PLANT LIFE

AMARYLLIS
YEAR BOOK

1980

"Yellow Pioneer" (#591-4) Large-Flowering Hybrid Amaryllis Produced by C. D. Cothran

THE AMERICAN PLANT LIFE SOCIETY

THE AMERICAN PLANT LIFE SOCIETY is organized for the "increase and diffusion of knowledge concerning plant life," and to carry out its objectives the main emphasis is placed on the publication of PLANT LIFE, the periodical devoted to plant life, incl. HERBERTIA, the yearbook devoted exclusively to the amaryllids, sponsored by the affiliated AMERICAN AMARYLLIS SOCIETY. The publications are international in scope. All paid up members are privileged to receive the current issues of PLANT LIFE, incl. HERBERTIA, THE AMARYLLIS YEARBOOK.

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1980

EDITED BY

HAMILTON P. TRAUB

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AMARYLLIS
YEAR BOOK
1980

Year Book of

The American Amaryllis Society

47th Issue

GENERAL AMARYLLID EDITION

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THE AMERICAN PLANT LIFE SOCIETY

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THE AMERICAN PLANT LIFE SOCIETY

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(AMERICAN AMARYLLIS SOCIETY, continued on page 125.)

PREFACE

Beginning in the 1930's, the present writer planned to produce large-flowering yellow hybrid *Amaryllis*. At the time, no yellow-flowering *Amaryllis* species had been discovered. He noted that among the discards in breeding Mead Strain Hybrids, there often appeared dirty greenish-yellow rejects, and he aimed to start the project by crossing these with the large-flowering Dutch perfumed White with creamy throats. In this way he hoped to obtain a race of *clear* perfumed greenish-yellow hybrids as *the base for further breeding*. However, he always had so many irons in the fire, that he never carried out the plan. This hopeful dream is mentioned as the introduction to the work of C. D. Cothran, who over a quarter century did carry out a similar program, using the more recently introduced yellow-flowering *Amaryllis* species from South America as the starting point.

The 1980 PLANT LIFE is dedicated to C. D. Cothran, who has been interested in *Amaryllis* breeding for the past quarter century, first as an avocation, and since his retirement in 1974 largely as a vocation.

By consistent application to the breeding of Hybrid *Amaryllis*, he has obtained outstanding preliminary results towards the long sought perfumed large-flowered hybrid *Amaryllis*. For his outstanding work, he has been awarded the WILLIAM HERBERT MEDAL for 1980. We can rest assured that we can expect important future introductions by C. D. Cothran, who contributes an interesting autobiography, detaining his important researches in the agri-business, and his results in breeding *Amaryllis* hybrids. All will join in congratulating him on his important achievements.

Again, the 1980 issue contains other important articles.

Dr. Bell provides the basic guidelines for *Amaryllis* breeding; Dr. Cage, unfortunately explains the end of an important Amaryllis inbreeding project aimed at producing pure lines of Hybrid *Amaryllis* which could be produced from seeds and thus simplifying the process of propagation; Mr. Deme provides a Double Amaryllis breeding update; and Mr. Manning writes about Amaryllis breeding and culture in Minnesota, and vegatative reproduction in *Paramongaia weberbaueri*.

Dr. Howard writes on the progress in Hymenocallis and Crinum breeding; Margot Williams contributes important articles on vegetative propagation of *Lycoris*, and the flowering of *Lycoris* in less than two years from seeds; Mr. Bennett provides a most important annual general report on Amaryllids, including a report on the rare *Cryptostephanus vansonii;* Marcia Wilson contributes the interesting annual Zephyranthese report; and Mrs. Menninger reports on the dwarfing effect of drought on *Haemanthus* at Victoria Falls.

Dr. Stephen-Hassard reports on a new *Crinum defixum* form native to Nepal; Marcia Wilson on a dwarf *Crinum* species from the Caribbean: Dr. Flory and G. L. Smith report on *Habranthus, Zephyranthes,* and *Nothoscordum* chromosomes; and Dr. Mueller-Doblies explains the inflorescence of *Agapanthus*.

There are also reports on the regional Amaryllis exhibitions, and other articles as shown in the Table of Contents.

