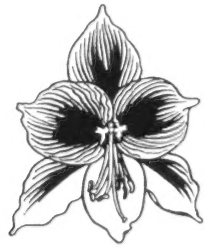
HERBERTIA

VOLUME 53 1998

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. Papers on geophytic plants in any plant family are welcome.



VOLUME 53, 1998

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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 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 only to the address on page one. Journal and newsletters are sent via air mail to addresses outside the United States.

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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 donations and bequests.

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

Some back issues are now out of print. For an up-to-date list of available issues and prices, please request a back issue order sheet, using the Society's mailing address on page one.

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 1998 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, graphs, charts and maps. Authors must obtain reproduction permission for all charts, graphs, etc. used which may already be copyrighted. 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.

On the cover:

Ammocharis coranica blooming a few weeks after the soil has been soaked by good rainstorms. The illustration shows typical development of the leaves at the time of flowering and the beautiful pink flowers..

Photo by Laurian Brown

HERBERTIA™ **volume 53, 1998**

COMMENTS FROM THE PRESIDENT

PART ONE: HEROES AND HEROINES

It's been my contention for years that there are far more heroes in this world than most people realize. These are the heroes of everyday life, people who see a job that needs to be done and simply go ahead and do it. They rarely receive much reward for doing these jobs and too often, no reward at all.

I'd like to tell you about four heroes and a heroine of mine. They're the people who volunteer their resources of time, energy, creativity and hard, hard work in order to bring you, the International Bulb Society's members, the benefits of this Society. They're the people who work on the Board of Directors of the IBS. Without them, there would be no International Bulb Society. Once you know a little about them, perhaps you'll admire them as much as I do.

Have you seen the Society's website? If not, you're in for a treat once you do. Designed and constructed by Director **Dr. Charles Gorenstein** who bought the books and the software and learned the process of building a website on his own, it's surely one of the most beautiful websites around. Is it good? It's so good that Microsoft Corporation displayed our IBS website on their website for a week during April, 1998. Thank you, Charles. You've made a site of beauty and inspiration for bulb lovers around the world. To reach this informative spot in cyberspace: **www.bulbsociety.com**.

Director Gorenstein wears another hat within the IBS: he's been the Society's Seed Exchange Director for some eight years now and he's accomplished a wonderful job throughout that time. This year more than 150 seed orders comprising thousands of packets of seed have passed through Charles's hands. Dedication, perseverance and a mind with its scientific attention to detail help him in this endeavor, along with his two daughters who are also willing to work. Nevertheless, just getting busy and doing the work required even when hundreds of other more pleasurable pastimes call is what it comes down to.

Director **Elisabeth Lassanyi** has been the Society's Executive Secretary for some ten years now. I'm convinced that never in the history of written minutes have a Society's minutes been written with such care to meticulous detail. Thank you, Elisabeth, for your ten-year service record, for your care of and knowledge of the workings of the International Bulb Society over such a long period of time and for always being able to supply the data necessary when a bylaw, a rule or a regulation or an historical note is needed. Elisabeth also designed and drew our Society's logo featuring the species *Hippeastrum papilio* and re-designed the Society's Herbert Medal,

then worked for two years with the diemakers and metalworkers in order to bring her design to fruition in the form of struck, engraved medals. Thanks also go to Elisabeth for sharing my workload this past year now that the Society has grown beyond one person's abilities to handle.

Congratulations to fellow Board member Director **Dr. Alan Meerow** for being the recipient of this year's Herbert Medal. No one ever deserved the Herbert Medal more. Alan, along with being a knowledgeable plant scientist, is also a skillful writer, as his long list of written titles attests. As the scientific editor of our Society's publications for many years, Alan's work has always been skillful, well thought out and interesting. Alan is also a *Hippeastrum* hybridizer with introductions just coming onto the market.

The IBS Bulb Forum (formerly the IBS Bulb Robin) buzzes along with more than a hundred members now. The creation of Director **Robert Turley**, another self-starter, the Forum just keeps growing. The Bulb Forum is composed of a dedicated group which has sparked many close friendships. You too can join by following the simple instructions on page 13 of this volume of **HERBERTIA**.

Robert also is our advertising director. **HERBERTIA**'s first ads in years appear in the back of this journal. The earliest journal published by this Society in 1934 included advertising as did many other of our journals, so it's not a radical concept.

Director **Michael Vassar**, the Society's editor, continues to do his usual wonderful work in a job which is neither exciting nor particularly fun. Editing and compiling **HERBERTIA** and two *The Underground* newsletters along with much of our Society's ancillary material each year looks easy. That's because Michael does the job so well, often burning the midnight oil into the wee, small hours of the morning, ignoring the brain's need for sleep and the eyelids that close involuntarily time after time. If we paid Michael what he's worth, we'd go broke.

Dylan Hannon and Guy Wrinkle both resigned from the IBS Board of Directors during 1997. Dylan cited a growing workload on the job and with his private plant and bulb collection. Guy is expanding his nursery business and has recently brought his son into the business to work with him. Thank you, Dylan, and thank you Guy for the time each of you served on the IBS Board.

Heroes and heroines are made, not born. Talk about *Carpe Diem*, heroes and heroines not only seize the day, they seize the job, its problems, its hardships and details and make a unified whole out of chaos. The heroes and heroines I've just mentioned not only accomplish their deeds, they do so with dignity slogging through the details until the job is done. They ignore the flak from

those of lesser lights and simply accomplish the work they've set out for themselves to do. In the case of most of our IBS Board Members, they do their Board work **while holding down full-time jobs or running their own businesses**.

Would you like to work with heroes and heroines? We're looking for people to serve on the Board. Are you a self-starter? Can you work with other people? Can you persevere with a project until it's completed? Are you interested in working with a dedicated group of people who expect nothing less from you than your personal best? Do you take as much pride in the details of your work as you do in accomplishing the finished product?

If so, why not send us a brief autobiography of yourself and what you feel you can accomplish for the International Bulb Society? If you can't think of a specific job, contact us anyway. There's always work to be done and far more than the current members of the Society's Board ought to be trying to handle. Will being on the Board of the International Bulb Society mean less TV time for you? Probably. But that should come as *good* news. There are other rewards as well. Contact us. We'll fill you in.

Due to the rules governing U.S.A.'s nonprofit 501 (c)3 organizations, only U.S. citizens are eligible to be on the International Bulb Society's Board of Directors. However, citizens of other nations and non-Board members may contribute to the Society in numerous other ways. Some examples:

- by writing and submitting informative articles and photos (slide transparencies are preferred) for publication [articles don't have to be long and good 1-2 paragraph filler articles are also useful]
- by seed donations
- by donations of money to keep your growing Society's list of member services healthy
- by a bequest to the Society in your will
- by sending photos/text for our website **www.bulbsociety.com**
- by joining and contributing to the IBS e-mail Bulb Forum
- by attending and participating in Society functions

These are just some of the ways those of you, our valued IBS members who live in other countries throughout the world or who are not Board members can help your Society.

PART TWO: THANKS

John Nolan Sahuc who has been growing and hybridizing hippeastrums for many years generously donated his bulb collection to the International Bulb Society in 1997. His collection was developed over a period of many years, a labor of love and hard work. The collection consists of many *Hippeastrum* species and numerous hybrids, many of them Nolan's own hybrids. And what exciting flow-

ers they are producing as they bloom during this, their first year in the Society's care. What treasures! The mind is humbled by the need for better adjectives to describe this magnificent collection of species and hybrid material.

Thank you Nolan for your incredible gift. Your kindness and generosity are greatly appreciated.

My personal thanks also to all you wonderful people who sent seeds to the IBS Seed Exchange, to all of who wrote letters and notes to thank your Board for your Society's benefits, to all of you who sent donations to continue the Society's work of promoting geophytic plants worldwide and to all of you who submitted articles and photos for publication. It takes time, effort, hard work (Hmmm...there's that "hard work" theme again; must be some message there...) and sacrifice of personal time to accomplish any of these good deeds yet no society amounts to much without the efforts of good people like you.

To all of you who took the time to fill out the questionnaires which accompanied **HERBERTIA** Volume 52/1997, thank you. Your Board is especially grateful for the encouraging comments (many), the helpful suggestions (plenty) and the generally congratulatory tone of these. With each of our two recent questionnaires it becomes increasingly obvious that your Society is filling a need for bulb enthusiasts worldwide.

PART THREE: OTHER

We certainly live in interesting times. Of major "interesting" significance for plant lovers has been El Niño, that mass of warm water that forms in the Pacific Ocean during certain years and which upsets weather patterns on a global scale.

But unless your house was carted off by a wall of mud or snow or your home's roof caved in from excessive weight of rain or snow or (fill in the El Niño-related calamity of your choice here), "The Little Child" has brought significant benefits to Southern California. The rains, the blessed, blessed rains have been plentiful. At my home 17 miles east of Los Angeles, we've had more than 32 inches (80cm) of rain this rain-year (July 1 any given year through the following June 30), twice what is considered normal. Desert areas surrounding Los Angeles to the east, the north and the south are ablaze with color. And our gardens hereabouts are a glory of green and flower hues. Ah, Paradise!

So may it be with your garden throughout this year and each year which follows.

Charles Hardman

WILLIAM D. BELL, IN MEMORIAM

Dr. William D. Bell, known as "Dave" to his friends and associates, died in Alachua, Florida last year. The news came as a shock to me, as I had renewed our correspondence shortly before leaving the country last spring.

To readers of **Plant Life** and Jim Shields' **Amaryllis Bulletin** during the 1970's and early 80's, his name should be familiar as the author of numerous articles on *Hippeastrum* hybridization. Dave was an extremely intelligent plant scientist, with great insights into the genetics of amaryllis.

I cannot recount much personal information about Dave; he never proffered much detail about his early life in our encounters. I know that he graduated from the University of Chicago with a Ph.D. in plant physiology. He did post-doctoral study at the University of Florida Fruit Crops Department, and then worked as a horticulturist at Fairchild Tropical Garden for some years. Exactly what he did subsequently, I am not sure.

I first met Dave in Gainesville, Florida when I was a graduate student. He called me after seeing one of my articles in **HERBERTIA;** Marcia Wilson had also informed me about his presence locally. He was living at that time in a fairly squalid trailer on the property of the late Albert Lorz, a retired University of Florida vegetable geneticist who had been haphazardly breeding amaryllis for many years. Interestingly, Lorz had possibly the largest collection of Mead germplasm in the United States, and had been breeding among these clones for many years, but with little record keeping. Dave apparently had his demons, but he was always lucid when I visited him and Dr. Lorz. Dave was a fount of interesting ideas on breeding directions in amaryllis, and I can state with no uncertainty that my discussions with him were the inspiration for my own breeding efforts in *Hippeastrum*. Dave gave me my first material of *Hippeastrum papilio* and two small seedlings of *H. brasilianum*, and a number of other interesting clones of amaryllis species. After my first trip to Brazil, he pumped me for details about the population structure of various *Hippeastrum* species that I had seen, and the levels of variation represented in nature. I sent him material of the species I had collected, and he sent me periodic reports of his continued breeding efforts in a barely legible scrawl. I, likewise, kept him informed of my own. It was obvious also, from his frequent address changes, that things were not going well, healthwise and otherwise. A modest inheritance allowed Dave to buy a house with some land, and for a while it looked like he might be able to fulfill his dreams and launch a large amaryllis breeding effort. Soon thereafter, he lost his home.. I believe he finally ended up in a nursing home or assist-

ed living facility—I am not clear about this—and it was here, I presume, that his troubled and lonely life ended.

The saddest thing to witness is a gifted life which fails to achieve its promise. I hope Dr William D. Bell died in peace, surrounded by some of the flowers that he so loved. A forthcoming release from my breeding program, an F_1 hybrid of *H. papilio* and *H. ambiguum* with excellent landscape properties, will bear the name 'Dr. Bell'. I think Dave himself would be pleased with that as a most fitting tribute to his vision.

Alan W. Meerow
Fort Lauderdale, FL

A SELECTED DAVE BELL BIBLIOGRAPHY

Bell, W.D. 1973a. New Potentials in Amaryllis Breeding. **Proc. Fla. State Hort. Soc**. 86: 462-466.

Bell, W.D. 1973b. The Role of Triploids in Amaryllis Hybridization. **Pl. Life** 29: 59-61.

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Bell, W.D. 1977a. More Potentials in Amaryllis Breeding. **Pl. Life** 33: 65-69.

Bell, W.D. 1977b. Double Flowered Amaryllis. **Proc. Fla. State Hort. Soc**. 90: 121-122.

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THE HERBERT MEDAL

The Herbert Medal is the highest honor that 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 predilection for amaryllids and achieved success in their hybridization. He 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 to be considered for the Herbert Medal.

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. E. Lawrence, North 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

HERBERT MEDALISTS, CONTINUED

Dr. Robert F. Hoover, California, 1955
Mr. E. O. Orpet, California, 1956
Mrs. Morris W. Clint, Texas, 1957
Mr. Wyndham Hayward, Florida, 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. L. Boshoff-Mostert, South 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
Sir Peter Smithers, Switzerland, 1997
Dr. Dierdre Snijman, South Africa, 1997
Dr. Alan W. Meerow, Florida, U.S.A. 1998

THE IBS E-MAIL BULB FORUM

Robert M. Turley
Lake Charles, LA, U.S.A.

The International Bulb Society has linked to cyberspace via personal computer e-mail. An **E-mail Bulb Forum** has been established for those wanting quicker communication with the international bulb community. You may connect anytime to Forum members anywhere in the world through the E-Mail Bulb Forum.

The E-Mail Bulb Forum is a discussion group. We do this through a Listserver which houses e-mail addresses of all the Bulb Forum participants. Any responses we make to the Bulb Forum are simply sent to the Bulb Forum Listserver. The Bulb Forum Listserver then forwards the messages to all the participants. In this way, we can be in touch with each other on a daily basis.

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®, Earthlink® or a local internet service provider.

3. You must be a member of the INTERNATIONAL BULB SOCIETY (see membership dues).

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

1998 HERBERT MEDALIST

ALAN W. MEEROW

I was born in 1952, the son of a garment center laborer, in a blue collar neighborhood of mostly Irish Catholics, ringed by greenery, and, perhaps most importantly, within walking distance of The New York Botanical Garden. The proximity of that august institution would, apparently at least, invade my subconscious mind. Yet science, and more specifically botany, was far from my mind in adolescence. I was fortunate to attend the Bronx High School of Science, one of the city's elite secondary schools that require an academic admissions test, and was introduced to smart kids from all over the city: sons and daughters of artists, theater people, writers and other intellectuals, as well as inner city youth with talent and inquiring minds. I was drawn to the art of writing and imagined myself a poet and crafter of fiction, with visions of a literary career. After high school I attended the State University of New York at Buffalo for one year, but despite my indulgence in creative writing, literature and philosophy, I felt restless and dissatisfied with school, and, to my parents' chagrin, opted to drop out of college after one year. A cross-country excursion that summer with two friends quickly persuaded me that my destiny lay west. In early 1972, at 19, I found myself in Santa Cruz, California.

Santa Cruz hosted a lively literary community, and a healthy alternative youth culture that by and large avoided the excesses of San Francisco's Haight Ashbury. I lived on an idyllic small farm in the Santa Cruz Mountains, nestled between redwoods and chaparral, and began my first tutelage in any local flora, with John Hunter Thomas' **Flora of the Santa Cruz Mountains** as my guide. By day, I grew vegetables, kept bees, goats and chickens; by night I wrote poems, imagined novels, and volunteered at a crisis intervention line called the Community Switchboard. When I moved off the farm into town, I began to investigate the burgeoning nursery industry around Santa Cruz, and worked at a variety of nurseries for varying stints of time, moving on to another specialty grower when I felt I'd learned all I could from the previous. In my spare time I broadened my botanical horizons, visiting the Mohave Desert in a particularly good spring, Munz' **A California Flora** in hand. I began to envision a career in horticulture as fair trade to support my artistic pretensions. This would lead me to the University of California at Davis, where I pursued a course of study equally divided between botany and environmental horticulture. At 23, I was four years older than the typical sophomore student, self-motivated and directed academically. I dove enthusiastically into plant taxonomy, anatomy, mor-

phology, ecology, geography and paleobotany with the likes of Grady Webster, John Tucker, Ernest Gifford, Mike Barbour, and Daniel Axelrod. In the environmental horticulture department, I studied floriculture with Tony Kofranek, arboriculture with Richard Harris, and plant materials with John Madison and Andrew Leiser. I began to orient myself towards the less commercial arena of botanical gardens and arboreta, working during most of my three years at Davis as co-student manager of the UCD Arboretum which was expanding rapidly along the banks of Putah Creek at the southern end of campus. I also made the acquaintance of Bijan Dehgan, who supervised the botany department conservatory while finishing a doctorate on the systematics of *Jatropha* (Euphorbiaceae). Bijan, who also had successfully integrated horticulture and botany in his career, had accepted a faculty position with the University of Florida Environmental Horticulture Department. We discussed the possibility of my pursuing graduate studies in plant taxonomy with him in Gainesville once I graduated from UC Davis.

One of the most formative experiences of my time at Davis, arranged with the help of Tony Kofranek, would forever orient me to the tropics as a focus of my work in the plant sciences. I spent the summer of 1977 in Costa Rica, living and working at Linda Vista S.A., the F_1 hybrid flower seed producer owned by Claude Hope, well known for his pioneering work in the development of modern impatiens varieties. One of the projects towards which Hope directed me was the evaluation and selection of his amaryllis (*Hippeastrum*) hybrids. Again, perhaps a subliminal effect was fostered by that exposure. Even more inspirational to me was Costa Rica's extraordinary local flora. At times by myself, or in the company of Linda Vista's plant breeder Leon Glicenstein, I traversed Costa Rica's diverse territory, adding thousands of new plants to my taxonomic vocabulary. I became particularly intrigued by the many species of *Bomarea* (Alstroemeriaceae) and epiphytic Ericaceae, and began to consider both as prospective subjects for graduate work. The experience also would later inspire my first contribution to **Horticulture** magazine, "The Cloud Forests of Costa Rica."

I left Davis, and California as well, upon graduation in December, 1978, heading back east with little planned other than beginning graduate school at the University of Florida the following fall. I began to look for something to occupy myself for the nine month duration, and, through Davis connections, managed to wrangle the position of interim greenhouse manager at the Marie Selby Botanical Gardens in Sarasota, Florida. This small, research botanical garden, barely six years old, had devoted itself to the study of epiphytic plants, and was under the direction of Calaway Dodson, one of the world's foremost authorities on orchids. I jumped at the opportuni-

ty, and joined Selby's diverse (and at times dysfunctional) staff with alacrity. When asked, a few months later, to consider staying on in the permanent position, I decided to postpone graduate school at least a year or two.

Selby was a wonderful experience. I quickly began to acquaint myself with Florida's subtropical flora, as well as with Selby's extensive collections of orchids, bromeliads, gesneriads, and other epiphytic plants. Dodson and the Garden's other research botanists were concentrating their collecting efforts in Ecuador, and Cal, knowing that I intended to pursue graduate study in plant systematics, began urging me to consider a family whose representation in the Ecuadorean flora was significant, but poorly understood. That family was the Amaryllidaceae. Adding his encouragement to that direction was the late ethnobotanist and taxonomist Tim Plowman of Field Museum, who was a frequent visitor at Selby on his way to and from his extensive field expeditions in South America.

About this same time, I began a correspondence with the late Marcia Wilson, who ran a mail order bulb business from Brownsville, Texas. I had decided to develop a bulb garden outside one of the Selby greenhouses, and had run across Marcia's advertisement in a horticulture magazine. We were soon trading bulbs, and our correspondence remained intact, if irregular, for many years. Marcia introduced me to the American Plant Life Society (now the International Bulb Society) and encouraged me to forge ahead into the taxonomy of the Amaryllidaceae. Marcia's parents, the Clints, had been ardent collectors of Mexican Amaryllidaceae and part of Hamilton Traub's circle of associates in the Society.

After a field trip in Costa Rica with some Selby associates, the temperament of the Garden began to change. Grumbling was heard in some quarters, and Mike Madison, Selby's Harvard educated aroid specialist abruptly quit the staff. The atmosphere became strained, and my long-postponed graduate school career began to look opportune. I left Selby, and after a brief vacation in California backpacking in the Sierra Nevada and writing, I began work on my Master's Degree at the University of Florida in 1981 with Dr. Bijan Dehgan.

I had decided to make the genus *Eucharis,* the Amazon lilies, the subject of my thesis. It was clear from the Ecuadorean material that Dodson and other Selby botanists had brought back to the garden that a lot more was going on in that genus than had previously been surmised. It was at that time that I had my first and only correspondence with Hamilton Traub. Traub welcomed my study of *Eucharis,* but reminded me that he had transferred the genus into *Urceolina* in 1971. I wrote back that yes, I was aware of his taxonomic changes, but didn't necessarily agree. That seemed to end our corre-

spondence prematurely.

At Marcia Wilson's behest, I wrote to many longtime amaryllid enthusiasts around the country, who were more than generous in sharing what material of *Eucharis* and the related *Caliphruria* they had obtained, as were many botanical gardens around the world. Chief among the former was the well-known Fred Meyer, and we began a friendship that has lasted to this day. The year 1981 was also a landmark for me in another way: I met my future wife, Linda Fisher, in an Advanced Plant Taxonomy class taught by her graduate supervisor, Walter Judd. Walt would become, in effect, my co-major professor during my graduate career.

Linda and I began a courtship that would take us to the Dominican Republic that summer where she completed field work for her own Masters Degree in Botany. While there, I searched in vain for the endemic *Zephyranthes bifolia* and had a nasty encounter with poisonwood (*Metopium brownei*) which, despite my efforts to avoid its resinous leaves, swelled my eyes shut for 24 hours with its volatile allergenic properties. We spent six unforgettable weeks on Hispaniola, exploring its cloud forests, pinelands and coastal scrub vegetation. Sadly, the once magnificent forests of the Republic's central mountains were almost completely gone.

Alan Meerow collecting *Eucharis* in Ecuador.

In May, 1982, Linda and I were married at her family's summer cottage on Lake Ontario. The lakeside woods were carpeted with the pristine white of *Trillium grandiflorum*, as good an augury as any for a monocot taxonomist. We honeymooned in South America, mixing work with pleasure, hunting amaryllids in the Peruvian and Ecuadorean Andes and Amazonas in July and August of that year.

The early 1980's were exciting times to be a graduate student in plant taxonomy. The emerging technology of personal computing was changing the way we did research, and the principles of phylogenet-

ics (cladistics) were creating a revolution in systematic theory and classification.

I finished my Masters degree in August 1983. It amounted to supporting work for a full-blown monograph of *Eucharis* and *Caliphruria*, so I decided to continue the research to its logical conclusion for my Ph.D. I was fortunate in obtaining both a National Science Foundation Dissertation Improvement grant and a Garden Club of America/World Wildlife Fund Fellowship in Tropical Botany; these funds allowed me to make several additional trips to South America. I participated in the International Bulb Society's Louisiana symposium, and met many bulb world luminaries. During my graduate student years I maintained lively correspondences with Les Hannibal, Thad Howard, Dr. Walter Flory and others (sadly, I never seem to have the time these days to keep such exchanges going). My goals began to evolve beyond my immediate dissertation problem; I became fascinated with the phylogeny of the entire Amaryllidaceae, and especially with the Andean genera to which *Eucharis* belonged, and which seemed to form a natural group by their shared chromosome number of $2n = 46$. Concurrent with my doctoral research, I accepted an appointment from the University of Göteborg in Sweden to prepare the treatment of the Amaryllidaceae for the Flora of Ecuador. Mitchell Beauchamp, editing **HERBERTIA** after the death of Hamilton Traub, invited me to take a more active role in the journal as one of several editorial board members.

In December, 1986, I graduated with my doctorate in plant systematics through the Horticultural Science department. My dissertation, entitled "A Monograph of *Eucharis* and *Caliphruria* (Amaryllidaceae)," was awarded that year as the best dissertation published in the Institute of Food and Agricultural Sciences of the University of Florida. That month also heralded the birth of our first child, Sara Anne. I needed to find gainful employment, fast!

It was not an easy time in the job market for budding plant systematists. Fortunately, my dual background in horticulture gave me some leeway in the search for an academic position. Almost as afterthought, I had applied for an assistant professorship at the University of Florida's Fort Lauderdale Research and Education Center. The position involved teaching and extension. It wasn't exactly what I had in mind, but to my surprise, an offer was tendered. In July, 1987 our family of three moved to Fort Lauderdale. No sooner was I on the job then I was off to Berlin with then IBS Executive Director Mitch Beauchamp for the World Botanical Congress!

The next ten years would be hectic ones for me. My family grew by two; Andrew, born in 1989, and Erica, who arrived in 1993. At

work, I walked a tightrope between fulfilling my duties as Florida's palm and tropical ornamental specialist and maintaining credibility as a plant systematist. At the 1989 IBS Symposium in Irvine, California, I met Drs. Julie Dutilh and Fernando Tombolato from Brazil, and spent a month doing field work with them that summer. Our cooperative work on Brazilian Amaryllidaceae and Alstroemeriaceae has brought me back to Brazil on six different occasions. I received tenure and promotion to associate professor in 1992, and petitioned successfully for a change in my academic appointment to 50% research in 1994. All indications are that I will receive promotion to full professor later this year (1998).

I began an extensive breeding program in *Hippeastrum* shortly after I took my current position, and received support for it from the American Floral Endowment for five years. The first patented varieties will be released from this program this year. A heat-tolerant *Alstroemeria* hybrid, 'Las Olas', developed jointly with Fred Meyer, is also being released in 1998. My work on the systematics of Amaryllidaceae was given a shot-in-the-arm two years ago with a National Science Foundation grant in support of molecular studies within the family, some of which is being completed in cooperation with Drs. Mark Chase and Mike Fay of the Jodrell Laboratory at the Royal Botanic Gardens, Kew, where I spent the majority of my academic sabbatical in 1997. The final month of that wonderful respite from my sometimes mundane university responsibilities was spent in residence at South Africa's National Botanical Institute headquarters in Kirstenbosch where I worked with Dr. Dee Snijman on a morphologically based cladistic analysis of the Amaryllidaceae. The opportunity finally to see many South African amaryllids in their native haunts was an experience I will not soon forget. Dee and I recently collaborated on a treatment of the family for the "Families and Genera of Vascular Plants," a modern update of the German classic **Die Naturlichen Pflazenfamilien** by Engler and Prantl.

Oddly enough, my reputation in Florida mostly centers around palms, and people are often surprised to find that my active research projects are focused around tropical geophytes, with the occasional foray into areas as diverse as cycad population genetics and research on coconut coir dust as an alternative to sphagnum peat. Plans through the next millenium include increased activity in the area of molecular systematics (I am currently setting up a new laboratory for these efforts), continued breeding and selection of amaryllis and alstroemeria, and ultimately, a new and (hopefully) sumptuously illustrated revision of Traub's **Genera of the Amaryllidaceae**, on which Dee Snijman has graciously agreed to collaborate. In 1997, I accepted appointment as chair of a new Bulb Specialists Group for the International Union for the Conservation of Nature,

and hope that our task force will be able to contribute a significant plan of action towards the conservation, preservation, and sustainable use of the planet's rapidly shrinking geophytic flora.

Through my years of association with the International Bulb Society, as member, editor and board member, it has been my privilege to interact with a marvelous cohort of individuals whose diversity of interests have had one common denominator: an unequivocal love of geophytic plants. It is an honor and equal privilege to accept the 1998 William Herbert Medal, the IBS' highest award. I look forward to many years of continued service to, research in, and enjoyment of the world of bulbous plants.

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ALSTROEMERIA IN CHILE

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The first species of *Alstroemeria* L. was described in 1714 by the French priest L.M. Feuillé; however, he referred it to the genus *Hemerocallis*. Linneaus established the genus *Alstroemeria* in 1761 in honour of one of his pupils, Clas Alströmer, who sent him seeds. *Alstroemeria* comprises more than 60 species with main centres of distribution in the central parts of Chile and the southeastern part of Brazil (Aker and Healy 1990). Bayer (1987) recognized 31 species representing 42 taxa of *Alstroemeria* in Chile. Ravenna (1988) described 18 additional species from Chile without, however, taking the monograph of Bayer into account. The number of species in Brazil is unknown. Baker (1888), Uphof (1952) and Aker and Healy (1990) mention between 18 and 30 species in Brazil. A revision of the Brazilian *Alstroemeria* species, which is much needed, should be in preparation.

The three other genera in the Alstroemeriaceae also are found in Chile. *Leontochir* and *Schickendantzia** are both monotypic genera; *Leontochir ovallei* Phil. is found near the Pacific coast around Carrizal Bajo (28°S) and *Schickendantzia pygmaea* (Herb.) Pax (syn. *Alstroemeria pygmaea* Herb.) in the Andes (up to an altitude of 4,800m). The genus *Bomarea* comprises more than 100 species with only *B. salsilla* (L.) Herb. found in Chile (the central part).

CHILE

Chile, situated along the western slopes of the southern parts of the High Andes, is a long, narrow strip of land, about 4,800km long and only 200km wide at most, extending from 18° to 56°S latitude. Many types of vegetation zones occur, from the rainless subtropical desert in the north, via a sclerophyllous region, to the very wet, temperate and subarctic forests and grasslands in the south. The country is divided into thirteen administative regions (Regions I–XIII), with Region I as the most northern. The profile at most latitudes

* Taxonimic Editor's note: The current consensus within the botanical community is that *Schickendantzia* should not be segregated from *Alstroemeria*.

shows a steep drop in altitude from the High Andes to the Pacific Ocean. Generally, the annual rainfall increases from the north (some years it does not rain at all) to the south (more than 3,000mm) and winter rain is prevalent throughout.

In Chile, *Alstroemeria* is geographically distributed from a latitude of 22°S in the north (*A. paupercula* Phil.) to 51°S in the south (*A. patagonica* Phil.). Due to this wide latitudinal geographical distribution of more than 3,000km and the large differences in altitude (0–3,500m) the different species are exposed and adapted to very different ecological conditions. Many of the species may stand up to a long period of drought and some of the northern species are even capable of surviving for more than a year without water uptake. The well-developed rhizomatous root system with tuberous roots is buried quite deeply in the ground and protected from the burning sun. After water uptake during winter rainfall, the rhizomes sprout; soon thereafter the plants are in flower. Approximately one month after anthesis the capsules dehisce and the round seeds are spread on the ground. Some seeds may germinate the following year, but others remain dormant in the soil for years. This seed bank ensures that some seeds germinate during years in which the precipitation is sufficient for the seedlings to flower and set seeds. It is possible to find flowering *Alstroemeria* in Chile most of the year; the different species flower in different months according to the period of rainfall.

A large variation regarding flower colours and patterns is represented covering all variations of pink, red, violet, purple, besides white and yellow. The most common pattern is red-purple-brown spots and stripes on the inner tepals and a yellow band on the two upward pointing petals. Some species have tiny flowers with a diameter of about 1cm, e.g. *A. revoluta* Ruiz & Pav., while others such as *A. magnifica* Herb. and *A. pelegrina* L. have large showy flowers with a diameter of up to 7cm. Plant height also varies considerably with stem length being about 5cm in some subspecies of *A. hookeri* H. Lodd. and 160cm in *A. magenta* Bayer.

Alstroemeria has been widely cultivated since the 1950's. A few species, such as *A. aurea* Graham, *A. ligtu* L. and Ligtu hybrids are not uncommonly grown as perennials in gardens, but *Alstroemeria* is economically most important as a cut flower. The cut flower cultivars presently used are all interspecific hybrids, involving a few Chilean species and one Brazilian species (*A. pulchella* L.f.). Recently an interest in growing *Alstroemeria* as a pot plant has appeared in the U.S.A., Holland and Denmark. It should be possible to increase the variation and enhance the quality of the commercial cultivars by including a larger part of the genetic variation found among wild species.

PREPARATION, TRANSPORTATION, COLLECTIONS

In 1993 the authors (botanist and plant breeder, respectively) visited Chile twice, in February and in December, in order to collect seed material of *Alstroemeria*. We used the monograph **Die Gattung *Alstroemeria* in Chile** by E. Bayer (1987) as a guide. During the trip in December, Mr. Luiz Arriagada, a botanist previously employed by the Botanical Garden in Valparaiso, accompanied us. His knowledge of the Chilean flora, the ecology, the habitats, the taxonomy, especially of bulbous plants, was of great importance for the success of the expedition.

For transportation, small rented cars, a Fiat Uno 1.3L and a Daihatsu Charade 1.3L were used. Even for driving in the Andes the power of the engines was sufficient but cars with higher clearance would have been advantageous due to bad, unpaved roads in some areas. In total, more than 10,000km were covered from Antofagasta in the north to Temuco in the south (Fig. 1).

Mature seeds as well as unripe capsules were collected. At some localities only dry stems were seen but seeds could be found on the surrounding ground, in the soil or among the rocks. The unripe capsules either matured during the trip or they were incubated *in vitro* after returning to Denmark. The dehiscence of some capsules was easily recognized by our ears as they popped like popcorn on the back seat of the car. Samples for herbarium sheets were taken and a live collection of species is now kept at the Botanical Garden, Copenhagen, Denmark.

NORTHERN SPECIES IN REGION II-IV (21°30'–32°S)

The most northern locality in which *Alstroemeria* has been observed in Chile is near Tocopilla (22°S) in Region II. The vegetation is sparse, with various species of cacti and other xerophytic plants near the coast and in the Andes. Moving further south, the annual precipitation increases and the vegetation gradually changes and becomes more complex.

Species of *Alstroemeria* are reported from several localities along the coast of the Pacific Ocean between Antofagasta and La Serena where the fog from the Pacific Ocean provides a large part of the precipitation. From La Serena and southwards, *Alstroemeria* is still found near the coast.

The winter seasons preceeding both trips had been extremely dry, resulting in plant dormancy and lack of rhizome sprouting, and we did not find any flowering *Alstroemeria* north of La Serena. At several places dry stems from the preceding years were observed. Rhizomes below these stems were collected near Taltal (Fig. 1.1), at Morro Copiapo south of Caldera, along the Pan American Highway by

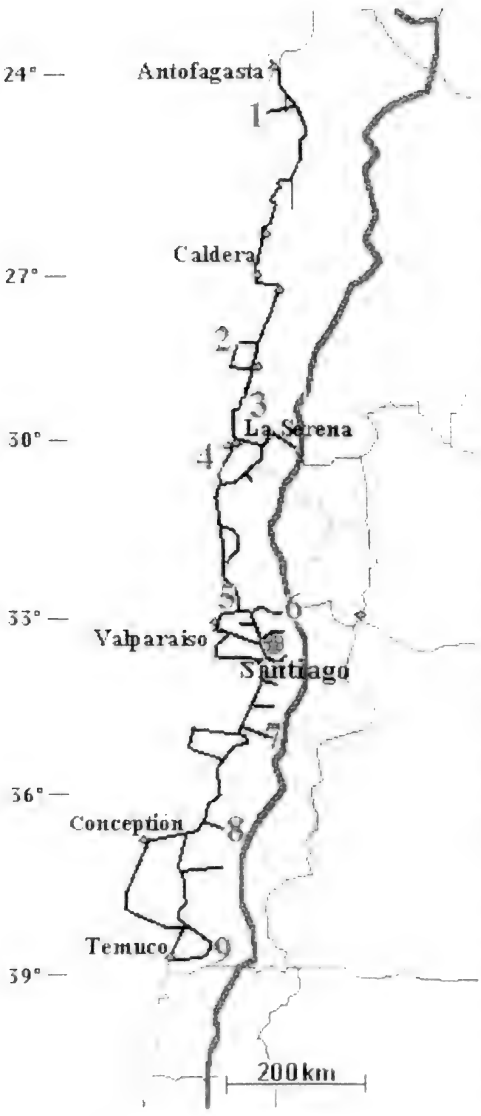


Figure 1. The central part of Chile with the route of the expedition indicated as fat black lines. Numbers indicate locations mentioned in the text. 1. Taltal; 2. Carrizal Bajo; 3. Observatories'La Silla' and 'La Campana' and Cuesta Pajonales; 4. Tongoy; 5. La Laguna, Los Vilos, Cta. Nague and Pichicuy; 6. Portillo and Farellones; 7. Rio Maule; 8. Termas de Chillan; 9. Conguillio National Park.

the road to the observatories La Silla and La Campana, and Cuesta Pajonales, and at Pta. Teatinos just north of La Serena (Fig. 1.3). The collected species were *A. paupercula, A. leporina* Bayer & Grau and *A. magnifica*, which all have relatively large and showy flowers. When returning to Denmark we observed, however, that it was very difficult to keep the collected rhizomes alive, and thus most rhizomes did not sprout during culture in our greenhouses.

In the Elqui Valley, from Paso del Agua Negra at the Argentine border to La Serena at the coast, it is possible to grow subtropical fruits like mango, papaya and avocado, and crops like tobacco, rice and cotton because of the high temperatures and the water supply from the Elqui River. At altitudes above 2,000m in the eastern part of the valley there are three taxa of *Alstroemeria*: *A. crispata* Phil., *A. andina* Phil. subsp. *andina* and *A. andina* subsp. *vunustula* (Phil.) Bayer. We found *A. andina* subsp. *andina* above 3000m growing on steep slopes in a 10-20cm deep layer of rocks. In the Elqui Valley along the road to the Observatoria El Tololo, *A. leporina* and *A. schizanthoides* Grau have been observed, and again we found only dry stems, some still with seed capsules. One *Alstroemeria*

was in flower; however it was none of the species previously reported from this locality. It had pinkish flowers and could be *A. pallida* Graham.

CENTRAL SPECIES IN REGION V–VII (32°–36°S)

The central region of Chile has the greatest number of species. In this area *Alstroemeria* has been found at altitudes from the coast to the Andes.

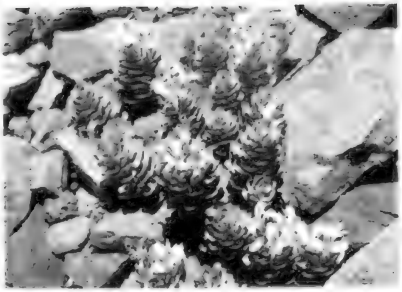
Bayer (1987) recognized four subspecies of *A. hookeri* H. Lodd.; some of these subspecies are difficult to separate from each other and intermediate types occur. They are all lowland plants which grow up to an altitude of a few hundred metres. All these subspecies have linear leaves, rather small flowers with a basal rose-pink colour, a yellow band across the two upper, inner tepals and more or less pronounced purple-red brown spots and stripes on the flowers. The height of the flowering stem varies from 5 to 20cm, and *A. hookeri* mainly grows in sandy soil near the coast. We found *A. hookeri* subsp. *cummingiana* (Herb.) Bayer along the Pan American Highway north of Los Vilos, *A. hookeri* subsp. *recumbens* Herb. at the beach at Pichicuy, and also unidentified subspecies of *A. hookeri* at Cta. Nague and near La Laguna at the Pacific Ocean (Fig. 1.5). The plants at Pichicuy had set fruits only 5cm above the sand, and numerous stems with fruits were found within a small area. However, species which are low in nature may often perform differently when cultivated in greenhouses.

Alstroemeria magnifica subsp. *maxima* (Phil.) Bayer, *A. ligtu* subsp. *simsii* (Spreng.) Bayer and *A. hookeri* were found near and along the coast 50km north of Valparaiso where the most northern island with penguins also is located. Just north of La Laguna bulbous plants such as *Hippeastrum advenum* (Ker-Gawl.) Herb., *Phycella biflora* Lindl. [syn. *Hippeastrum bicolor* (Ruiz & Pav.) Baker], and *Trichopetalum plumosum* (Ruiz & Pav.) J.F. Macbr. were found (Fig. 1.5).

One species with the largest and most spectacular flowers is *A. pelegrina* L., the type species of the genus. It only grows close to the Pacific Ocean in the central part of Chile. It is, however, also reported from Peru. We found *A. pelegrina* at Cta. Nague (just north of Los Vilos), at Los Molles, and at Pta. Curaumilla (south of Valparaiso). Large, continuous populations of *A. pelegrina* are found at these places. The height of the plants varies considerably, but the flower colour and pattern seem quite homogeneous.

Between Santiago and Valparaiso a number of *Alstroemeria* species have been reported. It is not possible to find *Alstroemeria* any longer at many of the older reported localities as these now are the most densely populated areas in Chile. However, *Alstroemeria*

1. Collecting *Alstroemeria diluta* subsp. *chrysanthus* seeds at the beach of Tongoy. Locality figure 1.4.



2. *Alstroemeria andina* subsp. *andina* east of Embalse La Laguna towards Paso del Agua Negra, altitude 3,150m.

Author photos

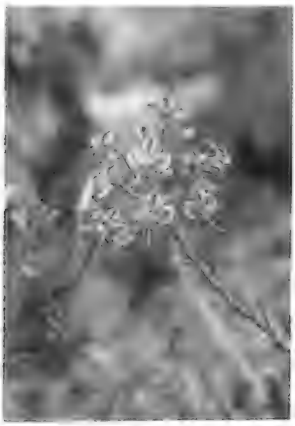
3. *Alstroemeria hookeri* subsp. *cummingiana* at Pan American highway, near Los Vilos, altitude 150m. Locality figure 1.5.

4. Flowering stems of *Alstroemeria hookeri* subsp. *recumbens* at Pichicuy beach. Locality figure 4.5.

5. *Alstroemeria pulchra* between Puchuncavi and Nogales, northeast of Valparaiso.

6. *Alstroemeria pelegrina* at Pta. Curaumilla south of Valparaiso, altitude 1m.

7. *Alstroemeria zöllneri* at Cero del Roble between Santiago and Valparaiso, altitude 1,800m.



8. *Alstroemeria revoluta* at the road towards Farellones, northeast of Santiago. Locality figure 1.6.

9. *Alstroemeria pallida* along the road to Farellones, northeast of Santiago, altitude 2,000m. Locality figure 1.6.

10. *Alstroemeria spathulata* at screes at Laguna del Inca, Portillos, altitude 2,800m. Locality figure 1.6.

11. *Alstroemeria ligtu* subsp. *incarnata* along Rio Maule, altitude 1,600m. Locality figure 1.7.

12. *Alstroemeria presliana* subsp. *australis* near Victoria, north of Temuco, altitude 350m.

can still be found in the mountain areas between these two major cities, e.g. at Cerro del Roble. *Alstroemeria revoluta* Ruiz & Pav., *A. pulchra* Sims and *A. ligtu* subsp. *simsii* (Sprengel) Bayer were found in the area. On the way from Runge we also observed *A. angustifolia* Herb., *A. zöellneri* Bayer and *A. garaventae* Bayer growing together with bulbous plants such as *Hippeastrum igneum* (Lindl.) Munoz and *Placea grandiflora* Lem. These species are all growing in the forest. On the top of Cerro del Roble, where a radio transmitting station is located, the vegetation is sparse grassland with a *Calandrinia* species, but seemingly with no species of *Alstroemeria* or bulbous plants.

It is possible to ascend to the Andes northeast of Santiago via Portillo and Farellones where several ski resorts are located (Fig. 1.6). On the way to Farellones several *Alstroemeria* species were found: at lower altitudes *A. revoluta* and *A. ligtu* among trees and shrubs, and above 1,500m only *A. pallida*, a variable species with regard to colours and patterns of the flowers. At altitudes of 1,5002,500m *A. pallida* was quite common. *Alstroemeria pallida* was observed again on the way to Portillo, at the screes along the hair needle spins at altitudes of about 2,000m. *Alstroemeria spathulata* C. Presl. was growing on the steep, stony screes east of the lake Laguna del Inca, Portillo, where some of the Inca treasures are thought to be buried. The leaves of *A. spathulata* are rather succulent and the pink flowers are only raised 10–15cm above the gravel.

Southeast of Santiago, on the way to San José de Maipo, there is a large recreation area. Here *A. ligtu* subsp. *simsii* was seen in flower several times growing along the road. At higher altitudes the vegetation again became more sparse. *Rhodophiala rhodolirion* (Baker) Traub was growing together with two unidentified species of *Alstroemeria* at an altitude of 1,900m. At an altitude of 2,100m, *A. umbellata* Meyen was growing in the grass together with species of *Rhodophiala* and *Solenomelus* which were not yet flowering.

REGION VIII-IX (36°–39°20'S)

South of the 36°S latitude the number of *Alstroemeria* species is limited to *A. aurea* and *A. presliana* Herb. with subsp. *presliana* and subsp. *australis* Bayer. The most widespread *Alstroemeria* species in Chile is *A. aurea*. The colour of the flowers of *A. aurea* varies between all shades of red, yellow and orange; it grows both in shaded humus-rich soil of *Nothofagus* forests and in unshaded gravel or grassy slopes. The northernmost locality for *A. aurea* is at Termas de Chillan (Fig. 1.8), a ski resort as well as a sanatorium with hot sulphurous springs. Getting there is quite difficult as it is located 80km east of the Pan America Highway; the first 60km of the road is paved but the last 20km is unpaved and was in bad condition.

Alstroemeria presliana subsp. *presliana* with purple flowers was also growing at Termas de Chillan, whereas *A. presliana* subsp. *australis* with orange-red flowers was found at lower altitudes near Victoria, north of Temuco.

ALLERGENS AND FLOWER PIGMENTS

Alstroemeria contains various allergens (tuliposides and tulipalin A) which may cause a severe skin disease. These allergens are known mainly from commercial production of cut flower *Alstroemeria* and tulips. Tulips contain the same allergens and the allergenic reactions have been named "tulip finger" as the disease was first observed in the tulip industry. The collected material has been screened for the content of allergens to select material suitable for a breeding program aiming to reduce the concentration of allergens in commercial cultivars (Kristiansen and Christensen, 1998). Differences in concentration and type of allergen were found both among and within species, but in most plants relatively high allergen concentrations were present.

The pink, red and purple flower colours are mainly determined by pigments called anthocyanins, whereas the yellow and orange colours are due to carotenoids. Nørbaek *et al.* (1996) screened 28 Chilean species and found seven different anthocyanins. The types and amounts of anthocyanins and/or carotenoids determine the flower colours, so by identifying the pigments in the parental species or cultivars used in hybridizations the flower colours of the offspring can be predicted.

HYBRIDIZATION

The collected material has been used in a large scale hybridization program with the major aim being to develop techniques enabling production of interspecific hybrids between a large number of species. Special emphasis has been taken to produce naturally low growing hybrids for use as new pot plants by including species of low height. For Danish conditions pot plants have to be grown in pots with a diameter of not more than 12cm, so newly marketed American pot plant cultivars are not acceptable due to their height.

Interesting new flower types and colours have been obtained from hybridization with species not previously used in the breeding of cut flower cultivars. The results obtained so far indicate that it is possible to hybridize many of the species and no clear indications of incompatibility have been observed. Most of the hybrids produced have reduced pollen fertility and it was only possible to produce many of them through ovule culture *in vitro*. The results of the *in vitro* experiments also showed that it is possible to cultivate the

13. One author among *Alstroemeria aurea* at Termas de Chillan, altitude 2,000m. Locality figure 1.8.

14. *Alstroemeria aurea* in Conguillio National Park, altitude 1,000m. Locality figure 1.9.

15. Left: *Hippeastrum bagnoldii* at Carrizol Bajo, altitude 60m. Locality figure 1.2.

16. *Hippeastrum advenum* at Cta. Nague, altitude 24m. Locality figure 1.5.

17. *Rhodophiala rhodolirion* at Banjos Morales southeast of Santiago, altitude 1,900m.

18. *Calandrinia litoralis* at Cta. Nague, altitude 1m. Locality figure 1.5.

immature ovules successfully as early as two days after pollination; however, the percentage of ovules that germinated increased with increasing ovule age (Kristiansen, 1995).

The variation among and within species and the many possibilities for species hybridizations opens up the possibility for production of a wide range of new cultivars suited for various purposes, such as cut flowers, pot plants and garden perennials. Hybrids for use as garden container plants are also marketed, and it is possible also to breed fragrant cultivars. The most showy flowers are found among the Chilean species, whereas the Brazilian species have strong foliage and two fragrant species, *A. caryophyllacea* Jacq. and *A. sellowiana* Shubert. Several breeding companies and research organizations in Holland, U.K., Brazil and U.S.A. are working intensively in *Alstroemeria* breeding.

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NOTES ON THE GENUS *LACHENALIA*

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BRIEF HISTORICAL BACKGROUND

The recorded history of the large and diverse genus *Lachenalia* extends over more than three centuries, beginning with a water-colour painting of the species now known as *Lachenalia hirta,* produced in the journal of Simon van der Stel, governor at the Cape of Good Hope, illustrating his expedition to Namaqualand in the Northern Cape Province of South Africa in 1685-1686. Over the ensuing two hundred years or so, several more *Lachenalia* species were published under other genera by such botanical luminaries as Thunberg and Linnaeus. But it was J.F. Jacquin who first described the genus *Lachenalia,* naming it after Werner de Lachenal (1736-1800), an eminent professor of botany in Basel, Switzerland.

However, it was J.A. Murray who was inadvertently responsible for the actual publication of the genus *Lachenalia* in 1784. The 1780's saw the publication of N.J. Jacquin's magnificent illustrated volumes in his **Icones Plantarum Rariorum**, in which more than twenty colour plates of *Lachenalia* were published, ten of which are iconotypes of his species, the holotypes having been destroyed during the bombing of Vienna in World War II. In 1897, J.G. Baker published his major work on *Lachenalia* in Volume 6 of **The Flora Capensis**, in which he recognised 42 species.

Most of the taxonomic work on *Lachenalia* carried out since the publication of Baker's final work was undertaken by Miss W.F. Barker, both during her twenty-four-year term as Botanical Assistant at the Compton Herbarium at Kirstenbosch, and her fifteen year term as Curator of the same Herbarium, and subsequent to her retirement in 1972. She published forty-seven new species and eleven new varieties for the genus. As a horticulturist curating the living bulbous plants collection in the Kirstenbosch nursery, I had the extremely good fortune of benefitting from the vast wealth of knowledge on *Lachenalia* Miss Barker had built up over many years of extensive field collecting, and equally important, meticulous herbarium recording. In the mid 1980's, I felt confident enough to begin work on a popular, illustrated guide to the genus, with a simplified key and brief notes on each species, which was published in 1988 as **The Lachenalia Handbook**, in which eighty-eight species were included. With Miss Barker's passing on the 27th December, 1994, at the age of eighty-seven, I have continued her work towards a monograph of the genus, and have to date published ten new species and one new

subspecies, with several more awaiting publication in the near future. I estimate the total number of species for the genus to be about 110, and am now engaged in an M.Sc. study of this fascinating group.

