 issues. Now that you know what we're looking for, don't hesitate to send in your articles, cultural tips, personal bulb adventures and more for publication. *The Underground* will continue to be published in spring and autumn of each year.

We hope you read ADOPT A BULB SPECIES on page 8 of the Autumn, 1995 *The Underground* and have already adopted your own species—or two. At the rate species are disappearing worldwide, one of the greatest blessings you can give to our planet and future generations of our own species is some life form that you can help save and pass on. I know of no finer work to which one can dedicate one's own life than to save a beautiful species of plant or animal from extinction. (Less beautiful species are worth saving, too, but, as beauty and ugliness are both in the eye of the beholder, each of us has to make those choices on a personal basis.) Don't ask: What can I do? How can I make a difference? Just do it. Once you start, you'll find you're already making a difference.

Every once in a while, a society such as ours, just like an individual, has to undergo change. Last year was a year of change for the International Bulb Society. We adopted *Hippeastrum papilio* as our new logo and with it changed the look of the Society's brochure and stationery. We trademarked the names **The International Bulb Society**, **HERBERTIA** and *The Underground*, purchased a new computer system, increased our membership worldwide, reinstated and redesigned the Herbert Medal, streamlined the procedures for the IBS board of directors and did our utmost to serve the needs

of you, our members. If anyone has a problem from past years (back issues ordered and not received, seed order placed but not received, etc.) please let us know, explaining the problem as clearly as possible. You'd be surprised at the letters and even payments we receive that don't make it clear what the senders want.

IMMEDIATE FUTURE: More and more bulb enthusiasts are discovering the International Bulb Society and joining those of us who are already members. There was a time in my callow youth when I thought I was the only person in the world who loved bulbs. Then I found a few others. Then I found the American Plant Life Society, predecessor of the International Bulb Society, and realized there are thousands of people all over the world who find something fascinating about a life form with chlorophyll in its blood that builds up a reserve of food in a special storage organ and that goes underground during certain times of the year. Sometimes certain of these life forms can even stay underground for years on end only to spring into visible life above the soil surface once again at the touch of rain or just the right conditions such as those brought about by the aftermath of a brush fire. It's even possible that there are millions of people who love bulbs and would like to be members of our Society. But how do we reach them all? We began a new advertising campaign this past year, and more bulb enthusiasts are becoming aware of the Society. All this is by way of saying: The International Bulb Society is growing and it looks like the future will continue to see our Society grow.

This year, instead of eight-page signatures in the printing process, we've gone to sixteen-page signatures. This allows us to have more flexibility in article layouts, to use color to better advantage and to bring you more color in the pages of **HERBERTIA**. The questionnaires which accompanied **HERBERTIA** 49 and which so many of you completed and returned indicated that more color is one of the things you want to see. As you know, color is expensive. But if it's important to you, it's important to us. More color it is!

FURTHER-ON-DOWN-THE ROAD FUTURE: So many plans and possibilities. More species on the seed list, more articles and pages in **HERBERTIA**, other-media presentations (Yes!, we're, talking about them, laying the groundwork), more offerings of species bulbs. We keep thinking "more" and "better" in everything we do. Once again my heartfelt thanks to my good friends and fellow Board of Directors members Charles Gorenstein (Seed Exchange Director), Dylan Hannon (Nomenclature Review) , Elisabeth Lassanyi (Executive Secretary and artist), Alan Meerow (Scientific Review), Michael Vassar (Editor/Assistant Executive Director), and

Guy Wrinkle. Guy is our newest IBS board director and we welcome him to the Board. Without these wonderful people who contribute so much of their time and so much of their energies to making this Society function, none of the work done by the International Bulb Society would be possible.

I also want to thank our contributors to **HERBERTIA** 51, the writers and photographers who patiently build words and their best photos into articles of interest for all of us to enjoy. Your work is also vital to this society and to the future of the bulbous plants about which you write.

To you, our members and readers go my special thanks for your continuing membership, your seeds, bulb and money donations and for your letters of praise, encouragement and suggestions throughout this last year. I am grateful too, for that special spark within each of you that gives you a love of the natural world and a special love for plants, particularly bulbous plants.

I also would like to express gratitude to whatever forces there be in the natural world which produced all those bulbs, corms, rhizomes and tubers which we Society members find so special and with which Nature has so generously decorated the earth. She may only have been trying to attract insect, bird, mammal and reptile pollinators with these unabashedly flagrant advertising devices which we humans call "flowers", but when we came along She succeeded in attracting us as well.

CONGRATULATIONS: To my friend and fellow bulbophile, Maurice Boussard, I extend my personal congratulations on your award of the Herbert Medal for 1996. Maurice has been a friend, mentor, advisor, and seed and bulb supplier to so many IBS members that his being presented with this award seems wholly within the natural order of things. Congratulations Maurice, and thank you for being a friend to so many of us.

ELECTRONIC COMMUNICATIONS VIA E-MAIL

Robert M. Turley
755 Caloosa Estates Drive, LaBelle, Florida, USA

The International Bulb Society is linking to cyberspace via personal computer e-mail. An **E-mail Bulb Robin** has been started for those wanting quicker communication than the traditional "snail mail" robin. No more waiting! You may connect anytime to robin members anywhere in the country or to the other side of the world through the **E-Mail Bulb Robin**. This robin flies not from mail box to mail box but through cyberspace whenever the urge and time is right for you. The modern e-mail robin is a discussion group. We do this by having a prepared mailing list containing the e-mail addresses for all the Robin participants. Any responses we make to the Robin are simply addressed to this distribution list. In this way, we can be in touch with each other on a weekly basis or a daily basis.

Where do I sign up? Listed below are the steps and requirements to join.

1. You will need a personal computer (IBM compatible or Macintosh) equipped with a modem of at least 2400 baud.

2. You will need a computer server. Examples are America On Line (AOL®), CompuServe®, Global Network Navigator (GNN®), or a local internet service provider.

3. You must be a member of the International Bulb Society.

4. Then send a request to join by e-mail to **RMTurley@aol.com** (Robert M. Turley, LaBelle, FL)

New members will be asked to provide some general information about themselves and their bulb interests for the Robin as a way of introduction. Your name will be added to the **E-Mail Bulb Robin** distribution list and this list will be e-mailed to you with instructions on how to use it. Then the fun begins. You may talk all you want about your favorite bulbs with members who have the same interests as you anywhere in the world. There are a lot of exciting things happening with bulbs and bulb people out there right now. We are all connected by the computer and e-mail right in our own living rooms. We are waiting to hear from you!

THE ALSTROEMERIAS OF ITATIAIA

Alan W. Meerow
University of Florida, Fort Lauderdale, FL 33314
and
Antonio Fernando C. Tombolato
Instituto Agrônomico, Campinas, SP Brazil

In southeastern Brazil, close to the point where the states of Minas Gerais, Rio de Janeiro and São Paulo join, rises the second highest peak in all of Brazil: Itatiaia. Reaching a height of 2,790 meters in elevation (once thought to be the highest in all of Brazil), Itatiaia occupies a point of great biogeographic interest. It marks the convergence of the three most important mountain systems of southeastern Brazil, the Serra do Mar, the Serra da Mantiqueira and the Serra do Espinhaço.

Itatiaia is a Tupi Indian word meaning "Multiplying Rock", and awe inspiring geology dominates the upper heights of the mountain. The summit, known as Agulhas Negras ("Black Needles") is a craggy mass of quartzite rock. It is in these tropical alpine heights that the lowest temperatures ever recorded in Brazil have been reported.

In March, 1995, we came to Itatiaia to study the species of *Alstroemeria* that inhabit this famous mountain. One of us (Tombolato) had been there before and made preliminary observations that warranted a second visit to Brazil's best known peak.

The genus *Alstroemeria* L. (Alstroemeriaceae) is a South American endemic with two main centers of distribution, one in Chile (extending into contiguous Peru, Bolivia and Argentina) and the second throughout the eastern third of Brazil and contiguous Paraguay and Argentina (Bayer, 1987; Aker and Healy, 1990). The Chilean species were recently monographed by Bayer (1987) who recognized 31 species. The Brazilian taxa are poorly understood; over 40 names are extant (Uphoff, 1952; Aker and Healy, 1990). All are herbaceous perennials (or facultative annuals) with fleshy root-tubers and rhizomes bearing separate sterile and fertile stems. The leaves are frequently resupinate and the flowers are usually zygomorphic. A race of hybrids with great commercial importance as cutflower crops has been developed through hybridization, primarily among the Chilean group, particularly *A. aurea* Graham, *A. ligtu* L. and *A. pelegrina* L. (Aker and Healy, 1990). The Brazilian species appear to represent a group distinct from the Chilean and generally have more tubular flowers with narrower perianth seg-

ments. The only known species with floral fragrance, *A. caryophyllaea* Herb., and *A. sellowiana* Seubert, belong to the Brazilian group.

For the past five years we have been systematically documenting the extant populations of Brazilian *Alstroemeria* for both monographic studies and germplasm evaluation and conservation in conjunction with an international assortment of colleagues. Our project is formally recognized by various federal natural resource agencies in Brazil, with whose cooperation we are gradually generating an unparalleled database of information about the genus in Brazil that will prove useful from a conservation and preservation perspective.

The vegetation of Itatiaia occupies four distinct zones in conjunction with altitude. The lowest, roughly 1,000m and below, was once a zone of evergreen rain forest, similar in composition to the great "Mata Atlantica", the Atlantic rain forest of Brazil, that once stretched unbroken from north to south along a distance equivalent to that from Maine to Florida [±2,160km]. *Hippeastrum aulicum* (Ker-Gawler) Herb. and *H. calyptratum* (Ker-Gawler) Herb. no doubt occurred as epiphytes in this forest zone. Just as the rest of the Mata Atlantica has been reduced to less than 10% of its former extent, the tropical forests of lower Itatiaia have been decimated. Here and there, a few species typical of secondary forest persist (*Tibouchina, Cecropia, Miconia*). At about 1,300–1,500m, the equally denuded subtropical zone occurs. The original forest of this zone, rich in tree ferns and epiphytic plants, must now be pictured in the mind's eye only. Exotic pines and eucalyptus are now the dominant arboreal species of the lower slopes, a great deal of the area of which has been developed as vacation homes for wealthy *paulistas* and *cariocas* (residents of São Paulo and Rio de Janiero). Nonetheless, it was in the now impoverished subtropical zone that we encountered the first of four *Alstroemeria* species that figure in Itatiaia's complex flora.

Forming large populations along the highway in semi-shade, from about 1,100–1,500m elevation, with a brilliant display of bright red flowers, we now believe this species to be the true *A. psittacina* Lehm. This name has long been considered a synonym for *A. pulchella* L.f., a name we feel is best associated with a red flowered species from the southernmost states of Brazil and adjacent Paraguay and Argentina.

One of the most striking characteristics of of *A. psittacina* is the silver "feather" that appears on the leaves of the vegetative stems. This irregular band of variegation runs along the midrib of the leaf. The parrot-colored flowers live up to the specific epithet

of this vigorous species, ranging from deep red to orange red on the outside, and yellow internally. The markings of the tepals are quite variable. Some flowers are spotted internally or bear striations of deep maroon. Yet others are entirely without any spots or lines on the yellow background.

In our explorations of *Alstroemeria* diversity throughout the eastern third of Brazil, we have encountered a number of species that occupy a similar niche as *A. psittacina*; namely, forming large albeit local colonies in disturbed but semi-shaded sites. When the area was thickly forested, perhaps these species occurred sporadically in gaps between trees or along streams. Our biochemical studies of genetic relationships among these species do not suggest that they necessarily bear immediate kinship to each other; this type of ecology appears to have evolved several times in various lineages. Relationships based on allozyme variation (enzymatic products of genes, visualized on starch gels and interpreted in a genetic context) indicate that *A. psittacina* is most closely related to *A. inodora* Herb., a widespread species of southeastern Brazil that has been cultivated in Brazilian gardens for centuries (Meerow et al., in review).

As we continued to climb the flanks of Itatiaia, we soon left asphalt behind. The road narrowed, and the air took on the refreshing tang of the montane temperate zone. Stretches of native evergreen forest appeared, with the occasional Paraná pine (*Araucaria angustifolia* (Bertol.) Kuntze) denoting the cooler temperatures. At times abundant from 1,600–2,300m elevation, these relatively northern *Araucaria* forests are remnants of the once extensive stands that dominated eastern Brazil during the Pleistocene glacial periods when temperatures were much cooler. A second gymnosperm, *Podocarpus lamberti* Klotzsch ex Endl., also occurs in these montane forests of upper Itatiaia, but we did not encounter it. At about 2,000m and continuing to about 2,200m, an unusual *Alstroemeria* is found primarily within the deep shade of the cloud forests and occasionally at the margins. The orange flowers of this species are extremely zygomorphic, and the tepals quite narrow, reminiscent of a *Sprekelia, Hippeastrum cybister* (Herb.) Benth. & Hook. and *H. angustifolium* Pax. This may be the plant that Dusén (1905) described as *A. radula*. As with so many Brazilian *Alstroemeria*, the descriptions are so depauperate, it is difficult to associate extant names with plants that we encounter in the field. Dusén reported this species from 1,300–1,850m elevation, considerably lower than our altimeter readings.

The forest gave way at about 2,200m to a beautiful small val-

Figure 1. The view towards Itataia from the lower slopes.

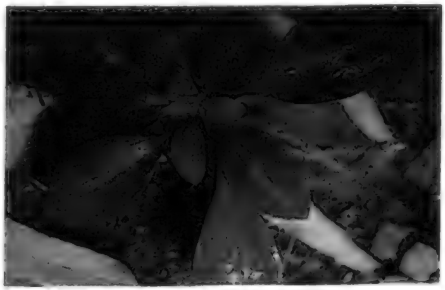


Figure 2. The silver feathered vegetative leaves of *Alstroemeria* aff. *psittacina*.

Figure 3. The parrot-colored flowers of *Alstroemeria* aff. *psittacina*.

Figure 4. The unusual spidery flowers of *Alstroemeria* c.f. *radula*.

Figure 5. The lovely flowers of *Alstroemeria* sp.

Figure 6. Another color form of *Alstroemeria* sp.

Photos: Alan W. Meerow

ley, through which the Rio Campo Belo had carved a narrow bed. The river was surrounded by wet meadow *(campo),* interrupted here and there with shrub glades and elfin forest. The beautiful *Vriesia itatiaiae* (Bromeliaceae) was in flower on the trunks of some of the trees and among the rocks. This area, known as Brejo da Lapa, was the lowest limits to the third *Alstroemeria* species of Itatiaia. Again, exact determination is daunting at this time. Dusén was of the the opinion that this species represents *A. monticola* Mart. Brade (1956) seemed to consider *A. foliosa* Mart. the correct name for this species. Since *A. monticola* was originally described from the state of Bahia, while *A. foliosa* was described from Minas Gerais, we are now inclined to use either nomenclature at this juncture. Unlike the shade loving *A. radula,* this species prefers open situations along the road, on small hillocks amid wet *campo,* and even formed a sizable population in a broad pasture. This species would remain with us all the way up through the rocky, alpine heights of Itatiaia. Certainly the showiest species on the *serra,* it varies from yellow through deep orange, including some particularly attractive bicolors. The tepals are broader than typical of most Brazilian *Alstroemeria* species, frequently with little of the dark spotting or striations characteristic of the genus. In the crisp air of upper Itatiaia, the flowers seemed to glow.

A few kilometers below the official entrance to the Parque Nacional do Itatiaia, we found lodging for the evening at a basic but comfortable *pousada* run by members of an evangelical church. We were the only guests and provided great entertainment for a young ward of the church who had probably been rescued from a desolate street life in the slums of Rio de Janeiro. This young man was inseparable from his Game Boy, upon which he played innumerable rounds of Tetris. He was very good at it. We enjoyed a hearty supper and a bottle of Argentine wine, while darkness fell and the temperature dipped considerably.

Early next morning, we arrived at the gate of the park, and woke a somewhat sullen park ranger from his slumbers. We continued on a short way until the road became impassable by car. We loaded our lunch and our cameras and began the hike to the rocky summits of Itatiaia.

As the Campo Belo roared below us, swelled by the previous evening's rain, we ascended slowly, admiring the flowers of a *Fuchsia* species and numerous members of the melastome family (Melastomataceae) in the genera *Chaetostoma, Microlesia, Lavoisiera* and *Tibouchina* that grew in profusion along the roadside. It was difficult to make ample progress, so distracting were

the many plants encountered. One of the most attractive milkworts *(Polygala* sp.) we have ever seen stopped us in its tracks with its diminutive beauty. Few woody plants reach tree size in these rocky uplands, but a plethora of shrubs, including *Buddleia, Escallonia* and a number of Ericaceous species, were apparent.

Clustered among the boulders grew a *Hippeastrum* species in abundance. None were in flower, but we know the species is red flowered. It has been variously referred to as *H. rutilum* Herb. by authors. We do know that at least two distinct species of *Hippeastrum* occur in the alpine heights of Itatiaia, including one allied, if not conspecific, with *H.* "Atibaya", an undescribed species first found by Harry Blossfeld further south in the state of São Paulo. These populations are under study by our colleague Julie Dutilh of the State University in Campinas, São Paulo. These *Hippeastrum* species probably experience intermittant snow cover every winter. Nearby, growing among a *Cortaderia* species and other tussock grasses and sedges, was the fourth species of Itatiaia's alstroemeria, *A. isabellana.* This species, with its uniquely tubular flowers colored pink, orange red, or yellow and tipped in green, is possibly the most widely distributed Brazilian species of *Alstroemeria,* occurring at high elevation from the state of Rio south to Rio Grande do Sul and west to Minas Gerais. The flowers are probably hummingbird pollinated and resemble those of a *Phaedranassa* or *Eustephia coccinea* Cav. (Amaryllidaceae).

The road abruptly ended and we began to follow a narrow trail across the rocks towards one of the secondary peaks of Itatiaia known as the Prateleiras. Very common among the rocks was the dwarf bamboo, *Chusquea pinifolia* Nees. Here and there, the impressive inflorescences of *Paepalanthus polyanthus* Kunth. and related species (Eriocaulaceae) rose above the stone.

The terrain of high Itatiaia appears as if sculpted by glaciers, but no glacier ever traversed the stony ground. The leaves of diminutive Iridaceae were everywhere (no flowers visible in this late summer season), and amaryllis were again visible, though clearly at the end of their active growth for the season. One of the most beautiful wildflowers of the alpine campos is *Esterhazya splendida* Mikan. (Scrophulariaceae), reminiscent of western North America's many *Penstemon* species. The red flowers must serve as clarion calls for hummingbirds. At the base of the Prateleiras, in the shadow of the huge rock called the "Tartaruga" (the turtle), the same *Alstroemeria* that occurred in Brejo da Lapa was abundant in cracks and humus pockets among the dark stones.

It seems wherever we venture in Brazil's eastern third, *Alstroe-*

Figure 7. *Astroemeria* sp. along the rocks in the higher reaches of Itatiaia.

Figure 8. The flowers of *Alstroemeria isabellana.*

Figure 9. Though the upper reaches of Itatiaia appear to have been sculpted by glaciers, none ever occurred on the mountain. The rock known as Tartaruga can be seen to the right side.

Figure 10. The secondary peak known as Prateleiras.

Figure 11. *Hippeastrum* has managed to colonize the frosty uplands of Itatiaia.

Figure 12. *Esterhazya splendida*, one of the showiest wildflowers of upper Itatiaia.

meria occurs in abundant diversity. The genus presents us with a complex pattern of adaptive speciation that will require a great deal of work to understand and place into a phylogenetic context. Our herbarium surveys and fieldwork make it clear that *Alstroemeria* is significantly represented in most if not all of the vegetational associations that constitute extra-Amazonian Brazil. Yet the impressive diversity that we have witnessed on just a single mountain is but a microcosm of the variation we have observed in the central planalto of the state of Goiás.

In a future article in **HERBERTIA,** we will report on our larger surveys of *Alstroemeria* diversity in Brazil.

ACKNOWLEDGEMENTS

Kevin Thomas kindly provided copies of floristic references. The Floyd L. Wray Foundation, Davie, Florida helped support the fieldwork in Brazil, and the Instituto Agronômico provided transportation. Florida Agricultural Journal Series No. R-05113.

REFERENCES

Aker, S. and W. Healy. 1990. The phytogeography of the genus *Alstroemeria*. **Herbertia** 46(2): 76–87.

Bayer, E. 1987. Die Gattung *Alstroemeria* in Chile. **Mitt. Bot. Staatssamml.** Munchen 25: 1–362.

Brade, A.C. 1956. A Flora do Parque Nacional do Itatiaia. Parque Nacional do Itatiaia Boletim No. 5. **Ministério da Agricultura, Serviço Florestal**, Rio de Janiero.

Dusén, P. 1905. Sur la Flore de la Serra do Itatiaya au Brésil. **Archivos do Museu Nacional do Rio de Janeiro** 13: 1–119.

Holt, E.G. 1929. Itatiaya—Brazil's most famous mountain. **Natural History** 29: 417–436.

Meerow, A.W., S. Yang, A.F.C. Tombolato and F. Meyer. In review. Allozyme variation among Brazilian *Alstroemeria* (Alstroemeriaceae). **Amer. J. Bot.**

Uphoff, J.C.T. 1952. A review of the genus *Alstroemeria*. **Plant Life** 8: 37–53.

QUEST FOR SOUTH AFRICAN AMARYLLIDS

Dennis Tsang
Hong Kong

Namaqualand is basically a winter rainfall area in the western part of South Africa. It is a vast area extending from just south of Garies to the Richtersveld and Pofadder in the north, in close proximity to the Namibian border; and from the Atlantic coast to the border of the inland district of Calvinia in the east. Due to varied topography, soil types and climates, Namaqualand comprises about ten vegetation zones, some of which are home to a wide range of amaryllids. The majority of these amaryllids flower during Autumn (March and April in the Southern Hemisphere) when the ground is still dry but seed would ripen when the rainy season resumes in August. Following is a summary of my recent visit to Namaqualand with field notes of various amaryllids which I encountered, both in the natural habitats and under cultivation.

Located at the eastern foothills of Table Mountain in Cape Town, Kirstenbosch Botanic Gardens carries possibly the world's largest and rarest collection of South African amaryllids. The bulb section is under expert attention of Mr. Graham Duncan. According to Graham Duncan, flowering time of cultivated bulbs can be up to a month earlier than wild plants. Possibly this is due to better watering and absence of problems resulting from grazing and veld fires.

Four *Brunsvigia* species were flowering during my visit to Kirstenbosch Botanic Gardens. *Brunsvigia orientalis* produces a large bright red umbel and is an exceptionally widespread species which can be found from behind coastal sand dunes around Cape Town to inland sandy flats to the south of Vanrhynsdorp. At Kirstenbosch, the species is grown in full sun where bulbs are subjected to winter rain and baking summer heat. *Brunsvigia orientalis* is easily cultivated, requiring only sandy soil, a deep pot, full sun and minimal root disturbance. In milder climates this species can be grown outside against a south facing wall. This species seeds very well as each umbel can produce over 50 seeds. Like some other South African amaryllids, *B. orientalis* is prone to attack by lily borers.

Brunsvigia litoralis is one of the giants of the genus, producing a very big and loose umbel of about 25 pinkish red flowers. The inflorescence can be up to about 90cm tall and about 70cm across. I examined a specimen and discovered that no seed was produced. Despite the large size of the bulbs, a 35cm plastic pot can accom-

modate four mature bulbs. To raise *B. litoralis* from seed is a time consuming exercise as it takes about nine years before seedlings reach flowering size. However, the patience is worth it.

Brunsvigia minor is a smallish species producing about 40 bright pink flowers on a fairly dense umbel of 15cm across. *Brunsvigia minor* prefers well drained soil. The bulbs at Kirstenbosch are grown in pure sand in full sun. This species seeds very well and some seeds even germinate in the seed pods.

Similar in size to *Brunsvigia minor, B. gregaria* produces pinkish red flowers with wider petals and a denser umbel. This species is cultivated in semishade at Kirstenbosch. According to Graham Duncan it is a reliable flowerer which never fails to flower yearly.

Cyrtanthus flammosus is a newly described species found so far only in Leeu-Gamka in the southern Cape area growing on sandstone outcrops in shade or sun. From the first glance, *C. flammosus* is not unlike *C. elatus* but it differs by the tapering leaves. At Kirstenbosch Botanic Gardens, *C. flammosus* is cultivated inside a shade house in very well drained soil. It enjoys being pot bound with the short neck exposed above the soil level. Judging from the number of bulblets attached to the main bulbs, *C. flammosus* seems to multiply quite quickly. It also seeds well and seeds germinate readily soon after harvest. This species is considered one of the most beautiful species of the genus and certainly has great horticultural potential.

Cyrtanthus herrei is endemic to the Richtersveld in the northwestern Cape where the climate is much drier than Cape Town. In the summer the Richtersveld may reach 50°C [122°F]. In cultivation, *C. herrei* does not seem to mind semishade and the cooler and wetter climate of Cape Town. It is an exceptionally stunning species producing twisting glaucous leaves and a large umbel of orange flowers. It enjoys being pot bound with at least half of the bulbs exposed above soil level. Growers should bear in mind that the area where *C. herrei* grows is an arid semi-desert region. Overwatering is a certain way of killing the bulbs. In areas where there is a high rainfall, bulbs should be cultivated in gritty soil, comprised of a mix of sand and small rocks in clay or terra cotta pots. A similar cultivation requirement is also recommended for some species of *Brunsvigia, Gethyllis, Haemanthus, Hessea* and *Strumaria* which are particularly sensitive to moisture.

Nerine sarniensis is a gorgeous species because of the presence of glittering gold dust on the petals. Red, orange and white flowering forms are cultivated at Kirstenbosch. I found the orange form most attractive because the gold dust reflects light much better

than the other colour forms.

There are two forms of *Cybistetes longifolia*. One produces a tall inflorescence and the other a rather short inflorescence. The taller form is definitely more showy but it is not so floriferous as the dwarf form. Whether it is tall or short, *C. longifolia* is a lovely species producing a dense umbel of about 30 light to pale pink trumpets with a sweet fragrance. This species is native to coastal sand dunes where the bulbs grow deep underneath the sand. In cultivation it needs a very deep pot so that the long neck of the bulbs can be covered completely by sand. *Cybistetes longifolia* should be easily cultivated in any well drained soil but sand is preferable. It is a half-hardy species which needs full sun and protection from lily borers because bulbs are often attacked by lily borers. These caterpillars hide themselves in the hollow inflorescence and eat the tissue of the plants. Such an attack is not normally noticed but when the destruction has become obvious or the caterpillars have reached the inflorescence base and consumed the tissue of the bulb, the plants may be completely destroyed. At Kirstenbosch frequent spraying is practised as the large number of bulbs makes checking on individual plants almost impossible.

Autumn is also the flowering time for the smaller species of *Haemanthus, Hessea* and *Strumaria*. These amaryllids are well represented in Namaqualand. In cultivation they do not need too much water but they do need sufficient sunlight and well drained sandy soil. These species are semi-hardy and therefore are recommended for pot cultivation against windows or in a protected location in cold climate areas. These small amaryllids are generally pest free and take a much shorter time than the larger amaryllids to flower from seed.

Two distinct amaryllids native to eastern Transvaal, a summer rainfall area, were flowering at Kirstenbosch. *Nerine platypetala* hails from lake margins where veld fires may be experienced. This hardy species produces very attractive bright pink flowers in a loose umbel. (Please refer to page 68 for detailed information on this species and its habitat written by Charles Craib.)

Clivia caulescens is also native to eastern Transvaal in the Drakensberg escarpment. This species is distinct from other members of the genus in that it produces aerial stems up to about 2m tall in their forest environment. A few years ago I visited a habitat site near Graskop where the species was growing in two localities. The first locality was on a dry, exposed cliff face where the plants clung right to rock crevices filled with dry leaves from surrounding shrubs and ferns. *Clivia caulescens* growing in this locality

received a lot of sunlight and did not produce very long aerial stems. The second locality was inside a forest where plants were completely under shade. However, *C. caulescens* seemed to flower very well here and produced much broader leaves and attained a bigger size than those in the first locality. *Clivia caulescens* grew basically everywhere in the forest, on tree trunks, the forest floor and rock surfaces. A couple of specimens produced a very long aerial stem of about 2 meters. In some cases, part of the aerial stem was detached from the plants and fell onto the ground where a new shoot developed. This provides evidence that *C. caulescens* can be propagated by cutting of the aerial stem. Apparently this species adapts well to different conditions. It seems to be a tender subject but might be able to withstand cold weather below 10°C [50°F] because the cliff faces where this species grows usually confront very strong upsurging cold winds from the canyon below. A low 15°C [59°F] was recorded on one recent midsummer afternoon. The area might receive light frost in winter. At Kirstenbosch this species is cultivated in very big plastic pots in shade. The plants do not produce long aerial stems but flower very well.

Cultivated bulbs receive extra attention and better watering yet they miss the hard love that nature intends. Fire is necessary to trigger the flowering mechanisms of a number of native South African amaryllids and to wipe out pests and surrounding weeds competing for nutrients and space. Drought is brutal to most plants and wild life but most bulbs need drought to induce dormancy and flowering. Without a distinct period of drought, bulbs tend to grow continuously and may not flower. Given the right conditions and time, bulbs can put on a real show in the natural environment.

Brunsvigia marginata is endemic to several hillslopes to the east of Paarl. I consider it the second most attractive species of the genus. This medium size species is a winter grower which flowers in March and April and the leaves are produced afterwards. It is the only *Brunsvigia* species whose petals are covered with a lustre of gold dust. The dense scarlet umbel is about 20cm across and about 30cm tall. A rare deep salmon pink or pinkish red form was also discovered. Bulbs grow on dry rock ledges on very steep slopes. The area experiences veld fires occasionally. I examined about ten flower heads but only two seeds were seen. Apparently the pollinating agent of this species was absent when the species was in flower.

Brunsvigia appendiculata, a native in the Kamieskroon area, is little known and seldom cultivated yet is very attractive. It pro-

duces a large dense umbel of about 60 pinkish mauve flowers that are 30cm across and 40cm tall. *Brunsvigia appendiculata* is different from *B. bosmaniae* in that flowers of the former are fragrant, the petals are pointed and have dark veins. *Brunsvigia appendiculata* grows in open sandy soil and is free from pests, making it a perfect rock garden subject in a frost free environment.

Graham Duncan qualified the Kamieskroon area as a centre of South African amaryllids, which I totally agree with. *Haemanthus crispus*, a small orange flowered species, is uncommon in the area but was seen flowering in an open sandy slope on a farm. *Haemanthus amarylloides* ssp. *amarylloides* produces a fluffy looking head of flowers from deep pink to pale pink and white. From a distance the flower head of this species looks like an up-side-down toilet brush. The species grows in open rocky locations. *Haemanthus graniticus* is a tiny species which often establishes big colonies of up to about 30 bulbs. Formation of such big colonies of bulbs is due to the *in-situ* seed dispersion strategy of the genus (Snijman, 1994). *Haemanthus* seeds are heavy and sticky so they fall onto an area and develop in the suitable environment where their parents have been growing. *Haemanthus graniticus* produces bulblets which multiply quickly. The bright scarlet flowers of this species rise above the ground and are easily spotted even from a long distance. *Haemanthus graniticus* is very widespread between Springbok and Kamieskroon and is pest free. Big bulbs of *Haemanthus dasyphyllus* were discovered in a single locality on a rocky slope in deep loamy soil. This species seems to tolerate semi-shade and had finished flowering when I was there. It was noticed that the bulbs were seriously deformed by the surrounding rocks. Tiny holes around the basal plates indicated that the bulbs were frequently attacked by pests.

Boöphane pulchra should be flowering in March/April but according to the local people, the weather was so dry last year that none of the bulbs managed to produce an inflorescence. According to Müller-Dobles, *Boöphane pulchra* is now an invalid taxon which has been replaced by *Brunsvigia pulchra*, but I would like to stick to the old name, at least for this article. *Boöphane pulchra* is said to grow in the Steinkopf area, but none were seen there by me. However, a bulb was found on a sandy slope among bushes on the Kamiesberg. The area must have experienced a prolonged drought as the contractile roots, which are supposed to be evergreen, had completely dried out. Another indication of hardship associated with the drought was a number of holes which had been dug by moles or porcupines. These animals had been desperate looking

for food. Wild animals do not normally feast on bulbs of the amaryllids but the drought had possibly destroyed their normal diet so that they had to eat them. A similar situation was observed a few years ago in Napier in the southwestern Cape where about 20 bulbs of *Boöphane guttata* had been eaten by porcupines, leaving in the holes remnants of basal plates, bulb tunics and withered leaves.

To the south of Kamieskroon near Garies, the last flowers of *Crinum variabile* were seen. The pale pink or white flowers are fragrant. The species grows in deep sand among big rocks in river beds subject to seasonal flooding. The bulbs are completely submerged in water during the rainy season.

Brunsvigia bosmaniae grows on open sandy to rocky slopes in the Vanrhynsdorp-Clanwilliam areas. This species should have been flowering during my visit but, possibly due to the drought the previous year, I did not see any flowers. On a gentle slope in Vanrhynsdorp, erosion had washed the top soil away, resulting in rows of gullies. Some bulbs of *B. bosmaniae* were washed away and lying on top of the soil. Other bulbs remained at their original locations exposing the top parts to direct sunlight.

Brunsvigia radula is possibly the tiniest among all species of the genus. The umbel is about 5cm across and 7cm tall, consisting of up to about 15 deep pink flowers. The small bulbs are not much bigger than a chestnut. In cultivation, this species enjoys sandy soil and light shade. Water should be withheld during summer dormancy.

Several amaryllids are native to Saldanha and the West Coast National Park. *Boöphane haemanthoides* and *Cybistetes longifolia* are endemic to this part of South Africa and are adapted to the sandveld environment. Bulbs of these two species grow on sand dunes where the coastal mists provide a reliable source of moisture for the plants. A site where *B. haemanthoides* grows was studied. It was noted that almost all the bulbs were sitting above the ground. The actual size of the bulbs is not very big but the dark brownish tunics exaggerate the size—a twin specimen over 100 years old reached the size of three basketballs put together but it is estimated that not more than 20% of the big clump of material is the living part of the bulbs. The root system of *B. haemanthoides* is very simple containing several main roots which penetrate deep into the sand to absorb underground water. The majority of the roots are shallow which assists the bulbs in anchoring on the shifting sand. When completely dormant the bulbs look like a big pile of cattle dung. In cultivation *B. haemanthoides* enjoys a well

drained soil and direct sunlight. An ideal growing medium is coarse sand. Terra cotta pots are recommended to drain any excessive water. This species might be grown outdoors in protected locations or against a south facing wall. Saldanha is like other rural settlements where the demand for development is so great that natural habitats of rare plants are threatened. While I was examining bulbs of *B. haemanthoides*, trucks were moving in and out of the site. It occurred to me that the area would be developed sooner or later. If this happens, bulbs of *B. haemanthoides* should be rescued by moving them to another place.

Cybistetes longifolia was not so lucky, as a site where they used to grow had been developed. According to a friendly man who grew up in Saldanha; and later moved to Cape Town, a small plot of grassland in close proximity to the beach front area used to be full of *C. longfolia* and some *Gethyllis*. It was sad knowing that these bulbs have already disappeared and now *Boöphane haemanthoides* seems about to repeat the same tragedy that has happened to *C. longifolia*.

ACKNOWLEDGEMENTS

I would like to express my thanks to Kirstenbosch Botanic Gardens, and especially to Graham Duncan for showing me their excellent collections of amaryllids and Graham's personal *Lachenalia rubida*.

FURTHER READING

du Plessis, N. and G. Duncan, 1989. **Bulbous Plants of Southern Africa**.

Duncan, Graham, 1996. **Growing South African Bulbous Plants—A Popular Guide**.

Snijman, D. A. 1995. *Cyrtanthus flammosus*, **The Flowering Plants of Africa** 54:100-103.

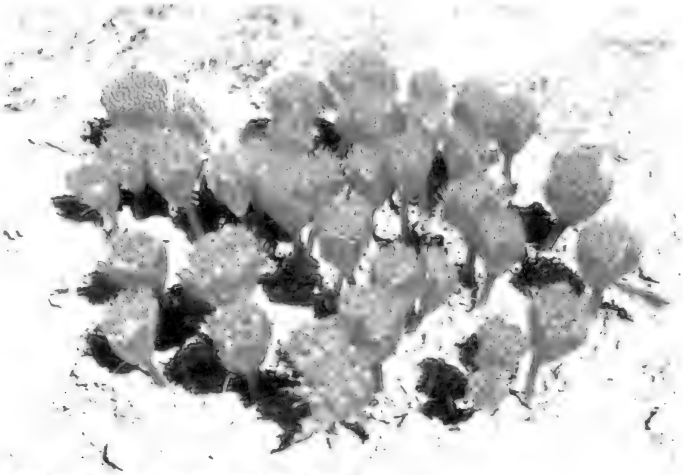
Snijman, D. A. What Makes Southern Africa's Amaryllidaceae Special?, **IBSA Bulletin** No 42, July 1994.

de Villiers, A. Systematics in Amaryllids, **IBSA Bulletin** No. 44 January 1996.

Hobbs, J. and T. Hatch, 1994. **Best Bulbs for Temperate Climates**.

Mostert, E. and M. Crewe-Brown, 1992. **A Traveller's Companion to Namaqualand**.

right:
Haemanthus graniticus near Kamieskroon



below:
Boöphane haemanthoides near Saldanha

bottom left:
Clivia caulescens

bottom right:
Brunsvigia marginata on Du Toitskloof

Photos: Dennis Tsang

THE GENUS *SCADOXUS* AND *SCADOXUS MULTIFLORUS*

Peter Knippels
Aakwerf 9, 2804 MZ Gouda, The Netherlands

Haemanthus (family Amaryllidaceae) is a well known genus and is widely spread among amateur growers of bulbs and succulents in northwest Europe. Less known is the *Haemanthus*-allied genus *Scadoxus*. I do not know why plants in this genus are not better known. In general *Scadoxus* species are easily propagated by seeds. Furthermore they are easy to grow and request no special treatment—they are "tolerant".

Friis and Nordal (1976) established that the *Haemanthus* subgenus *Nerissa* significantly differs from the subgenus *Haemanthus*. Based on the distribution patterns and morphological differences it can be concluded that the two subgenera represent two evolutionary lines which separated at a very early stage. They divided the genus *Haemanthus* into two genera, *Haemanthus* and the new genus *Scadoxus* (table 1).

According to Bjornstad and Friis (1972) the oldest available name for the subgenus *Nerissa* is *Scadoxus*. This name was first published by Rafinesque in 1836. He divided *Haemanthus* into four new closely related genera: *Leucodesmis, Perihaema, Scadoxus* and *Serena*. In his turn Salisbury in 1866 divided the genus *Haemanthus* into five genera: *Diacles, Haemanthus, Melicho, Hyaxis* and *Nerissa*. The first three genera have a bifarious, truncate bulb and sessile, unsheathed leaves and have truly distinguished involucral features. The species of the genera *Gyaxis* and *Nerissa* have sheathed petiolate leaves and conical to spherical bulbs. In 1888 Baker changed the genera as published by Salisbury into subgenera of *Haemanthus*. In later years experts in this field considered the subgenus *Nerissa* different from the other subgenera. Some species of the subgenus *Nerissa* have an elongated rhizome, and the position of the peduncle compared to the leaves is different. Salisbury's division provided the basis for division of *Haemanthus* into *Haemanthus* and *Scadoxus* by Friis and Nordal (1976). The type species is *Scadoxus multiflorus* (syn. *H. multiflorus*). Friis and Nordal (1976) distinguished eight *Scadoxus* species: *S. cyrtanthiflorus, S. cinnabarinus, S. longifolius, S. membranaceus, S. multiflorus, S. nutans, S. pole-evansii, S. pseudocaulus* and *S. puniceus*.

Scadoxus multiflorus can be described as a herb, 15–120cm tall, with rhizomatous bulb, 2–8 leaves, forming a 5–60cm long false stem, lanceolate to ovate leaves, 8–45cm long and 3.5–15cm broad.

The leaves appear during or after anthesis. The impressive inflorescence, 5–26cm in diameter, consists of 10–200 flowers. The perianth has a red colour (Bjornstad and Friis, 1974).

Scadoxus multiflorus includes three subspecies: ssp. *katherinae,* ssp. *longitubus* and ssp. *multiflorus.* The major differences between the subspecies are height of the plant, length of the perianth tube and breadth of the perianth segments (table 2).

LITERATURE CITED

Bjornstad I.N. and I. Friis. 1972. Studies on the genus *Haemanthus* (Amaryllidaceae) I. The Infrageneric Taxonomy. **Norw. J. Bot.** 19, 197–206.

Bjornstad I.N. and I. Friis. 1974. Studies on the genus *Haemanthus* (Amaryllidaceae) II. A revision of the sections *Gyaxis* and *Nerissa.* **Norw. J. Bot.** 21, 243–275.

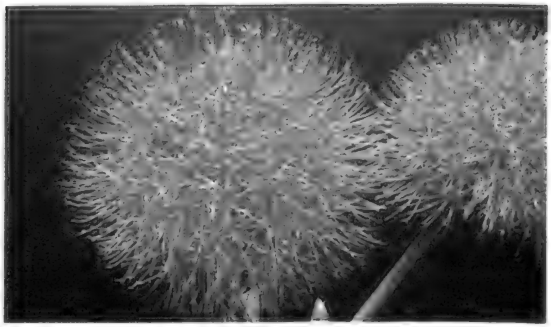
Friis I. and I. Nordal. 1976. Studies on the genus *Haemanthus* (Amaryllidaceae) IV. Division of the genus into *Haemanthus* s.str. and *Scadoxus* with notes on *Haemanthus* s.str. **Norw. J. Bot.** 23, 63–77.

Table 1. Differences between the genera *Haemanthus* and *Scadoxus* according to the key given by Friis and Nordal (1976).