Contributors to the 1981 issue of PLANT LIFE are requested to send in their articles by August 1, 1980, in order to insure earlier publication of this edition. Unless articles are received on time, publication will again be delayed to June or July or ever later as with some issues in the past. Your cooperation toward earlier publication will be greatly appreciated. *Those having color slides or transparencies which they wish to use as the basis of illustrations are requested to have black-white prints made, and to submit these with their articles.*

January 15, 1980, ***Hamilton P. Traub***
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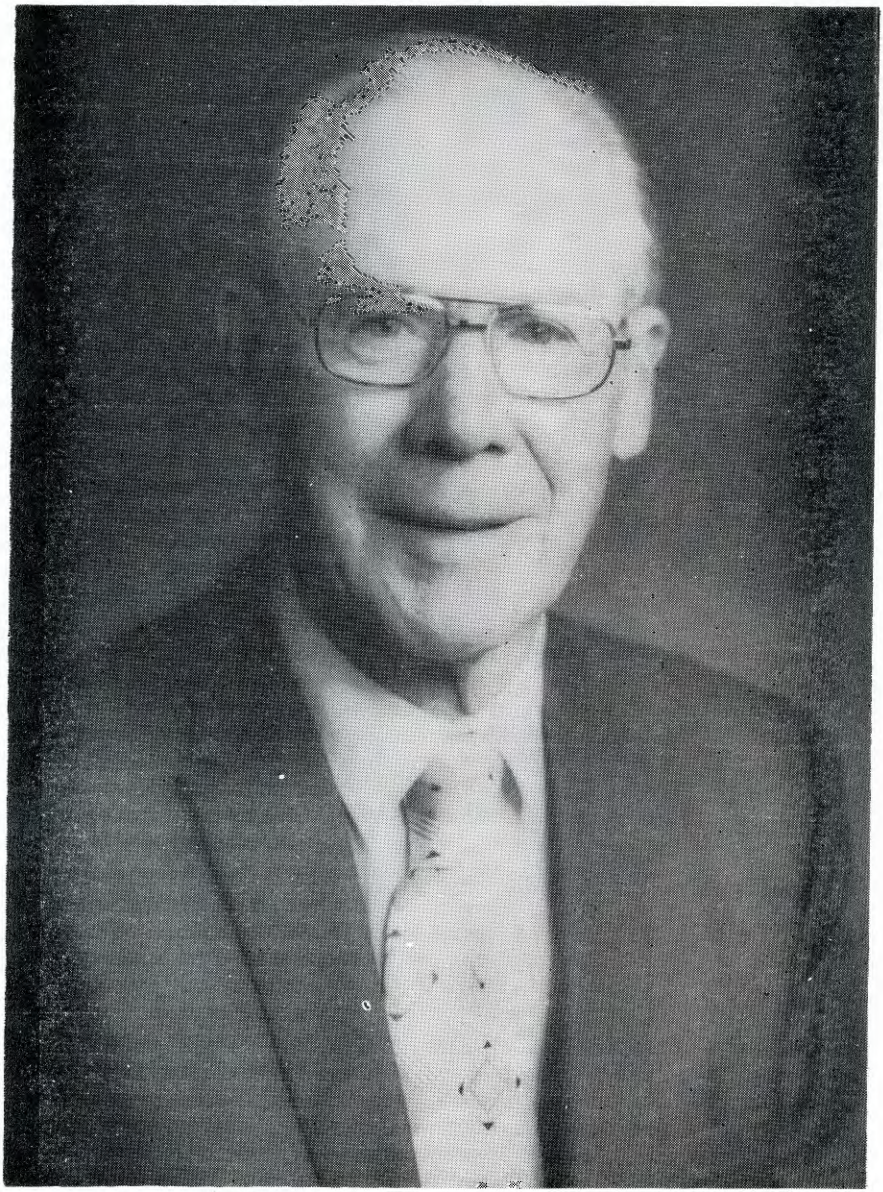
Dedicated to
Charles Dewitt Cothran



CHARLES D. COTHRAN - WILLIAM HERBERT MEDALIST

CHARLES DEWITT COTHRAN

An Autobiography

I was born August 21, 1904 on a farm in Greenville County, South Carolina, and although diminutive in size, almost four pounds, the country doctor and my mother soon brought me up to normal. My father bought a store in Honeapath, but the work proved too confining, and the doctor recommended a dry western climate. Trunks and suitcases were packed, and the surplus disposed of, including my new birthday tricycle.

After a train trip of seven days, which included a severe train wreck, we arrived in Banning, California. In 1910 Banning was a small frontier town with horses and wagons (or buggies) for transportation. A stage and freight wagons served a few mines and scattered ranches on the desert. Some fruit orchards were in existence, and more were being rapidly planted. Also, since *Eucalyptus* wood was said to be the furniture wood of the future, my father and another man raised large numbers of seedlings and planted them for other people. The bubble burst after two or three years, but some of the trees are still standing. The almond, peach, apricot, and prune orchards survived up until recent times, and the Spring bloom brought people many miles to see it.