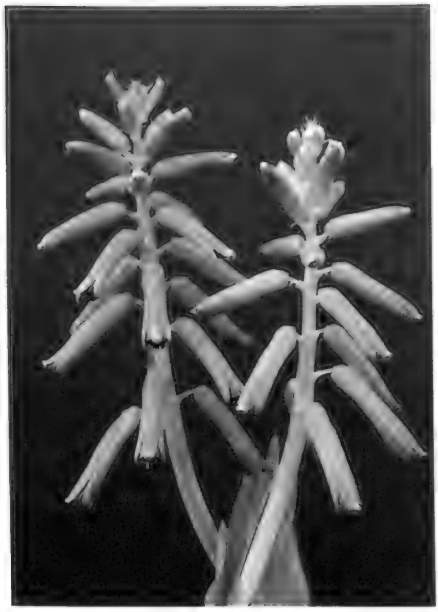
DISTRIBUTION

The Family Hyacinthaceae is very well represented in southern Africa by about twenty-five genera consisting of a total of about three hundred and seventy different species. The genera *Lachenalia* (about 110 species) and *Ornithogalum* (about 70 species) are the two largest groups within the region, and there are several monotypic, endemic genera, namely *Androsiphon, Amphisiphon, Daubenya, Lindneria, Litanthus* and *Whiteheadia.*

Lachenalia is endemic to southern Africa and has a wide distribution extending from the south-western coast of Namibia southward into South Africa, throughout the Northern, Western and Eastern Cape Provinces, and as far inland as the south-western part of Free State Province. With one exception, the genus is exclusively winter-growing, with a pronounced dormant period during the summer months. Most interestingly, the species occurring in areas of predominantly summer rainfall or intermediate rainfall, such as *L. campanulata* and *L. karooica*, nevertheless follow the typical winter rainfall growth cycle. To the best of my knowledge, the only *Lachenalia* species which follows a summer rainfall growth cycle is the diminutive, white-flowered *L. pearsonii* which occurs in southern Namibia. (Incidentally, the specific epithets "*pearsonii*" and "*piersonii*" have for very many years been incorrectly applied to the *Lachenalia* hybrid with bright orange flowers with maroon tips which is freely available in the trade.) The genus *Lachenalia* is concentrated in the Namaqualand and Western Cape areas, with the diversity decreasing rapidly towards the eastern end of the distribution range in the Eastern Cape.

Although several *Lachenalia* species are widely distributed, such as *L. bulbifera* and *L. obscura,* the range of a substantial number is quite restricted, in some instances to a single locality, such as the dainty *L. moniliformis* and the dwarf *L. mathewsii.* Several other species such as *L. polyphylla* and *L. viridiflora* from the Western Cape also are now seriously threatened in the wild state due to agricultural and other "development". As can be expected, those species which are widely distributed are, morphologically, widely variable. But even within species with relatively small distribution ranges such as *L. giessii* and *L. salteri*, a remarkable degree of variation exists.

A number of lachenalias are recorded from isolated localities such as in the Great Karoo, separated by vast "blank", undocumented

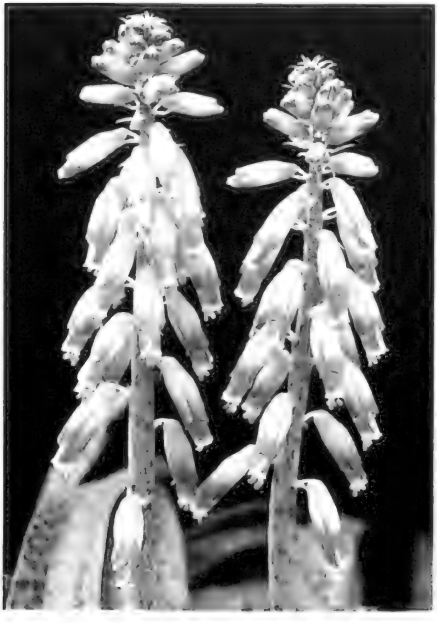


1. *Lachenalia bulbifera* is a variable, widely distributed species.

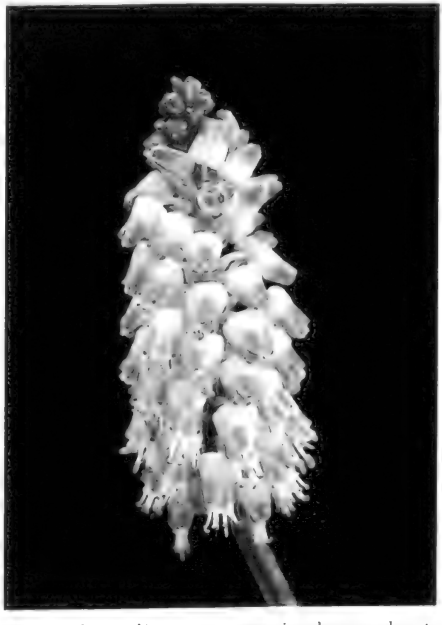
2. *Lachenalia rubida* occurs in pure sand and is the earliest-flowering of all the species.

Photos: Graham Duncan

3. *Lachenalia aloides* var. *quadricolor* grows in humus-rich cracks of granite outcrops.



4. *Lachenalia aloides* var. *vanzyliae* is restricted to certain mountains of the Western Cape.



5. *Lachenalia montana* is dependent on natural veld fires for successful flowering.

6. *Lachenalia viridiflora* is an endangered species from the Cape west coast.

7. *Lachenalia mathewsii* in habitat. This is a critically endanged species known only from one wild locality.

areas in between. Many of the species from these very arid parts of South Africa are adapted to undergo prolonged dormant periods as a result of the frequent droughts experienced there, such as in the Great Karoo, Namaqualand and Bushmanland. The often deep-seated bulbs of species like *L. xerophila* and *L. inconspicua* from these barren parts simply remain dormant in seasons of insufficient rainfall. The deciduous nature of the genus, inhospitable terrain and the fact that growth and flowering are dependent on sufficient seasonal rainfall are all factors which can be attributed to the as yet incomplete distribution records of several *Lachenalia* species.

HABITAT

With such a widely distributed genus, it is not unexpected that the species are to be found in an astonishingly wide range of different habitats. *Lachenalia rubida*, for example, always grows in deep, pure sand which, depending on wild locality, may have a high acid or alkaline pH value. This is the earliest flowering species in the genus (flowering period March-July) and is almost always found close to the seashore. In a few instances I have seen it growing within reach of the sea spray. At the other end of the spectrum, the dwarf, Eastern Cape montane species *L. campanulata*, occurs in heavy soil at altitudes exceeding 2,000 metres, and is one of the latest flowering species (flowering period October to the end of November). In between these two extremes, a multitude of other habitats are encountered for the genus, from humus-rich soil on granite outcrops (*L. aloides* var. *quadricolor*) to the mineral rich, barren stony flats of the Knersvlakte (*L. undulata*) to limestone outcrops (*L. muirii*) to seasonally inundated, heavy clay (*L. bachmannii*), to mention just a few. At least two *Lachenalia* species, *L. montana* and *L. sargeantii* are wholly dependent on the effect of natural veld fires for successful flowering, while the flowering performance of several others like *L. peersii, L. rosea* and *L. salteri* is greatly enhanced by fire, but is not dependent on it. Lachenalias are generally encountered in full sun situations, but a few occur naturally in shade (*L. margaretae*) or semi-shade (*L. orchioides* and *L. fistulosa*).

Brief notes on *Lachenalia* species not included in **The Lachenalia Handbook***, and new *Lachenalia* species or subspecies published since 1989**.

* denotes a species not included in **The Lachenalia Handbook**.
** denotes a new species or subspecies published since 1989.

1. ***Lachenalia alba* W.F. Barker ex G.D. Duncan

A white-flowered species with oblong-campanulate flowers and slightly exserted stamens, restricted to the Nieuwoudtville-Calvinia

area of the Northern Cape Province. It is closely related to another new species, *L. neilii* W.F. Barker ex G.D. Duncan which occurs in the same area.

2. ***Lachenalia aurioliae* G.D. Duncan

A variable species from the southern Great Karoo and Little Karoo, with pale bluish-white to yellowish-white, oblong-urceolate flowers with slightly exserted stamens, related to *L. schelpei* W.F. Barker.

3. **Lachenalia campanulata* J.G. Baker

This species was not included in **The Lachenalia Handbook** (1988) due to a lack of living material available for study at the time. A usually dwarf, high altitude species from the Eastern Cape Province with small, usually deep reddish-purple, campanulate flowers with exserted stamens.

4. **Lachenalia convallarioides* J.G. Baker

This species was not included in **The Lachenalia Handbook** (1988) due to a lack of living material available for study at the time. A usually dwarf species, restricted to the Albany District of the Eastern Cape Province, with small pinkish-white, campanulate flowers with included stamens.

5. ***Lachenalia inconspicua* G.D. Duncan

A dwarf species from the Kamiesberg, western Bushmanland and southern Namaqualand , with inconspicuous, pale bluish-white or greenish-white, oblong-campanulate flowers with included or very slightly exserted stamens, related to *L. concordiana* Schltr. ex W.F. Barker.

6. ***Lachenalia karooica* W.F. Barker ex G.D. Duncan

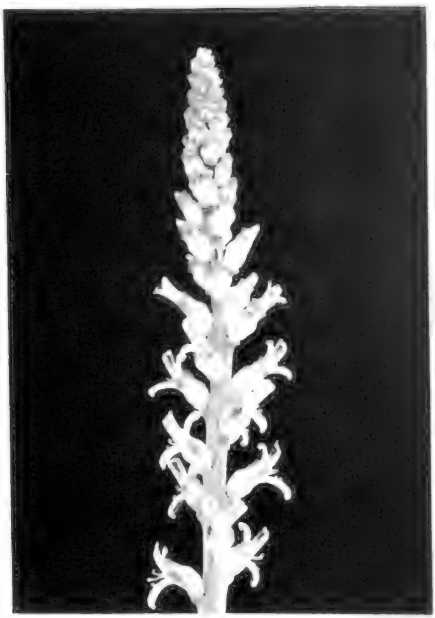
Occurs as far inland as the south-western Free State, and is also found in the Eastern Cape, Great Karoo and Northern Cape. It has dull white to greenish-white, oblong-campanulate flowers with well exserted stamens, and is related to *L. bowkeri* J.G. Baker.

7. ***Lachenalia marginata* W.F. Barker subsp. *neglecta* Schltr. ex G.D. Duncan

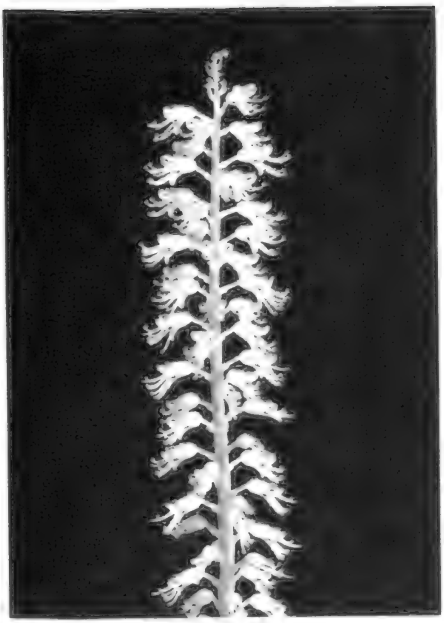
This new subspecies differs from the typical subspecies in having a much denser, elongated inflorescence of greenish-yellow, much smaller, narrowly urceolate flowers, and in its erect to suberect, lanceolate to ovate-lanceolate, conduplicate leaf.

8. ***Lachenalia marlothii* W.F. Barker ex G.D. Duncan

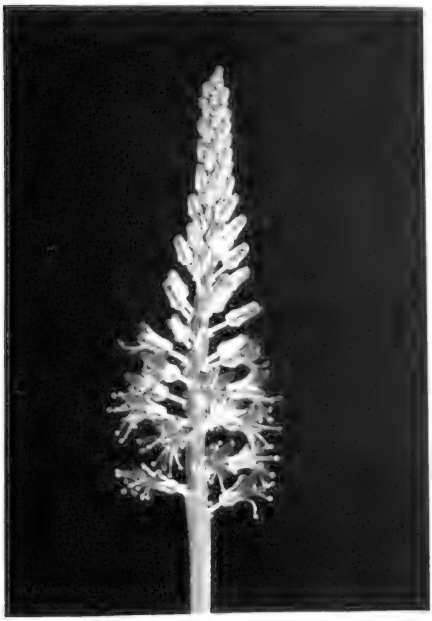
Occurs in the western Great Karoo and has pale blue and yellow-



8. *Lachenalia muirii* favours limestone outcrops in the wild.

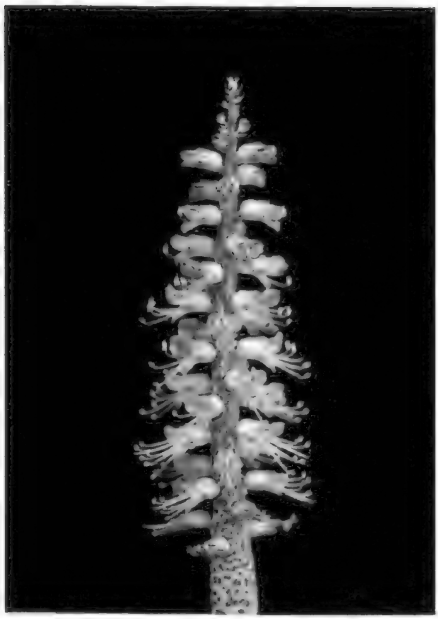


9. *Lachenalia thomasiae* is a newly discovered species with great horticultural potential as a pot subject.



10. *Lachenalia macgregoriorum* flowers at the end of the season as its leaves begin to wither.

11. *Lachenalia karooica* is a recently published species from the arid inland regions of South Africa.



12. *Lachenalia physocaulos* has a distinctive, inflated peduncle.

14. *Lachenalia campanulata* is a high altitude species from the Eastern Cape Province.

13. *Lachenalia convallarioides* is restricted to the Albany Division of the Eastern Cape Province.

ish-green, urceolate-oblong flowers with included stamens and a single ovate to ovate-lanceolate, suberect leaf. It is related to *L. marginata* W.F. Barker.

9. ***Lachenalia neilii* W.F. Barker ex G.D. Duncan

A greenish-white flowered species having oblong-campanulate flowers with blue bases and shortly exserted stamens, restricted to the Nieuwoudtville-Calvinia area of the Northern Cape Province. It is closely related to *L. alba* W.F. Barker ex G.D. Duncan.

10. ***Lachenalia obscura* Schltr. ex G.D. Duncan

An extremely variable, widespread species from Namaqua-

land, the Kamiesberg, the western Great Karoo and the Little Karoo. It has oblong-campanulate, pale yellowish-green to brownish-blue or cream flowers, with or without distinct magenta tips. The stamens are included or only slightly exserted, and its closest relative appears to be *L. maximiliani* Schltr. ex W.F. Barker.

11. ***Lachenalia perryae* G.D. Duncan

A very pale blue-flowered species from the Little Karoo and southern Cape with oblong-campanulate flowers with included stamens and a single, narrowly lanceolate, usually heavily barred leaf. It is related to *L. uniflolia* Jacq.

12. ***Lachenalia thomasiae* W.F. Barker ex G.D. Duncan

A most beautiful, white-flowered species with an erect, many-flowered inflorescence of oblong-campanulate flowers with brown or green markings and well-exserted stamens, restricted to the Olifants River Valley of the Western Cape Province. It is related to the dwarf species *L. margaretae* W.F. Barker, which occurs in the same area.

13. ***Lachenalia xerophila* Schltr. ex G.D. Duncan

Occurs in the dry, deep sand of the north-western and central Namaqualand, and in western Bushmanland. It has numerous small, oblong-campanulate white flowers with large, dull red to dark brown markings, and well-exserted stamens, and is related to *L. klinghardtiana* Dinter and *L. physocaulos* W.F. Barker.

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Duncan, G.D. 1997a. Five new species of *Lachenalia* (Hyacinthaceae) from arid areas of South Africa. **Bothalia** 27(1): 7-15.

Duncan, G.D. 1997b. *Lachenalia rosea*. **Flowering Plants of Africa** 55 t.2126.

LEDEBOURIA VISCOSA, ONE OF SOUTH AFRICA'S MOST STRIKING AND UNUSUAL BULBOUS PLANTS

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Ledebouria viscosa was described in 1970 in The South African Journal of Botany (Jessop, 1970:264). At the time of its description it had been recorded only from the vicinity of the type locality, the farm Waterval northeast of the Kransberg, which lies north of Thabazimbi in South Africa's North West Province. Later records (Venter, 1993:125) indicated that the plants also occurred closer to Thabazimbi in the plains to the southwest of the Waterberg. Now two records extend the known distribution further northward to the Matlabas district north of the Kransberg.

It appears that the species is a narrow endemic confined to sandy plains in the southern, western and northern foothills of the western extremes of the Waterberg mountain range. A good deal of suitable habitat exists north of Matlabas but a brief preliminary search did not yield any records for this area. It is possible that the species may occur in this region, but in a southerly direction plants are unlikely to be found beyond the Vliëberg, northwest of the Waterberg, where the habitat is not suitable.

LEDEBOURIA VISCOSA HABITAT

Ledebouria viscosa is always found in sandy, lightly wooded grassland. The colonies found by the authors were all in *Terminalia sericea* woodland, the dominant plant, with trees and shrubs such as *Grewia flava* and *Acacia erubescens* in smaller numbers. *Terminalia sericea* was found to be a good indicator plant of habitat suitable for *L. viscosa* colonies.

The woodland has many scattered open grassy clearings and it is mostly in these situations that the *Ledebouria* plants are found. The grassland is burnt periodically and grazed by cattle and antelope species. Grazing and burning are principally responsible for determining the ecology of the species.

The species was found to be best represented in the Matlabas area and least so east of Thabazimbi. The habitat in the former area is probably optimum for the species under modern conditions, whereas near Thabazimbi the woodland is mostly dense and often substantially degraded.

No other *Ledebouria* species was found growing together with *L.*

viscosa near Matlabas but *L. glauca* (Venter in ed.) was well represented in *L. viscosa* habitat southeast of Thabazimbi.

Associated bulbous and caudiciform flora included a *Bulbine* species, *Boophane disticha* and *Euphorbia tricadenia*. All these species are also elements of a grassland fire ecology.

ECOLOGICAL ADAPTATIONS TO ITS HABITAT

Ledebouria viscosa has developed some singular adaptations to its habitat. Many bushveld species reveal interesting adaptations to burning and grazing but *L. viscosa* copes with these in a most remarkable way. The foliage is unpalatable; quite often specimens are found with small chunks bitten off the top of the leaves, but nibbled no further. The tracks of antelope species are often to be seen near plants that have been freshly grazed in this way.

In contrast, the species has palatable bulbs which appear to be eagerly sought food by various grazing and burrowing animals. The timing of our ecological study was fortuitous and we were able to gather some illuminating data. One of the scattered colonies was located in wooded grassland that had not been burned for a few years, the other was in similar habitat that had been thoroughly burned the previous winter.

In the burned area most *L. viscosa* were lightly but effectively screened by grass which produced disruptive shadows, making the plants difficult to see. A coating of sand particles clinging to the leaves camouflaged them further. Shallow depressions around many of these bulbs indicated that they had been dug up and grazed a few years previously. (The holes dug by animals seeking food quickly fill up with sand during run-off after the heavy thunderstorms which frequently occur in the area.) All plants in these depression that were examined were found to have been grazed. Usually the mature bulb had been broken off the basal stem and a new bulb, occasionally two and even three, had sprouted at the site of damage.

It is interesting to notice that the attachment of the bulb to the basal stem is fragile and any burrowing animal can detach it with ease. There is, therefore, no encouragement for the animal to burrow further and remove the whole plant. Only a fraction of the plants examined at both colonies near Matlabas had not been damaged by browsing animals.

This interesting defense mechanism was explained in more detail when we examined plants at the recently burned colony. The depressions in the sand around the plants indicated that they had been eaten. The leaves were mostly undersized, spathulate and prostrate as opposed to erect which is one of the habits of this species. When the plants were examined it was found that these

leaves had been produced by small bulblets that had formed at the point where the basal stem had been broken off. These bulblets were of recent formation and it appears that the original bulb had been broken off and grazed early in the growing season.

Fire has the effect of completely clearing the habitat of grass and eliminating the disruptive camouflage which it provides. The *L. viscosa* leaves are, therefore, very easy to see the first season after a fire. At this time they are highly susceptible to predation.

We found that we located twice the number of bulbs at the burned colony in less than a quarter of the time it took to locate bulbs at the colony with a good grass cover. Whilst we were specifically engaged in applied research on these plants and therefore more likely to find bulbs, we were surprised at how conspicuous the plants were and how easy they proved to locate.

While burrowing animals are looking for bulbs to eat, cattle and large herbivores are responsible for trampling the plants, damaging and destroying seedlings as well as the leaves and inflorescences of mature plants. At both colonies studied cattle ranching is the main land use. The land was not heavily stocked and the veld lightly grazed. Despite this, all *L. viscosa* leaves in the areas where cattle had been grazing were damaged. In some cases leaves had been completely broken off and in others reduced to small stumps.

Only two seedlings were observed at one of the two Matlabas colonies and very few young plants. It appears that this species is particularly vulnerable to trampling, which destroys its vegetative parts and prevents the development of seedlings. In addition, the species flowers erratically and does not produce the abundance of seed found in most *Ledebouria* species.

Fire plays a significant role in *L. viscosa* ecology, clearing the habitat of large accumulations of moribund grass and thus creating room for the plants to grow under optimal conditions for several years afterwards. The first season after a fire the bulbs are exposed to predation and unlikely to flower. In subsequent years a thicker grass cover makes the plants less visible to predators and also creates semi-shaded conditions conducive to the germination of seedlings and development of young plants.

THE VISCOSITY OF *LEDEBOURIA VISCOSA* FOLIAGE

When Jessop described *L. viscosa* he made the significant observation that, although collection records and herbarium specimens indicated large numbers of sand particles clinging to the leaves, the foliage itself was not sticky to the touch (Jessop, 1970:264).

Jessop pondered whether the foliage was sticky at a certain time of the year or whether the phenomenon was a characteristic of the

sand rather than the plants. Our preliminary observations indicated that plants growing in tufts of grass, or among grass that had long since been burned, had little or no sand adhering to the leaves. (The grass cover was too thick to permit sand to be splashed onto the leaves during thundershowers.) All plants growing out in the open, however, had leaves coated in sand particles, so uniformly that their surface resembled fine sandpaper. It seems probable that exposure to direct sunlight promotes the viscous secretion on the leaves and in strong sunlight even new foliage is likely to produce viscosity. The few newly emerged leaves that were observed on plants towards the end of the growth cycle (the end of March and the beginning of April) all had a dense layer of sand particles adhering to the leaves. This may well be a device to render the leaves, especially those in the open, both less conspicuous and more unpalatable to grazing animals and insects.

A PRELIMINARY NOTE ON REPRODUCTION

The observations recorded below represent preliminary findings as a study on the reproduction of *L. viscosa*. This study will need to be conducted over a timespan of several years. We intend to carry out this research and publish it in due course.

Venter (1993:125) records the flowering season as January to April with most plants flowering during March and April. At the time our data was collected (31 March and 2 April), four plants out of approximately 250 had flowered. No developing flower buds were observed on any of the other plants. It is probable that in some years flowering is poor; this is likely to add to the difficulties associated with low recruitment of new individuals to a population.

Ledebouria viscosa either grows singly or in small compact groups of 2-4 plants about 1-4cm apart. These groups appear to have originated from seeds which germinated around the base of a parent plant. Evidence in support of this was found in the case of two seeds which had germinated about 1cm from a large bulb. In some cases these compact groups form larger scattered colonies.

DORMANCY

Plants start to go dormant in late March and early April, promoted by hot dry weather in early autumn. The dry leaves persist until they become detached from the parent bulb at the surface of the soil. One plant in a closely placed group of 2-3 specimens can goes dormant well before others which have tough erect leaves.

HABITAT DEGRADATION

A large proportion of *L. viscosa* habitat east of Thabazimbi has

been over-grazed and burned too frequently. This has resulted in dense stands of aggressive opportunistic species such as the sickle bush, *Dichrostachys cinerea*, and the formation of areas devoid of grass. Barrren compacted areas of soil are visible in several areas. In addition to these pressures large tracts of land have been cleared for crop production. The extent to which this has taken place is most readily observed from the plateaux at the top of the Bakkerspas in the Waterberg, looking back towards Thabazimbi.

Much of the existing potential *L. viscosa* habitat is not used for game ranching but unfortunately the changed land usage has come about after the habitat was already damaged. *Ledebouria viscosa* is likely now only to exist in isolated patches of suitable habitat which are considered marginal for cattle grazing. It is evident that the species is rare and unevenly scattered over its distribution range but this aspect needs to be surveyed and assessed more accurately.

REFERENCE:

Venter, S. 1993. A revision of the genus *Ledebouria* (Hyacinthaceae) in South Africa. :251 M.Sc. thesis, University of Natal, Pietermaritzburg.

The areas of sandy and grassy *Terminalia sericea* veld in the plains northwest of the Kransberg are typcal *Ledebouria viscosa* habitat.

A closeup of the viscid sand-covered leaves of *Ledebouria viscosa*. Notice how the leaf surfaces resemble fine sandpaper.

Photos: Laurian Brown

LEDEBOURIA GALPINII VENTER, A RARE MOUNTAIN TOP MIST-BELT SPECIES

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The South African *Ledebouria* species have recently been thoroughly revised in an interesting and informative M.Sc. thesis by Stephanus Venter submitted to the University of Natal Botany Department in 1993. During the course of this work Venter drew attention to the very small distribution ranges of several *Ledebouria* species occupying mist-belt niches on the escarpment mountains in Mpumalanga. *Ledebouria galpinii* is one of these species and this paper is a presentation of the ecological research data collected mainly during the 1997-1998 growing season.

Mist-belt *Ledebouria* species have a number of interesting characteristics. They grow in shallow sandy soil which is frequently saturated for many weeks on end during the summer growing season, from October to April. The winters are dry but the bulbs obtain some moisture from heavy dew, melted frost, and mist which is sometimes so dense that it falls as soft penetrating rain.

Flowering and seeding take place either just before or during the main rainfall months. Seeds are generally fertile, germinate quickly, and produce young bulbs in a remarkably short time.

HABITAT AT KAAPSEHOOP

Kaapsehoop is a small village on Kaapsehoop Mountain in eastern Mpumalanga to the southwest of Nelspruit. The entire area is afforested with exotic pines, except for Kaapsehoop Mountain itself. Kaapsehoop is becoming a popular holiday destination and new homes presently are being constructed on most of the areas occupied by the largest *L. galpinii* colonies. Formerly large colonies are now overrun and being smothered by Kikuyu grass (an introduced exotic) and periodically trampled by a herd of feral horses which now run wild in the area. The area is also widely used by hikers who inadvertently do some damage by trampling bulbs near the main hiking paths.

As a result of development and the introduction of alien vegetation the species currently occupies rocky outcrops on Kaapsehoop Mountain where it is inaccessible to trampling by people and horses

and open sandy patches between rock outcrops, areas rarely accessible to horses, and not within the vicinity of the hiking trail.

In years past, the main habitat comprised only sandy patches with a covering of short grass that was burned in winter grass fires every few years. A search was conducted on mountain tops adjacent to Kaapsehoop Mountain. Little of this species' habitat, remains unforested by exotic pines, however, and no further colonies of the species were located.

Ledebouria galpinii has not been recorded anywhere other than Kaapsehoop. If the present adverse pressures continue to operate on the populations the species is likely to be extinct within the next two decades.

THE SPRING AND SUMMER GROWING SEASON

Ledebouria galpinii is one of the earliest *Ledebouria* species to emerge from dormancy in the warm spring weather at the end of September. Flowers are produced well before the leaves are fully developed and some specimens come into flower as the leaves begin to emerge from the sand. Other associated bulbous and caudiciform flora mostly emerges from dormancy much later than *L. galpinii,* for example *Brachystelma bruceae* which starts to emerge about mid-October.

The species starts to seed in the second half of October and the season's inflorescences have usually withered by the beginning of November.

Ledebouria galpinii requires an open exposed situation to flower well. Plants covered by dense moribund grass do not generally flower until the habitat has been cleared by fires. Grass fires used to occur at least once every two years on Kaapsehoop Mountain. They now take place mainly on the mountain top furthest away from the new houses, where the fewest *Ledebouria* are to be found. The area around the houses is likely to be burned less and less owing to the danger to which this exposes residents' properties. Eventually these remaining populations will probably cease flowering altogether covered either in thick dead grass or weeds.

Seeds of *L. galpinii* are distributed by rainfall. Where habitat is cleared by fire the previous season, seeds are evenly distributed within a range of up to three metres from the parent plants. Seeds germinate very rapidly in about 7–14 days and the developmental stage of the young bulbs is short. Many young bulbs get trampled by the herd of feral horses. Those which manage to survive usually germinate at the sides of small pebbles, grass tufts or under the

leaves of clusters of mature *L. galpinii.*

Ledebouria galpinii habitat remains permanently moist in the summer from November until well into May, during seasons of normal rainfall. During the later summer months some of the season's young bulbs rot if they are in situations exposed to continual and prolonged moisture. This process, coupled to a high level of habitat disturbance by the grazing horses, ensures that few young plants are recruited to the population each year.

Populations in crevices on rocky outcrops flower and seed well, but little seed manages to find a suitable niche in which to germinate.

Bulbs start to go dormant in the first half of March, particularly if the weather has been hot and dry. Most bulbs in the colonies, however, enter dormancy during late April and early May when temperatures cool.

A COMPARISON BETWEEN THE ECOLOGY AND HABITATS OF *LEDEBOURIA GALPINII* AND *LEDEBOURIA RUPESTRIS*

Another remarkable and attractive *Ledebouria* with a small distribution range is *L. rupestris.* Formally described as *Scilla rupestris* in 1941, the species is clearly and correctly placed in *Ledebouria* as indicated by Venter (Venter 1993: 147).

Ledebouria rupestris is found within the vicinity of Mac Mac Falls on the escarpment near Graskop in Mpumalanga. The species grows in similar habitat to *L. galpinii* in short grassland amongst low rock outcrops. Unlike the habitat of *L. galpinii*, that of *L. rupestris* is relatively undisturbed, except for one narrow hiking trail path at Mac Mac Falls.

Plants throng shallow soil pockets and rock crevices, flowering and seeding well after the habitat has been cleared by grass fires. Numerous seedlings are found in December and January, some even establishing in mats of dense moss and *Selaginella* clumps.

Excess seedlings in damp places rot or else shrivel if there are dry spells and the seeds have germinated in very shallow soil or on sheets of exposed rock. Fire, too, eliminates clumps of seedlings that have become established in grass tufts. Overall, nearly all suitable niches in the very specific restricted habitat of this species are colonised by the plants. Development within the vicinity of Mac Mac Falls would pose a serious threat to the existence of this interesting dwarf species.

The present status of *L. rupestris* is probably comparable to that enjoyed by *L. galpinii* at Kaapsehoop in previous times. An examination of these plants indicates the probable abundance of

Habitat degradation at Kaapsehoop. Nearly all the *L. galpinii* habitat has been destroyed by extensive invasion of alien Kikuyu grass.

Ledebouria galpinii in an open grassy patch at Kaapsehoop. The grass cover had not been burned at this site the previous winter. Only plants in open areas are in flower.

Ledebouria galpinii in a rock fissure at Kaapsehoop. In most places the plants are now confined to these sites protected from fires, trampling and grazing. This is, however, the least typical natural niche occupied by these plants and has been brought about by habitat degradation.

Ledebouria galpinii in flower among moss at Kaapsehoop.

Photos: Andrew Hankey, Witwatersrand National Botanical Garden, taken in mid-flowering season, 20 September 1997.

CONSERVATION OF *LEDEBOURIA GALPINII*

Present indications are that *L. galpinii* is an endangered species. The situation could be reversed by paying attention to the conservation of Kaapsehoop Mountain. The most viable populations on the mountain could be fenced and those situated on land zoned for development or swamped by Kikuyu grass moved to the conserved areas. This could all be achieved with minimal effort and expense.

Provided that the conserved grassland could be burned every few years the species could be expected to re-establish strong and viable colonies in as little as a few years. The niche occupied by *L. galpinii* is not met by conditions in the Lowveld Botanic Garden and, unfortunately, the only feasible conservation measure will have to be carried out on Kaapsehoop Mountain.

CULTIVATION AND PROPAGATION

Ledebouria galpinii is one of South Africa's most attractive bulbous plants and makes a very interesting pot subject. It is easily grown from seeds and the young bulbs develop quickly.

It has not yet been established whether or not pollination in cultivation is comparable with that of plants in the field.

Plants thrive in peaty sandy soil and may be grown in either asbestos, earthenware or plastic containers. The soil should be kept moist throughout the summer growing season and the bulbs watered occasionally during the morning on winter days. This species, like most *Ledebouria* species, likes plenty of free air circulation in order to thrive. Ideally, it should be grown outside in a position of only morning sunlight. Some young bulbs tend to rot in the late summer if exposed to excessive moisture and this characteristic parallels that found in natural habitat.

ACKNOWLEDGEMENT

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LEDEBOURIA ATROBRUNNEA S. VENTER, A NEW SPECIES FROM THE WESTERN MAGALIESBERG IN SOUTH AFRICA'S NORTH WEST PROVINCE

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Ledebouria atrobrunnea is one of Mr. Stephanus Venter's remarkable discoveries, made during field research for his M.Sc. (Venter, 1993). Erect foliage in *Ledebouria* is shared by only a few species, two of which Venter discovered during his research (*L. atrobrunnea* and *L. dolomiticola*, Venter, 1998) Another species, *L. viscosa*, is found in Thabazimbi, North West Province (see page 49).

Ledebouria atro-brunnea, L. dolomiticola and *L. viscosa* are all known from small distribution ranges, with that of *L. atro-brunnea* probably the smallest of the three. The species is presently known from a restricted area of about 10 square kilometres in the western foothills of the Magaliesberg. The area comprises stony hills with *Protea caffra* and *Faurea saligna* woodland interspersed with short grass. The habitat is frequently burned in grass fires during autumn, winter and spring, from April until early October. This particular species has developed some singular adaptations to resist burning which are discussed here.

THE STUDY AREA

The study area consists of east-facing stony hillsides close to the type locality. The vicinity comprises small holdings and farms as well as several country hotels. The study area is not used for any farming activities and the only grazing animals occasionally present are small antelope species and rock hyrax. Some cattle are kept on surrounding properties and moderate grazing by domestic stock occurs throughout the distribution range.

Grass fires are frequent in the study area, usually occurring about once every two years. In seasons when the rainfall is above average, the grass cover is often sufficiently dense to burn in fires the following winter. This results in periodic annual fires for a few years in succession.

The colonies were studied towards the end of the growing season in late March and early April 1998. A severe fire had thoroughly burned the habitat the previous winter and this provided excellent opportunities for observations concerning the effects of fire on the two populations.

One population in an area of about 100 square meters consisted of small gracile plants, mainly tightly wedged into rock crevices or else growing among small aggregations of stones. A few plants occurred in dense groups of 3-12 or more individuals closely packed together in open sandy and grassy patches between rocks. The area in which this colony is situated consists of gentle east-sloping rocky ridges.

The second population largely comprises tightly packed groups of large bulbs in shallow sandy soil between rocks. This habitat consisted of steep east facing rocky slopes. In both populations some plants grew in cracks in almost pure rock. The bulbs in these situations were well protected from grazing animals by a thick mass of hard, tightly packed old bulb scales.

On the lower slopes, below the second population, a large colony of *Aloe peglerae* grows. The *Ledebouria* was not encountered growing with these plants as the grass cover becomes too dense here between grass fires for the establishment of seedlings.

THE ROLE OF FIRE IN THE ECOLOGY OF *L. ATROBRUNNEA*

Grass fires are common in the summer rainfall areas during the dry winter months. In most *Ledebouria* habitats fires are responsible for clearing the grassland of moribund vegetation, promoting vigorous growth of the plants in the summer after the fire. A clear, open habitat is also necessary for the germination of *Ledebouria* seeds as well as their distribution by water runnoff after thunderstorms.

Very few *Ledebouria* species are epigeal or semi-epigeal; two which have this habit are *L. atrobrunnea* and *L. dolomiticola*. The neck of the *L. atrobrunnea* bulb is partly exposed above ground and consists of a tightly packed mass of old hard bulb scales. These bulb scales ignite readily in grassfires, with variable results, discussed below.

When *L. atrobrunnea* grows in tighly packed groups fire only burns the uppermost exposed bulb scales. Plants growing in rock crevices escape burning and consequently often occupy the entire growing space in the rock crevice. Plants in more open habitats, such as in sandy soil among small stones or low tufts of grass frequently have rather loosely arranged bulb scales. These bulbs generally burn right down to the basal plate. Such burned plants regenerate themselves by producing bulblets from the basal plate at the beginning of the following summer. Bulbs which get burned produce 1-5 bulblets which form a small tightly packed clump. Over a few years this expands into dense larger clumps which are capable of resisting a hot burn during grass fires.

Typical *Ledebouria atrobrunnea* habitat at the western end of the Magaliesberg.

The rocky habitat of *L. atrobrunnea* which it shares with *Boophane disticha* and *Xerophyta retinervis*.

Large and small mature bulbs of *L. atrobrunnea* displaying the very hard scales which protect them against both fire and grazing.

Photos: Laurian Brown

Ledebouria atrobrunnea growing adjacent to rocks and grass tufts. Thorough burning has taken place the previous winter but the bulbs were protected by their layers of hard dry bulb scales.

Fire promotes growth and flowering of *L. atrobrunnea*, as well as its flowering in the following spring and summer. The seed set is high and many seedling plants are evident.

Observations in late March 1998, after the habitat had been thoroughly burned the previous winter, indicated an interesting distribution of seedlings. In most instances seeds had germinated around the parent plants, often around the perimeter of tightly packed groups. Few seedlings had taken root in rock crack populations, since the niches were already fully occupied by mature plants. Some groups of 2-10 or more seedlings had germinated in open sandy areas around grass tufts and stones. Where such groups were tightly aggregated they would be more likely to survive burning in subsequent winter grass fires.

Very few young plants were observed; those that were, occupied rock cracks or else were growing around or among mature bulbs. It seems probable that large numbers of seedlings are destroyed by fire.

Venter (1993:119) remarks that the very hard dead bulb scales possibly act as a deterrent to grazing animals. No grazed bulbs were observed in the study area, but this is likely to be related to the fact that there are hardly any grazing animals, as well as an absence of livestock. In addition to the defence afforded by the hard bulb scales the leaves may also be unpalatable.

HABITAT COMPARISON—*L. ATROBRUNNEA* AND *L. DOLOMITICOLA*

At the time Stephanus Venter researched his M.Sc. thesis, *L. dolomiticola* was known only from one dolomite mountain slope in the Strydpoort mountains near Pietersburg in the Northern Province. It has since been found at two other sites in equivalent habitat on dolomite mountains in the general district.

This unusual species grows on dolomite rocks in small fissures in the porous substrate. This habitat, with bulbs fully exposed, is rare in *Ledebouria*. It characterises one other rare species confined to cliff faces on the mountain gorges east of Barberton in Mpumulanga. This recently discovered *Ledebouria* is still to be described as *L. cremnophylla* and is one of several species discovered by Stephanus Venter since completing his thesis research.

These species escape burning by growing on rocks where fire cannot reach. *Ledebouria dolomiticola* is, however, vulnerable to grazing as well as predation by baboons—during a visit in early April, 1998, to the type locality of this latter species in the company of Stephanus Venter, several bulbs were found that had been broken off the rocks and the contents sucked out, probably by baboons. In other instances bulbs had been bitten in half and the upper parts

eaten. A close examination of the clumps revealed that many were comprised of bulblets which had regenerated from the basal plate in response to grazing.

Ledebouria dolomiticola are cryptically coloured plants, the papery grey covering of the bulbs nearly matching the lichen-blotched rocks on which they occur. This makes them less visible to predators.

Bulbs of *L. dolomiticola* are readily burned in fires that sweep up the Strydpoort Mountains in the dry winter months. Bulbs in the open usually are destroyed unless wedged among stones where the fire cannot reach.

Ledebouria atrobrunnea is able to occupy more niches than *L. dolomiticola.* However, the heavily wooded habitat of the latter is burnt at less frequent intervals than the predominantly grassy habitat occupied by *L. atrobrunnea.*

LEDEBOURIA ATROBRUNNEA IN A MODERN ENVIRONMENT

The Magaliesberg is a popular recreation area for South Africa's most populous province, Gauteng. *Ledebouria atrobrunnea* is probably protected in the long term from any serious habitat destruction, as it is part of a general conservation area. There are also several private nature reserves in the region.

The most significant threat probably lies in over-grazing coupled with too frequent burning. *Ledebouria atrobrunnea* is clearly well adapted to withstand fire damage, but habitat degradation, particularly erosion and trampling by livestock, would cause its numbers to decline. The known distribution of *Ledebouria atro-brunnea* is very small and consequently careful note should be taken of any significant habitat changes.

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STUDIES ON THE GROWTH CYCLE AND FLOWERING CONTROL OF *LEUCOCORYNE COQUIMBENSIS* F. PHIL.

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BOTANICAL CLASSIFICATON

The genus name is derived from the Greek *leukos*, meaning white, and *koryne*, a club, an allusion to the sterile anthers. This genus belongs to the Alliaceae family and the common name is Glory of the Sun, because they perform best where sunlight is profuse (Bryan, 1989; Harrison, 1971).

According to Zöllner (1972), there are some twelve species, all native to Chile. Only nine are worthy of mention, the others being little known. *Leucocoryne ixioides* is the most common species in cultivation and can be found in many of the better bulb catalogues. The height of the plants varies between 25-30cm. The leaves are narrow and grasslike, up to 30cm long. Flower color is variable but always in the white to pale blue-purplish range; the sterile stamens are white (Berger, 1936; Crosa, 1988; Huxley, 1992; James, 1937; Kroon, 1986, 1989; Mathew, 1978; Morley, 1970; Uphof, 1945; Van de Meer, 1993, Van Leeuwen, 1991, 1992).

The grasslike foliage of *L.*

Photo: Nitta Emiko

Figure 1. Cut flowers of *Leucocoryne coquimbensis.*

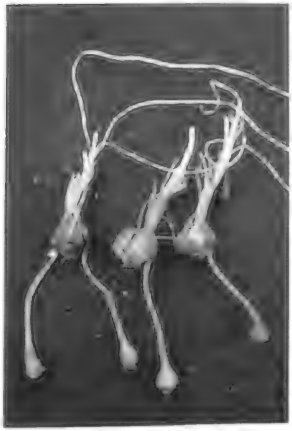

Photo: Yukinori Fukazawa

Figure 2. Droppers of *Leucocoryne coquimbensis.*

Photo: Kiyoshi Ohkawa

Figure 3. *Leucocoryne coquimbensis* in habitat in central Chile.

coquimbensis, up to 25cm long, clothes the lower part of the flower spike. The sweetly fragant flowers, up to eight per umbel, are carried on stalks that are about 40cm high. Flower color is variable, from very pale shades of blue and violet to darker, stronger shades (Fig. 1). The lower part of the petals form a narrow tube, some 1.3cm long, from which they flare out to form flowers 2.5cm in diameter. The sterile stamens are a good yellow. In some cases, *L. coquimbensis* bulbs form droppers (Fig. 2).

DISTRIBUTION

According to Hoffmann (1989), *L. coquimbensis* grows naturally around Coquimbo in the IV region of Chile, from which the species name derived, and Valparaiso and Aconcagua in the V region of Chile (Fig. 3).

Central Chile (latitude 28–37°S) has an exceptionally privileged climate for the existence of bulbous plants. After a short, rainy winter that is not very cold, there follows a long drought without rainfall for 7–10 months. In spring the slopes and lanes are covered with multicolored flowers. Some areas are covered with red flowering bulbous plants, others with yellow or white. These plants belong to different genera, such as *Rhodophiala, Hippeastrum, Phycella, Pabellonia, Placea* and *Alstroemeria* (Arriagada and Zollner, 1994-95).

GROWTH AND FLOWERING

The effects of storage temperature on flower bud development, emergence and flowering were investigated under protected conditions in Japan by Ohkawa *et al.* (1998). Bulbs were lifted in July, stored at 0, 5, 10, 15, 20, 25 or 30°C and then replanted in November. With temperatures of 20°C or higher for a finite period, dormancy was broken. The most effective temperature for storage was 20°C while 25 and 30°C were less effective. The first flower stem in the bulb developed with 20 to 25°C storage temperatures, but did not develop at 30°C. Bulbs stored at this high temperature developed abnormally, probably because of the subsequent much lower planting temperatures. Bulbs stored at ≤15°C appeared to be dormant as emergence was considerably delayed (Table 1). The loss of dormancy in these bulbs probably occurred in the greenhouse while the greenhouse temperatures rose above 20°C.

The growing period of *L. coquimbensis* is short with flower development beginning at the start of the rainy season so that flowering is over as soon as possible after emergence. Furthermore, bulb dormancy begins at the initiation stage of the bud to avoid or survive unfavorable conditions. Also, flower buds which have already formed stamens or a pistil tend to abort during storage. Therefore it appears that at the time of lifting the first flower bud which had

already formed a pistil aborts during storage, but the second flower stem begins development (Table 2). In *L. coquimbensis*, a flower bud is formed after two scales are produced (K. Ohkawa, unpublished).

Bulb size is the major and easily measured factor that determines the capacity to flower. The critical size is genus or species dependent (Le Nard and De Hertogh, 1993). Effects of bulb weight on growth and flowering were studied by Kim *et al.* (1996). With *L. coquimbensis*, small bulbs (0.1–0.2g) could flower, however, larger bulbs (> 0.3g) are required to produce good quality cut flowers.

During one growing season, 0.1–0.2g bulbs grew to larger than 1.0g bulbs, which will be able to produce high quality cut flowers in the subsequent season. The critical size can also vary with cultivar and environmental conditions (Hartsema, 1961). With an early planting, favorable growing conditions, and low competition, it might be possible for smaller bulbs to produce high quality cut flowers in the first growing season.

FLOWERING CONTROL

In warm areas of Japan, the air temperature rises rapidly in May and the leaves of *L. coquimbensis* wilt and die rapidly. At this point bulbs are dormant. After lifting, bulbs are stored at 20 °C and then planted in October or November when dormancy is broken. Flowering begins in mid-March. However, when bulbs were stored for 2 weeks at 15 °C after 20 °C storage, flowering commenced after planting one month earlier than usual. Pre-plant storage temperatures of 5–10 °C for 2 weeks also advanced flowering, however, the number of flower stems per bulb was reduced. After planting, the development of the flower buds was rapid following this short cool storage period and the period until flower stem emergence from the bulb was reduced (Ohkawa *et al.*, 1998).

Because of climatic conditions in Japan, the earliest flowering after pre-plant storage treatments is mid-February. For flowering prior to mid-February, bulbs need treatments which retard development. Ohkawa *et al.* (1998) also reported that the first flower stems of bulbs stored at 20 °C abort when stored more than 11 months by which time the second flower bud development is initiated. In its natural habitat, sometimes there is no rain from April to October. In that situation *L. coquimbensis* becomes dormant before the beginning of the dry season, the first flower stem aborts and the second flower stem starts to develop. This development is halted when the flower buds are at the growing point division to outer perianth formation stage.

With monthly planting forcing was possible at 20 °C storage (Table 3 and Fig. 4). When bulbs are lifted one year before planting in May or June, plants will bloom in November. When bulbs are

planted in July or August, flowering will occur in December. However, the period from planting to emergence or flowering will be delayed and the number of the stems per bulb will be less. If abortion of the first flower stem can be delayed, it would be commercially feasible to plant bulbs in September or October and make them bloom from November to January.

For the production of flowers for the desired fall marketing season in Japan, long-term storage (13 or 14 months total storage) of bulbs was assessed by Kim *et al.* (1998). When bulbs were stored at 20°C after initial storage at 5, 10 and 20°C (3 or 4 months initial storage), no bulbs flowered by January and long term storage at 20°C caused the first flower stem to abort and the second flower bud to be initiated. In contrast to bulbs that were stored at 25°C for 13 months, the aerial parts of bulbs stored at 25°C for 14 months aborted after emergence (Table 4). Consequently, maximum storage life at 25°C is 13 months. The first flower stem aborted when bulbs were stored at 25°C for more than 14 months, by which time the second flower bud was initiated. Further research is required to determine why the aerial parts of bulbs that were stored at 25°C for 14 months, and then planted, aborted after emergence.

The flower quality from bulbs stored at 25°C for 13 months was as good as from bulbs stored at 5 or 10°C for 2 months prior to 11 months storage at 25°C.

These results suggest that *L. coquimbensis* bulbs should be planted in August for fall flowering after storage at 25°C for 13 months. However, high ambient temperatures can adversely affect flower bud development (Ohkawa *et al.*, 1998). All bulbs that were planted in August and grown for a month in growth chambers at cooler temperatures flowered, whereas only 50-60% of bulbs planted in September and grown in a warm glasshouse flowered. The high ambient temperatures apparently inhibited the initial growth of *L. coquimbensis*. Therefore, *L. coquimbensis* bulbs need to be planted in cool regions during the hot season, as growth is poor in warm regions following an early September planting. In conclusion, it is feasible to force *L. coquimbensis* for early fall flowering as long as high temperatures are avoided after planting.

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Table 1. Effects of storage temperature on emergence, flowering and flower quality in *Leucocoryne coquimbensis* (Ohkawa *et al*, 1998).

Storage temperature (°C)	Emergence			Flowering[z]			Stem length (cm)	Stem Weight (g)	No of florets	No. of flower stems per bulb
	%	Date	Days	%	Date	Days[y]				
0	50	15 Feb	89 (66)[x]							
5	88	27 Mar	130 (30)							
10	100	5 May	169 (34)							
15	100	10 Apr	144 (42)							
20	100	3 Dec.	15 (7)	100	2 Mar	91 (13)	39.2 (4.3)	3.2 (0.7)	8.0 (1.2)	3.4 (0.7)
25	100	13 Dec	25 (6)	100	29 Mar.	107 (19)	49.1 (5.3)	4.1 (0.8)	8.6 (3.1)	3.5 (1.1)
30	100	26 Dec	38 (7)	100	13 Apr.	109 (8)	41.7 (4.8)	3.1 (0.7)	6.9 (1.2)	3.3 (0.9)

z: Flowering of the first flower stem floret.