Characteristic	*Haemanthus*	*Scadoxus*
Bulb	bifarious	rhizomes or globose bulb with rhizomatous parts
Leaves	Distichous, usually thick and fleshy, no distinct middle nerve, sometimes hairy	not distinctly distichous, herbaceous in texture, distinct middle nerves, always glabrous
Distribution	South Africa and Namibia	tropical Arabia and Africa as far south as Namibia and E Cape

Table 2. Differences between *Scadoxus multiflorus* ssp. *katherinae,* ssp. *multiflorus* and ssp. *longitubus* (Friss and Nordall 1976) .

Characteristic	ssp. *katherinae*	ssp. *multiflorus*	ssp. *longitubus*
Perianth tube	>16mm	>15mm	>15mm
Perianth seg	2.2-4.0mm	2.5mm	1.4-3.5mm
Plant height	up to 120cm	small to robust	up to 65cm
Habitat	coastal bush		lowland rain forest
Distribution	Natal and Cape Province, southern Swaziland	eastern and southern Africa	Guinea to Ghana



above: *Scadoxus multiflorus*
left: *Scadoxus multiflorus* ssp. *katherinae*
below: Fruits of *Scadoxus puniceus*

← see previous page

Addendum

Cybistetes longifolia
Photo: Marcia Wilson

Crinum graminicola
Photo: David Lehmiller

Dr. Thad Howard writes that the Ferrarii plate discussed in Les Hannibal's article (**HERBERTIA** 50: 101-106) would appear to much more closely represent *Crinum graminicola* or a related species rather than *Cybistetes longifolia*. He sent the above two photos for comparison.

CULTIVATION OF AFRICAN *CRINUM* IN POTS AND TUBS

David J. Lehmiller, M.D.
Doctors' Building, 3155 Stagg Drive, Suite 316
Beaumont TX 77701, United States of America

Horticulturists in the United States historically have regarded crinums as landscape plants. Quoting L.H. Bailey from **The Standard Cyclopedia of Horticulture** of 1950: "The crinums require so much room that they are not often seen in commercial collections in this country." Indeed, in his 1948 **Bulb and Plant Catalog** from Lakemont Gardens, Wyndham Hayward advertised his list of crinum bulbs under the heading "The Big Crinum Family." How much the concept "bigger is better" played in selecting the varieties introduced into cultivation is not known, but the endeavor to breed hardiness into commercial lines clearly doomed crinums to a garden or landscape existence. Of the many crinum hybrids which became popular since Herbert's time, most possessed the genetic code for vegetative propagation—one bulb soon became many, creating an impractical situation for pot culture.

Many of the African *Crinum* species do not multiply vegetatively or only sporadically produce offsets, making them potential candidates for pot or tub cultivation. Most of these species are indigenous to regions falling outside the tropical rain forests, an ecological factor favorable to pot cultivation which will become apparent later. Unfortunately a word of caution is necessary: all too frequently, species advertised commercially or passed among contemporaries are actually hybrids. For example, I have never observed vegetative offsets among indigenous bulbs of *C. bulbispermum* in South Africa or among bulbs which I have subsequently grown from seed and cultivated in Southeast Texas, yet every planting of "*C. bulbispermum*" I have encountered in the Gulf Coast, including one I could trace to its origin from a bulb catalog circa 1905, and every bulb I have received via horticultural circles has produced offsets (hybrids). Let the buyer beware. (Note: occasionally a species which does not multiply vegetatively will produce offsets if the bulb is damaged, such as might occur during transplantation.)

The cultivation of African species differs from that of commercial crinum hybrids; the latter thrive in any garden with minimal attention when provided with sufficient water, sunlight, nutrients, and where appropriate hardiness conditions are met. Cultivation of non-rainforest species is demanding, and stringent guidelines must be followed for successful pot or tub culture: 1. Knowledge

of the indigenous habitat; 2. Selection of appropriate pot or tub size; 3. Manipulation of local climatic conditions, and; 4. Water surveillance.

When choosing a pot for a given species, consult reference materials to obtain an idea of the ultimate or mature bulb diameter. With proper technique, the bulb will flourish and approach the upper range of bulb diameter listed in the reference. Diameter of the pot should be at least three times the anticipated bulb diameter. If the pot is too small, then the growth of the bulb will be impeded and it will experience stunting—overall reduction in size, non-uniform size reduction in flowering parts, smaller umbels and fewer umbels. In Natal, I once saw three bulbs of an unknown *Crinum* species grown from seed in a single 4 inch [10cm] pot; the bulbs were small and crowded together, their leaves were very slender, 7–9mm [¼ inch] wide, and one bulb sported a small scape bearing one flower. When informed of the remote collection site, my initial impression was that it might be a new species. I acquired one bulb, which I transplanted into an 8 inch [21cm] pot upon returning home. Two years later, the bulb had 20mm [¾ inch] wide leaves and bore an 8-flowered umbel; it was *C. lugardiae*. It is better to err by choosing a larger pot—you will be surprised at how large some of these bulbs will grow. This means that you will need a pot ±18–20 inches [50cm] diameter if you wish to avoid stunting with *C. bulbispermum* or *C. buphanoides*. Always utilize clay pots—the material is porous and breathes, permitting better moisture control. Also, when selecting a pot of a given diameter, choose the **tallest** variety—the increased depth helps to minimize root crowding.

African *Crinum* species indigenous to the non-rainforest regions can be classified into four ecological or habitat groupings: desert/semidesert, veld/forest, riverine/inundated, and vlei/semi-aquatic. Again consult your reference materials as well as the world almanac. This information determines the soil and water requirements. 1. Arid desert species should be grown in a porous sandy soil containing a good percentage of vermiculite; these bulbs demand good drainage else they will succumb to root/basal rot. Excessive watering must be avoided! All species which produce papillose seeds fall into this category: *C. acaule* (Fig. 1.) , *C. walteri* (syn. *C. minimum* sensu Verdoorn, non Milne-Redhead), *C. crassicaule* (synonym: *C. foetidum*), and *C. harmsii*. Other examples include *C. forbesii* (syn. *C. delagoense*), *C. lineare*, and *C. album** (synonym: *C. yemense*), although these species are more water tolerant and flourish in well-drained sandy loam. [Note: the asterisk

(*) identifies species which produce a few offsets.] 2. The veld/forest species do well in light-textured, sandy-clay loam. These bulbs should be watered regularly. Examples of this group include *C. politifolium**, *C. kirkii*, *C. graminicola* (Fig. 2.) and the related *Ammocharis nerinoides* (syn. *C. nerinoides*). 3. In the riverine/inundated group are those species which need moist, medium-textured, sandy-clay loam during the growing season. Some of these species endure periods of time in standing water in their native habitats. To ensure that the potting soil stays moist, place the pot in a water saucer and fill the saucer each time you water the bulb—at least twice a week during hot weather. Examples are *C. baumii, C. lugardiae, C. macowanii, C. bulbispermum, C. buphanoides, C. variabile**, *C. fimbriatulum**, *C. broussonetii, C. humilis** (Fig. 3), *C. yuccaeides* and *C. abyssinicum*. 4. The vlei/semi-aquatic species require clayish soil and should be grown in a standard, 12 inch [33cm] deep, galvanized wash tub. Fill the tub with 10 inches [26cm] of soil when planting the bulb; this way, 1–2 inches [2.5–5cm] of standing water can be maintained above the bulb at all times during the growing season. Examples of this group are *C. paludosum* (Fig. 4.), *C. carolo-schmidtii, C. rautanenianum, C. campanulatum**, *C. pauciflorum* and *C. distichum*.

The non-tropical rainforest ecologies of Africa are usually characterized by distinct rainy seasons and dry seasons. Dry seasons may last as long as 8–9 months wherein little or no rainfall occurs. In arid regions drought is commonplace. *Crinum* species from these areas have adapted to dry dormant periods, and many will either rot or not flower regularly in cultivation unless given a dry dormancy. This obligatory condition readily lends itself to pot or tub cultivation, especially if one has a greenhouse. In lieu of the latter, a heated garage, enclosed porch, or a basement will work as well, although a few muscles will be needed to tote the larger pots. I normally cease watering from mid-November through mid-April which coincides with winter in my locality, resulting in five months of dry dormancy. For *C. campanulatum*, the dormancy is extended to 6 months. During the dormant period, leaves gradually die back to the base and all bulbs eventually become leafless. *Crinum bulbispermum* is an exception: it is minimally watered to maintain a low leaf profile. Bulbs need to be protected from freezing during dormancy, and a minimum ambient temperature of >45°F [7°C] is recommended. Damp soil + cold temperatures = death for many species listed in this article; that is probably why such species were never introduced into commercial horticulture. Pot or tub culture eliminates the overwintering and moisture control problems.

Bulbs perform best when not disturbed. With proper pot size selection and maintenance, it should not be necessary to change potting soil for many years. Two cultivation tips need to be emphasized: 1. Regular applications of fertilizer are mandatory. Except for the desert species, fertilization can be supplemented with leaf mulching. 2. There is no substitute for rain water! If you want to be successful with crinums in pots, you should have one or more rain barrels strategically located about your home. Avoid city tap water.

Diseases and pests are local problems that often are common to other genera as well; I can only address my experiences while living in the Gulf Coast region. Owing to high humidity and rainfall, fungi are a constant threat and regular spraying with topical and systemic fungicides is necessary to prevent/control leaf spotting and other fungus infections. On occasions during very wet periods, a wet black rot may attack the central leaf column; if recognized early when still confined to decidual leaves, treatment with topical tetracycline is effective—if it extends into the bulb neck, the underground neck must be quickly amputated else the rot spreads downward to the growth plate. Common pests include cutworms, caterpillars and slugs. Giant grasshopppers usually surface in August and are best eradicated with the sole of one's foot. Red spider mites are especially attracted to *C. variabile*.

Cultivation of crinums in pots and tubs has received little attention in horticulture circles because of the dominant position held by commercial hybrids which rapidly multiply. Careful selection of African species which do not propagate vegetatively yields a promising selection of bulbs ideally suited for pot and tub cultivation. Anyone who thinks that commercial hybrids are more beautiful has never beheld *C. graminicola* or *C. rautanenianum* or *C. lineare* in bloom. Among these African species are also a group of small bulbs which can easily be grown in 6-8 inch [[15-20cm] pots, entirely dismissing the concept that crinums are landscape plants. Finally, for the hybrid enthusiasts, most of the small species readily cross and the resultant hybrids frequently lack the genes for vegetative propagation—yielding semi-dwarf hybrids suitable for pot and tub cultivation.

LITERATURE CITED

Bailey, L.H. 1950. **The Standard Cyclopedia of Horticulture**. The Macmillan Company, New York.

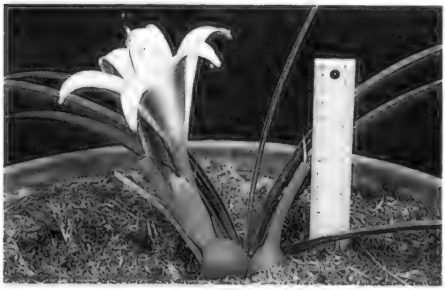


Figure 1, top left: Arid desert species in a pot: *Crinum acaule* Baker from Makakatana, Natal, South Africa

Figure 2, top right: Veld/forest species in large pots. In flower: *Crinum graminicola* Verdoorn from Haenertsburg, Transvaal, South Africa.

Figure 3, below: Riverine/indundated species in a small pot: *Crinum humilis* A. Chev. from Maroua, Cameroun.

Photos: David J. Lehmiller

Figure 4, above. Vlei/semi-aquatic species/hybrids in tubs: Bulb in flower is an interspecific hybrid; the seed parent was *Crinum paludosum* Verdoorn from Ndumu, Natal, South Africa.

See article next page ➜

Zephyranthes moctezumae

Zephyranthes dichromantha

TWO NEW *ZEPHYRANTHES* SPECIES FROM MEXICO

T.M. Howard
San Antonio, Texas, United States of America

Mexico has a great diversity of *Zephyranthes* species because of extremes in its topography, with coastlines formed by the Gulf of Mexico, Caribbean Sea, Sea of Cortez and the Pacific Ocean. Florally, *Zephyranthes* species can be grouped according to the ratios of the length of the perianth segments to the perianth tubes and pedicels and the lengths and positions of the filaments and styles, form and curvature of the anthers and the size and form of the stigmatic lobes. Sometimes length measurements are unreliable, as in the case of the *Z. lindleyana* complex (which probably includes the *Z. clintiae* complex as well) but overall they are reasonably consistent and it is unwise to exclude valid characteristics because of occasional exceptions to imperfect "rules". Generally the ratios and proportions are consistent. Other morphological and environmental factors are of considerable value in determining the different species and these are noted.

The following species are from east-central Mexico in low, level tropical environments: The pale pink flowered *Z. moctezumae,* from the tropical banks of the Rio Moctezuma, has been in cultivation since 1955. The unusual light yellow and red flowered *Z. dichromantha* is a more recent discovery (1991) from a tropical valley shared with several other *Zephyranthes* species (*Z. subflava*, and *Z. nymphaea*) although its known range is more than ten miles from their known habitat.

Zephyranthes dichromantha T.M. Howard, **sp. nov**. affinis *Z. pulchella* et Z. *nymphaea* sed perianthio tubo plus breviore, perianthio luteo extra rubiscente apisces striis rubiscenti. Differt a *Z. katherinei* en perianthio tubo breviore, stigmate excedens antheras, habitatio tropicus. *Howard* #91-02. Traub Herbarium (MO).

Description: bulb ovoid, solitary, ca. 2cm diameter, ca. 2cm high, neck ca. 1.5cm long, tunics blackish-brown; leaves 3–5, erect, linear, ca. 30cm long x ca. 3–4mm wide at base; spathe fenestrate, split on one side in distal half, ca. 2.5cm long, reddish; pedicel ca. 3.5cm long; ovary 5mm long; perianth tube olive green, ca. 3–4mm long; perianth limb light yellow, flushed reddish, funnel-form, suberect, segments oblanceolate, apiculate, ca. 2.5cm long, 7–8mm wide; flushed reddish on exterior, interior light yellow, lightly streaked reddish longitudinally to red apices; stamens inserted at

the throat, half as long as perianth; filaments white, 1cm long, erect to suberect; anthers versatile, antrorse, arcuate, ca. 6mm long; pollen orange yellow; style 1.5cm long, exceeding filaments; stigma trifid, lobes ca. 1mm long; seeds flat, black, D-shaped, becoming wrinkled when dry.

Mexico: State of San Luis Potosi, about 11 miles [17.7km] south of El Naranjo in tropical valley on unmarked paved road next to sugar cane fields. Rare and apparently endemic. Early July, 1991.

DISCUSSION

Zephyranthes dichromantha is the second yellow and red flowered *Zephyranthes* species reported from Mexico, the other being *Z. katherinei* var. *katherinei,* which is an intraspecific hybrid between yellow flowered and red or rose flowered forms of the same species, none of which are published as separate varieties. *Zephyranthes dichromantha* grows at lower elevations, near sea level, in a more tropical environment than do the *Z. katherinei* complex. The flowers have shorter tubes and longer pedicels and are more robust growing. Aside from color, *Z. dichromantha* is nearer to *Z. pulchella* and its allies in habits and overall appearance, but the tepal tubes are shorter, the styles longer, and the stigmas more distinctly trifid. Reddish penciled exteriors are known in some members of this tropical group (*Z. reginae* and *Z. primulina*) but only *Z. dichromantha* has perianths darkly streaked and tipped bright red, both inside and out, on a yellow background, while not flowering until late summer or early autumn. Apparently this new species is endemic to tropical valleys east of the foothills of the Sierra Madre Oriental, in east-central Mexico in swaley clay soils rich in organic matter. Unfortunately such lands are heavily cultivated for sugar cane which accounts, at least in part, for the scarcity of this species today. It seems reasonable to speculate that this species may have evolved through natural hybridization, as *Zepyranthes* species in this region are especially diverse, occurring at a wide range of elevations and in various environments. Putative parents for such a plant could conceivably have been lowland species such as *Z. pulchella* or one of its allies, with pink or red flowered species from the nearby Eastern Sierra Madre. Pink flowered species are known from lower elevations in this region but are still undescribed. In Mexico, most pink or red flowered species occur at higher elevations on mountains of the eastern Sierras or on the central plateau. By the same token, most yellow flowered *Zephyranthes* occur at lower elevations, inland from the Gulf of Mexico (i.e. *Z. citrina, Z. pulchella, Z. reginae, Z.*

nymphaea, Z. primulina and *Z. dichromantha*), with only the yellow flowered form of *Z. katherinei* from the mountains of Hidalgo and the xerophytic *Z. longifolia* of the central plateau as notable exceptions. White flowered *Zephyranthes* occur at all elevations. *Zephyranthes dichromantha* is of easy culture setting seed and slowly forming offsets. The epithet *dichromantha* is taken from the Greek and translates into "two colored flower".

Zephyranthes moctezumae T.M. Howard, **sp. nov**. affinis *Z. primulina* et *Z. macrosiphon*, sed in sylvis riparis humidis, praecipue secus juxta flumen moctezuma. Flos parvus, roseolus pallido, segmentis tortilis, tepalis tres interiores erectae, tres exteriores sub-reflexae. Habitatio tropicus. *Clint M-374* (holotypus MO).

Description: bulb globose, solitary or one of a cluster ca. 2cm long, ca. 2cm diameter, neck ca. 1.5cm long, with brown tunics. Leaves 4–7, linear, 2–5mm wide, ca. 18cm long, carinate, dark green, red-brown at base, suberect, spreading. Scape 17–30cm high, red-brown in the lower quarter. Spathe greenish, tubular, ca. 2cm long, exceeding perianth tube, fenestrate, split in distal third. Pedicel ca. 2.5cm long; ovary ca. 3mm long, 2mm wide; perianth tube 1.2–1.5cm long, greenish; perianth limb suberect, light pink, exterior suffused dark pink, opening widely at anthesis, the three inner segments then becoming suberect, curving outward, with the tepal margins recurving slightly from the midrib; tepals elliptic, 2–2.5cm long, 1–1.5cm wide; filaments white, 1cm long, erect or nearly so; anthers ca. 3mm long, suberect, slightly arcuate, versatile; pollen orange yellow; style as long as filaments; stigma shortly trifid, lobes ca. 1mm long; capsule ca. 1mm wide; seeds black, D-shaped, fleshy, wrinkled when dry.

Type: Mexico, state of San Luis Potosi, near Tamazunchale, banks of Rio Moctezuma. Clint M-374 (MO). Early summer to autumn in cultivation. Collected circa 1955 for the late Mrs. Clint of Brownsville, Texas, by L. E. Guerra, a Texas Rio Grande nurseryman who also had a tropical nursery in Tamazunchale, San Luis Potosi, Mexico.

DISCUSSION

Zephyranthes moctezumae is named for Emperor Moctezuma who ruled the Aztec Empire until the arrival of Cortez and his conquistadors in Mexico, and for the perpetually muddy Rio Moctezuma on which banks it grows. It is nearly evergreen in cultivation

where climate permits, with small round bulbs and dark green fleshy, deeply channeled leaves. *Zephyranthes moctezumae* is unique and its relationships to other species is unclear, though it seems nearest to *Z. macrosiphon* and *Z. primulina*, with which it is sympatric, in the carinate foliage. It is not likely to be confused with other known species because of its small, pale pink, oddly shaped flowers and riparian habitat. The tepal segs curve oddly a few hours after opening, with the three inner segs suberect and ruffled. Though tender, in cultivation it flowers from June until fall, and appreciates light shade and some moisture all year.

ACKNOWLEDGEMENTS

I wish to thank Dr. E.N. O'Rourke of Baton Rouge, Louisiana, a *Zephyranthes* afficionado who has successfully maintained *Z. moctezumae* long after it had been otherwise lost to cultivation. Dr. O'Rourke supplied living plants and dried specimens as it has not been recollected in the wild.

REFERENCES

Clint, K.L. 1957. Collecting Amaryllids in Texas and Mexico. **Plant Life** 13: 10-22

Clint, K.L. 1958. Collecting Amaryllids in Texas and Mexico. **Plant Life** 14: 12-17.

Flagg, R.O. 1960. The *Zephyranthes clintiae* complex. 1. Initial Report on the Somatic Chromosomes. **Plant Life** 16: 86-92.

Herbert, William 1937. **Amaryllidaceae**. J. Ridgeway and Sons. London. 428 pages.

Howard, T.M. 1954. Collecting *Zephyranthes* in Mexico. **Plant Life** 10: 41-44.

Howard, T.M. & Scott Ogden 1990. Six New Species of *Zephyranthes*. **Herbertia** 46(2) 105-112

Spencer, L.B. 1986. Six New Species of North American *Zephyranthes*. **Phytologia** 59(2): 85-88. [Author's note: two of Spencer's "species" are F_1 garden hybrids, *Z.* x *flaggii* and *Z.* x *floryii*; a third, published as *Z. katherinei*, is a natural hybrid between red, pink and yellow flowered forms of a single species.]

Spencer, L.B. 1973. Unpublished monograph of the genus *Zephyranthes* (Amaryllidaceae) in North and Central America. Ph.D. dissertation, Wake Forest University.

Traub, H.P. 1952. *Zephyranthes clintiae* Traub. **Plant Life** 8: 76.

Wilson, Marcia C. 1978. Zephyranthaea Report 1977. **Plant Life** 34: 108-115.

TWO NEW MEXICAN *HABRANTHUS* SPECIES AND A REVIEW OF THE MEXICAN *HABRANTHUS*

T.M. Howard
San Antonio, Texas, United States of America

Habranthus mexicanus T.M. Howard, **sp. nov**. Species a Habrantho ex Mexicana Centralis. *Habranthus concolor* et *H. immaculatus* affinis, sed habitatio collinus vel montanus, bulbis tunicis brunneus fuscus, foliis canalis, carinatus, non spiralis. Differt a *H. immaculatus* in planta leviter plus delicatus, bulbis leviter parvus, scapus leviter altus, et foliis plus angustius, flos interdum vittatus roseis, non fauce luteis. Differt a *H. concolor* in color albus vel vittatus roseis, non luteis. *Howard* #91-05 (holotypus MO)

Bulb solitary, ovoid to obovoid, 2.5–5cm in diameter, 2.5–3cm high, neck 2–5cm long, tunics dark brown. Leaves 1–2, 40–50cm long, ca. 0.5–1.7cm wide, glaucescent, reddish at base, erect, becoming suberect, linear-lorate, channeled above, keeled below, hysteranthous. Scape robust, glaucous, one-flowered, 2–5.5cm long, 3–5mm wide at base, terete; spathe 2–5cm long, purplish-green, split in upper third; pedicel 3–7cm long, elongated in fruit. Perianth funnelform, zygomorphic, declinate to suberect, 3–7cm long, pure white or veined pinkish to reddish within and without, or (rarely) entirely pink; tube less than 5mm long, greenish; segments 3–6.5 cm long, 1–1.5cm wide, oblanceolate, acute to nearly obtuse; filaments white, in four lengths, fasciculate, declinate-ascending, shorter than style; anthers versatile, U-shaped, 5–7mm long; pollen yellow; style exceeding filaments at anthesis, ⅔ the length of the segments; stigma deeply trifid, with filiform recurved lobes, lobes 5–7mm long; ovary 5–7mm long, ca. 2mm wide. Capsule broader than high, flushed reddish. Seeds numerous, blackish brown, D-shaped, flattened, becoming shrunken and wrinkled. $2n$=108, fide Flory (1959).

Blooms with the earliest summer rains before the foliage, May to June. Elevation range about 6,000–10,000 feet [1,846–3,077m]. In outcroppings of oak and pine forests or dry hillsides under thorny shrubs and cacti in sun or part shade. Mexico: state of Hidalgo, Puerto de la Zorra, 11k north of Jacala. June 23, 1991. *T.M. Howard* #91-05. (MO).

Live bulbs previously collected in the following states:
Hidalgo: *Clint* #445. Puerto de la Zorra. May, 1955; *Howard*

#62-100, between Pachuca and Tulancingo on dry mountain side. Wide glaucous leaves 23 July 1962; also *Clint* #565-A, about 20 miles south of Zimapan. June-July.

Guanajuato: #62-36. Mountain side, under shrubs and cacti. Cream-white flowers.

San Luis Potosi: *Howard* #87-34. Valle de las Fantasmas, Mex 70. Unpaved road to Microonda. Mountains and hillsides at middle to higher elevations on rocky outcroppings.

Queretaro: *Howard* #87-22. East of intersection of M 57 and M 111, on south side of road. In leaf May 1987.

Habranthus oaxacanus T.M. Howard, **sp. nov.** Species a Habrantho Oaxacana. Bulbo sub-globosa, tunicato brunneus, *H. mexicanus* et *H. vittatus* affinis. Differt a *H. mexicanus* in bulbis sub-globosa, foliis habens scabrus paralleleneurus, perianthio atro-roseis, scapo plus alto, et habitatio ad merideim. Differt a *H. vittatus* in scapo plus altissimus, perianthio leviter grandis, 7-7.5cm longis, solidus atro roseis, tubo et pedicillo plus longis, et habitatio sylva, montanus. *T.M. Howard* #92-4. (holotypus MO).

Description: Bulb ovoid to subglobose, solitary, ca. 3cm diameter, ca. 2.5-3cm high with neck 3-5cm long, tunics dark brown. Hysteranthus; leaves ca. 2cm long, ca. 4mm wide, erect, becoming suberect, dull green, reddish at base, linear-lorate, channeled, bluntly acute, 5-8 abaxial parallel nerves, minutely scabrous. Scape one flowered, 30-65cm long, 5-10mm wide at base, terete; spathe 2-4.5cm long, reddish, tubular in lower third, split on one side in upper half; pedicel 3-4.5cm long, elongating in fruit; perianth funnelform, zygomorphic, suberect-declinate, 6-7.5cm long, exterior deep pink, interior deep pink in outer third, paler in center, zoned whitish, then greenish at base; tepal tube 1-1.5cm long; segments oblanceolate, acute to nearly obtuse, ca. 1.5cm long; style declinate-ascending, exceeding filaments, ca. ¾ the length of the segments, stigma deeply trifid with filiform recurved lobes, 5-6mm long; filaments fasiculate, declinate-ascending in 4 lengths, shorter than the style. Anthers U-shaped, 5-7mm long, pollen yellow. Ovary ca. 1cm long, 3-5mm wide; seeds numerous, black, flat, D-shaped. Late June-early July rains, usually before the foliage.

Mexico: state of Oaxaca, in mountains south of Guelatao, in gravelly black alkaline soils, beneath oaks and shrubbery, in part shade at about 3,000 meters altitude. Known only from this location and presumed to be endemic.

Habranthus mexicanus

Habranthus oaxacanus

Photos: T.M. Howard

A REVIEW OF THE MEXICAN HABRANTHUS

Until recently, the *Habranthus* species of Mexico have been poorly understood, with few or no species being recognized and often mistakenly assigned to the genus *Zephyranthes* for the sake of convenience.

Habranthus tubispathus ssp. *texanus* (syn. *H. texanus*) is native to the eastern half of Texas and adjacent Louisiana and is nearly identical to forms found in Argentina, Uruguay and Chile. These forms occur almost equidistant from the equator. There is much wild speculation as to how and why it occurs in Texas and Argentina when the populations are so far-flung. Such speculations are fascinating but seem out of touch with reality. Several other bulb species are also found in both Texas and South America, such as *Cooperia drummondii* (Amaryllidaceae), which has as its identical counterpart in Brazil, *C. brasiliensis*. *Herbertia* (Iridaceae), *Nothoscrodum bivalve* (Alliaceae) and *Anemone decapetala* (Ranunculaceae), have identical counterparts in Texas and Argentina. South Texas resembles parts of Argentina northeast of Buenos Aires, with similar plant life, but aside from that I have no other explanation why these widely separated areas share similar species unless it harkens back to prehistoric times when continents and islands were drifting to form the Greater and Lesser Antilles, and merging to form the central American land chain joining North and South America. The drifting of islands and continents, of which we have evidence, seems more plausible. As far as I know, *H. tubispathus* var. *texanus* has not been reported from Mexico.

Habranthus concolor Lindl. (1838), the first *Habranthus* species described from Mexico, was revised as *Zephyranthes concolor* (Lindl.) Benth. & Hook. (1883) for more than a century. More recently (1957) Traub and Clint published *H. immaculatus*, but it was omitted by Rogers McVaugh in FLORA NOVO-GALICIANA in 1989. I recently collected living material from a roadside colony of this species in northeastern Jalisco. The epithet *H. immaculatus* suggests a spotless white flower, but the colors of the flowers are really quite variable. Many have yellowish throats and a few are completely yellowish, somewhat like *H. concolor*, but paler. Some may have faint reddish lines inside and out, especially near the tips of the segments. In such cases, one must resort to additional characters for identification. Mercifully there are several other reliable characters, especially in the leaves, bulbs, and the longer perianth form. Chromosome numbers vary considerably from one species to another. Most *Habranthus* are endangered from overgrazing by livestock.

McVaugh, in his 1989 book, maintained *H. concolor* as a *Zephyranthes* instead of a *Habranthus* as a matter of convenience, since it was believed that the genus *Habranthus* is strictly South American in origin. *Habranthus concolor* seemed strangely out of place in what was supposed to be the only *Habranthus* species in Mexico and it seemed better to return it to *Zephyranthes* since the lengths of the filaments in dried material was still in question. The publications discussing the validity of Mexican *Habranthus* by Walter Flory, and later by Katherine Clint, deserved more serious consideration than they each received. Since then, another new species (1990), *H. vittatus* T.M. Howard, has been added to this small but growing number of little known amaryllids. In the present paper, two new *Habranthus* species are added, *H. mexicanus* and *H. oaxacanus*.

Habranthus mexicanus is allied to *H. immaculatus*, but is found at higher elevations or rocky hills and forested mountains in the northeasterly ranges of the central plateau of Mexico.

Habranthus immaculatus is native to the west or southwestern edge of the central plateau on level ground or gentle slopes in rich black soils. The known ranges of the two species approach one another in Guanajuato, but are not known to overlap.

Habranthus mexicanus is sympatric with *H. concolor* on the eastern fringe of the central plateau but *H. concolor* inhabits lower, more or less level ground, and gently sloping hillsides in sandy loam or gravelly soil in company with other xerophytes, whereas *H. mexicanus* occupies the summits of rocky hills and mountain

forests in soil rich in humus, often wedged between rocks. It is found mainly where the leaves are not accessible to grazing. In its pink-striped forms it is somewhat reminiscent of *H. vittatus* from Oaxaca, but is taller (25–55cm tall, versus 17–21cm tall) and larger in all of its dimensions, growing at much higher elevations in a more northern part of central Mexico. *Habranthus mexicanus* is nearly as tall as the rose pink flowered *H. oaxacanus* from the mountains of central Oaxaca, but differs in having mostly pure white flowers or white flowers veined pinkish or reddish. The leaves are also different .

The flowers of *H. oaxacanus* are an even rose pink, not streaked, whitish in the center and green at the base. Also, the leaves of *H. oaxacanus* have 5–8 minutely scabrous longitudinal parallel nerves below and its bulbs are subglobose, while *H. mexicanus* has channeled, carinate leaves and bulbs that are ovoid. With scapes ranging from 30–65cm tall, *H. oaxacanus* is easily the tallest known Mexican *Habranthus*. It also has quite handsome, large, dark, rose pink colored flowers, with throats contrasted by white and green zones. While *H. immaculatus* persists out of doors in San Antonio, both *H. mexicanus* and *H. oaxacanus* are extremely difficult to maintain in cultivation, in the ground or in pots and usually decline after the first year. The will grow well in our summers but can't seem to adjust to our winters, even with protection. I suspect that it is not cold, but winter moisture that does them in and that they must be kept bone dry during that period.

Apparently *H. immaculatus* is more forgiving. *H. concolor* is somewhere in between and will persist if watered carefully in summer and kept dry in winter. The known range of the yellow flowered *H. howardii* is apparently restricted to northeastern Mexico, in the vicinity of Mamulique Pass, Nuevo Leon, and at Cima de la Muralla, a mountain pass south of Monclova, Coahuila. Overgrazing by livestock poses its biggest threat.

The genus *Habranthus* is now well documented in Mexico, with no less than six distinct species: *H. concolor* and *H. howardii* (both yellow flowered), *H. immaculatus* (white flowered), *H. mexicanus* (pure white or white-streaked pinkish flowered), *H. oaxacanus* (rose flowered) and *H. vittatus* (white with reddish striped flowers). There is the possibility that still more unidentified species may eventually be recognized.

Habranthus concolor can be very impressive when hundreds of them are blooming around the city of San Luis Potosi following early summer rains. Likewise, colonies of the rare *H. immaculatus* in flower are unforgettable. With the exception of *H. howardii*,

foilage of Mexican *Habranthus* species is somewhat flatter and broader than that of most *Zephyranthes* species. The flowers of *Habranthus* are chalice-like or funnel-form, but may vary from declinate to sub-declinate in posture as in *H. howardii.* Compared to Mexican *Zephyranthes,* the Mexican *Habranthus* are physically larger and more robust, with larger, black coated solitary bulbs. Some *Habranthus* species, e.g. *H. immaculatus*, produce bulbs and leaves equal in size to *Sprekelia formosissima.*

It has been suggested that the Mexican *Habranthus* species evolved along different lines from the South American group, i.e. parallel evolution may have occured, but this is speculation and has not been proven. In the meantime, Mexican *Habranthus* are among the rarest and most frustrating of rainlilies to cultivate within the genus.

LITERATURE CITED

Bentham, G. & J.D. Hooker 1883. *Zephyranthes concolor.* **Genera Plantarum** 3: 734–724. L. Reeves and Co. London.

Clint, K.L. 1955. Rediscovery of *Zephyranthes concolor.* **Plant Life** 11: 33–47.

Clint, K.L. 1957. Collecting Amaryllids in Texas and Mexico. **Plant Life** 13: 12, 21, 83.

Clint, K.L. 1973. A Vanishing Mexican *Habranthus?* **Plant Life** 29: 44–46.

Flory, W.S. & R.O. Flagg 1959. The Chromosomes of Three Mexican *Habranthus* Species. **Plant Life** 15: 51–54.

Flory, W.S., Julio Ciscero & Gerald Smith 1976. *Zephyranthes bifolia* (Aublet) Roemer: Its Chromosomes and Taxonomic Considerations. **Plant Life** 32: 47–57.

Hamor, George 1942. Notes *on Zephyranthes bifolia* From its Native Country. **Herbertia** 9: 60–62.

Hayward, W. 1937. *Habranthus cardinalis.* **Herbertia** 4: 72.

Howard, T.M. 1990. A new Species and Transfer in *Habranthus.* **Herbertia** 46(2): 115–117.

Lindley, J. 1838. *Habranthus concolor.* **Proc. Hort. Soc.** London 1:8.

McVaugh, Rogers 1989. *Zephyranthes concolor.* **Flora Novo-Galiciana** 15: 265–284.

Morton, C.V. 1937. A Checklist of the Bulbous Amaryllidaceae of Mexico. **Herbertia** 4: 103–108.

Traub, H.P. & K.L. Clint 1947. *Habranthus immaculatus,* species novum. **Plant Life** 13: 68–69.

Traub, H.P. 1963. *Zephyranthes howardii* Traub, sp. nov. **Plant Life** 19: 48–49.

Kniphofia typhoides. Painting by Adele Walters from **The Flowering Plants of Africa.** Reproduced courtesy of the National Botanical Institute, Republic of South Africa.

KNIPHOFIA TYPHOIDES: A SPECTACULAR SPECIES FROM SOUTH AFRICA'S GRASSLANDS

Charles Craib
PO Box 67142, Bryanston 2021, Gauteng, Republic of South Africa

Kniphofia typhoides was once widely recorded from the grasslands of Gauteng, Mpumalanga, the Northern Province, the Free State and Kwazulu/Natal. This species is endemic to heavy, black clay soil regions and is generally found in climax *Themeda triandra* grassland. The areas in which the plants grow are subject to grazing by cattle and sheep and habitat destruction and degradation. The populations found in Gauteng and the western part of Mpumalanga have been much reduced by urbanisation and the intensive agricultural development of the region.

Kniphofia typhoides is one of two species having scented dark brown or brownish maroon flowers. It is closely related to *K. umbrina*, a rare species endemic to the Forbes Reef area of northeastern Swaziland.

Kniphofia typhoides generally flowers in the first three weeks of February, often at the rainiest time of the year. The habitat, which is usually low lying marshy ground, may become inundated for several weeks while the plants are flowering. This species has declined markedly since the 1950s, but locating and counting populations is difficult as they only seem to flower during years of average or above average rainfall. The ideal conditions for a survey occurred during February 1996 when much of eastern South Africa had weeks of heavy rainfall.

A SURVEY OF *KNIPHOFIA TYPHOIDES*

Herbarium records in the National Botanical Institute in Pretoria indicated that *K. typhoides* was widely collected in the 1950s in Gauteng, Western Mpumalanga, the eastern section of the North Western Province and the North Central Free State, areas formerly known as the Witwatersrand, Eastern Transvaal and Western Transvaal. Some botanists stated that the plants were frequent where found, for example the Delmas area of Mpumalanga.

It was evident that since the 1950s and first years of the 1960s the species had declined. An effort was made to ascertain the status of the species in its former range in these regions and the time chosen for the survey was the first three weeks of February 1996. The time was ideally chosen for substantial rains throughout the summer had broken a drought of some six years duration. All

populations were in flower. The modus operandi was to drive by car along roads in the vicinity of the headwaters of various rivers in the census area. This is the primary habitat occupied by *K. typhoides*. When suitable *Themeda triandra* or other pristine grassland was found, occurring on heavy black clay soils, a brief investigation was made from the vehicle through strong binoculars. If populations of *K. typhoides* were evident they were investigated to determine their status. Approximately 3,000 kilometres were travelled during the course of the survey.

The survey area could not be covered in totality owing to the limited number of roads near suitable habitat, but despite this the results are instructive concerning the causal factors which have led to the plant's decline.

KNIPHOFIA TYPHOIDES HABITAT IN THE SURVEY AREA AND ASSOCIATED *KNIPHOFIA* SPECIES

Most *K. typhoides* habitat comprises grassy vleis (a South African term for low lying marshy ground). These vleis form the headwaters of various rivers which rise in the area such as Bronkhorstspruit near Delmas in Mpumalanga and the Mooi River near Derby in the eastern part of the Northern Province. Much of this habitat is heavily grazed and degraded. The species is very rarely found in degraded veld (grassland) in the survey area. It is nearly always associated with climax *Themeda triandra* grassland—the probable reasons for this are discussed below.

The plants have only been found growing on heavy black clay soil and this preference considerably limits the amount of suitable habitat available to them.

The largest colonies, numbering well over 2,000 plants per colony, were all situated in pristine *Themeda triandra* grassland. These colonies were found to be associated with the headwaters of the Bronkhorstspruit and Mooi Rivers where the habitat was relatively undisturbed. In areas where the habitat had been degraded the plants were found in pristine grassland patches in otherwise degraded habitat or the road reserves [protected areas along the sides of roads], particularly in the Villiers district close to the border between Gauteng and the Free State.

Parallel research was conducted simultaneously on populations of *K. multiflora*, a spectacular species frequenting pristine vleis which has been very much reduced in its former habitat in the Carolina and Nelshoogte areas of Mpumalanga through forestry and habitat degradation associated with overgrazing.

Overgrazing limits the ability of several *Kniphofia* species to

reproduce themselves. The inflorescences are broken by grazing stock and their seeds are heavily trampled into the soil where they are buried too deeply to germinate. This phenomenon affects several *Kniphofia* species and in the survey area was found to affect the following species: *K. albescens, K. multiflora, K. splendida* and *K. typhoides.*

Kniphofia albescens, a spectacular white flowered species, was once widespread in the Wakkerstroom area of Mpumalanga. It has now been reduced to a road reserve plant in several areas through heavy grazing and frequent burning.

THE EASTERN SECTION OF THE NORTH WESTERN PROVINCE

Kniphofia typhoides was recorded from the Swartruggens and Groot Marico areas of the North Western Province in 1953. This area and the black clay soil regions around Boons, Derby and Koster were surveyed in the first half of February 1996. *Kniphofia typhoides* was not observed in the Swartruggens and Groot Marico districts. The black clay soil within the vicinity of streams in these regions has been extensively used for crop production and areas adjacent to the streams are heavily forested with exotic poplars. The small amount of remaining habitat has been much degraded, usurped by weeds and pioneer grasses associated with overgrazing and changes in land usage.

One the largest colonies of *K. typhoides* seen during the survey was found near Derby, associated with the headwaters of the Mooi River. The plants were all growing in large vleis in climax *Themeda triandra* grassland. The extensive colony comprised scattered groups of plants each containing from 20-1,000 individual plants over a distance of some 3 kilometres.

POPULATIONS IN WESTERN MPUMALANGA

An extensive search for *K. typhoides* populations was carried out in the first three weeks of February 1996 in the Bethal, Ermelo and Kinross districts. It was collected several times in the Bethel district in the 1950s and near Delmas in 1950 and 1971. Plants were said to be frequent where found in the Bethal area.

Colonies were not located in the Bethal district, but might have been overlooked owing to limited access roads near suitable habitat in this area. Extensive but disjunct colonies were found associated with black clay soil and *Themeda triandra* grassland around the headwaters of the Bronkhorstspruit south of Bethal. Many of

these colonies were dwindling owing to degradation of the habitat by weeds and pioneer grasses. The plants were only found in small patches of *Themeda triandra* grassland in otherwise degraded habitat.

In areas of pristine *Themeda triandra* grassland, *K. typhoides* is well represented near Bethal, but this sort of habitat is now very limited. One large population exists close to Rietkol west of Bethal in a large vlei of typical *Themeda triandra* grassland.

POPULATIONS NEAR THE FREE STATE AND GAUTENG BORDER

Kniphofia typhoides was collected in the 1950s north of Villiers in *Themeda triandra* grassland on black clay soil. Plants were said to be widespread, growing in small groups in open grassland. The survey indicated that plants are still well represented in this area, which has been subjected to less habitat degradation than the other regions discussed in the survey.

Several large colonies were found in vleis and scattered groups of plants were widespread in open veld. All colonies were growing in the typical conditions discussed above. In one area the habitat had been degraded and *K. typhoides* was found only as a road reserve plant, remnants of larger populations which had once occurred in the surrounding farmland.