EDUCATION

I started school in the first grade and finished High School in Banning. We had good teachers, and a high percentage of those in my graduating class went on to college. I received a scholarship to the University of Redlands at Redlands, California, and attended classes there for three years with chemistry as my major, and mathematics and language as minors. I attended the University of Washington in my final year as I wanted to graduate from a larger university, and anyway I fell in love with the campus after a chance visit there. It proved to be all that I thought it might be.

AGRI-BUSINESS CAREER

Although 1927 did not start out very well, as I worked at a service station and odd jobs, it probably was the most auspicious year of my life. In August of that year I had an opportunity to go to work for the Brogdex Company of Pomona as a chemist, and in September I was married to Mildred Holloway of Redlands, a Kentucky girl whose family had come to Redlands in 1912 for the health of Mr. Holloway. In 1927 the Great Depression was just starting to get underway, jobs scarce, wages low, and food and rent high. But Mildred is a good manager, and we prospered.

The Brogdex Company is the originator of the use of wax and fungicides to protect harvested citrus fruit. It has remained a leader in this field, up to and including the present time. After about two years I became chief chemist and later Director of Research and De-

velopment. A number of patents have been obtained in my name on wax and fungicidal processes, and the processing field at this time includes all varieties of citrus fruits, tomatoes, cantaloupes, bell peppers, sweet potatoes, cucumbers, apples, peaches, and other specialty crops. The Company sells the processing materials and the machines to the various packing house companies, and provides general supervision of their use. Some of the fungicides require frequent analysis of the treated fruits to determine if it has been adequately applied, and also that it has not been over applied. Our laboratory chemists and technicians obtain the samples of treated fruits to make the tests.

But to keep things in chronological order, I went to New York in 1930 with Mr. E. M. Brogden, President of Brogdex Company, to study the feasibility of shipping fruit through the Panama Canal, and reprocessing and packing it into consumer size packages in the New York area. The idea seemed sound, and after helping to set up a packing house in Jersey City, I made several trips around through the canal with large shipments of oranges. The Luckenbach Lines ships took 18 days to make the trip from Los Angeles to New York, and it took a week to come back to Pomona on the train. Shipping citrus this way was sound, but the interlocking unions in the harbor area of New York gradually squeezed the profit out, so the Jersey City packing house was sold to a Florida citrus company.

In 1932 our daughter Mary Ann arrived, and for several months she ktpt us very busy. In September of 1934 the Company asked me to go to Yakima, Washington to see why our licensee there was losing business. I was there only a short time when I received a message from the Company asking me to return to Pomona immediately, that they wanted me to go to Italy. The Italian Department of Agriculture wanted to determine if treating their citrus fruit with wax and fungicide would help it to arrive better in the market.

In December of 1934 I took the train for New York, then embarked on the S.S. Olympic for Le Havre, France. It was a frightening trip; snow, ice, furious winds, with no one allowed on any of the exposed decks. The lighter at Le Havre bobbed like a cork, and it was miserably cold and raining. A young Frenchman who had been studying in the United States, helped me through Paris, and got me on the right train for Rome. A young Englishman shared my second class compartment on the train, spoke French and Italian well, and made our trip to Rome a breeze. I met the Agriculture people in Rome, and after several days discussion I took the train for Catania, Sicily where the work was to be done. That first six months in Sicily would of itself make a good story, but suffice to say the Sicilians were very kind and helpful and we got the machinery set up and running, and by that time I spoke pretty good Italian.

In July 1934 I returned home, Mildred and Ann and I packed up the things we would need, and returned to Catania. We then went on to Palermo where we rented an apartment, bought furniture, and worked until about December of 1939. There were only four or five Americans in Palermo including the American Consul with whom we became very friendly. The war was coming on, and in December 1939

the Consul told us to leave. At the same time the Italian Government told us the contract was cancelled, and advised us to leave Italy soon to avoid a detention camp. We saw many war preparations in Rome, Paris and London on the way home. Americans laughed when we said a war was coming.

While in Sicily we had many opportunities to travel throughout the island and observe the plant life. As a chemist, and not a botanist, there was much that I did not know. The slopes of Mt. Etna are covered with filbert and chestnut trees, and at higher elevations there are pines with ferns underneath, and acres of cyclamens. Dry washes run down the slopes to the sea, and are filled with oleanders. These are native, mainly single, and the range of colors is extraordinary. The farmers cut them to the ground each year for firewood which is in very short supply in Sicily. In many of the farm fields wild gladiolus and other bulbous plants are a pest. On rocky slopes schill grows in great abundance, and is sometimes harvested for pharmaceutical preparations. Some of the old olive trees planted by the Greeks are still growing in the vicinity of temple ruins, and still bear fruit.