6: Days from emergence to flowering.

x: Standard deviation.

Table 2. Flower bud initiation and development of the first, second and third flower stem florets during dry storage and growing period in *Leucocoryne coquimbensis*. Bulbs were lifted on 1 June, stored at 20°C until 1 Oct. when they were planted; 10 bulbs were dissected at each sample date (Ohkawa et al., 1998).

Month	Flower stem	No. of bulbs at each stage of flower bud development[z]											
		A	B	C	D	E	F	G	H	I	J	K	L
June	1st3		1	3	2	1	1	1	1				
(lifting)	2nd	6	3	1									
	3rd	10											
July	1st		2	3	2	1	1	1					
	2nd	6	3	1									
	3rd	10											
Aug.	1st		2	2	3	2	1						
	2nd	6	3	1									
	3rd	10											
Sept.	1st		1	7	1			1					
	2nd	6	3	1									
	3rd	10											
Oct.	1st				3	1	3	2	1				
(planting)	2nd	4	3	2	1								
	3rd	10											
Nov.	1st						2	1	5	2			
	2nd	1	2	4	1		1	1					
	3rd	8	1	1									
Dec.	1st									2	2	6	
	2nd					2	2	4	2				
	3rd	6	2	1	1								
Jan.	1st										2	8	
	2nd								1	3	6		
	3rd		1	2	1	1	1	1	2		1		
Feb.	1st											10	
	2nd									1	7	2	
	3rd			1	2		1	1		4	1		
Mar.	1st												10
	2nd										4	6	
	3rd			1	2					2	5		
Apr.	1st												
	2nd												10
	3rd									5	3		
	wilt[y]											2	
May	1st												
	2nd												
	3rd												6
	wilt												4

[z]: A. No. differentiation; B. Domed apex; C. Trilocular apex; D. Outer perianth initiation; E. Inner perianth initiation; F. Staminode initiation; G. Androecium initation; H. Gynoecium initiation; I. Anther and ovule initiation; J. Flower stem development in the bulb; K. Flower stem emergence from the bulb; L. Anthesis.

[y]: Aborted flower bud or stems which developed or elongated in the bulb.

Table 3. Effects of dry storage duration at 20°C on growth and flowering in *Leucocoryne coquimbensis* (Ohkawa et al., 1998).

Planting on th	Dry storage duration (months)	Emergence		Flowering[z]		No. of flower stems per bulb
		%	Date	%	Date	
August	3	80	5 Nov	70	10 Mar	3.0 (0.8)[y]
September	4	100	15 Nov	100	3 Mar	3.5 (1.0)
October	5	100	19 Nov	100	10 Mar	3.3 (1.2)
November	6	100	3 Dec	100	12 Mar	2.7 (0.7)
December	7	100	6 Jan	100	8 Apr	3.3 (1.6)
January	8	100	6 Feb	100	16 Apr	2.8 (1.3)
February	9	100	6 Mar	100	28 Apr	2.9 (1.4)
March	10	100	5 Arp	100	20 May	2.6 (1.3)
April	11	100	6 May	90	11 Jun	2.6 (0.5)
May	12	88	22 Sep	63	19 Nov	1.8 (0.8)
June	13	75	24 Aug	75	19 Nov	2.5 (0.8)
July	14	88	16 Sep	75	13 Dec	2.5 (1.4)
Aug.	15	75	30 Sep	75	29 Dec	1.8 (0.8)
Sep.	16	88	19 Oct	38	25 Jan	1.0 (0.0)

[z]: Flowering of the first flower stem floret.
[y]: Standard deviation.

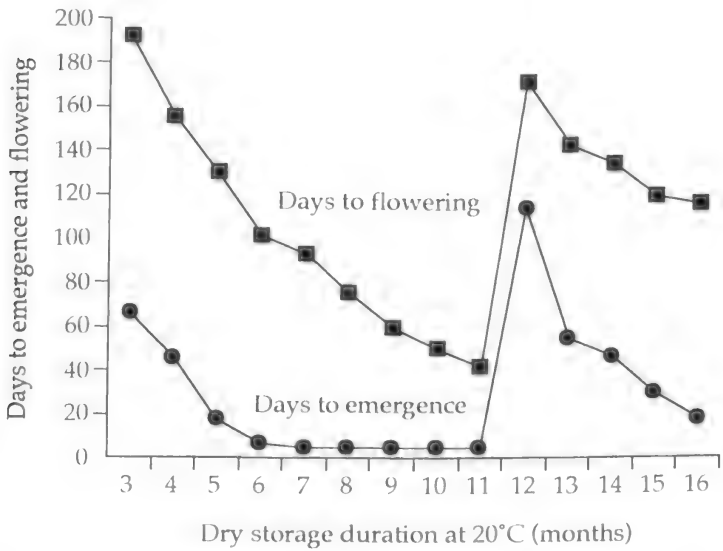

Figure 4. Effects of dry storage duration at 20°C on days to emergence and flowering in *Leucocoryne coquimbensis* (Ohkawa *et al.*, 1998).

CULTURAL SUGGESTIONS FOR *HIPPEASTRUM* SPECIES INCLUDING SPECIES CROSSES GROWN IN CONTAINERS IN A GREENHOUSE

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1. A greenhouse is preferred for most *Hippeastrum* species because temperature may be controlled, moisture can be conserved, ultraviolet rays from the sun may be reduced, and insects and diseases are more easily managed or eliminated.

2. As much sun as possible is needed by most *Hippeastrum* species. An entire day of sun is generally not too much. All *Hippeastrum* species were originally from Central and South America with some being found growing in hot desert regions. There are exceptions, however, to the amount of sunshine and heat as some species prefer a little shade but seldom complete shade. [In the deep southeast, U.S.A., 30% shade is required for success.]

3. The temperature should be controlled so that it does not drop lower than 50 F with 55-60 F being ideal. High temperatures require little control as most *Hippeastrum* species can stand 100 F and even higher with no detrimental effect. An exhaust fan or fans for good air flow, ventilation, circulation and/or air exchange is necessary.

4. Potting mix or growing medium: Excellent drainage is a must. Coarse sand, calcined clay, lightweight aggregate, expanded gravel, and/or "Haydite" should be used in the medium, unless another suitable and/or equal substiture can be found.

The following is the potting mix that I recommend:
20% perlite (coarse grade).
30% sand (coarse grade—not finer than 30-mesh).
30% light weight aggregate (or a material which is coarser than the sand being used).
20% vermiculate (coarse grade) (or 10% peat moss and 10% vermiculate, depending on the *Hippeastrum* species).
To this mix add enough dolomite lime to reach a pH of 7.0 (usually ½ to 1 teaspoon to a gallon of the above mix).

Note: This mix may require more frequent watering and/or fertilizing especially when the temperature is high or when the humidity is low causing rapid evaporation, but this medium minimizes or prevents bulb and/or root rot. Adjustments to the mix may or should be made depending on the *Hippeastrum* species and climatic conditions.

5. Potting: Clay or plastic pots are usually used in potting *Hippeastrum*. Each type of pot has advantages and disadvantages. Black plastic "nursery pots" with at least four or five drainage holes in the bottom are quite useful in helping to insure good drainage and also in conserving moisture. The pot size should be decided by considering the size of the bulb when mature, as well as the *Hippeastrum* species or hybrid being potted. The mature bulbs of some species are small, e.g. *H. traubii*, while the bulbs of some species are quite large, e.g. *H. aulicum*. If more than one bulb is being planted in the same container, additional adjustments need to be made. Allow one or two inches (with two inches being preferred) of potting mix between the bulb(s) and the inside edge of the pot.

After selecting the proper container size, place one inch of gravel of a size which will not pass easily through the drainage holes in the bottom of the pot. This will assist in good drainage and will prevent the potting medium from being washed through the drain holes when the bulb is watered. Add about an inch of potting mix on top of the gravel and pack it down with your hand. If the bulb being planted has roots, place the bulb in the container and spread out the root system as evenly as possible. Begin adding potting medium around the roots while holding the neck of the bulb slightly above the top edge of the pot. **Important note**: At least one-half to two-thirds of the bulb should remain above the surface of the potting mixture upon completion of the potting process. Continue adding potting mix until it reaches the top of the container. Then, while holding the bulb at the proper planting height, push the mix down and around the roots and the bulb with the fingers. Allow at least an inch of clearance between the top edge of the pot and the surface of the potting mixture. Water and fertilize the potted bulb until liquid begins draining through the holes in the bottom of the pot. If the bulb being potted has no roots, fill the pot as described above and then scoop out a hole in the potting mix and set the bulb into the hole. Then firm up the planting medium around the bulb to hold it in place. Conclude once again by watering and fertilizing.

6. Watering and fertilizing: Constant fertilizing (with every watering) is used during the period of active leaf development—from March through October in southern Louisiana (U.S.D.A. Plant Hardiness Zone 8). From November through February plain water at a pH of 7.0 and aged for at least 24 hours (to eliminate chlorine, etc.) should be used. Deciduous (non-evergreen) *Hippeastrum* which require a dry or vernalization period receive no water or fertilizer from November through February. Fall/Winter blooming and growing *Hippeastrum* reverse this procedure, as they remain completely dry from May through September. Evergreen *Hippeastrum* are watered sparingly from November through February with just

enough water to keep the leaves green, but not enough water to keep the bulb producing leaves or in an active growth cycle.

Use only custom mixed water soluble fertilizer which avoids all ammonium (such as ammonium nitrite), to obtain about a 95% NITRATE form fertilizer (a non-ammoniacal form fertilizer), and to supply the necessary micro-nutrients, as well as macro-nutrients, is recommended.

A water soluble chemicals and fertilizing formula follows:

A. **Mono potassium phosphate** (KH_2PO_4) which contains 78ppm (parts per million) of phosphorus and 97ppm of potassium.

B. **Potassium nitrate** (KNO_3) which contains 30ppm of nitrogen and 83ppm of potassium.

C. **Magnesium sulfate** ($MgSO_4 \cdot 7H_2O$) (Epsom salts) which contains 17ppm of magnesium and 23ppm of sulfur.

D. **Calcium nitrate** ($Ca(NO_3)_2$ which contains 131ppm of nitrogen and 160ppm of calcium.

E. **Micro-nutrients** consisting of boron (B) 0.036%, copper (Cu) 0.006%, iron (Fe) 0.31%, manganese (Mn) 0.14%, molybdenum (Mo) 0.0012%, and zinc (Zn) 0.048%.

Note: This gives a total of: 161ppm of nitrogen (N), 78ppm of phosphorus (P), 180ppm of potassium (K), 160ppm of calcium (Ca), 17ppm of magnesium (Mg), 23ppm of sulfur, as well as the important inclusion of micro-nutrients.

MIXING A CONCENTRATED SOLUTION WITH THESE CHEMICALS:

a. Place the first three chemicals listed above as A, B, and C, into a one gallon light-proof container (such as an unused photographic solution container), using 166.4 grams of mono potassium phosphate, 110.08 grams of potassium nitrate, and 88.32 grams of magnesium sulfate. Then add enough distilled water to fill the container (distilled water, because all drinking water contains many chemicals/elements which may interact with the chemicals being used in the solution). Remember that this is now a concentrated solution so one-half to one ounce of this solution is added to a gallon of regular water that has been brought to a pH of 7.0 and will now become the fertilizer to be used on the plants with every watering.

b. In a second light-proof one gallon container place only 409.6 grams of calcium nitrate and fill the container with distilled water. (The calcium nitrate is kept separated from the other chemicals in order to prevent a chemical reaction, flocculation, occurrence, and self-destruction of the other chemicals used in "a." above.) This concentrated solution of calcium nitrate is mixed with the other chemicals just before it is to be used on the plants. Add one-half to one

fluid ounce of this second concentrated solution to the one gallon of fertilizing solution which was prepared in "a." above and will be used to feed the plants.

c. In a third light-proof one gallon container place 6.4 fluid ounces of "Golden Grow Micro-Gold" (a micro-nutrient concentrate) and fill the container with distilled water. Add one-half to one fluid ounce of this third solution to the one gallon of solution which was prepared in "a" and "b" above. Because of the difficulty in procurement of the chemicals for the micro-nutrient solution, the difficulty of mixing the extremely small amounts required, and perhaps the unavailability of suitable commercial concentrate, the micro-nutrients may be purchased in several sizes from a commercial source such as: Light Manufacturing Co., 1634 SE Brooklyn Street, Portland OR 97202 (phone 503-231-1582 or 800-669-5483).

This company also sells all chemicals listed in A, B, C, D, E, and a, b, c, above, in non-ammoniac nitrogen form fertilizer in premeasured packages or by the pound. This avoids the necessity of measuring by grams if the chemicals are purchased in the premeasured packages. Then, too, this company's three part fertilizer formula is similar to the one given above and is sold as: "Golden Grow Bloom 7-19-14". The chemicals are packaged in three premeasured separate parts, one of which is the micro-nutrients in concentrated liquid form. These are also mixed in three individual containers the same as described above.

Recall that three individual one gallon concentrated solutions have been mixed and may be used to create as many gallons of plant fertilizer as may be needed for one complete greenhouse watering. The concentrated solutions may be used to make from one gallon to 256 gallons, depending on whether one-half ounce or one ounce is used to fertilize the plants.

7. Diseases and insects: Prevention is the best remedy for both disease- and insect-free plants. Once a disease has started it is usually difficult or impossible to eradicate. Spraying regularly with a systemic fungicide such as one containing Benomyl® or Banrot® and a systemic insect control such as Orthene® 75S or Cygon® 2E, usually prevents and/or eliminates both fungi and insects. If the disease can be specifically identified, such as "red blotch" or "leaf-scorch", caused by the fungus *Stagnospora curtisii*, another fungicide such as Dithane® M-45 (a broad spectrum fungicide) seems to be more useful. For some diseases, such as mosaic, which is a viral disease, there is currently no known control or cure. Bulbs or plants so infested are best destroyed to prevent the virus from spreading to disease-free plants. These viruses (there are two) can be transmitted mechanically or by insects. If an insect (or insects) is prevalent in your area, it is best to identify them and use an explicit insecticide.

8. Most *Hippeastrum* (species or not) require that offsets be removed or the parent plant will gradually deteriorate. Other *Hippeastrum* species do not mind being pot-bound and will fill the pot with multiple bulbs that produce numerous blooming scapes in a single container, for example *H. evansiae*, *H. papilio* and (EA)E.

A TYPICAL *HIPPEASTRUM* SPECIES CULTURE AND CARE CALENDAR: (BASED ON USDA PLANT HARDINESS ZONE 8)

January—Check evergreen *Hippeastrum* species (see list of types which follows) for buds. Water evergreen plants sparingly and only when actually necessary (just enough to keep leaves from drying out, but not enough to encourage active growth).

February—Continue as in previous month. Stop watering and fertilizing *H. fosteri*.

March— Begin watering and fertilizing all *Hippeastrum* species (evergreen and deciduous—see listing of different types which follows) except those few which are mentioned for special requirements, such as autumn and/or winter blooming and growing plants.

April— Continue watering and fertilizing as in previous month. Start watering *H. aulicum* sparingly until the month of August.

May— Continue watering and fertilizing all *Hippeastrum* except those with special requirements. Stop watering and fertilizing *H. fuscum* and *H. macbridei* and other autumn/winter blooming and growing plants.

June— Continue watering and fertilizing all *Hippeastrum* except those with special requirements.

July— Start watering and fertilizing *H. fosteri*. Continue watering and fertilizing all *Hippeastrum* except those with special requirements.

August— Begin watering and fertilizing *H. aulicum*. Continue watering and fertilizing all *Hippeastrum* except those with special requirements.

September— Stop watering and fertilizing *H. immaculatum*, *H. parodii*, and *H. tucumanum*. Stop fertilizing ALL *Hippeastrum*, but continue using plain water with a pH of 7.0 for all *Hippeastrum* except those with special requirements.

October— Start watering and fertilizing *H. fuscum* and *H. macbridei* and other autumn/winter blooming and growing plants. Continue using plain water with a pH 7.0 on all *Hippeastrum* except those with special requirements.

November— Stop watering all deciduous *Hippeastrum*, including *H. cybister*, *H.* (EA)E, *H. traubii*, etc. Begin watering all evergreen species sparingly. Continue watering and fertilizing autumn/ winter blooming and growing plants.

December— Evergreen types should need very little water now to keep the leaves green but not growing actively. Continue to water and fertilize autumn/winter blooming and growing plants.

SOME *HIPPEASTRUM* SPECIES AND SPECIES CROSSES CLASSIFIED ACCORDING TO TYPE:

Evergreen Species

H. aglaiae
H. aulicum (all varieties) (autumn/winter blooming)
H. aviflorum
H. blumenavium
H. brasilianum
H. calyptratum
H. caupolicanense
H. corriensis (all varieties)
H. crociflorum
H. divijulianus
H. doraniae
H. escobaruriae
H. ferareyrae
H. forgettii
H. fragrantissimum
H. mandonii.
H. miniatum
H. morelianum
H. nelsonii
H. papilio
H. petiolatum
H. pseudopardinum
H. psittacinum (all varieties)
H. puniceum (all forms)
H. reginae
H. rubrapictum
H. striatum (all varieties)
H. vittatum (all varieties)
H. yungacensis
Doran's unidentified sp. No. 1307
Doran's unidentified sp. No. 1863

Evergreen Hybrids

Doran's *H. aglaiae* x *H. brasilianum*
Doran's (*H. doraniae* x *H. fragrantissimum*) x *H. brasilianum*
Doran's *H. parodii* x *H.* (EA)E x *H. parodii*
Meerow's *H. papilio* x *H. cardenasianum* x *H. lapacensis*
Nelson's *H.* (EA)E (*H. evansiae* x *H. aglaiae* x *H. evansiae*)

DECIDUOUS SPECIES

(NO WATER for several months and plants lose their leaves)

H. ambiguum
H. angustifolium
H. anzaldoinum
H. apertispathum
H. ararapinum
H. arechavaletae
H. argentinum
H. barbatum
H. belladonna (all varieties)
H. blossfeldiae
H. breviflorum
H. candidum
H. canteranum
H. cardenasianum
H. criciflorum
H. cybister
H. damazianum
H. elegans (all varieties)
H. espiritensis
H. evansiae (all forms)
H. flammigerum
H. fosteri (autumn/winter blooming)
H. fuscum (autumn/winter blooming)
H. harrisonii
H. immaculatum
H. iguapensis
H. iguasuanum
H. kromerinum
H. lapacensis
H. leopoldii (all forms)
H. macbridei (autumn/winter blooming)
H. mollevillquensis
H. neoleopoldii
H. neopardinum
H. pardinum
H. parodii
H. reticulatum (all varieties) (autumn/winter blooming)
H. scopulorum
H. solandriflorum
H. starkiorum
H. stylosum
H. traubii (all forms)
H. tucumanum
H. viridiflorum
H. sp. Doran's unidentified no. 1756 (probably *H. ambiguum*)

Deciduous Hybrids

Doran's *H. crociflorum* x *H. parodii*
Doran's *H. doraniae* x *H. traubii*
Doran's *H.* (EA)E x *H parodii*
Doran's *H. fosteri* x *H. brasilianum*
Doran's *H. pardinum* (double form) x hybrid
Doran's *H. parodii* x *H.* sp. Doran K12 (12 pink flowers per umbel)
Doran's *H. parodii* x *H. viridiflorum*
Doran's *H. reginae* x *H. brasilianum*
Doran's *H. vittatum* var. *tweedianum* x *H. ambiguum*

Autumn/Winter Blooming/Growing Species

H. aulicum (evergreen)
H. fosteri (deciduous)
H. fuscum (deciduous)
H. macbridei (deciduous)
H. muesserianum (deciduous)
H. reticulatum (all varieties) (deciduous)

Autumn/Winter Blooming/Growing Hybrids

Doran's *H. fosteri* x *H. fosteri* (two widely separated clones)(deciduous)

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A note from the Scientific Editor:

The list of evergreen *Hippeastrum* species in the above article contains many species that other growers have concluded must have a leafless dormant period in order to flower. *Hippeastrum petiolatum* may even rot for some growers if it is not allowed a period of dormancy.

CONSERVATION CONCERNS FOR *BOWIEA VOLUBILIS*, AN UNUSUALLY SUCCULENT MEMBER OF THE HYACINTHACEAE

C. Bircher[1], C. Prentice [2], N. Crouch[1] and R. Symmonds[3]

SUMMARY

The unusual succulent adaptation of *Bowiea* has made it a collectible curiosity amongst bulb and succulent growers worldwide. However, in southern Africa this plant is under threat, as *B. volubilis* populations face severe degradation through over-exploitation for the herbal medicine trade. This has led to concerns for its long-term survival, and various conservation attempts have subsequently been made to reduce pressures on wild stocks. The current article reports on the ethnobotany of this highly valued magico-medicinal or muthi species, and the efforts made to propagate plants through sexual and vegetative means.

INTRODUCTION

Bowiea Harv. ex Hook.f. is unique in being the only genus known to possess an inflorescence as the sole adaptation to succulence (Smith et al., 1993). Some 27 genera and over 370 sub-generic taxa of the Hyacinthaceae are native to the Flora of Southern Africa (FSA) region (Meyer and Williams, 1997), which comprises South Africa, Namibia, Botswana, Lesotho and Swaziland. Of these taxa, only 34 species are considered to show succulent characters (Retief and Van Jaarsveld, 1997). Two of these belong to the genus *Bowiea*.

Bowiea was founded by W.H. Harvey to commemorate his contemporary, James Bowie (ca. 1789-1869), a plant collector and gardener at the Royal Botanic Gardens, Kew, who spent his later years at the Cape (Gunn and Codd, 1981), although the original specimen was sent to Harvey by Henry Hutto of Grahamstown (Galloway, 1911). The specific epithet *volubilis* means *ëtwiningí* in Latin, a reference to the growth habit of the scape.

Bowiea volubilis was initially thought to be the only representative of the genus in southern Africa. However, more recently *B. gariepensis* Van Jaarsveld, long considered conspecific with *B. volubilis*, was described following the collection of additional material

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from the Richtersveld. The two species are unlikely to be confused, as they show differences in floral, capsule and seed characters, and grow in geographically distinct areas (Reid et al., 1990). *Bowiea gariepensis* occurs from Springbok in the Northern Cape to Aiais in Namibia, along the lower Orange River (Fig. 1). In contrast, *B. volubilis* is widespread in eastern southern Africa, ranging from the Eastern Cape to the Northern Province. It extends north into Zimbabwe, Zambia, Tanzania, Uganda and Kenya, and has also been recorded from Mozambique, Malawi and Angola (Stedje, 1996). B. kilimandscharica Mildbr. from east Africa was considered by Reid et al. (1990) to be doubtfully distinct from *B. volubilis*, and has subsequently been placed in synonymy (Van Jaarsveld, 1992). Additional synonyms include *Schizobasopsis volubilis* (Harv. ex Hook f.) Macbride (Jessop, 1977), *Schizobasis volubilis* MacBride (Van Jaarsveld, 1992) and *Ophiobostryx volubilis* (Harv.) Skeels (Prain, 1921). The synonym *Ophiobostryx* was appropriately assigned by Skeels to this genus, suggested by the snaky lock appearance of the leafless branches (Galloway, 1911).

DESCRIPTION

Bowiea volubilis is a geophyte which climbs to 3-4 m in surrounding vegetation or scrambles over rocks on hillsides (Fig. 2). The bulb is commonly subglobose, reaching 150 mm in diameter, and comprises several fleshy scales which are usually white, becoming greenish-yellow if exposed. The upper edges of the scale series overlap, forming concentric rings around the centre of the bulb. 1-2 vestigial leaves 20-40 mm long are produced, which soon senesce. The much-branched, slender, solitary annual scape is bright green, succulent and twining, and lacks branches below. The pedicels are curved, 20-30 mm long, mostly non-fertile on the lower branches, and bear flowers 10-16 mm in diameter (Fig. 3). The 6 green tepals are usually reflexed at full anthesis, and are linear-lanceolate, 4-7 mm long, with incurved tips. The stamens are inserted at the base of the tepals. The ovary is semiglobose, becoming conical, and tapers into the 2-2.5 mm long style which terminates in a 3-lobed stigma. The trilocular capsules are 8-25 mm long, with acuminate valves which taper into the remains of the style. Each valve usually has a small horn two thirds from its base. The black, angular, shiny seeds are 5-10 mm long (Dyer, 1941; Reid et al., 1990).

Bowiea volubilis is very variable in size. Cape plants are usually smaller than plants from the Northern Province and more distant localities (Van Jaarsveld, 1992). The maximum flower diameter (24 mm), tepal length (10 mm) and capsule length (30 mm) recorded from central and east African material are greater than those from southern African populations (Reid et al., 1990).

Figure 2. Habitat of *Bowiea volubilis*, growing among rocks on a south- facing hillside near Kokstad, South Africa

Figure 3. (above) Close-up of succulent inflorescence showing hyacinthaceous flowers.

Figure 5. (right) Three bulbils generated from a single isolated bulb scale after six months. Note presence of the vestigial linear leaves.

Photos: Neil Crouch

Figure 4. A large bulb of *B. volubilis* (15cm diameter) traded as "igibisila" in the Ezimbuzini muthi market, Durban.

ECOLOGY

Bowiea volubilis occurs at low and medium altitudes, and is usually found along mountain ranges and in thickly vegetated river valleys (Van Jaarsveld, 1992). It tolerates wet and dry conditions (Dyer, 1941), growing in predominantly summer rainfall areas which receive approximately 200-800 mm of rain each year (Van Jaarsveld, 1992). In these localities *B. volubilis* often grows under bush clumps and in boulder screes (Dyer, 1941). In the Eastern Cape it has been recorded scrambling at the margins of karroid, succulent bush (Gledhill, 1969), and in KwaZulu-Natal it may occur in bushy kloofs at the coast and in the midlands (Hulme, 1954). In Gauteng, Mpumalanga and North-West Province, this species is often found in open woodland or on steep rocky hills, usually in well-shaded situations (Fabian and Germishuizen, 1997).

ETHNOBOTANY

Bowiea volubilis is known as ëigibisilaí, ëigulenií and ëgifisilaí to the Zulu, ëumagaqanaí and ëumGaqonaí to the Xhosa, ëgulinií to the Mpondo and ëmagaqanaí to the Nguni. It is referred to as ëknolklimopí in Afrikaans and ëclimbing green lilyí or ëclimbing potatoí in English. Bulb preparations have been and are still extensively used by various cultural groups for magico-medicinal purposes (Fig. 4).

The Mfengu, Mpondo and Baca mix the roasted, powdered bulb with hot water and take a tablespoonful as a mild purgitive. Symptoms of poisoning reportedly appear if the dose is exceeded or if the preparation has been incorrect (Watt and Breyer-Brandwijk, 1962). The Xhosa take bulb decoctions to induce purgation. To ensure that the effect is not too extreme, the water in which the bulbs are boiled is replaced several times before being used (Hutchings et al., 1996). Bulbs are also used by the Xhosa as a cure for barrenness and dropsy (Watt and Breyer-Brandwijk, 1962) and in the treatment of headaches (Batten and Bokelmann, 1966). Bulb juice is applied to the skin of sick people, and a decoction of the bulb is used as a lotion for sore eyes in the Transvaal (Watt and Breyer-Brandwijk, 1962). A hot water infusion of the outer bulb scales is administered by the Zulu in the Pomeroy district of KwaZulu-Natal to treat ascites (Watt and Breyer-Brandwijk, 1962). Bulbs are reportedly constituents of infusions used by the Zulu during pregnancy to aid delivery (Gerstner, 1941), and are also utilised to effect abortions (Hutchings et al., 1996).

Native doctors used to sprinkle warriors with a bulb decoction which was said to make their enemies flee (Watt and Breyer-Brandwijk, 1962). Crushed bulbs of this species, mixed with other plants, are ingredients in infusions used as protective washes by

travelling Zulus (Hulme, 1954). Zulu men also take bulb potions as love charms (Gerstner, 1939). According to a Swazi traditional healer, the skin of funeral attendees is rubbed with sap from *B. volubilis* as part of the mourning ceremony (Van Jaarsveld, 1992).

Bowiea volubilis has featured in court in cases of poisoning. The bulb has produced fatalities in man and animals, whilst the above-ground parts have reportedly caused the death of a sheep and goat. Symptoms associated with bulb poisoning may include vomiting, purging, salivation, heart irregularity, depression and pains similar to cramps. Deaths have been attributed to possible cardiac failure due to the digitalis effect of the bulb. The bulb has been shown to contain three active cardiac glycosides, one of which acts as a heart stimulant (Watt and Breyer-Brandwijk, 1962).

Schizobasis intricata (Bak.) Bak., known to the Zulu as ëumthondowemfeneí or ëumababazaí, has been used by traditional healers in KwaZulu-Natal as an alternative to *B. volubilis* (Drewes et al., 1993). *Bowiea*-like bufadienolide cardiac glycosides were not found in *S. intricata* following phytochemical screening of bulbs, so a rational use based on a similarity in chemical constituents is not indicated (Jäger and van Staden, 1995). It is possible that morphological confusion of these superficially similar taxa, or reduced availabilty of *B. volubilis* bulbs, could account for this usage (Jäger and van Staden, 1995).

CONSERVATION

Although the global conservation status of *B. volubilis* is listed as Insufficiently Known, it is classified as Vulnerable in KwaZulu-Natal and the Free State (Hilton-Taylor, 1996). Herb traders and rural herbalists in KwaZulu-Natal consistently rated this species as one of the top six medicinal taxa becoming scarce in the province as a result of over-utilization, and a reduction in the size of harvested bulbs has been reported (Cunningham, 1988). In 1997 this species was identified as the eighth most popular plant demanded by consumers in KwaZulu-Natal (Mander, 1997). Surprisingly, over a nine-year period, wholesale prices for igibisila in this province have remained constant or even declined, according to figures supplied by Mander (1997) and Cunningham (1988).

As law enforcement is largely proving ineffectual in containing the over-exploitation of indigenous medicinal plants (Cook *et al.*, 1988), it has been widely suggested that cultivation of threatened taxa could provide a legal source of supply. Because of its rapid growth rate, *B. volubilis* is a suitable candidate for conservation-through-cultivation initiatives (Cunningham, 1988). Unfortunately, however, some user-groups are reported to believe that cultivation reduces the inherent medicinal and magical properties of plants

(Hanneweg *et. al.*, 1996), and attempts at altering this perception are thus equally important if cultivation is to play a role in conservation.

PROPAGATION

The reproductive biology of this species is not well understood, although it is thought that the flowers are insect-pollinated (Van Jaarsveld, 1987). Flowering usually occurs in January and February (Reid et al., 1990), but may commence in September and continue into March. Flowers have been reported as both sweetly scented (Van Jaarsveld, 1992) and unscented (Jessop, 1977).

The fine seeds should be harvested as soon as the capsules start to split. Seeds should be sown in seedling trays onto a mix of ⅓ sand and ⅔ bark, and lightly covered with a similar mixture. From the experience of the horticulturalists at the Silverglen Medicinal Plant Nursery in Durban, it would appear that viability loss is remarkably rapid; six week-old seed germination was only one third as successful as that attained with one week-old seed. Germination proceeds in semi-shade, and depending on how thickly the seeds are sown, they can either be left in their trays or transferred into punnets containing a 50:50 mix of coarse river sand and bark. It has been surprising to note that, at least in Durban, seedlings in cultivation continue to grow throughout the winter months, although the adult plants tend to die back after flowering in the autumn. Mature bulbs can, however, be encouraged to break dormancy through watering or through the stresses associated with repotting. In such cases the reproductive stage is initiated, with rapid elongation of the inflorescence axes.

Nurseries have attempted traditional vegetative propagation methods of *Bowiea* bulbs such as daughter-bulb formation. However, these procedures can result in very slow multiplication rates (Hannweg et al.,1996). One such protocol, although not especially rapid, has proved successful at Silverglen. The outer bulb scales should be removed and dried in a cool, dry place. After two weeks the cut surface should have sealed. This is accompanied by the formation of a light callus. Following planting in coarse river sand, up to five bulblets should appear per scale (Fig. 5), each separable after six months, by which stage the parent scale will have largely senesced. Such a procedure represents an appropriate level of technology for transfer to traditional healers, conservationists and other parties interested in propagating material for muthi purposes.

Several *in vitro* propagation systems have been developed for the mass-production of this taxon, with varying levels of success (Table 1). In a third world environment this method of propagation is expensive and arguably inappropriate. Nevertheless, it could be used to increase plant stocks for use in more economic, traditional propagation methods (Cook *et. al.*, 1988).

RECOMMENDATIONS

As a result of the increasing scarcity of *B. volubilis* plants in the wild and the Vulnerable status assigned to this taxon in KwaZulu-Natal and the Free State (Hilton-Taylor, 1996), it is imperative that attempts be made to conserve this interesting medicinal species. Propagation and cultivation techniques which are appropriate for rural communities are an important means of preservation of this taxon. Additional healer training and horticultural research initiatives such as those underway at Silverglen in Durban are needed in developing countries if such a conservation-through-cultivation approach is to positively impact on vital medicinal flora.

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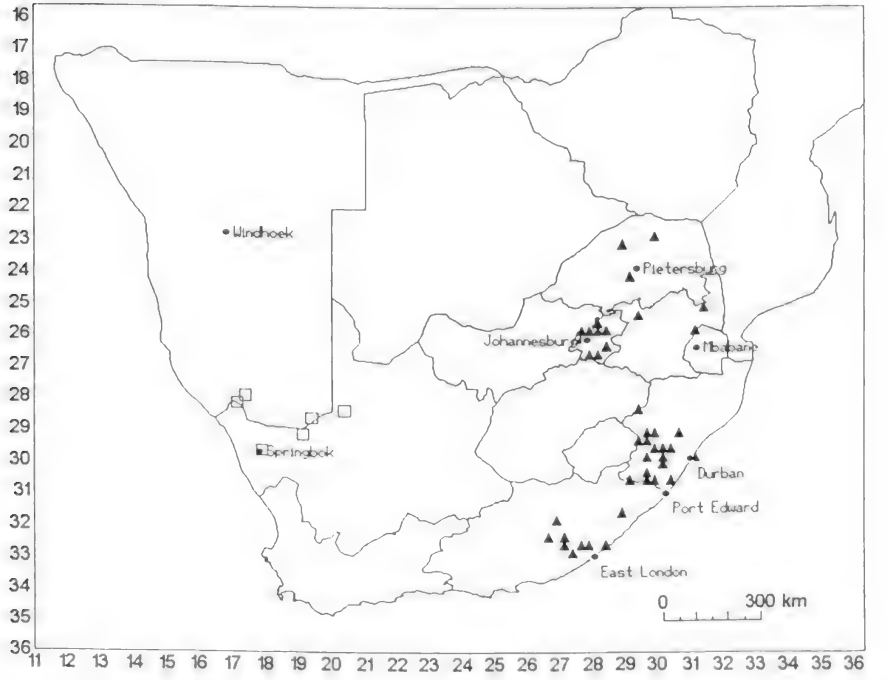
Table 1. *In vitro* approaches to propagation of *Bowiea volubilis*.

Figure 1. Recorded distribution of *B. volubilis* and *B. gariepensis* (in southern Africa.

Attempts	Explant used	Results
Jha and Sen (1985)	Inner bulb scales	400-600 bulblets formed in 16-20 weeks, with 80% of plants surviving when transferred to potting soil.
Cook et al. (1988)	Inner bulb scales	±50 bulbs (2-3cm diam.) per explant were produced after one year.
Hannweag et al. (1996)	Inflorescence sections	About 5 plantlets per explant after 13 weeks; thousands per inflorescence.



THE ECOLOGY OF *AMMOCHARIS TINNEANA* NEAR THE LIMPOPO RIVER IN SOUTH AFRICA

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The Malongavlaktes comprise an arid rain shadow area north of the eastern section of the Soutpansberg Mountains in South Africa's Northern Province. The region lies close to the Limpopo River and has been settled by the Venda people who live in villages close to rivers and wells.

The Venda keep large herds of cattle and goats and much of the area is heavily grazed. The grazing patterns have resulted in some bulbous plants predominating, such as *Albuca* species, with populations of others, such as *Crinum delagoense*, becoming scarce or else stabilising.

The region becomes sandy near the village of Masisi, but further west, where *Ammocharis tinneana* grows, a heavy clay-based soil is associated with dolomite outcrops. *Ammocharis tinneana* is absent from the sandy areas, but is partial to the dolomite flats where the soil is over a metre deep and not stony.

Rainfall is in summer, between November and February, falling as heavy thunderstorms. Winters are warm, dry, and largely frost-free.

AMMOCHARIS TINNEANA IN HABITAT

The area west of Masisi comprises flat *Combretum* and *Acacia* scrubland with very little grass cover except in seasons of heavy rainfall. The grass is completely grazed by livestock in drier years.

Ammocharis tinneana flowers from the second half of November until about mid-January—the hottest time of the year, with temperatures often above 40°C. The plants do not flower unless the vicinity has been soaked by a rainstorm. This species is capable of producing leaves and flower buds in as little as a week after good rains; some specimens flower in a leafless state, with the leaves emerging towards the end of flowering time, if at all.

The leafing and flowering period is short, averaging about 3-5 weeks, or even shorter if there is no further rainfall. Seed set is usually very poor, but most plants which flower tend to set at least some seed during years where flowering coincides with a few weeks of thundershowers.

Some plants flower twice in a season. They produce leaves and flowers or only flowers after the first rainstorm, then go dormant,

shedding their above-ground parts. When the next good rain falls further flowers are produced. This habit is shared with *Ammocharis coranica* in the Northwest and Northern provinces, but in *A. tinneana* a second flowering is not generally accompanied by the sprouting of a fresh set of leaves.

Some *A. tinneana* remain dormant after the first rains but flower later with December and January rainfall. This ensures that some seeds are likely to be produced in both the main flowering peaks.

Ammocharis tinneana is one of South Africa's most ornamental and striking amaryllids. The fan of leaves is jade green, the flowers have a pearly sheen and are usually a deep cerise, but sometimes are coral pink or white.

REGENERATION OF THE SPECIES IN AN ARID ENVIRONMENT

Ammocharis tinneana varies in the amount of seed set from one season to the next. Seeds are set during the hottest time of the year and may lie dormant in strong sunlight before they are distributed by rainfall. The topsoil has not been eroded in their habitat, probably as the area is flat, permitting little runoff after thunderstorms, but surface cracks do develop in hot weather. Seeds are able to lodge in these fissures, which allows for radicles to penetrate the soil easily.

The barren earth is suited to the germination of *A. tinneana* seeds since they obtain adequate light and little competition from other herbaceous plants. Grazing also serves to keep the habitat clear and in this way promotes both flowering and germination. Much seed is lost, however, from shrivelling in the sun or trampling by livestock. In order to germinate successfully, seeds also need a few thunderstorms to keep the earth sufficiently moist for the radicle to penetrate the soil and for a young bulb to develop.

Most plants in the colonies consist of large old bulbs with a small fraction of younger bulbs. Where young bulbs are found they are usually of roughly the same size. The seeds from which these bulbs developed were probably produced during years of good flowering and subsequent regularly spaced rainfall.

ASSOCIATED FLORA

The dense population of livestock around Masisi has resulted in a proliferation of some evidently less palatable plants, particularly *Albuca* species. The lack of competition, particularly from grasses, has allowed the *Albuca* species to scatter their seeds far and wide, dispersed by wind. The open heavily grazed habitat is also ideal for the large increase in numbers of these plants.

Some bulbous and caudiciform species have declined in numbers.

Crinum delagoense, for example, occurs in scattered small groups of mature bulbs which rarely obtain the chance to seed successfully. As with *Ammocharis tinneana*, seeds are usually trampled by livestock or else land on bare compacted earth where they shrivel in the sun. The only seeds which germinate are those set during years of above average rainfall. During such years the ground remains moist enough for the roots to penetrate the soil and the attention of grazing animals is largely directed to grasses which proliferate along the water courses and in the low-lying areas.

Little flora grows with *A. tinneana* since seeds of most other species occurring naturally in the region cannot germinate where there is trampling and severe dessication of the environment. Two species which are quite often encountered, however, are *Stapelia kwebensis* and a *Raphionacme* species. These plants usually are found under low acacia scrub, where they are able to escape the attention of grazing animals until they become established.

A species of *Eriospermum*, which may be undescribed, occurs out in the open with *A. tinneana*. The small rounded seeds which it produces also lodge in cracks in the soil and caudices begin to develop soon after germination.

Ammocharis tinneana in its arid, overgrazed habitat, with clouds from an isolated thundershower visible on the horizon.

Ammocharis tinneana shortly after flowering. Note the older prostrate flower stalks, evidence the plant has flowered twice in a leafless state.

Photos: Laurian Brown

IN APPRECIATION OF THE HEDGEROWS AND ROADSIDE FLOWERS, ESPECIALLY BULBS, OF BRITAIN

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Many of us have had the pleasure of visiting England. If we have not, then a treat is in store, and I would encourage all, on their next visit, be it the first or not, to pay attention to the hedgerows. Hedges are quite remarkable. They have existed for centuries, the number of species of shrubs, as an example, found in a 30-yard length of hedge can indicate its age. If 10 or more are found, then the hedge is likely to be pre-Conquest, which every English schoolboy knows means pre-1066.

The enclosure act of 1813 gave rise to a number of hedges; this act dictated that private land had to be enclosed. The result was the construction of hedges, but also of the many stone walls that are to be found in England.

People who have traveled with me on one of my tours become accustomed to my behavior. They are not surprised when I holler for the coach to stop, when I jump out and beckon for them to join me. Such they quite understand, at least when they are on their second tour with me. They expect to find wildflowers worthy of an effort to see, and never have I had any one complain when I show them a grand spike of an orchid, a *Dactylorhiza* species, to which genus belong the Marsh Orchids, or perhaps an Early Purple Orchid, *Orchis mascula.*

I am pleased to say that orchids, and many other species, are becoming increasingly common in the hedgerows of England, now that trimming and cutting takes place after the greater majority of the wildflowers have finished flowering and producing their seed. A much appreciated recent law.

There are not too many bulbous species native to Britain. We do have a few, and the majority of them inhabit the hedgerows. Take a walk along a country lane in early spring and you will be able to enjoy many species of wildflowers, including a number of bulbs.

I did not expect to find a tulip growing in a hedgerow in Wales. It was *Tulipa sylvestris.* Not even its mother could say this was a great beauty, but because of its comparative rarity, and perhaps simply because it is a bulb, I was soon in raptures over spotting it. I could not help but smile over the bemused look on the faces of certain members of my group; it is not exactly a ravishing beauty like its garden cousins. But they did appreciate the admitted novelty of finding a species of tulip growing in the wild in Britain. After all Britains' climate is not one associates with *Tulipa.*

The original habitat of *Tulipa sylvestris* is not definitely known, but it is now found throughout Europe, into North Africa and as far east as Central Asia and Siberia. Quite a large area. And while it sometimes reaches 12-18 inches in height, the plant I found was only 4-6 inches, no doubt because it had to exist in only a few inches of earth. The nodding flower with pointed tepals often described as golden but more correctly perhaps a dusky yellow with a distinct green midrib, no doubt relies on its unobtrusive qualities to escape collection, which might not be the case if it were more like its garden relatives. Forms of this species have been selected and are known as 'Major', with as many as three flowers per stem, and 'Tabriz', with larger flowers and, I am told, a distinct fragrance.

The hedgerows of southern England are very old, long established, and while numerous hedges have been removed to accommodate modern farming, there still exist many that have been in existence since before the Norman Conquest. I think that Devon and Cornwall have the major share of hedges. The rather mild climate in certain areas no doubt contributes to the great diversity of plant material.

It is interesting to remember that the conquest of England in 1066 departed from Normandy, the conquest of Europe in WWII departed from England and landed in Normandy. But unlike invasions in olden times, the modern armies do not take with them any living plant material. The Sweet-chestnut was introduced in Roman times, sycamore in the Middle Ages, and *Rhododendron ponticum*, now a terrible weed, was introduced more recently.

In a three mile walk in Devon last March, I came across many bulbs at home in the hedgerow. The first was *Arum maculatum*, known, and I know not why, as "Lords and Ladies", with its finger-like purple spadix, and thus easily distinguished from its relative the larger *A. italicum* with its yellow spadix. Another distinguishing feature is that *A. italicum*, known as "Cuckoo Pint", heaven knows why, has larger more triangular leaves with creamy veins.

But what is springtime in England without the bluebell and the primrose? After being placed in various genera, hopefully the bluebell has found its resting place as *Hyacinthoides non-scripta*. The best specimens are always found in deciduous woods but there are many in the hedgerows. It is quite noticeable that those growing in a north facing hedgerow are larger than those which face south. In all such areas these lovely bulbous plants are a remarkable combination with the white flowers of *Cerastium arvense* and the red flowers of *Silene dioica*, the Red Campion, a very common hedgerow plant that is in flower for many months. A truly patriotic blend of red, white and blue.

The bluebell is often also seen in combination with the English Primrose. These lovely plants, *Primula vulgaris,* remain in flower for a long period, start before and continue after the bluebells. On occasion the yellow flowers of the lesser celandine, *Ranunculus ficaria,* one of the flowers mentioned by Shakespeare, add an additional sparkle of yellow. The buttercup and the dandelion are also common denizens of the hedgerow.

A remarkable thing about the bluebell is the depth to which the bulbs will descend into the soil. Often in spring you will see children carrying large bunches of flowers home. They have been picked by the simple expedient of pulling the stems from the soil. The white portion, indicating that part growing without light, will often be 12 inches or more in length. True, in the woods the soil will be friable and loose, but it is still of considerable depth. Incidentally, the sap of the bluebell can cause an irritating skin rash.

Those of us fortunate to have been born in Devon, refer to Dartmoor as simply "The Moors". They are one of my favorite haunts. I noticed a bank of white flowers on my way up to the moors (one always says "up" as The Moors consists of outcroppings of granite known as "Tors", and the elevation is above the lush pastures of the Devon countryside, through which streams originating on Dartmoor flow). What were they? I searched for a spot to park. The very narrow lanes—it is possible to touch both sides of the road from the car—make parking difficult. I found a place but I had to walk back to this mass of white. My efforts were well rewarded. I came across a mass of snowdrops, *Galanthus nivalis.* They were growing on a slope which extended into the edges of a small wood. The soil was damp, lightly shaded, rich with rotted leaves and well drained. While some plants had extended into the wood, they were prolific where there was more light and crowded out all competition. They reigned supreme over their domain, a grand sight, and as they were on a bend in the road, would have been admired, at least one hopes so, by many. I do not think that the summer snowflake, *Leucojum vernum,* forms such extensive drifts, seemingly preferring to exist in more isolated clumps. Why should this be?

I am sure most bulb lovers know the easy way to tell the difference between the genera *Luecojum* and *Galanthus.* Think of the first letter "L" and allow this to stand for level. All the tepals of *Leucojum* are of the same length, they are unequal in *Galanthus,* the inner being shorter. *Leucojum* are found in Britain, but are rare, the species being *L. vernum* and *L. aestivum.*

In a shady nook in the hedgerow one can often find *Anemone nemorosa.* This jolly little plant with the distinct 3 leaves on the flowering stem, held in a whorl just below the flowers, is known as

the wood anemone, and indeed such is its more common home. One reads that it has white flowers, but to me they are off-white with a hint perhaps of pink, often found on the undersides of the sepals and there is a pink form, leading me to the opinion that the pink is to be found, to a greater or lesser degree, in most if not all flowers.

While found in hedges, the more common habitat, apart from the woods, are quite open areas where soil has been disturbed, seed soon arrives and these plants quickly establish themselves. But they do not persist for many years, which they will do in the woods and in favorable locations in the hedges.

Allium triquetrum, easily distinguished by the triangular stem, can be found in north-facing hedgerows, or those which are a little shaded. I spotted it nestling in quite a large area in shade and where there was considerable moisture. The field on the other side of the hedgerow along the road where I was walking was some four or five feet above the level of the road. This is quite a common occurrence, and accounts for the additional moisture where the *Allium* was growing. *Allium triquetrum* will form large clumps, and if it finds itself in rather poor soil, with good spring moisture but on the dry side later in the summer, it will spread rapidly to cover a considerable area. Sometimes known as "Wild Garlic" or "Three Cornered Leek", it is a plant deserving of being grown in gardens, especially if there is a woodland area where it can be contained. It is purported to have been imported into Britain, where it is most certainly at home, but supposedly comes from southern Europe.

As mentioned, it is not unusual for the fields to be well above the level of the roads.. For years the roads have been used, and before they were black-topped they would have been dirt and the earth would have been blown away in summer or washed away by the winter rains.

As I approached the town of Kingsbridge I noticed a *Muscari* in the hedgerow. There is a species that is reputed to be native to Britain, albeit a rare plant, *M. atlanticum*, now placed with *M. neglectum*. These had deep blue flowers, almost black, with the lobes white and slightly reflexed. The leaves were quite narrow and untidy, but I feel these grape hyacinths were more likely to have been garden escapes than naturally occurring in the wild.

Certainly the many different *Narcissus* found in hedgerows, growing in very shallow soil on walls, were all garden escapes, but nevertheless great to see. I am amazed how tough these plants are, growing in places I would have thought were impossible for them to survive, certain it is that they would not have had more than an inch of soil over them, if that.

Having reached my destination, Kingsbridge, a charming little

town that has changed little since before WWII, it was time for a cup of tea, a look at a few book stores and a print shop. Then I decided to walk the three miles back to my hotel, passing on the way the different bulbous plants I had noticed before, but also spending time to enjoy the many other species of wildflowers that were such a pleasure to see.

The thought occurred regarding the possibility of creating a hedgerow as a feature in a garden—we have borders, mostly flat and often not too exciting. But a hedgerow, often as much as eight feet in height, containing many species living often on top of each other, is an exciting year-round fountain of interest, not only for plants but for various wildlife as well, a living eco-system that I find fascinating. And yet hedgerows are often overlooked. They ought not to be.

I set no records on my six mile walk. But I had enjoyed myself, found most of the bulbous plants known to be native to Britain, regaled myself in the air blowing in from the English Channel and perfumed by fragrances of freshly turned soil, of farmyards, and enhanced by the birdsongs of many different species, including the thrush and the blackbird.