Grazing cattle were observed to knock over stems of flowering plants, but they were only lightly grazed and would still have been able to set seed. A very low number of plants was observed in all these colonies. This also was noted in all the other regions where the plants were investigated.

POPULATIONS IN GAUTENG

Gauteng is the most densely settled region of South Africa, containing Johannesburg and the various gold mining towns of the Witwatersrand. *Kniphofia typhoides* populations were reported from various areas of typical habitat during the 1950s. Most of these places are now surrounded by urban development and suitable habitat has largely disappeared. One small colony of plants was found east of Springs in an isolated patch of *Themeda triandra* grassland situated in a vlei in otherwise degraded habitat.

It is probable that the species still survives in small numbers in its former habitat in Gauteng but these populations are not viable in the long term. (The settled and industrialised areas of Gauteng were not so extensively searched as the other regions.)

DISCUSSION

Kniphofia typhoides has declined throughout its former range, largely as a result of habitat degradation. The species is an indicator plant of climax *Themeda triandra* grassland and seems to disappear quickly when such habitats are degraded. Grazing livestock trample some plants and their hooves damage the root systems. The species, however, does not appear to be heavily grazed. As the cattle are moved around from one area to another, grazing in the habitat is temporary and grazing may not take place in some seasons, allowing the plants the chance to recover. The low number of young plants at all colonies requires further investigation, but appears to be related to trampling by domestic stock at some localities.

THE GROWTH CYCLE

Kniphofia typhoides begins its growth cycle once the first substantial summer rains have fallen in October and November. Most leaves have formed by late December, and during January the flower stems start to form. During very wet years such as the summer of 1995–96, flowers may open in late January but the first three weeks of February are usually the peak flowering time.

The flowers are pollinated by honey bees and possibly other insects. They are strongly honey scented and contain large amounts of pollen. Numerous honey bees were observed pollinating the plants at all the colonies visited.

Seeds start to form in late February and are fully developed by the third week in March. A survey of the colonies near Derby on 24 March 1996 indicated that nearly all the flowers had produced fruits, allowing for millions of seeds to be liberated into the environment that season.

Seed is liberated in sunny autumn weather during April and May when the capsules split open. Seed liberated early in April would obtain the best chance to germinate as the cold weather has not started and the habitat is still sufficiently moist to allow seeds the chance to sprout. Seed is distributed by wind and the grazing activities of domestic stock, as well as in rain water once it has fallen onto the clay below. Most seed lies dormant until the following summer when the rains begin. In situations where the habitat is grazed and trampled much seed gets heavily buried in the clay and does not obtain the chance to germinate.

Further study is required concerning the relative abundance of seed produced from one year to the next, as well as the factors

which govern germination patterns. Seeds are parasitised by insects but not to the same extent as *Aloe* seed which is nearly always heavily infested.

The habitat dries out during May and is dry from May to October. All areas in which the plants are found are subject to severe frosts from May to August and to winter grass fires. This is of little consequence as the parts of the plant above the ground die off during the first frosts and cold weather in May.

Winter fires have the effect of thinning out excessive grass cover. Periodic burning is required in order to maintain healthy populations of this species. (Fire plays a significant role in the ecology of many grassland plants in various genera in South Africa.)

CONSERVATION OF *KNIPHOFIA TYPHOIDES* IN HABITAT

Kniphofia typhoides occurs in one of the most populated regions of South Africa, and all of the habitat is used for stock farming of various types. It is clear that a number of *K. typhoides* populations have disappeared over the last three decades, and the future of those that remain lies in the hands of property developers and the farming community.

Most landowners are probably unaware of the *K. typhoides* populations on their property. The most effective way of conserving the plants is to point out their significance to the various landowners, in order that they can control grazing pressures and the frequency of burning the grassveld. *Themeda triandra* is one of the best grazing grasses in the survey area and *K. typhoides* is an indicator plant of healthy habitats. It is, therefore, in the farmers interest to manage their grasslands well, which also directly benefits the kniphofia.

If *K. typhoides* populations ever needed to be translocated owing to land development, an instructive study exists on the distribution and status of the closely related rare *K. umbrina* in Swaziland. Populations of this species were translocated from an area zoned for settlement of Swazi families. Some of the factors (Heath 1985) which led to the decline of *K. umbrina* parallel those found in the *K. typhoides* survey, namely, repeated burning and overgrazing.

HORTICULTURAL POTENTIAL OF *KNIPHOFIA TYPHOIDES*

The horticultural potential of most South African kniphofias has hardly been developed. There are many spectacular species

and *K. typhoides* is certainly one of the most unusual with its brown flowers, strongly scented of honey.

Kniphofia typhoides makes an ideal bog plant and may also be grown in moist areas with heavy clay soil. It is resistant to sub-zero temperatures in winter and is likely to be an interesting horticultural item in parts of the Northern Hemisphere that do not experience excessively cold winters.

Plants lend themselves to hybridisation with other *Kniphofia* species such as *K. multiflora*, and some spectacular cultivars could be produced. A detailed study is currently under way concerning techniques for growing the plants from seed.

ACKNOWLEDGEMENTS

I would like to express my thanks to the following people and institutions who assisted with this research: Mrs. Claire Archer who permitted me to consult the *K. typhoides* herbarium records at the National Botanical Institute Herbarium in Pretoria, and for permitting me to peruse the *K. umbrina* population and status reports in the herbarium files at the National Botanical Institute; and Mr. N.P. Frits van Oudtshorrn for discussing aspects of Highveld grassland ecology in areas where *K. typhoides* occurs.

REFERENCES

Codd, L.E. The South African Species of *Kniphofia*. **Bothalia**, vol 9, parts 3 & 4, October 1968.

Heath, L.M. Distribution and Status of *Kniphofia umbrina*, March 1985 (files in the Herbarium of the National Botanical Institute, Pretoria).

Stehn, T. Distribution and Status of *Kniphofia umbrina*. August 1978 (files in the Herbarium of the National Botanical Institute, Pretoria).

Van Oudtshoorn, Frits. **Guide to Grasses of South Africa**. Briza Publications, Arcadia, Pretoria, 1992.

AN ECO ARTICLE

THE TANGLED WEB

Terry Hatch
New Zealand

During a recent visit to the Cape Region of South Africa to see plants in their natural habitat, I had my ideas and assumptions confirmed on how, where, when and why.

To be able to see plants growing where they appear to be most suited is a large help when it comes to cultivation, and certainly for successful long term conservation and flowering of rare species. While I have a leaning towards bubs I enjoy learning all there is to learn about the ecology of flora and fauna, so life will never be dull!

It was immediately obvious on arrival as to why many of the glorious South African plants we grow so well in New Zealand are not in widespread cultivation in their native land. The answer was of course "eaters", for every plant, especially bulbs, there seemed to be at least five animals intent on eating the last rare specimen.

The balance of nature has been upset as usual by the human population and there were huge populations of a molerat (Bathyergidae) which gobbled vast quantities of choice bulbs overnight, while the molesnake had all but been wiped out by the snake haters. A legion of larger animals chomped and dug bulbs whenever possible and huge areas of prime habitat for smaller bulbs has been taken over by the Australian wattle *(Acacia), Hakea* and *Eucalyptus* species. There are also many more plant invaders to be seen as well as all the choice habitat taken over by farming.

While this is all negative, there are still many areas that have a fairly balanced habitat with plants and animals flourishing as they should. Many rare bulbs could be seen flowering among *Elegia capensis*, a giant rush with tough roots, where the moles could not dig through. Exquisite *Romuleas, Geissorhiza, Hesperantha* and *Gladiolus* grew in huge colonies in poor lunar scape conditions, while *Lachenalia, Veltheimia* and *Wurmbea* clumps enjoyed the protection provided by the shade of large rocks. The species seemded endless as also were the varied types of habitat.

Further north huge *Aristea major* plants arched out from sheer cliffs like sky blue wands, and the heady scent from the citrus groves permeated the air for miles around. A too short stay at Nieuwoudtville was a botanical delight producing many more treasures to see plus a large tortoise and a Cape Vulture, a very rare

sight. While in this area which was extremely hot (to us) I happened upon a very large spider's web. The occupants to me were interesting in the fact that they were communal, the web having about fifty spiders at home, a number were busily feeding and some were cleaning up! In the left hand corner of the web a large midden of dessicated corpses and other items held together by old web appeared to be where the spiders spent most of their spare time. To the casual observer this might not be unusual, but to a bulb grower it was extremely interesting. Much of the debris collected appeared to be seed of *Gladiolus* and *Watsonia* species while there would have been seeds of many more plant species ensconced quite happily until the web was destroyed.

Various conclusions can be made on this phenomenon. The seeds are protected from insects by the spiders. The seeds would have a nutrient source from the insect remains when the midden falls to the ground and other plant remains would provide a humus and moisture content to the immediate area. Some questions: how long would these webs last? What is the spider's name? Has anyone else observed this phenomenon? It would be interesting to know if certain plant species survive by this method and just how many seeds were in such a web.

AN OLD *SINNINGIA* 'ARIZONA'

About 1974, I purchased a small collection of sinningia tubers (gloxinia) of varieties then common in the trade. Growing them in a plastic greenhouse which is subjected to the scorching heat of our Southern California summers as well as the occasional frosts of winter which can bite through the usually unheated greenhouse covering, I lost a few each year in this anti-sinningia environment until, after about five years, only one remained.

It still remains with me 22 years after I purchased it. 'Arizona' is the cultivar's name. Each year it awakens from its winter dormancy in April to reward me with from three to five growths, one or two of which are topped with beautiful white and rose-pink flowers in June. These are in thanks for the small amount of time and effort I spend annually on its care.

The tuber now measures 7.25 inches (18.4cm) at its longest measurement. It grows a little fatter and longer each year.

Does anyone have an older or larger hybrid sinningia tuber?

Charles Hardman

SOME GEOPHYTIC PELARGONIUMS

Michael Vassar
Van Nuys, California

Few people would think of the geranium family, Geraniaceae, as having tuberous species. Actually there are many species in the Geraniaceae that are tuberous. The genus *Pelargonium,* which contains approximately 300 species, is taxonomically divided into 14 sections. Nine of these sections contain plants that are tuberous. Many species are xerophytic or succulent plants with tuberous roots. This article is only about the section *Hoarea,* which is the largest group of tuberous plants in the geranium family. All species in this group are completely geophytic, dying back in the heat of summer to underground tubers with no above ground plant parts until the beginning of the next rainy season.

The section *Hoarea,* named in honor of Sir Richard Colt Hoare, is a group of small, stemless plants, producing rosettes of leaves from a central mostly turnip-like tuber; smaller tubers often branch off from the main tuber. Leaves are variable, from entire to deeply divided; many species have juvenile leaves that are entire, with each succeeding leaf becoming more divided. Flowers are usually showy and are often produced in branched scapes of many flowers. The former section *Seymouria* was combined with this section recently as plant growth and habit were the same; the only difference being the number of petals per flower.

This section is composed entirely of winter growing plants from the Western Cape of South Africa. All require as much sunlight as possible when in growth. Most species receive little to moderate amounts of winter rainfall in habitat and all the rain is in winter with only a few exceptions. Areas near Cape Town in the southwest Cape can annually receive 70cm of rain or more. The Richtersveld, an area of the northern Cape where *P. namaquense* and *P. oblongatum* are found generally has rainfall of less than 10cm yearly. All species (with only a few exceptions) have a complete dormancy during the hot summers in habitat. The leaves dry completely and are blown away, leaving only a dormant underground tuber.

Plants in the section *Hoarea* begin growth in autumn, coming out of dormancy as the night temperature cools and winter rains begin. Leaves are produced rapidly in a rosette above the tuber. Some species begin flowering quite quickly, often in as little as 4-6 weeks after growth begins. Most species flower at the end of their growing season as the days warm with the arrival of spring and as

leaves begin to yellow with dormancy approaching. The last species to flower in my collection are *P. rapaceum* and *P. oblongatum*. The leaves dry down and the bases of the leaf petioles cover the tubers, insulating them from the long, hot, dry summer of the Western Cape (and Southern California).

CULTURE

In cultivation plants which have been dormant should be watered lightly the first week of September (northern hemisphere). When new growth begins showing, move plants to full sunlight or as much light as possible. This is also the time to repot if plants need a larger container, but when repotting it is best to repot only to a container that is 1 inch [2.5cm] larger than the plant grew in the previous year. Do not move plants to larger containers if they did not grow well last season or if they do not appear to be healthy and they were in at least a 4 inch [10cm] container.

Winter growing geophytic species are easy to grow if you just duplicate the conditions they receive in habitat: bright light, a relatively poor, sandy/gravelly, quick draining soil with little organic matter. Plants grown in conditions replicating those of habitat are tight, compact plants. The leaves of many species have a blue-green or silvery color when grown in the correct amount of light. Plants that are grown in a richer soil mix and/or in low light will look entirely different, having thin, long, weak and floppy leaves of a pale green color. *Grow them hard.* Remember also to rotate plants ocasionally or all growth will be to the sunny side during winter.

I use a planting mixture consisting of: 50% pumice (white volcanic rock ¼ inch/6mm diameter), 35% washed builders or washed plaster sand (the coarser the better) and 15% organic matter (I find that a leaf mould based potting mix is excellent—avoid peat moss based potting mixes if possible as peat moss stays wet for too long and then when dry is very difficult to get to reabsorb water. Mix the contents thoroughly. This planting mixture should be slightly moist when you use it but should not be wet. In areas of high humidity or less sunlight, increase the amount of pumice. Fertilize with a dilute (¼ strength) low nitrogen fertilizer once a month, but only on a sunny day and only to plants that have moist planting mixture. NEVER use a stronger fertilizer.

PROPAGATION

Most species are self fertile and will produce true seeds if self polllenized. Isolate plants or disbud other species in the area as most species intercross readily and will produce hybrids. If polli-

nation was successful the petals usually drop within one day and a beak-like fruit begins to emerge from the flower. If pollination was complete each beak will have five seeds at its base. Remove the husk from the seeds. Seeds should be scarified to get fastest germination. To scarify the seeds I scratch a small hole in the largest end of each seed with a needle. An alternate method is to cut off a tiny piece of the seed end with a razor blade. Scarification allows moisture to get into the seed—otherwise it can take up to many years for germination as most pelargonium seeds have a very water resistant seed covering. Plant the scarified seeds in a pot or tray of the above recommended planting mix but add some extra coarse sand. Bury seeds about ¼ inch [6mm] and water them in with a fine mist so as not to wash them out. Label each species and container. Place in bright filtered sunlight. Germination should take place within 3-14 days. If in seed trays, transplant seedlings to individual pots when the second true leaf develops, handling seedlings gently and by holding only a leaf. After a couple days to reestablish, move the potted seedlings to bright light.

Many species are readily propagated from tuber cuttings by removing smaller tubers branching off the central tuber and treating them as cuttings. Tuber cuttings should be planted immediately into the regular, poor, gravelly planting mixture that is just slightly moist. Wait one day before watering the pots of tuber cuttings if the weather is sunny; if skies are dark or humidity is high, wait two to three days before thoroughly watering the cuttings. Keep the cuttings just slightly moist; growth normally begins within 3-4 weeks. All species with tuberous or even slightly succulent or fleshy roots can be propagated from root cuttings. Almost any piece will root, but you must have the piece of root *in the same up-and-down orientation* it had on the parent plant. I have good success individually planting the root cuttings in small, deep pots, [2½ inches wide by 3 inches deep [approx. 55 x 75mm] with the upper ¼ inch [6mm] of the tuber cuttings above the potting mixture surface. Light seems to enhance the formation of callus tissue which will differentiate into new growth. Do not compress the mixture around the tuber—air spaces in the planting mix are necessary. Start cuttings in bright filtered sunlight. After the root cuttings have begun sprouting (4-6 weeks usually), move them to as much light as possible to keep them compact and normal.

SOME TUBEROUS SPECIES IN SECTION *HOAREA*.

P. appendiculatum (L.f.) Willd. (1800) Considered to be a rare plant in habitat, this species is an easy and dependable species in cultivation and with much to recommend it. Plants form a large

rosette of leaves to 10 inches [26cm] wide. The finely divided leaves are a silvery green and covered with short glandular hairs which, when rubbed, give off a pleasant, spicy, woodsy scent. The turnip-like tubers can get quite large; the largest plants I have has 4 inch [10cm] diameter tubers; I have never found any smaller tubers branching off the large tuber. The flowers are large, up to 1 ½ inches [4cm] tall and are produced in large umbels of up to 30 flowers. Mature plants can produce hundreds of flowers over a few months time. Flower color varies from cream to light yellow, most having red veining in the upper petals. It is very showy in flower. This species is very self fertile and when self pollenized all flowers will produce five seeds. It is easily grown from seed to flowering in one season.

P. asarifolium (Sweet) G. Don (1831) This is a most unusual species. The leaves are entire, rather thick and leathery and covered on the underside with a thick layer of short, soft white hairs. Plants produce few leaves, usually two to three. This species flowers in early summer after the leaves have withered. The unusual reddish purple flowers have only two upper petals which are sharply reflexed in mid-petal. A staminal column of the same color protrudes outward below the petals. Many flower clusters are produced per plant from branching inflorescences. With age the plants produce clumps of rounded tubers.

P. auritum ssp. ***auritum*** J.J.A. van der Walt (1977) Leaves of this species can be extremely variable, from entire to slightly lobed to deeply pinnate. All forms I have seen in cultivation so far have had slightly angularly lobed leaves covered with short stiff silvery hairs. As spring and its warmer weather approach, plants produce branched inflorescences with up to 15 flowers per cluster. Flowers are virtually black, being very dark, blackish purple-red with a white base to all petals. The tubers are turnip-like but often have smaller tubers branching off the main tuber.

P. auritum ssp. ***carneum*** (Harv.) J.J.A. van der Walt (1980) Plants are similar in habit to the above but the flowers are white, larger and have red veining in the upper petals. It is an easy to grow and quite dependable species.

P. ellaphieae E.M. Marais (1981) This species was named for a most gracious lady and friend, the late Ellaphie Ward-Hillhorst, botanical artist extraordinaire, whose paintings grace the pages of **Pelargoniums Of Southern Africa**. It is a very unusual species, having dense rosettes of simple leaves, generally not notched or lobed, about 3 inches [75mm] long by about ½ inch [12mm] wide, and of a bright green color. The strange and interesting flowers

have only two petals that are dark wine red in color, and the petals are sharply reflexed backward about midway. A staminal column of the same dark wine red flares out below the petals. This species flowers in early summer shortly after the leaves have dried back in the first heat of summer. The tubers are longer and thinner than most species and produce small offsetting side tubers.

P. incrassatum (Andr.) Sims (1804) One of the showiest and earliest of the *Pelargonium* species in section *Hoarea,* this is also easy and dependable. The leaves are up to 5 inches [13cm] long with many rounded, deeply lobed segments and are covered with silvery hairs. Flowers are produced not long after mature leaves are produced, sometimes within one month. Flowers are about ¾ inch [2cm] tall and are produced in large clusters on unbranched stems. New color forms have recently been discovered so now this species is available in brilliant pinkish purple, bright pink and a white form. The tubers are turnip-like but do produce small side tubers from the main tuber. Plants are easily self pollenized, producing many seeds, and are readily grown from seed to flower in one season. Large, old, mature plants can be shockingly beautiful in flower.

P. leipoldtii Knuth (1912) This species has leaves of a general triangular shape with pinnate lobes that are themselves irregularly lobed or incised. The leaves are covered with short glandular hairs. The flowers are unsual, having large sepals that are green to reddish, only two upper petals which are shorter than the sepals, and are white with reddish feather-like veining. A yellowish staminal column protrudes below the petals. Pseudo-umbels of about 10 flowers are produced on a many branched inflorescence. Tubers look like elongated turnips. This species is not easy to maintain in cultivation.

P. longifolium (Burm. f.) Jacq. (1792) The botanical name is rather meaningless as the leaves are extremely variable, from completely entire to deeply divided and not normally long at all contrary to what the name implies. This species also has undivided juvenile leaves and deeply divided adult leaves in some forms. The flowers are usually showy and vary from white through shades of light yellow and to shades of pink, mostly with red or purplish blotches or veining in the upper petals. Flowers are borne in clusters of up to 20 flowers on 3–5 branched inflorescences. All forms I have grown are self fertile if hand pollenized and are easily grown from seed. Tubers are relatively small, usually narrow and oblong, and produce many small offsetting tubers.

P. namaquense Knuth (1912) This species is native to areas of southern Namibia and the Richtersveld of northwest Cape Province,

an area that gets little rainfall—about 4 inches [10cm] per year, less in some years. The leaves are pinnately compound and are about three inches [8cm] long. Flowers are white to shades of pink and in clusters of about 16 flowers on unbranched stems held well above the leaves. Flowers are produced while the leaves are still green in spring. Tubers are small and turnip-like.

P. nephrophyllum E.M. Marais (1992) Just recently described, this new species is just working its way into cultivation. Plants are small, growing to about 4 inches (10cm) tall or less. The tubers are turnip-shaped, about 1 inch (2.5cm) in height and width and are in active growth in winter as it is from Namaqualand. Leaves are about 1 inch in diameter, kidney shaped, with about 9 rounded lobes at the edges. The flowers are showy. The five pink petals each have a central orange spot. Self pollinated flowers have produced seeds so nursery grown plants should be available in the future. It has been easy to grow and maintain.

P. oblongatum E. Mey. ex Harv. (1860) One of the showiest flowering species, this will produce hundreds of flowers from a large mature plant. Native to the Richtersveld, this species has large, thick leaves that are roundish, not lobed, and are covered with coarse hairs. Flowers are up to 1½ inches [4cm] from top to bottom and vary from pure white through ivory to light yellow. The flowers are produced from 6–8 branched inflorescences in clusters of up to 50 flowers in cultivation. Individual clusters of flowers are up to 6 inches [15cm] in diameter. One old plant last year had over 400 flowers! Flowers are self fertile and a good seed crop can be obtained by self pollinating (or better yet, cross pollinating to another plant). Plants are easily raised from seed and flower young but take some years to reach sufficient size and maturity to really show off. Tubers are long and narrow, about 1 inch [2.5cm] diameter and up to 5 inches [13cm] long. In cultivation it should be grown with the top 2 inches of tuber above the planting mixture.

P. pinnatum (L.) L'Herit. (1789) True to its name, this species has pinnately divided leaves, with the number of leaflets (pinnae) off the rhachis being variable on plants from differing localities. Leaves are covered with very visible coarse hairs. Flowers are usually showy, produced in branching inflorescences and can vary from white, creamy or pale yellow to shades of pink, all with darker veining or blotches in the upper petals. This species is relatively common in the southwest Cape Province and is quite variable over its habitat range. The turnip-like main root often forms numerous side tubers in cultivation.

P. punctatum (Andr.) Willd. (1800) This species produces rosettes

of entire and undivided leaves that are densely covered with glandular hairs and the leaf surface is often flushed purplish when grown in adequate light. Mature plants are showy for many weeks when in flower. Flowers are light yellow with red to purple-red blotches and streaking in the upper petals. Up to 25 flowers are produced in each cluster on a many branched inflorescence. Many tubers are produced by cultivated plants.

P. rapaceum (L.) L'Herit. (1789) Of all the *Pelargonium* species in section *Hoarea, Pelargonium rapaceum* is probably the most commonly available species in cultivation. It is widely distribution in Cape Province. The linear leaves have pinnae that are divided or lobed (pinnatipartite) and have a ferny look. Some forms have deep green leaves, others can have greyish to silvery leaves covered with dense whitish hairs. The most interesting part of this species is the flowers—they are pea shaped, with the upper two petals reflexed backward above the middle and the lower petals overlapping the lower center petal. They look exactly like a pea or bean flower. Flowers are produced in many-flowered clusters and can be pure white, cream, light yellow, or shades of pink, mostly with red streaking at the base of the upper petals. From the tuber [Latin *rapa*=turnip], this species normally produces many smaller tubers attached to the main tuber. Flowers are self fertile and by hand pollinating a good seed set can be obtained. Plants flower within one year from seeds planted early in autumn. Large, mature old plants can produce hundreds of flowers.

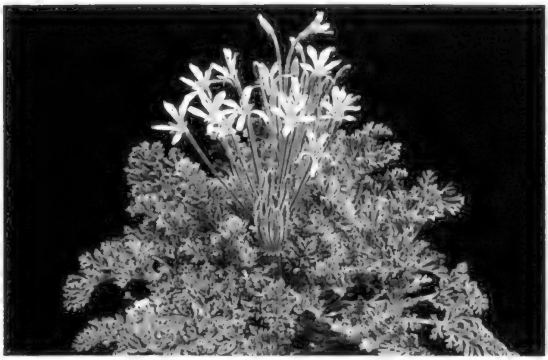
Plants of tuberous pelargoniums are generally not easy to find but some nurseries and mailorder nurseries specializing in succulent plants often list a few. Unfortunately many are habitat collected plants that are difficult to reestablish and often do not survive. Plants so easily propagated should not need to be reimported. When seeds are available plants can be produced relatively quickly to flowering size. As indicated above many can be grown easily from tuber cuttings, but only if you have or know someone with an existing plant from which to get a tuber. Seeds of some tuberous species will be on the IBS Seed Exchange autumn listing.

REFERENCES

van der Walt, J.J.A. 1977. **Pelargoniums of Southern Africa.**

van der Walt, J.J.A. and P.J. Vorster. 1981. **Pelargoniums of Southern Africa**, Vol. 2.

van der Walt, J.J.A. and P.J. Vorster. 1988. **Pelargoniums of Southern Africa**, Vol. 3.



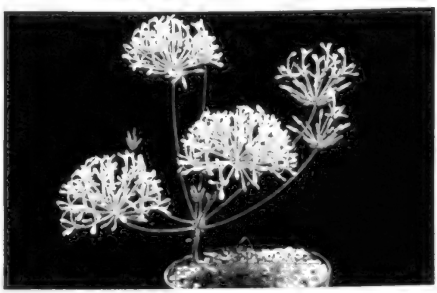
Pelargonium appendiculatum

Pelargonium incrassatum

Pelargonium oblongatum

Pelargonium rapaceum

Pelargonium sp. from Bitterfontein



Pelargonium punctatum. All plants shown are in section Hoarea

Photos: Michael Vassar

VALIDATION OF NAMES IN *HYMENOCALLIS* (AMARYLLIDACEAE)

Joseph E. Laferriere
Herbarium, 113 Shantz Building, University of Arizona
Tucson AZ 85721, United States of America

In reviewing published literature on the genus *Hymenocallis,* I noticed that some of the names in common use have not been validly published. Such oversights are corrected below.

The International Code of Botanical Nomenclature specifies that any name published after 1959 is not validly published unless it is accompanied by the designation of a single specimen or illustration as holotype. Several names have been published since that date in the genus *Hymenocallis* with two or three specimens listed as types. Hence they are not validly published. Use of invalid names is undesirable because they have no priority status against competing synonyms. The ICBN does specify that a name may be validated without an accompanying Latin description if full reference to a previously published description is given. Such is done below for ten names published by Hamilton P. Traub, Pierfelice Ravenna and Thad M. Howard. Howard (pers. comm.) selected the holotype for *H. maximilianii;* hence its name is credited solely to him.

H. azteciana Traub ex Laferr., sp. nov. — *H. azteciana* Traub, **Plant Life** 23:53, 1967, nom. invalid. Holotype: Mexico, Jakusci, near Jalpa. *J. Garcia de Frias s.n.* (MO ex TRA 1031a).

H. choctawensis Traub ex Laferr., sp. nov. — *H. choctawensis* Traub, **Plant Life** 18:70, 1962, nom. invalid. Holotype: Cult., source: Florida, Walton Co., *M.G. Henry s.n.* (MO ex TRA 236a).

H. duvalensis Traub ex Laferr., sp. nov. — *H. duvalensis* Traub, **Plant Life** 23:66, 1967, nom. invalid. Holotype: Florida, Fairbanks, 29 April 1927, *C.F. Weber s.n.* (FLAS 6296).

H. floridana subsp. *amplifolia* Traub ex Laferr., subsp. nov. — *H. floridana* subsp. *amplifolia* Traub, **Plant Life** 23:67, nom. invalid. Holotype: Cult., source probably Florida, *F. West et al. s.n.* (FLAS 10473).

H. henryae Traub ex Laferr., sp. nov. — *H. henryae* Traub, **Plant Life** 18:71, 1962, nom. invalid. T: Cult. from bulbs coll. from Florida, Santa Rosa, by M.G. Henry, *Traub 282a* (MO ex TRA).

H. incaica Ravenna ex Laferr., sp. nov. — *H. incaica* **Nordic J. Bot.**

6(4):463, 1986, nom. invalid. Holotype: *Ravenna 2880* (USM).

H. maximilianii T.M. Howard, sp. nov. — *H. maximilianii* T.M. Howard, **Plant Life** 38:41, 1982, nom. invalid. Holotype: Mexico, Guerrero, 5 July 1968, *T.M. Howard 68-220* (MO ex TRA 1249a).

H. moldenkiana Traub ex Laferr., sp. nov. — *H. moldenkiana* Traub, **Plant Life** 18:71, 1962, nom. invalid. Holotype: Cult., source Georgia, Appling Co., *M.G. Henry s.n.* (MO ex TRA 272a).

H. palusvirensis Traub ex Laferr., sp. nov. — *H. palusvirensis* Traub, **Plant Life** 18:71, 1962, nom. invalid. Holotype: Cult., source North Carolina, Brunswick Co., *M.G. Henry s.n.* (MO ex TRA 251a).

H. puntagordensis Traub ex Laferr., sp. nov. — *H. puntagordensis* Traub, **Plant Life** 18:71, 1962, nom. invalid. Holotype: Florida, Punta Gorda, *C.L. Burlingham s.n.* (MO ex TRA 878a).

LONGIFLORUM-ASIATIC LILY HYBRID

Longiflorum-Asiatic or LA-hybrid lilies were introduced in 1994 and are now available in commercial quantities. They combine the colors and upright calyx of Asiatic lily hybrids with the strength and sturdiness of *Lilium longiflorum*. These new hybrids produce elegant, well formed flowers and an unusual, but welcome, color range.

The following varieties are now available: 'Evening Star' (white), 'Eternal Flame' (orange), 'Arizona' (pink), 'Salmon Queen' (salmon), and 'San Jose' (salmon-orange).

As *Lilium longiflorum* (the Easter Lily—grown by the millions) and its varieties generally are limited to white flowers—only the cultivar 'Casa Rosa' has colored segments and they are pink—it's good to have its quality genes combined with Asiatic genes thus expanding the color range. In addition to quality coloration, these new lily varieties show size, strength and elegance. The flowers make excellent large bouquets and attention-getting decorations. Vase life of the new hybrids is 10 to 14 days.

Shipping the cut flowers of these hybrids is easy as flowers have an upright calyx not generally susceptible to breakage.

While the peak period of bulb auction sales of these new lily varieties is May-September, the Dutch auctions have these new LA-hybrids available year-round.

See the **Pacific Nurseryman & Garden Supply Dealer**, July 1994.

Nerine platypetala. Painting by Gillian Condy of a plant from the colony near Wakkerstroom.

NERINE PLATYPETALA HABITAT STUDIES AND CULTIVATION

Charles Craib
PO Box 67142, Bryanston 2021, Gauteng, Republic of South Africa

Nerine platypetala is a spectacular marginal waterplant found at the edges of extensive perennial marshes to the southeast of Volksrust in the Transvaal, South Africa. The species is relatively well represented where it is found but rare overall as its distributional range in the southeastern Transvaal is very limited.

The plants grow in swampy conditions amongst short marsh grasses and marginal waterplants (*Phragmites australis* and *Typha latifolia*) which fringe extensive reed beds. They form loose colonies scattered over a wide area in groups of about six to several thousand individuals.

DISTRIBUTION AND STATUS

Nerine playtpetala is only known from the extensive marshes around Wakkerstroom, a small town in the Volksrust district of the southeastern Transvaal. The plants are quite well represented where they are found, but tend to flower only sparsely during dry seasons. Much of the plants' habitat near Wakkerstroom is located in a wetland reserve proclaimed largely for conservation of birds.

Some of the colonies are grazed by cattle during the early summer and at flowering time in the late summer and early autumn. Many of the nerines get trampled at these times. The plants are, however, able to withstand moderate trampling, and some manage to flower and set seed even when their habitat is heavily grazed.

Nerine platypetala is associated with large perennial marshes and grows in mud which usually remains moist throughout the year. The partiality of the plants to these conditions probably explains their absence from many of the seasonal pans and vleis in the Wakkerstroom, Groenvlei and Dirkiesdorp districts of the southeastern Transvaal. The health of *N. platypetala* populations in the future is closely linked to the wetland conservation strategy for the area around Wakkerstroom.

THE GROWTH CYCLE

Nerine platypetala starts its growth cycle in September, usually towards the middle of that month, after the last winter frosts. The bulbs push up small shoots but grow no further until the first substantial rains of the summer have fallen, usually during the

second half of October and November. Once the habitat is again sodden and boggy the plants start to grow vigorously. During December and January Wakkerstroom quite often floods and the areas where *N. platypetala* grow become inundated for as much as a week. Flower buds begin to form in the second half of January and the plants start to flower at the beginning of February. The peak flowering period is generally mid February. Seed is rapidly produced and most colonies are in seed during late February. Seeds may begin to germinate whilst they are still attached to the plant, particularly if there is rainy, misty weather at this time.

Nerine platypetala produces copious amounts of seed which falls directly from the parent plant into the mud below. Seed is dispersed by rainfall and flooding.

The marshes around Wakkerstroom are burnt at least once every two years. This has the effect of clearing the dead clutter of marginal waterplants which have accumulated and permitting favourable growth and germination conditions for the *N. platypetala* colonies.

Nerine platypetala enters dormancy during late April and the plants are normally fully dormant by May. Severe frosts occur in the Wakkerstroom marshes from May until early September and the ground freezes most nights in the winter months.

NERINE PLATYPETALA COLONIES

Three colonies of *N. platypetala* near Wakkerstroom have been kept under observation for two years. These observations are discussed below.

Colony A is situated to the east of Wakkerstroom, fringing a large reed bed. This environment forms part of a recreational area for the public, with one section in which the nerines are found being a bird sanctuary. There is no grazing domestic stock at the *N. platypetala* colony and the habitat is undisturbed. The area is also frequently burnt and consequently the marginal waterplants amongst which the nerines grow become very dense in years when there have been no fires.

The plants grow tightly packed together in scattered groups. Seed is not generally evenly dispersed, owing to the rank vegetation, and most of it germinates at the bases of the parent plants. The locality (the upper end of a large dam) also is not subject to flooding as the water levels of the dam are artificially controlled.

Plants in this colony have tall stems with large shell pink flowers. They differ from plants found in the other two colonies.

Colony B is situated within the Wakkerstroom municipal boundaries. It occupies a swampy field which is frequently inundated during the summer months when Wakkerstroom floods its banks. The nerines share their habitat with *Gladiolus papilio*, another marginal waterplant frequent in the Wakkerstroom area. Plants in this colony are short stemmed with dark pink flowers.

This swampy field is grazed periodically by cattle and horses throughout the summer. *Nerine platypetala* is, however, numerically strong at this locality. Plants are evenly scattered over the field and seed is distributed by fluctuations in water levels, rainfall and grazing animals. The field is regularly burnt in the winter months, which has the effect of removing any clutter of dead vegetation which always accumulates during summer months. The ground remains permanently moist, even during the dry winter months.

Colony C is large, comprised of scattered groups of plants extending for a few kilometres. It is situated at the edges of the extensive marshes to the south of Wakkerstroom and falls within a proclaimed wetland reserve. Plants grow amongst grasses and sedges and large concentrations of *Gladiolus papilio*. Cattle and horses graze in a section of the colony and the reed beds and surrounding sedge beds are burnt most winters. The ground remains moist throughout the year and in winter soil moisture is augmented by melted frost, which is common between May and August.

Seed is distributed in the same manner as at colony B, and this again explains the even distribution of plants in the environment.

DISCUSSION

Nerine platypetala is a specialised marginal waterplant associated with a fire ecology, and dependant on fluctuating water levels in the main to distribute its seeds. The plants are well represented around Wakkerstroom and have probably benefitted from man-made changes to the environment, such as more frequent burning and moderate grazing by domestic stock.

The bulbs seem to need moisture during dormancy which is provided in their habitat by the extensive perennial marshes where they are found. This probably accounts for the absence of plants from habitats which dry out completely during the winter months.

It would be useful to monitor the plants in habitat over the years in order to ascertain how many plants flower during drought and how long it takes the bulbs to reach flowering size after germination. In addition, the overall stability and numerical strength of the different populations could be assessed.

CULTIVATION

Nerine platypetala seed germinates readily; the small bulbs are easily transplanted in their second year. Seed should be harvested when it begins to turn a reddish green colour on the parent plant. Seed should be sown evenly on the top of a heavy soil mixture and partially and very lightly covered with earth. The growing medium should be kept permanently moist throughout the summer growing season, preferably by standing the seed trays in containers full of water. The seed trays should be lightly watered every few weeks in the winter months and the water containers drained of their water until the beginning of the following spring (about mid September in the southern hemisphere).

Seeds takes about 2–3 weeks to germinate; small bulblets develop after two months. In cutivation it takes the bulbs 3–4 years at least to reach the flowering stage when grown from seed.

Mature bulbs are best stored in their pots and the soil kept moist. Bulbs stored on shelves tend to dry out a lot and frequently do not flower once they have been planted the following season.

HORTICUTLTURAL POTENTIAL

Nerine platypetala makes a decorative water garden feature or bog plant and, as it is so easily grown from seed, it could become a popular horticultural item.

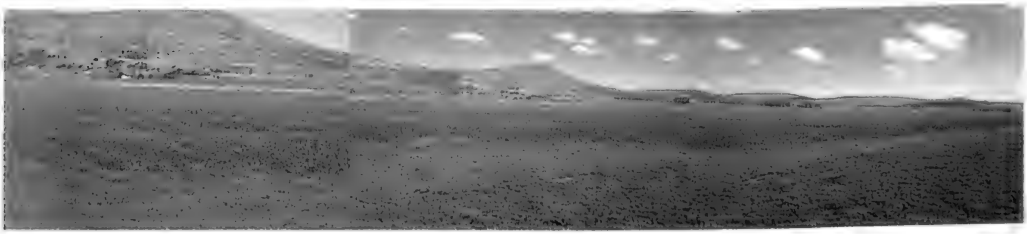
The flowers are particularly striking, being amongst the largest and most attractive of all South African *Nerine* species. It is possible to select in favour of various strains of this species in cultivation, such as large flowers, dark or pale colours and long or short stems. It is probable that the species could be hybridised with other nerines in order to create some attractive cultivars.

The bulbs tolerate low temperatures and might acclimatise to out-of-doors conditions in the northern hemisphere.

Seed is produced in large amounts both in the wild and in cultivation, but needs to be sown within three weeks of maturity. After this time it shrivels and becomes too dry for germination.

Nerine platypetala habitat, Colony A, as the reeds and marginal waer plants start to grow after being burnt by winter fires. All photos this page were taken in early summer.

Nerine platypetala habitat, Colony B. This area is flooded in the late summer when *Nerine platypetala* is in flower.



Nerine platypetala, Colony C, clearly showing the location of the *Nerine platypetala* colonies amongst the marginal water plants in the immediate foreground. The most extensive *N. platypetala* colonies are situated here. In the middle distance is a large bed of *Typha latifolia* and in the distance are extensive beds of *Phragmites australis*.

Photos: Fritz van Oudtshoorn

AN INTRODUCTION TO THE GENUS *BULBINE*

Peter Knippels
Aakwerf 9, 2804 MZ Gouda, The Netherlands

INTRODUCTION

In recent published bulb and succulent literature little attention is given to the genus *Bulbine*. I do not know why. The species are quite attractive and not very difficult to grow. With this article I want to introduce the genus *Bulbine* and especially the species *Bulbine haworthioides* and *B. mesembryanthoides*. Attention will also be given to the culture of these two species.

Bulbine (family Asphodelaceae) is a genus of about 25 species native to the eastern and southern parts of Africa. Most species are common in South Africa. The name *Bulbine* is derived from the Greek *bulbos* which means bulb. I do not think that it is a well chosen name. The plants do not have bulbs, but have swollen, fleshy, tuberous roots or tuberous bases of the roots. The species are stemless or short stemmed, with linear leaves held at the base of the plant (basal rosette). The small flowers are yellow. Other flower characteristics are the spreading segments and the bearded stamens (figure 1). The flowers are held in a loose raceme and are open for only one day, opening in succession for many days. The seeds are black and winged.

A division based on the roots divides the genus into two groups. The species in the first group have fleshy tuberous roots and the leaves do not fall off during the resting period (evergreen). The representatives of this group can be characterized and grown as succulents. The best known species in the first group is *Bulbine alooides*. *Alooides* means "resembling an *Aloe*". The plants forms leaves to 10cm long, 3cm wide and up to 4mm thick. The pale green leaves stand in a basal rosette. *Bulbine alooides* is common in the Cape Peninsula of South Africa. Along with other representatives of this group, *B. alooides* is quite easy to grow. In habitat the plants flower in August; in the northern hemisphere plants flower very early in spring. The *Bulbine* species in my collection flower between November and March. Plants form leaves or start regrowing in the period from October to December. The plants flower during the growing season. Plants in my collection flower February–March. They are dormant between May and October.

The second group contains the species with a tuberous root base. The leaves of the representatives of this group fall off during the resting period. These species are more "bulbous" than the

ones in the first group. Because of the bulbous character the plants in the second group need a true resting period (duration, temperature and humidity) in order to grow and flower successfully in the next season. In general the species in the second group are more difficult to grow and are not widely spread among (amateur) growers in the northern hemisphere. Well known species are *Bulbine haworthioides* and *B. mesembryanthoides.*

BULBINE HAWORTHIOIDES

Bulbine haworthioides is a small plant, even for a bulbine, reaching a diameter of 3–4cm and a height of 1–1.5cm. *Bulbine haworthioides* forms a basal rosette with 20–35 leaves. The leaves have longitudinal dark green stripes. The upstanding margins of the leaves are covered with white coloured, short hairs. The margins of the second half of the leaves are more upright than the first half; they almost touch each other (Figure 3). The light brown tubers are almost round in diameter, the upper and lower side are more flat. Tubers have a diameter of 1–1.5cm and a height of 0.5cm. They grow mainly above the soil surface.