I could not help but remember that the best things in life are free, but far too often we do not allow ourselves the time to enjoy these gifts of nature.

We ought.

Hyacinthioides non-scripta

Arum maculatum

Photos: John E. Bryan

A NEW SOIL MIX FOR HIPPEASTRUMS AND OTHER AMARYLLIDS

Charles Hardman
Baldwin Park, California

Two years ago a soil mix for *Hippeastrum* came to mind so, on an experimental basis, I tried it on a few amaryllid bulbs, then more, now many. It works beautifully.

This mix has a number of advantages: it drains quickly so the bulbs rapidly develop large root systems; it's entirely inorganic so there's less chance of micro-organisms harming the plants; it provides some nourishment to the plants in the form of phosphorus and potassium, and some trace elements; the mix is simple and therefore it's easy to remember the proportions of each ingredient.

Here's the mix: one-quarter part each of granite sand including dust particles, white silica sand #12 particle size, small coarse red volcanic cinders, small coarse black volcanic cinders. Four ingredients, that's all.

(Admittedly, not everyone will be able to get all these ingredients. My suggestion is to try a coarse mix of various mineral ingredients available at your closest rock and gravel salesyard until you find a mix that works well for you under your conditions. Just make sure there are plenty of small particles—at least 5%—fine sand or dust in the mix to facilitate the ion exchange factor necessary for the plants' roots to properly absorb dissolved fertilizers and other water dissolved chemicals.)

The principal drawback to this mix is its weight: it's heavy. If this is a problem for you, try adding up to 20% perlite, in other words five ingredients altogether, equal parts of each. Please bear in mind that perlite floats on water and also blows about in wind. As a result, you can quickly end up with an extremely messy growing area unless you take steps to keep the perlite under control right from the start.

The results of using this mix have been remarkable for the *Hippeastrum* species and hybrids and some other amaryllids under my care. The bulbs grow quickly and are less temperamental about care in their watering routine.

While I have achieved good results under the fertilizing program I'm currently using (quite unscientific, so I will not report it here), I intend to switch to *Golden Grow Bloom* and *Golden Grow Micro-Gold* both of which are available from Light Manufacturing Co., 1634 SE Brooklyn St., Portland OR 97202, Phone 800-669-5843 or 503-231-1582 as mentioned in John Nolan Sahuc's *Hippeastrum* article which

begins on page 72 in this journal. Nolan's success with Hipps is legendary, so I'm sure I'll get as good as or better bloom than I'm getting now when I switch to using the formulas which have brought him so much growing success.

The following chemical analysis was provided by IBS member Patricia Colville who kindly did the tests and wrote up the data.

Analysis of Sands and Cinders

by Patricia Colville

Chemistry by X-ray Fluorescence (first pass powder standards)

Element	Graded Silica	Decomposed Granite	Red Cinder	Black Cinder
SiO_2	80.2	70.5	47.5	49.0
Al_2O_3	9.78	14.88	15.75	15.8
Fe_2O_3	.53	3.32	12.01	14.3
CaO	.7	1.9	9.9	9.0
MgO	.18	.55	7.34	3.4
Na_2O	1.78	3.97	2.7	3.0
K_2O	4.51	3.09	.71	2.8
TiO_2	.09	.33	3.9	2.3
Nm_2O_3	.02	.06	.25	.22
P_2O_3	.05	.08	.28	.34
L.O.I	.51	1.08	.53	.60
	98.35	99.76	100.87	100.76

Graded silica—I thought this would be all quartz, but there is a lot of feldspar present (around 40–50%) which accounts for the high alkali-sodium and potassium and aluminum.

Decomposing granite contains quartz (about 25%) plus sodium and potassium feldspar. Also present are some (<5%) mica and hornblende and just a little kaolinite. The aluminum silicate clay— kaolin is the most common weathering product of the feldspars in granite.

The red and black cinders are the products of explosive types of volcanic eruptions and are composed mostly of frothy porous glass much like pumice. These samples are from basaltic lava, high in iron (and probably mined from those cinder cones we see out in the Mojave Desert).

The red cinder owes its color to highly oxidized red iron oxide—hematite. It has some crystalline material present, minerals common in basalt—pyroxene with mixed calcium and sodium potassium feldspars.

The black cinder has some olivine and mixed high calcium feldspar. Basalts do not contain quartz and generally weather rapidly, acting as a source of calcium, iron and magnesium.

TWO SPECIES OF THE GENUS *LEUCOCORYNE* (ALLIACEAE) IN CHILE

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Casilla 4058, Valparaiso, Chile

The genus *Leucocoryne* contains more than a dozen species which are abundant on the slopes and plains of central Chile (Latitude South 33) and in the adjacent northern provinces. The basic color of the flowers is white, but several species have a slight bluish tone in their tepals. The flowering period is Spring. In many places these plants cover slopes and plains in such abundance that the ground appears white, which can be compared to the fields of narcissus in Switzerland. Most of the species like open sunny places, but the two species described here grow in shaded locations.

The genus *Leucocoryne,* until recently, did not attract many gardeners interested in their cultivation because many species have a scent of onion (*Allium sativum*) in all parts of the plants.

Leucocoryne conferta Zöllner (Alliaceae)

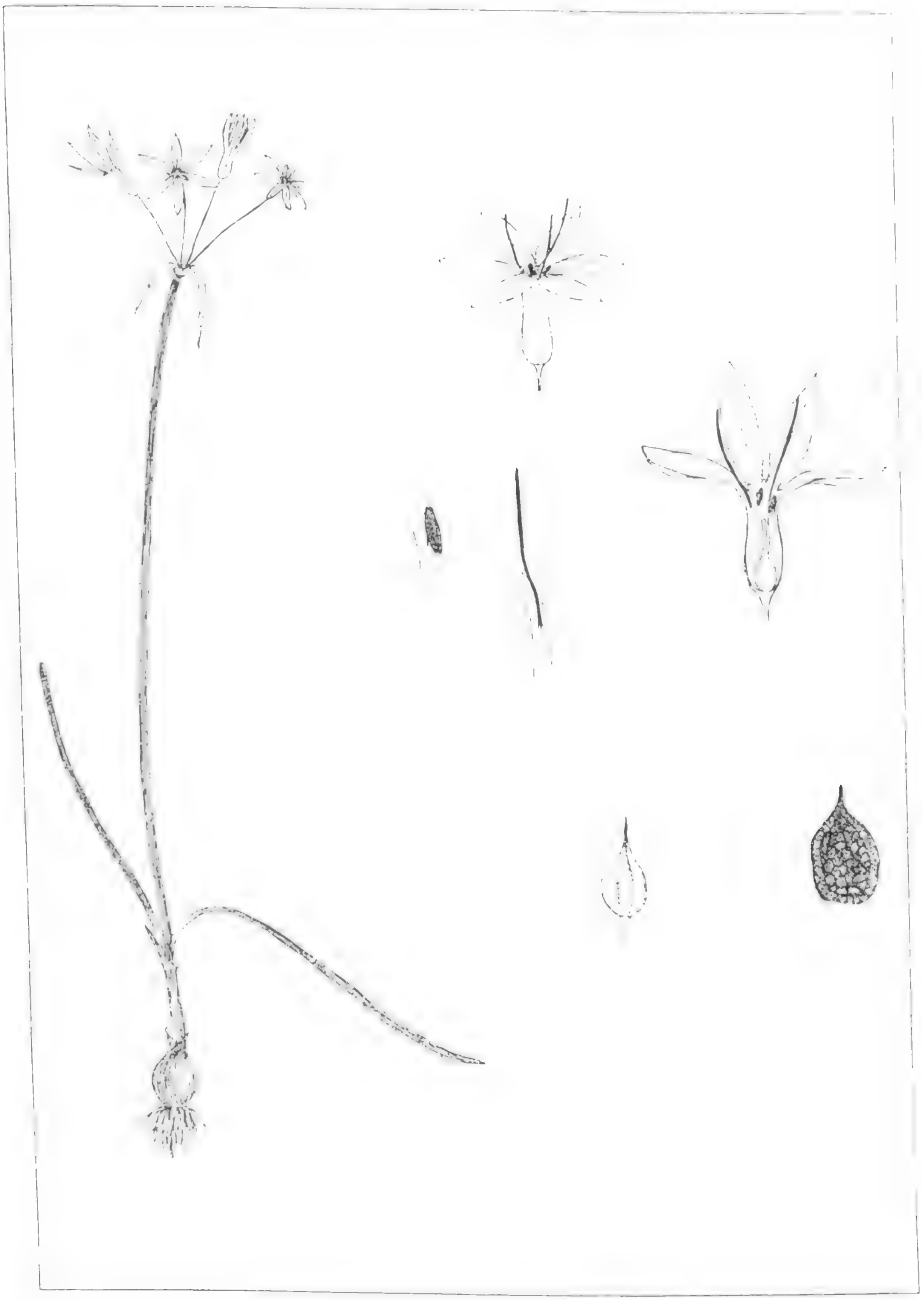
The bulbs of this species are spherical in form, 1.1–1.5cm in height, and 1.4–1.5cm in diameter, with the bulbs covered by dark scales. A cylindrical neck with a length of 3–5cm and a diameter of 2–3cm arises from the apex the bulbs

Plants have two glabrous flaccid leaves, each up to 15-25cm long and 1.8–2.6mm wide. One glabrous scape arises from each bulb, and is cylindricall and erect, 15–30cm tall and 2-3mm in diameter. The scape terminates in two membranaceous spathe valves with 9–10 veins. The spathe valves are about 4cm long and are sometimes joined at the base.

The inflorescence is an umbel of 4–7 flowers. The flowers have cylindrical glabrous pedicels that are 2.5–3.8cm in length. The white flowers are formed of a cylindrical tube and three outer lobes and three inner lobes. The tube of the flower is 8mm in length and the outer lobes 1.1–1.2cm long; the inner lobes are somewhat smaller.

At the mouth of the flower tube there is a small paraperigone that is inserted on the inner lobes and looks like sterile anthers. The ferttile anthers are hidden in the flower tube; the three fertile anthers are fixed on the tube without filaments. The style of the piltil surpasses the anthers but is still within the flower tube.

The fruit is a capsule with three carpels containing dark seeds.



Leucocoryne conferta

Leucocoryne angustipetala Gay (Alliaceae)

Leucocoryne angustipetala has bulbs with a diameter of 1.2–2cm that are covered by dark scales. The apex of the bulb continues into a thin neck 5-7cm in length that is covered by dry leaves.

The plants have two or three flaccid leaves 10–25cm in length. The leaves are glabrous, slightly fleshy, and 1.6–2.2mm in width.

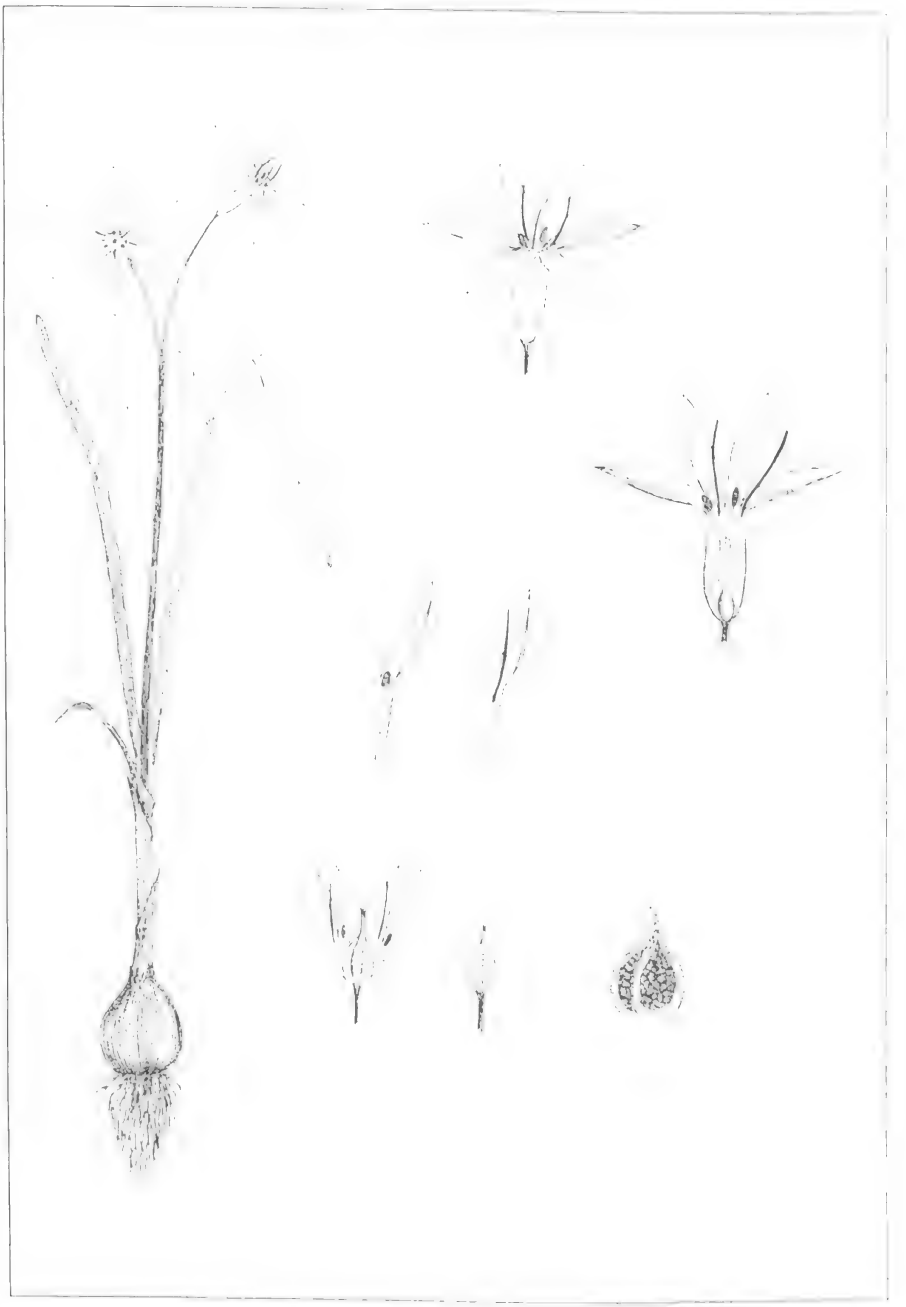
Each bulb produces only one flower scape which is cylindrical and erect, glabrous, 2–2.2mm in diameter and 20–30cm in height.

The scape terminates with two membranaceous valves which are joined at their base and lanceolate in form. The spathe valves are covered by many parallel nerves 2.5–2.8cm in length. This species generally has 2- or 3-pedicelled flowers, rarely more. Pedicels are cylindrically glabrous, thin, 3–5cm in length, and each pedicel has a small bract on its base.

The flowers are of a white color, with 6 tepals forming a tube on their base, with 6 free lobes in two series, three external and three internal. The tepal lobes are 0.8–1cm long and 2mm wide. On the mouth of the tepal tube there are three cylindrical small erect structures 2–3mm high with a slightly yellow color. Botanists have considered these structures to be sterile anthers. Three fertile anthers without filaments are fixed to the wall of the tube. The pistil has an ovary with three carpels; the style slightly exceeds the length of the anthers.

The fruit is a capsule which opens in three parts, containing 8–12 seeds, each of a dark coloration and an elongated form.

This species grows on ranges in the coastal cordillera at altitudes of more than 1,000m in open places in the woods in lightly shaded locations.



Leucocoryne angustipetala

THE TRIBE GILLIESIEAE (ALLIACEAE) IN CHILE

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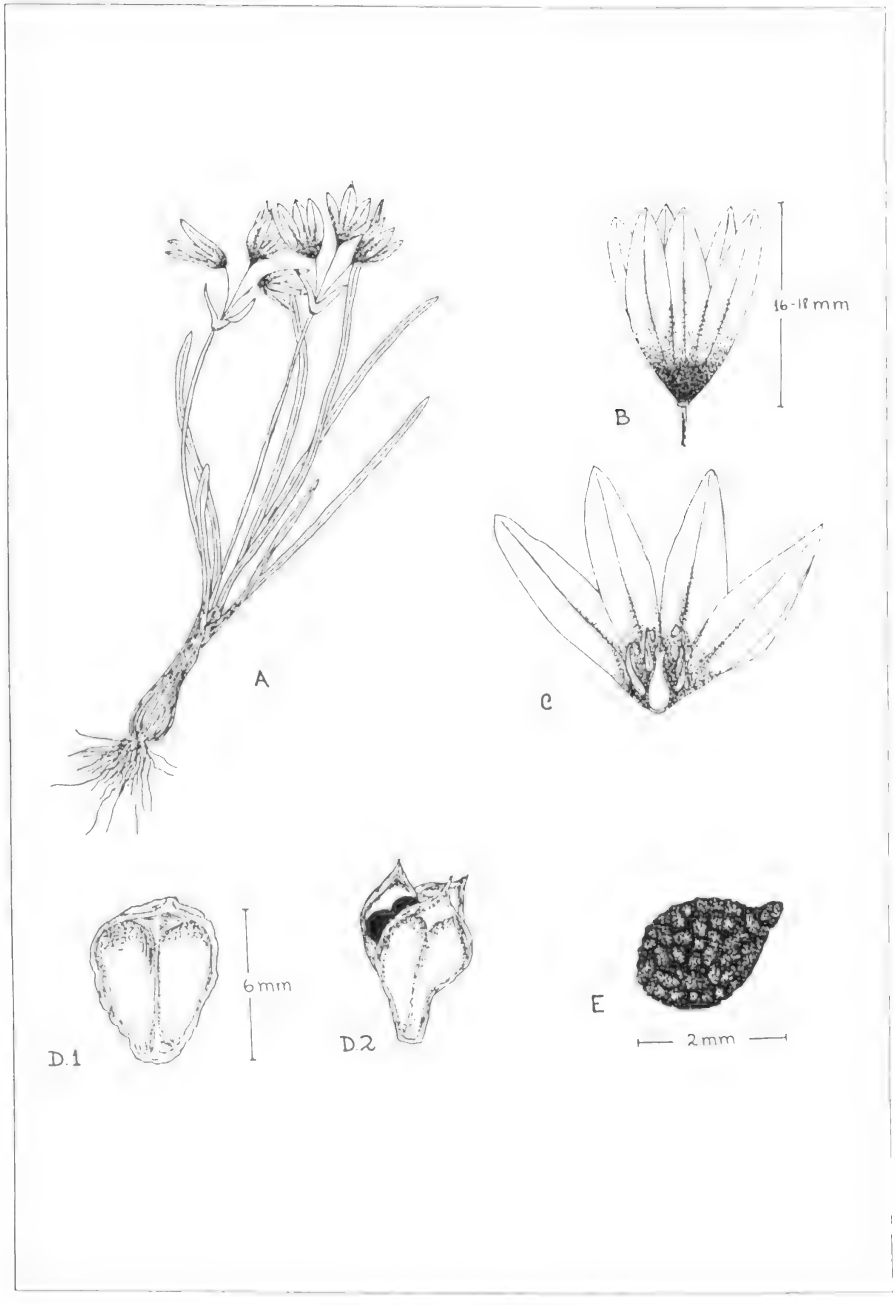
The tribe Gilliesieae includes a few genera of Chilean bulbous plants. They are endemic and generally monotypic. They do not embellish gardens or serve other ornamental purposes because their flowers are green like grass and plants do not exceed 20cm in height. But their morphological structure is obviously interesting and much appreciated by botanists. The Gilliesieae are spring blooming, often flowering in the last months of winter when there are no insects to affect pollinization. The flowers are usually shadowy and insignificant. No botanist has investigated the process of pollinization in this group of plants until now. We present a study of two genera.

Ancrumia cuspidata Harv. (Baker) (Alliaceae)

Ancrumia is an herbaceous bulbous plant with green flowers. The bulbs are 18-20mm high and 8-10mm wide and are covered with grey scales. The neck of the bulbs is cylindric, short, 15–20cm long, and is formed by layers of dry leaves. Each bulb has 5–7 leaves of different lengths, 7–18cm long, flat, glabrous, never exceeding the scape. Leaves have five parallel nerves and are a bit fleshy. The flower scapes are cylindric, glabrous, green in colour, 9-14cm long, finishing with the two spathe-valves joined for 2mm at their bases. The rest is green. The membranaceous spathe-valves are 15–16mm high and 2.5mm wide.

The pedicelled flowers are borne in umbels of 3-5 flowers. The pedicels are cylindrical, glabrous and 18–20mm long. The flowers are funnel-shaped with three exterior and three interior tepals. The tepals are lanceolate in form; the exterior tepals are 15–18mm in length, the interior tepals are a bit smaller. The six stamens are of different lengths and are on the edge of the tepal-tube. The stamens have introrse anthers, with filaments adhering at their bases to their tepals, they are part green. The filaments are encurved with yellow anthers. Gynecium with stigma is three-lobed, the style not exceeding the anthers and with a three-carpelled ovary. The fruit is a capsule with three valves. The fruits have many seeds which are black, 2mm long and 1.5mm in diameter.

Ancrumia cuspidata is an abundant plant in spring, growing in the provinces of Choapa, Limari and Elqui, but only in coastal regions. Its geographical distribution is 31°30' lat. S and its natural environment is slopes with open bushes.



Ancrumia cuspidata

Solaria miersioides Philippi (Alliaceae)

Solaria is an herbaceous bulbous plant with green flowers. The bulbs are 25–30mm in length and are about 1cm in diameter near the base. The bulbs are covered by grey scales. The bulb neck is short, cylindric and formed by the remains of old leaves. Plants have only two flaccid glabrous leaves between 20–30cm in length and 8–10mm in width. The scape is always shorter than the leaves, cylindric, with a height of 15–20cm. On its base there are two spathe-valves joined a bit on their base, 2mm. Spathe-valves are membranaceous with many thin parallel nerves.

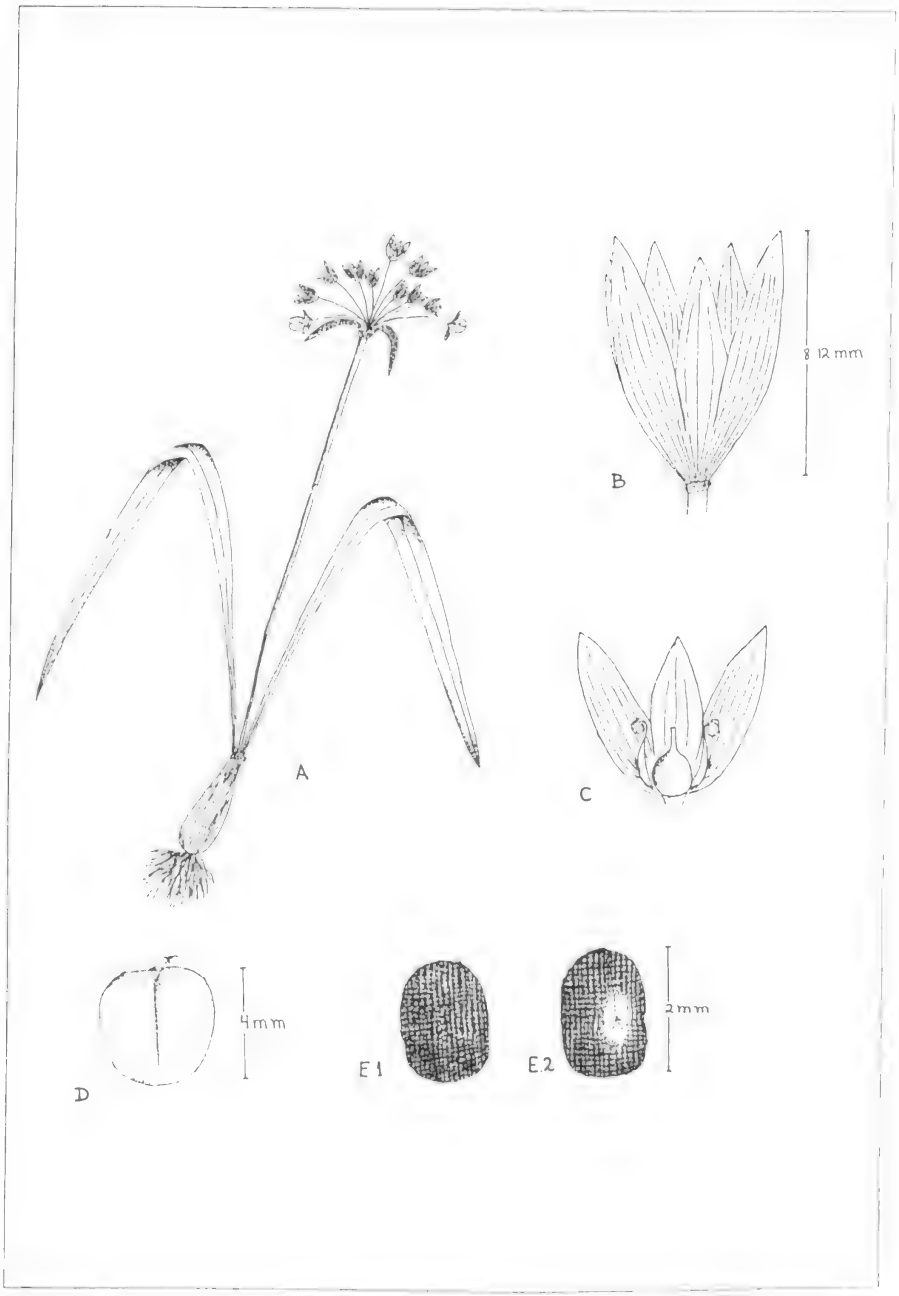
The inflorescence is an umbel formed by 5–13 pedicelled flowers; pedicels are cylindrical, glabrous, 0.5–4cm long. Each pedicel has a diminutive bract on its base. The flowers are funnel-shaped with 3 outer tepals and three inner tepals. The green coloured tepals are lineal-lanceolate in form, the outer tepals are 7mm, the inner tepals are a bit smaller.

The flowers have three fertile stamens with filaments with anthers and three filaments without anthers; stamens are curved to the tepals and are extrorse. The ovary has three carpels. The fruit is a spherical capsule with many black seeds. The seeds are 2.5mm long and 1.5mm in diameter.

Solaria miersioides is an Andine plant. We collected plants in Lagunillas, in the Maipo-Valley, Metropolitan Province at 2,200m. Plants grow between rocks.

The following characters differentiate these two endemic Chilean genera:

	Ancrumia cuspidata	*Solaria miersioides*
Leaves	5-7, erect	2, flaccid
Umbel	with 3-5 flowers	with 5-13 flowers
Length of outer tepals	1.5–1.8cm	0.7–1.2cm
Stamens	6 fertile stamens	3 fertile stamens and 3 filaments without anthers
Anther	Introrse	Extrorse
Distribution	Plants grow on slopes near the coast, in the IV Región	Plants grow on high Cordillera de los Andes at 2,000m in the Región Metropolitana



Solaria miersioides

GROWING AFRICAN BULBS

Gregg Pettit
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I am a relative newcomer to the world of African bulbs. I started my collection in 1984 and at that time grew only clivia. In 1991 Lionel Schroder introduced me to the beauty of our African bulbs and I was hooked for life. Soon thereafter I closed my retail nursery down and went wholesale. That was not the answer so a year later I turned full time to bulbs.

CYRTANTHUS

In 1945, a friend living in Southern Rhodesia (now Zimbabwe) gave Ray and Margaret Ansell bulbs of six different *Cyrtanthus* species: *C. mackenii, C. suaveolens, C. macowanii, C. obrienii, C. bicolor,* and *C. brachyscyphus.* They took them to their home in Northern Rhodesia (now Zambia) and from these bulbs **The Ansell Collection** was started.

In 1967 Ray and Margaret, as well as their two children moved south and settled in Durban, South Africa. Under permit, they brought a nucleus of their collection to South Africa and continued their hobby of developing the collection which now numbers well over 12 distinct cultivars. (From the original white, pink, yellow, coral, orange and red of the naturally occurring species and subspecies, Ray and Margaret developed and increased their collection until they eventually ended up with twelve cultivars.)

In 1995 Ray and Margaret kindly allowed me to take over their collection and I have moved it to Queensburgh, on the western outskirts of Durban, where I am carrying on with the Ansells' sterling work.

Species from the *C. macowanii* complex have the potential to become one of the best cut flowers in the world. They are small, compact and pretty as well as having a distinct scent. I think they are ideal for the restaurant trade in that they do not obscure the vision of people talking across the table.

I have bred dark yellows with green streaks, reds, and golden oranges that are displaying the erect flowers that I am looking for. However, although the flowers have a more fluted neck, they have shrunk in the process and once I have bred length back into them I will begin mass production.

I now have planted more than 30,000 bags of "Ifafa" lilies. Their original location here in Natal was at Ifafa Beach, hence their common name. I split and resplit every year and soon I hope to have

over 100,000 bags of *Cyrtanthus mackenii* plants.

I have at least 31 species and hybrids of *Cyrtanthus*. These are *C. clavatus, C. speciosus, C. obliquus, C. eucallus, C. sanguineus, C. spiralis, C. elatus* (pink and red), *C. tuckii* subsp. *viridilobus, C. montanus, C. loddigesianus, C. contractus, C. breviflorus, C. macowanii, C. bicolor, C. falcatus, C. epiphyticus, C. obrienii, C. brachyscyphus, C. sauveolens* and *C. mackenii* var. *mackenii* x various other *Cyrtanthus* resulting in white, cream, pale and dark yellow, salmon, orange, apricot, coral, light and dark pink, yellow with a red centre, red, and two new hybrids, an extremely floriferous gold and a blood red.

Cyrtanthus mackenii, C. epiphyticus, C. macowanii, C. bicolor, C. sauveolens, C. brachyscyphus and *C. obrienii* readily hybridise with each other and are most likely the easiest of all the *Cyrtanthus* species to grow. One needs a rich but sandy soil mix which is high in organics and manure or compost to get excellent flowering year after year. They enjoy being crowded and one large bulb of *C. mackenii* can produce up to 25 offsets in one growing season. They can be planted partially exposed but bigger bulbs are produced when the bulbs are sunk up to the neck. I always mix in coarse river sand so as to ensure good drainage.

In their natural habitat, *C. mackenii* used to grow on sand bars in the mouth of the Ifafa River on the Natal South Coast. Time and human exploitation have put paid to the idea of seeing any more of them there, but I know of a clump of *C. mackenii* subsp *cooperii* growing on a bank near Queensburgh, Durban. The roots are often kept wet during the rainy season but I must point out that they are growing in pure river sand so the drainage is very good.

Cyrtanthus sanguineus and *C. eucallus* flower from mid to late summer and all they need is to be half covered and left to dry out on occasion. They need cross-pollination to ensure seeds. However, they readily form offsets so one can still have a thriving but self-sterile colony within a few years.

CRINUM

Twenty eight species and hybrids of mostly African *Crinum* are my pride and joy. I have struggled to get the better ones and spend every spare cent on locating and buying in new species.

To date I have the following species: *Crinum baumii, C. nerinoides, C. buphanoides, C. moorei, C. moorei* var. *alba, C. kirkii, C. firmifolium, C. subcernuum, C. campanulatum, C. paludosum, C. acaule, C. lineare, C. variabile, C. macowanii* (all three forms), *C. graminicola, C. elagoense, C. forbesii, C. lugardiae, C. bulbispernum, C. asiaticum, C. abyssinicum, C. scabrum, C. indica, C. bracteatum,* and two others that I still have to identify. I also have many hybrids,

including x *Crinodonna* and 'Red Mogul', two cultivars that were produced by the Europeans and Americans.

Many *Crinum* are suited to pot culture and not all are "landscaping" plants. *Crinum acaule, C baumii* and *C. nerinoides* are all suited to the small pot. *Crinum moorei, C. macowanii, C. delagoense, C. forbesii,* etc., all thrive in large pots in my shade house. I prefer to keep *Crinum* stock plants in pots or bags as growing conditions such as water, food and pests can be controlled more effectively.

However, I do have 100 stock plants each of *C. macowanii, C. moorei* and *C. delagoense* growing naturally in the open ground.

I have succeeded in crossing *C. delagoense* with *C. graminicola* and *C. macowanii* and the F_2 seedlings are now in their second year.

My tropical *Crinum* are mostly small but I have some mature *C. kirkii* that I hope to cross with *C. macowanii* and *C. delagoense* in 1997. The *Crinum firmifolium* from Madagascar is my fastest growing species—from seed to flowering stage was just three years. That could be due to the fact that I live on the Natal coast. We have temperatures in the 30's [C] and humidity often reaching the 70% ± range. I have crossed *C. firmifolium* with *C.moorei, C. macowanii* and *C. delagoense* and so far the takes have been rejected. *Crinum firmifolium* has pale brown recurved petals that are very narrow and the flowering stem lies on the ground.

My *Crinum moorei* range in colour from white to dark pink and the petals from campanulate to recurved. Some of the flower stalks are over 1.2 metres in height. This often poses a problem with the wind that breezes up the valley. Subsequently, I once staked the stems after hand pollinating them. That caused a second problem—it became a source of fun for the monkeys who took to jumping in the staked field resulting in mashed foliage and snapped off stems. Now I take my chances on the wind.

Successful growing and flowering of *Crinum* depend on many factors and some of my *Crinum* produce flowers and seed year after year. *Crinum macowanii* is, for me, one of the easiest to cultivate. All I have to do is ensure that well-rotted manure and compost are piled around the roots every spring and then nature takes over. *Crinum macowanii* occurs naturally on my land. Every year my 100 or so stock plants of *C. macowanii* produce about 50 flower heads during the first flowering and then about 20 during the mid-summer flush.

Except for *C. moorei,* all of my *Crinum* need good sunlight to flower. The *C. moorei* are kept in my small forest and are adjacent to, and in between, two periodical streams. At the top end of the stock-plant bed is a small spring that flows for about 6–9 months a year. Thus the *C. moorei* are kept damp and in 95% shade. There

they do even better than the *C. macowanii* in that I have a flower crop of over 80% in early and mid-summer. The first to flower are variety *alba* and at the tail end of the season my standard pinks start to bloom. Even though I know that variety *alba* is the most sought after of the *C. mooreii* forms, I still prefer the pinks. Their show is more striking. Once again spring is the time of the year when they get a good top dressing of compost and manure.

I plant *Tagetes minima* [marigold] amongst my *Crinum* species. This keeps the amaryllis caterpillar away. *Tagetes* is commonly known as Khaki bush and is a member of the daisy family.

My *Crinum delagoense, C. forbesii*, and *C. graminicola* all flower in mid-summer. The bulbs are, by and by, much larger than those of *C. macowanii* and need to be planted with only the short neck exposed. The soil mix has 50% river sand added in since *C. delagoense* and *C. forbesii* occur in and on the sand dunes of Zululand. They grow in semi-shade and the soil is always well drained. The *Crinum delagoense* leaves are flaccid and broad.

In passing, the only plants planted into the open ground on my land are those which do or did occur in the Durban area (I live in Queensburgh which is part of Durban). My land is four and one half acres in extent and the plants in my forest could all naturally occur in the region. Hopefully, before I get too old, it will once again be a pristine coastal sub-tropical dune forest.

DIERAMA

I have the following 14 species of *Dierama* in my collection: *D. insigne, D. pauciflorum, D. tyrium, D. igneum, D. luteoalbidum, D. pallidum, D. dubium, D. dracomontanum, D. medium, D. floriferum, D. nixonianum, D. trichorhizum, D. erectum* and *D. reynoldsii.*

All except *Dierama medium* occur naturally in Natal. The only one that is difficult to sustain in cultivation is *D. dubium*. I strongly feel that some of the species should be lumped together because whenever I send specimens for identification the result comes back with a "CF"(check for). Now, in my opinion, if the experts cannot separate the species with any degree of certainty, then the need to keep, for example, *D. nixonianum, D. igneum*, and *D. floriferum* separate seems questionable.

I was lucky to meet a person who had a colony of *Dierama dubium* on his farm. As some of you will know *D. dubium* is on the CITES Red Data list. In November 1994 I collected seed from the colony and about 100 seedlings came up. All went well until I gave them a good watering after which they all rotted away. The following year saw a new collection of seedlings of this species. These were doing well until winter when they all disappeared. They had gone

dormant. For those of you wondering why I am making an issue of water and dormancy, *Dierama* are described as evergreen and occur in damp areas. However, I learned the hard way that *D. dubium* is the exception to the rule.

The only other place that I have ever seen *Dierama dubium* is on the top of a 100-acre or so plateau. There, the flowering stalks are only 30–60cm long as opposed to their normal 75–150cmm. This is nature's way of compensating for the high winds that blow up there. That difference alone is not sufficient to warrant a new classification.

A damp sunny spot seems to be the best place for dieramas. *Dierama floriferum* and *D. igneum* occur naturally in damp clayish soil. I have copied that on my land and the result is good flowering. However, the specimens that I have bagged in a bark and river sand mix also flower equally well so perhaps *Dierama igneum* and *D. floriferum* will flower in almost any damp and sunny situation. I have found that if the back corms are removed from the mother plant they will sprout and form new plants. This means that if a bag of *D. igneum* is broken up into separate corms a person can end up with as many as six new plants per growth point. Even *D. dubium*, which consisted of a leafing corm and two back bulbs, gave me a total of 3 plants.

In a good year a clump of *Dierama* can double its number of corms so very soon one could have a garden full. Of course you must realise that I speak for collectors who live in climates similar to mine (hot and humid).

In January 1997 I saw *Dierama luteoalbidum* ripped up on a site near Pinetown, just outside the Durban metropolis. When *Dierama* are not in bloom they resemble blades of grass and the bulldozers had moved in to clear the grass patch for a housing development. I knew where the dierama plants were and had, in fact, been coveting them for the past 2 years. One can imagine my sorrow upon finding "my" patch of 9 or 10 *Dierama luteoalbidum* lying exposed to the sun. If I am lucky a few of the rescued plants will survive.

CLIVIA

I have over 20 forms of clivia ranging from 'Natal Yellow' to various yellows, from pale orange to dark reds and from a single stem with 7 flowers to a giant double stemmed orange with 35 flowers on each pedicel. Some flower petals are narrow and recurved whereas others are broad and semi-campanulate. Some flowers have yellow centres; others are snow white. At one time I was photographing all the forms but it seems as if no two flowers are identical.

'Natal Yellow' is a creamy-white with a yellow centre. It always forms red seeds and is not a genetically pure yellow (as are the dark

yellows). That is where the confusion comes in with regards to seed setting true to form (**HERBERTIA** 1985, page 30). The original clump was found near Howick. It seems to me that 'Natal Yellow' is in fact an albino of sorts in that it has the ability to produce "normal" orange offspring. This can be seen in humans as well, as an albino can produce normal children. The lack of pigmentation is recessive. My dark yellows set true to seed and always produce yellow offspring.

Clivia are relatively easy to grow, needing only a frost free environment, plenty of shade, and a soil mix high in humus. I have succeeded in getting clivias from seedling to flowering stage in three years. I start off with 15 seedlings per bag and the second year they go one to a bag. For the third year they go into open ground and then they are sold.

In 1995 I planted just over 30,000 seeds so my crop should now be big enough to supply my local market. I have just over 2,000 stock plants of *Crinum miniata;* from them I collect about 10,000 seeds every year. This year I will be buying a further 40,000 seeds so perhaps in two years' time I will be exporting clivia as well. *Clivia gardenii* and *C. caulescens* are not at all popular in South Africa but I have a small market for them in the USA, Japan and England.

I have a six-month show of *Clivia* blooms every year but at any time of the year I always have at least one flowering plant. The first to flower are plants of *C. caulescens.* They start flowering in May and the 1,000 plants are crowded together in a small 500 square foot bed. The red with green- and yellow-tipped flowers are pendulous and resemble the flowers of an aloe. They last about six weeks and before they end their season the *C. gardenii* begin flowering. *Crinum gardenii* is larger but not so pendulous. The flowers are semi-erect and lack the vibrant red of *C. caulescens.* Their flowering season also lasts about six weeks and before they have completed their cycle the *Clivia miniata* begin flowering. *Clivia miniata* var. *citrina* begins flowering in August/September but I move the plants into the house to ensure no cross pollination takes place. I hand pollinate the yellows and that is why I get 100% yellow offspring.

Clivia miniata flowers from August/September and the main season is over by October. That is when the second flush of flowers appears. I have about 50 *Clivia miniata* that throw two sets of flowers every year. They are marked and I use as much of their pollen for cross pollination as I can manage. Likewise, the *Clivia* that produce more than 26 blooms per stem are also used for hand pollinating.

Some of the supposed crosses with *Clivia* and other amaryllids I am taking with a pinch of salt. For that statement I am going to get shot out of the sky but so be it. I have *Clivia miniata* with green

streaks, *Clivia* that are scented and naturally occurring hybrids between *C. gardenii* and *C. miniata*. The last mentioned hybrid is easily made in nature.

The various species of *Clivia* occur together naturally. From May to July in Natal the people burn the fields so as to ensure good soft grass for their cattle in spring. If the fire escapes and burns the forest then the *Clivia* will be stimulated into flowering. That is nature's rule of survival. So at such times, *C. miniata* and *C. gardenii/ C. caulescens* are all flowering together. The forest pollinators are not fussy...pollen is pollen. A cross is now available in the trade named x *C. cyrtanthiflora* that carries recessive dark yellow or green colouring. Sooner or later that yellow or green will show in the *C. miniata* that is now been crossed back with its own species in its own flowering season. That is how my *Clivia* get their green colouring. It would therefore be theoretically possible to have a pure green, yellow or red *Clivia* carrying F_1 chromosomes for that colour. In fact, I have a *C. gardenii* that is almost pure yellow and has less than 2% green showing at the tips.

The basic colouring of *Clivia gardenii/C. caulescens* is yellow and red with a green tip that fades with age. That could be why pure yellow and red clivia occur and the pure green occurs in rumour and legend only. I was shown the so-called scented clivia and my natural clivia sometimes have the same scent.

Since my neck is already on the block, I will go one step further and suggest that it is high time that *C. caulescens* and *C. gardenii* were subbed into *C. nobilis*. *Clivia nobilis* was the first of the three to be discovered and I will take any botanist into the natural pristine forests and show him all three growing in the exact same area. I will point out *C. gardenii* with serrated margins and *C. nobilis* with entire margins as well as *C. caulescens* and *C. gardenii* with pseudostems.

BRUNSVIGIA

I have the following twelve species of *Brunsvigia: B. appendiculata, B. bosmaniae, B. comptonii, B. grandiflora, B. gregaria, B. josephinae, B. littoralis, B. marginata, B. minor, B. natalensis, B. orientalis* and *B. undulata*.

One of the most spectacular flowers in Natal has to be *Brunsvigia undulata*. Out of the green grass of summer appears an 18- 24 inch umbel bearing up to 35 dark wine-red flowers. From afar it appears as if someone has polluted the veld with bright material but on closer inspection the truss and semi-flaccid leaves are thrust at you. The clear pink flowers of *Brunsvigia natalensis* growing alongside the highway make for interesting viewing but to stop to inspect

is to invite a fine from the police since it is illegal to stop on the national freeways.

That is something that I have first-hand experience with. In 1993 I stopped alongside the N2 Highway to photograph *Eulophia speciosa*. It was a Sunday and the road was empty. I had no sooner stopped when a carload of officious twerps pulled up and started their "official prattle". I am not known for my tact or diplomacy and told the police officer that he was messing me around on a Sunday. I guess my choice of words was not the best. Anyway, I ended up in jail for *crimen injuria*. My family bailed me out of jail and after two court appearances the case was thrown out of court. The judge lectured me on the disadvantage of having a sharp tongue and then dismissed the case. I still stop on highways but now I open my hood and if I am harassed again I will just say that my vehicle has a problem.

I find *Brunsvigia* very easy to grow but almost impossible to get to flower. The micro-climate around here is too hot. Natal *Brunsvigia* need a cold winter to enable them to bloom. I cheat and use my refrigerator to get cold loving bulbs to go dormant. This works well but, as you can imagine, my wife is not amused. I have been sent five forms of *Brunsvigia* from the Cape Province so perhaps they will flower for me this winter. All come from the coastal areas of the Cape and do not need so much cold as the native Natal plants do.

South Africa is a developing country and as such there are always new roads and dams being built as well as large areas that get cleared for development. In many areas in South Africa, you can get permission to go in and rescue plants before construction actually begins. This has proved to be a great source of material for me. At all times the golden rule needs to be observed—you can collect but you may not sell the plants collected. However, they can be used for breeding and the offspring can be sold legally.

Permits also need to be arranged beforehand with the relevant conservation board. This ensures that dubious "rescues" are not arranged by collectors and dealers. This has occurred in the past, especially with regard to the rescue of cycads and orchids.

SEED GERMINATION AND EARLY GROWTH OF *HIPPEASTRUM* SPECIES AND HYBRIDS IN WATER

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Germination of *Hippeastrum* species and hybrids in water is particularly easy and successful. It is most surprising that little attention appears to have been given to this particular medium for germination and early growth. This paper details the success I have had with growing *Hippeastrum* species and hybrids from seed and describes the various stages for successful growth.

Hippeastrum seeds from the large flowering red 'Jumbo Striped', and 'President Johnson', a large white hybrid with lime green throat and a red picotee were harvested April–June 1996. Both hybrids produced many viable seeds with 80–100% germination rate being obtained when sown 2–3 months after harvesting. Seeds also were obtained of four *Hippeastrum* species—*H. elegans* and *H. stylosum* in August 1996 and *H. bifidum* and *H. elwesii* in January 1997—again good germination rates were obtained after being sown immediately upon arrival from overseas. These seeds had been freshly harvested.

HARVESTING OF SEEDS

Seeds are ready to be harvested when the fruit (capsule) has split, revealing three distinct chambers, each of which usually is filled with large dark brown/black papery disc-shaped seeds. The papery outer coating is not unlike burnt tissue paper. In the centre is a hard raised object which is the seed.. The number of seeds per capsule can range from as little as 20 to over 80. Size and shape of seeds varies markedly among *Hippeastrum* species and their hybrids. In the case of 'President Johnson' I have found the number of seeds per capsule to be particularly high, ranging from 60- 85 seeds per capsule, whereas 20–45 seeds per capsule seems to be the norm among many of my *Hippeastrum* hybrids.

PREPARING FOR SOWING AND/OR STORAGE

Before planting or storing seeds, seed viability should be determined. Those having only the outer papery covering and no hard raised central portion should be discarded. In the centre of the papery outer layer is a hard raised object—this is the seed. Fragments which are abnormally small and shrivelled inevitably do not contain viable seeds. This can be most disappointing.

Having identified viable seeds, allow them to dry in the open air for 24 hours before carefully placing them in a paper envelope since, rather like a newly emerged butterfly, they are damp at first.

Seal and label with the name of the species/cultivar and date when harvested. Place the envelope in a plastic bag and store in the refrigerator at a temperature of 32–37°F (0–3°C). Seeds can also be stored in a jar containing a desiccating agent (silica gel) but it is important to check regularly and to replace with fresh silica gel as and when necessary. I have found no loss in viability after four months. It is advisable to check the seeds at monthly intervals to make sure no dampness from the refrigerator has permeated the envelope and damaged the seeds. If moisture has penetrated, providing there is no evidence of damage, allow the seeds to dry off and place them in a fresh envelope.

In the case of seeds received from overseas, either plant them immediately upon receipt (with luck they will have been freshly harvested) or store them in a refrigerator as previously described until you are ready to plant.

SOWING

Fill a clear glass jar (a jam jar is ideal) three quarters full of tap water and sow the seeds on top. Then place the jar in a light and warm position—a conservatory is a prime spot for this. An ideal temperature is 69°F (21°C). Germination normally takes place within 2–20 days, but I have found that the majority of seeds germinate in 4–10 days. During this period, some may sink towards the bottom of the jar, particularly when fresh tap water is added to top up the jar. This does not seem to be detrimental to healthy growth; root and foliage development continues and can be most vigorous. Remember to keep the jar topped up with water. I have found that after a month when the first leaf is about 2cm long, a second root has sometimes appeared. At this time I have potted up the young seedlings since the plants now benefit from extra nutrients and there is the danger of the seed rotting if it is kept in water any longer. A thick green slime may develop at the bottom of the jar. Carefully remove the seedlings and thoroughly clean the jar before refilling with fresh water and replacing the seedlings.

Studies carried out in summer 1996 to determine the effects of gibberellic acid upon germination of freshly harvested seeds revealed that soaking in either concentrations of 10mg or 100mg per litre for 58 hours prior to sowing in tap water had no effect whatsoever upon germination rates. Since *Hippeastrum* seeds are easy to germinate, there would seem to be little point in applying hormone treatment at this stage.

POTTING UP

Plant the young seedlings into a light sandy soil in 3 inch pots, four to a pot and water in well. A planting mix of Irish moss peat,

coarse sand and grit in equal parts has proved most successful. Plants are fertilised fortnightly with a complete liquid fertiliser containing the trace elements once they have become established. It is vital that salts do not build up in the soil so I administer the fertiliser at half the recommended strength. I have found that a well balanced liquid feed of nitrogen, potassium and phosphate has proved very successful to promoting good foliage and this is administered throughout the period of foliage development.

The plants should be placed in a light and warm position at a temperature of around 70–77°F (21–25°C)—a shelf above a radiator is ideal. The young plants thrive particularly well at temperatures around 77–81°F (25–27°C). Endeavour to keep the plants growing throughout their first and second winters; if this proves impossible reduce the amount of water but never allow the soil to dry out. I have found that many of my seedlings have died back of their own accord during late Autumn/early Winter (November/December). Resume regular watering and fertilising when new growth commences early the following spring—this tends to be around the end of January to the beginning of February in the U.K.

0–13 WEEKS OF GROWTH

Within 6–19 days of sowing a first leaf has usually appeared followed by a second leaf after about 7 weeks. A third leaf appears approximately six weeks later (week 13). The leaves grow rapidly, each one increasing in width and, in the case of many of the large hybrids, the leaves are a bright glossy green and are miniature versions of mature leaves. Leaves of *Hippeastrum* species can be markedly different from hybrids as regards colour and shape, *e.g. H. stylosum, H. elwesii* and *H. bifidum* all put forth the first leaf quickly after germination has taken place. They resemble thin blades of grass and are bright green. On the other hand, *H. elegans* leaves are slightly thinner than *Hippeastrum* hybrids and are dull green.

ADVANTAGES OF SOWING SEEDS IN WATER

There are significant advantages to sowing *Hippeastrum* seeds in water:

1. Any signs of fungal growth can be detected immediately and affected seed/s removed before other seeds are contaminated.
2. Problems associated with soil infestation and possibility of soil drying out are avoided. Soil drying can be a problem particularly during the hot summer months.
3. Only healthy plants with an established root structure and foliage are transferred into a suitable potting medium and grown on. Plants quickly become established and growth can be

most vigorous during the summer. Sowing in March/April is recommended as this will give seedlings maximum time to become established before autumn. Plants which have bloomed during January and February have produced seed by March and April. Seeds produced from May to July also will do very well if planted straight away in tap water.

4. Sowing in water in a clear jar and placing in a light position enables photosynthesis to take place from the earliest possible stage in the plant's development and healthy foliage is produced from a very early stage.
5. From a microscopist's point of view, it is most interesting to be able to observe the development of the young plants from their earliest stages. If microscopical studies are to be carried out, then growing in water enables the seedlings to be removed easily from the water without damaging the delicate organs.

CONCLUSION

Germination in water is cheap, easy and successful and is highly recommended for early growth of *Hippeastrum* species and hybrids.

SURPRISING HIPPEASTRUMS

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Stimulated by Charles Hardman's article "Trends in Modern Hippeastrum Hybridizing" (**HERBERTIA** 52, 168-178, 1997). I will risk telling about my modest experience with hippeastrums.

Our starting point was to doubt some of the published facts, which are found in the literature, *i.e.* minimum size of bulbs for flowering (20cm, Okubo, 1993), minimum number of leaves until the first flower and time of induction of a flower until emergence of the stalk (8-14 months, Rees, 1992). In German books we find that plants will flower earliest after 3 years, although Rees and Okubo stated that seedlings may flower after 18-24 months and offset after 2 years.

The second starting point was the fact that many people in Germany do not prefer the big flowering cultivars, but prefer hybrids with smaller flowers. These hybrids are known under the name "*Hippeastrum gracilis*". That is not a valid botanical name, but rather the name of a group of hybrids which were developed by H. Boegschoeten from the Netherlands and distributed by van Meeuwen about 40 years ago. Boegschoeten used a hybrid of *Hippeastrum rutilum* by a *Hippeastrum* hybrid and produced backcrosses with *H. rutilum*. This species (also *H. striatum*) is native to Brazil and has small bulbs of 5-7.5cm in diameter and two- to four-flowered umbels. Gracilis hybrids can bear two or three flower stalks with four to six medium-sized flowers (Okubo, 1993). For our experiments we used seeds from self-pollinated 'Donau', a medium-sized Gracilis hybrid. Seeds were sown February 5th, 1994, and potted in July, 1994. They were grown either under natural daylight and daylength at greenhouse temperature of 20 C or with supplemental light (sodium high pressure, 3 Kilolux 16 hrs per day) and bottom heat (26°C). Offsets were not removed during the following three years. Plants were fertilized with liquid fertilizer and repotted into 3-5 liter containers. What happened with the plants?

GROWTH AND OFFSETS.

As expected, growth of seedlings and offset formation was quite variable. Growth of bulbs was strongly influenced by supplemental light and higher soil temperature (Fig. 1). The average diameter of bulbs grown under those favourable conditions was 58 ±8mm (about 18cm circumference) after 16 months instead of 40 ±7mm (about 12.5cm in circumference), (lower part of Fig. 1) without bottom heat

and supplemental light. Variability of bulb growth, however, was high: Under favourable conditions more than 5% of the bulbs from a total 252 seedlings did not reach a circumference of 14cm and nearly 5% of the bulbs grew up to a circumference of more than 22cm. Production of offsets was as highly variable as bulb growth (Fig. 2). Some of the seedlings (about 5%) produced none or only one or two offsets within two years and nearly 5% of the plants each produced more than 27 offsets!

Offset formation did not influence bulb growth: there was no correlation between number of offsets and bulb diameter! Therefore it should be possible to select seedlings with either strong bulb growth without offset formation or strong bulb growth with extremely high offset production. Strong or weak bulb growth and rate of offset formation seem to be fixed genetically but independent from another. Really, offset production may be a typical attribute of a variety: About 25 years ago nearly 250 varieties were tested at Naldwijk/Netherlands for the production of offsets and only 8 varieties produced more than 10 offsets (after Okubo, 1993).

FLOWERING

The following observations were made only with the group of plants which were grown under favourable conditions. The most surprising thing was the fact that some seedlings (19 plants =7%) flowered without precooling in May and June, 1995, with an age of 15–17 months, with an average bulb diameter of less than 57mm. All the plants therefore were dried out during August, 1995, and stored dry at 15°C for nine weeks. At the end of the storage period the plants were 21 months old and were grown in a greenhouse at 20°C with supplemental light. After flowering in November and December the plants were repotted and grown again with bottom heat and supplemental light until dry-cool treatment from September to November, 1996. Flowering period was December 1996 and January 1997. After three years from the date of sowing it was possible to evaluate the productivity in flowering.

Let's first have a look at the 19 seedlings which flowered before cooling. All plants produced a second flower scape within a few days after cooling and seven plants produced a third flower scape. Average number of flowers per stalk was 4.1, average length of flower scape 41cm. After the next growing period, including eight weeks cooling, they flowered again and some of their offsets flowered also. Three years after sowing the total yield of flower scapes allow the 19 plants to be placed into four groups (Table 1.), which can be characterised by higher and lower yield of the main bulb, from the offsets and the bulb diameter. It is seen that higher or

lower productivity of the main bulb may be combined with either higher (group 1,3) or lower productivity of the offsets (group 2,4). Bulb diameter may depend more on the productivity of the offsets: higher rate of flowering offsets seem to be correlated with smaller bulb diameter, although the differences are not statistically significant. I think it is remarkable that within three years from sowing there were five plants which produced 27 flower scapes from the five main bulbs and additionally 31 flower scapes from their offsets! This seems to be in contrast with the dogma that one inflorescence needs 8-14 months from induction to emergence or that seedlings need at least 18 months to reach flowering size and so on!

Now let's have a look at the whole progeny of our self-pollinated 'Donau'. The growing procedure was the same as for the group of 19, but this group included 185 seedlings. The total yield of flower scapes per plant is shown in Table 2. It is remarkable that 11 plants (nearly 6%) produced only one or two flower scapes per plant, but 78 plants (about 43%) produced four to five scapes per main bulb and six or more totally. It is seen that increasing total yield is caused by increasing number of flower scapes from the offsets. It is useful, to divide the total yield into flowers, coming from the main bulbs and from the offsets and to look at the distribution of this character. From Fig. 3 it is seen that the yield from the main bulbs (left part) ranged from 0 to 7 scapes and is distributed normally. The average is about four, but 12 individuals produced six or seven scapes. Distribution of plants with flowers from offsets shows another character: more than 40% of the plants did not produce flowers from offsets, but 10 offsets produced six or more flowers! And again we can demonstrate the hypothesis that productivity of main bulbs may be combined with productivity of offset formation and flowering. In our example, we use only those plants which produced either five flower scapes per main bulb or three within three years. Within these two groups we find again two subgroups with either higher or lower yield from offsets (Fig. 4). We may assume that there is a genetic background here at work and therefore it should be possible to select genotypes with high productivity of the main bulb—without changing flowering offsets or high productivity of both main bulb and offsets. Five or six scapes per main bulb plus five or more from offsets within three years are only possible if rapid growth and differentiation of flowers in an early stage of development are combined with a high rate of offset production.

BULB DIAMETER AND FLOWERING.

Bulb diameter is commercially important, because bulbs are sold in different grades, *i e.* 22/24cm (circumference) or more. The expected yield per bulb is 1 stalk for 22/24cm graded bulbs, 1.5 for

24/26cm graded bulbs, and 2 for 26cm up bulbs. Therefore, we have measured the correlation between bulb diameter and subsequent following yield of flower scapes for two years and the increment of bulb diameter from 1995 to 1996.

After the 1995 cooling period only six plants produced three flower scapes and nine plants produced nothing. The average diameter was 63mm and 44mm, respectively. That is not enough to demonstrate the mentioned correlation, but the 1996 measurements should give better data. There are two ways to control the hypothesis: First, to grade the bulbs commercially by using the bulb diameter before cooling in 1996 and then to calculate the average number of flower scapes. The second way is to calculate the average bulb diameter from bulbs with 1, 2, 3 or 4-5 flower scapes. Results of both methods are shown in Tables 3 and 4.

Although there are significant correlations between grading and average number of flower scapes per bulb (Table 3, $r = 0.91$) or yield of flower scapes and average bulb diameter (table 4, $r = 0.98$), it is clear that bulbs with two flower scapes may be found in all gradings of Table 3 or bulbs with 1-4 scapes may be graded 22/24cm! If we calculate the correlation over all bulbs (not only for the 7 or 4 average values), we find a coefficient of correlation of only $r = 0.414$, which is significant, indeed, but only 17% of the variation of the generic character "yield" may be explained by the variation of the bulb diameter. Dependence of yield from bulb diameter therefore is unimportant, because we cannot decide, whether a bulb of grade 22/24cm will produce one, two or three flower scapes. We have, therefore, to test, whether high productivity is genetically fixed.

FLOWER QUALITY

Quality of flower scapes will not only depend on length and strength of the scape, but also on the number of flowers per scape. From nearly 700 inflorescences coming from the main bulbs, more than 50% had four flowers, only 15% had three or two flowers, but 25% had five and about 7% had six flowers. The average number of flowers per scape varied plant to plant and ranged from 2.5 to 6.0.

Therefore we selected two groups of 12 plants with a total yield of at least four or five flower scapes within two years (total 54 scapes per group) which had either many flowers or only a few flowers per umbel (Fig. 5). The average number of flowers per scape was either 5.3 ± 0.7 or 3.1 ± 0.8. This difference is significant, while the differences between the 12 plants within each group were not. We may assume again that number of flowers per umbel may be fixed genetically and selection for plants with five or six flowers should be possible.

CONCLUSIONS

In early February, 1997, we selected several groups of plants for different characters (Table 5) and separated the offsets. Original seedling bulbs and some of the biggest offsets were grown under supplemental light and with bottom heat. Up to now (early November, 1997), it is clear that in the sample bulbs which were selected for their ability to produce a lot of offsets, they did so again after detachment during the 1997 growing period. Others selected for strong bulb growth demonstrated again their ability for rapid growth. Perhaps it is possible, to tell something of the results of our selections in the 1999 issue!

To summarise: Since some of the desirable characteristics are fixed genetically, and as some of the nondesireable characteristics also are fixed genetically, it is possible to select seedlings with similar characteristics, *i.e.* average number of flowers per umbel, strong growth of bulbs, early flowering, high number of early flowering offsets and so on, and use this material for breeding purposes. After stabilizing the desired characteristics, it may be possible to propagate selected plants vegetatively to produce new cultivars.

LITERATURE

Okubo, H. 1993. *Hippeastrum* (Amaryllis) in: De Hertogh, A. & M. Lenard, (Editors) **The Physiology of Flower Bulbs**. Elsevier, Amsterdam, London, New York, Tokyo.

Rees, A.R. 1992. **Ornamental Bulbs, Corms and Tubers**. C:A:B: International Wallingford, UK.

Table 1. Total yield of flower scapes within three years of 19 early flowering hippeastrum seedlings.

Group	Average number of scapes Main bulb	offsets	total	bulb diameter mm
1	5.6	6.2	11.6	66
2	5.8	0.5	6.3	72
3	4.0	2.2	6.2	67
4	3.4	0.4	3.8	76
HSD 5%	1.4	2.1		not significant

Table 2. Yield of flower scapes within three years of 185 'Donau' x 'Donau' seedlings.

Total yield per plant	Number of plants absol.	%	Average yield from: main bulbs	offsets
1	4	2.2	1.0	0
2	7	3.8	1.9	0.1
3	29	15.7	2.9	0.1
4	37	20.0	3.7	0.3
5	30	16.2	4.1	0.9
6	27	14.6	4.4	1.6
7	15	8.1	4.5	2.5
8	17	9.2	4.5	3.5
9/10	8	4.3	5.4	4.0
>=11	11	5.9	4.7	7.0

Table 3. Average yield of flower scapes after the second cooling period of graded 'Donau' x 'Donau' seedlings.

Bulb Grade No.	Bulb Circum-ference	Bulb Diameter mm	No. of	Average no. stalks	Coeff. of variance	Number of stalks
1	below 16	51	9	0.9	67.6	0-2
2	16/18	51-57	20	1.8	34.2	0-3
3	18/20	57-65	34	2.2	30.9	1-3
4	20/22	64-70	52	2.3	27.7	1-4
5	22/24	70-76	33	2.4	36.1	1-5
6	24/26	76-83	23	2.5	36.4	1-4
7	26 up	83	14	2.8	35.0	1-4

Table 4. Number of seedlings with 1 to 4/5 flower scapes and corresponding bulb diameter and commercial grades.

Number of seedlings	With yield 1996/97, no. of stalks	Bulb diameter in mm	Commerical grades
24	1	63 ± 11.5	16/18-22/24
96	2	67 ± 9.0	18/20-22/24
52	3	71 ± 8.8	18/20-24/24
10	4/5	79 ± 7.6	22/24-26 up

Table 5. Average data of selected hippeastrum seedlings.

Motive for Selection	No. of selected plants	Total yield scapes/pl	No. of flowers/ umbel	bulb incre-ment, diam. in mm	No. of offsets 1977
High total yield (scapes)	17	10.8a	4.2c	8.0c	18.3c
High no. of flwrs/umbel	11	6.2b	5.4a	11.0c	19.1c
Low no. of flwrs/umbel	6	7.0b	2.9b	8.5c	17.6bc
High bulb increment	8	3.6b	4.0c	28.0a	7.8bc
Low bulb increment	11	5.6b	3.8c	0.5b	19.7c
High no. of offsets	5	5.8b	4.3c	11.4c	41.6a
Low no. of offsets	10	5.7b	3.9c	16.7c	4.8b

Values with the same index letter do not differ significantly.

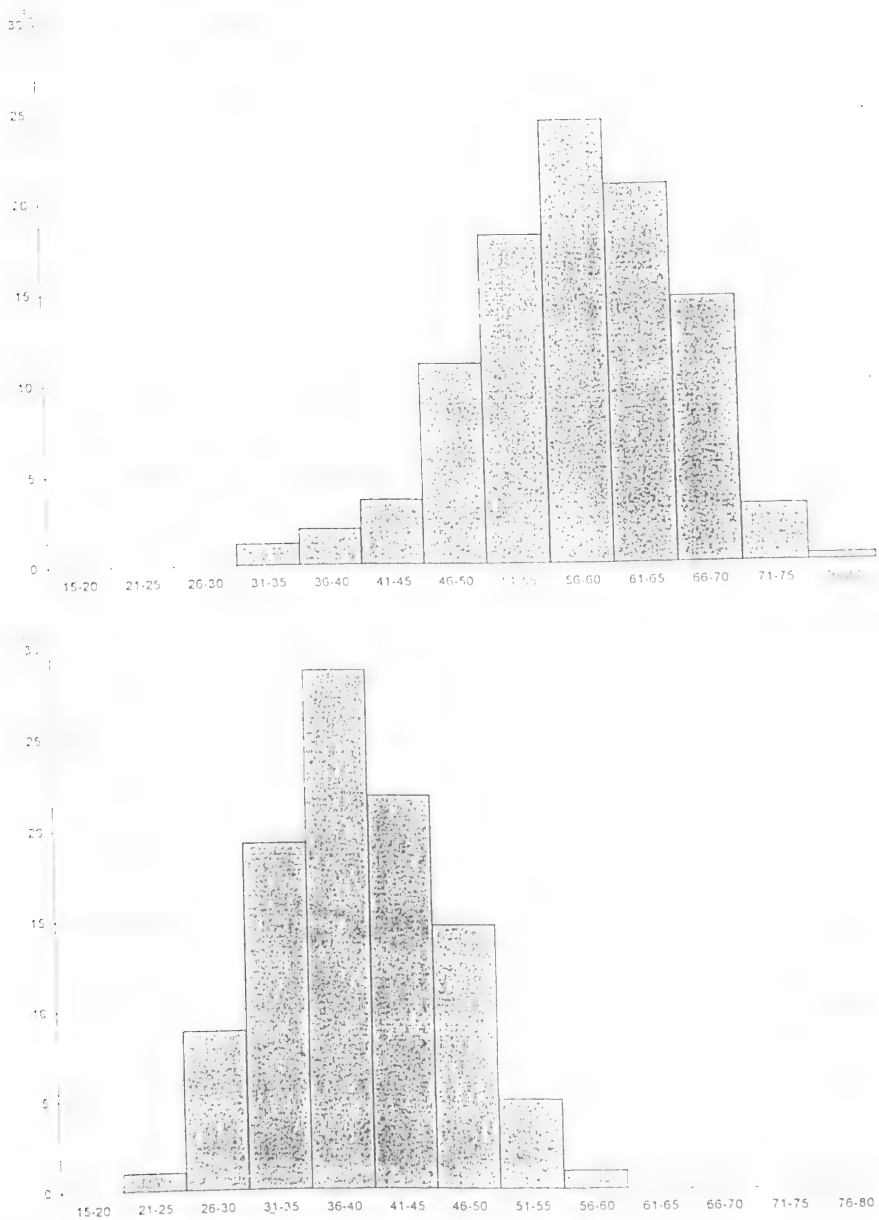

Figure 1. Distribution of bulb diameters in 16 month's old hippeastrum seedlings grown under either supplemental light and bottom heat (above) or under natural light at 20°C (below).

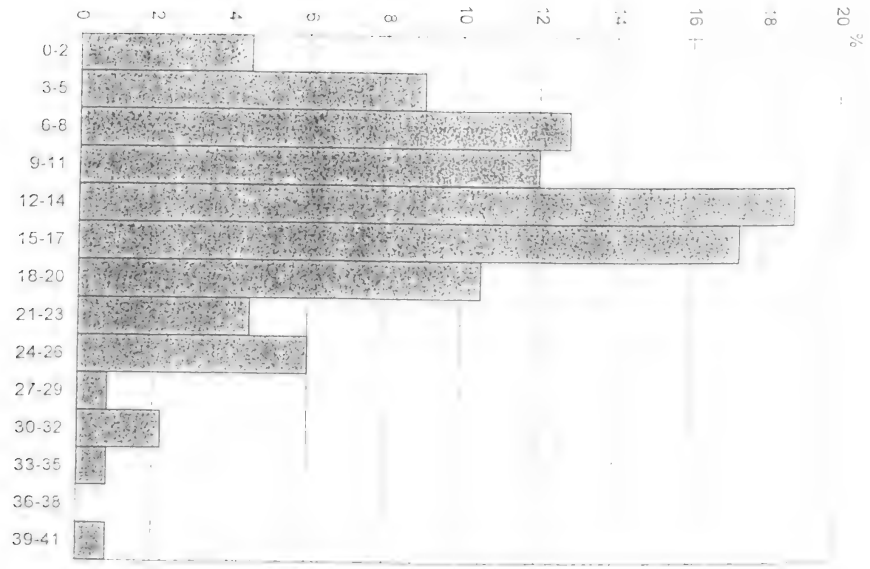

Figure 2. Distribution of the number of offsets per seedling 18 months after sowing.

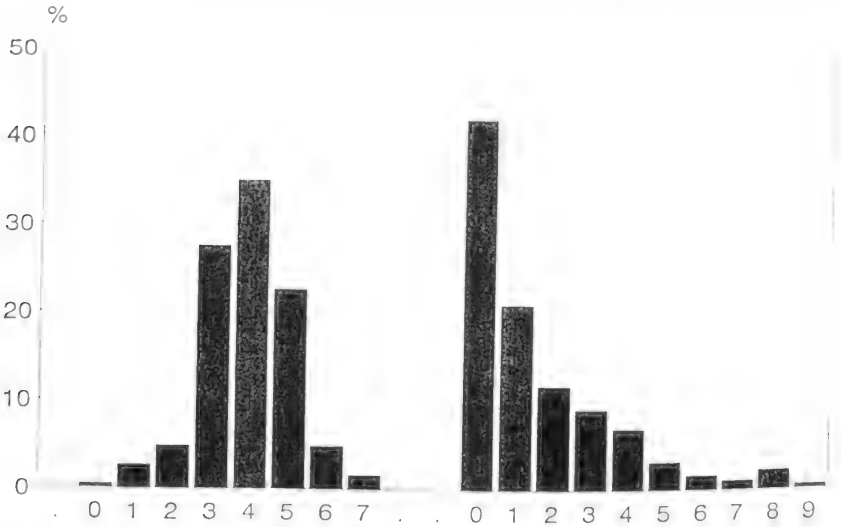

Figure 3. Distribution of number of flower stalks within three years per main bulb (left) and from offsets. Read: % plants with 1 to 7 stalks per main bulb or 0 to 9 stalks from offsets.

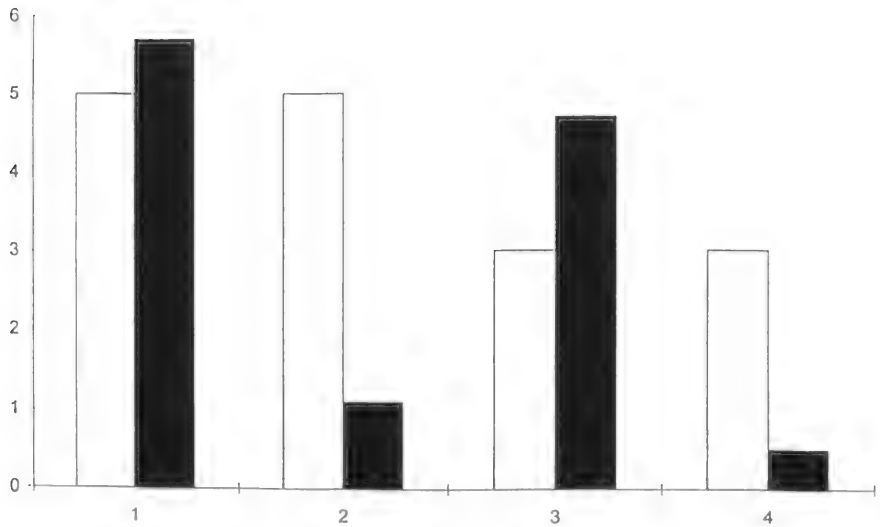

Figure 4. Number of scapes from main bulbs (white, 5 or 3) or from the offsets (black). Number of plants per group: group: 1: 9, group 2: 33, group 3: 10, group 4: 41.

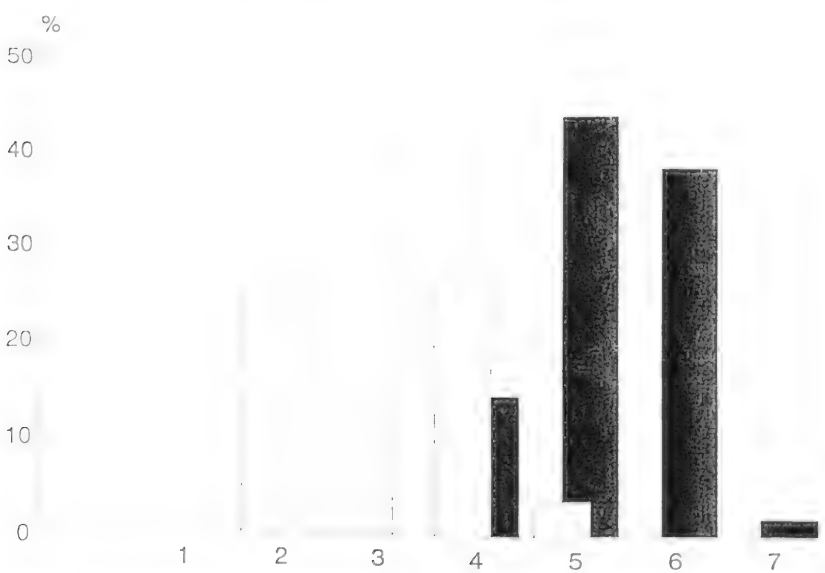

Figure 5. Distribution of number of flowers per umbel in 54 scapes with only few flowers (white) or 54 stalks with many flowers (black).

PROGENY OF *HIPPEASTRUM PAPILIO*

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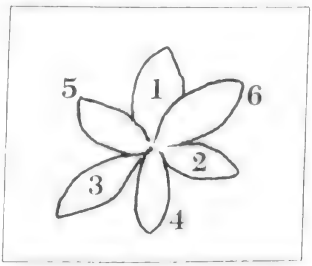
Hippeastrum papilio imparts an air of royalty even in the ambiance of other amaryllis and other flowers. It is among the largest *Hippeastrum* in bulb size and foliage. Vigor is an obvious asset. Seedlings of *H. papilio* grow quickly; thus they are an ideal parent in hybridizing. Today a few cultivars are marketed with *H. papilio* in the parentage.



Tepal (petals + sepals) arrangement as given in this article may be communicated more effectively with the individual segments numbered as shown in the diagram. The setepal segments are numbers 1–2–3, rotating clockwise; number 1 is the uppermost segment. Petepal segments are numbered 4–5–6, rotating clockwise; number 4 is the lowest segment.

A characteristic of *H. papilio*, and some other Brazilian species (and varieties) is for the two petepal segments numbers 5 and 6 to be the widest segments, the dominant segments. The number 4 petepal segment is the most narrow. Generally, setepal numbers 2 and 3 are slightly wider than petepal number 4. These are typically narrowly ellipitical. Width of setepal number 1 is usually about 10mm narrower than the dominant petepals 5 and 6. This is a differentiating trait from the Dutch hybrid *H. leopoldii* types which have the setepal segments dominant. Setepal segment number 1 is the widest with the petepal segment number 4 the most narrow. Segment widths vary less in some other species. This is significant in reviewing the hybrids resulting from intercrossing these different varieties.

The flower form, with the dominant petepals number 5 and 6 and color marking suggested a butterfly, hence *papilio,* Latin for butterfly. The dark maroon veining and blotch, heavier in the upper three segments (setepal number 1 and petepal numbers 5 and 6) overlaid on the light green to chartreuse green base results in the eye catching blooms.

A characteristic in *Hippeastrum,* as well as some other amaryllids, is that setepals number 2 and 3 tend to be similar in form, size and color markings, except opposite hand. Petepal segments numbers 5 and 6 are similar in form, size and color markings, except opposite hand. Number 1 setepal typically is closer to the petepals number 5 and 6 in color markings. And number 4 petepal often

shows similarities in color markings to the lower web (below the rib) setepals numbers 2 and 3; whereas above the rib (setepals 2 and 3) resemble petepals 5 and 6 in color markings.

Hippeastrum papilio follows this pattern with the upper three segments showing the heavy prominent dark maroon veining. The number 4 petepal is near solid light green (with some strains suggesting a chartreuse influence); a percentage may have a trace of pale reddish veining on one or both sides of the petepal number 4 rib area. The lower web of the segment (below the rib) of setepals numbers 2 and 3 resemble this number 4 segment and the upper webs, the other half, of those setepals resemble the three segments (numbers 1, 5 and 6).

Propagators and hybridizers initially experimenting with *H. papilio* are apt to be introduced to its idiosyncracies. Learning the characteristics of this species is no doubt essential—the first order of this process. A few of these are covered:

1. Strains of *H. papilio* now in the U.S.A. seem to resist setting seed with their own pollen; they also resist setting seed with some relatives. However, some *H. papilio* strains set seed with distant strains of *H. papilio*. Most *H. papilio* strains offset freely. Some exceptions to the above-mentioned seed production has been reported. *Hippeastrum papilio* seems to be selective with the *Hippeastrum* types with which it is compatible. The *H. papilio* strains tried here seem to resist setting seed, both ways, with most of the "old Mead" hippeastrums as well as the *H. leopodii* type Dutch hybrids. Some pollinations that initially appear to be setting seed and showing development beyond 28 days, subsequently abort [Science Editor's note: this is probably due to $2n \times 4n$ crosses (*H. papilio* is diploid, hybrids are tetraploid.)]. And some of those fruits that continue on into a mature seed stage yield only chaff. The fruit likely would have revealed stunting in the latter part of the term. Occasionally, one of the "runt" fruits will produce 3-4 viable seeds and those are grown with anticipation. However, a few progeny of *H. papilio* F_1 and F_2, etc., appear less finicky.

All is not futile—with luck, perseverence and right conditions some species that are compatible with *H. papilio* can be discovered.

2. The flowering window of *H. papilio* is relatively defined and consistent, with a limited straggler period. In working with *H. papilio* for over 25 years, no flowers have been produced (in the strains here) after a few days beyond the end of the seasonal flowering window. However the F_1 and F_2 hybrids produce stragglers. The flowering window for *H. papilio* in this locality, greenhoused (winters), is about the first week in March plus or minus 10 days, depending upon the seasonal weather conditions. The flowers con-

Hippeastrum papilio #23

Ackerpap x 'Sumac

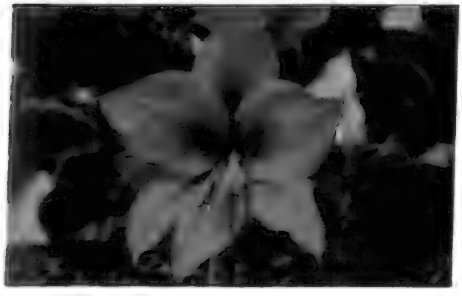
Photos: John D. Fellers

H. papilio x *H. aulicum*

H. papilio x *H.* x *ackermannii*

H. papilio x *H. fragrantissimum*

H. papilio x *H. striatum*



H. papilio x *H. aulicum*

(*H. papilio* x *H. fragrantissimum*) x *Sprekelia formosissimum*

tinue to open for about three weeks, then they shut down. [In California, plants frequently flower in both spring and autumn.]

A pollen bank is a necessary resource to achieve a reasonable variety of *H. papilio* hybrids. Most compatible plants follow *H. papilio* in blooming during a specific season; (some bloom in fall or winter) thus pollen from previous accessions is required when *H. papilio* is to be used as the seed parent. *Hippeastrum* pollen has a fairly good shelf life and can be kept at room temperature for many weeks as long as the humidity is low. Current pollen is kept in packets (labeled) in refrigerator containers while the bloom season is peaking. When this subsides the containers are capped and enclosed in doubled plastic bags, tied and placed in a refrigerator— never frozen. *Hippeastrum* pollen stores well in refrigeration but usually fresher pollen of each plant replaces the old before the pollen materially deteriorates.

3. *Hippeastrum papilio* plants are virtually evergreen with a brief resting period in mid-summer; this resting period lasts for 3—4 weeks, then new growth begins to emerge. This is the ideal period for repotting or transplanting; however, this species tends to defer blooming until the roots get re-established after being disturbed. Like many other amaryllids, *H. papilio* tends to bloom more consistently when root bound.

4. Pure *H. papilio* appears relatively resistant to some diseases that plague other *Hippeastrum*. This trait seems to be passed on to some of the progeny, but it is not universal. *Hippeastrum papilio* seedlings with a *H. puniceum–belladona* type pollen parent seems to be susceptible to some of the diseases that attack this pollen parent.

One group with a *H. puniceum–belladona* type pollen parent (*H. papilio* as seed parent) consistently flowers for the first time at a young age. These flower in the third year rather than requiring the typical four to seven years. A seedling of one of these bloomed as a two year old, and an F_1 seedling of that flower bloomed in one year but failed to set seed. Wrong pollen donors could have been selected.

5. No tests have been conducted to test cold hardiness of *H. papilio* or progeny in this locality, potted or in the ground. These amaryllids are all kept potted and moved out of a greenhouse in the early spring after the last frost. Plants are moved out only after all seed capsules have matured and are returned to the greenhouse about November when frosts could occur. Plants are covered for a light freeze (cardboard or even carpet) and they are summered under pine trees, thus frost protected when early fall frosts occur. On one occasion an early cold front approached with a predicted 30°F low. A batch of pots not yet in a greenhouse were covered sufficiently for that light freeze. Unexpectedly the cold dipped to about

24°F and held below freezing for some hours. The pure *H. papilio* came through without noticeable damage. Flowering in the subsequent season was fairly good considering the predictable shock. Some of the (hybrid) progeny also fared reasonably well, considering the stress. However, *H. papilio* x *H. fragrantissimum* kept in three and four gallon pots suffered significant damage (same conditions, same protection). These were moved into a greenhouse before another cold spell. Most bulbs lost foliage; some struggled throughout the following summer before leaves started to grow. Blooms were nonexistent in the following season and stingy for a couple more years.

6. Vigor is an attribute of *H. papilio* and bulbs are comparatively large. This vigor is passed on to progeny with several parent combinations. Flower characteristics is another issue. Most *H. papilio* crossed with another species usually will result in F_1 seedlings which show flowers influenced by the other parent. Flower form and size may be affected, but color predictably will be dominated by the other parent. Without parent knowledge, one would be hard pressed to visually identify *H. papilio* traits in many of its F_1 hybrids. The same may hold true with the F_2 generation unless back crossed with *H. papilio* (and this could be a longer shot than expected). Third generation F_3 crosses with both parents having *H. papilio* in the parent trail have produced seedlings that reveal some *H. papilio* traits. (And a limited few are somewhat close.)

Some exceptions surface from color carryover from the pollen parent when *H. papilio* is the seed parent. A percentage of these seedlings show some *H. papilio*-like flower traits but the color quality and pattern markings are often altered. They are just not the real *H. papilio*; however, a low percentage may be close. They may be lighter or some may have more intense, dark green color. Patterns of the maroon veining and solid color blotch may be altered; this color may be browner in lieu of prominent brown-red. The flower form may not be typical *H. papilio* with reduced dominance of petepals number 5 and 6. Displayed beside the real *H. papilio*, the difference is detectable.

Some of the *H. papilio* progeny will be described. The scenario on the progeny of *H. papilio,* for the most part, includes F_1 crossings with *H. papilio* as the seed parent. Some reverse crosses and some extended generations (F_2, F_3 etc.) are included.

Typical measurements of the predominant strain of *H. papilio* in the parent trails of the cultivars introduced were: perianth, vertical (antithesis, *i.e.* tip of number 1 setepal to end of number 4 petepal) is about 7.5 inches (19cm); the width of setepal number 1 is 44mm, setepals 2 and 3 are 33mm, petepal number 4 is 34mm and petepals

5 and 6 are 58mm, the dominant segments. The color of this strain is a rich prominent maroon (not scarlet) veining and blotch overlayed on a rich light green. The pollen, after anther dehiscence, is greenish. The flowers are displayed on thick, strong scapes about 27 inches [68cm] tall.

The first breakthrough found in discovering other hippeastrums compatible with *H. papilio* was with another Brazilian native, *H. aulicum* (1977). *Hippeastrum aulicum* produces smaller bulbs and plants than *H. papilio* but the flowers are about 6.5 inches (165mm) vertically. This *H. aulicum* strain looks similar to the *H. aulica* Ker Gawl. imported by Robert Goedert in 1966. In the flower segments of this *H. aulicum* a very dark, almost black, banding is sandwiched between a blue-green throat and the dark brownish-red segments. The pollen is greenish. Like *H. papilio*, the petepals numbers 5 and 6 are dominant. The lower three segments, setepals numbers 2 and 3 and petepal number 4 are long and narrow.

[Hybrids listed below follow the conventional method of listing a cross, the female (seed) parent is listed first, the male (pollen) parent is listed second.]

Cultivars of crosses with *H. papilio* as the seed parent and *H. aulicum* as the pollen parent are labeled "Papaul" to facilitate identity. That is, Papaul (*H. papilio* x *H. aulicum*). This cross was accomplished in 1977 and again in 1978. The 1977 seedlings from these crosses were labeled Papaul 77-1, Papaul 77-2, 77-3, etc. This cross produced plants and bulbs substantially larger than either of the parents. Albeit there are variations in shades and tints among all of the Papaul 77's that have bloomed to date, they are all dark reds that resemble a big *H. aulicum* (except one lighter seedling). Some are more toward garnet and some are bright dark red. The flowers of the Papaul 78's are darker still; some blooms show dark purplish-red veining on the dark red base. The segments tend to be more slender and narrow than the Papaul 77's. All of these seedlings have dominant petepals numbers 5 and 6 which is characteristic of both parents.

The parents of Papaul bloom in different seasons; *H. papilio* blooms about March 1 and the *H. aulicum* strain traditionally blooms about November 1. Papaul blooms about five weeks after *H. papilio* finishes, except for three Papaul 77-3 seedlings. The atypical light colored seedling blooms in mid-summer and is light, dull bay brown-red fading to yellowish chartreuse toward the apices of the lower segments. The segments are also atypically wide. The other two bulbs bloom near or during September and one of these is significantly similar to *H. aulicum* (just bigger). None of these three late bloomers have set seed.

Typical Papaul hybrids have flowers 7.5 inches (19cm) from top to bottom and have thick strong scapes about 25 inches (63cm) tall. They have lush disease-resistant foliage. The characteristic green pollen of *H. papilio* is inherited. Papaul hybrids have been important parents in extending the *H. papilio* progeny.

The next cross achieved was a reverse of the above: *H. aulicum* x *H. papilio* and labeled Aulpap. Other Brazilian species also proved to be compatible. *Hippeastrum corriensis* and *H.* x *ackermanii* crossed readily with *H. papilio.*

Although there are some minor differences in three batches of Aulpap they are similar enough that the premier one may be discussed as representative. Aulpap 77-1 evolved with a huge crinum-like bulb and vigorous leaves. It is a dependable bloomer each season with 7.5–8 inch (± 20cm) perianths. This mother bulb and its scions have produced three- or four-flowered scapes. Like its parents the numbers 5 and 6 petepals are dominant; however the other segments are long and slender, more like the forms of some of the Papaul 78. The color for all Aulpaps is lighter than the Papauls toward harsh orange, although it is a darker orange-red (not scarlet). Petal veining is prevalent as with some of the Papaul 78's. This seedling (and siblings) to date has set seed only with *H. angustifolium* pollen. Other crosses, including selfs, produced a long list of failures. Other batches of Aulpap have a limited number of compatible breeders also.

Hippeastrum papilio crosses readily with pollen from a *H. puniceum-H. belladonna* type found growing in Florida near an old farm house purchased by a friend. The flowers are apricot-orange with a yellow throat and short ribs. Plant and flowers were larger than typical *H. puniceum* found growing in Florida. Seedlings from the cross 80-2 (*H. papilio* x *H. puniceum-belladonna* type) bloomed with shades of light orange to apricot with yellowish throats and ribs, (half way to apicies) which is different from the pollen parent. One is a solid orange, a bright lively orange. The flower of the orange seedling is smaller than its siblings, about the size of its pollen parent. The apricot-orange seedlings with yellowish throats produces blooms larger than the pollen parent with wide imbricated segments. These, especially the solid orange cultivar, have been used in a number of breeding combinations.

One would be hard pressed to predict either parents of seedlings produced by crossing *H. papilio* with *H. corriensis,* crossed either way. The strain of *H. corriensis* used has relatively small plants and bulbs with *H. gracilis*-sized flowers about 4.5 inch (114mm) vertical. The orange-red flower segments have green throats. Thin speckled green bands separate these colors. The segments are

long, slender and elliptic. This strain usually blooms here in late June. Seedlings of this *H. corriensis* crossed with *H. papilio* generally bloom earlier than *H. corriensis*.

Hippeastrum corriensis crossed with *H. papilio* as either seed or pollen parent produced seedlings with similar plants intermediate in size between these parents. Flower forms are similar but with large slender segments. Petepals number 5 and 6 are only marginally wider than the other segments. The flowers produced by Papcor 81-1 (*H. papilio* x *H. corriensis*) have porcelain white bases with dark red (to mauve) thin stripes or wide veins. The throat and lower ribs are dark green. The reverse Corpap 81-3 (*H. corrienses* x *H. papilio*) is darker red with much less white. Ribs show some dark green in the lower segments. The intense purplish dark red in segment centers of petepals number 5 and 6 extends down the segments into the throat.

Hybrids produced by crosses between *H. papilio* and *H.* x *ackermannii* (*H. aulicum* x *H.* x *johnsonii*) show similar results to those with *H. corriensis*; these seedlings do not resemble either parent. However, cultivars with *H. papilio* as the seed parent have lighter colored flowers than cultivars with *H.* x *ackermannii* as the seed parent. *Hippeastrum* x *ackermannii* is about the size of *H. aulicum*. The flowers do not open so widely, only about 5 inches (12.5cm) across. The color is claret-orange. The color of the Papacker 81-5 (*H. papilio* x *H.* x *ackermanii*) seedlings are near solid dark red, with some lightening between veined areas. Ribs and apices of setepals numbers 2 and 3 are lighter as well. This tint appears to have a purplish brown influence. Feathering contiguous to the greenish rib at the throat is almost black. This is the selected average; others are lighter or darker. The characteristic wider petepal numbers 5 and 6 are evident in these blooms.

The reverse, Ackerpap 81-6 (*H.* x *ackermanii* x *H. papilio*) produces richer darker ruby-red flowered seedlings. The plant selected as an example displayed a lighter colored margin at the segment ends on the flower reverse; only a trace of this reflected in the flowers. The segments are wider than Papacker 81-5 seedlings. Ackerpap 81-6 used as the seed parent and crossed with another species hybrid (non-*papilio*) produced eye catching dark ruby red flowers. *Hippeastrum* Ackerpap crossed both ways has proven to be a significant parent.

One cross with Ackerpap as the seed parent and pollen from 'Sumac Pinini' resulted in a cultivar with a unique color along with siblings more closely aligned with the pollen parent in color. It is labeled 85-Apap-18 (Ackerpap x 'Sumac Pinini'). Siblings from this cross revealed several flower colors and shades. The unique darkest

flowered, identified as 85-Apap-18a, produced flowers about 6 inches (16cm) vertical ; these were rich maroonish with light pergameneous picotee edges on all segments. The leaves of all siblings are somewhat bluer than *H. papilio* leaves.

The majority of the seedlings that survived to flowering age from 85-Apap-18 bloomed much lighter in color. Some flowers were lineolate or with fine dots of darker tints reflecting traits traceable through the pollen parents with "leopard spotted" flowers. Seedling flowers varied in perianth size (vertical) from 5.625 inches (144mm) to 7.25 inches (195mm). The smaller lighter flowers are labeled 85-Apap-18b. They are not remarkably different in flower size and form from 85-APAP-18a. The longer perianth lengths had long, slender, elliptical segments.

Hippeastrum papilio crossed with leopard spotted hybrids seems consistently to bear seedlings with spotted flowers. The plant and flower color quality may be enhanced. 89 Pap-101 (*H. neopardinum* x *H. papilio*) produced seedlings that flowered with similarities to the lighter colored form of 85-Apap-18b. 89-Pap-101 flowers had clean defined lines in the veining. Those with long, slender, lacy segments were suggestive of a cultivar marketed as 'Spotty'.

Hippeastrum papilio is reported to be in the genetic background of at least one of the yellow flowered cultivars currently marketed. The influence of a yellow parent in *H. papilio* F_1 crosses can be demonstrated with 85-Pap-27 (*H. papilio* x *H. mananita*). *Hippeastrum mananita* Doran is a medium-sized plant with a flower form somewhat suggestive of the currently marketed 'Germa'. The tepal tube is longer and the yellow color is slightly more canary by using *H. mananita.* Leaves and growing habits are not similar.

The F_1 seedling 85-Pap 27 inherited a yellow base from the pollen parent; the medium light red veining can be attributed to *H. papilio.* The color markings are consistent with the characteristic *H. papilio* patterns in other hybrids. Knowledge of the parentage assists in suggesting this.

Hippeastrum papilio x (Korsakoff form of *H. greenii* x *H. aglaiae*) produced a dominant white with red veining mid-segment to apices on petepals 5 and 6 only. Thin picotee margins and a green throat set off the color. Interestingly, this cultivar resembles *H. papilio* x *H. fragrantissimum* in color. The form is individual with the high setepal number 1 and downward extension of petepal number 4; this results in an abnormal perianth measure misleading the flower size. The width displays an interesting form. The dominant petepals number 5 and 6 draw inward butterfly wing-like suggesting kinship to *H. papilio.* This plant is identified as 84-Pap-4 [*H. papilio* x (Korsakoff form of *H. greenii* x *H. aglaiae*)].

The hue in the red color in *H. papilio* flowers has a suggestion of brownish influence. *Hippeastrum papilio* x *H. striatum* brings out brown in its seedlings. This seems to be a trend in this parent combination. The *H. striatum* strain used is apricot with a buff throat. The segments are not wide.

85-Pap-7 (*H. papilio* x *H. striatum*) produces seedlings with flowers that vary from near solid lively orange-brown with only a slight trace of veining near the throat, to more pronounced bright orange veining. Another seedling, 85-Pap-8, with similar parents, has a buffish rib stripe in setepals numbers 2 and 3 and petepal number 4 . The segments are medium wide without dominance by setepals or petepals. The tepal tube is long and sometimes exceeds its perianth in measurement; a ratio of about 7.5 inches (19cm) tepal tube to about 6.75 inch (17cm) perianths have been recorded. The flowers are slightly drooping, a characteristic of *H. striatum*. Scapes and buds develop a purplish red color in early development and age reddish at flowering. Scapes tend to age more greenish during the bloom period.

Hippeastrum papilio and some of its F_1 crosses have a history in bigeneric crosses. Papauls and Papfrag (*H. papilio* x *H. fragrantissimum*) as seed parents crossed with pollen of strains of *Sprekelia* resulted in bigeneric crosses that produced several blooms.

Hippeastrum papilio crossed with the bigeneric hybrid x *Hippestralia* 'Mystique' produced cultivars with flowers different from either parent. 'Mystique' was acquired, being marketed to be a *Hippeastrum* x *Sprekelia* hybrid. Identity of its parents was not provided. 'Mystique' is a lively dark red flower with a flower form closer to *Hippeastrum* yet different enough to be believable as a half-*Sprekelia* hybrid. The bloom is about the size of *H. gracilis*. Hybrids resulting from crossing this bigeneric hybrid with *Hippeastrum* species have produced blooms appearing to have reverted to the *Hippeastrum* flower form. A dark red *H. gracilis* x *Hippestralia* 'Mystique' bloomed with a distinctive tangerine color and larger than both parents.

92-Pap-11 resulted from a trial crossing of *H. papilio* by 'Mystique'. The seedling plant shows vigor, typical for *H. papilio* progeny. Blooms are wide open, about 6.5 inches (167mm), with segments not remarkably different in widths. The number 1 setepal is about 6mm wider than petepal numbers 5 and 6 and petepal number 4 is about 12mm narrower than the other four segments. The color is lively light orange-red overlayed on a yellow-buff base. This is a bloom with a "sunny" appearance. The light red occupies about the same pattern and position on the segments of this cultivar that the dark brownish-red occupies on *H. papilio* and a bit more solid. The yellow replaces the light chartreuse green of the *H. papilio*.

H. neopardinum x *H. papilio*

Ackerpap 81-6

Papaul 78-1 x Papfrag

H. iguazuannum x Austpapst

Hippeastralia 'Mystic' x *Sprekelia*

Papfrag x double

Papaul 78-1 x (Papaul 77-3 x *H. mananita)*

85-Apap-18a

Further crossing with second and third generation hybrids of *H. papilio* ushers in a wider world of intrigue. The vigor seems to elevate in some of these. Wide, long leaves; thick, wide diameter scapes (sometimes taller); and big flowers are also common. More variance in the sibling seedlings from a single capsule was observed. Plants showing incompatibility in breeding with *H. papilio* may set seed with certain *H. papilio* F_1 and F_2 plants: Papauls (*H. papilio* x *H. aulicum*), Papilo 80-2 (*H. papilio* x *H. puniceum-belladonna* type).

H. PAPILIO x *H. FRAGRANTISSIMUM*

The *H. papilio* x *H. fragrantissimum* hybrid was purchased and incorporated into my breeding programs. To assist in maintaining identity and parent trail documents, code Papfrag was assigned, consistent with F_1 crosses produced in this program. *Hippeastrum papilio* x *H. fragrantissimum* has white flowers with red veining contiguous to a wide whitish rib, predominantly in the petepals. Throat and ribs show a pale greenish chartreuse-ivory suggesting royalty. Tepal tubes usually exceed the vertical measure of flower perianths, about 6.75 inches (172mm); these are supported on tall 30 inch plus scapes. Flowers on offsets may vary with the concentrations and thickness of lines of the red veining from the mother bulb (of this hybrid); an interesting phenomenon. A slight pleasant fragrance also is passed from the pollen parent.

84-Pap-20 (Papaul x Papfrag) is a product of *H. papilio* F_1 generations in both parents. Seedling siblings from this union produced blooms quite diverse in color. Flowers near white to very dark red (toward black) surfaced also with in-betweens. One bloom had an vory-green throat suggesting pollen parent influence and a lavender blush on segments. The white seedling 84-Pap-20a is suggestive of *H. papilio* with vigor as well as flower size and form. Petepals numbers 5 and 6 are the dominant segments; only these two segments possess sparse, faint, thin, red veins on a white base (noticeable with close inspection). Thin red picotee edges appear only on these two segments also; the other segments are pure white. The perianth measures about 7 inches (18cm)

Flower form of 84-Pap-20b, the dark black-red form, is closer to that of the pollen parent Papfrag. Segments of this flower are not remarkably different in width. The bloom is only slightly larger than *H. gracilis* with 5.75 inch (148mm) perianths.

Extending the breeding program with *H. papilio* x *H. aulicum* F_1 generations, (Papauls) unlocks some gems. 90-Pap-25 [Papaul 78-2 x (Papaul 77-3 x *H. mananita*)] captured the plant vigor contributed by *H. papilio* and produced flowers with 7.125 inch (184mm) perianths. Dominant petepals numbers 5 and 6 also came through. The color

is a unique honey-melon with a pale salmon-cinnamon blush. 90-Pap-28, with substantially the same parent trail, blooms with near identical flower form but the flowers show a more pinkish salmon blush. The blooms are a measure of improvement over paler flowering cultivars produced by Papaul 77-3 x *H. mananita.* The dark flowering siblings of this latter cross are a unique rich, dark mahogany (giving an air of elegance). This is a color that has surfaced in other combinations.