BULBINE MESEMBRYANTHOIDES

Bulbine mesembryanthoides is common in the Richtersveld (the northwest part of Namaqualand in South Africa). The tubers grow above the surface and are oval or compressed-spherical. This species has two different growth types. The best known growth type is with only one or two upright leaves. The leaves are melon shaped, swollen, up to 6cm high and light green in colour. From bottom to top of the leaves they have longitudinal impressed lines. *Bulbine mesembryanthoides* has no real round leaves. The sides of the leaves are bent towards each other, almost touching each other, forming in this way a channel in the centre of the leaf. From this centre grows the inflorescence. Like all *Bulbine* species, the flowers are yellow. The tubers resemble those of *B. haworthioides,* but are slightly bigger. The second, and less known growth type, forms a basal rosette of 4–8 leaves, rather than 1–2 round, upright leaves. Remarkably, this form has only leaves but no inflorescence. The leaves of this form of *B. mesembryanthoides* resembles *B. allooides.* The cause of this growth type is too much water in the beginning of the growing period.

CULTURE

The *Bulbine* species grow in the northern hemisphere in winter and rest during summer. In November and December the new

leaves are formed; the flowering period is January to March. In April and May the leaves dry and fall off. This happens only to the bulbous species. Because the plants do not stand temperatures below 5°C, they have to be grown indoors.

Before saying more about culture, I will say something about the climate in The Netherlands. The mean temperature in winter is -5 to 5°C, in summer 20–25°C. Rainfall occurs all year (750mm a year), with most rain falling July to November (monthly average: 80mm). "Dry" months are February to June (monthly average: 50mm). There is an increased chance of fog, especially in the months October to January. Influenced by the North Sea, the air humidity is high during the whole year, about 50%. One can say that we have a wet climate. The climate (temperature, rainfall, air humidity and amount of sunshine) decides to a great extent the growing circumstances in our glasshouse or house.

The species are sensitive to too much fog as well as high air humidity. This is especially a problem at the beginning of leaf growth in November and December. In this period air humidity is relatively high. Influenced by the humidity, fungi can easily propagate and affect the plants. Central growth buds and newly formed leaves are especially sensitive. The result of fungal infection is that the leaves die. If the growth bud is also affected the whole plant will die.

DISCUSSION

The "bulbous" species of the genus are rare in cultivation. During the last two years this is changing. The species that are already spread among the specialised growers are due to propagation programs also available for a larger group of interested people. Plant and seed collectors in South Africa are showing in recent years more interest in the "smaller" bulbs. New plant material has become more available in our countries in quantitative (amount) as well as in qualitative (different species) ways. It will take some years before these plants are described and more knowledge is gained about culture and propagation. It has to be said that *Bulbine* species in general have little commercial value. The lack of commercial value is due to the short flowering period and the size of the plants and their inflorescences.

LITERATURE CITED

Jacobsen, H. 1986. **A Handbook Of Succulent Plants. Descriptions, synonyms and cultural details for succulents other than Cactaceae.**. Volume 1. 5th Ed. Blandford Press, Dorset, England.

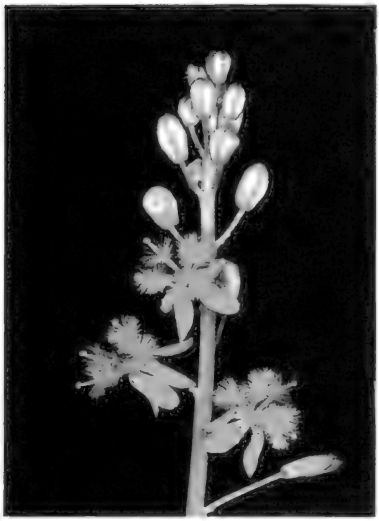


Figure 1. Above left. Inflorescence of a *Bulbine* species.
Figure 2. Above right. *Bulbine mesembryanthoides.*
Figure 3. Below. *Bulbine haworthioides.* Photos: Peter Knippels

A PASSION FOR RAINLILIES: *COOPERIA, HABRANTHUS* AND *ZEPHYRANTHES*

John D. Fellers
Auburn, Alabama, United States of America

INTRODUCTION

Observations and experiments resulting from more than 30 years of propagating *Zephyranthes, Habranthus, Cooperia, Cooperanthes* and (possible) bigeneric crosses will be discussed. The approach will include some descriptions and observations but will lean more toward management than taxonomic detail, although some varieties will be presented. Some of the rainlily varieties were collected, others acquired from a number of sources and observations (and notes) have been made on varieties left in the wild. Natives of Southeast and Southwest U.S.A., Mexico, Central and South America are included.

Plants in the collection acquired in the early years have been exposed to at least 3 localities: Gainesville, Florida; Mobile, Alabama (15 years) and Auburn, Alabama (in that order). Winter weather conditions became colder with each move. Summers remained hot in each location, but rainfall varied. Weather patterns cycled and varied (especially in Auburn) from very dry summers to extremely wet seasons, sometimes back to back.

My accessions of rainlilies has increased significantly every season. About 95% of the rainlilies in the collection are kept in pots (some have been potted 25–30 years). In all three locations, the potted bulbs have been greenhoused during winters or protected from frost and freezing weather. The greenhouses are cool houses, only heated enough to prevent freezing (35–40°F) [2–4°C]. Rainlilies in the greenhouse are watered sparingly in winter, thus some controlled conditions are maintained.

Each plant acquired is coded and each pot labeled with a group prefix and individual number code. This facilitates maintaining identity and parental trails. A sophisticated logging and data system is maintained. When plants flower they are described, measured and some characteristics and habits logged. The process is actually more detailed but this conveys the idea. This article will discuss some information accumulated and some of the perceptions developed. Other reports on these rainlilies may have been based on other conditions (or perspectives). Attempts will be made to present the experiences and findings in this setting and let the reader develop the conclusions.

GENERAL

Variations in rainlilies are many. Some of these variations are addressed in brief in this article. Not all mature rainlily bulbs bloom every year; however in certain varieties, a bulb may flower several consecutive seasons before skipping a season (or seasons). It is not uncommon for a given bulb to only surface with a flower every 3, 4 or more years. Others nearby may flower; however this is easy to document when only one bulb is in a pot (and it does not offset). Zephyranthes 'Wyndham Hayward', Z. 'Fools Gold' and Z. 'C.K. Darking' are among those that seem to bloom sporadically.

Bloomers and free bloomers traditionally produce 1-2 flowers per bulb per season; some large bulbs get on a roll and produce 3-4 blooms generally spread out over the season. Varieties that have a track history as multiple bloomers are H. brachyandrus , Z. 'Twinkle' type hybrids. Z. 'Cypress Gardens' (a seed sterile variety in this collection) and some Cooperia and Cooperanthes. In a greenhouse, zephyranthes begin blooming mid-February (plus or minus a week) each year. A few-to-many rainlilies flower nearly every day thereafter until mid-October, with a few stragglers blooming later. *Zephyranthes atamasco*, potted as seed parents, leads off the early bloomers; but generally within about a week other varieties start blooming. During March, *Z. treatiae*, Z. 'Horsetail Falls', *Z. iturbide*, *Z. katherinae* (baby pink form), *Z. katherinae* (powder white form), x *Coobranthus* (*Cooperanthes*) *lancasterii*, some unnamed seedling crosses and occasionally a *Cooperia drummondii* (strain) blooms. Protected pots of *Z. atamasco* wintered outside also flower from early March to the end of April.

The volume of flowers from several species and hybrids increases in April, and includes rebloom from those listed above. Several strains of *Cooperia drummondii, C. morris-clintii, Z.* 'Fantasia' ('Fantasma'), *Z. grandiflora* and *Cooperanthes* 'Bayberry Bells' flower consistently in April. In the ground outside, *Z. atamasco* blooms in April. In this locality, it begins to flower about the time the potted bulbs finish.

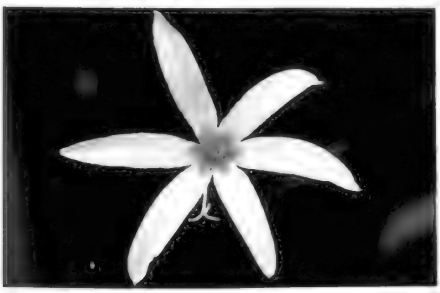
There is a significant increase of flowering in May with new species and hybrids joining those listed above. The habranthus start blooming in early May and continue through the month. *H. robustus* and several groups (part *H. robustus*) including *H.* 'Russel Manning' are among these (although these varieties also explode with flowers in June). *Z. macrosiphon* (LT. Var); *Z.* 'Twinkle', *Z. reginae*, a white (bantam) *Z. verecunda* type, and other unnamed zephranthes and cooperanthes surface in May. The flowering unnamed varieties include two similar varieties with bright gold

Zephyranthes atamasco

Zephyranthes bifolia

Zephyranthes atamasco PNT-3

Zephyranthes simpsonii x *Z.*



Zephyranthes atamasco TPT-1

Zephyranthes What's It #1

Photos: John D. Fellers

centers and wide margins with *Z. capricorn*-like tinting. Unnamed members of a complex comprised of *Z.* 'Grace Primo' progeny (including some gems) start blooming late in May.

The borderline May-June flowers occur in a mixture of pots moved outside and those not yet transferred (the latter comprised the most). In this short window of time *Z.* 'Summertime', *Z. forsteri*, *Z.* 'Libra', *Z.* 'Aurelian', several unnamed *Zephyranthes* hybrids, *Z. grandiflora* seedlings (hybrids), *Cooperanthes* 'Prairie Sunset', *Habranthus branchyandrus* and an unnamed white *Habranthus* (to be discussed in "Breeding Rainlilies") has started flowering. Thus the summer bloom season is just about to spring forth with a myriad of blooms.

Note that almost all of the blooms mentioned above occurred in a greenhouse heated only enough to prevent freezing. Normal nighttime low is about 45°F [7°C] in winter in this area, except for the recurring fronts followed by frosts and freezes. Note too that these varieties have been hand watered sparingly all winter. When buds and scapes surface in a pot, watering is increased. Weather functions mostly to influence greenhouse warmth and humidity.

The transfer of pots from the greenhouses to outside has traditionally occurred from late May through early June. In 1994, an excessively wet summer, and in 1995, a very dry summer, the greenhouse was on the property on which the rainlilies would summer outdoors. Because of the weather, a part of the inventory of several varieties was delayed from being transported outside. The motive was to control blooming of a selected group to flower in the traditional valley periods between the traditional peak blooming periods outside (influenced by weather and rain).

The discovery was that when companion varieties outside burst forth with blooms, counterparts inside the greenhouse also flowered. Controlled watering in the greenhouse and shelter from natural weather did not alter flowering all that much. This is substantiated roughly with the practice of bringing pots back under shelter when flower buds show. These are analyzed, described, emasculated and often pollinated while in bloom. Plants setting seed are kept under shelter until seed is harvested. These continue to flower, however in this setting they are watered regularly and a bit more heavily than non-flowering pots in the greenhouse.

There are 4-5 peak bloom periods during each summer in the pots relocated outside (I call these blitzes). That is, the flower volume is much increased during these periods. New flowers appear each day during the peaks for 3-5 days (or sometimes 6 days with a dip in number about day 4). The first peak (blitz) starts in early

June (June 10±4 days). Peaks repeat at about 10-14 day intervals. The final blitz occurs about mid-August. The early June and mid-August peaks tend to have the greatest volume of flowers. Rainlilies continue to bloom during the slower periods between peaks but the volume is less and some of the players are different.

Habranthus robustus dominates the early June blitz. This is its calendar. *Habranthus* with *H. robustus* in them (mostly *robustus-brachyandrus* of some ratio) are triggered in this period; however zephyranthes bloom in this period and many zephyranthes will flower well into August. Rainlilies that start flowering in late May continue along with a number of unnamed forms into June. *Cooperia drummondii* and *C. morris-clintii* types tend to flower in this period. A number of rainlilies that start (or continue) blooming in June will have blooms throughout summer. These peak enough to create a second blitz in June. During this period (peaks and valleys included) flowers will appear on *Z. macrosiphon* (both light and dark varieties), *Z. grandiflora*, 'Ruth Page', 'Ajax', 'Aurelian', 'San Antonio', 'Big Shot', 'Sun Burst', 'Nelson Pink', 'Desiree', 'Apricot Queen', 'Mockingbird', 'Carmen Jones', 'Summertime', *Cooperanthus* 'Bayberry Bells', 'Prairie Sunset', *Habranthus brachyandrus, H. tubispathus* and several unnamed varieties/complexes.

By the third blitz (about the first week of July) pure *H. robustus* is winding down and *H. brachyandrus* is increasing in volume. A white unnamed *Habranthus* (in development) is also nearly in its prime. *H. martinezii*, 'Teddy Bulher', *Cooperia pedunculata, Z. primulina*, 'Candidax', 'Concar', 'Cypress Gardens', 'El Brogue 6913', 'Smoky' and other unnamed plants have bloomed.

The late summer bloomers are waking up by the 4th blitz (late July). *Cooperia smallii, C. jonesii, Cooperanthes* 'Bombay', 'Loran Smoyer', *Z. simpsonii, Z.* x *flaggii* (Nelson's little Panama pink), *Z.* 'Hildago Gardens', 'Grandjax', 'Pink ice'. 'Jacala Blush', 'Grand Canyon', 'Capricorn', 'Lone Star', 'Aries', 'Burnt Offering', 'Fire Ball', 'Hellen Wyatt', and 'Maria Louisa' are among these. Certain varieties will flower into August and after. *Z.* 'Grand Jax', 'Aries' and 'Burnt Offering' often flower late in September. Unnamed rainlilies with late calendars will flower along with these. Carryovers such as *H. branchyandrus* tend to straggle and keep appearing.

The final blitz occurs in August, usually by August 20 and features the yellow flowered zephyranthes: *Z. dichromantha, Z. rosea, Z. citrina*, 'Sulphurea', 'Texas', 'Lolita', 'Midas', 'Sugar Doodle', 'Pink Star', 'Peachy', 'White King' and many yellow hybrids (especially those plants having *Z. candida, Z. citrina*, and *Z. pulchella* as a parent). *Z. candida*, a near hardy white, begins in late August and

flowers into October or later. *Z. candida* (in the ground) seems to set seed better late in its flowering season.

RAIN INFLUENCE IN INDUCING FLOWERING

By the name it is obvious that rainlilies have long been associated with rainy times or rains. It is poetic to state that variety "y" blooms about one rain later than variety "x". Other amaryllids are associated with weather also. In differing areas *Lycoris radiata* and *L. aurea* are known as hurricane lilies. These flower in autumn even if no hurricane is imminent. The reader may suspect that some rainlilies may have similar tendencies at the conclusion of this section. *Zeyphranthes atamasco* are known as Easter Lilies in several rural localities, suggesting a link in the time of flowering.

Certainly rains on the right dates function as a catalyst to inspire blooming in a number of varieties of rainlilies. (Please note the experience mentioned in the above section where rainlilies were kept in a greenhouse but flowered on schedule without benefit of rain. Some of these bloomed with limited watering.)

Certain *Cooperia, Cooperanthus* and some *Zephyranthes* send up flower scapes quickly after a rain. However, there are certain rainlilies that traditionally seem to wait a period of time after a rain to bloom; this is after peak blooming volumes by other varieties—following a rain—have subsided. These seem to bloom after the sun has beamed down for two to three days or more after a rain. They also seem to be inhibited by too much rain (rain every day for a period). An example is the red flowering *Z.* 'Carmen Jones' which tends to flower 4–5 days after rains (and in the lull after a bloom blitz), but seldom blooms if it rains too often.

One unofficial test of weather influence on rainlilies blooming might be gleaned from the flowering histories of 1993, 1994 and 1995. Nineteen ninety-three was representative of normal years with normal rains. Following mid-June the summer rains came regularly, but 2–3 days dry-out time was often permitted. Rain in 1994 was excessive, often every day (and all day and all night at times). Nineteen ninety-five had a very dry summer. Bloom volume in 1995 exceeded the volume in 1994 by about 30%; however bloom volume in 1993 doubled the 1994 output. One can suspect that the excessive rain inhibited flowering in some varieties as this was the only variable in conditions.

FLOWER COLOR VARIATIONS

It has been said that color is secondary in classifying amaryllids; but it is primary to gardeners. Generally rainlily colors range

from purples, lavenders, lilacs and violets to magenta, dark roses, rose reds and pinks to white, oranges, salmons, apricots, yellows, golds, buffs, ivories and a spectrum of variations of these.

Red, especially dark red, is rare and blue is very rare. A blue (*Z. caerulea*) is reported to exist in South America but it seems to be difficult to acquire. It seems probable that reds and blues can be developed by breeding (reds seem easier). The challenge is to discover the right parent combinations. There are some cool pinks such as *Z.* 'Pink Star' that suggest blue tones, but it is likely that if a blue is accomplished, it will come from the most unlikely source.

Zephyranthes 'Carmen Jones' seems to be one of the toughest reds and less rare than *Z. bifolia* and others. *Z. bifolia* is a tender and temperamental species from the Dominican Republic that has a chromosome number of $2n=60$. Pollen from *Z. bifolia* does not seem compatiable with rainlilies available in the U.S.A. Attempts to hybridize with *Z. bifolia* pollen in the early 1980s failed. However, hybrids were received by me with this species in their parentage, so apparently it can sometimes be used in hybridizing. 'Carmen Jones' is being used in one of the breeding programs under way here. Some of its seedlings have shown promise.

The colors of rainlilies are more vivid at opening and tend to age to optimum quality in about an hour. Color quality tends to fade with aging. Some species and some "established varieties" tend to hold basic colors throughout the bloom period. Generally, more reliable descriptions can be written if the color analysis is accomplished within 3–4 hours of the flower's opening. *H. robustus,* a species with pale pink above the throat, fades lighter in hot sun toward whitish on day one. The color tones hold better when protected. However some species and cultivars with intense pigmentation hold their color well. This is particularly true of the yellows (*Z. citrina, Z. pulchella, Z.* 'Midas', etc.).

Hybrids are another story. Colors change practically throughout the bloom cycle in some of them. This is a flower tone change, not physical aging. The color changes but the color quality holds well into day two. In order to savor all of the splendor of rainlilies one must live with them closely throughout the bloom cycle.

Early hybrids by Dr. Thad Howard and contemporaries are still gems. *Zephyranthes* 'Grand Canyon', aptly named, opens with an array of colors of orange, salmon, rust, apricot and buff in strata form suggesting a great canyon. It is a huge, almost floppy flower, which enhances the grandeur. After opening, the colors intensify for an hour or so to 7:00-7:30 a.m.; then the color transformation becomes evident with constant changing of hues and tones. Light

may be a factor contributing to these color changes. By mid-afternoon, 'Grand Canyon' has developed to a bright, near solid buff. At this point it somewhat resembles another large flowering hybrid at about the same stage (day one), *Z.* 'Sunburst'. 'Sunburst' starts out a bit less spectacular with orange-rust blush on a wheat straw tinted base. *Z.* 'Sunburst' ages slightly more smokey (in day two). In late day two, both of these hybrids have aged to an off-white, creamy, pinkish tint. *Z.* 'Desiree', another large flowered variety opens a tawny or salmon orange blush on a very light yellow base; the segments are upright at first. It ages to a pinkish cream in day two with the segments greatly recurved downward.

Seedling *Z.* 'P7-91-18', a product of this collection, opens a vivid, intense, slightly harsh orange (slightly more tangerine than pumpkin). It ages toward melon (lighter than cantaloupe) by nightfall. Then it does a reverse color change during day two, starting near ivory-flush it ages to a heavy watermelon tint by mid afternoon before fading. The seed parent is *Z.* 'Nelson Pink' (not the little Panama pink); this one is slightly different from *Z.* 'Ruth Page' being redder and a different form. It is not known if it is a cross or a species. The pollen parent is *Z.* 'Texas' x (*Z. citrina* x ?). This immediate pollen parent (*Z. citrina* hybrid) is about twice the size of *Z. citrina* and is an intense clear gold. The seed parent of this hybrid is known to be *Z. citrina* but a label mishap lost the pollen parent documentation which is thought to be *Z. pulchella* or *H. howardii*. Other seedling crosses from *Z.* 'Nelson Pink' are interesting but probably not as dramatic. The list of these variable colored rain lilies is not short. They seem to be predominantly Zephranthes hybrids.

MANAGEMENT

Losses have been minimum when the rainlilies were kept in pots and handled as indicated in the introduction. A significant percentage of the originals dating back into the 1960s and early 1970s are still flowering. Losses have occurred mostly with desert varieties such as *Z. longifolia*, etc., during moves when there was inability to protect them from excessive summer rain. Some losses occurred during floods (including some desert varieties) from a couple of dam collapses after Hurricane Frederick (in Mobile). A number of those dumped were retrieved, repotted and identified when they subsequently flowered. However, some enthusiastic naturalists may report exciting discoveries downstream some day.

Experience with rainlilies planted in the ground has not been so favorable as keeping them potted. Losses have been sustained

when non-native varieties were planted in the ground, even with varying methods of management. Varieties moved only a couple of hundred miles sometimes succumbed; winter survival seems to be the biggest challenge. Certain tough varieties such as *H. robustus, H. tubispathus, Z. grandiflora, Z. candida* and *C. drummondii* can survive in the ground in this locality if the conditions are right (sun, drainage, etc.). This is borderline USDA Plant Hardiness Zone 7 and 8. Lessons in learning are costly; some gems have been lost.

Acid loving plants such as rhododendrons thrive better if some lime is applied periodically. Applying a small amount of agricultural lime to potting mixtures for rainlilies also seems to be beneficial, especially when a high amount of bark, peat, etc., is used in the mixtures. The amount of lime would depend upon the soil pH and mixture used. A little lime also seems to reduce albino leaves in germinating amaryllid seedlings.

Rainlily seeds are relatively perishable. The window in which the seeds may be exposed to atmospheric or room temperatures and still achieve optimum germination is limited. Holding seeds for planting from one accession to the next has been disappointing. One writer reported in **HERBERTIA** the results of a study indicating that seeds aged for 10 days after maturity then planted immediately yielded the best germination rate. No question that planting rainlily seeds during the growing season as quickly as practicable enhances the chance for optimum germination.

Late flowering varieties such as *Z. candida*, many yellows and others set seed late in September and October and thus ripen in very late autumn. Conditions for germinating and surviving for these late flowering varieties is no longer ideal and the results confirm this. A method (similar to holding pollen) in which the seeds were packaged, sealed and refrigerated until the next growing season was tested. Seeds were placed in styrofoam cups and nested (one seed pod per cup) then packaged in polyethylene tubes (3-ply and criss-crossed) and sealed. Thereby some insulation was afforded.

Seeds were planted in June next season and germination was favorable; better results were achieved than using Grow Lux™-lights, floating and other methods tried previously. This became the operating procedure thereafter for these late bloomers (the results continued good). Encouraged by this experience and because of construction on the property, a portion of the 1992 accession of rainlilies was processed and held over for 1993 planting—in all, 873 pods in cups plus some bulk packages.

A substantial portion of these 1992 seeds were planted in June

and July 1993, about the same time that early 1993 accessions were planted. Germination yield was about the same for both accessions. All 1992 low percentage yield varieties and some higher yield varieties were planted; however, a portion of the high yield varieties were left over and held refrigerated.

In 1993 a similar situation, construction of a new greenhouse, prompted processing about the same number of 1993 accessions for 1994 planting (as done in 1992). Planting procedures in 1994 followed those applied in the previous year (with some improvement in facilities and equipment). The results were as good as the previous results. In addition, two packages of seeds from 1991 accessions were found in storage. These were *Z. citrina* and an habranthus (adulterated *H. robustus*). These germinated quickly with high yield and are growing like weeds.

An informal experimental program was launched in 1994 to hold some of these 1992 and 1993 accessions and plant a sample each subsequent year as long as they last, and/or continue germinating. Any fall-off in germination would be noted. The criteria for planting the 1992 accessions in 1994 was broad. The intent was to verify that a representative number of seeds planted in each pot (for each variety) germinated. No attempt was made to count the seeds planted or count the number germinated within a specified time to get a germination percentage. The procedure adopted was to plant at least 6 seeds or one seed pod, whichever was more, in each quart [liter] pot. The test would be: 1. If any seeds germinated at all and: 2. If 4 seeds or more germinated. Success would be based on 4 or more seeds germinating. The pots for each variety would be averaged to get the seeds per pot germinated. The growing ability is also being recorded.

The seeds were planted late in 1994; the results were favorable. All pots had at least one (or more) seed germinate and averaged more than 4 seeds per pot germinated, some significantly more. The survival rate at the end of three months was favorable. The habranthus had a high yield.

VARIETIES IN THE 1994 TEST STEP

Seeds of the 1992 accession varieties planted in 1994: *Z. citrina* (6 pots); *Z.* 'P10', 'Twinkle' type (26 pots); *Cooperia drummondii* three strains (12 pots), *Habranthus* 'H11' (*H. robutus/H. brachyandrus* crosses) (20 pots): seeds approximately two accessions old.

The 1995 step in the experiment followed the same criteria as 1994 and these germinated with an average of 4 or more seeds per pot. Most of these survived at the three month check.

VARIETIES IN THE 1995 TEST STEP

The seeds of the 1992 accession varieties planted in 1995: *Z citrina* (12 pots); *Z* 'P10', 'Twinkle' type (8 pots); *Habranthus* 'H-11' *Z. robustus-brachyandrus* crosses (20 pots); *Habranthus* 'JD Stain', *H. robustus-Zephryanthes* crosses (22 pots). 1993 accessions planted in 1995: *Z citrina* (12 pots); *H. tubispathus* (6 pots). Note that these seeds were approximately two and three accessions old.

A representative sample of 1992-1993 accessions were sent to a colleague who reported getting reasonable germination.

The samples were planted in quart pots; the soil mixture was made up of 40% commercial top soil and 60% native dirt. To this a small amount Milorganite™, bone meal and agricultural lime was mixed into the soil. It was topped with a thin layer of commercial potting soil under a layer of wet Canadian spagnum. A pinch of real iron (yellow powder), a few grains of agricultural lime and a few grains of Osmocote™ (18-6-12) were added. This is sufficient feeding until the first bloom. The pots are thoroughly wet down for 2-3 days before planting. After planting the seeds are kept wet until initial germination is observed (a few radicles) then reduced to keep the soil slightly damp. Humidity is one key to success. A soft water spray is used to prevent splashing and thus to reduce the chance of seed escapes. A low wind area is also beneficial in reducing escapes. Rainlily seeds are highly mobile. Chamelions, toads and other small animals can do some tracking. Seeds are planted when the night temperature remains warm, about 60°F [16°C] or above.

ZEPHYRANTHES ATAMASCO

Rainlilies classified as *Zephyranthes atamasco* are native to the Southeast U.S.A. and are found in a wide geographical area. The northern range extends from the Atlantic Ocean approximately across the southern border of U.S.D.A. Plant Hardiness Zone 7, across the Chattahoochee River for about 100 miles [161km] into central Alabama. Plants of *Z. atamasco* are reported to extend northward along the Atlantic coastline upward into Virginia. The southern range of *Z. atamasco* extends south into Florida about through Zone 9. Two other very rare *Zephyranthes* species, *Z. treatiae* and *Z. simpsonii*, are found in Florida, restricted to Zone 9 (although some strains considered to be *Z. treatiae* are in Zone 8). There are reports of *Z. atamasco* being found in locations to the north and west of the range stated. It is probable that these were transported by people during earlier times and they have subsequently escaped. *Zephyranthes atamasco* in locations reported in

Virginia and Pennsylvania would likely be in protected areas in which the ground does not freeze very deeply.

Zephyranthes atamasco bulbs in colder regions of their range have been found to extend deeper into the ground than normal, similar to daffodils. Populations reported in western Alabama, Mississippi and East Texas seem to be in localized areas suggesting escapes in past years. Bulbs known to have been transplanted to East Texas about 40 years ago are reported to be thriving as natives. The weather and soil conditions in these western sites are similar to Alabama and west Georgia.

Publications on native plants in Texas dating back 150 years or so lists *Z. atamasco* as native to that state; however, subsequent reports have revealed that this was a mistaken identity. This species was first identified in literature by Parkinson in 1629 and tranferred to a new genus *Zephyranthes* in 1821 by Herbert. Early folk lore of settlers and Native Americans has revealed that *Z. atamasco* has long been appreciated. Native Americans (apparently southern neighbors of the Cherokee) used them as calendars. When *Z. atamasco* flowered it signalled time to plant corn and certain other crops.

Z. atamasco includes a group of white flowering rainlilies with a broad window of characteristics. There are more differences in *Z. atamasco* than in some of the yellow zephyranthes and some of the pink zephyranthes that are classed as separate species and separate varieties.

Having begun collecting and dabbling with *Z. atamasco* in the mid 1950s, I have been intrigued with new information learned about them each season, including 1995. Much has been written about *Z. atamasco* and for the most part it seems correct for a strain (or strains) in a given locality; but, *Z. atamasco* in other regions or states may display some differences from these. In some regions, particularly in Florida localities where literally millions bloom at once, several uniquely different flower forms can be seen at one time, but the other characteristics may be common. One clump of flowers may have segments narrowly elliptic (linear to almost ribbon-like) while another clump might have more rotund and imbricated flowers. There may also be some varieties, however, that appear to be different strains. *Z. atamasco* in localities in northern regions seems to have developed strains more unique to that locality.

A given strain of *Z. atamasco* may be traced around a particular creek or river and down that waterway for several miles into areas where these may overflow during summer. This may not

substantiate that they prefer wet areas and/or aquatic conditions, but that they can tolerate and survive in flood plains. However, *Z. atamasco* can also be found in highlands, on ridges, in fields, on road beds, etc. They are likely to be more abundant in the lowlands because seeds have washed there during rains (and possess survival ability) throughout eons and because higher ground habitats have been reduced by agriculture and other development.

Zephyranthes atamasco grows in pine woods and in areas with mostly deciduous hardwood trees. It will flourish in full sun or in shaded sites. The soil in Alabama, Georgia, and the Carolinas where this species grows is mostly quite heavy clay. The lowlands may be more sandy with silt washed in, whereas in other lowland sites plain black muck is found (becoming very hard if it ever dries out). Florida and south Georgia have sandier soils and sandy loam. The pH of the soil is generally acid where *Z. atamasco* grows.

Typically *Z. atamasco* produces big flowers for a small bulb. Some blooms are bigger than most habranthes flowers. Blooms up to 6 inches [15cm] across the perianth are not uncommon. Strains in the northern range produce bigger flowers and have wider leaves than most Florida strains.

The growing habits of *Z. atamasco* resemble daffodils more than other rainlilies. Leaves start appearing near the end of December in several of the strains in the northern range and grow through the blooming start ups. While the blooming and reblooming period lasts 3 weeks or so in the wild, the leaves start dying back and complete the process by the time the last seeds are harvested. These bulbs never completely go dormant, they continue growing, offsetting, etc., under ground, and short leaves can sometimes be found under cover of fallen leaves.

Flowers in the northern range can be expected about April 15 just after the dogwoods [*Cornus florida*] bloom. Central Florida strains leaf out 2–3 weeks prior to northern strains and flower around March 15 (concurrent with azaleas). There are unique strains in Florida. One is a cold weather bloomer near Tallahassee which flowers early in February. The flowers often show cold and frost effect with the pinkish aging. The flowers are often pitched with the upper setepalsegs recurved back and the lower petepalsegs extending out. The flowers are medium size for *Z. atamasco*. This one typically has a rose tint on the segment reverse apex especially setepalsegs. The narrow leaves are deep bluish green (glaucous).

As expected, *Z. atamasco* strains wintered in a greenhouse or potted and protected from freezing and frosts behave differently from their counterparts in the wild. They leaf out about the same

time but the blooming period starts in February in the greenhouse and continues into April, about the time field grown strains in the local area start flowering. All strains of *Z. atamasco* remain in flower longer (more days) than other rainlilies, including *Z. candida* (even *Z. atamasco* growing outside in the field holds flowers 3-4 days longer than other species). However, in a greenhouse, and for the protected strains brought into a greenhouse in bud, the in-bloom period is extended significantly. Ten days in flower is common. The winters that pots were placed on a concrete greenhouse floor a number of plants of *Z. atamasco* remained in flower 12-15 days. Some northern strains tended to hold the longest.

Other March flowering rainlilies such as *Z. iturbridi* and *Z.* 'Horsetail Falls', held flowers longer than the summer-flowering varieties (2-3 days longer). However, none of these varieties (in my collection) outlasted *Z. atamasco* or *Z. treatiae* (and *Z. atamasco* outlasted *Z. treatiae* by 2-3 days). There are some unnamed seedlings rainlilies in the collection that have surfaced lasting a day or two longer in flower during hot summer weather than contemporaries; these are being watched with intrigue.

The long flowering term of *Z. atmasco* complicates knowing when is the optimum time in the bloom cycle to pollinate (the ovulation period). Trial and error practices revealed that pollinating *Z. atamasco* like other rainlilies on day 1, 2 or even day 3 netted poor results. Subsequently a method evolved to pollinate first at about day 6 and again when evidence of the approaching flower termination is observed. This seems to produce the best percentage of seed setting for *Z. atamasco.* (The last pollination is predictably the key.) Flowers holding 10 days or longer often get pollinated three times in intervals beginning with day 6.

All *Z. atamasco* flowering in the greenhouse, including those moved in when buds form, are pollinated with another variety. Note that at this date insect activity is nil. Nevertheless, emasculating all rain lilies expeditiously is practiced in order to minimize the chance of unknown adulteration.

Z. atamasco, like other amaryllids, has strains that set seed with foreign pollen more readily than other strains, and pollen from certain varieties is accepted better than other varieties. When these are known the percentage of success is predictable. Other combinations seem to be lucky chances where conditions are just right at that moment. Several takes (successes) may be achieved if this combination is duplicated within a short period of time. Successes with such a combination of parents may not have happened before and may not happen again (at least for a while).

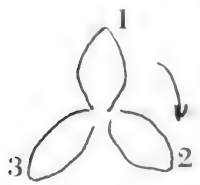
Short of knowing chromosome numbers of the donors, trial (success and failures) functions as the fact finder.

Some of the *Z. atamasco* hybrids result in interesting varieties. A few of these will be presented in this section. Patience is virtue when working with *Z. atamasco*, because many of these are slow to show radicles in germination and are also slow to flower.

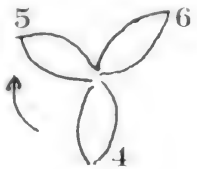
Although all *Z. atamasco* produce a "white" flower, some differences may be shown in flower form and color. Flower perianths typically are funnelform, reducing to narrowly funnelform in the lower third. It is predictable that all strains of *Z. atamascos* have similar chromosome numbers (or multiples of a common number).

Bulbs of *Z. atamasco* typically tend to be globose but occasionally they can be ovoid. They tend to be lighter in color than other zephyranthes. Flower segments are generally oblanceolate with variations in length-to-width ratios of different varieties and strains. They tend to start suberect 30–45° and curve outward. Some flowers nod slightly, probably because of the weight. The filaments and styles are white except for a unique one which showed up in my hybridizing. Anthers are light yellow, medium slender, 9–12mm long, evolving with yellow pollen. The anthers are versatile, generally leaning toward the segments, and are lower than the stigma. Style length and thickness vary; thin ones sometime curve toward a segment, then up or out.

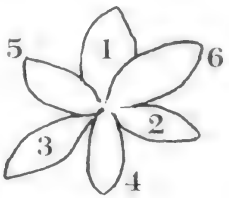
Another factor arises in the measurement and definition of segments of rainlilies. In some rainlilies the six segments are not mirror images of one another as occurs in some other plants. The segment forms may vary and the widths may vary more than 20%. *Z. atamasco* is no exception (but more variation occurs with habranthus, especially *H. brachyandrus*). The setepalsegs of *Z. atamasco* tend to be wider than the petepalsegs. In that the measurements of bulbs, leaves, and flowers serves as an indicator of the physical characteristics of the varieties, knowing more about all six segments conveys more meaning. The following drawings are used to provide a clearer image of the flowers:



Setepalsegs



Petepalsegs



Setepalsegs and Petepalsegs

Measurements in the following descriptions are listed in this order:

Setepalsegs: segments 1, 2 and 3, in milimeters (mm)

Petepalsegs: segments 4, 5 and 6, in milimeters (mm)

Often #1 is the biggest and #4 is the smallest of the floral segments.

Variations in the *Z. atamasco* species may be detected in the detailed presentation of the strains. Terms are defined to clarify some of the measurements.

TERMS USED

Vertical— The measurement on the reverse of the flower from the apex of the segment (number one setepalseg.) to the ovule.

Scape — The measure from the bottom of the pedicel to the ground or bulb neck whichever is higher.

Perianth — The measurement from apex of number one setepalseg to apex of number four petepalseg, (the width of the flower is not given in measurements in this presentation).

A representative variety of a region is presented with a discussion of the characteristics in the strains. A given region includes strains within a 50-100 mile radius. A code will identify the strain.

EAST CENTRAL ALABAMA REGION

In this region the *Z. atamasco* strains tend to have dark green, shiny (luminescent) leaves, somewhat like young *Z. candida* leaves but darker green. Leaves appear on these in late December and start dying back during or after flowering while seeding. Leaves feel tender but occasionally the older leaves last long enough to get slightly slicker and a tougher feel (late in their existence), but are not as wiry as *Z. treatiae* or summer flowering zephyranthes.

Z. atamasco PNT strains were found on slopes 3-4 ft. [1-1.3m] above ditches in sunny locations with scattering water oaks.

Strain (PNT-1) Leaves 7mm wide, 33.2cm long, near flat, slightly concave; Scape 20.8cm.; Pedicel 5cm; Spathe 4.2cm. Flower buds light ivory with brownish tinted rib tip at apex. Perianth 10.4cm, vertical 9.3cm; setepalsegs 26-25-24mm wide; petepalsegs. 22-22-22mm; tube light green. Stigma trifid, furcate, branches thin, 2mm long. Some larger individuals in this strain had flowers 12.2cm perianths with the other numbers about in the same ratio.

Strain (PNT-2) are located about 5 miles from PNT-1 and flower-about 2 weeks later. Leaves 3mm wide, 24.6cm long, concave; Scape 17.2cm, olive to copperish at base; Spathe 3.2cm; Pedicel 2.1cm; Flower buds (as well as spathe and scape) very red 24 hours before flowers open, aging to dark mauve rose upper half, olive base on lower half at flower opening, carried rose blush on flower reverse at the apex of setepalsegs, petepalsegs less; Perianth 8.6cm; vertical 7.4cm; segments flushed rose on ends at apex, petepalsegs less; setepalsegs 19-18-17mm; petepalsegs 16-15-17mm; Anthers medium slender, 10mm long; Stigma trifid, furcate, branches 5mm long (very long and thicker than variety PNT-1); Style medium long with stigma just above anthers.

Note the white is intensely pigmented giving a heavy texture effect similar to *Z. simpsonii*. This strain has narrow leaves, very long stigma branches (thicker than Florida strains), shorter style (shorter than typical for the region), longer pedicel than typical and smaller flowers than typical for the region (still funnelform but they do not open so wide as typical).

Strain (PNT-3) This strain was growing about 30 miles [48.3km] SW from the two strains presented above. Leaves 6mm wide, 27.8cm long, medium channelled; Scape 20.2cm, slightly amber at base; Spathe 3.2cm; Pedicel 9mm; Flower buds light rose at apex, carried through lighter on segment reverse with blush on apex (end tip) of setepalsegs; Perianth 9.8cm; vertical 8.3cm; setepalsegs 29-28-28mm; petepalsegs 24-25-25mm; segments very widely obovate (almost circular), imbricated, white with pink blush apex (tip) setepalsegs; tube light lime; Stigma trifid, furcate, short branches (lobes), above anthers 5mm. Exhibition quality flowers of royal white are enhanced by the very wide imbricated segments. Some bulbs have 8mm wide leaves ending bluntly at the apex.

GF strain was collected from a heavily wooded flood plain approximately 70 miles [113km] northeast of the PNT strain sites. They flowered well in that setting. Within the secluded area, this strain seems to have pretty well evolved into a common variety (standard breed). Flowers are generally large and predominantly pure white; yet a percentage of flowers are flushed with rose on the segment reverse apex. Buds of flowers with a slight blush on segments are dull reddish to slightly purple; buds of the pure white flowers are whitish or white with a slight brownish tint at rib apex. Flowers measuring 14-15cm across the perianth are no surprise. The flower forms vary somewhat and pedicels vary from about 1.6cm

to almost sessile (.5-.8cm is normal). Minor variations within this strain seem to be within an acceptable tolerance.

Strain (GF-1) Leaves 7mm wide, 31.7cm long, slightly concave; Scape 19.8cm, light copper tinted one inch above base; Spathe 3.7 cm, straw green; Perianth 13.4cm, vertical 10.3cm; setepalsegs. 28-27-26mm; petepalsegs 22-23-23mm; tube green; Anthers medium slender, 12mm long, yellow, powders early; Stigma 7mm above anthers (see above)..

The unique aspect of this "GF" strain which sets it apart from most *Z. atamasco* strains is the stigma. The stigma is trifid, however the branches are so tiny that they almost look capitate. These are nubbin-like, extending from the top of the style, and too tiny to measure (less than 1mm). This strain sets seed readily and sets seed with pollen from other varieties at a higher percentage than many other strains. Other *Z. atamasco* strains have short, stubby stigma branches, but these other varieties seem to be somewhere between the GF-strains and the longer branch stigma types.

CENTRAL SOUTH CAROLINA REGION

Zephyranthes atamasco found in this region tends to have a higher percentage of pure whites than those of the east Alabama regions. Tint on those with blush is faint and fades more with age. Segments tend to be long and slender. One sub-strain resembles a huge *Z.* 'Big Shot' in form (perianth 15.4mm). Leaves are dark grass green and surface at about the same time as East Alabama-West Georgia varieties to a week later. This strain blooms among the later flowering *Z. atamasco* in my collection. The flowers hold very long (10-14 days in a greenhouse). Two bulbs in this strain have light reddish tint near the upper quarter of the styles—a contrast against the white segments and the white stigmas. This is intriguing. Not many zephyranthes have pink tinted styles. *Z. rosea* progeny sometimes show pink tint in the styles. (Note: The real *Z. rosea* is a very tender species and dainty; not the misnamed variety featured in trade catalogues in that area as *Z. rosea*—which will turn out to be a *Z. grandiflora* if ordered.)

Strain (SC-1) Leaves 6mm wide, 25.1cm long, slightly concave; Scape 29.1cm, pure green; Spathe 2.9cm; Pedicel 1.8cm; Flower buds have slight, light brownish tint upper quarter to apex on greenish ivory base, opens with green tip at apex (rib tip) in setepalsegs; Perianth 11.6cm; vertical 9.12cm; setepalsegs 22-20-

21mm, petepalsegs 18-18-19mm, pure white icy sparkle; tube light green; Stigma trifid, furcate, branches 5mm long, decurrent, high (very long styles) and 8 mm above anthers. This strain has flowers that tend to be unguiculate (number one setepalseg). Segments are long and slender and tend to nod slightly. A more spokey, loose flower that blooms late in the flowering season is presented as (SC-2).

Strain (SC-2) Leaves 5mm wide, 23.8cm long, slightly concave; Scape 29.4cm, dark green; Spathe 3.3cm; Pedicel 1.2cm; Perianth 15.4cm, vertical 11.2cm; Setepalsegs 23-21-20mm; Petepalsegs 18-18-19mm; Stigma trifid, same as SC-1 above.

SOUTH CENTRAL GEORGIA REGION

This strain would possibly be classified as a separate species if it were found in another region outside of the *Z. atamasco* range. There are unique differences in this strain from strains presented above and from several northern range strains not presented. It is different from the north central Florida strains; however, it could possibly be in localities in north Florida (Monticello and east). The first noticeable difference is growing habits; this strain never quite loses all leaves from all bulbs in the population (in pots or in the ground) in summer. Partial die-back is later than other strains in the springtime. Also the leaves begin growing sometime in September (growing well by October). The leaves are small and grass-like, 2mm wide, during the early months and only approximately 17mm long. They are grass green at this point, but they continue growing through and beyond flowering. The leaves at flowering are a slatey blue green but not dull.

These bulbs start flowering in April but sometimes continue flowering into mid-May in hot weather. These last flowers will still hold well. One that bloomed June 7 held 5 days. This is much later than most other strains of *Z. atamasco*. Note again that the leaves of this strain do not die back readily. Plants are robust with tall scapes and some flowers tend to nod slightly. The long slender, spokey segments are more lanceolate than elliptic. Leaves are 3-5mm wide. There are some variations in the population but within a tolerance to suggest a standard variety. These grow around shallow, small streams and ditches in sparsely wooded areas. They endure some dry times, some wet feet and a considerable amount of sun.

Zephyranthes What's It #2 with triple petaled flowers

Zephyranthes 'Carmine Jones'

Zephyranthes 'Super Doodles'

H-21

What's It #3

Zephyranthes 'Capricorn'

Strain (TFT-1) Leaves 4.5mm wide, 39.8cm long; Scape 21.3cm, light tint at base; Spathe 4.2cm, salmon tannish; Pedicel 3mm; Flower buds light pink on apex (rib tip) carries onto setepalseg reverse at apex (tip end); Perianth 13.9cm; vertical 10.2cm; setepalsegs 22-20-19 mm wide, petepalsegs 17-18-18mm, white with sparkle, throat (and tube) green; Anthers 13mm long, medium low (medium short filaments); Stigma trifid, furcate, ages decurrent, branches 7mm long, high (i.e. long style) 12mm above anthers. This is a large, loose-flowering strain.

Unique variations in varieties in this strain are: 1. flowers with 7 or 8 segments—a small group consistently produces the extra segments and a separate unique strain may be developing in the localized area (a few samples have been potted to study this coupled with watching those in the wild.); 2. flowers with pink centers both sides of the rib area. Note: this is a pink flower tone. It is not the pinkish tint developed through breakdown of the white during aging, which occurs most frequently because of excessive cold weather. Some writers have called this flower breakdown "pink through maturing" which may mislead some readers.

There are reports that more solid pinks (hues) have been observed in the locality in which this pink sub-strain is native. These are being watched by a colleague. The day prior to flowering the buds on this pink sub-strain have a heavy rose blush up the rib (almost all red). At that stage the tube is very long and thinner than other strains. The flowers open with the heavy rose blush on the reverse of the setepalsegs down the ribs; much less in the petepalsegs. The flower setepalsegs have a clear, light, soft pink streak bordering the center rib with wide white margins. The petepalsegs have only a pink blush on the apices. The remaining aspects of this sub-strain are presented in Strain TFT-2.

Strain (TFT-2) Leaves 5mm wide, 37.1cm long; Scape 23.2cm, very thick, light tinted base; Spathe 3cm, dried green; Pedicel 6mm; Flower buds (see introduction); Perianth 10.9cm, vertical 9.5cm, tube light green, setepalsegs. 20-19-19mm (soft medium pink rib and center wide white margins); petepalsegs 16-17-16mm, white, soft pink blush apex (rib tips); Anther and stigma see strain TFT-1.

FLORIDA REGIONS

Z. atamasco in Florida localities have characteristics similar to some other strains and yet some individualities occur. This may suggest an evolution involving the dainty little Florida strains crossing with strains from the Northern areas possibly introduced

through rivers and streams. There seems to be more commingling of types with different forms within limited localities in North Central Florida than in the northern localities. A strain with larger flowers than typical Florida forms and resembling a northern strain—except for leaf surfaces—occurs throughout North Florida sites and to south of Brooksville. The leaves are wider in the northern strain but the flower forms have similarities. The trifid stigma is stubby, similar to the stigma presented in Strain PNT-2, except the branches are thicker and some larger (almost lobed in appearance). The leaves are 2-3mm wide but more grass green and slightly slicker to the feel than the PNT strains.

Flowers on Florida strains are generally smaller, appear daintier, and the scapes shorter than Northern strains. Within a large field of flowers, small localized areas and clumps will each display individualized flower forms including segments that are suberect, recurved, ribbon-like (almost lorate or narrowly oblong), widely obovate and imbricated or something between these. Stigmas are mostly trifid, furcate, with branches 2mm plus. Florida strains planted in the ground in Alabama failed to survive the cold, wet winters. Those now in the collection are mostly potted seedlings.

Strain (FL-1) This strain grew on the Florida side of Lake Seminole (catchment of three rivers including the Chatahoochee). It has survived 25 years potted and is the first or near first *Z. atamasco* to flower every season (normally late February). The flowers hold six days or more. Leaves are 4.5mm wide, 40.1cm long (very long), dark green, slightly concave; Scape 14.5cm (often shorter), heavy copper lower 5cm; Spathe 2.9cm, reddish; Pedicel 8mm; Flower buds dark purple rose apex, heavy tint carries a segment reverse (apex) heavier in setepalseg; Perianth 9.7cm, vertical 9.2cm, setepalsegs 21-19-19mm wide; petepalsegs 18-19-20mm wide, intense snow white, light-rose flush at apex (sets heavier), light chartreuse throat; Anthers medium slender, 10mm long; Stigma trifid, furcate, short stubby branches on long style 6mm above anthers.

Strain (FL-2) Seedling from North Central Florida strain. Leaves 3mm wide, 28.2mm long, dark green, slightly concave; Scape 14.6cm, copper base 5cm above ground; Spathe 2.6cm, brownish; Pedicel 9mm, reddish brown; Flower buds pinkish at apex, blush segment reverse on setepalsegs at apices; Perianth 8.9cm, vertical 8.2cm, setepalsegs 21-19-19mm wide, petepalseg 18-17-17mm, segments recurved, icy white, throat chartreuse; Stigma trifid, furcate, long members 4mm, high (long style) 2.8mm above anthers.

Z. ATAMASCO HYBRIDS—PROPAGATION

Interest has been shown by rainlily fanciers in *Z. atamasco* as a hybrid parent. *Z. atamasco* will set seed with pollen from other rainlily varieties and *its* pollen is fertile if the right combinations can be discovered. As with other amaryllids, some strains reward with a higher percentage of seed setting than others.

Idiosyncrasies of *Z. atamasco* must be dealt with to achieve optimum success. Patience is essential. The long flowering period (days longer than other rainlilies) is an early challenge. Finding the right moment(s) in the flowering cycle to pollinate improves chances for success (see introduction).

After seeds are set, the term until harvest is longer than other rainlilies. The number of hybrid seeds at harvest can be scarcely more than one, to exceeding the number of typical selfs (one to several). Selfed flowers produce several little black D-shaped seeds slightly larger than seeds of *H. tubispathus*.

The growing habits of *Z. atamasco* provide another challenge. Bulbs typically leaf out in early winter and flower in early spring (suggesting a growing habit) but the little bulbs continue a growing ritual under the topsoil all the time. Because of the apparent dormant habit some people hold the seeds until autumn to plant them (probably from a good experience). But, this is not the way it is done in nature. In nature the seeds drop to the ground to face the summer; the population is extended with that process. It is recommended these seeds be planted reasonably soon after harvest. With hybrids the pollen parent may assert some influences.

Hybrid seeds may send out visible radicles along with other varieties (if planted same time) or they may follow the *Z. atamasco* schedule and surface later. Because of the habits of these, it is recommended not to give up on pots with *Z. atamasco* seeds for two years. Surprises have been experienced by those giving up on *Z. atamasco* and adding other plants to the seed pots only to see *Z. atamasco* flowers spring up 4–5 years later.

Z. atamasco seedling leaves are fine and hairlike at first (finer than most zephyranthes). Yet an occasional hybrid may react opposite and show very vigorous leaves. The first blooming of seedlings often takes longer than many zephyranthes. The wait may be 4–5 years, or longer.

ZEPHYRANTHES ATAMASCO HYBRIDS

A few results with *Z. atamasco* as hybrids (or crosses) follow. The names will be used for named parents. Unnamed pollen (or

seed) parents will have the code or label identifying the variety. Both parents will have a code (each individual clone in this collection, including named species and cultivars, has its own code). This facilitates in following the parent trail and in retrieving histories and details about each plant.

Z. atamasco x *Z.* 'PB34' Seed parent: East Central Alabama *Z. atamasco* strain close to the strain presented as PNT-2. Pollen parent: Product of unnamed seedlings, variable color opening with a reddish burnt orange (sort of *Z.* 'Capricorn' shades) with a low stigma (short style). This clone: the colors are unique with three different tints. They are well pigmented. Five segments are a dark, rose pink as intense as 'Libra' but a different pink and darker; the color is about even from apex to the white throat. One segment, the upper setepalseg (number one setelpalseg) is 2-3 shades darker than the other five, being almost maroon. The white throat forms as an inverted "V" upward into each segment with clean lines. The contrast in colors is noticeable and the effect is star-like. It blooms in June and it is fertile both ways and has set seed.

Leaves not contemporary with flower (naked flowered) and leaf measure was taken later. Leaves 3mm wide, 10.6mm long, grass green, slicker than typical *Z. atamasco* to the feel, slightly concave; Scape 8.3mm (short); Spathe 3.2cm; Pedicel 9mm; Flower buds (early) vivid bright rose, red upper half, dulled by flower opening, reverse segment setepalsegs heavy mauve rose on rib at apex, petepalseg less; Perianth 6.4mm, vertical 5.1mm, segments lanceolate (and acuminate), setepalsegs 14-15-16mm (Note: the odd darkest segment is the smallest set), petepalsegs 13-12-14mm; Anthers light orange, medium fat, 15mm long, ⅔ length of anther above stigma; Stigma trifid, furcate, but thick stub (rather than clavate or globose), pink tint on the style, 2mm+ immediately under the stigma.

Z. atamasco x ***Z. grandiflora.*** Seed parent: East Alabama strain with wide imbricated segments with blush of pink on setepalseg apex; medium large flower. Pollen parent: large flower; wide, segments imbricated, vivid dark rose type. This clone : Flower medium light rose with a suggestion of salmon, almost glossy, (viz *Z. atamasco*); ages lighter during a two day period. Segments wide and imbricated (viz. both parents). Flower form suggests *Z. grandiflora* but smaller. Anthers show long slender influence of *Z. grandiflora* but not so orange. Pollen looks fertile, but was not tested. Flowers June-July. Does not seem to set seed readily.

Leaves 7mm wide, 35.1cm long, slightly concave, grass green, slicker to the feel than *Z. atamasco*; Scape 18.2cm, copper tinting lower one-quarter; Spathe 3.6cm, brownish (just covers ovule); Pedicel 3.2cm; Flower buds salmon pink, center to apex, willow green tube; Perianth 7.8cm, vertical 6.2mm, segments more widely ovate, acuminate upper setepalseg, (number one setepalseg) serrated both sides, two lower setepalsegs (number two and number three) serrated outward toward number one setepalseg; setepalsegs 20-20-19mm; petepalsegs 18-17-18mm; Anthers slender, 16mm long, light orange; Stigma trifid, furcate, thick, long branches, well above anthers.

Z. atamasco x ***Z.*** **'PB5-76-1'** Seed parent: a strain collected from a flood plain in the northwest regions of *Z. atamasco*. Pollen parent: pink cross between *Z.* 'Desiree' and *Z. grandiflora* (8 segments). This clone: Flowers open dark brownish purplish red (mauve) on a white base; both tints are intense. The dark red is in the form of wide veins or streaks overlaying the white base color. The red ages to a brighter dark red during day one and seems to decrease some while the white increases. The segments are narrow (spokey) more in the form of lanceolate ratio 1:6. Acute at apex. This variety blooms mid-June to early July and sets seed.

Leaves 3mm wide, 19.2cm long, slightly concave, slick to feel, grass green; Scape 18.1cm, thick, olive green lower one-quarter; Spathe 3.8cm, greenish straw tint; Pedicel 2.8cm; Flower buds veined dull reddish, reverse segments retain finer veining of reddish tint, increasing toward apex on all segments, green tube; Perianth 7.9cm, vertical 7mm, setepalseg 12mm wide, petepalseg 11mm wide; Anthers fat, gold, 9mm long; Stigma trifid, clavate (big, thick lobes) well above anthers.

Z. atamaso x ***Z.*** **'Horsetail Falls'** Seed parent: strain from the Northwestern flood plain region of the *Z. atamasco* range. Pollen parent: tends to have more pink than typical *Z.* 'Horsetail Falls'. This clone: Flowers white, not so intense a white as the seed parent, more of a paper white with no sparkle. Form resembles a white 'Horsetail Falls' (slight flare at apices). To date the flowers have been smaller than either parent. It flowers in mid-June and has not set seed to date.

Leaves 7.5mm wide, 38.6cm long, slightly concave, dark dull green, increasing dark olive blue toward base; Scape 12.8cm, dark copper at the base; Spathe 4.2cm, slightly darker green than neu-

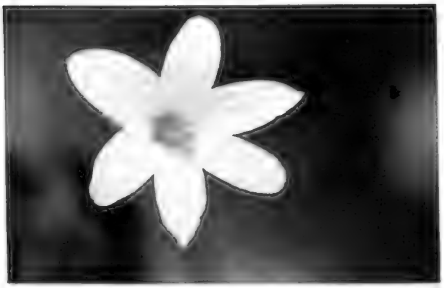
tral green; Pedicel 2.5cm; Perianth 6.2cm, vertical 6.3cm, setepalsegs 19mm, petepalseg 19mm, segments white, medium green throat; Anthers gold; Stigma trifid, lobes clavate; Style medium low with stigma approximately at mid point of anthers.

Z. atamasco x ***Z. katherinae* (*rosea*)** Seed parent: east Alabama piney woods variety; large flowers medium long, slender segments, near pure white (faint blush reverse, aged white early day one). Leaves 6mm wide, 29cm long. Stigma trifid, furcate (very short stubby branches). Pollen parent: pink, wide large, imbricated segments. Stigma trifid, clavate, low and thick; located about at lower end of the anthers. Wide leaves, 8mm wide, 54cm long, slightly darker than grass green, slick. This Variety: opened dark, mauvish magenta with white throat, aged more magenta day one and lighter day two. Slender segments (spokey); narrow leaves are different from both parents (some variation in seedlings; this is one).

Leaves 3mm wide, 38.1cm long, darker than grass green; Scape 22.8cm; Spathe exceeds pedicel and ovule; Pedicel 3.7cm; Perianth 7.1mm, vertical 5.9, setepalsegs 10-9-9mm, petepalsegs 7-7-8mm; medium slender, 11mm long, light gold; Stigma trifid, lobes thick, clavate, high (long style), well above anthers.

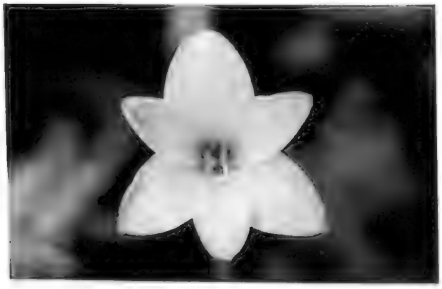
Cultivar Showing *Z. atamasco* as Pollen Parent. *Z.* 'W9-61-45', x *Z. atamasco* Seed parent: carried label as El Naranjo 62-J until a recent report by Dr. T.M. Howard in **HERBERTIA** Vol. 46, 1990, indicated that *Z.* El Naranjo had been defined as *Z. subflava,* an ivory colored species (and confirmed in a telephone conversation). This species has intense dark mauve-rose markings (veining) on the reverse segments becoming more solid toward the apices, which influences the flower appearance, (more intense in setepalsegs). The flowers open a faint pink that quickly ages to white (within a couple of hours). The white is heavy pigmented but with some influence from the petal reverse. Leaves are dark grass green about 3mm wide and 30cm long; the stigma is clavate. Pollen parent: *Z. atamasco* native to the northwest range of the Atamascos growing in a flood plain. This clone: opens pink (not intense) but the pink holds through aging and tends to sparkle. Flower buds are heavy rose pink from upper half to apex. The flower form is similar to *Z. citrina* or Z. 'Summertime' (form and texture differs from seed parent). Flowers late July-August and sets seed.

Leaves 4mm wide, 24.5cm long, convex-concave, grass green, wiry, slick to feel; Scape 14.3cm; Spathe 3.4cm; Pedicel 1.7cm; Flower buds heavy rose pink, intense, carries on reverse setepalsegs, less on petepalsegs; Perianth 5.2cm, vertical 4.4cm, setepal-

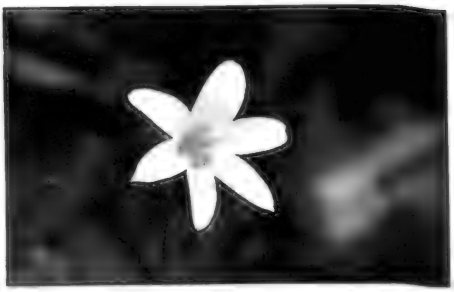


Habranthus H-21-1

Habranthus H-12-2



Habranthus 12-1



Habranthus H-21

Zephyranthes 'Sunburst'

segs 13-12-13mm, petepalsegs 12-12-12mm, segments widely obovate; Anthers medium fat, 12mm, gold, fairly high; Stigma trifid, clavate, about parallel with bottom end of anthers, low in flower. The influence of *Z. atamasco* is observed in the sparkle, flower, segment shape and slightly wider leaves than seed parent.

These are a few of the *Z. atamasco* hybrids. Some of the first-time bloomers can be presented when another season or two of blooming confirms the histories. An interesting one with intense ruby pink and a light frosty overlay looks to be a potential gem. A cross was accomplished about 30 years ago through dumb luck with *Z. atamasco* as the seed parent with an habranthus. The progeny turned out to be a paternal but a little more glossy white than the pollen parent. However, chromosome studies of selfs of this variety matched the habaranthus parent. This cross was duplicated a few times with similar results. Armed with this information some other low percentage attempts have been tried with some rewards. This original variety has been an ingredient in some breeding programs undertaken.

DISCUSSION—*ZEPHYRANTHES ATAMASCO*

Some writers state that *Z. atamasco* and *Z. treatiae* turn "pink with maturity". This is not a flower tone pink, but a process of aging and dying (not aging and changing of flower tones). Not all *Z. atamasco* and *Z. treatiae* flowers develop this. It is seldom seen when the weather is relatively warm (more seldom in a greenhouse; if then, about day 10-12 of the flower). Excessive cold weather with cold chilling wind, frosts, etc. influence this.

A spin-byte from a study on *Z. atamasco* is that strains found in the piney woods produce smaller flowers and thinner leaves than wet plain strains because of location. It is also contended that the piney woods strains have been termed *Z. treatiae*. The argument offered is that these two are one and the same except for the enviornment. The rationale is that when seedlings from the piney woods were planted in conditions similar to flood plains, the progeny produced wider leaves and larger flowers than their parents, about the size of other flood plain strains. This is not contested. Other plants react the same. Varieties with smaller flowers (8-10cm) and narrower leaves (2-3mm wide) can be found in flood plains. Potted *Z. atamasco* seedling flowers, scapes, etc., are often bigger than their parents in the wild, but leaves tend to only be 1mm or so wider if any, and have the same form and color.

The largest strain of *Z. atamasco* that I have observed in the wild were on a slope on a high ridge in plant hardiness Zone 8.

They received morning sun, but were shaded thereafter predominately by pine trees. These massive flowers had very large perianths and wide imbricated segments. They were bigger than *Z. atamasco* in my collection which have exceeded approximately 15cm perianths and 28-30mm wide segments. (Unfortunately only notes could be taken; they were not collectable).

Note that the rivers in *Z. atamasco* country in Alabama and western and central Georgia run south to the Gulf of Mexico, the Suwannee River or the Okefenokee swamp (the source of the Suwannee). The Sante Fe River with tributaries also runs into the Suwannee River from the east (south). Note that areas in north Florida have several strains or varieties of rainlilies often in one locality. Could this result from crosses between the dainty Florida strains with strains introduced from the north via the rivers?

ZEPHYRANTHES TREATIAE

Articles covering *Z. treatiae* in **HERBERTIA** (and other publications) have presented at least two schools of thought about this rainlily. One is to consider *Z. treatiae* as a separate species. Another is to argue that *Z. treatiae* is a strain of *Z. atamasco*. After reviewing the descriptions of the varieties and discussions presented by the authors some impressions come to mind. 1. The authors described one of the several narrow leafed rain lily varieties found in South Georgia and North Florida locations; or, even the dainty little variety farther south in Florida. 2. Another author could be describing a natural hybrid between a Florida *Z. atamasco* and the variety that Mrs. Mary Treat found near Green Cove Springs, Florida and Sereno Watson described in 1879. That is, if the word "glaucous" describing the color of the leaves is interpreted to mean "yellowish green" (one of its definitions in the dictionary) in lieu of bluish green, there is a variety that may fit. This yellowish green leaf variety was found several years ago in a limited region between Jacksonville, Florida and the Okefenokee Swamp (and it may not be much farther west). This rainlily has leaves 2-2.5mm wide and 33cm long, concave, thick, crescent shaped, resembling *Z. citrina* leaves but are more yellowish and turn more yellowish green with aging. This species holds some leaves much of the year. The leaves are tough, wiry and feel slick to the touch, as opposed to *Z. atamsco* leaves which tend to feel tender up to near the dying back time. Blindfolded one can differentiate *Z. treatiae* from traditional *Z. atamasco* by feeling the leaves.

The flower buds have pink to rose over the upper quarter to the apex. This tinting carries over with a blush on the reverse side

of the segments, more dominant on the setepalsegs. The flowers are flat white, more chalky than sparkling (opposed to *Z. atamasco*) and have a light chartreuse throat. Segments have a suggestion of thickness. A typical member of this variety: Leaves 2-2.5mm wide, 33cm long; Scape 13mm; Spathe 3cm; Pedicel 1.5cm; Perianth 9cm, vertical 7.8cm, setepalsegs 18-17-17mm wide, petpaleseg 15-15-15mm wide, the segments are short and wide (almost imbricated); Stigma trifid, furcate (almost decurrent) with very long branches (5mm); Pistil medium high with stigma above anthers. It seems tender if tried north of its habitat. This strain flowers in April in Florida after most *Z. atamasco* have finished. It follows the same trend in the greenhouse, flowering with the later blooming *Z. atamasco*. For some years I have considered this unique strain to be authentic *Z. treatiae* in my collection.

ZEPHYRANTHES SIMPSONII

Zephyranthes simpsonii is a rare species found in Central Florida. It has been found near Miconopy in the vicinity of Levy Lake. Some herbarium specimens indicate that they were collected further north, however the date on these specimens predated several freezes that wiped out the citrus to the vicinity of McIntosh, Florida. *Z. simpsonii* is a tender species.

This is a temperamental rainlily. It does not respond well after being disturbed or moved even when moved in a large clod of soil. It is reported to be found singly in the wild, however, they are sometimes found growing in clumps. *Z. simpsonii* blooms from June to mid-July (sometimes earlier). In the greenhouse it has occasionally bloomed at about the same time *Z.* 'Horsetail Falls' flowers: March and April.

Leaves of *Z. simpsonii* are very long and very narrow. The distinguishing characteristics of a typical representative strain would be: Leaves 3mm wide, 52cm long, (very long) concave (thick at center) medium, light bluish green; Scape 19.8cm; Spathe extends beyond very short pedicel; Pedicel 4mm; Flower buds rose red upper ⅛ to apex, heavy rose carries through on reverse segment apex on setepalsegs, trace on petepalsegs; Perianth 6.9cm, vertical 7.1cm, funnelform, does not open wide, flower intense white, throat chartreuse, setepalsegs 23-22-22mm wide, petepalsegs 19-19-20mm, imbricated; Stigma trifid, clavate (thick club), medium low in throat below anthers style medium short. *Z. simpsoni* will cross with other zephranthes. One cross is presented.

Z. simpsonii x ***Z.* 'Horsetail Falls'** Seed parent: (see above). Pollen parent: Leaves 9mm wide, 49cm long, grass green; Tall

scape, 24cm; Flower pink with white throat, cupped; wide segments approximately 18mm wide; Stigma trifid, clavate, medium low, just above lower end of anthers. This hybrid: form of flowers is about intermediate between parents (flares slightly at apex). Color of segments is flat white (not sparkling); different from seed parent, more nearly an extension of the white tint in the throat of *Z.* 'Horsetail Falls', with faint smokey-mauve effect more visible on the number one setepalseg; tube dull green toward olive. Reverse segments flushed with purple-rose at apex.

Leaves 3.5mm, 41.3cm long, bluish, slightly concave (viz. a wide *Z. simpsonii* leaf); Scape 16.9cm hollow, tinted base; Spathe 4.3cm, amberish brown; Pedicel 3.2cm; Perianth 5.7cm, vertical 6.3cm (a long type tube), setepalsegs 16-14-13mm, petepalsegs 12-13-12mm; Anthers thick, 10mm long; Stigma trifid, more clavate than furcate (thick stubby branches), medium low, just above lower end of anthers. Note: only one seedling from the seed capsule has bloomed.

BREEDING PROGRAMS

The initial breeding activities increased the number of potential seed parents and probed for information or combinations that will set seed and produce interesting results. Eventual blooming of these contributed to feedback. Reviewing the data generated opened insights on trends and predictability that new, improved forms and hybrids can be developed. Arriving at that point, objectives were defined and programs for working toward the objectives were formulated.

Enhancing techniques such as irradiation or using colchicine were excluded. Manual methods employing time-tested practices in emasculating, pollen collection and storage and pollinating were used with emphases on techniques and documentation.

THE PROGRAMS

A program with the objective to develop "standard forms" conforming to defined characteristics was launched. The requirements were: 1. The end point cultivars should be unique and interesting; 2. Once the process reached the objective variety, the "this is it" variety model was defined; 3. With the model variety defined the breeding will be directed toward refinement, throwbacks and non-conformers will be purged and with each new generation, the tolerances for deviating from perfection (the model breed) are tightened; 4. The test is in the progeny—when the flowers and plants of the seedlings from the model breeders come true 100%

of the time (within defined tolerance) the "standard variety" is achieved (this is similar to developing standard breeds of animals such as Leghorn chickens, Hereford cows, Clydesdale horses, etc.).

The standard form, once developed, can be defined and named. This standard form can then be propagated and quantities developed. They also can be distributed with confidence that their seedlings will be true, unless pollinated by something else. A number of real treasures are produced in pollinating programs but the only way they can be propagated and extended is through cutting or offsetting. Both are slow and some do not offset well. Seedlings from those gems will likely be something different.

It is difficult to assign an F_3, F_4 etc. to steps in this program. Several bulbs that went into the base bulbs from which the model breeders were selected had different parent trails and histories. After 3–4 generations into the refinement process the throwbacks and throwouts are significantly reduced.

PROGRAMS IN PROGRESS TO DEVELOP STANDARD VARIETIES

Habranthus **'H21'** is a white flowering habranthus which is into 3–5 generations of breeding (since definition). It is as white as *Z. atamasco* at opening, not a faded white aged by a day in the hot sun. A degree of sparkle is developing and attempts to intensify this sparkle will continue. A high percentage of seedlings which are products of cross pollinating of cultivars within the selected breeder models are blooming as white or whiter than the parents. A few pure whites are surfacing; these may be isolated into a group of pure whites. However, the tolerance at this point permits a trace of pink on the apex (rib-tip) and these are quite prevalent. This is less blush than on some *Z. atamasco*. About 20% of the seedlings flowering this past season had a very thin purple edge at the apex of the segments. The reverse segments, especially setepalsegs, had slightly more tinting (but minimal). Some of these may be selected to attempt a picotee. Flowers that have a blush more than 2mm at the apex of segments have been purged from this breeding program during the previous generations.

This variety tends to be smaller than typical *H. robustus*. The flowers nod but do not open so wide as *H. robustus*, being more on the order of *H. brachyandrus* in flower form. It predominately flower mid-June to mid-July, generally later than *H. robustus* but collateral with *H. brachyandrus* (it stops abruptly whereas *H. brachyandrus* continues to flower). This is a product of a rather complex intercrossing of habranthus with zephyranthes (with some reintroductions). An x *Zephybranthus?* Maybe not. There is a

possibility that chromosome studies would indicate that this cultivar has *Habranthus robustus*-like chromosomes. (One parent used in the early stages, a *Zephyranthes* x *H. robustus* tested *H. robustus* chromosome characteristics.) Filament lengths of 2-1-2-1 suggest that this is an habranthus.

Leaves 8mm wide, 30.7cm long, concave, grass green, feeling tender; Scape 26.7cm; Spathe 4cm, wheat straw tint; Pedicel 3.9cm; Flower buds white with light pinkish to purple veining at apices, reverse segments may have light blushed tips; Perianth 8.1cm, vertical 7.5cm, funnelform, suberect to horizontally declinate, setepalseg 20-20-20mm wide; petepalseg 16-18-18mm wide, segments white, light sparkle, oblanceolate to obovate, throat light lime; Anthers medium thin, yellow, 19mm long, filaments white; Stigma trifid, furcate, branches medium thick, 7mm long, style white.

There are both larger and smaller flowers in this group than the model presented (it is about typical). Some small ones were purged. Some large ones might be a variation to cultivate, having wider segments, but they have not picked up the sparkle much.

In the breeding trail on the way to developing a model, certain individual cultivars were beneficial, and other strains of that species (or cultivar) proved detrimental. A *Z. atamasco* strain with minimal rose blush on the reverse crossed to a "white" *Habranthus* 'H 21' model produced seedlings showing a good white flower but the blush on segments excelled the broad tolerance. There is a white habranthus in my collection, which I acquired via an importer from South America as a white *H. robustus*. It has short, stubby, imbricated segments with a little rose veining at the apex. It looked white. When this variety was crossed to a white *Habranthus* 'H 21' model, the progeny flowered with a wider blush on the segments than either parent (the blush seemed to be intensified).

Habranthus 'H12' This habranthus has recently come together with a quality showing promise to be broadly described as a model. Presently five selections have been admitted as models. There may be co-seedlings from the parents of these that may be acceptable as they flower and some new forms may surface. There are several flowers to the right and left of this model which may contribute to the selective breeding; some of these are very close to the model but many are sterile. The program has been ongoing for some years. The parent history is predominately an amalgamation of *Habranthus* (*H. brachyandrus/H. robustus* crosses) with some zephyranthes interjected.

Habranthus 'H12' are pink to rose with tint and pigmentation as intense as—or more so than—*Z.* 'Libra' or *Z. grandiflora*. There

are some variations in characteristics and in color tints at this stage. These will be standardized in the breeding process. The five forms will set seed and they seem to be self compatible and compatible with the others. These may represent an intermediate form. Seedlings from these five bulbs are now growing so feedback is not far away.

The 'H12's have a combination of filament lengths with no consistency in patterns. All seem to have three or more levels. Two have anthers very low in the tube and one or two of the anthers are sitting at the bottom (on the ovule). The model is presented. Leaves 8mm wide, 22.5cm long grass green; Scape 18.2cm, tinted base; Spathe 4.6cm, reddish straw tint; Pedicel 4.3cm; Perianth 7.2cm, vertical 6.7cm, setepalsegs 25-20-20mm, petepalsegs 16-18-18mm, imbricated segments, color—see introduction; Anthers (see introduction); Stigma trifid, furcate (some age decurrent), beyond anthers, style white. (Note: style and filaments may become tinted in future refinements.)

WHAT'S ITS

As expected, several "what's its" have arisen in the breeding pools. One has a double flower (almost triple) on a siamese-twin ovule and pedicel. The filaments are random between the segments and not complete. It would be difficult to determine lengths. It is from predominantly habranthus parentage. One compartment of the seed capsule has borne seed. Another habranthus type with filaments in four lengths has very dark, intense, cherry purple segments; the throat and outer tube is almost black (a blackish dull cherry purple). Anthers are very dark brown; the pollen is a slatey brown. Filament and style are very dark, almost throat tint, and the ovule is a red dark brown. Leaves are wide, 9mm plus. This should not be classed as an *H. brachyandrus*. Color is atypical; it has some zephyranthes in the parent history.

Another "what's it", H-90-158, that surfaced in the breeding is a mystery. It was mistaken for a hippeastrum until it flowered because the 18mm wide leaves looked like a hippeastrum. Then the tag was dug out of the pot. Filaments are very short, the longest not longer than 3mm; others seem to sit on the tube base on the ovule. Anthers are fleshy and it has not set seed to date. Two blooms appear each season from the bulb about a month apart and different. The first bloom is always larger, sessile, suberect, with the segments projecting out almost dagger-like. The spathe extends over the tube. The second flower always has a pedicel about 2.8mm long. The first flower is larger. The second

bloom is more funnelform. The upper setepalseg (segment number one) is very dominant; the lowest petepalseg (segment number four) is very narrow in both blooms.

The color is a general rundown *H. brachyandrus* type. Segments are a harsh rose lavender toward the ends and apices with more creamy tinted centers. The throat is chocolate mauve; the outer tube is chocolate mauve reducing to olive green before the ovule; rib through tube is olive green. A description of the first flower of the first plant to bloom follows.

Bulb globose 4.4cm diameter, tunic medium brown; Leaves 18mm wide (very wide), 39.8cm long, ending bluntly, channeled, grass green; Spathe 3.3cm; Scape 29.8cm, thick; Pedicel sessile; Perianth 9.8cm, vertical 13.2cm, (conservative opener); setepalsegs 39-24-23mm wide (number one set dominant); petepalsegs 15-23-22mm (number four petal very narrow); upper setepalseg (number one petal) widely obovate, other setepalsegs oblanceolate; lower petepalseg (number four petal) narrowly elliptic (almost lorate), other petepalsegs oblanceolate; Anthers fleshy and low in tube. Stigma trifid, furcate, long thick members decurrent.

A program is ongoing to upgrade *H. brachyandrus* above the varieties circulating in the trade, many of which have deteriorated in color even though some of these deteriorated forms are much bigger, tougher and hardier.

Another program involves developing a difference in two named cultivars that have grown to look about the same: *Z.* 'Aries' and *Z.* 'Burnt Offering'. 'Aries' has flowers with a honey gold base color with cinnamon rust overlay or blush. 'Burnt Offering' originally was a little darker with a smoky gold base and darker cinnamon and shorter segments. Seedlings of these are close in appearance to 'Aries'. *Z.* 'Fireball' pollen is being introduced on 'Burnt Offering' to see if it will produce a darker and different color.

Z. 'Aurelian' is very similar to Thad Howard's *Z.* 'San Antonio'. Both will reproduce true seedlings when selfed. Some experimenting is being done in search of a form with recognizable differences in color but holding the good characteristics of these. Ability to hold the new color through subsequent generations when selfed is essential. Then a standard variety has been achieved.

REFERENCES:

Howard, Thad M. 1990. Six New Species of *Zephyranthes,* **Herbertia** Vol. 46 p. 105.

Howard, Thad M. 1990. x *Coobranthus,* **Herbertia**, Vol. 46 p. 123.

AMARYLLIS BELLADONNA MULTIFLORA

Vic Abela
Woodville Park, Adelaide, S.A., Australia

South Australia has the unenviable title of being the driest state on the driest continent in the world. The low annual rainfall on the Adelaide plains of 450mm and the hot, dry summers forced our early settlers to grow plants which could survive these trying conditions. *Amaryllis belladonna* was one of those plants. The Mediterranean climate experienced here replicated that found in their place of origin, the Southwest Cape of South Africa, so bulbs flourished and became naturalised in many areas of the state.

The belladonnas, as they are called here, have origins in Australia dating back to the early nineteenth century. The first recorded breeding of the belladonna was in 1841 by John Bidwill in Sydney. He reported crossing *A. belladonna* with *Brunsvigia multiflora.* The resultant seedlings flowered six years later and were said to be very beautiful, producing from 20 to 40 flowers per umbel. Bidwill mentioned that many of the flowers were blotched with white and the leaves varied in width from 25mm to 100mm. A great amount of debate has raged since then regarding which *Brunsvigia* species Bidwill was calling *Brunsvigia multiflora.* I am quite convinced the *B. multiflora* Bidwill mentioned was in fact a larger growing form or cultivar of *A belladonna.* It was erroneously called *Brunsvigia* in Australia because its mature, radial umbels closely resembled that of *Brunsvigia* species. The name *multiflora* was given due to the high number of flowers per umbel.

All the true intergeneric crosses involving the belladonna with *Brunsvigia, Nerine* and *Crinum* species in the past have created sterile hybrids. Cowlishaw in his 1935 **HERBERTIA** report stated he used *B. multiflora, B. multiflora rosea* and *B. multiflora alba* in his breeding and that they were all good seeders. So these also must have been belladonnas.

These larger, vastly improved belladonnas were eye-catching with their tall stems and large radial umbels. They soon were popular and became commonly known as the multifloras. Bulbs of these original multifloras were exported to California, Holland, New Zealand and Kew Gardens. In the 1938 **HERBERTIA** Ernst Krelage described how, in 1922, the Dutch company van Tubergen obtained from Australia an *Amaryllis belladonna* hybrid "which produces very tall spikes, crowned with a very great number of large, bright rosy flowers with a yellowish-white center."

Above: Grandma's multifloras in early stage of flowering.

Right: Jason Abela holding large bulb of Grandma's multiflora

Photos: Vic Abela

Grandma's multifloras in full flower. Note colour fade due to hot weather.

In more recent years nothing has been heard about the original very large multifloras and many wondered if they still existed. Well, the good news is that, yes, they still exist here in South Australia where our ideal climate assured their long survival. I was fortunate enough to locate a clump in my grandmother's garden. I call it Grandma's multiflora. The mature bulbs produce from 30 to over 40 flowers in an impressive, fully radial umbel. The flowers open a bright deep rose pink with a contrasting white centre. The throat and the exterior base of the flower are a yellowish orange colour. After a few days the white centre disappears and the whole flower becomes bright deep rose pink. The flower form is excellent as the petals are broad and well reflexed. The flowers are highly fragrant.

Foliage of Grandma's multiflora.

x *Amarygia* in early stage of flowering.

x *Amarygia* near the end of flowering. Pedicels elongate substantially. The largest bulbs may have 50-60 flowers in their umbels.

On maturity as the fruiting heads are forming the pedicels lengthen up to 20cm. The stems are sturdy and reach a height of 70–80cm in full sun. A position near tall trees will have the stems and the foliage attain a greater height than normal. The foliage of these multifloras is quite distinct with their erect broad leaves and pronounced leaf necks. The bulbs themselves have necks and may be over a kilogram in weight when fully mature, measuring 15cm in diameter by 15cm in length. It's possible this multiflora is identical to the type van Tubergen received in 1922—the one Cowlishaw mentioned as *B. multiflora rosea*.

I was so impressed with its beautify, the urge came to obtain more. I was able to obtain a number of other multiflora and *A. belladonna* forms and cultivars from various sources and locations in the state but none matched the size of Grandma's multiflora.

I then decided a few years ago to commence a breeding program with the main objectives being to raise multifloras with all the identical superior features of Grandma's multiflora but in a wide range of colour shades, especially deep rose reds, glistening snow whites, picotees with deep coloured borders and various multicoloured umbel types.

I do possess a belladonna which has small multicoloured umbels, the flowers opening predominately white then turning pale pink and eventually deep pink after a few days, all the colours being present in one umbel. This feature occurs naturally amongst belladonnas and these were known as "variable forms". Another interesting belladonna is one I named 'Torrens River'. I discovered it growing wild on a dry band of our Torrens River here in Adelaide. Flowers open pure white and after a few days turn to a delicate pale pink. The foliage on this one is rather narrow.