The pure orange seedlaing of 80-2 (*H. papilio* x *H. puniceum-belladonna* type) has contributed several credible orange flowered plants. 8427-Auspapst has 8.25 inch lively orange flowers with minimal yellow throat and nodding form; it is a cross between a plant imported from Australia and Papilio 80-2. 8427-Auspapst has not set seed to date but the pollen is fertile. *Hippeastrum iguazuanum* x 8427-Auspapst resulted in seedling 90-AM-1 which bloomed with enormous flowers, about 10 inch (252mm) across. Thick, strong scapes supported these flowers. Setepal number 1 measured 83mm wide; the other two setepals were 76mm wide. A degree of nodding form also transferred. Flowers opened wide and did not show the clawed petal characteristic of *H. iguazuanum.* The bright, intense orange was interrupted with light yellow ribs almost to the apices.

Three F_1 selections of *H. papilio* x *H. fragrantissmum* (Papfrag) shows the versatility of this cultivar in breeding. A picotee type, evolved in breeding, was selected as the seed parent to be pollinated with Papfrag. Seedling 94-PAPP-21 (picotee type) x Papfrag displayed pure picotee flowers with no fleck or blemishes. Rather than porcelain-white, a very pale greenish ivory off-white surfaced. It also inherited *H. papilio* vigor with 33.5 inch (85cm) scapes of 1.5 inch (38mm) diameter. The dominant setepals formed a flower wider horizontally than the 7.5 inch (192mm) vertical perianth measurement. The segments are wide and imbricated. Setepal number 1 measured 96mm wide and numbers 2 and 3 measured about 93mm wide; width of petepal number 4 was 58mm with the other two petepals 74mm. Petepals were slightly erect adding interest to the form. A sibling more normal in plant and flower size produced a perfect clear porcelain white flower with distinctive dark, ruby red picotee margins. The cross seemed to make it better.

Massive blooms surfaced on seedling 93-Pap-13 (Papfrag x a double flowered *Hippeastrum*). With about 24 segments, 93-Pap-13 might be termed a quad. The flowers were substantially larger than the pollen parent, about 8.375 inches (21cm) wide. Tepal tubes about 6 inches (15cm) long added abnormal weight on the scapes. A very thick, strong 26 inch (66cm) scape required staking when both flowers opened. On the flower the four base segments have similar form with the light ivory green color observed in the setepals of

Papfrag (*H. papilio* x *H. fragrantissimum*). The upper segments reflected the petepal markings of Papfrag. The characteristic thin picotee edges (of Papfrag) are also present on all segments of this cultivar.

The bi-generic cross 94-Papsk-14 (*H.* Papfrag x *Sprekelia* TMH) affords an interesting scenario. This is a cross with *H. papilio* x *H. fragrantissimum* as the seed parent and a *Sprekelia formosissima* strain as the pollen parent. These seedlings developed a characteristic vigorous plant. The leaves are not remarkably different from typical *Hippeastrum* in appearance; however they are thicker which helps them resist flexing in the wind. The process of flower development seems to go through stages before anthesis. At first the flower opens minimally with the setepal number 1 recurving upward slightly. The impression is that the flowers might have a long tepal tube and a modest opening. The number 1 setepal continues to recurve upward while the other segments remaine straight. This is a form characteristic reminiscent in other bigeneric crosses of *Hippeastrum* with *Sprekelia* in the early stage of the bloom. Then the flowers open and look like a *Hippeastrum*. The perianth measures about 5.25 inches (134mm) and the tepal tube measures about 4.5 inches (115mm). The setepals are dominant. Flower color is bright, clear, medium dark red with white ribs extended halfway up the segments.

In summary, these are samples of the cultivars derived from hybridizing with *H. papilio* in the parent trail. This demonstrates that *H. papilio* progeny can enhance our amaryllid repertoire. The frontier is still out there.

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BOOPHONE ERNESTII-RUSCHII (DINTER EX. SOLCH), A "LIVING DIAMOND" IN SOUTH-WESTERN NAMIBIA

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Southwestern Namibia is amongst the world's most remote and unspoiled areas. Sparsely populated as urban development is kept to a minimum, the area is Namibia's largest alluvial diamond deposit. Livestock farming and diamond, zinc and lead mining are the major economic activities. In this background, southwestern Namibia is home to the "living diamond"—*Boophone ernestii-ruschii.*

CLIMATES AND HABITATS

The climate of southwestern Namibia is classified as semi-desert or "cool" desert by authorities. The cold Benguela current keeps the coast of the Namib Desert cool, damp and rain-free for most of the year with thick coastal fog. The rain falls sparingly in winter in inland areas. Winter days are generally warm and pleasant but nights can be fairly cold. The temperature may further fall to approaching freezing temperature before dawn. Summer temperatures are high while the altitude means that nights are cool. The sun shines severely, especially during summer months because cloud cover is minimal. The ground temperature may exceed 50°C and the bright light and glare is intense. Diurnal temperature varies from around 40°C in a summer afternoon to below 10°C in dusk. Rainfall is scarce in this region but the water marks in dried up river courses indicate that occasional flooding seems to happen once every few years. Precipitation is mainly in the form of fog at night, with a total of 45mm [1.75in] a year. Daytime humidity remains low, seldom exceeding 50%.

However, In the Hunsberge, where *Boophone ernestii-ruschii* grows, rain falls in two distinct seasons. The first season is in March and April when small troughs of moist air develop and heavy thunderstorms may fall. The second season is June to August when powerfully developed cold fronts sweep up from the Cape. Annual rainfall at the localities of *B. ernestii-ruschii* is between 60–70mm [2.375–2.75in]. In some years no rain may fall at either time or it may fall as virga (evaporating in the heat before it reaches the ground).

The area of Namib comprises different types of landforms. Coastal southwestern Namibia is characterised by sandy desert landforms with a few major mountain ranges. On the other hand, the mountainous areas in the inland around the Fish River Canyon are steep, rugged and covered with a thin layer of topsoil. Every plant species growing here is equipped with a specialised form to adapt to this harsh environment.

Above: The habitat of *Boophone ernestii-ruschii* showing the steep slope, plants of *Pachypodium namaquanum* and diamond area in the background.

Right: A clump of ten bulbs growing on a lower slope

Below: Close-up of the bulbs.

Photos: Dennis Tsang

Boophone ernestii-ruschii grows on dolomite mountains in steep boulder-strewn ravines. The dolomite hills in the Fish River Canyon area are also home to several interesting endemics, two of which have been described only in recent decades, namely *Rhadamanthus namibensis* and *Strumaria hardyana.* As this area is vast and largely inaccessible, thorough botanical survey is required in order to examine the level of endemism.

Most plant species from this area are unique and beautiful, and *Boophone ernestii-ruschii* is one of the native species much sought after by world-wide growers.

THE SPECIES—ITS CHARACTERISTICS

The name *Boophone ernestii-ruschii* was given by Dinter and the species was first described by Solch in **Flora Sudwest-Afrika** in 1960. Its distribution was once considered confined to only one hill slope in southwestern Namibia but findings of botanical surveys in the early 1990's indicated that this species is endemic to several hills slopes to the west of Hunsberge in the vicinity of the Fish River Canyon. Guy Wrinkle, in his article entitled "An Introduction to the Genus *Boophone*" (**HERBERTIA** 40: 77-82, 1984) states that *B. ernestii-ruschii* never grows naturally south of the Orange River (South Africa) though the landforms and climatic conditions of the Richtersveld are comparable to the Hunsberge. Nevertheless, certain plant species associated with *B. ernestii-ruschii* are also found growing in the Richtersveld and parts of Namaqualand, including *Aloe ramosissima, Gethyllis namaquensis, Pachypodium namaquanum, Albuca* sp., etc.

Closely related to *B. disticha* and *B. haemanthoides, B. ernestii-ruschii* is often considered the most attractive species. It is distinguished from these related species for its confined distribution in semi-desert habitats. *Boophone haemanthoides* is endemic to the west coast of South Africa, a winter rainfall area; this species is found growing on sand dunes not far from the coastlines. *Boophone disticha* has an extremely wide distribution, from the eastern Cape and northeastern South Africa through Zimbabwe to Kenya and Tanzania in tropical eastern Africa. Other species, including *B. flava, B. guttata* and *B. pulchra* have been transferred to *Crossyne flava, C. guttata* and *Brunsvigia pulchra*, respectively.

The size of individual mature bulbs of *B. ernestii-ruschii* may reach up to 50cm [20in] across and are bigger than *B. disticha* and about the same size as *B. haemanthoides.* However, this size is boosted by several hundred layers of silky bulb scales, suggesting that some of the bulbs are at least 500 years old. *Boophone ernestii-ruschii* differs from *B. haemanthoides* by its light brownish bulb scales and its smooth, round-shaped bulb while the bulb of *B. hae-*

manthoides is dark greyish-brown of irregular shape and the bulb scales are coarse and papery in texture.

From my previous visit to its habitats, I observed that *B. ernestii-ruschii* either grew singly or in clumps comprising up to ten bulbs, which was quite enormous compared to only about three bulbs to a clump in the case of *B. haemanthoides*. The bulbs of *B. ernestii-ruschii* stood completely above the ground among big rocks and low bushes, mainly on the central slopes of steep southwest flanks of the hills. However, large clumps of bulbs were also found on the lower slopes, in close proximity to seasonal water courses. It was also observed that about two hundred bulbs were growing on a steep slope with the majority over 100 years old. A brief survey indicated that only a few seedlings and bulbs were younger than 50 years old.

The fan-shaped leaves of *B. ernestii-ruschii* are bigger in size (about 50cm [20in] in length and 6cm [2.375in] width), are less wavy than any other species of the genus, emerge just before the winter rains and continue to grow until the end of spring. The upper part of the leaves near the tip is very slightly twisted at an angle. In cultivation this feature may still persist. This species produces its distinct dark pink flowers in February (southern hemisphere). The inflorescence of *B. ernestii-ruschii* is up to 50cm tall and the umbel, carrying over fifty flowers, is about 45cm across. Like *Brunsvigia* and other species of *Boophone,* mature umbels of this species detach from the bulb and tumble down the hillslopes or are blown along by the wind, dispersing seed as they go. Only a small quantity of seed is produced. Some seed germinates readily in crevices among rocks where the soil remains moist after thunderstorms; the remainder may germinate in the winter when the south and southwest slopes retain moisture for several weeks after a rain shower. The seedlings are shaded for much of the day in winter. However, viability remains poor and seedlings are difficult to maintain in cultivation.

Boophone ernestii-ruschii multiplies mainly by bulb division, *i.e.*, a big bulb divides itself naturally into several smaller bulbs. This form of vegetative reproduction is unique to *B. ernestii-ruschii* and *B. haemanthoides*. The two species also share the same growth cycle as winter-growing species. Like *B. disticha* and *B. haemanthoides, B. ernestii-ruschii* bulbs grow above the ground level with a long and shallow root system and the inflorescence is in the form of a dense umbel. In habitat *B. ernestii-ruschii* is free from pests. Perhaps this species, like *B. disticha,* is a highly toxic plant.

ADAPTATIONS TO THE NATURAL ENVIRONMENT

Boophone ernestii-ruschii adapts to its harsh environment in a number of ways. The thick layers of scales provide an insulation to

stabilise the temperature of the bulb and protect it from drying out, especially in summer. This species evades drought and heat by experiencing summer dormancy. To absorb the maximum amount of moisture from condensation during nighttime, the bulbs develop a long and shallow contractile root system and the large bulbs are exposed completely above the ground to provide shade and to collect moisture for absorption by the shallow roots.

Boophone ernestii-ruschii occurs only on open south/southwestern slopes and near seasonal water courses to take advantage of moisture. Bulbs of *B. ernestii-ruschii* tend to crowd the central and lower slopes because the detached inflorescences are blown down slopes by the wind, and the lower slopes are better shaded and able to afford seeds a greater probability of germination.

CONSERVATION

Although the habitats are currently under private ownership for livestock farming and therefore significant development is unlikely in the forseeable future, southwestern Namibia is a major centre for mining activities. Endemic only to several hillslopes west of Hunsberge, *B. ernestii-ruschii* is subjected to serious threat of habitat destruction in the form of mining activities. Unless the habitat of *B. ernestii-ruschii* is protected under Namibian regulations, the threat of habitat destruction may result in the extinction of this species.

Without sufficient evidence, it is uncertain if the numbers of this species are increasing or decreasing in the natural habitat. The presence of only a few seedlings and young bulbs in the habitats may be due to trampling by livestock, climatic change, or may be associated with the mining activities around the area. In any case, the existence of *B. ernestii-ruschii* in the long term is already under threat. Detailed study of the ecology of the habitats may unfold the mystery behind the small number of *B. ernestii-ruschii* seedlings and the findings may be useful in the conservation of this rare species.

CULTIVATION

Boophone ernestii-ruschii is appreciated for its rarity and the very ornamental glaucous leaves in a fan-shape arrangement. Mature bulbs make excellent container subjects for dry, mild and sunny climates. This species is not cold hardy so in severe climates the bulbs must be grown in a heated greenhouse environment.

This species is not fussy about the growing medium but it certainly requires a lot of sunlight and sharp drainage, very little watering and a big terra-cotta pot to allow sufficient space for root run. Plant bulbs completely above the soil level. After planting, give a good watering around the edge of the pot so that the bulbs can set-

tle in. Let the growing medium dry out completely before each watering. Sharp drainage is necessary for *B. ernestii-ruschii*. Use a mix of four parts sand and one part rock chips. In cultivation, the long roots can be sunk well below the surface provided that the growing medium is well-drained. Selected rocks can be put on top of the growing medium to help secure the position of the bulbs and for ornamental purposes.

Avoid watering on the bulbs directly to minimise accumulation of excessive moisture between the bulb scales. A few pebbles may be inserted immediately beneath the bulbs to improve aeration around the basal plate and to reduce chances of bulb rot. In high rainfall areas, watering should be reduced to the minimum and growers may also consider removing a few outer layers of the bulb scales and improving ventilation. Water should be withheld completely when the first sign of dormancy takes place in late spring. As a general rule, do not give any water if in doubt, bearing in mind that *B. ernestii-ruschii* is a semi-desert species.

Boophone ernestii-ruschii enjoys a light application of phosphorous for strengthening of the long contractile roots and bulbs. Under cultivation, red spider mites are the major pest. Infested bulbs must be treated immediately to cure the problem. Bulbs should be left undisturbed for several years in order to flower. Given the above recommended conditions, *B. ernestii-ruschii* is easy to grow in cultivation.

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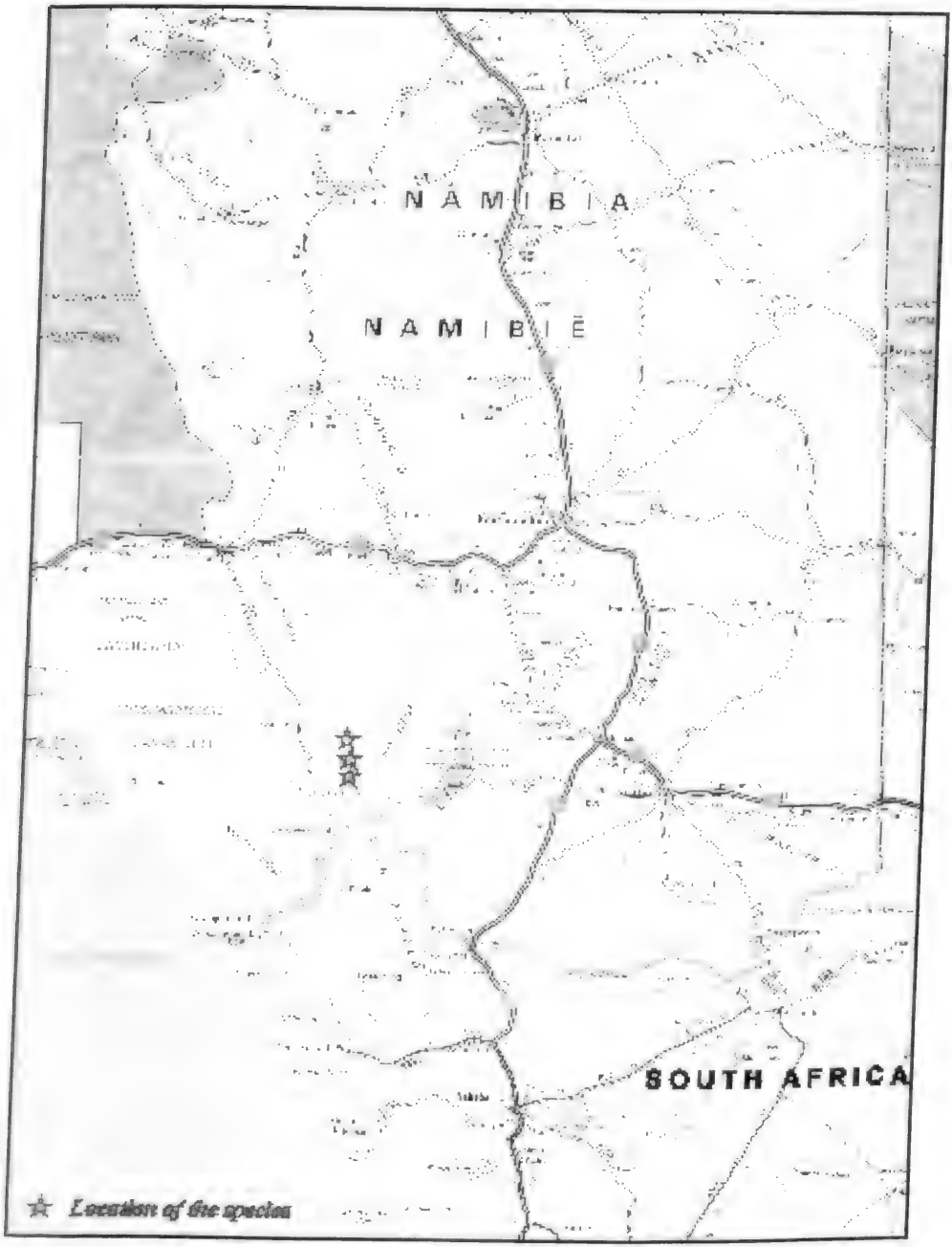

Map of Namibia

THE ECOLOGY OF *EUCOMIS VANDERMERWEI* ON THE STEENKAMPSBERG IN SOUTH AFRICA'S MPUMULANGA PROVINCE

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Eucomis vandermerwei is a dwarf species confined to rocky outcrops on mountain summit mistbelt grasslands. It is known from few collections; the records are largely from the vicinity of Dullstroom to the mountain peaks east of Roossenkal, a distance of about 30 kilometres.

Some herbarium specimens at the National Botanical Institute in Pretoria require reassessment as the plants appear far too robust to be this species. They also were recorded from habitats where the ecology is completely different from the Steenkampsberg. Reassessment of this data may reveal that the species is a narrow endemic confined to the highest outcrops of the Steenkampsberg.

Eucomis vandermerwei is one of South Africa's most attractive and unusual bulbous plants. The bright green leaves are heavily spotted with blackish mauve and russet in a variety of patterns. The small but conspicuous flowers are deep, plum-mauve. It is the only species in South Africa with cryptic colouration (see Fig. 1) making it difficult to detect among the lichen-blotched stones and short grass cover which are typical of its habitat. The species has other singular adaptations to this habitat which are discussed in the text below.

MOUNTAIN HABITAT

A study was conducted of *E. vandermerwei* in the Steenkampsberg east of the town of Roossenekal. This was carried out during the summer growing season from late November to February. Three colonies were investigated, all of them close to one another within a radius of about one square kilometre.

The niche occupied by the species at all sites was the same, comprising crevices in low rocky outcrops and adjacent open short grassland within a few metres of the outcrops. Most plants grew in east- or south-facing positions in groups of 4–30 or more individuals. Occasional single plants were encountered also.

All the populations were on the summit of the mountain, which is frequently covered in mist in the summer months. The precipitation is also high; nevertheless, most of the sites where the plants grow are very well drained. The bulbs are rooted in shallow, sandy

soil in rocky crevices or else amongst short tufts of grass. Despite extensive searches no plants were found on the numerous rocky outcrops at lower altitudes on the eastern and western slopes.

The plants share their habitat with a broad-leaved and more robust form of *Haemanthus humilis* subsp. *hirsutus*, *Brachystelma stellatum*, *Ledebouria sandersonii*, and a dwarf species of *Albuca* with daffodil-yellow flowers (Fig. 4), which may as yet be undescribed. At one of the colonies there are a few clumps of *Aloe woolliana*.

Both bulbs and leaves of *E. vandermerwei* are subject to damage by grazing sheep and rock hyraxes. The bulbs are eaten by rodents also, but only partially. This apparently occurs in the winter months, probably as their normal food sources are more restricted.

Between one quarter and half the mature bulbs in these populations flowered during the 1997–1998 growing season. Few of the plants produced fertile seeds; in most cases many of the seeds were parasitised by insects, leaving few to ripen in autumn.

THE GROWTH CYCLE

Eucomis vandermerwei is late to begin sprouting leaves; this usually occurs from mid to late November, once the main summer rains have started. Flower stems emerge quickly and the plants begin flowering in early December. Fruit begins forming in late December, but seeds are not fully developed until April and May. Seeds are liberated from the parent plants at the onset of winter, in May, when the leaves die back and the stems start to wither.

The summit of the Steenkampsberg is subject to severe frost which normally starts during the second half of May. By this time the bulbs are fully dormant.

The species is well adapted to survive damage by rodents and grazing animals. Partially eaten bulbs proliferate bulblets as long as the basal plate remains intact. The old bulb plate eventually withers, leaving 3-6 or more young bulbs in its place. Where the upper parts of bulbs are damaged by the hooves of antelope and sheep, a few bulblets are formed in a perimeter around the parent plant.

ROLE OF FIRE

Two of the three colonies studied had been subjected to winter grass fires before the growth cycle the following summer. Many more plants flowered at the sites which had been burnt than at the locality where no burning had occurred. Fire has the effect of removing the moribund grass layer which often covers the habitat where there have been no fires for a few years in succession. As fires usually occur from May to September, well before *E. vander-*

merwei starts to grow, their effect is to provide a clear habitat which promotes growth of the plants as well as flowering. It is noteworthy that, at the locality which had not been burned, flowering was restricted to plants occurring at the edges of exposed rock where there was the least grass cover.

Eucomis vandermerwei produces far fewer flowers and seeds than most other *Eucomis* species and also grows in situations which have the densest grass cover, albeit short. Particularly vigorous growth follows thorough burning. The grass is usually only dense enough for this to happen every 2–4 years, but some areas can escape burning for many years. The best flowering years are those that follow thorough burning. This is also the optimum time for seeds to germinate and to develop young bulbs, growing at sufficient depth to withstand the next substantial grass fire. Seeds may also germinate well after exposure to smoke in grass fires. No data exists on this at present but plans are under way to conduct experiments in this regard.

Recent ecological research has indicated the significance of exposure to smoke for the germination of seeds of the autumn-flowering form of *Chortolirion angolensis*. (Research into the significance of smoke for the germination of seeds of grassland species in the summer rainfall areas of South Africa is still in its infancy.)

The summits of the Steenkampsberg are a high lightning-strike area. Before the advent of human settlers in the region, lightning must have been responsible for intensive grass fires every few years, when the grass was long enough to ignite. Fires, though now an annual event in these mountains, burn *E. vandermerwei's* habitat thoroughly only when the grass cover is thick enough to ignite, which is still usually once every few years. In this respect they are similar in effect to lightning strike fires of former times.

HORTICULTURAL POTENTIAL

South Africa's various *Eucomis* species are popular horticultural subjects, both in the garden and for pot culture. Striking colouring and diminutive proportions make *E. vandermerwei* most appealing; much room exists for the creation of cultivars via cross-breeding and selection of strains with various characters, such as profusely spotted leaves. The species is also very cold hardy and may well adapt to cold temperate climates of the Northern Hemisphere, in gardens and out of greenhouses. Outdoor culture would probably only be possible in climates that are not subject to excessive and prolonged winter rainfall, which could make the bulbs rot.

Eucomis vandermerwei is certainly one of South Africa's most attractive pot subjects. The major drawbacks for horticulture is the

paucity of seed available and the fact that production of bulblets from parent stock has limited scope.

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Fig. 1. *Eucomis vandermerwei* in typical rocky habitat; several plants are in flower, having grown well as a result of clearing by fire the previous season.

Fig. 2 A cluster of *Eucomis vandermerwei* among unburned grass. None of this cluster of ±10 plants has flowered.

Photos: Laurian Brown

Fig. 3. Left: A robust and beautiful white-flowered form of *Haemanthus humilis* subsp. *hirsutus* grows in the same rocky outcrops as *E. vandermerwei*.

Fig. 4. Right: An *Albuca* species, which may be undescribed, emerges in late summer when grassland has been burned the previous winter.

HAEMANTHUS NAMAQUENSIS, A RARE AND IMPRESSIVE SPECIES FROM NAMAQUALAND, SOUTH AFRICA

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Haemanthus namaquensis is one of Southern Africa's rarest species. It has been recorded from South Western Namibia to the southwestern section of central Namaqualand. Most records are from the Steinkopf area of the Southern Richtersveld. The wide distribution of the species and its rarity throughout its distributional range prompted some in-depth ecological research. The findings indicate that the species has developed some singular adaptations to its arid habitat.

THE HABITAT NEAR STEINKOPF

The area northwest of Steinkopf comprises a hilly and mountainous area elevated above the coastal plain to the west. *Haemanthus namaquensis* is found sparingly in a few areas usually among small low boulder outcrops under *Rhus undulata* bushes. Occasionally single plants or clumps are found growing out in the open, generally in flat areas or gently south- or east-facing slopes. The species is absent from a large amount of suitable habitat and is not generally found in mountains or their more elevated foothills.

Plants usually occur in groups of 4–20 individuals, occasionally singly, particularly if they are growing in the open. The larger groups are found in the deepest and most extensive humus-rich pockets amongst boulders. Groups of plants in these situations are normally at maximum size with little or no room left for seeds to sprout.

The growth cycle starts in late February; bulbs that are going to flower push their stems through the soil and are in full flower by mid-March. This species starts to produce leaves much earlier than most other *Haemanthus* species in the winter rainfall area of Southern Africa. Leaves start to emerge in late February and are often at least 8cm tall within the first half of March. February leafing and flowering usually occurs in response to heavy thunderstorms which may develop over the Richtersveld and southern Namibia from February to April.

Few plants flower each year, fewer than in all other *Haemanthus* species in South Africa. In large clumps near Steinkopf between one and about four bulbs normally flower in any given season in the largest clumps.

Seeds ripen in May and June and are usually ready for germination (sprouting) by the beginning of June. Good rains usually fall in

the Steinkopf area in June and July and development of young bulbs occurs at the coolest and wettest time of the year.

SEED DISTRIBUTION AND DEVELOPMENT OF YOUNG BULBS

Seeds are distributed by winter rainfall. Most seeds land in situations where they either shrivel on barren rock surfaces or else in niches where there is practically no soil in which to develop young bulbs. If the rainfall in the winter is substantial, seeds get washed well away from the parent plants. Those which stand the best chance of germinating lodge in loose sand in sandy washes or else under scrub. Germinating seeds in open areas are usually trampled by sheep and goats but some of that which lands under scrub escapes trampling. In years of poor rainfall almost the entire seed crop is lost, getting buried in dry humus or burning on bare rock in the sun.

There is little doubt that a generally low seed set, and a preferred niche amongst rocks where populations cannot increase more than to a certain extent, contributes to the rarity of this species. It is probable that Littledale's Whistling Rat (*Parotomys littledalei*) which builds its elaborate stick and twig nests in the same habitat occupied by the bulbs is responsible for distributing some seeds. (Deduced from the fact that plants growing in the middle of large boulder outcrops cannot have originated from seeds distributed by rainfall.)

Littledale's Whistling Rats and their nests have a very interesting relationship to the *H. namaquensis* colonies. Rat nests are built under the lowest branches of the scrub and around boulders. New rat nests sometimes cover *H. namaquensis* bulbs, preventing the bulbs from producing leaves or flowers for a few years. When the nests finally decompose they create additional humus niches for the germination of new *Haemanthus* seeds. Bulbs found growing in rock fissures with scant humus usually have resulted from seeds shed on decomposed plant matter from old colonial rat nests.

Haemanthus namaquensis is one of the earliest Namaqualand species to enter dormancy. Leaves start to wither at the beginning of September, particularly if the weather has been hot and dry. The leaves have always shrivelled fully by late October. Effectively, seeds only have the period June to late August to germinate and establish young bulbs. The development of seedling bulbs is rapid and takes place at the time of optimum moisture availability.

HAEMANTHUS NAMAQUENSIS HYBRID

In July 1998, while examining a large population of *H. unifoliatus* northwest of Steinkopf in northern Nama qualand, a mature hybrid bulb of *H. namaquensis* x *H. unifoliatus* was found. The bulb was unifoliate with one marked undulation at the edge of the leaf.

Although the leaf had the typical shape of *H. unifoliatus* it was completely lacking in the characteristic pubescence associated with this species. The bulb structure was similar to that of *H. namaquensis*. An extensive search was conducted in the area but no bulbs of *H. namaquensis* were found.

Haemanthus namaquensis and *H. unifoliatus* may flower at the same time but generally occupy different habitats. The probable agent of pollination is Littledale's Whisting Rat, which sometimes visits the flowers of both species, getting pollen grains caught up in its whiskers.

ADAPTATION TO GRAZING BY ANIMALS

Haemanthus namaquensis is well adapted to resist damage by grazing animals. The conspicuous foliage is not grazed and is probably toxic. Goats often clamber up onto the rocky outcrops to browse new shoots and during this activity trample *H. namaquensis* bulbs. The largest clumps are often situated under dense *Rhus undulata* bushes as goats are not able to gain access to these situations. Bulbs within the protection of lighter scrub are trampled from time to time. Frequently the outermost bulbs in the clump are damaged down to the area within the vicinity of the basal plate. The plants respond by producing new bulbs; for this reason small plants are sometimes found at the edge of clumps of large bulbs.

Trampling of the habitat remains the principle reason *H. namaquensis* is rarely encountered growing in the open. If bulbs do get the chance to establish in these areas, they are avoided by grazing stock and may, on occasion, become very large.

ECOLOGICAL COMPARISON WITH *H. CRISPUS* AND *H. UNIFOLIATUS*

Haemanthus crispus and *H. unifoliatus* are commonly found in mountains and their foothills adjacent to most areas in which *H. namaquensis* is found. These two species flower in most years and set abundant seeds. Seeds ripen in late March and April and can, therefore, germinate in wet weather associated with late summer thunderstorms and the first winter rains sometimes falling in late April and early May.

The early production of abundant seed, and occupation of several niches in the habitat ensures that these two *Haemanthus* species remain relatively plentiful in the Steinkopf area. Rainfall, once again, is the main agent that distributes seeds.

Haemanthus unifoliatus tends to grow under scrub in flat or gently undulating areas near Khosies as the area is heavily grazed and most seed gets trampled by livestock.

REFERENCE:
Snijman, D. 1984. **The Genus *Haemanthus*: A Revision**. Journal of South African Botany, Supplementary Volume No. 12. CTP Book Printers, Cape.

Haemanthus namaquensis bulb.

Photos: Michael Vassar

Young bulb damaged by grazing livestock is producing a new bulb from the basal plate.

TRADITIONAL MEDICINE

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The indigenous people here in Africa have a powerful belief in he forces of evil, their ancestors, and the power of witch-doctors and natural home cures for any and every ailment. Most of the health cures have a pretty good chance of doing the job. "Nyangas" spend many years training to become traditional healers and a good few of them are adept at curing many illnesses.

An example is *Siphonochilus* species (Natal Ginger). I know a few white people who use it for bronchial complaints and it really clears the lungs of phlegm and other blockages. *Dioscorea sylvatica* is used as a pain-killer and a shortcut to get "out of your mind" drunk. It was the precursor of cortisone which is a strong pain killer. *Hypoxis rooperii* is currently used as a cure for certain types of cancer and a patent has been granted on one of its extracts.

I could go on and on, but I am sure that you know the medicinal usefulness of many bulbs, herbs, barks, and other plant parts. Anyway, the point that I am trying to make is that the indigenous Africans have a valid reason for removing plants from the (or should I say "their"?) land. We do not have the moral right to deny the people their chances of being cured of a physical or psychological illness.

The problem lies with the colonial masters who gave the people a drug as cure for measles, smallpox, malaria, TB, etc. However, they omitted to teach the people that better lives could be had by having smaller families, simply because smaller families mean more money for education, food, clothes, etc.

The end result was a population explosion in Africa, Asia and South and Central America. The natural plant population that was previously able to support the people, now came under pressure and steadily new botanically unexplored areas were denuded by "illegal" harvesters. I am not wont to refer to them as illegal harvesters, since by taking plant material from extremely rural areas, they are making money and therefore feeding themselves and their families. Is that wrong? The First World seeks to criminalize the indigenous populations for taking what they perceive as being their own. Is that such a crime?

Granted, there are people making a fortune out of the denudation of Africa's natural resources but the average woman at the market earns for herself and her dependents a grand total of about R100-00 (±$22.00) in a good week. For that she has to camp on the side of the road, under plastic or cardboard. Come rain or shine she

must smile and call prospective clients to her wares. If she is lucky, she will not be robbed of her money or even raped. In all likelihood, I suspect that she has to pay a commission to the unofficial bossman at the market and if she has a good week her husband will take whatever she brings home. The more intelligent woman arrives home with her sack of milled grain and that will feed her family, until she returns to market once again.

The children will grow up without a mother's care. "Granny" will raise the children and "Mother" will carry on having children until well into her fifties. For the first 18 to 36 months the newest baby will accompany Mother on her trips to the city where it will play in the filth and mud of the market. Flies will use its body as a transport medium and the baby will most likely get dysentery or diarrhea.

The future is even bleaker. Sometime within the next three to five years the total harvesting areas will collapse and there will be no more plant material to gather and sell. That is a fact recognised by most of the pickers but they say that in the meantime their families are being fed so they will carry on regardless.

New plants that are unknown to the botanical world have appeared at the market. In1996 *Haemanthus pauculifolius* was seen for the first time. In 1997 a red crinum that weighed in at over eight pounds appeared at the market. It had four flower stems that had been snapped off and the leaves and roots had been removed with a machete. On investigation I found that it was a bulb from iZingolweni and that the flowers were red and not pink or white (important because *C.moorei* and *C. macowanii* occur in that area). It came from a mountainous region. It is the largest crinum bulb that I have ever seen in Natal.

The plants arrive at the market sans roots or leaves. More often than not the basal plate is rotten or damaged beyond regrowth.

According to the conservation body's ruling, only black people are allowed to purchase medicinal and magical "cures". The only time conservation bodies raid the market is when they receive a tipoff that parts of endangered animals or large cycad species are being touted for sale.

I am not allowed to go to the market to buy bulbous material, despite the fact that I have a licence which permits me to buy and sell rare, endangered and protected plants. I am only allowed to buy from licensed dealers. So, if I purchased bulbs from the muti market to ensure the survival of the species I would be breaking the law.

In any case, I would never buy cycads or animal parts because I feel that by doing so I could possibly encourage the indigenous people to seek a First World market, thereby depleting the limited resources at an even faster rate. It must be remembered that most

of the plants, animals, reptiles, birds, etc. that are currently taken out of Africa end up in Asia, Europe and North America so it is the First World peoples who are indirectly denuding Africa.

The Natal Parks Board officials are pretty sharp. Examples are: last year tortoises came in from Madagascar and the smugglers were caught. Leopard skins came in from Mozambique and again our Parks Board was on the ball and a major court case ended with conservation winning. When a foreign fishing vessel was found to have gill nets on board the fine was given to the Parks Board for conservation.

It is estimated that the bulb market in KwaZulu-Natal alone generates around sixty million Rand ($1.00=±R4.85) per annum. It is believed that the total consumption of all traditional and medicinal items sold in Africa is approximately one billion rand per annum. This figure includes animal parts, animals, birds, reptiles and cycads and although bulbs are one of the biggest sellers, they make up less than 5% of the fiscal amount.

I have taught my staff to utilize trees without damaging them. For example, by taking bark from only one side of *Pittosporum* trees, and by using all of the trees they will never deplete my one hundred or so trees. *Pittosporum* is used as an emetic.

There is light at the end of the tunnel. Places like Silverglen Medicinal Nursery in Durban grows plants for restocking denuded areas. Silverglen is owned by Durban Municipality and the staff is actively engaged in suppling traditional healers with stock plants to enable them to grow their own medicines. This is slowly beginning to happen.

On a political vein I would like to mention that all the plants and most of the animal parts come from "hot" areas. To clarify what I mean, a hot spot in Africa is an area that is experiencing political upheaval. By that I mean that two or more political or faction groups are at loggerheads and the ruling government of the day is shying away from sending in police or conservation bodies to carry out the task of everyday conservation.

When Mozambique was a death trap many animal parts and plants from that country arrived in South Africa. They were smuggled over the border and used by the illegal aliens as a means of generating cash for themselves and their families back home. I have noticed that material from Kenya is now coming into the market. Towards the end of 1995 I even came across a fetus of a dolphin that had come down from Northern Mozambique.

On a lesser scale, when we have problems in parts of my country, be it third force or inter-political, new faces are seen at the local market. This can only mean that the rule of conservation and to an extent, the rule of everyday law, has been suspended. I am not

implying that parts of South Africa are ungovernable, what I am saying is that in times of strife, the police and army concentrate on dangerous criminal activities and, because of a lack of manpower, everyday duties such as conservation take a back seat.

However, many farmers and collectors are now planting for the future. So even if the plants are wiped out in the "wild" they will still exist in gardens and on farms. Sometime in the future we will go back to those places and restock the original areas. This places us in a better position than highly developed countries. Americans will never be able to replace their passenger pigeons, their bald eagles are endangered and many plant species have been wiped out. The Europeans have denuded their forests, the early Indian Ocean explorers decimated the dodo populations. The list goes on and on.

This year (1997) I am buying in 1,000 *Scilla natalensis* from my usual source but for a different reason than is normally the case. I will be cutting off the basal-plate of each plant and treating the plates with hormones before planting them in a heated bed. The 1,000 damaged bulbs will be donated to the local medicinal market and in my own puny way I will be saving 1,000 *Scilla natalensis* from destruction.

I hope to obtain at least five to ten suckers from each damaged basal-plate and through vegetative means, become self sufficient in one more species. I am always bragging that I live in a tropical zone. The downswing is that even though I can grow anything here, I often cannot get my cold-hardy bulbs to flower, which means that I will never be able to get enough of my own *Scilla natalensis* to flower to collect any decent amount of seed.

Whether we are "settlers" or indigenous Africans, we will pull together and one day have a pristine continent. South Africa has an increasing reforestation level. Natal has the largest percentage ratio of land mass to conservation area in Africa. We are already making great inroads into educating the indigenous peoples. We already use sustainable conservation in many areas. The KwaZulu Department of Conservation (ex Zulu semi-independent homeland prior to the 1994 elections) pioneered the idea that people living adjacent to reserves should benefit from those reserves. That concept is slowly gaining ground and the populations surrounding the reserves are already benefiting from "their" conservation areas.

THE COWLISHAW CLIVIAS

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In 1935 in the second volume of the **Year Book of the American Amaryllis Society** (now **HERBERTIA**), G.K. Cowlishaw wrote "Notes on Amaryllid activities in Australia". In this article he described his breeding of clivias as well as many other subjects.

Although this may have had little impact outside Australia, in this country Cowlishaw hybrids occasionally have been found and queries from time to time arise about these plants.

When I visited and met Mr. Cowlishaw during the late sixties I noticed he had a very large number of clivias, growing in large pots and gardens. However, they weren't in flower and as I was interested in some other plants we didn't discuss them.

Mr. Cowlishaw died in his nineties about 15 years ago. His property was sold and his article is now the only information we have about his plants. The only person with some known plants from his collection is Mr. Ken Smith, a horticulturist with an interest in clivias. His plants were selected from Mr. Cowlishaw's plants about 10 years ago. In general they are large growing plants, often with quite large flowers but usually of fairly open shape and not outstanding by present standards.

One particular plant, however, is quite distinct. In this plant, as well as the flowers being orange, the orange colour continues into the ovaries and into the pedicels so that the whole umbel, to the point where the pedicels join the stalk (peduncle) is orange. I have never observed this in any other clivia.

Cowlishaw stated in his article that his initial work with clivias started in 1920 when he crossed *Clivia nobilis* with *C. miniata*. This interested me as I have always maintained that present-day clivias were improved by selection over almost 150 years and that no hybridisation was involved. I argued that no one would cross *C. nobilis* with *C. miniata* with the aim of improving *C. miniata*. As well as reducing the size of the flowers, the slow growth of *C. nobilis* is passed on to its seedlings so that progress in restoring flower size would be extremely slow. Also, there is no record available to suggest that this type of breeding actually took place. So the Cowlishaw plants were of interest to me. Recently some more inquiries were made to Mr. Smith about these plants and we again discussed this matter.

This led me to reread the original article and a number of interesting points emerged.

1. In his introductory remarks Cowlishaw says "*C. cyrtanthiflorum* is also scarce. This is a so called hybrid of a reputed parentage *C. nobilis* x *C. miniata*." He said a "so-called" hybrid and "reputed" parentage because none of his plants from this parentage resembled *C. cyrtanthiflora* so he followed with "I have raised hundred of this cross and have never had a seedling yet with flowers in narrow drooping umbels as in *C. cyrtanthiflorum* [sic]".

Of relevance to this is my observation of crossing *C. nobilis* (as now grown in Australia) with our common (non-improved) *C. miniata*, which I did over 35 years ago and which produced plants nearly identical to *C.* x *cyrtanthiflora*. The latter is now grown in large numbers in many parks and public gardens around Sydney. I would point out that I only made the cross above to observe the resulting progeny and to check it against the plant grown in Australia as *C. cyrtanthiflora*.

2. Cowlishaw says further on "some fourteen years ago (*i.e.* 1920) I possessed several plants of *C. nobilis* and a plant or two of *C. miniata*". This is worthy of comment because he had said earlier that *C. nobilis* was very scarce and certainly since I began growing clivias in the late 1940's *C. miniata* was thousands of times commoner than *C. nobilis*. Yet Cowlishaw had more "*nobilis*" than *miniata*.

He goes on to say "the former were orange-red and the latter were orange." He makes no comment that *C. nobilis* is tubular and *C. miniata* open- or cup-shaped. "In September 1920 I crossed the flowers of these plants both ways". Seventy-three seedlings were obtained of which the first flowered in August 1923.

3. "All were vigorous and on the whole, far more robust than their parents". This is, again, strange as *C. nobilis*, as I remarked earlier, usually passes on its slow growth habit to its seedlings and the progeny from this cross can not usually be described as "far more robust than their parents." Perhaps more robust than *C. nobilis* itself, but not both.

Then, most peculiarly, he states "the flowers produced by quite 90% of the plants were decidedly larger than those borne by either of their parents." I believe this is quite impossible if in fact *C. nobilis* was one parent.

4. From this F_1 generation he selected the ones with the "widest petals, the roundest tips, the largest flowers and the most robust. These were inter-crossed."

This F_2 generation "were decidedly an improvement on their parents". They were more vigorous and flowered sooner. He described various flowers as outstanding in various ways. The largest flowers "were 5" across!, perfectly round and reflexed".

5. From various selected plants of the F_2 generation he obtained selfed seed to produce a further generation (F_3). As would be expected, this produced more variation with some dwarf plants. Cowlishaw goes on to make one of the most interesting and important comments in his article:

"Many of this batch reverted to the starry form of C. nobilis *and one can hardly tell them from the original plant from which they sprang."*

No one, I am sure, could describe *C. nobilis* as a starry flower.

The rest of the section on clivias is interesting but I will only comment on one section later. For now I will concentrate on my conclusion that the Cowlishaw hybrids did not arise from crossing *C. nobilis* with *C. miniata*. I suggest they are a cross between a near wild (unimproved) form of *C. miniata* similar to the Australian "common" *C. miniata* with an improved *C. miniata*, "hybrid types imported from England" as he described in his introductory section of the article.

This conclusion is based on the five sets of data listed above and summarised here.

1. His primary cross did not produce even one plant resembling *C.* x *cyrtanthiflora* out of "hundreds of seedlings".

2. Cowlishaw had more *C. nobilis* (= common *C. miniata*) and only one or two *C. miniata* (=- imported improved *C. miniata*).

3. His F_1 generation was more robust and most of the flowers were larger than either parent. I suggest this is impossible with the stated parents.

4. The results of his F_2 generation show much too rapid improvement for a simple *C. nobilis* x *C. miniata* cross and are much more likely from a *C. miniata* x *C. miniata* cross involving one markedly improved type as one parent.

5. His F_3 generation shows a quick expression of primitive (wild type) flowers and he describes these as identical with his original *C. nobilis* flowers. However, these are "starry flowers" which can only apply to *C. miniata*—never *C. nobilis*.

Since reaching the conclusion that Cowlishaw's *C. nobilis* was really the common *C. miniata*, or very similar to it, I have endeavoured to find some supporting evidence to indicate such a confusion existing in the past. I recently obtained a page from a major Australian gardening magazine dated June 1974 which has a colour picture of the common (starry) *C. miniata* labelled *C. nobilis*. If *C. miniata* were still being confused with *C. nobilis* as recently as 1974, then it is more than likely such confusion existed more than 50 years earlier.

Cowlishaw's article also throws some light on the most widely grown form of *C. miniata* grown in this country.

What we call the "common form" of *C. miniata* (in Australia) has a "starry" flower which is a rather dull pale orange colour. The plant has strap-shaped leaves about 4cm wide which slowly narrow to a fairly pointed tip. It is a smaller grower overall than wild-type plants which I have raised from South African seed. However, its outstanding characteristic is its propagation rate. A single plant will form a large clump within two to three years as it is a prolific offset producer. In most of the world *C. miniata* is grown from seed as offset production is too slow to be of commercial use. This *C. miniata* is scarcely ever seed raised as it provides numerous offsets each year. One nurseryman known to me produces 20,000 plants a year from a quite small operation. There are numerous gardens around Sydney which contain thousands of plants in large solid masses, often only ten to twenty years old.

The origin of this plant has always puzzled me. Was it an unusual wild form? As such a prolific plant has not been described from South Africa I doubt this explanation. Was it a mutation which arose in Australia and which spread widely and rapidly due to its rapid propagation rate? This can't be ruled out.

However, Cowlishaw in his article describes quite a few dwarf plants appearing in his F_3 generation. Although he doesn't mention them I would presume there were intermediate sizes also. I would not call the "common *miniata*" a dwarf but it is a smaller grower, particularly in a clump and under conditions which are harsher than usual. However, he does say the following of the F_3 plants: "Another feature is that many are rapid in increase" and then "some of the new seedlings even before they had flowered had 3 or 4 growths breaking away and one in particular (a poor flower type it is true) has in its third year of flowering, made upwards of 15 new growths".

It is this latter plant which I suspect could be our "common *miniata*". The combination of the rapid proliferation with "a poor flower type": from a group of seedlings which also produced smaller than usual plants and which appeared over sixty to seventy years ago, seems a very likely origin for our common plant.

It is worth noting that in all the **HERBERTIAS** to the present day there are no other descriptions of breeding results with clivias. There are occasional comments about large collections or references to other breeders but Cowlishaw's article is the only one which describes results from generation to generation. Although there is a problem with his nomenclature for one of the original parents in his initial cross, I think Cowlishaw's article is most interesting and valuable and it is unfortunate that there are not others like it.

GROWING TULIPS IN THE COASTAL STATE OF LOUISIANA, U.S.A.

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Early research with the tulip in the United States considered the bulb completely unadapted to the southernmost states, but this is no longer the case. Experiments with growing practices and cold storage have enabled gardeners in Louisiana to grow tulips with success. By following a few simple cultural rules, anyone can create beauty and interest in the spring garden with this spectacular flower.

Select Top Size Bulbs—Top size bulbs must be planted if good results are to be expected. Bulb size directly influences the size and quality of flowers, stem length and stem quality. Bulbs should be inspected for signs of disease, injury and drying out. Planting inferior bulbs is a waste of both time and money. Bulb size varies somewhat among the varieties but securing bulbs from a reputable source will insure that your order is filled according to your specifications.

Order Bulbs Early—Tulips should be planted during December, because time must be allowed for the cold storage treatment. The bulbs should be ordered early enough (late September or early October) to specify delivery about 60 days before planting.

Some bulb distributors offer "precooled" bulbs to the southern trade area. These "precooled" bulbs are satisfactory if not allowed to remain at room temperature for longer than five days between the time they are removed from storage and the time they are planted. Order precooled bulbs for delivery at planting time and plant them immediately upon receipt. Planting should be completed by January 1.

Some recommended tulips for planting include: '**Apricot Beauty**', apricot with darker rose; '**Aristocrat**', dark rose with lighter petal edges; '**Elizabeth Arden**', salmon-pink flushed with violet, '**General Eisenhower**', bright red; '**Glacier**', white; '**Ivory Floradale**', very large, ivory white; '**Jewel of Spring**', golden yellow with red petal edges, '**Maureen**', tall, large white; '**Mrs. John Scheepers**', very good yellow; '**Scotch Lassie**', violet; **Smiling Queen**', rosy pink.

Cold Storage of Bulbs—Climatic conditions in the northern United States are naturally favorable for tulip growing. Louisiana's warm, humid, subtropical climate on the other hand, makes it necessary to place the bulbs in cold storage prior to planting.

Research in Louisiana indicates that the bulbs should be stored for **45-60 days at a temperature of 35-40°F**. This storage practice

has a tremendous influence upon the overall quality of flowers produced as well as the length of stems upon which the flowers are borne.

Plant bulbs immediately upon arrival from cold storage. Do not expose the bulbs to room temperature conditions any longer than is absolutely necessary between removal from storage and planting. The advantages of cold storage treatment may be lost if bulbs remain at room temperature too long following removal from storage.

The vegetable drawer of the home refrigerator generally meets the temperature requirements for bulb storage. If other facilities are not available this will serve the storage purpose satisfactorily. Bulbs may be stored in the containers in which they are shipped from the distributor.

Select and Prepare the Planting Site Early—Locate beds for planting tulips in well-drained areas exposed to full sun or only partial shade. Tulips make a more effective show when planted in masses of single colors. Beds should be designed and located to take advantage of this fact.

Soil preparation should include raising the bed area 6-8 inches above the surrounding soil level. Beds should be thoroughly tilled and formed two to three weeks prior to planting time.

As in the case with most bulbs, fertilizer must be used with caution since excessive amounts may cause injury. Two pounds of 8-8-8 or an equivalent amount of other complete fertilizers per 100 square feet of bed area may be broadcast and worked into the soil two weeks prior to planting. Specialty or bulb fertilizers are available and may be used.