The development of early and especially late flowering multifloras is desirable to prolong the season. Most of the multifloras commence flowering in Adelaide from the middle of February. From December–February Adelaide is prone to periods of very hot conditions during which the temperature may hover around the 40°C [104°F] mark for a few days before a much appreciated southerly cool change drops the temperature down to our summer average maximum of 29°C [85°F]. These scorching conditions occur a number of times every summer and if I am unlucky enough to experience them whilst the multifloras are flowering the display is adversely affected. The flowers either burn or the colour dramatically fades due to the heat. Even with our normal summer temperatures the flower colours here would not be so deep as for the same bulb in an area experiencing cooler temperatures. A flower

described as deep pink here in Adelaide is truly deep pink. So the desire to produce later flowering multifloras is important to me as the chances of extreme heat are less as we progress into March.

I am also hoping to breed a number of cultivars which will reliably produce two scapes per bulb. This is currently a rare occurance with the belladonnas and multifloras.

A far reaching goal is to produce a yellow/orange cultivar. These colours are common in the throats of many belladonnas and multifloras. It is also prominent on the exterior flower bases of some multifloras.

My final ambition is to cross a multiflora or *A. belladonna* successfully with a *Brunsvigia* species and then *Nerines.* A bit strange one may think since I have stated the resulting hybrids produced in the past all were sterile. I should however mention some of these old intergeneric hybrids are superb. The best being a *Brunsvigia josephinae* x *A. belladonna* hybrid we grow in Australia, correctly called an x *Amarygia.* Nearly everyone in Australia has it labeled as the *Brunsvigia josephinae* species. I believe it is very similar to a hybrid resulting from the same cross by the van Tubergen nurseries many years ago. We do not know who raised our hybrid but it has been around for a long time. I suspect *B. josephinae* was the seed parent as the hybrid closely resembles it in many respects. I would describe the hybrid as a vastly improved version of the *B. josephinae* species. Those who have seen the true *B. josephinae* species or a photo of it would know the size of the inflorescence is huge with its tall stem and exceptionally long pedicels but the flowers flaw the spectacle by being small. The hybrid has the same huge inflorescence, the pedicels being only slightly shorter but the flowers are considerably larger and a stunning, intense deep pink. The flowers have a faint fragrance. This hybrid is sterile so it does not set any seed. It does produce a small amount of pollen but apparently even this has exceptionally low fertility. I will keep trying its pollen on the multifloras as one day I may get lucky.

There is a also another version of this x *Amarygia* which is similar but has a smaller semi-radial umbel and the flowers are not so deep pink in colour. The x *Amarygia* flowers reliably in Adelaide but in the eastern states they do not perform so well due to summer rain, humid conditions and insufficient dry baking heat during summer to properly ripen the bulbs.

I hope I may spark more interest in the belladonnas and multifloras. They certainly deserve it.

LIVING JEWELS: NUMBER 3 IN A SERIES

HIPPEASTRUM BLUMENAVIA

Charles Hardman
Baldwin Park, California, United States of America

It has been more than twenty years now since I received my first bulbs of *Hippeastrum blumenavia* from Ivan and Meta Korsakoff. Little did I know then the prize they had bestowed upon me. Of all the bulbous wonders I grow, this species has proven to be one of my favorites. In part, that's because of its extreme beauty and ease of culture. Then there is its uniqueness among the entire *Hippeastrum* clan and its continuing bewilderment to the botanical and taxonomic community.

It's hard to imagine anything more beautiful than a potful of this dainty amaryllid blooming away during its late spring flowering period—the month of May for me. The flowers are pink to rosy pink on a white background with distinctive rosy pink veining. In some forms the color is darker than in other forms. Flowers are 2½-3 inches (6.5-7.5cm) wide with from 2-8 blooms on a 5-7 inch (13-18cm) stem. Not only the flowers are beautiful—the broad, dark green, lance shaped leaves with veining throughout are exquisite in their own right.

In his article "Collecting Amaryllids in Latin America" (**Plant Life** 7, 1951, page 17), Mulford B. Foster has this to say about *H. blumenavia*: "On this trip I collected still farther south in Brazil than I had done previously. This time I went on to the state of Santa Catharina and not far from Blumenau I collected the beautiful little *Amaryllis blumenavia* [now *Hippeastrum blumenavia*]. This is really a meadow flower as lovely as any species in the family. I brought back both bulbs and seeds and have had them bloom since my return. The seeds are semi-succulent, not as globular as those of *A. reticulata* var. *striatifolia*, but very different from the flat wafer seeds of the usual *Amaryllis* species."

This species has proven to be one of the "easy" amaryllids in my bulb collection so I found it odd to come across the following in Mr. Foster's article: "Several attempts have been made to grow *A. blumenavia* in this country [U.S.A.] and apparently with but little success. My experience has been that it desires much water in a loose, rather spongy soil and it will thrive best on the shady side."

He's right about this species thriving in shade. I've tried various locations for *H. blumenavia*, but those it seems to like best are shady in the summer, with more sun in the winter, and cool, always.

As Mr. Foster stated, this species does like plenty of water.

Recently, I asked my friend Leonard Doran about the correct culture for this little gem. Leonard told me it comes from an area where it rains nearly every day during the wet season, and that frosts are not uncommon during the winter, although I doubt he means frosts hard enough to freeze the ground.

In time, I may have to differ slightly with Mr. Foster with regard to his "loose, rather spongy soil mix". It's true that most of my *H. blumenavias* grow and do quite well in such a mix. But a bulb grown from a seed casually tossed into a potful of crushed granite sand grows and multiplies best of all—in soil compacted from years of watering and settling. Further experimentation should lead me to a more definitive "best" soil for this species.

Leonard Doran grows his bulbs in silica sand. He fertilizes frequently, as do I. His bulbs, like mine, grow like troopers. I should mention, at this point, that Leonard was a chemist by profession, and knows a good deal about agronomy and just what to feed and when to fertilize his bulbs, while I am far less scientific in my approach. Leonard also grows his bulbs in a hot greenhouse in full light, a method which certainly did not work well for my bulbs—mine lived but didn't thrive under such conditions.

If all this sounds confusing to would-be growers of this fine species, the point I'm hoping to make is that both Leonard Doran's set of bulbs and my own grow, flower and multiply in spite of our opposite approaches to culture. The term "ease of culture" comes to mind here, so if you get a chance to grow this fine species, don't hesitate to make the attempt.

Mr. Foster must have tended the seeds he brought back from Brazil with the utmost care and kept them moist throughout their trip. Seeds from my plants have been known to die within three to five days—depending on whether or not we're having a hot spell—if they are not able to absorb water once they drop from the parent. That's because they're nearly unique seeds for a *Hippeastrum*, being fleshy. (I say "nearly unique" because Mr. Foster mentions another *Hippeastrum* in his article which also produces succulent seeds: *Hippeastrum reticulata* var. *striatifolia*). About half the size of a green pea, sometimes roundish, sometimes with angles due to compression within the seed pod, seeds of *H. blumenavia* require a 6 week period of ripening while they're still on the mother plant and a 6–10 week period of after-ripening once they've fallen off before they germinate and grow. They are extremely subject to fungus attack during this after-ripening stage. In fact, for years, I had trouble germinating any but a few seeds out of the 200 or so I

would harvest on an annual basis. The reason for this was a fungus which no amount of fungicide could cure. It seemed to be passed on to the radicles while the seeds were still being formed on the mother plants. Once the seeds were planted, the fungus then attacked the radicle and killed it, usually before the radicle had a chance to grow. The seed endosperm would soon follow the radicle in death.

There was a cure for this problem, however. I noticed that once the tiny plants germinated and were growing, the same fungus could attack the plants and, while it might slow them down, it did not completely stop them from growing. A systemic fungicide came to my aid, and I now apply this fungicide four or five times a year to the mature plants, the mother bulbs. I am careful to do this at least twice—January or February, then March or April—before the plants bloom in May. Then the fungicide is applied once more while the seeds are forming. This procedure has eliminated the problem of seed death before germination.

Hippeastrum blumenavia can plant its own seeds. The plant is curious in that, once the spike has bloomed, it bends its developing fruiting stems over, seeds and all, and once the seeds have ripened the pod bursts and spills the fleshy, black-coated seeds upon the ground. This process is one of nature's little curiosities which never fails to amuse me.

In **Plant Life** 6, 1950, Mr. Foster wrote: "In southern Brazil, down in Santa Catarina (sic), I was rewarded with the great thrill of finding the rare *Amaryllis blumenavia*. Years ago it was classed as *Griffinia*. It was in a rather rich, moist section both in the forest and on the meadow edging the forest. Evidently it prefers rather moist conditions. With an umbel of 6 to 8 flowers, white, streaked with pale rose, this cheerful *Amaryllis* surely must come back to our collections. It is a small plant, only 6 to 8 inches high, but nevertheless a very worth while (sic) subject."

I quote Mr. Foster here for several reasons. The first is to clarify the locale of *H. blumenavia*'s origin: "southern Brazil", possibly an important climatic clue to its preference for growing conditions which I find to be somewhat cool rather than warm. The second is to clarify its habitat for those readers who might be trying to grow this species: "rather rich, moist section both in the forest and on the meadow edging the forest...it prefers rather moist conditions." The third reason is to provide a thumbnail sketch of the species: "umbel of 6 to 8 flowers, white streaked with pale rose...small plant...6 to 8 inches high...very worth while (sic) subject."

The fourth reason I include this quote is that the debate over

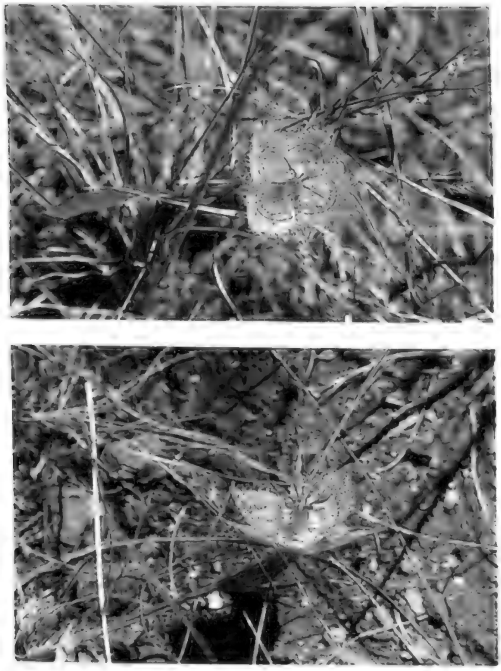
just what this amaryllid is, rages on. Several of the best taxonomic minds concede that, while *H. blumenavia* superficially resembles a *Griffinia,* it is not a member of that genus. On the other hand, while it taxonomically resembles a *Hippeastrum,* it may not belong in that genus either. Leonard Doran believes it probably should be placed in a monospecific genus all its own. I tend to agree with him, but, as neither of us is a botanist nor a taxonomist, we must both defer to those of higher learning in those fields.

In the meantime, I'll segue out of this nomenclature debate by using the "a rose by any other name..." quote and while I'm still obliged to call it *Hippeastrum blumenavia,* whatever it's called now or in the future, it's a great little bulb to grow, easy of culture—with **cool**, **moist** and **bright shade** being the key words here—and extremely rewarding with blooms and seeds. A potful of bulbs is an entire bouquet.

One other thing I've noticed: *H. blumenavia* usually has a 4-6 week period of dormancy just before it blooms, at least it does for me. I'm not sure this is a hard and fast rule, though, as I used to give it more sunshine than it wanted and only in the last year have I concentrated my observations for its culture while growing it in the shade. (I must say, it's doing *much* better in the shade.) In his excellent article "*Amaryllis Blumenavia*" in **Plant Life** 16, 1960, page 125, Douglas D. Craft quotes Dr. Hamilton P. Traub from his article in **The Amaryllis Manual**, p. 35, 1958 as writing about *H. blumenavia*: "It should be well watered during the summer growing season, and sparingly during the winter resting period. It is best not to dry off the plant entirely at any time...". Douglas Craft himself writes in the same article: "It is also noted that this species would appear to be practically an evergreen one."

If you are interested in learning more about *Hippeastrum blumenavia,* you'll probably want to get a copy of **Plant Life** 16, 1960 and read Douglas Craft's most interesting article on this species.

[Illustration at bottom of following page]



Three views of *Calochortus tiburonensis* in habitat on a grassy hillside in Tiburon, California.

Photos: Michael Mace

← See previous page

Hippeastrum blumenavia

Photo: Charles Hardman

MY HUNT FOR AN ENDANGERED SPECIES

Michael Mace
San Jose, CA, United States of America

Last June I hunted for an endangered species.

Calochortus tiburonensis, the Tiburon Mariposa, is a bulb that grows wild in only one place on Earth—a single hillside in Tiburon, California, just north of San Francisco. It is federally listed as a threatened species, and is almost impossible to obtain from other enthusiasts. Unlike a number of other endangered bulbs, such as *Moraea aristata*, *Calochortus tiburonensis* is notoriously difficult to grow in captivity. If you want to see it, you have to go look for it.

It's awkward to write about a rare species like this one because the more people know about it, the more danger there is that someone irresponsible will go pick the flowers or dig up the bulbs. (For the record, don't do it. Wild-collected bulbs of *Calochortus* species rarely survive in captivity; they just can't adapt to the change. Also, these particular bulbs grow on Nature Conservancy land and the Conservancy doesn't take kindly to poaching.)

On the other hand, anonymity can also be dangerous. A butterfly in Southern California called the Palos Verdes Blue was well protected by its almost complete anonymity, until someone who didn't know better mowed the grassy area where it lived. Fortunately, it was rediscovered a few years later somewhere else.

So I'll tell my story and hope that it will help to keep the lawn mowers away. But I'll leave out some of the details on location.

Calochortus tiburonensis has a strange history. Even though Tiburon is a heavily populated area and has been for many years, this flower was only discovered in the 1970s. Its discovery is credited to a Dr. Robert West, who, along with three other local residents, brought it to the attention of science. Tiburon is a densely populated suburb of San Francisco, and it is amazing that the flowers not only survived but escaped notice for so long. The area had been thoroughly explored botanically several times.

I had read about *C. tiburonensis* for several years and wanted to see it for myself. A business trip to the area in June, the height of the *Calochortus* season, gave me an opportunity. The heavy rains of 1994-1995 had produced a bumper crop of bulb flowers, so this was the best time to look. The only trouble was that I did not know exactly where to start. Tiburon is a peninsula and it has a lot of hillsides. Because *C. tiburonensis* is so rare, the printed sources I checked were deliberately vague about where to find it.

In fact, I had been told by someone knowledgeable that it was closly guarded. I pictured a razor-wire fence, guards armed with walkie-talkies, and maybe some trained attack dogs. I wasn't sure if I would be able to get near it, even if I did find the site.

All I had to go on were some vague hints. Combining them with a detailed map of the area, I made an educated guess to look along a particular road. The only problem was, the road I had found on the map didn't exist in real life. Instead there was a residential area that dead-ended into a hillside.

I was confused, but decided to take a look at the hillside anyway. There was a very old barbed-wire fence, almost completely collapsed, and the vague outlines of a foot trail leading uphill along the fence. The ground was right—a thin layer of red-brown oxidized soil over solid serpentine. There were none of the European annual grasses that have taken over most of California, just native bunch grasses and a huge number of small brodiaeas. Looking around, I couldn't see any Mariposas sticking up above the grass, which is the way you usually spot a stand of them.

Fortunately, I have learned to watch where I step, so I didn't walk on the first Tiburon Mariposa I encountered. It was lying across the path, a small plant with a short stem and a flower about an inch and a half [4cm] across.

It's hard to describe the flower of *C. tiburonensis*. Picture a flesh-colored radar dish covered in blond fur and you'll have a rough idea. There are three diamond-shaped petals, slightly cupped, straw-colored, and densely covered in curly hairs. The petals are stippled and lined in shades of brownish maroon. In the center of the flower is a thick style, with six canoe-shaped anthers sticking out at a 90° angle, parallel to the petals.

Flowers of most *Calochortus* are indisputably beautiful. The flowers of this one are indisputably odd. It has the same feeling of extra-terrestrial strangeness that you get from some fritillarias.

Once I spotted the flower, it was easier to understand why they went undiscovered for so long. Because of their color, they blend in beautifully with the dry grass. But now that I knew what to look for, and I realized that they were actually low-growing (unlike a drawing I had seen), it was easy to discover more. They dotted the hillside all around me. In some places I had to step carefully to avoid crushing them. But they didn't extend far; fifty yards [162m] away they started to peter out and I didn't spot any more. It's possible that there are other stands of them in the vicinity, but there can't be many.

I had carried a box lunch with me. I sat on an uncomfortable rock and ate lunch with the Mariposas. They have a great view. Their hillside, about fifty feet [65m] away from a housing tract, faces San Francisco Bay and the hills beyond. It's literally a million-dollar view, and we're lucky that the whole hillside wasn't converted to houses years ago. I was surprised that there was no physical protection for the plants—no sign, no fence, and definitely no guard dogs. I had the spot to myself and could have picked a bouquet of endangered species if I had wanted to.

Fortunately for *C. tiburonensis*, it's what most people would call ugly, and so probably no one will ever bother to do that.

This flower raises a lot of questions. How did it get there? Why Tiburon, and nowhere else? Why is it so hard to grow? What did it evolve from—it looks vastly different from almost every other member of the genus. The petal shape is something like an exploded version of a fairy lantern (such as *C. amabilis*), but those grow in shade, among trees and bushes. This flower is out in the open, on a sunny and windswept hillside.

Why are they so pale-colored? The *Calochortus* species are well known for their conspicuous colors. I wish I had thought to smell them—they look a little like some *Tigridia* species that smell dreadful and use flies for pollination.

The only scientific literature I could find on *C. tiburonensis* echoed my confusion. Albert Hill concluded that *C. tiburonensis* is difficult to fit in the current classifications used for the genus. Its leaf and flower shape seems to fit with the section *Cyclobothra*, but those species are generally found in Southern California and Mexico. Judging by the shape of the gland (a diagnostic feature used heavily in classifying *Calochortus* species), the plant might be closer to section *Calochortus*. But those generally grow further north. He speculated that it could be an ancient hybrid, but other tests discounted that.

I don't pretend to be qualified to judge these scientific questions. My point is that if there's a mystery plant like this in the middle of a housing tract in urban California, you have to wonder what still lurks out there in the less populated parts of the state.

The Tiburon Mariposa winks at us and dares us to go out and look.

HYMENOCALLIS 'SULPHUR QUEEN'

James Sleznick Jr.
P.O. Box 939, San Juan Bautista CA 95045-0939
United States of America

'Sulphur Queen' is a remake of a cross first made by botanist and bulb hybridizer William Herbert in the early 19th Century and originally called 'Spofforthiae' after his estate in England. He used as parents the species *Hymenocallis narcissiflora* and *H. amancaes* with the yellow dominance of *H. amancaes* expressing itself in the offspring. Fortunately the hybrid also inherited the ease of cultivation from *H. narcissiflora*. The cross was repeated by van Tubergen [The Netherlands] for the garden market and called 'Sulphur Queen'. The late Len Woelfe made the same crosses in the mid 50s giving cultivars the Greek names 'Icon', 'Helios' and 'Pax'; only 'Pax' appears in the retail trade today. Recently a cultivar called 'Golden Ismene' was offered in a popular garden catalog and appears to be a contemporary remake of 'Sulphur Queen'.

Both *H. amancaes* and *H. narcissiflora* are native to the lower elevations of Peru thus 'Sulphur Queen' requires protection from frost and freezing ground temperatures. Lifting plants in the winter in colder climates is necessary; mulching will provide suitable protection in more moderate areas. Well drained soils, slightly acidic in nature, with good organic content, provide the deciduous bulbs with a suitable support medium. Reproduction is by offsets.

Mature bulbs produce 2–4 flowers, 3–4 inches [[7.5–10cm] in size on a solitary stalk, primrose yellow in color and lightly scented. Flowering is in late spring—early summer in colder climates. Growing sites should provide full sun or light shade.

Mexican style terra cotta pots, approximately 14 inches [[36cm] in diameter and lined with a sealant to reduce moisture loss will handle several bulbs. Sweet alyssum (*Lobularia maritima*) can be used to soften the bulb/soil interface visually. Offsets could be carried in smaller containers to maturity. Plants appear to be relatively free of pests and rarely require insecticides but can be targets for snails. Local conditions may require specific treatment(s).

Hymenocallis 'Sulphur Queen' is popular and readily available, serving gardeners well as a dramatic statement in the garden or in containers in mixed planting combinations. Flowers are suitable as accents in cut flower arrangements. Mature bulbs tend to flower reliably and provide an attractive floral presentation when used in a complementary color combination of flowers with equal values.

Hymenocallis 'Sulphur Queen'

Top: *Hymenocallis* 'Festalis'
Bottom: *H.* 'Sulphur Queen'

Photos: James Sleznick, Jr.

See following page →

left: *Disa* orchids growing in foam at Pui Chin's in San Francisco.

Photo: Harold Coopowitz

right: Disa hybrid

Photo: Elisabeth Lassanyi

left: *Disa uniflora*

Photo: Charles Hardman

DISA: A GEM OF A TERRESTRIAL ORCHID

Elisabeth Lassanyi
Arcadia, California

Disa is a lovely but little known orchid genus. Disas make excellent cut flowers and merit closer attention from both hobbyists and commercial growers. Plants and seeds are available, usually from the most specialized orchid nurseries. The culture of these wonderful orchids was a well kept secret while they were grown as cut flowers for the European market during the 1800s. Then, for more than a hundred years, their cultural secrets were lost.

Disas provide a fresh face and a new challenge for orchid aficionados and bulb enthusiasts alike. A basic introduction to these stylish orchids and their care is in order so disas can come "out of the closet" and bask in greater popular enjoyment.

Disa flowers are borne well above the whorl of foliage and range from a couple of millimeters to about 11cm (4.33 inches) in diameter, and each inflorescence holds from one to several hundred flowers, depending on the species. The pointy-hooded, short-stemmed flowers typically bloom in various shades of more or less unpatterned cerise, rose pink, red or red orange. Recent hybrids have pastel pink, yellow and orange hues, some even have polka dotted patterns. The showy parts of a disa are the large, colorful sepals, the upper of which is hood-shaped with a slight point in the rear, and the lower two sepals are shaped like shallow spoons. Petals are diminutive relative to the sepals. The upper two petals join to form an arching hood around the anther-like structures (viscidia), and the lower petal forms a small tail or pointy "tongue" which descends from the white, glistening sessile stigma.

Why should you grow Disa? Well, they are beautiful flowers, and the intricately marked pinks and spectacular, large red flowers are breathtaking. But aside from their obvious good qualities, disas have one more to consider: they are a challenge. They are completely unforgiving of mistakes. This is the genus for the plant lover who has "been there, done that, grown it all before", a real test of one's horticultural prowess.

BIOLOGY

The genus *Disa* is found throughout Africa and Madagascar. Plants grow rooted in rocky, gravely crevices in or alongside clear, fresh running streams.

The family Orchidaceae contains several subfamilies, including

the subfamily Orchidoideae, containing the true terrestrial orchids. The genus *Disa* belongs to the tribe Diseae in subfamily Orchidoideae and produces tuberoids as well as roots. Tuberoids are part stem, part tuber. *Disa* has three natural means of reproduction: two vegetative and one sexual. The sexual method is the usual seed producing way, allowing the possibilities of cross pollination and recombinations of genes to obtain new strains or hybrids. Plants also reproduce vegetatively (self-clone) either by producing a rhizome/runner/stolon (the tip sprouts scale leaves and then becomes a new plant that may grow and flower like the parent plant) or by sprouting a "keiki" [pronounced *kay kee*]. "Keiki" is the Hawaiian name for the side growths which sprout from the base of the parent plant. Keikis are "blind" (non-flowering) growths which root, but may or may not produce tuberoids. If a keiki forms a tuberoid, the tuberoid sprouts a plant which will be a strong bloomer. If the keiki plant sets seed, seedlings often flower without making tuberoids and die soon thereafter.

CULTURE: LIGHT, AIR AND WATER NEEDS

It takes some trial and error to grow *Disa* right, but once you get the hang of it, it is easy to grow them. Just remember that you cannot neglect them. Check them daily or at least every few days and do not let them dry out. They won't forgive you for taking off on a month-long vacation.

The greatest factor in disa culture is the intensity of light received. Light levels greatly influence the size of the spike and flowers and their color intensity. Full sun stimulates better flowers and more intense color, but shade (up to 30 or 40%) produces longer stems. Many growers prefer lightly shaded growing conditions—a happy medium between full sun and 40% shade.

Disa roots are quite brittle and seem to need lots of air (via a fast-draining, loose planting mixture) and good quality water. Use a loose planting medium to ease transplanting, minimize root breakage and provide excellent aeration.

Considerable emphasis has been placed on using good quality water for watering disas. Disas are sensitive to minerals and salts and can burn with only slight buildups. Many growers use ion exchange resins, distillation or other types of filtration, or they steep their irrigation water in sphagnum peat to remove salts. Some disa growers recommend avoiding any water containing chloramines or chlorides. Acidic water (rain water, peat runoff) is acceptable. Other growers no longer worry about chlorine compounds. Genie Hammond, a small-moderate scale commercial orchid grower in Chula

Vista near San Diego, California, has concluded that it makes no difference whether the plants are watered with deionized, rain or municipal tap water, as growth and bloom quality are identical on her plants no matter which water she uses.

PLANTING AND REPOTTING, UNIVERSITY OF CALIFORNIA, IRVINE ARBORETUM METHOD

When planting disa seeds, seedlings or adult plants, you can use a mixture of ⅓ sphagnum peat, ⅓ fine vermiculite and ⅓ fine perlite in the upper ⅔ of the pot. The bottom ⅓ of the pot should contain styrofoam "peanuts" (not the hemispherical chips) or super coarse perlite for drainage and air circulation. Do not use cupped styrofoam packing chips as they fill with water and provide stagnant pools in which disease pathogens multiply. Cover the "soil" surface with a thin layer of small pebbles or bark to prevent disturbance of soil and roots during watering. Water from the top and let the water drain straight through the pot; do not leave any standing water in the pots.

Mature plants in 4–6 inch (10–12cm) pots may survive and grow, but plants in half gallon pots will put out more roots and have larger, nicer flowers. Repot mature plants annually. You can grow them "hard" under quite dry conditions with minimal fertilization. There is a touchier artificial streambed growing method, but I don't recommend it for novice growers.

COMMERCIAL GROWER'S METHOD

Use a light planting mixture of ⅔ perlite (medium, #2 size) and ⅓ peat with some fine charcoal. Spread a layer of volcanic gravel or pebbles onto the surface of the mix to hold down the perlite. No perlite or styrofoam layer is used at the bottom of the pots. Let the plants determine their repotting time. Wait until growth is very slow, then repot after removing dead tuberoids and roots.

Grow disas like lilies, and keep the roots cool in hot or arid climates. To cool and insulate pots and raise humidity, use planting flats with sides that are 4–5 inches (12cm) high, line them with burlap, then place pots of disas inside the flat, leaving a little room (½–2 inches/1–5cm) between pots and also between each pot and the sides of the flat. Before filling with sand, place the flat where you intend to keep it for the next few months as sand filled flats are quite heavy. Fill the spaces with damp sand (held in by the burlap) which cools, insulates, humidifies and sometimes provides a water reserve for the roots. You can also use smaller containers as they are easier to move around than are the flats.

DISEASES

There are two main diseases disas can contract. The first is a small black bacterial spot which starts on a leaf, grows, spreads and will kill the whole plant if the leaf isn't removed soon after the spot appears. This disease may be killed with Subdue™ or tetracycline solutions, although such treatment may give mixed results. Benlate™ has also been tried for this problem, but it gives the plants chlorosis. The best option is prevention by fastidious cleanliness and sanitation.

The second disease is a fungal (*Cylindrocladium* sp.) crown rot with root decay. The key symptom is that the leaves begin to die from the tip inward toward the crown turning from green to yellow to a brownish color over some time (about 6 weeks). This fungus can be spread easily to other disa plants. To stop its spread, kill and sanitarily destroy all infected plants, and wash your hands (and anything else that came in contact with the rot) well in soapy water. BanRot™ used at a bedding plant drench rate seems to stop the rot's progress for some growers. Susceptibility to the fungal rot seems to be genetically influenced. The variety 'Kirstenbosch Pride' seems to be resistant to *Cylindrocladium*. To prevent the rot occurring keep soil temperatures down and do not fertilize heavily. Use only about ¼ tsp. ammonium nitrate or ¼ tsp. 20-20-20 fertilizer per 2 gallons of water.

OBTAINING, STORING AND GERMINATING DISA SEEDS

Take up the challenge of growing disas from seed if you want to grow a large quantity of varied plants at a relatively low cost. Although some growers may sell seeds, you are more likely to find single plants for sale. That is not a problem because all you need to produce your own crop of seeds is a single blooming stalk.

Disa flowers have three large, showy sepals and three much smaller petals, amongst which are nestled two viscidia (the pollen bearing structures), which can be dislodged with a pencil, and the stigma (further into the flower), where pollen is deposited. After the flowers are pollinated, seeds may mature in as little as 4-6 weeks after pollination (in summer). Given adequate sunlight even a cut flower spike will produce viable seed (2-3 pods full). When the seed is ripe the ovary will split open all the way down to the stem, allowing the dust-fine seeds to blow out. Five thousand disa seeds fill a volume smaller than that of a used pencil eraser!

Experiments on *Disa uniflora* by University of California, Irvine undergraduate Alan Thornhill and Dr. Harold Koopowitz in 1990 revealed new information on storage requirements of disa seed.

Seed vigor varies greatly with temperature, dryness, time and other factors. A seed's vigor is reduced exponentially as storage temperatures increase, so the colder the temperature, the longer the seeds will be viable. Storage temperatures in the study ranged from about -40°C (-72°F) up to the mid 20s (celsius) (around 70°F), and the seeds stored at subfreezing temperatures had the highest percentage of viable seeds. Also, the fresher the seeds, the greater the percentage that will germinate.

Moisture is another factor in viability of stored disa seeds. If you intend to store seeds for several months or more, dry seeds thoroughly or they will lose viability quickly. Water comprises 45% of a disa seed's mass. When dried well (over a dessicating agent such as Drierite™ [anhydrous calcium chloride]), water comprises only 11% of a seed, and each disa seed is approximately 4.65×10^{-6} grams (0.000465 milligrams). You must desiccate the seeds if you intend to store them at or below freezing temperatures. Otherwise ice crystals will form in the seeds and destroy the embryos.

Once planted, seeds germinate in 5 months, then seedlings are allowed to grow in the original pot for one year before they are separated and planted out into another pot for further growth. These orchids take 2-3 years from seed germination to flowering.

Now that you know a little about how to grow them, give a disa a try! Your efforts will be rewarded with stylishly shaped flowers and clear colors, and your gardening friends will admire your horticultural prowess.

SOURCES

These sources are recommended by Dr. Harold Koopowitz. They are listed in no particular order.

Christian Lueg, Ellingshoal 76, 56076 Koblenz, Germany. Flasks, hybridizes and sells *Disa* and other terrestrial orchids.

Mr. Pui Chin, 2936 Baker Street, San Francisco CA 94123, U.S.A. Phone: 415-567-4715. Sells excellent *Disa* plants, mostly hybrids, but also some species. Call first before ordering or visiting.

Sidmar Disas, 24 Monterey Drive, Constantia 7800, Republic of South Africa. Grows/hybridizes *Disa* and also has meristems available.

Dr. Louis Vogelpoel, 7 Sunnybrae Road, Rondebosh 7700, Republic of South Africa. Grows, hybridizes and sells *Disa* seeds and plants.

Ron Maunder, Paradise Orchid Nurseries, PO Box 2107, Tauranga, New Zealand. Grows, hybridizes and sells *Disa* plants.

Dr. Warren Stoutamire, 3615 Mogadore Road, Mogadore OH 44325 U.S.A. Sells *Disa* plants.

THE GENUS *PLACEA* MIERS EX LINDLEY (AMARYLLIDACEAE) IN CHILE

Luis Arriagada and Otto Zöllner,
Laboratory of Phanerogamia, Universidad Catolica de Valparaiso,
Casilla 4059, Valparaiso, Chile

Chile is a very interesting country for botanists. The land is ribbon-like, extending from 17° 35' latitude south to 54° 53' latitude south. Two mountainous ranges run along the land: the Coastal Range with heights to 2,400m and the high Cordillera with heights to 7,000m. Northern Chile is desertic. Only in a few valleys are there plants, mostly xeromorphic ones. On the other extreme, forests in the south cover plains and hills in a rainy climate area. There the rate of yearly precipitation is between two and three metres. The best climatic conditions for human living reign in central Chile. Precipitation occurs only in the winter months from May to September, then the long period of drought resumes. All plants in this zone are adapted to these conditions. Trees and bushes in this area have perennial leaves of xeromorphic type. This type of climate with short rainy winters followed by long summer droughts is also called a Mediterranean climate as it is similar to that of the Mediterranean area in the old world. When winterly rains are abundant and favorable and fall in the semi-desertic regions, then we can observe here in Chile the rare phenomenon of the Flowering Desert. But this phenomenon does not happen often.

The climate of central Chile, with short winter rains and a long summer drought is favorable for bulbous and rhizomatous plants. With the first rains, many of these plants (orchids, *Miersia, Gavilea*) quickly produce leaves; some of them, such as *Miersia* and *Gilliesia,* form flowers in the depths of winter. During September and October all our fields and hills are covered with flowers of white, yellow and red (*Leucocoryne, Phycella, Pasithea, Alstroemeria,* and orchids).

But this beautiful wonder does not last long. In November when the summer heat begins, all these beautiful flowers have formed fruits and seeds, the leaves dry up and all the flowers disappear.

The higher mountains often are covered for a long time with snow. There, the flowering period is retarded until January. Here we will present the endemic Chilean genus *Placea* which grows in the higher regions from 1,300m to more than 2,000m.

PLACEA AMOENA Philippi in **Anal. Univ.** 93: 145, 1896

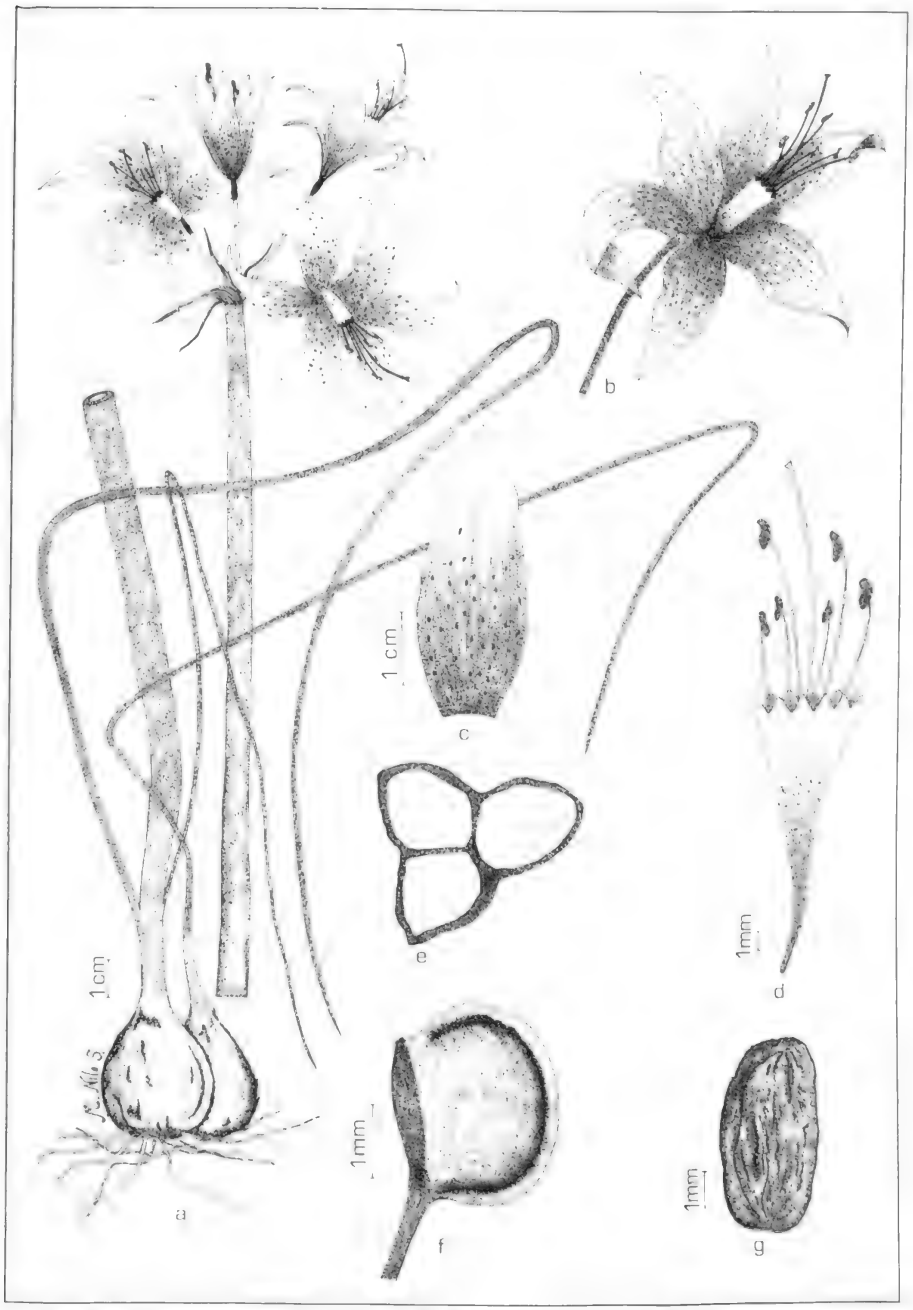
Bulbous plants, 30-40cm high; bulb ovoid, pear-like, 3.5-4.0cm high and 2.5-3.5cm wide, covered by dark membranes; leaves generally 3, reflexed, filiform, fleshy, 15-25cm long and 2.5-3.0mm wide, leaves have two hole channels; the bulb has only one peduncle, it is cylindric, glabrous, erect and interiorly whole, 15-25cm tall by 0.4-0.5cm wide; valves are membranaceous, have lanceolate form and are pink to red coloured, 2.5-3.5cm by 0.5-0.6cm; flowers joined in an umbel with 3-6 flowers; on the base of the pedicels and involved with spathe valves there are several hairs; pedicels thin, cylindric, glabrous, are 2-4cm long; flowers funnel shaped, slightly zygomorphic, with 3 outer and 3 inner tepals, oblong-acute in form, free tepals red to purple, the base of them is maculate, tepals 2.5-4.0cm long; in the interior of the tepal tube is the paraperigon, forming a ring of 8 to 10 lobes, this ring is also red, its height up to 1.6cm; six stamens with filiform filaments, the stamens of inequal height, but not overpassing the tepals, filaments inserted on the back side of anthers; ovary inferior, tricarpelar, trilocular, angular, style surpassing the anthers, stigma capitate; fruits are capsules with seeds of ellipsoid form.

Placea amoena grows in the Province Illapel of the IV Region. These plants do not grow near the coast, but only on slopes of mountains at 800-2,000m in places which are covered with snow in winter.

The representants of the genus *Placea* Miers are endemic Chilean plants. There, the following species of this group are the most beautiful: *Placea amoena* with red tepals, *Placea grandiflora* with white tepals having red stripes on them, and *Placea arzae* with yellow tepals having red stripes on them.

LITERATURE CITED

Traub, H. 1949. **Amaryllidaceae: Tribe Amarylleae.**
Nuñoz, Carlos. 1966. **Flores Silvestres de Chile.**



Placea amoena Phil. **a**. plant; **b**. flower; **c**. tepal; **d**. paraperigone; **e**. section of fruit; **f**. fruit; **g**. seed. Drawing by Ms Nagaly Nilo.

EFFECTS OF GAMMA IRRADIATION ON MUTANTS OF TUBEROSE (*POLIANTHES TUBEROSA*)

S. K. Datta and R. Shukla
Mutation Breeding Laboratory, National Botanical Research Institute, Lucknow 226001, India

ABSTRACT

Bulbs of 'Rajat Rekha', 'Svarna Rehka' and 'Sikkim', three mutant genotypes of *Polianthes tuberosa* L. were exposed to 500 and 1000 rads of gamma rays for testing their radiosensitivity and to induce genetic variability. Differential sensitivity could be detected among the cultivars as assessed on the basis of different cytomorphological parameters. Gamma rays successfully induced further new chlorophyll variegation patterns in all cultivars.

Polianthes tuberosa L., belonging to the family Agavaceae, is one of the most popular bulbous ornamental plants which has commercial importance for extraction of essential oil, and for ornamental floral purposes. This species does not have much natural variability either in flower colour or plant type. Only a white flower colour is known, with flowers being single, semidouble or double. Limited work has been done for its improvement through induced mutations. Ionizing radiation has been used by some workers for induction of mutations (Gupta et al. 1974, Younis and Borham 1975, Abraham and Desai 1976). Two chlorophyll variegated mutants, 'Svarna Rehka' and 'Rajat Rekha' have been developed through gamma irradiation of double and single flowered forms respectively (Gupta *et al* 1974). Sensitivity of both single and double flowered forms of tuberose to gamma rays have been determined on the basis of different cytomorphological parameters (Shukla and Datta 1994).

Variegation of leaves provides additional ornamental beauty to plants even when there are no flowers. Two gamma ray induced mutant genotypes of tuberose, 'Rajat Rekha' and 'Svarna Rekha', and one spontaneous mutant genotype of 'Sikkim' were selected as materials for testing their radiosensitivity and to determine further effects of gamma rays on their variegation pattern.

MATERIALS AND METHODS

'Rajat Rekha', developed from a single-flowered type, has silvery white streaks along the middle of the leaf blade and 'Svarna Rekha', induced in a double flowered tuberose, has leaves with golden yellow streaks along the margins. The leaves of 'Sikkim'

are quite similar to 'Svarna Rekha' in variegation pattern, though the variegation appears to be ivory in colour.

Bulbs of all three cultivars were exposed to 500 and 1000 rads of gamma ray radiation from a cobalt 60 radiation source with a dose rate of 27 seconds per Krad. Treated and equal number of control bulbs were planted in beds. Data were recorded on different cytomorphological aspects.

For cytological studies root tips were fixed in propionic acid: alcohol (1:3 v/v) for three hours. Temporary squash preparations were made after hydrolysing the root tips at 60°C for 13 minutes and staining in Feulgen.

RESULTS AND DISCUSSION

The somatic chromosome number in all three tuberose cultivars was found to be $2n=60$. The interphase nuclear volume (INV) and interphase chromosome volume (ICV) in 'Rajat Rekha', 'Svarna Rekha' and 'Sikkim' were 747.89 ±22.30 and 12.46; 738.37 ±19.39 and 12.30; and 714.22 ±19.35 and 11.90 (μm^3) respectively.

Different types of chromosomal aberrations were recorded during root tip mitosis of control roots of all the cultivars. The abnormalities included early and late separation, exclusion, laggard, bridge, clumping, micronuclei, cytomixis and unequal distribution of chromosomes (Table 1). Late separation was found only in 'Rajat Rekha' (0.39%) and 'Svarna Rekha' (0.18%). Cytomixis (0.19%) and unequal distribution of chromosomes (0.09%) were observed in 'Rajat Rekha'. In control materials 7.19 ±0.81, 6.65 ±0.61 and 3.66 ±0.68 percent of cells showed chromosomal aberrations in 'Rajat Rehka', 'Svarna Rekha' and 'Sikkim' respectively. These effects increased in all cases with increase in the dose of gamma rays. Types of chromosomal aberrations in irradiated populations were the same in all cases as in the control except for a few. Late separation was found only in 'Rajat Rekha' (1.15%) after treatment with 1000 rads. Fragments could be detected only in 'Sikkim' after treatment with 500 rads. Cytomixis (0.15%) was observed in 'Rajat Rekha' at 500 rads. Unequal distribution could be induced at 500 rads treatment in both 'Svarna Rekha' (0.23%) and 'Sikkim' (0.10%) respectively. The frequency of other abnormalities and total aberrations have been shown in Table 1. There was an increase in aberrations with increases of dose of gamma rays in all the cases. The increase was significant ($P<0.01$ to $P<0.0001$) in 'Svarna Rekha' and 'Sikkim'. A maximum increase of about 35.74% (as a percent of control) of the cells showed chromosomal aberrations after the highest exposure of 1000 rads in 'Rajat Rekha'. In 'Svarna Rekha'

and 'Sikkim' about 89.62% and 138.52% of cells, respectively, showed increase in aberrations (as a percent of control) at the highest exposure (Table 1).

Sprouting was much affected in 'Svarna Rekha' and 'Sikkim'. In both cases sprouting of 93.3% and 96.0%, respectively, was observed in the control and 500 rad treatment in 'Sikkim cv' and 'Svarna Rekha', respectively. In 'Rajat Rekha' 84.0%, 72.0% and 64.0% sprouting was recorded in the control, 500 and 1000 rads respectively. The total leaf growth rate of the control and treated populations was recorded in all the cultivars at monthly intervals up to five months. The leaf number was significantly reduced ($P<0.01$) only in 'Rajat Rekha'. Growth rate, in general, was slow in the control and treated populations of 'Rajat Rekha' in comparison to the others. Significant reduction in growth ($P<0.05$ to $P<0.001$) was recorded only at the highest exposure (1000 rads) in 'Svarna Rekha' and 'Sikkim' (Table 2).

Changes in the green and variegated leaf zones were observed in treated populations of all cultivars. The details of change in variegation pattern after gamma irradiation in all cultivars have been shown in Figures 1 to 3. Some leaves were completely creamish; also the variegation patterns of some leaves were of a striped nature. Percentage of plants with such change varied among the cultivars. In 'Rajat Rekha' 20% and 22.2% of plants showed a variegation zone at 500 rads and 1000 rads respectively. In 'Svarna Rekha' 29.16% and 68.0% of plants showed such a changed character at 500 rads and 1000 rads of treatment, respectively. In 'Sikkim' only 28.5% of plants showed leaf variegation zones after treatment with 1000 rads. Measurement of leaf width with a careful estimation of the green and variegation zones showed changes in all the cultivars. In 'Rajat Rekha' there was an increase in leaf width and green zone and a decrease in the variegated zone. A maximum (about 15%) decrease (as a percent of control) of the variegated zone was recorded at 1000 rads in 'Rajat Rekha'. There was decrease in both leaf width and green zone and an increase in the variegated zone in both 'Svarna Rekha' and 'Sikkim'. A maximum increase (as a percent of control) of 28.41% and 60.21% of the variegated zone was recorded at 1000 rads in 'Svarna Rekha' and 'Sikkim', respectively (Table 2).

Out of three mutant cultivars tested in the present experiment, 'Sikkim cv' was found to be more sensitive to gamma rays as measured on the basis of severity of chromosomal damage. The mutant genotype 'Rajat Rekha' was found to be less sensitive in the present experiment although its parental type (single cultivar)

was found to be more sensitive than the double flowered type (Shukla and Datta 1994). No positive correlation was observed between chromosomal aberrations and INV of the present materials. There was no significant difference between INV and ICV among the cultivars, but the magnitude of chromosomal damage differed among the cultivars. From the present experiment it is clear that the chromosome segment (gene(s)) responsible for chlorophyll synthesis and/or maintaining variegation pattern is very sensitive to gamma rays. In the first experiment gamma rays successfully induced the chlorophyll variegated mutants 'Rajat Rekha' and 'Svarna Rekha' in single and double flowered types, respectively (Gupta *et al* 1974). In the present experiment gamma rays have again changed the variegation pattern in all the mutant cultivars.

Bulbs of the plants showing newly induced variegated leaf patterns are being maintained separately to isolate them in pure form. Gamma rays have been successfully used at this laboratory for development of chlorophyll variegated mutants in *Bougainvillea* cultivars also (Gupta & Shukla 1973, Datta & Banerji 1990).

ACKNOWLEDGEMENTS

Thanks are due to the Director, National Botanical Research Institute, Lucknow, for providing the facilities. Thanks are also due to the Scientist-in-Charge, Botanic Garden for providing bulbs of 'Sikkim'.

LITERATURE CITED

Abraham V. and Desai, B.M. 1976. Radiation induced mutants in Tuberose. **Ind. J. Genetics and Plant Breeding** 36:328-331.

Datta, S. K. and Banerjee, B.K. 1990. 'Los Benos Variegata'—A new double bracted chlorophyll variegated *Bougainvillea* induced by gamma rays. **J. Nuclear Agric.** Biol. 19 (2):134-136.

Gupta, M.N. & Shukla, R. 1973. Mutation breeding in *Bougainvillea*. Ind. **J. Genet.** 34 A: 1295-1299.

Gupta, M.N., Shukla R. and Ram Sumiran. 1974. Mutation breeding of tuberose, *Polianthes tuberosa* L. Proceedings of Symposium on Use of Radiation and Radioisotopes in Studies of Plant Productivity held at G.B. Pant University of Agric. and Tech., Pantnager, April 12-14, 1975: 169-179.

Shukla, R. and Datta, S.K. 1994. Gamma Irradiation Studies on *Polianthes tuberosa* **L. J. Orn. Hort.** 1(2):36-41.

Younis, S.E.A. and Borham J.H. 1975. The effects of gamma irradiation on *Polianthes tuberosa*. **Egypt J. Bot.** 18 (1,3):205-217.

Table 1. Percent of cells with chromosomal aberrations during root tip mitosis in three tuberose mutants.

Chromosomal aberrations (%)	Control	500 rads	1000 rads
		'Rajat Rekha'	
Early separation	2.34 ±0.47	2.86 ±0.16	3.46 ±0.62
Exclusion	0.29 ±0.16	0.95 ±0.38	0.23 ±0.16
Laggard	0.48 ±0.21	0.79 ±0.35	0.69 ±0.28
Bridge	2.73 ±0.50	3.65 ±0.74	4.00 ±0.66
Clumping	0.39 ±0.19	0.00	0.00
Micronuclei	0.29 ±0.16	0.00	0.23 ±0.16
Total aberrations (%)	7.19 ±0.81	8.40 ±1.10	9.76 ±1.00
As a % of control	100.00	116.82	135.74
		'Svarna Rekha'	
Early separation	2.24 ±0.34	2.42 ±0.52	3.26 ±0.66
Exclusion	0.36 ±0.14	0.92 ±0.32	0.85 ±0.34
Laggard	0.42 ±0.15	1.42 ±0.41	1.70 ±0.48
Bridge	2.85 ±0.16	5.53 ±0.77	4.54 ±0.78
Clumping	0.12 ±0.08	0.00	1.98 ±0.36
Micronuclei	0.48 ±0.17	0.34 ±0.19	0.28 ±0.19
Total aberrations (%)	6.65 ±0.61	10.93** ±1.05	12.61** ±1.25
As a % of control	100.00	114.36	189.62
		'Sikkim'	
Early separation	1.70 ±0.46	1.74 ±0.41	2.42 ±0.56
Exclusion	0.13 ±0.13	0.00	0.00
Laggard	0.26 ±0.18	0.51 ±0.22	0.40 ±0.23
Bridge	1.57 ±0.45	3.28 ±0.57	3.09 ±0.63
Clumping	0.00	0.61 ±0.24	2.56 ±0.57
Micronuclei	0.00	0.00	0.26 ±0.18
Total aberrations (%)	3.66 ±0.68	6.75** ±0.80	8.73*** ±1.03
As a % of control	100.00	184.42	238.52

** = P<0.01 *** = P<0.0001

Table 2. Effect of gamma irradiation on leaf characters of three tuberose mutants.

Mutants/ Treatment (gamma rays)	Leaf			Green zone (cm)	Variegated zone (cm)	Variegated zone (%)
	number	length (cm)	width (cm)			
			'Rajat Rekha'			
control	22.50 ±1.80	35.67 ± 1.61	1.15 ± 0.04	0.74 ±0.03	0.40 ±0.02	34.78
500 rads	18.79 ±1.65	36.13 ±0.47	1.16 ±0.03	0.80 ±0.02	0.36 ±0.01	31.03
1000 rads	14.77 ±1.57	32.92 ±1.27	1.18 ±0.03	0.82 ±0.03	0.35 ±0.01	29.66
			'Svarna Rekha'			
control	25.29 ±1.43	55.48 ±0.97	1.55 1.05 ±0.03	0.53 ±0.02	34.10 ±0.01	
500 rads	24.21 ±1.68	52.83 ±1.20	1.23 ±0.03	0.89 ±0.03	0.54 ±0.02	38.29
1000 rads	21.91 ±1.47	48.46 ±1.09	1.37 ±0.02	0.76 ±0.02	0.60 ±0.02	43.79
			'Sikkim'			
control	13.87 ±0.74	53.80 ±1.73	1.54 ±0.03	1.12 ±0.02	0.42 ±0.01	27.27
500 rads	12.64 ±0.82	53.13 ±1.92	1.43 ±0.04	0.91 ±0.07	0.45 ±0.01	31.46
1000 rads	14.15 ±0.52	47.77 ±2.04	1.19 ±0.04	0.67 ±0.05	0.52 ±0.03	43.69

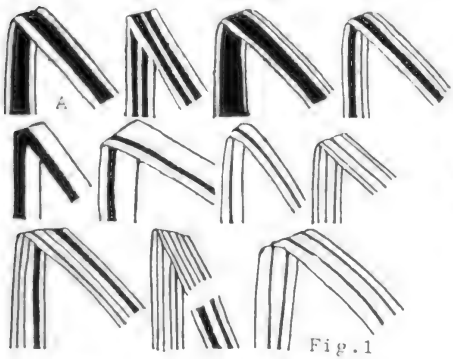


Fig.1

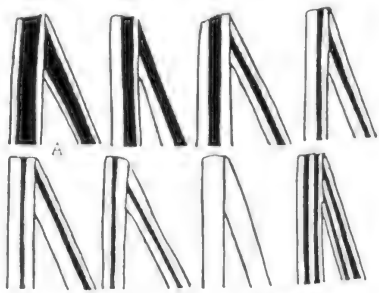


Fig.2

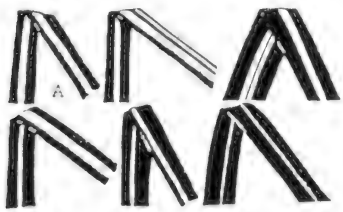


Fig.3

Figures 1-3. Leaf chlorophyll variegation pattern of three tuberose cultivars. 1A is a control leaf of 'Svarna Rekha'. 2A is a control leaf of 'Sikkim'. 3A is a control leaf of 'Rajat Rekha'. Other leaf drawings show induced changes in leaf variegation patterns of the respective cultivars.

MODERN DAY PLANT EXPLORERS: GUY WRINKLE

Guy Wrinkle
North Hollywood CA, United States of America

PART ONE: INTRODUCTION

I have done considerable traveling in search of rare plants so a friend suggested I do a series of articles documenting the adventures of a modern day plant explorer. This is a topic that I have never written on before and I think it's an exciting one. My hope is that **HERBERTIA** readers will come to see what is involved in bringing new species into cultivation.

During the last fifteen years I have traveled extensively in the pursuit of learning more about what I think is a most interesting topic—Natural History. Although I am more involved with plants than other organisms at this time, I am interested in all aspects of natural history. When I was a graduate student at the University of California at Los Angleles twenty years ago, my main interest was insects, especially beetles. Even then I was interested in unusual plants and was strongly influended by the writings of Bob Foster and Charlie Glass in the **Cactus and Succulent Journal**. Just a few years earlier, they had found so many new plants in Mexico that I dreamed of going to exotic places and seeing plants, insects, reptiles, people, etc. that were new to me.

About this time Frank Horwood, a leading horticulturist and plant explorer from England, moved to Southern California where I live and we soon became friends. He was ready to go on another trip to Africa and mentioned that I might want to join him. You have to understand that prior to this I had never even been on an airplane. I had driven several times to southeastern Arizona to study their unique insect fauna but I had never even been out of the U.S.A. except for a few trips to northern Baja California. Frank's proposition sounded wonderful but totally out of my reach. This is a good example of what limited thinking will do to you. Because of this invitation from Frank my horizons expanded and I now have been to Africa (South Africa, Namibia, Zimbabwe and Botswana) seven times, made several trips to remote locales in southern Mexico in the states of Chiapas, Oaxaca and Veracruz as well as other parts of Mexico, Peru, Venezuela, Central America nad several other places. All of this in the short time span of just 15 years. I recently got back from a trip to northern Idaho just to take a rest from traveling.

When all the well known early plant explorers set off for far-

away places in the early days of plant exploration, the world was a different world from the one we now live in. People faced extreme logistical problems in travelling. They often had to travel for weeks or even months by sea to go where we now can get to in one day by airplane. One thing that has not changed, however, is the fact that there are many unexplored or relatively unexplored places still left to see. Today we also have some new problems that did not face the early explorers. We now have rules and regulations regarding what we can and can not bring back. Anyone who plans to travel in search of plants or animals must now deal with the U.S. Department of Agriculture and in some cases with the U.S. Department of the Interior.

Much has been said and written regarding the trouble that can be caused by the U.S.D.A. when it comes to plant inspections but my experience has been that if you know what you are doing and follow the regulations, most of your problems are solved before they have a chance to happen. I have had a few unhappy experiences with the U.S.D.A. but only a few. I think that the real problem is that the inspectors are continuously rotated so that it is impossible to build up any kind of trusting relationship with them. Another problem that results from this rotating is that there are many new and inexperienced inspectors out there. In any case, most of our agricultural pests are non-native species that have been inadvertently imported into the country and are now responsible for huge financial losses as a result of their importation. When I bring plants into the country I always spend a great deal of time cleaning and inspecting them. If one snail is found the whole lot probably will be fumigated or destroyed. This is also the case if species of scale insects which are not already here are found. When I bring in plants from tropical parts of Mexico, I start out by taking each and every plant and shaking it vigorously to knock off any insects that it may harbor. I even cut a few open to see what may be inside the plant. All soil is thoroughly washed off the plants. I then go over the plants again to see if I can spot any scale insect species that can not be knocked off the plants. If I find any scale, I will scrape it off if it is a mild infestation. Plants that have a heavy infestation of scale are discarded. Even though I then take all the plants and dip them into an insecticide solution, it is still a good idea to discard plants with heavy scale infestations. It is not worth it to try and argue with the inspectors as to whether or not the scale is dead or alive.

After I dip the plants in the insecticide, I let them dry thoroughly so that no fungi will start growing on them. Fungi are

another cause to have the plants confiscated. The last thing I do is pack up the plants into several thick plastic bags and seal the bags with tape. If there is something that I have missed, it will be confined to the bag. This is very important because if one pest is found in the shipment, the entire shipment will be treated as if it were infested. If I keep any potential pest isolated, I have a good chance of only having problems with that one bag and not the whole shipment. If a pest problem is found when the plants are inspected the inspectors will then let me know what action will be taken. In some cases, they will allow me to come down to the inspection station and dip the plants in an insecticide that they prescribe. Sometimes the plants must be fumigated with methyl bromide which will almost always kill any soft-leaved species such as bromeliads. If the worst happens the plants will be destroyed. Because of my knowledge of entomology, I can keep on top of what is happening at the inspection station and I've been able to prevent problems before they go too far. If all of this sounds like a great deal of extra work, it is. It is very necessary, however. Imagine what it must feel like to go to all the trouble to get the plants and then have them destroyed.

Some plants and animals are considered endangered species and are regulated by a treaty which is called C.I.T.E.S. (Congress on International Trade in Endangered Species) through the U.S. Department of the Interior. As the U.S.D.A. already inspects plants when they come into the U.S.A., they have been given the job of enforcing C.I.T.E.S. regulations. Many plants are not regulated by C.I.T.E.S. (at least not at this time) so there is no problem with them in this respect. However, many of the groups of plants that I am most interested in, such as cycads, orchids and several types of succulents, <u>are</u> regulated by C.I.T.E.S. (that is, they are considered to be endangered). Importing these plants takes at the very least lots of red tape and often there is no legal way to do it. I should also mention that these are laws in the United States. All other countries have their own unique laws which have to be dealt with.

The worst problem I had as far as importing plants was when I was in Hawaii and shipped some plants from there to California. They never got here. After some heavy-duty investigation, I learned that the Hawaiian Department of Agriculture had confiscated them at the airport and destroyed them. I was told that they were gone and there was nothing more that could be done. I found out they knew the plants were rare because they contacted several botanic gardens to see if there were any recent thefts. I have a feeling that those plants are now in someone's collection.

Because many of the things that I am looking for often are found in remote areas, I have frequently been confronted by various officials wanting to know what I am doing. This has resulted in a full spectrum of responses—all the way from some very helpful people to having a cocked forty-five or automatic rifle put in my face. The concept of due process is not a universal one and it is best to know the customs of the country you are in.

When I first went to Africa I knew nothing about photography but I did know that I wanted to bring back pictures for lectures, articles and my personal use. I talked to various people and learned what I could about photography and then decided on a 35mm Olympus single lens reflex (slr) camera that was totally manual in its operation and very light in weight. After walking mile after mile, I appreciated the light weight and I thought that the fact that all the settings were manual gave me total freedom to be creative with my photographs. That camera took many hundreds of very nice pictures but the time came when I wanted something better. I now have a Nikon camera that is totally automatic (including the focus) but with a manual override for everything. The camera is heavy and particularly intolerant of being dropped in the mud but it has made a big difference in the quality of my photographs. Several professional photographers told me that my Olympus was a perfectly good camera and not to worry about getting something else, however, the features on the Nikon really do make a difference. This is especially true when it comes to photographing animals which don't sit still for very long. Looking for plants and animals and wanting to seriously photograph them are really two different endeavors which is to say that good photography takes a lot of time. This is something that one must come to terms with in the time allotted.

I am often asked about the problem of diseases and dangerous animals. Tropical diseases are something that must be taken into consideration but they are not so much of a problem as most people think. I have been in malaria areas and watched the mosquitos sucking blood out of my arm but I have never come down with malaria. I have also been in close contact with people who had tuberculosis but I have never developed tuberculosis. On the other side of the coin, I have come down with some severe cases of dysentery and flu-like diseases but nothing really life threatening.

Regarding dangerous animals, they have never been a problem. I am constantly looking for animals and consider it a privilege to encounter them. I have been way too close to rhinos, elephants, crocodiles, lions and poisonous snakes as well as other animals

that most people fear but I have never had any problem develop out of these contacts. It has taken a lot of work to find these animals and I think that most people would not even see many of them. One of my most unique experiences was to walk into a rain forest at night and just sit there. Many people consider this crazy but I have found it to be one of the most peaceful and enchanting experiences I have ever had.

Anyway, back to my first trip which was to South Africa with Frank Horwwood, about fifteen years ago. Frank and I got to the airport to discover that we were ready to leave on the first day of a strike by the air traffic controllers. The airport was in total chaos and many of the flights had been cancelled. We were to fly to New York and then on to South Africa and our flight to New York had been cancelled. We were able to book a flight on another airline if we could get there on time. Of course, the other airline was at the opposite side of the airport and was due to take off very soon. Frank and I took off running and it soon became apparent that Frank, being a heavy smoker, would not be able to make it. He was coughing like crazy and it looked like he was going to die on the spot. I don't know how I did it, but I took Frank's luggage as well as my own so Frank did not have anything to carry and we were able to get to the other terminal just in time to make the flight. The next thing I knew, Frank and I were on the plane and on our way to the first of many adventures to come.

To be continued.

YELLOW-FLOWERED CYCLAMEN

A yellow-flowered cyclamen plant has been grown in Japan. The plant is said to be the result of inbreeding diploid white flowered cyclamens. The yellow color in the petals is the result of chalcone in the petals and is due to a single gene which is recessive. The yellow color is pale, but there is an ongoing program to deepen the color. It is felt that cyclamen plants with new colors eventually will be the result of future breeding with this cultivar.

This information was reported in **Scientia Horticulturae** 64:55-63 and reprinted in the Summer, 1996 **Pacific Horticulture** journal.

Crosses between *Cyclamen* species are rare—only four had been verified by 1988 while a few more were still being debated. Cyclamen buffs and commercial growers alike will be interested to learn in what species this yellow-flowered plant has appeared.

THE SIGNIFICANCE OF PLOIDY LEVELS IN BREEDING AND SELECTION OF DESIRED PLANT TYPE IN *GLADIOLUS*

Deepak Ohri
National Botanical Research Institute
Lucknow-226001, (U.P.), India

The main events which transformed *Gladiolus* from relatively unattractive elemental species to one of the most attractive cut flowers span nearly 100 years. This has indeed been a great success story with more than 30,000 cultivars today while 100-200 are being added every year. These forms are all hybrids having arisen from eight elemental species with at most 12 other species contributing in a small way to the gene pool (Ohri & Khoshoo 1983b). The main factors responsible for the establishment and perpetuation of so many cultivars have been the growth habit and vegetative propagation. Repeated cycles of hybridization among elemental species (both diploid and polyploid) led to recombination between multiple sets of genomes and polysomic inheritance. Further recombination in these heterozygous forms resulted in reassortment of heterozygous gene/gene combinations producing large variation in the progeny (Ohir & Khoshoo 1983b). As a consequence of this, no two individuals obtained by selfing a plant or by a cross combination, are similar. Therefore, vegetative propagation is the only way to perpetuate any novel forms showing sufficient merit (Ohir & Khoshoo 1983a,b).

Today *Gladiolus* breeders can draw upon the tremendous variability present in thousands of named cultivars. It needs to be mentioned here that the earlier breeding and improvement was primarily carried out by European nurserymen who inadvertently selected only those species and cultivars which were suitable for European conditions. Now *Gladiolus* is being grown in many non-traditional areas and further requirements regarding size and constitution of spike and disease resistance would necessitate enlargement of the genetic base for breeding. For this purpose the tremendous genetic variability present in over 200 species of this genus needs to be understood properly. In this regard work was initiated by the present author at the National Botanical Research Institute, Lucknow, which involved a thorough understanding of genetic race history of garden gladiolus, and using this knowledge, to produce the cultivars suitable for the subtropical climate of the Indo-Gangetic Plains (Ohri 1982, Ohir & Khoshoo 1981, 1983a,b, 1985a,b). It may be pointed out here that in India, gladiolus have been grown only in some hilly areas. Therefore a planned breeding

programme with definite objectives and strategies needed a thorough understanding of the genetic system.

BREEDING SYSTEM

The flower structures and the positional barrier between anthers and stigma suggest that *Gladiolus* is essentially an outbreeder (Ohri & Khoshoo 1981). This is is further proved by the fact that maximum pod development takes place only in hand pollinated flowers, whereas natural pollinated and bagged flowers showed considerable reduction in pod formation. Most remarkably, self-incompatibility was found in the diploid species *G. tristis* and two tetraploid cultivars (Ohri 1982; Ohri & Khoshoo 1981). In this situation no seeds are set when the stigma is fertilised with the pollen of the same plant or of a different plant of the same clone. The tetraploid cultivars form a graded series with respect to seed set under selfing with totally self-sterile 'La Paloma' and 'Debonair' to a highly self-fertile 'Solid Gold'. The pollen germination studies reveal that whereas in self-incompatible taxa the pollen grains germinate on the stigma and penetrate stigmatic tissue, the tips of their tubes become swollen in the stylar tissue and stop growing further.

CHROMOSOME NUMBERS AND MEIOTIC PAIRING

It is rather significant that all large flowered summer flowering cultivars studied until now have a tetraploid ($2n$=60) constitution (Ohir & Khoshoo 1985a). Meiosis in these cultivars shows some irregularities in the form of a small number of multivalent configurations like quadrivalents, and trivalents along with bivalents and univalents. Bivalents are predominant. At anaphase I normal 30:30 segregation was observed in most cases. Bivalents and quadrivalents disjuct regularly but laggards and unequal segregation resulted from univalents and unequal disjunction of trivalents. Pollen stainability among cultivars ranges from 49.87–98.0%. All the cultivars produced 6-70% of seeds that were fertile.

In contrast to this the diploid ($2n$=30) and tetraploid ($2n$=60) species studied show regular bivalent formation without any multivalents. There is normal anaphase segregation. The pentaploid ($2n$=75) cytotype of *G. dalenii* (=*G. psittacinus*) however, showed irregularities in the form of pentavalents, quadrivalents, trivalents and univalents. The mean bivalents per cell range from 19.52 to 29.88 in six cultivated types of this taxon. As is expected of an odd numbered polyploid anaphase is rather irregular with different types of segregation. Pollen stainability ranges from 65.07 to

94.26 percent and all the types produce 1-20% of fertile seed (Ohri & Khoshoo 1985a).

One dodecaploid ($2n$=176) species (*G. communis*) analysed shows very high frequency of bivalent formations. Number of bivalents range from 80-88 with a mean of 84.75 percent, trivalents range from 0-4 and univalents from 0-5. Anaphase I segregation is unequal. Pollen stainability and seed fertility are 87.16 and 60.0 percent respectively.

HYBRIDIZATION

This study involved an analysis of intra- and interploidal crosses (4x, 5x, 2x). Twenty tetraploid cultivars were both selfed and crossed amongst themselves. Out of 47 progeny plants studied for their chromosome numbers randomly, only two plants having $2n$=4x-1=59 and $2n$=4x+1=61 were detected. The rest of the 45 plants were tetraploid ($2n$=60). Their meiotic behaviour was the same as that of the parents (Ohri & Khoshoo 1983a). The progeny of 5x cytotypes of *G. dalenii* possessed chromosome numbers from 68 (5x-7) to 79 (5x+4). Besides, two plants with $2n$=105 (7x) and $2n$=116 were also found which shows the formation of unreduced gametes. These plants, however, did not reach flowering stage. From this it is evident that although they may be fertile, the propagation of pentaploids is possible only by vegetative means.

The 4x x 2x crosses was successful only when the tetraploid was used as the female parent. Of the 12 plants from G. 'Friendship' x *G. tristis*, 11 were triploid while one had 3x+1=46. This again shows that the tetraploid parent regularly contributes 30 chromosomes. Similarly, in the crosses involving G. 'La Paloma" (4x) and G. 'Pacifica' (4x) with *G. callianthus* (=*Acidanthera bicolor*) (2x) the progeny was predominantly triploid. These triploids showed very irregular meiosis with the formation of trivalents and a very high number of univalents. These were completely seed sterile and pollen stainability was only 8.8 percent.

5x x 2x crosses also succeeded when a pentaploid was used as the female parent. The progeny showed a range of chromosome numbers from 49 (3x+4) to 54 (3x+9). In these hybrids bivalent formation was higher than in triploid hybrids. Besides, also quadrivalents, trivalents and univalents were observed in varying frequencies. Pollen stainability ranged from 38.1 to 46.2 percent and there was 0-5 percent seed fertility. This shows that chromosome imbalance is not tolerated below the level of tetraploidy (Ohir & Khoshoo 1983a).

The 5x cytotypes of *G. dalenii* and garden cultivars (4x) could

be crossed reciprocally, and the chromosome numbers in the progeny in both cases ranged from $2n$=64 (4x+4) to $2n$=69 (4x+9) with $2n$=68 occurring in highest frequency. The meiotic behaviour is essentially the same as that of the parents. Anaphase I showed various kinds of segregation. Pollen stainability ranges from 77.4 to 96.45 percent. These aneuploid derivatives do not show any deleterious effects in the shape and size of spike or flowers and were as seed fertile as their parents and these could be backcrossed. A mitotic analysis of the two plants from the progeny of $2n$=64 x $2n$=60 showed that they had somatic complements of $2n$=61 and $2n$=63. This proves that $2n$=64 plants transmit gametes with 31 and 33 chromosomes and the progeny could be stabilized to exact tetraploid level by further backcrossing (Ohir & Khoshoo 1983a).

It is clear from these studies that *Gladiolus* possesses a very plastic genome and practically any species (except the Eurasian ones) could be crossed with any other irrespective of ploidy level. This brings forth another point, that although there is hope of further improvement in *Gladiolus* by involving diploid species from South Africa ($2n$=30) (Ohir & Khoshoo 1983a,b; Littlejohn & van der Walt 1992) and tropical Africa showing dysploid numbers (x=11, 12, 13, 14) (Goldblatt et al. 1993), the size of spike and flowers is abruptly reduced at triploid level. Further backcrossing of these hybrids is not possible because of sterility (Ohri & Khoshoo 1983a). However, if one requires dainty spikes having small flowers, then breeding for triploids would be very profitable in *Gladiolus*. It was amply demonstrated by the cross *G.* 'Friendship' (4x) x *G. tristis* (2x) which yielded stunningly attractive progeny showing a very high production of cormlets (100–150 cormlets per corm) like *G. tristis*. This single cross resulted in a number of early flowering triploid cultivars, e.g. 'Hans', 'Indrani', 'Manhar', 'Manisha', 'Pitcambar', 'Sanukta' and 'Triloki'. The 5x cytotype of tropical African species *G. dalenii* was used because of its remarkable adaptability to agroclimatic conditions of the North Indian Plains. Its progeny with other attractive tetraploid cultivars did not show any apparent deleterious effects due to extra chromosomes from the pentaploid parent. However, along with the positive features some undesirable characters with regard to flower shape were also transmitted from the pentaploid parent. These could be rectified by backcrossing the progeny with tetraploid parents which also led to the stabilization of chromosome numbers at tetraploid level. A number of hybrids suitable for growing in the North Indian Plains have been released for the floriculture trade. Notable among these are 'Archana' ($2n$=68) and 'Arun' ($2n$=65).

The chromosome numbers of these hybrids were wrongly copied from my work by Sharma and Sharga (1990).

Tetraploidy is therefore optimal for plant size and vigour in *Gladiolus*. Any ploidy level below or above this results in loss of vigour and size. However, a breeder can always make use of the immense variability present in over 200 species and can yet produce desired plant type at tetraploid level by different approaches such as (6x species x 2x species) x 4x cultivars, 4x cultivars x induced tetraploids of 2x species, (4x cultivars x 2x species) x 4x cultivars (tetraploids might originate by the unreduced gametes from tiploids), (5x species x 2x species) x 5x species followed by selection for tetraploids, 5x species x 4x cultivars followed by backcrossing with 4x, etc.

LITERATURE CITED

Goldblatt, P., Takei, M. and Razzaq, Z.A. 1993. Chromosome cytology in tropical African *Gladiolus* (Iridaceae). **Ann. Miss. Bot. Gard.** 80: 461-470.

Littlejohn, G.M. and van der Walt, I.D. 1992. *Gladiolus* breeding using indigenous species. In: Sixth International Symposium on Flower Bulbs Vol II, (Eds.) M. Saniewski, J.C.M. Beijersbergen, W. Bogatko, Skierniewice, Poland. 12-15 May 1992. **Acta Horticulturae** 325.

Ohri D. 1982. Self-incompatibility in *Gladiolus*. **Incompatibility Newsletter** 14: 111-115.

Ohri, D. and Khoshoo, T.N. 1981. Cytogenetics of garden gladiolus. I. Pollination mechanism and breeding system. **Proc. Indian Natn. Sci. Acad.** B47: 510-515.

Ohri, D. and Khoshoo, T.N. 1983a. Cytogenetics of garden gladiolus III. Hybridization. **Z. Pflanzenzuchtg** 91: 46-60.

Ohri, D. and Khoshoo, T.N. 1983b. Cytogenetics of garden gladiolus IV. Origin and evolution of ornamental taxa. **Proc. Indian Natn. Sci. Acad.** B49: 279-294.

Ohri, D. and Khoshoo, T.N. 1985a. Cytogenetics of garden gladiolus II. Variation in chromosome complement and meiotic system. **Cytologia** 50: 213-231.

Ohri, D. and Khoshoo, T.N. 1985b. Cytogenetical evolution of garden gladiolus. **Nucleus** 28: 216-221.

Sharma, S.C. and Sharga, A.N. 1990. *Gladiolus* Breeding for the Tropics. **Herbertia** 46: 54-58.

A SOURCE LIST OF GEOPHYTIC PLANT MATERIAL

Dave Casebier
45 Priest Street, Hudson MA 01749, United States of America

This list is intended as a resource for members of the IBS and is in no way an endorsement of the businesses listed. Whereas I have had personal experience and/or correspondence with the majority of those suppliers listed, I cannot vouch for the reputations and/or reliabilty of all listed below. I was able to get a firm toehold on this list several years ago with the help of Barbara Barton's book **Gardening by Mail: A Sourcebook** and include it here as an initial reference.

It is intended that this list be updated and expanded yearly with the aid of members and suppliers who wish themselves to be known. Information on quality of service, time taken to receive orders, accuracy of naming and quality of products would be beneficial. Please send addresses and/or catalogs to Dave Casebier, at the above address. In particular there are few South American sources, and I would like to add more such sources which could be used by members.

SEEDS

B & T World Seeds
Whitnell House, Fiddington, Bridgwater, Somerset TA5 1JE, England
David Sleigh Fax & Tel 0278-733209
Huge, very extensive lists of seed, organized by type (the first you will get is a list of lists: alpine, perennial, trees etc., ask for list number 6 (bulbs); they will also try to fill requests.

Chiltern Seeds
Bortree Stile, Ulverston, Cumbria LA12 7PB, England
Tel (01229) 581137 Fax (01229) 584549
Large seed supplier, lists some *Bomarea* and *Stenomesson* species and has had *Pamianthe peruviana* in the past.

John Watson and Anita Flores de Watson
24 Kingsway, Petts Woods, Orpington, Kent BR5 1PR England
Tel (0689) 822494
Wild collected alpine seed from South America, *Rhodophiala* sp.

Luis D. Arriagada G.
Casilla 8261, Viña de Mar, Chile
Tel 223-2287
Hippeastrum, Rhodophiala, Placea, Phycella species; Iridaceae and Liliaceae, all from Chile.

Martin Kunhardt
Wahroonga, PO Box 144, Merrivale 3291, Republic of South Africa
Seed of *Cyrtanthus, Brunsvigia, Watsonia* and high veld bulbs, also hybrid *Cyclamen* and *Streptocarpus* seed.

Monocot Nursery
'Jacklands', Jacklands Bridge, Tickenham, Clevedon,
Avon BS21 6SG, England
M. R. Salmon
Extensive list of *Narcissus,* Araceae, *Colchicum, Puschkinia, Scilla* and *Crocus,* as well as other dwarf bulbs. Collector number and locality supplied with many of the offerings.

Silverhill Seeds
18 Silverhill Crescent, Kenilworth 7700, Republic of South Africa
Rachel and Rod Saunders Tel (021) 762-4245 Fax (021) 797-6609
Successor to Parsley's Cape Seeds. Large listing of South African plants, including extensive bulb section. Can obtain amaryllids at times.

BULBS

Amaryllis, Inc.
PO Box 318, Baton Rouge LA 70821 U.S.A.
Ed Beckham Tel (504) 924-5560, (504) 924-5421
Mostly *Hippeastrum* hybrids, but some species of *Hippeastrum, Habranthus, Lycoris* and other bulbs.

Anthony J. Skittone
1415 Eucalyptus, San Francisco CA 94132, U.S.A.
Tel (415) 753-3332
Large list of South African bulbs and hybrids. Very good selection.

Avon Bulbs
Burnt House Farm, Mid Lambrook
South Petherton, Somerset TA13 5HE, England
Chris Ireland-Jones Tel (0460) 242177
Wide-ranging list of hardy bulbs with both species and hybrids.

Broadleigh Gardens
Bar House, Bishop's Hull, Taunton, Somerset TA4 1AE, England
Christine Skelmersdale Tel (0823) 286231
Specializes in dwarf bulbs: *Crocus, Fritillaria* species, tulips and iris, hyacinths and daffodils as well as other dwarf rarities.

Cambridge Bulbs
40 Whittlesford Road, Newton, Cambridge CB2 5PH, England
Norman Stevens Tel (0223) 871760
Extensive list of hard-to-find, hardy , small bulb species, also offers *Tecophilaea cyanocrocus, T. cyanocrocus leichtinii,* and *T. violacea.*

Cape Flora Nursery
PO Box 10556, Linton Grange, Port Elizabeth 6055
Republic of South Africa
Tel (041) 732096 Fax (041) 733188
Good list of amaryllids, including *Brunsvigia* and *Cyrtanthus,* and irids from the Cape.

Clivia Breeding Plantation
4-28, Kurodo Mobara-city 297, Chiba Prefecture, Japan
Yoshikazu Nakamura Tel/Fax 0475-23-5444
Clivia species and hybrids, including 'Vico Gold' and variegated leaf forms.

Croft Wild Bulb Nursery
PO Box 61, Stutterheim 4930, Republic of South Africa
Tel (0436) 31330 Fax (0436) 31931
Specializing in bulbs of the Eastern Cape region.

David Sampson
Oakdene, Street End Lane, Broad Oak,
Heathfield, East Sussex, TN21 8TU, England
Tel (0435) 864382
Primarily an alpine grower, but has some *Lilium, Iris* and *Trillium* species.

Diggers Garden Company
105 Latrobe Parade, Dromana VIC 3936, Australia
Tel 05987-1877

Flowers and Greens
PO Box 1802, Davis CA 95617, U.S.A.
Roy Sachs Tel. (916) 756-9238 Fax (916) 756-1201
A hobby out of control. Sells own *Alstroemeria* hybrids in unusual and nice color combinations; sometimes has warm-growing species for sale.

Glenbrook Bulb Farm
28 Russell Road, Claremont, TAS 7011, Australia

Grant Mitsch Novelty Daffodils
PO Box 218, Hubbard OR 97032, U.S.A.
Dick & Elise Havens Tel (503) 651-2742
The cutting edge in daffodil hybrids, still searching for the true red-on-white. These are luscious, exotic bulbs for those of us who live in the tundra. Catalog is $3.00 U.S.

Guy Wrinkle Exotic Plants
11610 Addison Street, North Hollywood CA 91601, U.S.A.
Tel (310) 670-8637 Fax (310) 670-1427
Rare plants that are in short supply from the wild—cycads, caudiciforms, rare succulents. I have seen his list and it is quite impressive. Some plants are collected in the wild but more and more are nursery propagated.

Imbali Bulbs
PO Box 267, Auckland Park 2006, Republic of South Africa
Robert and Andrea Orr Fax 011-27-486-1527
Wonderful list of South African bulbs, both from the Iridaceae and Amaryllidaceae, good selection and reasonable prices.

Jacques Amand Ltd.
The Nurseries, Clamp Hill, Stanmore, Middlesex HA7 3JS, England
Tel (981) 8138 Fax (981) 6784

Well known nursery for bulbs, somewhat pricey but has interesting and rare material, including *Tecophilaea cyanocrocus, T. cyanocrocus* var. *leichtinii,* and *T. violacea.* They now have an American supplier and an 800 phone number, but the tack-ons, dollar-pound exchange, additional shipping and phytosanitary certificates can be expensive.

Jim Duggan Flower Nursery
1452 Santa Fe Drive, Encinitas CA 92024, U.S.A.
Tel (619) 943-1658
Primarily South African irids and some *Lachenalia* species. List varies somewhat from year to year. Now has the stock of BioQuest Int.

John Scheepers, Inc.
PO Box 700, Bantam, CT 06750, U.S.A.
Tel (203) 567-0838 Fax (203) 567-5323
Same owners as Van Engelen (which see), with a similar listing. Primary difference is in quantities and pricing.

Joy Plants
Runciman Road, Rd 2, Pukekohe East, New Zealand
Terry Hatch Tel 1649-238-9129
Sells a wide variety of bulbs; nerines are a specialty.

Kelly's Plant World
10266 E. Princeton, Sanger CA 93657, U.S.A.
Herb Kelly, Jr. Tel (209) 294-7676
List is U.S. $1. He sells a broad selection of *Canna* and *Crinum* hybrids; also has a large collection of choice *Lycoris* hybrids.

Lousiana Nursery
Route 7, Box 43, Opelousas LA 70570, U.S.A.
Ken, Albert and Dalton Durio Tel (318) 948-3696 or 942-6404
Catalog is U.S. $3. Large listing of choice *Crinum* hybrids and some rare bulbs which thrive in the southern U.S.A.

Lowlands Nursery
P. O. Box 9, Kei Road 4920, Republic of South Africa
Ms. Joan Bursey Tel (0432) 820731 or 820730 Fax (0432) 820731
Sells a number of cycads but also has a good number of bulbs for sale at low prices. My experience with her has been excellent.

McClure and Zimmerman
P.O. Box 368, Friesland WI 53935, U.S.A.
Tel (414) 326-4220 Fax (414) 326-5769
Large list of choice bulbs, varying slightly from year to year.