Soils with a high natural level of fertility may not require the addition of fertilizers—additional fertilizer accomplishes little.

Planting the Bulbs—In general, plant bulbs during December. Plant at a depth of about four inches in heavier soils and about five to six inches in lighter soils. Space bulbs eight to ten inches apart for mass effect during blooming. Remember that a mass of one particular color in one location produces a more desirable effect in the landscape than does a mixture of coors in a single location. Consideration must be given also to date of blooming when grouping varieties in a particular planting.

Care After Blooming — Following the peak of the blooming period and just prior to petal-fall, remove blooms from the plants by cutting or breaking the flower stem about two inches below the base of the flower. Flowers should be destroyed and not allowed to acccumulate on the surface of the bed area.

Dig the bulbs about three weeks after blooms have been removed. Do not allow the bulbs to be exposed to direct sunlight for an extended period of time during the harvesing operation.

If you do not plan to save bulbs from one season to the next, remove bulbs from the beds and discard.

Following harvest, store bulbs in a relatively cool, well ventilated area. Dust the bulbs thoroughly with a fungicide and insecticide before storing to reduce storage rots and insect damage.

SOME COMMON TULIP DISEASES

Botrytis Blight — Caused by the fungus *Botrytis tulipae*, this is the most serious disease affecting tulips. Symptoms may be present on all parts of the plant. The disease is carried over from one season to the next on bulbs or in the soil, and is spread from plant to plant by spores carried by wind or water.

Symptoms: The leaves become flecked with small yellowish or brown spots which may enlarge and coalesce, and cause death of large areas of leaf tissue. When an infection occurs on the edge of the leaf near the tip, there is a characteristic bending of the leaf to one side. A gray growth of the fungus develops on dead areas during humid weather. If the stalk is attacked, the resulting rot may cause it to break off and rot completely.

Lesions on the flower begin as small whitish to light brown spots, which may increase in size and affect large areas. If infection takes place while the flower is still in the bud it may keep the bud from opening.

Small black bodies the size of a pinhead are often found on the brown outer bulb scales. These are the sclerotia, or resting bodies, of the fungus. If the outer scales are removed, deep yellow or brown circular lesions may occur at the nose or the base of the bulb. The lesions rarely penetrate to the inner, white scales. Plants arising from infected bulbs are dwarfed and turn a pale yellowish green and the flowers fail to open.

Control—As soon as the disease appears in a bed, infected plants should be carefully and completely removed and destroyed. An appropriate labeled fungicide application should be started when the plants are four inches high. Applications should be discontinued as soon as the blooms begin to open so spray will not spot or discolor flowers.

As soon as blooming ceases, all plant debris should be removed and destroyed. As soon as the bulbs are dug, the stems should be removed to prevent spread of the disease to the scales. Careful handling of the bulbs in important, as infection occurs more readly on injured bulbs.

Bulbs should be examined carefully before planting, and those showing evidence of the disease should be discarded so they will not infect other plants. This is extremely important in controlling this disease.

If the disease has been severe in a particular location, tulips should not be planted in that spot for at least three years, as the fungus in the soil will attack the bulbs. If you must replant in an infected area, treat the soil with a fungicide, for example, PCNB (pentachloronitrobenzene) at the rate of 1 tablespoon of 75% active material in a gallon of water per 10 square feet of area. The material should be applied as a soil drench after bulbs are planted.

BULB ROTS

A number of fungi cause rotting of tulip bulbs. These include basal rot (*Fusarium oxysporum*), blue mold (*Penicillium* sp.), crown rot (*Pellicularia rolfsii*), and gray bulb rot (*Rhizoctonia tuliparum*). The names of these diseases are descriptive of the symptoms occurring on the bulbs. Other evidences of bulb rotting fungi are poor bulb emergence and weak or discolored plants. In general, the precautions recommended for control of botrytis blight, such as careful handling of bulbs, avoidance of replanting in areas in which diseased bulbs have been grown, and soil treatment with an appropriate labeled fungicide will help control this disease also.

BREAKING

Breaking is the oldest known virus disease of tulips. Flowers become variegated in which light green or white stripes develop on the leaves. The variegation in the flower consists of bars, stripes or streaks of a darker color on a lighter shade or on pure white or yellow. Infected plants are reduced in size and vigor.

The virus causing this disease is spread by aphids. Infected plants should be removed and destroyed as soon as they appear. Plants should be monitored for the presence of aphids. When detected, the plants should be sprayed with an appropriate labeled insecticide to control the insects which carry the virus. This is important if you are saving bulbs from year to year.

TULIP INSECTS

Aphids. The green peach aphid attacks bulbs while in summer storage, causing damage that results in weakened growth and poor flowering. This aphid also attacks growing plants and may transmit certain virus diseases from infected to healthy plants.

The tulip leaf aphid feeds on the foliage where large clusters may be found sucking the sap from the leaves and shoots. As a

result, the leaves may fail to open or the plants may be killed.

Control aphids on bulbs by using an appropriate labeled insecticide as a dust or spray. Where the foliage is being fed on by aphids a labeled insecticide may be used. Do not apply insecticides after flower buds begin to show color or the flowers may be damaged.

Mites. Several species of mites attack tulips. They are minute, barely visible to the naked eye, and may be red, green, yellow, or greenish-red. They are found on the undersides of the leaves where they feed. As a result, entire leaves may become yellow, gray or brownish. An appropriate miticide labeled for bulbous plants may be used for supression or control of mites prior to flowering.

Wireworms. Tulip bulbs are sometimes subject to attack by wireworms especially where turf is turned under in preparing the tulip bed. This brownish to yellowish, slender, tough larva of a click beetle tunnels into the growing bulb. The punctures it makes provide entrance for soil fungi which rot the bulbs. Control measures are to incorporate a granular soil insecticide such as chlorpyrifos during bed preparation.

PESTICIDE USE

Users should read the label on the pesticide container and follow the directions and precautions on the label when using any pesticide. All pesticides are poisonous and should always be used with caution. Pesticides are the "medicines" of domestic plants. Medicines should be kept out of the reach of children. Follow the label in administering treatment. If you have a headache you may choose to take an aspirin or you may not. Plant medicines are the same. If you have a pest problem you may choose to give treatment or you may not. The choice is yours in how much pain or plant damage you are willing to accept.

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CULTIVATION NOTES ON *WORSLEYA RAYNERI*

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This magnificent plant is not the easiest of plants to establish, though once growing it should persist in doing so, provided that a few simple points are followed:

- The medium needs to be very well drained (orchid-like)
- Feed well. I use slow release fertilizer like Osmocote (for indoor/balcony use) over the growing season and 1/2 strength Phostrogen every second watering. Rain water is by far the best or water from a fish pond. Be sure to cease fertilising towards the end of the growing season. This helps eradicate salt buildup in winter.

I have tried the following growing mediums:

- 1.3–5ml washed gravel with 10ml washed orchid bark. Mixed at 25% gravel and 75% bark in a 40 liter foam box.
- Perlite (90%) and compost (10%), underlaid with 2 inches of foam chips in a 40 liter foam box.
- Foam beads (83%), compost (7%) and pine bark (10%), in a 40 liter foam box.
- Crushed conglomerate rock (100%). High in silicate. Larger pieces are used for the drainage, working in smaller pieces towards the top. Finally, use what's left of the crush to pot up the bulb in a 6 inch pot.

All of these mediums worked well. It really is a "feel" thing.

During winter the bulbs should be dry with little, if any, water.. Some plants will go dormant. They are all very individualistic. Bulbs may lose most of their leaves during winter so don't be tempted to water as it will rot the roots and set the plants back drastically.

Over winter I keep my bulbs inside, making sure that no frost gets to them.

In the growing period, allow the plants to dry out moderately before the next watering (remembering that in their natural environment they are rock dwellers and mist is mostly their main water supply). In summer this could mean watering once every morning. You really have to keep a regular eye on this beauty—after all, it's not just any bulb!

THE ECOLOGY AND STATUS OF *HAEMANTHUS CANALICULATUS* IN ITS MODERN ENVIRONMENT

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Haemanthus canaliculatus is a rare species endemic to a small area on the South Western Cape littoral, approximately between the towns of Rooiels and Betty's Bay. The species was described fairly recently (Snijman, 1984: 76), and has one of the most singular habitat preferences as well as a very interesting ecology which is dependent on fire. The latter has been referred to before (*ibid*) but the specifics of the ecological processes at work required thorough field research. This research can only be carried out after fires have burned the dense, somewhat swampy terrain in which the species is found. Fires usually occur only about once every decade and consequently research opportunities are limited.

In late midsummer of 1997/1998 a fire swept through the *H. canaliculatus* habitat from the outskirts of Betty's Bay to the vicinity of Pringle Bay providing an ideal time to collect and analyse the research data presented, as well as to take habitat photographs.

THE ROLE OF FIRE IN REPRODUCTION

Many bulbous species in South Africa's eastern grasslands flower after veld fires. Some, such as species in the genus *Cyrtanthus,* flower directly after fire; in other species favourable growing and flowering conditions are created by a habitat cleared by fire of accumulated moribund vegetation.

In the genus *Haemanthus* the flowering performance of *H. humilis* subsp. *hirsutus, H. humilis* supsp. *humilis* and *H. montanus* is always much better in the two-year period following veld fires. Burning usually occurs between May and September, well before the growth cycle begins between October and early December.

Most *Haemanthus* species in South Western Namibia and the Northern and Eastern Cape frequent rather open sandy habitats where the vegetation is predominantly scrub and succulents and where little moribund grass clutter accumulates. In Namaqualand and the Richtersveld, as well as South Western Namibia, grazing animals play a significant role in keeping the habitat open and suitable for the flowering and seeding of the majority of *Haemanthus* species, most of which are endemic to these regions.

In the Western Cape, however, *H. canaliculatus* and *H. san-*

guineus remain well covered by moribund vegetation unless the habitat is burned. In the case of *H. sanguineus*, where the cover becomes very thick some populations cease flowering until the su roundings are cleared by fire.

COLONIES NEAR BETTY'S BAY AND PRINGLE BAY

The remaining pristine *H. canaliculatus* habitat near Betty's Bay and Pringle Bay comprises peaty, sandy watercourses and their swampy surroundings, thickly covered by dense fynbos which may reach over two metres in height in places. Occasionally plants are found growing on gentle slopes; where this does occur it appears t be related to abnormal seed distribution in heavy rainfall.

The bulbs occur in two basic niches. Most commonly they are found on, or at the edges of, sandy washes. More rarely they grow in clumps of restios or amongst the woody tangled mass of roots produced close to the soil surface by dense scrub.

In disturbed habitat the bulbs have been found in pine plantations, at the edges of excavations, in the vicinity of a rubbish dump and in uncleared sections of new suburban gardens in peri-urban Betty's Bay. The largest colonies observed after the most recent fire are nearly all threatened, either by the suburban sprawl of Betty's Bay, or the associated problems that go with such expansion: increased disturbance of the habitat, rubbish dumping and the restriction of fires which would directly threaten suburbia. Near Pringle Bay the habitat has been degraded to such an extent at one well-known colony that only a few plants were observed after the most recent fire.

Haemanthus canaliculatus is also directly threatened by introduced exotics. The Port Jackson acacia, originally introduced from Australia to stabilise sand, is widespread around Betty's Bay, Pringle Bay and the shoreline around Cape Hangklip. Fire is required for the successful germination of this acacia's seed, and after fires the seedlings proliferate. The water table subsequently is lowered and specialised bulbs such as *H. canaliculatus* eventually succumb.

Bulbs of *Haemanthus canaliculatus* are able to survive in exotic plantations—a pine plantation burned in the recent fire contained several flowering colonies. The thick carpet of fallen needles had been thoroughly burned and the trees reduced to charred trunks with a few branches. Should this habitat be allowed to revert to natural conditions little harm ought to come to these colonies.

GROWTH AND SEEDLING CYCLE

The findings presented here have had to be made after one fire and ideally should be made against an assessment of comparative

data. In this instance the comparative paradigm, which we prefer, cannot be used since the next opportunity is unlikely to present itself for at least another decade, when fire next occurs.

After the recent fire, flowering extended from late January to late March. About half the populations in the burned habitats had flowered by the end of February. The remainder flowered during March with the last flowers produced in the second half of the month. In previous years the species has been observed in full flower in the second half of March (John Lavranos, pers. com.). The timing of flowering is probably related to when the fire actually occurs. This is usually between January and early March, the hottest, and usually the driest, time of the year in the area.

At the time of the first research visit in late February, some plants already had umbels of fruits in an advanced state of development. Since the flowering to fruiting process takes four to six weeks the latest time at which these plants could have come into flower would have been the end of January.

Seedset in the species is apparently variable and seems to be related to the timing of flowering. Few early flowering plants had more than 1-6 developing seeds, whereas plants that flowered in greater concentrations had far more ripening fruits. This probably implies that either larger groups of plants are more attractive to the pollinators or that pollinating agents were absent at the beginning of the flowering period.

A proportion of bulbs did not flower and the tiny caniculate leaves were just beginning to emerge from the ground while their neighbours were flowering and fruiting. This habit is typical of the genus and curiously applies also to this species which is characterised by such limited opportunities for its reproductive biology.

Several trenches had been dug during the suburban development of Betty's Bay. One of them had been cut through large scattered groups of *H. canaliculatus* and the bulbs excavated during this process provided some interesting data for analysis. The colony had been, before the fire, partly in a very dense bush and partly in lighter, less tall vegetation. Young bulbs found in the area which had the thickest vegetation were very small (Fig. 1), while those in the habitat which had been less densely covered were a little larger. These observations make it clear that after seeds have germinated bulbs have little time to develop before they are screened from sunlight by a dense regrowth of vegetation. This process occurs rapidly. During late March, 1998, *Pelargonium cucullatum* seedlings, some of them already a few centimetres high, were present in many places with *H. canaliculatus*.

It is likely that the development of young bulbs to flowering

Photos: Laurian Brown

Destruction of *Haemanthus canaliculatus* habitat via the accelerating urban sprawl of Betty's Bay. Development takes place through the middle of several large bulb colonies. The trench in the foreground has been dug through the middle of large colonies of this rare bulb species.

An immature bulb which germinated at the time of the last fire six+ years ago.

Haemanthus canaliculatus coming into bloom during mid-March after a bushfire had burned the vegetative cover to the ground. Note how rapidly the vegetation starts to regrow even during the dry autumn. The area is damp throughout the year.

size is extremely slow in the natural habitat. This pattern of slow growth, in the face of steady encroachment by housing development from Betty's Bay and Pringle Bay, makes the status of the plants more precarious.

STATUS IN A MODERN ENVIRONMENT

It is probable that *H. canaliculatus* will be extinct in the wild within the next few decades. As suburban developments expand, further groups of plants will be destroyed by housing. The lower-lying swampy areas which presently carry some good concentrations of plants will be less and less likely to get burned owing to the fire hazards this would pose for urban developments.

The spread of Port Jackson acacia invasions in these swampy areas eventually will destroy the habitat of the *H. canaliculatus* bulbs. Fire in areas colonised by this acacia is the trigger for the germination of its seeds; large numbers of acacia seedlings appear after burning.

The most sensible conservation measure for *H. canaliculatus* would be to remove as many bulbs as possible from areas currently being developed and zoned for development. These colonies could be established at the Harold Porter Botanic Gardens in nearby Betty's Bay as well as in other local botanic gardens such as Kirstenbosch. Some colonies could also be specifically protected *in situ* in a small reserve or reserves set aside for this purpose. These would need to be subject to carefully planned burning regimes.

It is evident that the conservation of *H. canaliculatus* needs to be urgently addressed if this rare and beautiful species is not to slide into extinction.

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BREEDING *CYRTANTHUS* FOR CUT FLOWERS

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This is the story of my fifteen years of enjoyable retirement and I recommend similar projects to other retired people—no previous experience required! When I retired from engineering, I had no real knowledge of plants or horticulture. At my boys school we learned mathematics, not biology. So I decided to try to rectify this by growing bulbs. I chose bulbs as I reckoned they were designed by nature to withstand all sorts of hardships; with me they were bound to get plenty of that, but the end product I wanted was flowers.

First I needed a specification, so I talked to various flower experts, and was told to look for long stems, upward facing flowers, good colour range, and the possibility of all year around flowers of some sort. Then I collected together all the bulbs I could from the normal common catalogues and tried them out. Hippeastrums, nerines, lycoris, etc. Plus *Cyrtanthus parviflorus* (*Brachyscyphus*) and *C. mackenii*. These two showed a precocious willingness to cross and to set seed, so I chose *Cyrtanthus* as my new hobby. Although some South African plants are hardy here, *Cyrtanthus* are not, so I had to build my first and only greenhouse.

Here in Cornwall, we get rain and wind all the year around, so the summers are not too hot or too dry—around 15-25°C [60-76°F] and 16 hours of daylight. The winter temperature seldom falls below 0°C and -5°C [23°F] is near catastrophic, but daylight diminishes to 8 hours. I try to keep the greenhouse temperature above about 3°C, but as my need for space has expanded, I have had to rely on polythene tunnels and bubble film plastic for the bulk of my bulbs.

GROWING

I use a quick draining mixture of 2 parts peat, 2 parts grit, 1 part sterilised soil, and a small quantity of fertiliser. This is used for both seed pots and mature bulb pots. In the polythene tunnels the bulbs are in a natural quick draining soil. Most species prefer slightly acid soil, but I do not take much trouble in that respect. Also, cyrtanthus generally prefer a temperature of around 15°C [60°F] to grow well all the year around, but mine have to put up with long spells of sunless winter, with temperatures around 5°C [41°F]. They get better treatment from colleague Cor van Eijk over in Holland.

Seed is sown in trays or pots, and must be sown within two or three weeks of ripening unless refrigerated. Small or special quantities may be floated on water kept at 15°C with daylight. Transplant when the leaves are 25mm long. The peak of seed sowing is during

the dull cold days of October and November, so the trays are placed in a specially insulated cabinet with a 40 watt fluorescent tube about 30cm above them. This gives them a temperature of around 15°C; the lamps are switched on to give a 16 hour day.

At about six months, the seedlings are either potted up or planted out in the tunnels. Some flower in two years, others take three to four years. Most varieties are evergreen, and do not like being disturbed or dried off, so I keep them moist in winter and feed them in the summer. A vigorous hybrid vallota bulb can weigh 200 grams and may need a 5 litre pot.

My bulbs don't suffer from too many pests or diseases, and I don't try to maintain perfect health. I aim to produce good strong resistant strains, so that those which fail to stay healthy, particularly those with virus, are put on to the garden bonfire. Aphids and narcissus fly (*Merodon* and *Eumerus*) are the worst pests, and bulbs in the tunnels tend to suffer fungus trouble from drips of condensation from the roof. Continual production of new seedlings to replace old stock tends to keep severe trouble away. Noticeably, some clones attract all sorts of bugs, but others seem to be immune.

PROGRESS

Getting started was a slow job. I knew nothing of HERBERTIA and the International Bulb Society, and the first four years were spent finding sources of bulbs and seeds and technical help.

It soon became apparent that seed was the best option. Bulbs from the warmth of South Africa did not like the move to cold and damp Cornwall, and were confused by the change from southern hemisphere to northern hemisphere. It often took them three or four years to recover, during which time seed of the smaller bulbs could germinate and grow to maturity.

The most important acquisitions were as follows. In 1985 I obtained some *Cyrtanthus eucallus* seed from J.A. Holmes of South Africa, which resulted in some bulbs with fertile cream coloured flowers. Then, in 1986, I received seed of some *C. capensis* hybrids from Michael Willetts of California. These gave fertile white flowers. Also in 1986, a generous packet of vallota (now *C. elatus*) seed from Denis Carron of Western Australia resulted in 400 vigorous bulbs, one of which had a head of 15 florets. By 1988 I was crossing vallota with white and cream coloured flowers. September 1990 produced my first miracle—some cream coloured vallota.

Meanwhile, in 1986, Cor van Eijk, a Dutch commercial flower grower, came to see me. He was looking for good strong white nerines but I sent him away with a selection of *Cyrtanthus* bulbs, mostly *C. mackenii* hybrids. After trying them out, he agreed with me

Photos: Frank Holford

Cyrtanthus elatus (vallota) hybrid PH13

Cyrtanthus elatus (vallota) hybrid 02NO-6

Cyrtanthus hybrid 0294-21 tetraploid

that *Cyrtanthus* could well turn out to be a useful cut flower. He was very enthusiastic and helpful and we started a scheme whereby I first made a selection of possible good flowers, and then passed them on to him. He grew them under his commercial conditions and made strict, detailed and wide ranging analysis of their growth, flowering, number of stems etc. My selections were around 1%, i.e. 50 from 5000 seedlings, and he made a further selection of about 1%, as possibles for further propagation and growing on.

The next few years saw a rapid increase in the number of new colours and flower forms, but at the same time a lot of odd crosses which produced nothing useful at all. On top of this, I found that year by year I became more "expert", so that I became more difficult to please. I still am, but what will a perfect cyrtanthus look like?

As the number of crosses and hybrids built up, it became obvious that while two species might cross to give fertile seed, the resultant hybrid was likely to be sterile. My first successful hybrids were of *C. mackenii* x *C. brachyscyphus*. These and similar crosses with *C. obrienii*, etc., were all fairly fertile, but the next lot of hybrids were *C. mackenii* x *C. eucallus*. They were an extraordinary surprise, because many of them flowered almost continuously, *i.e.* a flower stem every 8–12 weeks. By cutting the bulb in half along the axils of the leaves, some could be found with an incipient bud every two leaves, and often with 2 or 3 stems coming from the same point. Unfortunately however they were all more or less sterile and gave no seed.

To try to solve this problem, I attempted to make them tetraploid. This I did by soaking segments of bulb in 0.05% colchicine for about four hours. Four years later I found that I had a fully fertile hybrid, which grew fairly true from seed. I tried other methods with colchicine, such as soaking the seed or injecting dilute solution into the flower buds, but if I did get any success I had no way of proving it. A four year wait is also a bit beyond my ability to keep accurate records.

In 1992 I had the honour of a visit from Gunnar Ising of Lund University, who had done so much work on the chromosome make-up of the genus *Cyrtanthus*. Our meeting was a major change in my destiny. Long words, mystical explanations of gametes and endosperms, etc., but one simple instruction—I needed a microscope to examine the pollen. While examining my cream and pink vallota hybrids he pointed out that *C. eucallus* and *C. sanguineus* had a split stigma, with the split frequently 5mm long. *Cyrtanthus elatus* (vallota) had a pinhead stigma. Of the hybrids most had splits around 3mm long, but some only perhaps 1mm, and those with a small split were often more pink in colour.

This was probably due to a double dose of *C. elatus* chromosomes, *i.e.* the normal hybrid was one set from each parent, thus producing a normal diploid. The abnormal hybrid contained two sets of *C. elata* chromosomes thus producing a triploid. Gunnar refers to this phenomenon in **HERBERTIA** 1997 but only briefly. This triploid is liable to produce an odd mixture of pollen grains—some haploid, diploid and triploid (unreduced). Hence the need for a microscope. I was straight away into the realms of Super Science.

How and why the female cell of *C. elatus* vallota comes to have a diploid nucleus may be common knowledge of those lucky people with a biological education, but for me it was rather like being invited on to the space ship Galactic Enterprise. Back in the 1939 **HERBERTIA** (pages 196–201) is an article discussing something similar with *Zephyranthes.* This was to explain why we sometimes try to get a hybrid by cross pollinating, but the progeny turns out to be identical to the seed parent. This is usually described as parthenogenesis. With our triploids, perhaps the pollen grains did unite with the diploid vallota nucleus and did carry on to form a viable seed. Whatever the explanation, the idea opened up a completely new programme of breeding.

The pollen is examined and the plants are labelled with any interesting results, *i.e.* 5% or 20% unreduced pollen, or a mixture of different sizes. For those not of a mathematical mind, the ratios of diameters of pollen grains is as follows: If the haploid diameter is 1.00, diploid is 1.26, triploid is 1.44, tetra is 1.59 and hexaploid is 1.82. Bulbs with erratic pollen size are my breeding stock, which I hope will lead to new and improved varieties.

During Gunnar's last visit we found a plant with five different pollen sizes, and by translating the pollen diameter we had 50% sterile, 23% haploid, 13% diploid, 10% tetraploid, and 3% hexaploid. A plant with a similar pollen structure has been produced by Cor van Eijk. This was done by using oryzalin to double up one of my triploids, thus logically producing a hexaploid. The leaves and petals of this plant are all of increased thickness and stiffness. This is another test I use, just using my finger tips, to try and detect plants which are polypoids.

BASIC SPECIES

If we take our specification of 50cm [20 in] stem, good range of flower colour, repeat or all year around upward facing flowers we have to try and match that to existing species.

Cyrtanthus mackenii, with careful selection, can produce a stem of 50cm but normally it is much shorter. It has a good number of florets on the head, can be various colours in its hybrid forms, and can

be nicely scented. I have great difficulty in crossing it with vallota, but it hybridises freely with *C. eucallus* and *C. sanguineus*. There may be other ways of increasing its flower size and other desirable features.

Cyrtanthus eucallus tends to produce more flowers than *C. sanguineus* although a little smaller. I have had one which produced four stems simultaneously, each with 2 or 3 flowers, from one small bulb. The stems are short however at around 15cm [6 in] but the hybrid colour range and flower form is excellent. It tends to go to sleep in the winter and it is difficult to keep it growing vigorously. Hybrids with vallota are easy, giving longer stems and interesting forms. Unfortunately these hybrids are usually sterile and only bear 2 or 3 florets per head.

Cyrtanthus speciosus (*C. capensis*) belongs to a group including *C. smithiae*. The bulbs tend to be winter dormant and stems are short with just 2 or 3 flowers per stem, so it is not a source of good genes in these respects. But the flowers are white and often have a pronounced red stripe and it has been a major source of colour change and flower form in my vallota hybrids.

Cyrtanthus elatus (*C. purpureus* or vallota) is the mainstay for cut flowers. By selection and breeding we can get stems up to 60cm long, although rather thick compared with nerine stems. As already mentioned, it can be pursuaded to produce a good range of colours and flower shapes. By steady selection and breeding it is possible to get three or four flowers a year, or to get two or three flowers at the same time. Being evergreen with good large leaves it grows well all the year round if kept at around 15°C.

Cyrtanthus montanus is, to my mind, almost a subspecies of *C. elatus* with which it forms very vigorous and fertile hybrids. It adds an improved head of upward facing flowers, but the flowers tend to be smaller than true vallota, and the petals are narrower. It also produces masses of small offsets.

Cyrtanthus falcatus has a large bulb and is winter dormant. For me it flowers in early spring, with a head of rather strangely coloured drooping tubular flowers. However it can be pursuaded to cross with *C. elatus* and *C. montanus*, with which it produces very vigorous plants which flower in the autumn for me. It only produces 2 or 3 leaves in the spring, so it is of no help when it comes to repeat flowering. The first cross gives drooping tubular flowers, so probably several generations of selection are needed to get acceptable cut flowers. *Cyrtanthus fergusoniae* gives similar vigorous hybrids and late autumn flowers. I think that maybe I have managed to get some winter flowering forms of vallota by adding *C. falcatus* or *C. fergusoniae* genes, but I am not really sure about that.

These seven species are the main source of my collection. There may be other genes floating around in species such as *C. guthrieae*, and in my opinion many genes which give specific shape or colour to individuals, are in fact floating around as recessives in many common species. Gold glitter, for example, shows up all over the place. To get plenty of growth and plenty of flowers, it is essential for the plant to gain energy by the leaves and roots. Many botanically interesting species, only produce 2 or 3 small leaves, for example *C. galpinii*. These are not suited to our cool dull climate. *Cyrtanthus elatus* x *C. falcatus* can give plants which are almost embarrassing in their leafy exuberance and massive roots.

THE FUTURE

As I progress and learn more about my bulbs, I look for better and better plants. The first cross produces a hybrid roughly half way between the two parents. Further crossing can produce a muddle, but selfing allows the genes to sort themselves out, giving hybrids of more obvious character. Some of my plants are now two generations beyond the first cross. I can see that probably another 5 or 6 generations are required, *i.e.* another 15 to 20 years to get these hybrids near perfection. That would make me an unlikely 100 years old. So that is work for someone else. There are also interesting problems to be solved. Can scent be spread to other cultivars? Can offset production be changed to flower production?

Just growing more cyrtanthus all round the world will produce vast improvements, by encouraging natural evolution by mutation.

Cor van Eijk continues to select and improve cyrtanthus for the ornamental market. And perhaps as a gesture to prove that mother nature knows best, among a block of 2,000 carefully propagated creamy pink flowers, a beautiful white vallota has appeared by mutation. Better than anything I have produced.

In terms of variations in colour, shape and general interest, what I have said about possible cut flowers is completely overshadowed by the latest results with smaller varieties, *i.e.* with 15–30cm stems. With my hybrids of *C. mackenii* and *C. eucallus,* etc., plus a few genes from other species, I have a marvellous range of these flowers, but unfortunately I have neither time, knowledge, ability or facilities to make them into pot plants. That is also a job for someone else.

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CRINUM BUPHANOIDES IN SOUTH AFRICA

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Crinum buphanoides is widely but sparingly distributed in South Africa's Northern and North West Provinces. The plants frequent sandy flats, loamy flats, or the gently undulating foothills of mountain ranges such as the Waterberg, in the North West Province. *Crinum buphanoides* is usually the commonest *Crinum* species where it is found. It is much more frequent than *C. delagoense, C. foetidum* and *C. minimum*, three other species generally found in similar habitats.

The reason for the relative frequency of *C. buphonoides* lies in the plants' ability to produce abundant seeds, to flower even in severe and prolonged droughts and to form large populations in given habitats. This paper focuses on these interesting ecological adaptations.

COLONIES IN THE NORTHERN PROVINCES

During the last three years several *C. buphanoides* colonies have been studied near Thabazimbi, Ellisras and Potgietersrus.

The colony near Thabazimbi is situated in arid acacia thornveld on clay based soil. The area is used for cattle ranching and game farming as well as mining since the region is rich in platinum deposits.

Crinum buphanoides grows in open grassy patches between acacia trees and also within grassy road reserves in large numbers in some places. The plants come into flower when the first summer thunderstorms begin between the end of September and the beginning of November. The plants push their flower buds through the soil at the same time as the leaves begin to emerge.

Flowers have been produced at this colony every year even during two years of severe drought with unusually high temperatures. Seeds are set during late November and distributed by the rainfall runoff after thunderstorms.

The Ellisras area is home to several large populations of *C. buphanoides*. The 1997/1998 growing season was characterised by searing summer temperatures and a few isolated thunderstorms associated with the El Niño weather phenomena. The result was that some areas received enough rainfall to bring *C. buphanoides* into flower, while in other areas the first rains did not occur until December. The first research trip to the area, in the first half of October, took place in hot dry weather. The hills south of Ellisras had

received some rain and the *C. buphanoides* were in bud and flower. A large colony, about 30km north of Ellisras, near the Limpopo River also was visited. There had been no rain and the plants were dormant. Subsequently, during early December, this area received one heavy thundershower. The bulbs came into leaf and flower and produced an abundant seed crop.

North of Potgietersrus *C. buphanoides* grows on clay soil in acacia thornveld. At one locality near Limburg, about 50km north of Potgietersrus, the species is well represented. It occurs in groups of 2–30 or more plants over an area of several square kilometres. The 1996–1997 growing season was accompanied by above average rainfall in the area. Most of the seed set was destroyed by the amaryllis caterpillar, *Brithys trinii* subsp. *pancratii* (Cyrillo, 1787) which is often abundant during times of above average rainfall. The 1997–1998 growing season was accompanied by a severe drought, high temperatures and isolated thundershowers. Fortuitously, the Limburg area received good rains at the *C. buphanoides* flowering and seeding time. Seed was set in vast quantities, some plants producing piles of seeds up to 15cm high.

SEED PRODUCTION AND DISTRIBUTION

Little seed has been set at the Thabazimbi colonies over the last few years. That which has been set has largely been destroyed by the amaryllis caterpillar. In the 1997–1998 growing season the infestations of these pests was so bad that most flowering stems were eaten before the plants had finished flowering. The caterpillars moved to the seedling bulbs after eating the foliage and flowers of the mature plants. Most of the young bulbs produced the previous season were eaten as well. The caterpillars start by feeding on the leaves and then eating down into the young bulbs until they have been destroyed.

Generally, infestations of amaryllis caterpillar are not common during dry years. Should the caterpillars be present, however, *C. buphanoides* is one of the few amaryllids that comes into flower during the first half of the summer and is therefore heavily parasitised in years when these pests are present during droughts.

In the Ellisras area the good rainfall of 1996–1997 resulted in a large number of amaryllis caterpillars. These destroyed most of the seeds set in all the different populations under study.

In the 1997–1998 growing season the large amount of seed set in December mostly shriveled in the virtually rainless months of January and February.

The plants near Limburg, north of Potgietersrus, were subjected to good rain showers after their abundant seed set. The seeds were

distributed by runoff after thundershowers, and germinated in clusters in the vicinity of the parent plants. Young *C. buphanoides* bulbs develop quickly and within about a month are sufficiently well formed to withstand severe drought in the later summer and autumn months. No amaryllis caterpillars were observed and an optimum seed set was given favourable weather conditions in which to germinate, free of pests.

ANALYSIS OF REPRODUCTION

Crinum buphanoides is adapted to flowering after minimal rain and produces some seed in every season it flowers. The cyclical production of large amounts of seed ensures that many young plants are periodically recruited to the populations. This occurs only if an abundant seed set is accompanied by an absence of the amaryllis caterpillar, that is, generally only during hot dry summers. Occasionally conditions conducive to excellent germination do occur and at these times *C. buphanoides* populations are able to expand. The success of the species in South Africa's Northern Provinces is related to its ability to produce seeds persistently year after year.

In contrast, *C. foetidum*, a rare species growing in sandy soil near Ellisras, does not even come into leaf during severe droughts. It may produce leaves after a few thundershowers but requires consistent rainfall to flower and set seeds.

HORTICULTURAL POTENTIAL

Crinum buphanoides makes an attractive horticultural subject because of the umbels of white stellate flowers and the large distichous leaves. The plants grow well in arid conditions and can be recommended for gardens in dry areas.

The species is easily propagated from seed. Seeds should be evenly scattered across the surface of large deep seed trays. The best time for sowing is at the time the seeds start to sprout. The ideal sowing mixture is a sandy loam to which a few heaped teaspoonsful of bonemeal have been added and well mixed in. Leaves usually sprout after about three weeks. Small bulbs have usually developed three months after the seeds have been sown.

Crinum buphanoides has good potential as a landscaping subject in parks and suburban gardens. It can also be grown in large pots which are big enough for the bulbs to attain their full size.

Crinum buphanoides in flower south of Ellisras, Northern Province, in early November 1997. Flowering had occurred after a single isolated thunderstorm.

Close-up of the inflorescence of *C. buphanoides*.

Photos: Lauran Brown

The dry foliage of a group of *C. buphanoides*, part of an extensive colony north of Ellisras. No rain had fallen and consequently the bulbs were still fully dormant in early November 1997.

CRINUM GRAMINICOLA NEAR JOHANNESBURG AND PRETORIA IN SOUTH AFRICA'S GAUTENG PROVINCE

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Crinum graminicola is one of two species found near Johannesburg and Pretoria, one of the most developed and industrialised parts of South Africa. The other species is *C. bulbispermum* which is confined to low lying moist areas, often marshes at the edges of streams (known as vleis in South Africa). *Crinum graminicola* is found in open grassland mainly in sandy soil as well as areas of red sandy loam. The areas north of Johannesburg and around Pretoria used to be home to some large concentrations of *C. graminicola*. The majority of these populations have now been destroyed through suburban development and those which remain are nearly all in areas zoned for future housing estates. Populations that do exist on smallholdings are eventually choked by alien weeds or, if they do survive these conditions, fail to reproduce.

This paper focuses on the status of *Crinum graminicola* around Johannesburg and Pretoria before extensive development and compares and contrasts this with the present situation.

The status of *C. graminicola* is paralleled elsewhere in South Africa. Near Wolmaransstad in the North West Province most of the habitat has been converted to extensive monoculture of maize. Some *C. graminicola* colonies on the southern outskirts of the town are presently being plowed up for low cost housing developments as well as small diamond claims.

This paper focuses on two *C. graminicola* colonies, one on the periphery of a large informal settlement in Witkoppen north of Johannesburg, and another on the western outskirts of Irene near Pretoria. In the former case the habitat has been progressively degraded over the last few years and in the latter instance the grassland is being cleared for industrial and urban development. These situations typify what is happening throughout South Africa at present. Some species are likely to become extinct within the next few decades, particularly rare plants endemic to small areas such as *Haemanthus canaliculatus* near Betty's Bay in the Western Cape.

THE WITKOPPEN COLONY

Crinum graminicola has been growing at the Witkoppen site for many years. The land originally comprised a small farm with cattle and peach orchards. About 25 years ago the farm was deserted and the orchards were taken over by natural grassland.

The colony was widely scattered over an area of about two

square kilometres, with *C. graminicola* growing either singly or in scattered groups of 2–20 or more plants. Initially the grassland wa burned every two to three years in accidental grassfires, a commo feature in the grassland interior of South Africa in winter. Since the establishment of the informal settlement about four years ago the grassland has been burned every winter and even in the summer during rainless periods where the grass dries out sufficiently to ignite.

Before the establishment of the informal settlement *C. gramin icola* flowered every year in October and early November. Seed set varied from one year to the next but was rarely plentiful. In some years the flowers, leaves and seeds were eaten by the amaryllis caterpillar, *Brithys tinnii* subsp. *pancratii* (Cyrillo, 1787) the main natural control predator of *Crinum* plants in the summer rainfall parts of South Africa.

After the settlement was established residents picked or destroyed most *C. graminicola* inflorescences. Their leaves were trampled by passersby or by cattle and other livestock kept in the vicinity. In addition to this, attacks by the amaryllis caterpillar have been severe in the past three growing and flowering seasons. Degradation of the veld has meant that the little seed that has been set has dried out on hard ground before it has the chance to germinate.

Some bulbs have been dug out for traditional medicinal purposes but the majority of plants making up this population have remained intact.

A COLONY ON THE OUTSKIRTS OF IRENE NEAR PRETORIA

The Irene area has, for many decades, been used for small-scale farming. In the last five years widespread suburban development has taken place as well as the construction of industrial sites in areas zoned for this purpose.

In the second half of October a visit was made to a colony of about 200 *C. graminicola* on the western outskirts of Irene. Almost 75% of the population was in flower, and three weeks later most of the plants were beginning to form seed. At this stage land developers had moved onto the site and began excavating trenches as a precursor to development. This population was rescued by the Witwatersrand National Botanical Garden [see page 199].

The land where the colony was situated consisted of climax highveld grassland, with a number of species present only found on land which has not been over-grazed or degraded. One of these, *Brachystelma barberae*, was present in very large numbers for this species with healthy populations of seedling and mature tubers.

An investigation of the *C. graminicola* population revealed the

Crinum graminicola in habitat west of Irene, flowering in short grassland burned the previous winter – ideal conditions for the optimum growth and flowering of this species. Watercolor painting by Gillian Condy from the author's personal collection.

Left: *Crinum graminicola* near Irene in flower at the peak of the season. This is typical of the flowering habits of this species. Note the short grass cover after grass fires the previous winter.

Right: *Crinum graminicola* colony west of Irene: general habit at the edge of the Johannesburg-Pretoria highway, an area zoned for industrial development. All of the plants were subsequently removed in a rescue operation.

Photos: Laurian Brown

typical age structuring and seedling development that characterises healthy and undisturbed populations of the species. About 75% of the bulbs comprised mature flowering-size plants. The remainder consisted of younger bulbs at various stages of development. Groups of seedling bulbs were found among short grass tufts adjacent to mature bulbs consisting of about 10–70 or more individuals. Older seedlings, three or more years of age, were less numerous which is typical for this species. The young bulbs are destroyed by mole rats and are eaten by the amaryllis caterpillar during years when it is abundant.

ECOLOGY AND THE GROWTH CYCLE

Crinum graminicola is the characteristic *Crinum* species in the grasslands around Johannesburg and Pretoria. The species is associated with short grassland which is regularly burned in the winter months. Fires are essential for the species; they clear moribund grass permitting opportunities for the plants to spread their large prostrate leaves over the ground and produce flowers well above the grass, permitting the various pollinating agents to visit the flowers. By the time the plants set seed in November and December the grass has regrown to about 15–20cm above the ground. This light grass cover is ideal for the germination of seeds since the lightly shaded earth retains some moisture after thunderstorms.

In years when there have been no grass fires, fewer *C. graminicola* flower and the seed that is set often fails to germinate. It either falls into thick moribund grass where it eventually shrivels or else lands on ground under dense cover where it does not get enough light to germinate.

The runoff after thunderstorms is the means for the distribution of *C. graminicola* seed. Seeds are seldom moved more than a metre away from the parent plants. Germination is rapid and seedling bulbs develop in about a month.

The amaryllis caterpillar largely controls the introduction of new bulbs to the populations. The caterpillars eat right down into the necks of young bulbs, and further, thereby destroying them. Once the young bulbs are about 3–4 years old they are sufficiently large to resist attacks by the caterpillars. Numbers of amaryllis caterpillar are cyclical under normal circumstances and where there are none or few of them in successive years *C. graminicola* is able to build up the population of young plants. There is evidence that in recent times the amaryllis caterpillar is becoming much more abundant around South African towns in the summer rainfall areas. It is probable that gardens in towns act as reservoirs for the caterpillars and their moths. Amaryllids are widely grown in towns and serve as a

year-round food source for caterpillars. Crinums only go dormant in June-July (mid-winter) in Johannesburg if they are periodically watered, and evergreen amaryllids are attacked by caterpillars throughout the year.

In areas of the summer rainfall region where crinum populations are far from towns, droughts and unfavourable conditions control the numbers of the amaryllis caterpillar. Some unfavourable conditions for the caterpillars are when crinums enter dormancy in late summer while the moths are still active, and when crinums remain dormant until well into summer without providing any opportunity for moths to lay their eggs on the plants' leaves.

A NOTE ON ECOLOGICAL STUDIES AND SOUTH AFRICAN BOTANY

South Africa is losing habitats or witnessing their severe degradation at a high rate. This inevitably will lead to the extinction of a number of plant species during the course of the next century. Despite this, practically no ecological research is being carried out by professional or amateur South African botanists. Ecological studies on specific plant species and their associated communities are rarely published. The main reason for this appears to be that South African botany is by and large obsessed with systematics and taxonomy and rewards and incentives for research are strongly allocated in this direction. Systematics can only be expected to reach a zenith if conducted in a climate of well developed sister research disciplines.

There are a number of reasons for South African botanists' obsession with systematics and taxonomy. Revision of genera is a popular route towards post-graduate degrees. Taxonomic studies are less expensive than thorough ecological research, and also require a completely different set of aptitudes and competencies. Although ecological studies are more relevant now than ever, it seems unlikely that they can be sustained in the present taxonomic orientated climate of "publish or perish".

HOW TO GROW BETTER HIPPEASTRUMS

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The following cultural instructions have been written as a result of having successfully grown a wide range of cultivars for several years, including the large, medium and small flowered singles as well as double flowered hippeastrums. This follows a visit to discuss the latest Hippeastrum developments with the Dutch hippeastrum breeders and growers earlier this year [1997].

Many hippeastrum bulbs each year are sold without adequate accompanying cultural instructions and those sold as bare bulbs usually lack instructions altogether. Whilst the plants are undoubtedly very easy to grow, they do have specific requirements and unless these are satisfied, the plants are unlikely to realise their full potential and may never flower again. Some people become fed up with the bulbs' not blooming in subsequent years and throw them away. Others even discard them after the bulbs have bloomed their first year, not realising that hippeastrums can live and continue to bloom for 20 or more years. By following these simple instructions your plants should continue to grow and bloom for many years.

PLANTING

1. Select a clean 7 inch [18cm] pot for all bulbs except *Hippeastrum papilio* and the small flowering cultivars ('Pamela', 'Lemon Lime', 'Baby Star', 'Germa'). Use a 6 inch [15cm] pot for these smaller flowered bulbs. Use a 10 inch [25cm] pot if planting three bulbs together. Make sure there is about 1 inch [3cm] between the bulb and the rim of the pot.
2. It is highly recommended that before planting you dip your bulbs in a systemic fungicide for 30 minutes as a preventative measure. Follow the instructions given for bulbs when making up the solution and use tepid water.
3. If not dipping the bulbs in fungicide, place the roots in tepid water for 12–24 hours. This will assist the speedy take-up of water and other nutrients by the bulbs after planting. Ensure that ONLY the roots are in water—the disc [basal plate] underneath the bulb must not be allowed to get wet.
4. Mix well together Irish moss peat, horticultural sand and sharp grit in equal proportions and place in the pot. Form a small mound in the centre.
5. Place the bulb on top of the mound, spread out the roots and cover with more compost until the bulb is two thirds covered.

(the neck and nose should be exposed.) Firm the compost around the bulb and roots leaving no air pockets and then water thoroughly using tepid water. Place in a light, warm place—a shelf above a radiator is ideal—at a temperature of 69-71°F [21-22°C].

GROWING

1. Keep the compost just moist using tepid water until the shoot appears in order to stimulate growth of the root system. Do NOT water the bulb's nose.
2. Once a shoot appears, give plenty of water but never allow plants to stand in water. This can cause rotting. Fertilise fortnightly using Fisons Flowerite at HALF strength. Flowerite is available from Home Base, Robert Dyas and most garden centres.
3. Plant are extremely light sensitive and flower stems can easily become twisted if the light source is unidirectional. To avoid this, turn plants round a little each day—45 degrees is ideal.
4. When the flower scape reaches 2 feet [60cm] in height, it is advisable to support it with a stick to avoid stem collapse due to the weight of the flowers.
5. Providing that the temperature does not drop below 16°C (60°F) your plants should bloom within 6-10 weeks; flowering will be delayed if the temperature drops below this. To prolong the life of the flowers it is a good idea to lower the room temperature to around 16°C (60°F) or move the plants into a cooler place. Depending on the size of bulb planted, each bulb will produce 1, 2 or 3 scapes per year, each scape bearing 2-6 flowers depending on the cultivar. Bulbs are graded by circumference in centimeters. Bulbs 26-28cm in circumference will produce 0-1 scapes (bulbs this size cannot be guaranteed to flower); 28-30cm bulbs will produce 1 scape; 30-32cm bulbs will produce 2 scapes (sometimes 3); 32-34cm bulbs will produce 2 scapes (often 3); 34-36cm bulbs will produce 3 scapes and 36-38cm bulbs will produce 3 scapes (sometimes 4). It is normal for there to be a gap of several days, weeks or even months before the flowers on the various scapes come into bloom.
6. *Hippeastrum papilio* is different from the hybrids. It has only 2 flowers per scape (in container culture) and usually a maximum of two scapes. Newly purchased bulbs can take a year before the plants bloom and plants may take much longer to grow than other cultivars, so be patient. When it does flower it is so stunning that the wait is well worth it! *Hippeastrum papilio* is evergreen— as soon as one set of leaves has died back a new set appears. This species multiplies easily and enjoys being pot bound.

AFTER FLOWERING—SPRING AND SUMMER CARE

1. Leaves will develop throughout the spring and summer. During this period it is essential that you continue watering and feeding your plants. Plants will require lots of tepid water, particularly during the summer. Stop using Fisons Flowerite and switch to Fisons Tomorite and use weekly. Always follow the manufacturer's instructions when making up the solution and NEVER apply the fertiliser to dry soil—moisten first before fertilizing.

2. Once the danger of frost has passed the plants can be put in their pots in the garden. A bright sunny spot is ideal. Plants thrive in temperatures of 21-30°C (70-86°F) and do particularly well in humid conditions. Make sure that the plants are always well watered since they will dry out very quickly in the hot sun. If you have your plants indoors, spray the leaves daily to increase the humidity.

3. Growth will slow down during early autumn (September/October). If your plants are outdoors, bring them inside as soon as there is danger of ground frost.

PREPARING FOR NEXT YEAR'S FLOWERING

In October-November move the plants into a cool, light place for 10-12 weeks. The ideal temperature is 10-13°C (50-56°F) but hippeastrums will be fine at temperatures of 5-10°C (41-50°F). Plants must not be kept in any place where there is danger of frost. Stop fertilising and reduce the amount of water. Always keep the soil moist. During the winter, leaves may turn yellow or orange before dying back—this is perfectly normal and is to be expected. (Some leaves may have died back during the summer, only to be replaced by new ones.) This dormant period is known as the "Cold Period" and is essential if your bulbs are to flower next year.

SPRING

1. After plants have received 10-12 weeks of 5-13°C (41-55°F), remove any old leaves by cutting them off 10cm (4 inches) above the nose of the bulb.
2. Remove the top 3 inches of soil and replace with new soil and water well. Bulbs should not need repotting after only one year. Repot every 2-3 years.
3. If bulbs have developed small bulbs attached to the mother bulb, this is the time to remove them. Only detach them if they have their own root systems. Pot them up separately into small pots and grow on in a warm, light position until they reach maturity (3-6 years). Transfer into larger pots once a year. Do NOT

give them the cold treatment in their first year but keep them growing in a warm, light place. After the first year treat exactly the same as for mature bulbs.

4. Bring the bulbs back into a warm, light place as before, and within a few days or weeks new shoots should appear. Now give exactly the same care as in year one under the instructions for GROWING.

Left: Steven Baloyi and Piet Ngwenya patiently excavate an adult *Crinum graminicola* bulb.

Below: Adult *Crinum graminicola* plants in full flower after being removed from the rescue site.

Photo: Sharon Turner
Witwatersrand National Botanical Garden

A RESCUE ACCOUNT OF A POPULATION OF *CRINUM GRAMINICOLA* NEAR PRETORIA

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In early spring of 1997 Charles Craib informed the staff of the Witwatersrand National Botanical Garden (WNBG) of the imminent development and consequent destruction of a large population of *Crinum graminicola* on the rapidly developing outskirts of Pretoria, which he became aware of while doing research on and photographing the species.

Realising the urgency of the situation, rescue attempts were initiated immediately and attempts were made to contact the land owner. The developer, Mr. Van Niekerk, gave his full assistance by contacting the land owner and obtaining the relevant permission and documentation.