Monocot Nursery
'Jacklands', Jacklands Bridge, Tickenham, Clevedon,
Avon BS21 6SG, England
Extensive list of *Narcissus, Araceae, Colchicum, Puschkinia, Scilla* and *Crocus,* as well as other dwarf bulbs.

Paul Christian – Rare Bulbs
PO Box 468, Wrexham, Clwyd LL13 9XR, United Kingdom
Species-oriented, extensive list of hardy bulbs and some more tropical species. Careful attention is given to customers and to accurate names of the plants. Summer list: £0.60, DM 1.50, FF 5.00; also a winter list.

Pine Heights Nursery
Pepper Street, Everton Hills, Queensland 4053, Australia
Tel (01617) 353-2761
Sells *Calostemma lutea* and *C. purpurea*, also *Sprekelia, Crinum, Habranthus, Zephyranthes, Hippeastrum* and other subtropical amaryllids.

Plantation Bulb Co.
Box 159, TyTy GA 31795, U.S.A.
Tel (912) 388-999
Large listing of *Crinum* & *Hymenocallis* species/hybrids, other tropical bulbs.

Potterton and Martin
The Cottage Nursery, Moortown Road, Nettleton
Caistor, Lincolnshire LN7 6HX, England
Tel and Fax (1472) 851792
An alpine grower. Extensive list of dwarf bulbs, both hardy & temperate.

Robinett Bulb Farm
PO Box 1306, Sebastopol CA 95473-1306, U.S.A.
Expanding list of Cape and native California bulbs.

Rust-en-Vrede
P.O. Box 753, Brackenfell 7560, Republic of South Africa
Hendrik van Zijl Tel (021) 981-4515 Fax (021) 981-0050
Established, reliable supplier of South African bulbs and seeds. Extensive list from a wide range.

Russell Graham, Purveyor of Plants
4030 Eagle Crest Road N. W., Salem OR 97304, U.S.A.
Tel (503) 362-1135
Primarily a perennial grower of North American native plants, has some *Lilium, Trillium* and *Sanguinaria* species

Sunburst Bulbs
P.O. Box 183, Howard Place 7450, Republic of South Africa
Tel (021) 531-9829 Fax (021) 531-3181
Species and hybrids of South African bulbs; very variable list.

The Botanist
16 Victor Close, Green Point NSW 2251, Australia
Tel 04367-7524

The New Peony Farm
P.O. Box 18235, St. Paul MN 55118, U.S.A.
Ken Crossley Tel (612) 457-8994
Peony hybrids and species, sources of which are very few.

The Plumeria People
P. O. Box 820014, Houston TX 77282-0014, U.S.A.
Richard and Mary Helen Eggenberger Tel (713) 496-2352
A few assorted tropical bulbs, *Zephyranthes* and *Habranthus* species.

Tzitzikama Nursery and Seed Supply
PO Box 1069, Plettenberg Bay 6600, Republic of South Africa
Tel (04457) 48896 Fax (04457) 48791

Van Engelen Inc.
313 Maple Street, Litchfield CT 06759, U.S.A.
Tel (203) 567-8734 Fax (203) 567-5323
28 page catalog of Dutch bulbs at very reasonable prices.

Woodbank Nursery
RMB 303 Kingston TAS 7150, Australia
Tel 00239-6452

COMMERCIAL AND GARDEN SOURCES

B & D Lilies
330 "P" Street, Port Townsend WA 98368, U.S.A.
Bob and Dianna Gibson Tel (206) 385-1738 FAX (206) 385-9996
Cutting edge Oriental, Asiatic, and Aurelian lily hybrids; large number of *Lilium* species; also sells daylily and *Alstroemeria* hybrids.

Borboleta Gardens
15980 Canby Avenue, Faribault MN 55021-7652, U.S.A.
Dave and Jeanne Campbell Tel (507)334-2807
Hybrid lilies, iris, daylilies and peonies.

The Bulb Crate
2560 Deerfield Road, Riverwoods IL 60015, U.S.A.
Tel (708) 317-1414
Primarily lily and iris hybrids.

Cascade Bulb and Seed
PO Box 271, Scotts Mills OR 97375, U.S.A.
Dr. Joseph C. Halinar Tel (503) 873-2218
Offers their own seeds and bulbs of lily and *Allium* species and hybrids. Also sells *Hemerocallis* species.

Cruickshanks, Inc.
1015 Mount Pleasant Road, Toronto, Ontario, Canada M4P 2M1
Tel (416) 750-9249 or (800) 665-5605
Daffodil and tulip hybrids and species; the only supplier on list who sells *Narcissus cyclamineus.*

Crutchers Colors
18900 South Pear Road, Oregon City OR 97045, U.S.A.
Ken Crutcher Tel (503) 631-3656
Grows and sells their own hybrids of Asiatic, Oriental and Trumpet lilies.

The Daffodil Mart
7463 Heath Trail, Gloucester VA 23061, U.S.A.
Brent and Becky Heath Tel (800) 255-2852 Fax (800) 420-2852
Sells daffodil, tulip and other garden bulbs, most hardy, some not, as well as some hybrids not readily available. Price on some items are less expensive than most sources, especially for the high end items.

Dutch Gardens
PO Box 200, Adelphia NJ 07710, U.S.A.
Tel (908) 780-2713 FAX (908) 780-7720
Commercial Dutch importer for garden varieties; also some species.

Lindel Lilies
5510 239th Street, Langley, BC V3A 7N6, Canada
Linda and Del Knowlton Tel (604) 534-4729
Hybrid Oriental, Asiatic, and trumpet lilies and some species.

Messelaar Bulb Co.
PO Box 269, County Road, Route 1A, Ipswich MA 01938, U.S.A.
Pieter Messelaar Tel (508) 356-3737
Commercial Dutch importer for garden varieties.

The Lily Garden
36752 S. E. Bluff Road, Boring OR 97009, U.S.A.
Judith McCrae Tel (503) 668-5291
Lily hybrids and a nice selection of species.

Van Bourgondien Bros.
PO Box 1000
245 Farmingdale Road, Rt 109, Babylon NY 11702-0598, U.S.A.
Tel (800) 622-9997 FAX (800) 669-1228
Primarily garden varieties, but occasionally has an odd bulb of interest. Not known for their customer satisfaction. Free catalog.

Van Dyck's Flower Farms, Inc.
PO Box 430, Brightwaters, NY 11718-0430, U.S.A.
Tel (800) 248-2852
A commercial Dutch importer for gardens. Good service and quality for the price.

SOCIETIES WITH A SEED EXCHANGE INCLUDING GEOPHYTES

These societies are absolutely the best way
of acquiring the difficult to locate species

Alpine Garden Society
Membership Secretary, AGS Centre
Avon Bank, Pershore, Worcestershire WR10 3JP, England
Publishes a nice quarterly. Seed list usually includes some *Rhodophiala, Alstroemeria* and *Bomarea* species.

Botanical Society of South Africa (BSA)
Kirstenbosch, Claremont 7735, Republic of South Africa
Publishes a quarterly journal and an annual seed list from Kirstenbosch National Botanic Garden.

North American Lily Society
Executive Secertary-Treasurer
PO Box 272, Owatonna MN 55060, U.S.A.
Dr. Robert Gilman
Publishes a News quarterly; extensive seed list of lily species and hybrids.

North American Rock Garden Society
Executive Secretary, P. O. Box 67, Millwood NY 10546, U.S.A.
Publishes a quarterly journal and good seed list including *Narcissus, Romulea* and *Roscoea* species.

Scottish Rock Garden Club
20 Gorse Way, Formby, Merseyside L37 1PB, Scotland
Ian Aitchison, Treasurer
Publishes a good, biannual journal. Extensive seed list with a number of South American species that seems to be supplementary to the AGS with little overlap.

The Clivia Club
Koos, Geldenhuys, Treasurer
P.O. Box 74868, Lynnwood Ridge 0040, Republic of South Africa
Publishes a bulletin now and then; Clivia species, hybrids and sports.
Please note—this is their **new address**.

The Indigenous Bulb Growers Society of South Africa (IBSA)
3 The Bend, Edgemead, Capetown 7441, Republic of South Africa
Paul F.X. von Stein
Publishes an annual, a newsletter and a fairly variable seed list.

ACKNOWLEDGEMENT

The editor thanks Joan de Fato, the wonderful librarian at the Plant Library of the Arboretum of Los Angeles County, for her generous assistance on dates, names and references.

She always seems to know what I should be looking for!

SWAP COLUMN—PLANT SEARCH

Exchanging plants and seeds is a great benefit to gardeners. Many friendships have blossomed along with the plants and seeds exchanged. We include this page to promote such plant and seed exchanges. After checking the Seed Exchange list (see page 3), if you are still unable to locate certain bulbs or plants, send your request to:

Swap Column, The International Bulb Society,
PO Box 92136, Pasadena CA 91109-2136,
United States of America.

William Armitage, Apt. 820, 400 Jarvis Street, Toronto M4Y 2X8, Ontario, Canada, would like to obtain *Haemanthus albiflos* (all forms), *Scadoxus cinnabarinus, S. multiflorus, S. longitubus, S. membranaceous, S. puniceus* 'Magnificus', and *S. puniceus* 'Natalensis'. He is also searching for bulbs of the *Scadoxus* hybrids 'King Albert' (also known as 'Koenig Albert', 'King Albert of Saxony' and 'Prince Albert') and *Scadoxus* 'Andromeda'.

Ron Crowden, PO Box 267, Kettering, Tasmania, Australia 7155, has been collecting nerines for about 20 years. He has over 80 cultivars at present. He would like to correspond with members who share an interest in nerines. He hopes to have excess bulbs of his own hybrids for trade soon.

GESNERIADS: GEOPHYTIC HOUSEPLANTS PAR EXCELLENCE

Bulb enthusiast need not confine themselves to growing bulbs outdoors or even in greenhouses. There are many geophytic (bulbous) plants which grow and bloom well as houseplants.

In fact, there is at least one plant family which lends itself remarkably well to cultivation in the home: gesneriads.

Even if you don't have a bright window in your home where you can enjoy a few members of this remarkably diverse, beautiful and dependable group of plants, you can be successful with gesneriads. As Virginie and George Elbert state on page 5 of their book **The Miracle Houseplants** (©1976; unfortunately this book is no longer in print), "No major gesneriad in cultivation requires more light than can be provided by an ordinary fluorescent fixture. Low light needs and adaptability to the rest of our home environments are the reasons why we can grow and bloom them indoors."

Some commonly available geophytes in the gesneriad family are *Achimenes*, which grow from scaly rhizomes and gloxinias (*Sinningia*) which grow from tubers. Many other geophytic and non-geophytic members of this exciting plant family can be obtained from specialist nurseries (please see A Source List of Geophytic Plant Material beginning on page 152).

Charles Hardman

Book Reviews

A REVIEW OF *ALLIUM* SECTION *ALLIUM* by Brian Mathew. 1996. Royal Botanic Gardens, Kew. 176 pp. Hardbound. £21.00

Since his retirement as a Principal Scientific Officer at the Royal Botanic Gardens at Kew, Brian Mathew has been anything but idle. Well known to plant scientists for his taxonomic work with many groups of primarily monocotyledonous geophytes, and to bulb enthusiasts for his many books on the horticulture of bulbous plants, Mathew has long been interested in the genus *Allium*, which has speciated to an extent unparalleled among geophytic monocots. There are an estimated 750 species of this decidedly northern temperate group, among which several are important cultigens (species unknown in the wild state) with great economic importance. In this volume, Mathew has undertaken a taxonomic revision of *Allium* section *Allium*, within which garlic (*A. sativum*) and leek (*A. porrum*) figure prominently.

Taxonomic work with most monocot geophytes is nigh to impossible based on herbarium collections alone, since so many important diagnostic characteristics are obscured in the drying process. Mathew wisely concentrated on living material, and his detailed descriptions are overwhelming based on meticulous examination of living plants.

A brief history of the section is followed by short chapters on leaf anatomy (by Mary Gregory at Kew), cytology (by Margaret A.T. Johnson of Kew and Neriman Oshatay from Istanbul University), and flavenoid distribution (by J.B. Harborne and C.A. Williams of the University of Reading). This is followed by a brief discussion of the ecology, distribution, and economic botany of the section. The bulk of the volume is devoted to providing detailed descriptions of the 114 species recognized as belonging to section *Allium*. Sixteen color plates illustrating almost 50 species are provided. No other illustrations of the species are included. Each description is prefaced with place of publication, synonymy, citation of the type specimen if known, and additional references that provide illustrations of the species if available. Notes on flowering season, ecology and distribution as well as the author's general notes on the species follow the technical description. A listing of representative herbarium specimens, standard fare in a taxonomic revision or monograph, are lacking. Instead, a list of voucher specimens for the living collections can be found at the rear of the volume. A diagnostic key to the species of the section is provided. This is very well arranged and annotated.

Mathew modestly calls his work a "review", given the time limitations of this study (2 years) which prevented more in-depth investigations of particularly thorny taxonomic problems among the 114 species grouped together in the section. Nevertheless, with the accompanying anatomical, cytological and biochemical studies contributed by various colleagues at Kew and other institutions, this review will likely remain the definitive reference for section *Allium* for many years to come. It will be extremely useful to economic botanists and plant breeders interested in the improvement of cultivated members of the section. But, it is a decidedly scientific work and amateur bulb enthusiasts would likely find the book on the dry side. For the horticulturist interested in the more ornamental members of the genus *Allium*, Dilys Davies' **Alliums, The Ornamental Onions** (Timber Press) or one of Brain Mathew's own excellent bulb books would be a more logical bookshelf addition.

Alan W. Meerow, University of Florida, Fort Lauderdale, Florida

ALPINES: THE ILLUSTRATED DICTIONARY by Clive Innes. 1995. Timber Press, 133 SW Second Ave., Suite 450, Portland OR 97204-9743. 92 pages, 957 color photos. 8½ x 10¾ inches, hardcover. $39.95

For over twenty years, Timber Press has published gardening and botanical books characterized by quality, beauty and style. Timber Press knows how to present good, solid information combined with a flare that tantalizes and teases, forcing one to want to read on and on as the midnight oil burns and the eyelids droop.

Alpines, The Illustrated Dictionary is a remarkable book with so many color pictures, informative descriptions, and brief, no-words-wasted gardening and propagating suggestions it's hard to imagine how anyone could work so much useful stuff into "only" 192 pages.

One could be forgiven if at first glance this book were dismissed as merely a beautiful coffee table book. However, a peek between its covers convinces otherwise. Each section of the book is presented alphabetically. Each plant is presented in full color picture. Each botanical plant name has beneath it the name of the plant family from which that species springs.

And each brief description, growing instruction and propagation suggestion beneath the plants' pictures is succinct, wasting no words yet providing the reader with plenty of information should he or she wish to include the plant in their own garden plans.

Luckily for bulb lovers, many plants considered alpines grow from bulbs, corms, rhizomes or tubers, so you'll find plenty of "bulbous" plants in this book. The word "alpine" probably conjures up an image of small or tiny plants growing high in the mountains, subjected to harsh weather conditions. Well, sort of. Fortunately, the inside fold flap on the front cover breaks the boundaries of that stereotype by informing us: "What constitutes an alpine is less easy to define. Alpines may be found at low altitudes in warm Mediterranean climates, on the mountain slopes of Saudi Arabia, or high in the mountains of the Alps, the Andes, the Sierra Nevada, and most other ranges around the world."

In fact, while most of the plants presented in this book are small or tiny, a very few such as *Acanthus molllis* at "60cm (24 in) or more tall", *Agapanthus praecox* and *A. walshii* with leaves "60 cm (24 in) or longer" and *Boophane disticha* "60cm (24 in) wide", and a brief list of others do not fit into my own definition of small or tiny. However, "small" and "tiny" are not entirely what alpines are all about. Seeing the four species just mentioned included in this book helped me expand my concept of just what "alpine" means. The same can be said of a number of other species included: they're compact, giving the appearance that they got that way while adapting to high altitudes or harsh weather conditions. Yet compact, small or tiny plants can originate in low elevations under weather conditions which are not so bad after all. "High" and "harsh" were two more words I now give less "alpine" credence to after enjoying this book for a few evenings.

You'll see pictures of plants in this book that you'll never grow but not because you won't want to! The fact is there are so many lovely plants featured in this book that a whole series of gardens would be required to hold them all.

Some readers may find a genera or two lacking from this book that they wish had been included. I would like to have seen at least one *Dudleya* from our own Southern California mountains and perhaps a *Roscoea* or two from the Himalayas. Lest anyone think this is criticism, let me hasten to say that this is merely a personal observation. With the wealth of exquisite pictures and descriptions Clive Innes has included, there is more information within these pages already than any of us will be able to absorb in many nights' worth of midnight oil and drooping eyelids.

I recommend this book to all bulb enthusiasts seeking to expand their gardening horizons and bulb growing enjoyment.

Charles Hardman

GARDENING WITH BULBS: A Practical and Inspirational Guide by Patrick Taylor. 1996. Pavilion Books Ltd., London, England SE1 9PD and Timber Press, Inc., 133 S.W. Second Ave., Suite 450, Portland OR 97204-3527. 256 pp, 5 x 7½ in./12.7cm x 19cm, paperback. $17.95.

Gardening With Bulbs is a lovely book for guiding temperate climate gardeners in their selection and use of bulbs to create pleasing effects in the landscape. Patrick Taylor leaves treatises about general bulb culture and physiology to other books in order to concentrate on the bulbs themselves, their characteristics and how to display them to their best effect in a garden setting.

In his introduction Mr. Taylor comments on the many merits of bulbs in the garden, and he includes well-written explanations of what bulbs, corms, rhizomes and tubers are (though he doesn't distinguish between tubers and tuberous rooted perennials), giving examples easily understood by beginners. A tour highlighting the author's favorite bulb planting ideas in sequence through the seasons rounds out the introduction. The "directory of bulbs" immediately follows the introduction.

This work is primarily an encyclopedic descriptive list of bulbs focusing on those that can be used in temperate gardens in mixed borders, though a few bulbs needing more specialized or Mediterranean conditions are also included. The cover text says that whether common or rare, all the listed bulbs are commercially available. However, some (*Dactylorhiza, Paradisea* and *Tecophilaea*) will be very difficult to locate and obtain.

Entries are listed alphabetically by botanical name. Within each genus Mr. Taylor tells about the plant's habit, where each taxon (genus, species or cultivar) would fit into the garden landscape, when it blooms, giving cultural requirements and sprinkling in propagation tips as he goes. For each species a general area of origin and coldest tolerable hardiness zone are listed in the margin. A pair of cold hardiness zone maps for Europe, Canada and the United States is included in the back of the book for convenience. Common names are often included in the text though not referenced in the index. Handily, all measurements are given in both metric and non-metric units.

The author conveys his zest for landscaping in each variety's description, pointing out attributes useful either in garden design or for up-close display. Taylor's prose is rich and succinct, sometimes verging on the poetic, and he tells it like it is whether the bulb is flashy or dowdy, a tidy embellishment or an invasive imp.

One feature of this book is particularly handy for resolving

readers' confusion between listings in other books: in the first paragraph of each genus listing, the author includes both the contemporary and the old name of the family to which the genus belongs. The format is as follows: contemporary family name/traditional name. For example, for *Camassia, Scilla* and *Muscari* you would find Hyacinthaceae/Liliaceae.

Excellent, clear, color pictures (204 in all) accompany almost every entry and give a good representation of the relative size, shape, color and growth habit of the bulbs discussed. The pictures generally provide perspective and show enough of each plant to get a sense of overall appearance and aid in identifying plants in the garden. Not all photos are captioned or explicitly identified. Often (but not always) an unlabeled photograph goes with the text immediately following it, so rely on the text description for confirmation.

Mr. Taylor covers many genera, listing just one taxon for some and many, varied taxa for others, including quite a few welcome listings for *Allium, Erythronium, Fritillaria, Iris, Lilium* and *Tulipa* species. The stunning, newer *Hemerocallis* cultivars and the many lovely *Chasmanthe, Ixia, Moraea, Romulea* and *Tritonia* varieties that prosper in and enhance well-drained gardens are absent. Aside from the daylilies these oversights are easily forgiven. The **Daylily Journal, Herbertia** and recent books on South African bulbs and Mediterranean climate gardens can fill any gaps with aplomb. Gardening books are always a personal reflection of the writer's experience and gardening passions and the accessibility of plants in their areas. Patrick Taylor has avoided the too common pitfall of speaking with an air of authority but without experience. The book's writing is alive with evidence that the author has personally grown and experimented with the majority of bulbs mentioned and that he has observed the remainder.

Rounding out the book are specialty lists, hardiness zone maps and an index. A recommended reading or reference list and lists of seed and bulb suppliers would be particularly welcome in this section. Limited lists for special purposes and areas (shady, sunny or damp areas, meadows) or effects (striking appearance, scents, showy foliage) immediately follow the encyclopedic listing and may be of help to new temperate climate gardeners. An index of bulbs by botanical name completes the book and could be enhanced by the addition of common names and cross-references to items in the introduction and special purpose lists.

Gardening With Bulbs is a lovely resource of information, planting ideas and inspiration for the temperate bulb gardener: it

admirably lives up to it's subtitle. It is guaranteed to shake off the dullness of winter, inoculate you with the author's upwelling enthusiasm for bulbs in the landscape, and have you springing right out the door trowel in hand to plant drifts of bulbs throughout your entire garden.

Elisabeth I. Lassanyi

THE GARDENER'S GUIDE TO GROWING LILIES by Michael Jefferson-Brown & Harris Howland. 1995. Timber Press, 133 SW Second Ave., Suite 450, Portland OR 97204-9743, 160 pp, 70 color photos, 40 line drawings, 7½ x 9¾ in. Hardcover. $29.95

The Gardener's Guide to Growing Lilies is one of those must-have books if you are a lily buff. Written by two men who have the authority which can only come from lifetimes of experience with their subject, this book provides answers this reader didn't even know there were questions for.

If you're not exactly a lily buff you may want to try on this book for size anyway. You'll certainly pick up a lot of fascinating information. I was delighted to learn, for instance, that there is an epiphytic lily, *Lilium arboricola* which "grows in the debris collected in the nooks of tree branches in the forests of parts of northern Burma" (now Myanmar).

It was fun, too, to learn that some species, among them *L. concolor* and *L. pumilum*, have bulbs which are only slightly larger than marbles while the bulbs of other lily species can be as large as an artichoke.

Who could have imagined that lily bulbs would come in five different styles or that the roots, stems and leaves of lilies could be so diverse? There are even two different forms of seed germination in the genus *Lilium:* epigeal, in which the first leaf is a cotyledon or seed leaf and hypogeal, in which the first leaf is a true leaf, the cotyledon stage having been dispensed with altogether.

Do words like "epigeal" and "hypogeal" annoy you when first encountered? Don't worry, you're in comforting hands with Jefferson-Brown and Howland. They explain these and other words and in fact, whole concepts which might be new to the reader, with enough pictures and line drawings to render every subject covered within the grasp of the average reader. (This could have been a difficult book; the genus *Lilium* is not a simple one.)

Growing lilies in the garden rates an entire chapter along with

companion plants which enhance and blend well with lilies. A chapter is devoted to cultivation and the fascinating subject of propagation rates a chapter all its own. Then come chapters on the lily species, hybrid lilies, breeding your own lilies, a species checklist, false lilies and an appendix.

This is a grand book with a lot of information, color pictures, drawings and just down-to-earth gardening enjoyment worked into its 160 pages. I recommend it—and not just to fans of the lily, either. Anyone who loves bulbs can learn and apply much from this book.

Charles Hardman

BULBS FOR THE ROCK GARDEN, Jack Elliot. 1995. Timber Press, 133 SW Second Avenue, Suite 450, Portland OR 97204-9743. 160 pp. 64 color photos, 36 b/w drawings. 16.5 x 24.5cm. $29.95

From amongst an increasing number of bulb books to choose currently, **Bulbs for the Rock Garden** stands out for its straighforward, concise approach, which is amed primarily at the amateur bulb enthusiast. Following chapters on general information (habitats, pests, etc.), growing bulbs in the garden and on propagation, each with smaller, easily digestible subchapters, the bulk of the book then treats the bulbs under four sections according to season. Each of these sections addresses a discrete set of genera, with a few split between spring and autumn flowering species within the same genus. A combination of color photographs and line drawings, though not lavish, serve nicely to break up the text and whet the appetite. At the end of the book are a list of bulbs having earned a Royal Horticultural Society Award of Garden Merit, a very brief "Further Reading" list and a short list of relevant societies.

The title of the book is somewhat misleading as the bulbs covered and techniques discussed may be applied to a variety of garden situations, and the author readily acknowledges this early in the text. Smaller bulbs suitable for rock gardens as well as cold frames, containers and the carefully tended small garden are essentially the theme of this volume and the information given, both with regard to cultivation and varieties available, is decidedly from a British Isles perspective. Still, the book will be very useful to any bulb growers living in a cool to cold winter climate. "Bulb" is taken here to include corms and well-defined tubers as well as true bulbs, for the most part leaving out many rhizomatous plants (most *Iris* species, for instance). Horticultural advice often is given

in general terms, though with enough sound guidance, based on the author's own extensive experience, that different local conditions and available materials can be accomodated in other parts of the world.

Under the treatments of the different genera (some 56 in all), general comments are followed by discussions of individual species. The focus here is primarily on those bulbs more likely to be met with in the catalogues, though a good number of the rarer, more tantalizing species and cultivars are also touched upon. In several places tables are given which compare attributes or needs of selected species in a given genus, a very useful feature. Less fortunately, little information on the native ranges or habitats is given under any of the species. A few typos were noted, most glaringly *Calochortus "weeedyi"* (in the text and the index) instead of *C. weedii*, and one photo was positioned sideways.

Allowing for the minor flaws just mentioned, **Bulbs for the Rock Garden** will make an excellent addition to the books already available on the broader subject of bulbs. The relatively narrow scope of the book, while still encompassing a broad range of temperate and marginally hardy bulbs, will serve to assist and inspire both the beginning and more advanced bulb hobbyist with any interest in the many charming smaller bulbs.

Dylan P. Hannon

ROCK GARDEN PLANTS OF NORTH AMERICA, An Anthology from the **Bulletin of the North American Rock Garden Society**, edited by Jane McGary. 1996. Timber Press, 133 SW Second Ave., Suite 450, Portland OR 97204-9743. 504 pp, 105 color photos, 11 line drawings, 6 x 9", hardcover. $49.95

What a delight it is to set
Fireflies loose in bed
Beneath the net.

So reads the charming Haiku poem which, for some, is replete with philosophical and psychological metaphors. One doesn't have to dig any deeper for its meaning, however, than to take it at face value: a child playing with a jar of fireflies under the mosquito netting of a bed.

Or, to elaborate just a bit, it's equally valid to equate the "fireflies" of new ideas gleaned from the minds and hearts of others

set loose in one's own mind and kindling one's own emotions to try or do something new. This book does just that with 58 articles selected from the fifty year history of the **Bulletin of the North American Rock Garden Society**.

North America is home to an amazing array of rock garden plants. This diverse group is eloquently written about by writers whose names many readers will recognize. (For the sake of brevity and not wanting to offend any of the book's numerous excellent writers by exclusion, individual writers' names are not included in this review.)

The book is divided into six parts. These are: Far West, Great Basin and Rocky Mountains, Plains States, Northeast, Southeast, and Throughout North America. Fascinating, beautiful, amazing, wonderful, exciting rock garden plants are found in all these regions. Is it any wonder they are such a diversified group?

What does all this have to do with bulbs? While one may come across bulbous, cormous, rhizomatous or tuberous plants throughout this book, there are entire chapters with the following titles: Liliaceous Bulbs, Calochortus: Why Not Try Them?, Irises of the Pacific Coast, Trilliums of the West, Some Small Eastern American Irises, Eastern American Trilliums, Anemones in the West, Dodecatheon (yes, *Dodecatheon* produces long fleshy roots, but some species also produce rice-grain bulblets; see page 390).

Ferns, Cacti, *Penstemon, Arbutus, Shortia, Dryas, Draba*, and North American native *Primula* and *Phlox*, all have their own chapters, as does *Lewisia*. (*Lewisias*, especially *L. rediviva* with its ability to revive after years of total dryness, have always struck this reviewer as being more bulb-like than herbaceous.)

There are locale articles, as well: Northern California, the Siskiyous, the Red Buttes, Great Basin, Eastern Cliffs, Pine Barrens, Arizona, Middle Atlantic States, Virginia Shale Barrens, the Carolinas, the list of articles goes on and on with not a boring read among them. Editor Jane McGary has turned what must have been a daunting selectional task—50 years worth of published articles to choose from; Whew!—into an excellent reading adventure.

I recommend this book for its diversity of subjects alone, but add to that its diversity of writers and you end up with a book that's a double winner. It's sure to set gardening fireflies loose in your mind and heart.

Charles Hardman

Hardy Herbaceous Perennials by Leo Jelitto, Wilhelm Schacht and Alfred Fessler. 1990. 3rd edition, revised. Timber Press, 133 SW Second Avenue, Suite 450, Portland OR 97204-9743. 721 pp. in two volumes. 648 color photos, 352 black and white photos. 8½ x 11 inch. Hardbound. $125.00

This magnificent two volume English translation of long popular German editions has been updated to include American cultivars and the USDA Plant Hardiness Zone maps. English speaking gardeners now have access to a virtual encyclopedia of useful and needed information.

The plant listings, which begin on page 6, are subtitled "Encyclopedia of the Hardy Herbaceous Perennials". Listings indeed!—809 genera are included. There are 7,900 species, subspecies, varieties and cultivars listed under those genera. Many enjoyable evenings spent reading this book produced a list of 175 genera with hundreds of species that are cormous, bulbous, tuberous or rhizomatous—geophtyic in habit.

I pulled all the recent books on herbaceous perennials from my library to be able to compare. It didn't take long to realize that comparisons were unfair. None of the other books came even close to the volume of information, plant listings and overal quality. Especially in plant materials—and have no doubt: this is a book only on plants, lots of plants. There are some other herbaceous perennial books that are very good, including a couple that go into much detail on how to use plants, the actual planting, locating, use in garden design, etc., but they do not begin to come close to the information available on the plants themselves.

But **Hardy Herbaceous Perennials** is vastly superior to books that simply list perennials. Even included are herbaceous perennials that are aquatics and succulents as well as geophytes. A few borderline hardy plants are included but gardeners interested in the tender bulbs should search out **Bulbous Plants of Southern Africa** by Du Plessis & Duncan, Tafelberg, 1989 and **Best Bulbs for Temperate Climates** by Hobbs & Hatch, Timber Press, 1994.

This book is particularly good because this is a listing not just of plants commonly grown and available but those you actually **can** grow—with a little work to locate the odd, unusual, rare and spectacular uncommon species and cultivars. A few of the interesting plants that I was not familiar with are: *Glaucidium palmatum* (Ranunculaceae), *Lithophragma parviflora* (Saxifragaceae), *Menyanthes trifoliata* (Menyanthaceae), *Ostrowskia magnifica* (Campanulaceae), *Paradisea liliastrum* (Liliaceae), *Speirantha convallarioides*

(Liliaceae), *Thalia dealbata* (Marantaceae), *Trachomitum venetum* (Apocynaceae), *Weldenia candida* (Commelinaceae) and *Wulfenia orientalis* (Schrophulariaceae).

General information is given on each genus, species in the genus, where the species are found and where plants grow best along with brief, accurate cultural information. Plants with poisonous parts are noted as such.

The genera with the most species usually are listed in sections by flowering height and season of flowering. The larger genera, each with multi-page listings, include: *Aster, Anemone, Campanula, Colchicum, Crocus, Cyclamen, Dianthus, Fritillaria, Gentiana, Geranium, Hemerocallis, Iris, Lilium, Narcissus, Nymphaea, Paeonia, Penstemon, Phlox, Primula, Salvia, Saxifraga, Sedum, Sempervivum, Trillium, Tulipa* and *Viola.*

The 648 color photos are very good to excellent. Approximately 350 black and white photos are used and all are clear and good illustrations. I found only one typo—a plant in the family "Amaryllidacea"—missing the final "e". Truly not much wrong!

One thing I found strange, even illogical, was the inclusion under *Oxalis* of *O. corniculata*—easily one of the worst weeds in the world, being almost everywhere. Eight *Oxalis* species are listed, including *Oxalis corniculata* as "an invasive weedy species; the purple-leaved var. *atropurpurea* Planch, may have garden merit if used with caution". Even cautious use will not prevent the seeds from shooting up to 25 feet away, then spreading and spreading and spreading!

Hardy Herbaceous Perennials easily has more useful information on herbaceous plant species and cultivars than my favorite 5 or 6 perennials books I usually use for reference. This set is not inexpensive, but you get your money's worth. For a top-quality two book set with over 1,000 illustrations and covering nearly 8,000 individual plants it is a real bargain. I highly recommend this great two volume book set to all gardeners.

Michael Vassar

HARDY PERENNIALS by Graham Rice. 1995. Timber Press, 133 SW Second Ave., Suite 450, Portland OR 97204-9743. 209 pp., 42 color photos, 29 line drawings, 7¾ x 9¾ in. Hardcover. $27.95

With gardeners everywhere returning to increasing the numbers of hardy perennials in their garden planning, we're fortunate

ve this new book on just those subjects. **Hardy Perennials** is f practical information with the best of the old and the new es, varieties and cultivars included here.

ut it would be a mistake to leave the word "practical" hanging e air without adding a few others. Let's begin the word addi- with "risks"; Mr. Rice takes some in the pictures and writing ghout this book. When most of us think of plant or flower res, we wait until our plants are in their full glory of leaves or rs and then snap the photo. There are plenty of those kinds ots in this book, but you'll also find several pictures of plants on frosty mornings when ice crystals crinkled and etched leaves into a whole new perspective; look at the pictures of ed leaved *Bergenia* 'Eric Smith' and the frost laced evergreen ge of *Helleborus argutifolius*; you'll see what I mean. The t flowers of yellow skunk cabbage, *Lysichiton americanus*, r looked more beautiful nor has the plant appeared more ily aromatic than in Peter Ray's photo of this species, while eaves of the normally blue leaved *Hosta* 'Halcyon' become a king burnished copper in Mr. Rice's autumn photo.

As for Graham Rice's writing and writing style, the words *htful, humorous, interesting, breezy* when he's relating a rite anecdote, *down-to-earth* and *scientific* when he wants to g home a point and, well, yes, *practical*, all come to mind. The ng risks taken by Mr. Rice are in his slightly different angle on ubjects—he calls "Summer—The Drowning Season" because e is such a plethora of plants putting on their shows at that —and on his combinations of words as in "appealingly py" referring to the flowers of *Cyclamen coum* and "an armed sion" with a "heady, almost sickly fragrance" referring to *sites fragrans*, the winter heliotrope. A good writer is best yed by reading his or her works, so don't take my word for it: the book.

But the book's pictures and its writing, while wonderful, are in long run overshadowed by the real purpose of the book itself: noting the culture and use of hardy perennials. Here we have a ter gardener who also happens to write well. And take good ures. After reading only a few paragraphs one gets the feeling eing in the hands of a fine gardening teacher, safe and com- able, but learning all the while.

Taking a seasonal tack, Mr. Rice leads us from Winter Into ng in the first chapter and from there progresses through all seasons with perennials. This is a little different format from A-Z descriptive style he might have used but he carries

through well with this approach and the results are commendable.

Of bulbs, corms, rhizomes and tubers, Mr. Rice has included *Amaryllis belladonna*, and species of *Allium, Anemone, Arum, Corydalis, Cyclamen, Dahlia, Erythronium*...the list goes on and while they're scattered throughout the book, a good index makes locating "bulbous" plants easy as long as you know the generic names of what you're looking for. While some of your favorite perennials and perennial "bulbs" might not be in here, let's face it, a writer has to stop somewhere.

I recommend this book if you plan a garden re-do, especially if you live in a climate which gets cold in the winter and especially if you want to learn more about the wonderful world of perennials. This book is enjoyable, informative, exciting and fun. Readers ought to get a kick out of it while absorbing plenty of good gardening information.

Charles Hardman

ADVENTURES OF A GARDENER by Peter Smithers. 1995. The Harvill Press, 84 Thornhill Road, London N1 IRD. 211 pages, 106 color prints, 11 black & white photos, prints and drawings. £30.00

"I had grown up in the world of the English manor houses, a nice thing to do," writes Peter Smithers—actually Sir Peter Smithers—in Chapter One of his autobiographical book, **Adventures of A Gardener**.

And "nice" his growing up was, with wealth, class, privilege, position and power being exuded by the people with whom, and the manors and situations with which young Peter came into contact on a daily basis.

But anyone who expects this gentleman's tale to unfold in Merchant-Ivory fashion with Helen Bonham Carter and Anthony Hopkins clones angsting their way through genteel garden settings is in for a wonderful surprise: this is an *adventure* story, this is an *adventuresome* gardener's story, this is an *adventurous* man's story.

I suppose young Peter could have chosen a less adventurous path in life. Certainly the media paint a far more effete, even vacuous, picture of the gentry than appears in this book. Those to the manor born have often been depicted in the media, perhaps unfairly, as having allowed the accoutrements of the good life too often to become their main handicaps to living well and truly.

One surely does not get that feeling from Peter Smithers.

Obviously he has lived well and truly, having plunged into life with a monumental interest in it at a young age and now, past 80, he still keeps the interest fires burning strong.

This interest in life no doubt served him in good stead early on, for, at the age of nine, young Peter went to a boarding school which he describes grimly as: "Hawtrey's School in bleak Thanet by a cold chalky sea..."

Yoiks!

If this sounds ghastly—and apparently for the most part it was—it was perhaps marginally better than being around his governess, "Tom", who, when he was eight years old, once "doubled up her fist and knocked (him) flat on the floor." And I always thought life was just a bowl of strawberries and cream for those young manor-born chaps.

Tom's attention-getting device was another event in Peter's life which served him well, though. As his tale unravels, we are led to understand that Tom's punch was a crucial point in Master Smithers' learning to accept and also to dispense authority with dignity. While there isn't much dignity in dazedly staring up from the floor at a well delivered fist—one wonders: was it a knuckle sandwich or a body blow?—that punch was a lesson he never forgot.

But then, there isn't much Sir Peter forgot. From his experiences in MI6, British Foreign Intelligence Service, during the Second World War to his experiences at the British Embassy in Washington to his adventures in the American tropics, to his family, friends, acquaintances, fellow diplomats, politicians and staff members, to his several gardens and many plants this story relates much of the life of this modern Renaissance Man who has been to so many places and done so many things.

Because Sir Peter has a lot of tale to tell, there are times when it comes tumbling out so fast it skips from place to place and person to person without much locale transition or character explanation in between. This might leave some readers wondering: just where is this action taking place?, or, who was that person who went fleeting by in that last sentence? Those of us who have had conversations with Sir Peter know that he writes as he speaks, expecting the listener—in this case reader—to keep up. So never mind asking questions about such incidentals and certainly don't ponder over them. The trick is to clear your head and read on. Anything that's not important has been glossed over in the writing of it. Anything that is important, you'll have it brought to your attention.

Gardeners will find much to delight them in this book. Just reading about the astonishing variety of plants (including bulbs aplenty) Sir Peter has grown is enough to whet one's desire to stretch and try something new. Those of us who have lost treasured plants can find comfort here, too. Sir Peter's philosophy is that, after we've done our best for them, it is the plants themselves which decide whether or not they will grow well in the locations we choose for them. To quote the man himself writing about his early experience with tree peonies on page 50, "I was impressed with the wisdom of growing plants which like one's garden conditions, and forgetting about the rest however desirable."

As for the book's color plates they're nothing short of outstanding. Oh, did I mention that Peter Smithers is also a professional quality photographer who had 23 photographic exhibitions between 1984 and 1995 and won seven gold medals plus one Grenfell Medal from the RHS between 1981 and 1992? Well, not surprisingly I suppose, he is and he did.

I recommend this book. Do yourself a favor: get a copy and settle in for a wonderful reading and seeing adventure. If you're like me, I doubt if you'll want to put it down. Just be sure you have your seat belt fastened before you begin the first page.

Charles Hardman

PLANT FAMILIES WITH GEOPHYTIC SPECIES

While doublechecking some information about a genus that was believed to be tuberous I became interested in making a list of all the plant families which have species that are tuberous, bulbous, cormous or rhizomatous. I had read that there were about 30 families that would qualify. After a few hours of research I came up with the following 77 families. Please let me know if you are aware of other plant families that should be on the list.

Michael Vassar

Adoxaceae
Agavaceae
Aizoaceae
Alismataceae
Alliaceae
Alstroemeriaceae
Amaryllidaceae
Apiaceae
Apocynaceae
Aponogetonaceae
Aracaceae
Asclepiadaceae
Asphodelaceae
Balsaminaceae
Basellaceae
Begoniaceae
Berberidaceae
Bignoniaceae
Cactaceae
Campanulaceae
Cannaceae
Colchicaceae
Commelinaceae
Compositae (Asteraceae)
Convolvulaceae
Crassulaceae
Cruciferae (Brassicaceae)
Cucurbitaceae
Cyperaceae
Davalliaceae
Dioscoreaceae
Droseraceae
Eriospermaceae
Euphorbiaceae
Fumariaceae
Gentianaceae
Geraniaceae
Gesneraceae
Graminae (Poaceae)
Haemadoraceae
Hippuridaceae
Hydrophyllaceae
Hyacinthaceae
Hypoxidaceae
Icacinaceae
Iridaceae
Lamiaceae
Leguminosae
Liliaceae
Malvaceae
Mesembryanthemaceae
Moringaceae
Nyctaginaceae
Nymphaeaceae
Onagraceae
Orchidaceae
Oxalidaceae
Passifloraceae
Papaveraceae
Pedaliaceae
Periplocaceae
Phytolacaceae
Piperaceae
Polygonaceae
Polypodiaceae
Portulacaceae
Primulaceae
Ranunculaceae
Saxifragaceae
Scrophulaceae
Solanaceae
Taccaceae
Tecophilaceae
Tropeolaceae
Umbelliferae
Vitaceae
Zingiberaceae