The WNGB strives to promote and conserve the dwindling flora of the greater Witwatersrand and regularly engages in rescue operations of this kind in the Gauteng area. For this reason Mr. John Baker of the Gauteng Directorate Nature Conservation has issued the garden a permit to collect plants anywhere in Gauteng provided a valid letter of permission from the land owner has been obtained.

This permit regularly helps to expedite the process and allowed the Garden staff to move onto site within four days of the building development being brought to their attention.

Once on site, careful excavation began in earnest. Within two days of meticulous digging through hard deep red soil, approximately eighty adult bulbs and numerous small seedlings were removed. Due to the time of year, little or no rain had fallen and the bulbs were extremely difficult to remove. Consequently, approximately fifteen bulbs were damaged in the process. Other plants rescued from the site included numerous *Brachystelma barberae* tubers, *Babiana hypogea* (which was very rare on the site and only a few plants were located) and various other species that were not represented in the Botanical garden.

Once the rescue was completed the bulbs were re-established in the Wild Flower Area of the Botanical Garden. Plants that were damaged were left on a dry bench in the potting shed and treated with flowers of sulphur. After approximately four months many of these bulbs had developed bulbils in the scales and on the basal plate in and around the damaged areas.

A few plants from this site were donated to Kirstenbosch

National Botanical Garden for their living collection of South African bulbs.

Acknowledgements:

The Staff of the WNBG wishes to thank Mr. Charles Craib, Mr. F. Erasmus, Mr. K. van Niekerk, the land owner, and the Gauteng Directorate Nature Conservation for all their assistance and cooperation in making this project possible.

LIVING JEWELS: NUMBER 6 IN A SERIES

VELTHEIMIA

Charles Hardman
Baldwin Park California

There's just something about veltheimias that can make an enthusiast out of even the first-time grower.

Maybe it's their ease of culture combined with their beauty: Veltheimias are plant-and-grow bulbs with a flair for satisfying the eye. They don't require any special fuss in order to enjoy their graces. Just give each bulb a pot and some soil, cool—not cold—temperatures during its winter growing period, water it occasionally, keep it out of hot sunshine and give it a small amount of fertilizer every two or three weeks and before you know it, the bulb will have a crown of wavy leaves atop followed by an elegant stalkful of pendant flowers. The leaves continue long after the flowers have faded (seed usually is easy to produce if you want more plants) so continue watering sufficiently and fertilizing lightly. As warmer weather approaches, the bulb will lose its leaves and go into dormancy for about three months. As weather cools once again, growth commences and the entire cycle starts anew.

There are currently two species in the genus *Veltheimia*: *V. bracteata* and *V. capensis*. The former species comes from the eastern side of South Africa's Cape Province while the latter hails from the western side. Both species have several variants. Both are easy to grow from seeds which are nearly always available from the International Bulb Society's annual Seed Exchange list.

Veltheimia bracteata, previously known as *V. viridifolia*, has shiny, deep green wavy-margined leaves. No plant is more handsome than this species when it's in full leaf. While the tubular flowers have their own sophisticated beauty and are long lasting into the bargain, it's those leaves that make the show for most of the plant's long growing season; even if *V. bracteata* never produced flowers, people would grow it for its leaves alone.

But it *does* produce flowers, tall, stately spikes of flowers which display a regal air by pointing upward as the stalk is developing, only to turn gracefully pendant as they begin to open. The flowers tend to be colored in pastel shades of cream with tiny pink or red-pink dots flecking each segment. In the type commonly available, the general effect is of a pink or reddish color. The tips of the flowers start out green but gradually fade into the base color in many forms. In others, they remain green although softened from the original hue.

There are several variations on this theme including a range of yellow variants from chartreuse-yellow to a good, strong lemon-yellow, and a form called 'Rosalba' which is pale cream and pink. No doubt there are others in cultivation and in the wild.

Don't allow your virus alarm to go off if you obtain a yellow-flowered plant (seeds are sometimes available) only to find its leaves streaked with white and cream striping, looking very much like a virused plant. While the effect is beautiful, it's also alarming. And it's quite natural, being a genetic striping common among yellow-flowered plants of *V. bracteata*. I have read about this trait only once, and just in time, too, for I was on the verge of destroying one of the most incredibly white-striped-leaved plants in my small *Veltheimia* collection.

Veltheimia capensis produces smaller plants. This species comes from a drier area and displays blue-green leaves with a matte finish. Its flowers also are tubular, an inch or so long and the color is pink with green tips or rosy-pink dots on a cream background. Some of these latter can be quite creamy or even fairly white in appearance. *Veltheimia. capensis* is altogether a dandy plant and, while smaller, is fully as desirable as its cousin.

There's a variant of *V. capensis* which showed up in a batch of seedlings grown by Michael Vassar years ago. Michael gave me the bulb which blooms with perfect proportions but with all parts about half the size of the typical members of this species. Could this be the plant which used to be called *V. deasii*?

During the Victorian era, veltheimias were popular house plants. Houses were kept cooler then—sometimes temperatures dropped almost to freezing near windows (and no doubt a few catastrophes did occur as veltheimias don't withstand freezing temperatures)—so it's not difficult to imagine these plants growing alongside a palm or two, a *Miltonia* orchid, an *Aspidistra* and any other plants sufficiently vigorous to endure the varying temperatures, dryness and dustiness indoors.

In fact veltheimias were so popular during the Victorian era, that they were sold as cutflowers as well as potted plants. The color range was greater during those times, as well, with reds, deep reds and variations on the pink and rose shades having been developed. It's possible those forms are still around somewhere and if they're not, they should be developed again.

Hybridizers take note: veltheimias are plants of great beauty with a varied gene pool begging for attention. I can imagine reds, scarlets, pinks, lavenders, oranges, whites, spots, no spots, tall, short.....the mind boggles at the opportunities.

Top left: *Romulea sabulosa*

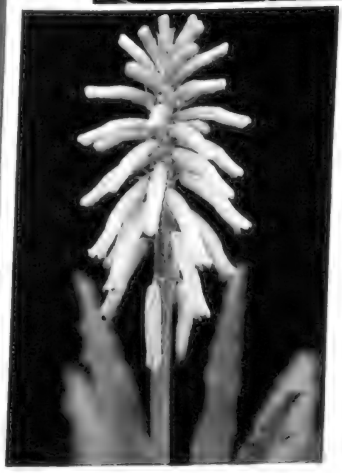
Left: *Romulea sabulosa*, white form

Below: *Romulea monadelphia*

Photos: Charles Hardman

➤

Below and lower right: a small growing form of *Veltheimia capensis*.



LIVING JEWELS: NUMBER 7 IN A SERIES

ROMULEA MONADELPHA AND *ROMULEA SABULOSA*

Charles Hardman
Baldwin Park, California

Of all the bulbous plants I grow, two of my oldest and most faithful friends are *Romulea monadelpha* (Sweet) Bkr. and *R. sabulosa* Schltr. ex Béguinot. They've both been with me a long time—more than twenty years—and my enjoyment of them increases with every spring's flowering.

Known as "Satynblom" in their native South Africa, these two species form an odd pair within the genus *Romulea*. In the first place, they look similar superficially, although after you've spent enough time with them they appear not so similar after all.

In the second place, they are both red, though of different shades, value (lightness or darkness of a color) and intensity (saturation or strength of a color). In *R. monadelpha* the color leans to the burgundy-red shades, is darker and has intense saturation while the color of *R. sabulosa* leans slightly to the orange-red or pink shades and tends to be paler (value) and have less saturation (intensity) than the other species.

A third shared characteristic is that they are sympatric, growing together in some of the same areas.

Fourth, they bloom at about the same time, with bloom seasons overlapping.

Fifth, both species have flowers which are among the largest and most beautiful in this genus, a genus noteworthy for having many beautiful members.

Sixth, They are very closely allied and, in fact, have the same chromosome number; the structure of their leaves and corms is similar.

And, seventh, in a genus in which species do not hybridize readily with one another, these do.

Morphologically, *Romulea monadelpha* is unique. Compare its black delpha at the base of its filaments with the base of the filaments of *R. sabulosa* or any other *Romulea* and you'll see what I mean. In fact, *R. monadelpha* was placed in a genus all its own, *Spatalanthus*, at one time and has also been classified as *Trichonema* and *Icones*. Let's hope *Romulea* sticks for the duration—*Spatalanthus* sounds too salivary while the names *Trichonema* and *Icones* bring to mind parasitic creatures of some kind.

Growing these two species with their satiny-textured flowers is not difficult as long as their need for plenty of sunshine is met; they

simply don't do well in locales which have a lot of gloomy or overcast days during their winter growing season. This presents a challenge to growers in certain parts of the world. (New and improved extended ray flourescent lighting may be of benefit to those growers who want to try their hands at winter-growing, narrow-leaved species such as these.) As for soil, I've grown and bloomed both these species in everything from firmly-packed garden soil (they grow in their native habitat in clay) to sand.

As noted previously, *R. monadelpha* tends slightly toward the burgundy (with some blue) or claret end of the red spectrum, while *R. sabulosa* tends slightly toward the orange. Both species have a fair degree of variability in their throat markings. *Romulea sabulosa* has more variability in its color range, some forms of this species being nearly white while *R. sabulosa* var. *trichonema* is described as "a purple-red form". I have not yet come across a white nor even a pale *R. monadelpha* although such may exist.

Bulbs will produce some offsets but you'll get more plants faster by sowing seeds. Hand pollination helps bounteous seed set. However, if rain falls during bloom season, I'll get little seed that year. At my Southern California home, even during the best of years *R. monadelpha* is far less generous with its seed crop than is *R. sabulosa*. That may be due in part to the fact that the former's seeds are generally larger than the latter's thus taking more energy per seed.

REFERENCE:

De Vos, Miriam, P. 1972. The Genus *Romulea* in South Africa. **J. So. Afr. Bot.**, Supp. vol. 9

MODERN DAY PLANT EXPLORERS, PART 3

Guy Wrinkle
8034 Altavan Avenue, Los Angeles CA 90045

As I have been to Africa seven times, it is not that I have nothing more to say about this continent, but I just got back from Ecuador and that is what is on my mind now. After going to Africa several times, I started going to Latin America. First I made several trips to southern Mexico, then to Costa Rica, Venezuela, Peru and finally, Ecuador.

Although Africa and Latin America are different experiences, I have enjoyed them both. I would like to point out from the start, however, that I have always felt that Africa was a safer place to be. In complete opposition to some of my experiences in Mexico, my experiences in Ecuador have been totally positive. Because of the fact that I was traveling in what are considered as zones of national security, I was constantly being stopped by the police and the military. In this case zones of national security were near the Colombian border and the drug problems, and near the Peruvian border and the border dispute between Peru and Ecuador. I was never mistreated or threatened by an Ecuadorian policeman or soldier. In most cases these people were very friendly, asked a few questions, checked my passport, and let me pass. If I needed help, it was freely given. I never had a gun pointed at me, which I have found to be all too common in Mexico. Ecuadorian people were friendly and helpful.

Because of the devastating effect of the El Niño rains, I was warned not to go to Ecuador at the time I went (February 1998). As Dennis Cathcart of Tropiflora Nursery was so encouraging, I decided to ignore these warnings and go anyway. Although I had some close calls with problems related to the heavy rains, I am glad that I did go. The El Niño effect caused droughts in areas of normally heavy rainfall and flooding of normally dry areas. Friends going to Ethiopia and Tanzania this summer had to leave because the rains were so heavy that travel was impossible. Because of the improved economy of northern Ecuador (gold and oil) the roads are much better than those in the southern part of the country. My trip did, however, all work out.

After a flight from Los Angeles to Panama City and then from Panama City to Quito, we were in Ecuador without incident. Quito is very high and polluted and the combination of the altitude and pollution gave me a raging headache. After we rented a four wheel drive vehicle in Quito we got out of the city into cleaner air and lower altitudes where I felt much better.

Ecuador is a small country but because of the tremendous variation in altitude there are many life zones. There are lowland forests on the Pacific coast and the Amazonian forests to the east. There is permanent snow on many higher peaks of the Andes Mountains and many beautiful cloud forests on the slopes. In addition to this there are also deserts in the south and very dry areas in the north.

Our first destination was Lita, a small town located in the northwest area not too far from Colombia. This area is famous for orchids, bromeliads, aroids, ferns, etc., but my main interest here was cycads. As we left Quito for Lita we decided to stop in Otavalo which has the reputation of having the largest Indian market in South America. Like any local market anywhere in the world, you never know what you will find. Unfortunately, the day we were there there was not much of interest with the exception of many different groups of Indians. As Ecuador is the home of the Jiavaro Indians who are famous for their ability to make shrunken heads, there were reproductions of these in the market. They were not well made. On our way from Otavalo to Lita we passed through a dense cloud forest with many beautiful plants and then through a dry area with *Tillandsia secunda, T. recurvata,* and succulent *Oxalis* and *Jatropha* species. In the cloud forest we found a beautiful *Xanthosoma* species, many nice bromeliads and on the side of cliffs grew an amaryllid with petiolate leaves. This is probably a *Eucrosia* species, but I will have to wait until they bloom to be sure. This was all while driving during a relatively short span of time. Because of the fact that if you drive any distance at all in Ecuador you are going to change altitude, this scenario would be repeated many times. For a real taste treat we passed a shack where there was a woman roasting what looked like chicken on a spit. We found she was not cooking chicken but guinea pig! These animals are native to this area and are frequently eaten.

The town of Lita is along a dirt road at an altitude of about 2,000 feet which is higher than a coastal lowland forest and lower than a cloud forest. This is normally an extremely wet area but because of El Niño it was fairly dry when we were there. This was fortunate as I was not looking forward to driving on that muddy wet road. The hotel we stayed in was a real experience. Although I have been all over the world and stayed in some places that I would rather not stay in again, I have never really stayed in a hotel that I would call a real dump. That is until Lita. This unconditionally qualified as the worst. The local vegetation, however, made up for this (just barely).

One often hears of the deforestation taking place in western Ecuador. The bad news is that this is true, but the good news is that there is a lot of forest left. After a night in Lita we traveled further west on the only road. The fact that this was the only road is signifi-

cant as it is easy to get lost in Ecuador. More on this later. We crossed the Rio Mira on the new bridge. We were fortunate that the new bridge was there as the river was deep at this time and we would never have been able to cross. We drove further toward the coast and found *Zamia gentryi* and a little further away we found *Zamia roezlii* which is more common a bit north in Colombia. With these localized distributions, one wonders how long these species will last here. There were also several palms, aroids, ferns, orchids and bromeliads. One most interesting plant here is the bromeliad *Guzmania graminifolia.* which looks like one of the narrow leaved tillandsias such as *T. aruji,* an unusual form for a *Guzmania.*

Next on the agenda was the paramo at El Angel. Paramo is a tundra-like area found in the higher altitudes in South America. The elevation is about 10,000 feet and the vegetation is characterized by long coarse grass, *Puya* species, and the unusual giant composite, *Espaletia.* This particular area is close to the Colombian border. We went through another dry area with thousands of *Tillandsia secunda* and other *Tillandsia* species, and then began to climb in altitude. Even though it was a national park and well publicized on the way into town, we were lucky we found it on the first try. There were (as always) few signs, many forks in the road and few locals who even knew this area existed. I think that it was just pure luck we did not get lost. Before we got to the paramo there were many interesting high altitude shrubs, bromeliads and dwarf perennials such as a beautiful dwarf *Aquilegia* species. I found the famous red datura, *Brugmansia sanguinea,* in bloom and in seed. The seeds have germinated well and it will be interesting to see if this plant can live where I do, near the ocean in Southern California. We also found a beautiful orange-red *Bomarea* in bloom. There is almost a line drawn where the paramo starts with virtually no transition zone.

After a night in Ibarra, we were off down the west coast to the town of Santo Domingo de Los Collaros, which is named after the Colorado Indians. They are an unusual group of people in that the men put a thick reddish-brown paste in their hair and tattoo pictures of shoes, belts, bracelets, etc. on themselves. We were on the way to the biological station further south at Rio Palenque to see the cycad *Zamia lindenii* but had to stay the night in Santo Domingo. It started to rain so hard that we could barely see where we were going. At one point the water was flowing so fast across the road that I thought we would be swept off. Fortunately, we were not, and got to a hotel with a large covered outdoor eating area. The good part was that where we ate was dry but as the roof was made of corrugated metal, it was very noisy. The noise made it hard to sleep. This lasted all night and when I woke up, it was still raining. I did not want to get out of bed to face the rain but then my friend was

knocking at the door and asking me to get up. I couldn't believe my eyes when I answered the door. The sun was out and my friend wanted to know why I was not outside. I told him that with all the noise, I thought it was still raining and he said "Look where your room is!" I looked outside and I was right next to a large river that was making all kinds of noise!

After breakfast we went south to Rio Palenque and found a locked cable across the road. We asked the people who lived in the house by the road where our friends were, and were told that they were back in Quito and that there was no way we were going to get in. After I got home, I called a friend who stays at Rio Palenque and told him what had happened. He said he was there when I was and that I had been misinformed by the locals. So much for that.

The next place we visited was an area further south near Santa Isabele. This area, although dry, was described to me as "plant heaven". It is an extremely interesting area.. Some parts are so dry that almost nothing was growing. There were many xerophytic plants growing in other areas. There were also *Tillandsia* species, such as *T. mima, T. disticha, T. latifolia,* and a small form of *T. tectorum.* In addition, there were several other fascinating plants such as *Puya,* succulent *Oxalis* species, succulent *Peperomia* species, *Euphorbia, Jatropha,* and an amaryllid with petiolate leaves.

We spent the night in El Pasaje. We were miserable as it was extremely hot. I wanted to make a collect phone call home but could get no one to let me use their phone. They said that even if I made a collect call, the phone company was controlled by the Mafia and that they would wind up paying for the call plus extra charges.

We then traveled to the Loja area in southern Ecuador, a part of the country which received the most damage from the El Niño storms. There were several roads that were impassable because bridges had washed out. As luck would have it, whenever we got to an area where the bridge was out, a temporary bridge had just been set up by the military and we were able to pass. Sometimes this required a long wait but we were able to go on. Recently several people and a large number of animals were killed by floods in southern Ecuador. In addition to this there was an increase in the incidences of various diseases such as cholera. One area in particular smelled bad because of the decaying bodies of animals in the water. This did present a problem in relation to one of the local customs. In a few days the yearly carnival was about to start and it was common practice at this time to throw water on passing cars. Some people just used a can whereas others had more sophisticated devices. Once, when we were driving through a particularly foul smelling area with the car windows rolled down, someone got me

right in the face with nearly a gallon of the local water. I thought for sure that I would come down with some horrible disease because of this dousing, but, luckily, I did not.

After spending the night in Loja we got up the next day and went to Zamora, at the base of the Condor Mountains, one of the most inaccessible and unexplored areas of Ecuador. We were warned to be careful in this area but did not encounter any difficulties. This is really a wonderful area with extensive cloud forests and many new species have been and will be discovered here. Once you get past Zamora the roads get very bad. A separate trip dedicated to this area would be necessary to see even a little of it. Even so, we saw many wonderful plants in the immediate vicinity of Zamora. There were many orchids, including a beautiful *Epidendrum,* a *Pleurothalis* and an *Oncidium.* Blooming *Guzmania* and *Vresia* could be seen in the trees with many other bromeliads. Someone had moved a magnificent *Vriesia* species next to a little church. The plant had a branched red inflorescence that was about six feet high. There were lots of interesting ferns, fungi, mosses, and even the plant that is used to make the red die for lipstick. On the way out we found a beautiful purple-flowering tree and a *Calceolaria* species in full bloom found only in one spot, right at the summit, and growing in a permanent seep covered with liverworts. Not exactly the habitat I could easily re-create at home.

Several people in Loja told us that we should go to the nearby town of Vilcabamba. This was described as a major tourist attraction because of the mineral water baths. As we were a bit tired, we decided to go. When we got there we could not find the baths and started to ask the locals. We had a hard time finding anyone who knew what we were talking about! We finally found the baths on our own, by chance. There was a locked gate in front and we could see that the place had been abandoned. We tried to drive around from the other side and wherever we went there was someone to tell us to leave. When we got back to town we were rewarded with two beautiful orchids growing on a palm tree. These were *Cattleya maxima* and a species of *Stanhopia,* both in full bloom.

One of my main objectives on this trip was to find and collect specimens of *Tillandsa marnier-lapostolii.* This is a large gray-leaf species which is rare in collections. I knew that it grew on cliffs in dry areas but that was all. After some inquiries, I was told that it could be found near Celica which is south of Loja. As we drove toward Celica It got drier and drier, which was a good sign. We found two species of *Agave, Opuntia,* a *Bougainvillea* species with orange flowers, *Jatropha* species (possibly *J. macrantha*) with large red flowers and several other xerophytic plants. There were also some spectacular *Ceiba* trees, some with huge green trunks. As we

got closer to Celica, we were stopped at a military checkpoint, probably because we were getting close to Peru. The guard was polite and, after the usual questions and passport check, he let us pass. Then we started to go higher and higher in elevation and eventually entered a cloud forest. When we got to Celica, we were surrounded by cloud forest, which is not the habitat of *Tillandsia marnier-lapastolii.* There were several roads leaving Celica in different directions. We tried them all and they all led to more cloud forest. It was so wet that there were several species of epiphytes growing on the telephone wires as well as all over the trees. In addition to bromeliads such as *Vriesia somnians,* there were several beautiful orchids in bloom, gesneriads, ferns and lots of mosses. We had obviously been given the wrong locality.

As we drove back to Loja, it became drier and drier again. There were blooming plants of *Vresia espinosa* (which looks like a gray-leaf *Tillandsia*) and also *Tillandsia straminea.* We saw a cliff face behind the roadside vegetation with what looked like a few large bromeliads growing on them and stopped to investigate. After a short hike we found ourselves surrounded by *Tillandsia marnier-lapastolii.* Most of the plants were huge but there were several small, transportable size plants. Most of the plants were growing higher on the cliffs but we did not have to climb too high to get to the lower ones. In this area were a wide petiolate leaved amaryllid, a *Dracunculus* species, and other *Tillandsia* species. This is the only place we ever saw *T. marnier-lapastolii* growing and we were lucky that we stumbled upon it.

As we wanted to check out some perennials that we had seen earlier, we started back via Giron and then the road back to Santa Isabel. We climbed higher in elevation and suddenly saw that we were not the only ones on the road. There were two men on bicycles who were making a trip across the Andes! We stopped at an oak-like tree that was covered in at least five species of *Tillandsia* and a thick growth of lichens. As we climbed higher, we came to Paramo vegetation, with *Puya* species and the typical long coarse gray grass. As we descended, we came across several beautiful perennials such as a blue *Salvia,* a yellow *Calceolaria,* a red *Fuchsia,* and more *Epidendrum* and *Pitcairnia.*

We were now working our way back to Quito by driving along the inter-Andean valley. We spent the night in Rio Bamba and had the usual problem with hot water. It seems that hot water for showers is not much of a priority in Ecuador and often you either just don't get hot water at all or only at limited times. Try a cold shower at night in the Andes sometime! In Rio Bamba we saw the Andean palm *Parajubaea cocoides.* This species is found in many Andean cities. It looks somewhat like a coconut but is much more cold

hardy and is being tried in southern California.

On our way back to Quito we stopped to investigate a brilliant red bromeliad growing in a tree not too far from the road. When I got out of the car I was greeted by a land crab which looked much like the species that lives in the tide pools in southern California. The ground was wet and muddy—shoes were constantly being sucked off my feet. I took them off and continued on up the side of the hill. When I got to the tree I found this plant to be a magnificent species of *Guzmania*. It was a little high to get hold of but fortunately, there were several seedlings lower down on the trunk. There was also an unusual *Tillandsia* species with a tall spike that was dark purple-brown in color. When I got back to the car my legs were covered with mud but there was a small stream nearby where I was able to clean up.

A bit further along we found some beautiful flowering shrubs that looked like they should be in the protea family. After some research, I now think they are in the Compositae. There were also some beautiful species of *Pitcairnia* in the area, one with purple orchid-like flowers. As we continued on, the vegetation started to become more and more tropical which did not make sense to us at all. Then, as we rounded a curve in the road, we saw the ocean in the distance. Once again we were victims of Ecuador's almost nonexistent road signs. Try going from about 10,000 feet in elevation down to near sea level and then all the way back up again. We got to sleep late that night. As we were up early and back on schedule again, we decided to stop in Baños, a tourist town and one of the gateways to the Amazon. On the way we saw what looked like hundreds of ferns growing on the rocks. We got out to look at these and they turned out to be orchids. Probably a species of *Stelis*. We also found succulent *Oxalis* species and *Tillandsia latifolia*. Baños was full of tourists and crowded. One of the features of Baños is their sugar cane stands which sell packages of sugar cane which has been cut in strips for chewing.

The rest of the trip back to Quito went fast. All the traffic was going out of town to various other cities for the carnival weekend. As we had been cleaning the plants as we went along, we had little of that left to do. I think bromeliads are the worst in this respect because there are so many places for pests to hide. At the airport we were required to stand next to our bags on the runway as they lead the dogs by to check for drugs and whatever else they sniff for. After a long and uneventful flight home, I got a few hours sleep and then it was off to the college to teach a class.

A SOURCE LIST OF GEOPHYTIC PLANT MATERIAL

Dave Casebier
161 Ember Lane,Carlisle MA 01741, U.S.A.

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. A good initial resource for these materials is **Gardening by Mail: A Sourcebook** by Barbara Barton.

The list has expanded yearly with the aid of members and suppliers. If you feel that any of the descriptions are inaccurate, or could offer opinions, I would welcome them. Information on quality of service, time taken to receive orders, accuracy of naming and quality of products would be beneficial. Please send comments, suggestions and/or catalogs to Dave Casebier at the above address. The chronic shortage of material and suppliers from South America continues to be troubling. Any reliable good sources are most welcome.

SEEDS

B & T World Seeds
Whitnell House, Fiddington, Bridgwater, Somerset TA5 1JE, England
David Sleigh Fax & Tel 0278-733-209 **www.b-and-t-world-seeds.com**
Huge, very extensive lists of seed, organized by type. The first list 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. Large website with enormous lists to download. Files are zip compressed—you will need software to read them, but they are worth it. These contain current files of the snail-mail version.

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.

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* (some of the best anywhere) 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.

Bill Morris
PO Box 17, Meadowie, New South Wales, 2318, Australia
Sells seeds of hybrid *Clivia,* notably yellows with the emphasis on quality and cutting edge hybrids.

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.

Southwest Native Seed
PO Box 50503, Tucson AZ 85703
Sally and Tim Walker.
Sells seeds of indigenous Southwestern plants, including *Tigridia, Calochortus* and *Zephyranthes* species.

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, Lycoris, Habranthus,* and other bulbs.

Avon Bulbs
Burnt House Farm, Nlid 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.

Bulbs d'Argence
Mas d'Argence, 30300 Fourques, France
Lauw de Jager
Mediterranean grown bulbs from South Africa, South America and the Mediterranean. Several *Pancratium* species. Ships overseas.

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, Rep. of South Africa
Tel (041) 732096 Fax (041) 733188 **www.radley.net/capeflora**
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.

Cooley's Gardens
11553 Silverton Road NE, PO Box 126NT, Silverton OR 97381, U.S.A.
Tel: (503)-873-5463 Fax: (503)-873-5812 **cooleyiris@aol.com**
Sells bearded iris rhizomes, extensive growing fields for display.

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.

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

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 geophytes. 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.

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. $1.00. He sells a broad selection of canna and crinum hybrids; also has a large collection of choice lycoris hybrids.

Klehm Nursery
4210 North Duncan Road, Champaign IL 61821
Tel: (800)-553-3715 Fax: (217) -373-8403 **klehm@soltec.net**
Peony hybrids and various perennials. Nice website. **www.klehm.com**

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 **www.garden.com**
Large list of choice bulbs, varying slightly from year to year. Shares a web-site with van Bourgendien.

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.

Old House Gardens
536 Third Street, Ann Arbor MI 48103-4957
Scott Kunst **ohgbulbs@aol.com**
Catalog is $2.00 U.S. Sells select hybrid rare and unique garden bulbs.1197 catalog had nice selection, including exclusive listing of tulips from the Dutch "Tulip Museum". They do not ship internationally.

Paul Christian – Rare Bulbs
PO Box 468, Wrexham, Clwyd LL13 9XR, United Kingdom
Fax: (=44)-01978-266466 **paul@rareplants.c o.uk**
Wonderrful gif and jpg files for online ordering; well worth the look-up. Good value and great selection of some pretty hard-to-find plants.

Schreiner's Iris Gardens
3671 Qinaby Road NE, Salem OR 94303
Tel: (800)-419-4747 ext. 71 **www.oregonlink.com/scva/iris/**
Full catalog is $5.00 (76 pages!), but will send a free "mini-catalog". Large selection of bearded iris, also with large growing and display fields.

Shosholoza Nursery
PO Box 63, Mooi River 3300, Natal, South AFrica
Gaye Simmons
Tel: (+27)-333-32830 Fax: (+27)-333-32827
Bulbs from the Natal highveld.

Thai Am Marketing Co.
Mae Joe PO Box 6, T. Nong Han. A. San Sai, Chiangmai 50290, Thailand
Ed Dodson Tel/Fax: 290-027
Cut flower marketing company that represents several bulb suppliers in the subcontinent. Very little information presently.

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

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.

Cascade Bulb and Seed
PO Box 271, Scotts Hills OR 97375, U.S.A.
Dr. Joseph C. Halinar Tel (503) 873-2218
Offers their own seeds and bulbs of *Lilium* 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.*

The Daffodil Mart
30 Irene Street, Torrington CT 06790-6668
Division of White Flower Farm 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. The catalog is well laid out and contains much useful information and growing tips.

Dutch Gardens
PO Box 200, Adelphia NJ 07710, U.S.A.
Tel (908) 780-2713 FAX (908) 780-7720 **www.dutchgardens.nl**
Commercial Dutch importer for standard garden-type varieties; also some species.

Kelways, Ltd.
Barrymore Farm, Langport, Somerset Ta10 9EZ, England.
Old firm that sells Iris and Hemerocallis, but famous for hybridizing some of the best peonies known. They grow and sell over 600 cultivars.

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.

R. Seawright
201 Bedford Road, PO Box 733, Carlisle MA 01741-0733
Tel: (508)-369-2172
Large list of over *Hemerocallis* and *Hosta* hybrids and species. High quality material.

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 **www.garden.com**
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.

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.

SOCIETIES WITH A SEED EXCHANGE INCLUDING GEOPHYTES

These societies are absolutely the best way to acquire 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. **www.alpinegardensoc.demon.co.uk**

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. **www.nbi.ac.za**

North American Lily Society
Executive Secertary-Treasurer
PO Box 272, Owatonna MN 55060, U.S.A.
Dr. Robert Gilman **www.lilies.org**
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. **www.nargs.org**

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. **www.dundee.ac.uk≈fbcaudwe/srgcweabsite.htm**

The Clivia Club
Koos Geldenhuys, Treasurer
P.O. Box 74868, Lynnwood Ridge 0040, Republic of South Africa
Publishes a periodic bulletin; Clivia species, hybrids and sports.

The Cyclamen Society
Tile Barn House, Standen Street, Iden Green, Benenden, Kent TN17 4LB, United Kingdom

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.

The International Bulb Society
PO Box 92136
Pasadena CA 91109-2136, U.S.A. **www.bulbsociety.com**
Publisher of this Journal and *The Underground* newsletter. Extensive seed list is mailed with the autumn newsletter.

BOOK REVIEWS

SPECIALTY CUT FLOWERS, The production of annuals, perennials, bulbs and woody plants for fresh and dried cut flowers by Allan M. Armitage. ©1992, reprinted 1995, 1998. Varsity Press/ Timber Press. 372 pages. 50 line drawings, 99 color photos. $39.95.

If you are a cut flower grower, if you plan to become a cut flower grower, if you just like to grow your own cut flowers for arrangements, this is a book for you.

"Dr. Allan Armitage, a professor of horticulture at the University of Georgia, is a leader in the United States in the development and implementation of new ideas in specialty cut flower crops." So reads the back flap of this book's jacket. It's obvious in reading this fine book that Dr. Armitage knows whereof he speaks when it comes to cut flowers. His book is filled with interesting cut flower minutiae.

An example: *Oxypetalum caeruleum* (synonym *Tweedia caeruleum*) —"exciting potential as a cut flower or pot plant...relatively unknown in the American market." A member of the Asclepiadaceae (milkweed) family, this plant has sky-blue flowers, amazingly enough. Problems? Well yes, there are a few. Dr. Armitage points out that this plant possesses "Milky sap, unappealing foliar fragrance and a twining habit." Also, "the flowers discolor if rain falls upon them". Dr. Armitage then goes on to tell us how to propagate and grow the plant commercially.

Why grow it with these drawbacks? The answer is that its drawbacks are outnumbered by its assets including one of the biggest assets of all: the plant is virtually new to the American market—and probably a lot of other markets, as well. And new, newer, newest sell, whether in the American or any other market. With growing advice, postharvest care, field performance, greenhouse growing, drying and much, much more, this book is a fascinating distillation of a lifetime spent growing and observing plants.

There's even 73 pages devoted to growing flowers from bulbs.

With all the good, technical information included, somehow Dr. Armitage avoids the pitfall of becoming scientifically stuffy. An honest-to-goodness human being wrote this valuable book as the simple, easy-to-understand wording testifies.

In short, this is a useful book which, along with being a cornucopia of information for the professional cut flower grower, just happens to be fun to read. That's lucky for the rest of us for it allows even a beginning gardener to profit from Dr. Armitage's abundant plant expertise.

Charles Hardman

WATER GARDENING, Water Lilies and Lotuses by Perry D. Slocum & Peter Robinson with Frances Perry. 1996 (Reprinted 1997). Timber Press, The Haseltine Building, 133 SW Second Ave., Suite 450, Portland, Oregon 97204, $59.95

Mention the word "geophytes" and the words "water lilies" come to mind, right? Well, not exactly. Yet water lilies deserve the "geophytes" epithet fully as much as do desert bulbs, corms, rhizomes and tubers. Water lilies do, in fact, produce tubers and they do grow in earth—"soil" in gardening jargon, albeit muddy soil.

If you've been bitten by the water-garden bug, you'll want to own this fine book. Not only does it cover the seven genera and numerous species, varieties and cultivars of true water lilies but the reader is taught how to build, maintain and enjoy water gardens and bog gardens.

WATER GARDENING is divided into two parts. Part One, Water and Bog Gardens by Peter Robinson with Frances Perry is a tour de force of the history of, design and construction of, planting of, floating plants of, submerged plants of— you get the picture—water gardens. Included in Part One is an excellent section—Chapters 5, 6, 7 and 8—devoted respectively to Floating Plants, Submerged Plants, Marginal and Bog Plants and Moisture-loving Trees, Shrubs, Herbaceous Perennials, Ferns and Ornamental Grasses, the whole of which is a virtual encyclopedia of plants that love wetness. These four chapters could almost constitute a book on their own. To gardeners who have soggy soil, this section will be worth the price of the entire book even if no pond or water lily awaits them in their futures.

Bulb lovers will find much to fascinate them in this section of the book, for, while we're accustomed to thinking of geophytes as plants which need a drying off period during each year, such is not always the case and there are bulbous, cormous, rhizomatous and tuberous plants galore which love water, even, in some cases, year-round water.

The fauna of water gardens is covered in Chapter 9. "Fish" is likely the first word that pops into one's mind when the subject of aquatic fauna is broached. But amphibians, some flying insects, certain snails and many small wild birds can all be a welcomed part of a pond community.

Water lily hybridizers, their agonies and ecstacies are discussed in Chapter 2. Having dabbed pollen all my gardening life, I must admit a certain awe in imagining a fellow hybridizer's having to slog through water in hip high waders or climb into a boat in order to practice the hybridizer's art. But there have been plenty of water lily

hybridizers over the last 150 years ("the first deliberate attempt to hybridizer water lilies in Britain occurred in 1851..." and resulted in "a brilliant rose-pink with blooms 12 inches (30cm) across, 'Devoniensis'") who have been willing to do whatever it takes to get the pollen on the pistil.

Part Two, An Encyclopedia of Water Lilies and Lotuses, by Perry D. Slocum is another tour de force. The family Nymphaeaceae contains seven currently recognized genera: *Nymphaea, Nuphar, Euryale, Nelumbo, Victoria, Barclaya* and *Ondinea*. These are discussed, their species, varieties and cultivars detailed. Growing, propagating, day bloomers, night bloomers, hardy types, tropical types, they're all covered thoroughly as are the few diseases and pests one might encounter.

Plenty of pictures and drawings throughout this book help the reader's understanding of the text. A great many of the pictures are in color and these are simply luscious. The portrait photos of individual water lilies are especially sumptuous.

The authors have done a fine job of writing this book and assembling its pictures. And enticing the reader.

A water garden is a garden in a world beyond the ordinary. How could I have lived all these years without one?

Where's my shovel?!

Charles Hardman

CORYDALIS, a gardener's guide and a monograph of the tuberous species by Magnus Lidén and Henrik Zetterlund. 1997. Alpine Garden Society, AGS Publication Ltd., AGS Centre, Avon Bank, Pershore, Worcestershire WR10 3JP. 1997. 146 pages. 125 color plates, many black and white drawings.. (Check AGS for current price and shipping costs.)

The popularity of *Corydalis* has surged onto the world gardening scene in recent years. Yet not many books have been published about this exciting genus. We are lucky to have this new one, even though its scope is largely limited to the tuberous species in a genus which also contains rhizomatous species as well as non-geophytic annual and biennial species. The authors have done a fine job describing the tuberous species and their forms.

I was surprised to find *C. cashmeriana* listed in this book (it is not tuberous) until I saw the chapter title under which it is located: Non-Tuberous *Corydalis*, A Selection. This is a tricky genus taxonomically and, sure enough, some species have "swollen storage roots crowned by bulb-like hibernation buds" which are often

referred to (though incorrectly) as "tubers". At any rate, the better forms of *C. cashmeriana* have lovely blue flowers and it is one of the most desirable species in the entire genus so "hibernation buds" or "tubers" notwithstanding, it's best included in such a book.

The color pictures range from excellent to ginky with everything in between. One of the photographers in particular has a fondness for photographing pink flowers against pink backgrounds, blue flowers against blue or blue-gray backgrounds, red flowers against red, yellow flowers against yellow. In far too many cases these gorgeous, delightful *Corydalis* flowers are largely swallowed up in their similarly colored backgrounds. Why he did this is beyond me and beyond the most basic rules of photography, not to mention human logic.

Once that's said, I'll state, as well, that, in spite of the poor quality of some of the color plates, we are probably fortunate in being able to see these species at all, as most of us will never grow them or at least not all of them. Many of the color pictures are quite good, however, and so are the drawings throughout the book.

This is probably a book for the professional plant scientist and for the *Corydalis* enthusiast. With plants and leaves (often lacy, feathery or ferny) and flowers as charming as these, however, it wouldn't take much to *become* an enthusiast as attested to by the increasing numbers of growers throughout the cold-winter parts of the world who are doing just that.

Charles Hardman

***IRIS* OF CHINA** by James W. Waddick and Zhao Yu-Tang, Timber Press, Inc. 1992. 192 pages. 31 color photos, 21 detailed line drawings. 6¼ x 9¼ inches. (16cm x 23.5cm) Hardcover, $27.95.

You don't see books like this every day: Truth is, it's not just one book, it's two: "Chinese Iris in the Wild and in the Garden" by Waddick and "The Iris of China" by Zhao, translated by Mr. Young-june Chang.

The genus Iris is well represented in China with "more than 60 species, forms and varieties of wild irises discovered and named over the past 200 years." "More beardless species in greater variety are distributed in China than anywhere else."

The quotes are from Dr. James Waddick, fellow IBS member, plant explorer, photographer and geophyte collector extraordinaire who, in 1989, went on a 7,500 mile collecting expedition which resulted in the introduction of many *Iris* species new to the West.

Some of the photos in this book picture Iris species known the world over: I. *tectorum, I. chrysographes, I. delavayi, I. formosanum, I.*

japonica. Other photos are of species less well known: *I. typhifolia, I minutoaurea, I. rossii, I. tenuifolia, I. tigridia, I. colletii.* It's fun to see them all and to learn from the text the individual reasons why so many of these latter species are poorly known in Western gardens.

You won't find any bulbous iris listed in this book (oddly, while many are known from Asia, none are known to be native to China) and certain other sections of the genus *Iris* are sparsely represented in China. But fans (no pun intended) of the "beardless" iris should get a lot of enjoyment from this book. Certainly every iris society should have a copy for its lending library, and many individual members will want to get a copy for themselves.

Charles Hardman

MY GARDEN IN SPRING, MY GARDEN IN SUMMER, MY GARDEN IN AUTUMN AND WINTER (three different books) by E. A. Bowles. 1914. Facsimile of the 1914 edition, published 1998. Timber Press. ±300 pages each. Old black and white photos. $24.95 each.

Edward Augustus Bowles (1865-1954), "Gus" to his friends, "Gussie" to his family, wrote these three charming books during the course of one year. They are travel books, a tour through Mr. Bowles' famous garden at Myddelton House, Enfield, England.

First published in 1914 and 1915, just as World War 1 was changing the world forever, these books represent a style of writing considered modern at the time and which somehow manages to combine quaintness, charm and sophistication with humor, insightful garden observations and practical gardening information. Bowles was not foremost a garden designer. Rather, he was a plant collector who nurtured and even coddled his collections of bulbs, plants and trees.

E. A. Bowles was famous in his own day as a keen observer and a brilliant grower of plants, for once a plant came under his nurturing care, that plant was almost certain to thrive somewhere in his garden.

Bowles also was a bit of an eccentric: "he refused to have electricity and relied on oil lamps for light" writes his great-great nephew, Brigadier Andrew Parker Bowles O.B.E. in a forward to "Spring". Apparently these oil lamps provided sufficient light not only to write by, but to paint by, for Bowles was an accomplished painter of botanical and avian pictures. Most of his paintings are owned now by the Royal Horticultural Society.

Well off financially and with a large house staff, Bowles never had a paid occupation He never married, either, which left him nearly 89 full years to devote to the four loves of his life: plant collect-

ing and gardening, garden writing, painting and voluntary work for the underprivileged and for the many botanical societies and committees in which he was interested.

These books are delightful to read as is another Bowles book, "Crocus and Colchicum", first published in 1924.

It's been 84 years since the "My Garden In..." series was first published and this is the third printing of Bowles' famous trilogy.

E. A. Bowles' writing endures.

Charles Hardman

MERRY HALL, LAUGHTER ON THE STAIRS, SUNLIGHT ON THE LAWN, three different books by Beverley Nichols returned to print by Timber Press. Approximately 300 pages each. Drawings by William McLaren, with black & white photographs. $24.95 each.

Of Beverley Nichols' Merry Hall trilogy, only the original, Merry Hall has been re-printed as I write this. The other two are on their way. Hooray! Timber Press is doing us a favor by bringing out these books again.

Beverley Nichols (1898-1985) was a prolific writer and he was especially facile at writing garden books—he wrote a total of ten, dashing them off at a rapid clip and packing them with bon mots, humor and wit. This is not to say that Nichols was a particularly noteworthy plantsman or horticulturist—("he was neither and assiduously avoided the practical side of gardening") writes Ann Lovejoy in the book's foreward.

But what a writer was Mr. Nichols. And what a hoot it is to read his work! In Chapter 1, third paragraph: "One of my grandfathers died of a clump of *Iris stylosa*; it enticed him from a sick bed on an angry evening in January, luring him through the snow drifts with its blue and silver flames; he died of pneumonia a few days later. It was probably worth it."

Then there was Beverley's great-uncle who expired because of his passion for pear blossoms.

And Oldfield, Nichols' gardener, Gaskin, his factotum and One and Four, his cats and Miss Emily and Rose and Merry Hall itself. (Yes, there really was such a place—and perhaps still is—and that really was its name—and perhaps still is).

Nichols traveled the world as a political and general news correspondent for a number of English newspapers, magazines and journals. He wrote more than fifty books during his long life, dipping his pen into such diverse genres as detective stories, children's books,

novels, political works, travel books, short stories, religious essays, popular culture, dramas, popular show tunes, librettos, cat books and a dozen miscellaneous collections and anthologies.

He also wrote no fewer than six autobiographies! Three would have been a sufficiency for one of lesser lights (and one or none for most of us) but this was, after all, Beverley Nichols he was writing about.

Daffy and fun, Nichols' writing reminds us that gardening, as life itself, should not be a somber discipline at all. Do read one or more of these books, just for the joy of it.

Charles Hardman

GREAT GARDEN FORMULAS by Joan Benjamin and Deborah L. Martin, editors. 1998. Rodale Press, Inc., 33 E Minor St., Emmaus PA 18098. (800) 848-4735. 342 pages, numerous line drawing illustrations. Hardbound, $27.95.

Here's a recipe book devoted to gardeners who like the hands-on approach to gardening with a twist of organics.

The book gives you a lot for your money with ten chapters of formulas for: 1. Composting; 2. Fertilizer; 3. Soil Improvement and Soil Mix; 4. Pest Control; 5. Disease Control; 6. Weed Control; 7. Bird, Butterfly and Beneficial Insects; 8. Herbal Formulas for Cooking and Crafts; 9. Salves, Balms and Home Remedies; and 10. Fantastic Yard and Garden Designs.

There's a ten-page source list, a list of further recommended reading and simplified metric conversion tables. A nice index is included as is a USDA Plant Hardiness Zone Map. This latter is a bit small to be well detailed and comes with the warning "...Your particular conditions may vary." As this map is only one of many "cold hardiness maps", each different from the other, the warning should be taken to heart.

I especially like this book for its simplicity of style and wording. No complicated formulas here and no fancy English either. Though I don't recommend an all-organic approach to bulb growing—it certainly didn't work particularly well for me under my conditions, although I gave the method a trial run of several years!—there's little doubt that building garden and crop soils *requires* an organic approach.

This book is well written, well presented, and its formulas are well worth the price.

Charles Hardman

GLADIOLUS IN SOUTHERN AFRICA by Peter Goldblatt and John Manning. Watercolors by Fay Anderson and Auriol Batten. Line drawings by John Manning. Fernwood Press (Pty), Ltd, PO Box 15344 Vlaeberg, South Africa. 464 pages. 144 color plates. 30 x 23cm. U.S. $62.50 plus $25.00 postage.

This book is a masterpiece and may well be the magnum opus of the two scientists, the two artists, and even the publisher and printer, all, in fact, who worked to produce it.

The book is an exhaustive monograph on the genus *Gladiolus* in southern Africa which last received revision in 1972. One only needs to glance through this magnificent volume to know that the labor which went into its creation was formidable. What drives people to create works of such elaborately detailed dimensions? Two things, I believe: A need to know and a need to tell.

At 255 species and growing, *Gladiolus* is the largest genus in the Iridaceae. Growing? Well, yes. The authors suffer no delusions that this is the last word on the subject—on page 13 we find their statement "New species almost certainly remain to be found".

There's much to like in this book. I like the easy-to-understand maps, John Manning's line drawings (good portrayals and good art, as well), the layout and design and the magnificent paintings by Fay Anderson and Auriol Batten. Some people may object to the use of two different artists with two different styles used to produce the species' portraits for the color plates. I doubt there will be many objectors, however, as each of these artists is well qualified for the task and brings it her own sense of artistic dimensions. The results in both cases are satisfying and stunningly beautiful.

It must be remembered, however, that plant "Science" with a capital "S", factual and detailed, is what is encompassed within this book's pages. This is not a book to curl up with for a good emotional reading experience. Readers will find few anecdotal bits and humorous asides here.

Throughout the whole of the work, one can sense the guiding hand of the master of monographs himself, Dr. Peter Goldblatt, who has brought us so many excellent monographic works in the past. All of Dr. Goldblatt's botanical labors bear his fine understanding of scientific protocol. He doesn't let us down here even in so huge an undertaking.

The typeface in which the body of **GLADIOLUS** was produced is small and many eyes will need magnifying glasses to read the text. This may well be a blessing in disguise, for the book is already large and weighing in at approximately two kilograms (over four pounds), quite heavy.

No one interested in this remarkable and diverse genus will want to be without this magnificent book. It's going to be the final word on *Gladiolus* in southern Africa for a long time to come.

Charles Hardman

LILIES, A Guide for Growers and Collectors by Edward Austin McRae. 1998. Timber Press, Inc. Hardbound. 392 pages. $34.95

A person would have to have a heart of stone not to love, or at least admire, lilies. Regal—even majestic—graceful, colorful, scented: lilies have it all. And "all" is explained for us in this new book by a man whose background in growing and hybridizing lilies has given him the scope of knowledge needed to bring us this fine book.

There are 107 color plates, most of them showing good to excellent photography and the best sort of color reproduction, the latter a tribute to the art and science of the modern printing trades.

Part One of the book covers the all-important fundamentals. The author begins with a chapter called "The Lily Plant", a self-explaining title, the text of which gives us a clear description of just what we're working with: the lily plant and its various parts.

Lilies in the Garden rates an entire chapter in which the author gives us some tips on background and companion plants for lilies and the proper garden setting for allowing lilies of different types to be shown off to their best advantage. Propagation is covered thoroughly including the how-to's and advantages of growing lilies from seed (one advantage: no virus), a theme to gladden the hearts of those of us who love to grow plants from seed to flower. Cultivation, diseases, pests, all are covered thoroughly. All these are the sorts of subjects we expect from books of this type, all written about with an authoritative hand.

Part Two begins on page 103 and starts out with Chapter 7 which really shines for it contains a most wonderful descriptive catalog of lily species that continues for 102 pages Beginning with *L. alexandrae* and almost ending with *L. xanthellum,* McRae has done us the favor of adding as the last entry to this species lily list that magnificent eight-to ten-foot giant of a "lily", *Cardiocrinum giganteum,* which seems so unreal that it's almost as though Nature plucked it out of a Disney animation movie and gave it to the world to enjoy. It's a fabulous close relative of lilies which is obvious from the imposing picture of the species on page 203 showing it grown to perfection by Robert Long of Salem, Oregon.

Part Three covers exhibiting and hybridizing—yes!, there's still lots of hybridizing work to be done—followed by subsequent chapters

including commercial bulb production, commercial cut flower and pot lily production and an extremely thoughtful Chapter 18 called "Personalities of the Lily World" featuring people who have played significant roles in lily hybridizing and lily culture and promotion. A glossary, a bibliography and an index of plant names round out the book.

In short, Mr. McRae has presented us with a fine work, the essence of his life with lilies. This book is well written, well illustrated and, well, I recommend it highly.

Charles Hardman