Back in Pomona things went rather quietly for a while, but the war came on and we lost half of our laboratory force to the armed services, and worked very hard to find supplies for our business. As the war ended a man in Israel asked the Company to send over a technician to look at citrus in Israel. My assistant was sent, and soon thereafter we sent some machinery and a man capable of placing it. However, war broke out between the Arabs and Israel, the machinery was buried in an orchard, and our men rode an armored car to the airport and left in a hurry.

In late 1949 I went over and worked with the Israelis for about five months. The machinery (the ressurected equipment, and a second shipment that arrived at the same time I did) worked very well, and in one stride Israel joined the modern age in citrus handling. At this time their packing houses are as modern as any in the world, and number about fifty in total, with some of the houses having two or more processing units.

I made about twelve trips to Israel, often combining visits to Greece, Cyprus, Lebanon, Tunisia, Morocco and Spain. On two different occasions I went on from Israel to South Africa, Mildred going with me at one of those times. We spent more than three months there, mostly in Nelsprit in the Province of Natal, but I did have the opportunity to drive to Port Elizabeth and work for a while in the packing houses on Sundays River. I also was able to see the herd of wild elephants that had been fenced in with miles of fence made of railroad rails and ship's cable. They had been fenced in because they had killed quite a number of people, the last a little girl on her way home from school. Nelsprit was a short distance from Kruger Park, and we had the opportunity of spending quite a few hours there, and seeing almost all of the animals that are said to be there.

In all of the countries I visited I had an opportunity to spend some time in the citrus groves, and also observed both wild plants, and those in parks and by peoples houses. Of all areas I think South Africa was

the most interesting, as the people not only had many native plants in their gardens, but also those of Europe and the Americas. In the wild there was a great abundance of plants and trees, very few of which I recognized. Most of the flowers seemed to be orange or blue. There are many small nurseries in South Africa, often featuring some special plant. I was particularly interested in Camellias at that time and looked up some of the larger nurseries, and home plantings. One beautiful home on top of a high hill on a tree farm had about five acres of gardens, with one hundred and twenty five Camellia trees about eighty years old, many deciduous azaleas, and other beautiful shrubs and plants. Deer and antelope jumping the fence kept all of them trimmed. The owner of the farm and a helper harvested trees from the 300 acres, and by the use of water power sawed them into lumber. They replanted the trees as needed, and the owner said his grandson would probably harvest them.

The last several years with the Brogdex Company was spent perfecting formulas containing fungicides. Thiobendazole (TBZ), Benlate, Captan, Botran, sodium orthophenylphenate, sodium and calcium hypochlorite, amino butane, and some new materials on a trial basis, are all used on one product or another. I have found that some of these are also useful for amaryllis and other bulbs, helping greatly in preventing attacks by various molds. I retired as of January 1, 1969, but continued to consult for four more years, making a total of forty seven years with the Brogdex Company.

SECOND CAREER, 1973 TO DATE

I do find a few minutes now and then to go to the laboratory to see what is going on, but have launched on a second career of Amaryllis hybridizer, devoting a great deal of my time to this rewarding occupation. However, I still consider myself an amateur and am learning as I go along. My interest in Amaryllis breeding began over a quarter century ago and has increased gradually.

A very large number of crosses have been made with A. evansiae both as seed parent and as pollen parent. In general crosses with A. evansiae bloom precociously, and put out a number of offsets, which together with the parent bulb, can fill a six or eight inch pot with flowers in a couple of years. This can be a very desirable trait. A cross of A. evansiae and A. papillio was described in an article in Plant Life, pp 61, 1979, and the reciprocal cross was made by Mr. Sterling Harshbarger of Pasadena, California. A cross with A. neoleopoldii did not yield anything of value in the primary hybrids, but Mr. Fred Boutin, Botanist for Huntington Gardens and Library, San Marino, California, recrossed the primary hybrid with a sibling and came up with a much finer and more interesting flower. A. evansiae crossed with A. striata produced hybrids which were similar to 'Senorita' hybrids which were made earlier with the same two species, but the earlier cross was superior to mine. It is possible that the A. striata that I have is not a species, but is in fact a hybrid itself. A. cross of A. evansiae with A. parodii yielded a rather small yellow flower with medium tube

length, and four flowers to the scape. It seems to grow well, blooms from small bulbs, and has a long resting period similar to A. parodii. Leonard Doran crossed (EA x E) with A. parodii pollen and obtained a four flowered scape with the flowers about five inches across the face, and a nice yellow color but not deeper than the yellow of the parents.

'Senorita' was available to me before A. evansiae, so I used it with a number of Houdyshell and Dutch varieties. The first two years I could not get 'Senorita' to set seed, but its pollen produced an abundance of seed on the above varieties. I wanted pastel colors and 'Senorita' produced them. The flowers were usually 5½ to 7½ inches in diameter, edges often waved, and sometimes the segs were slightly

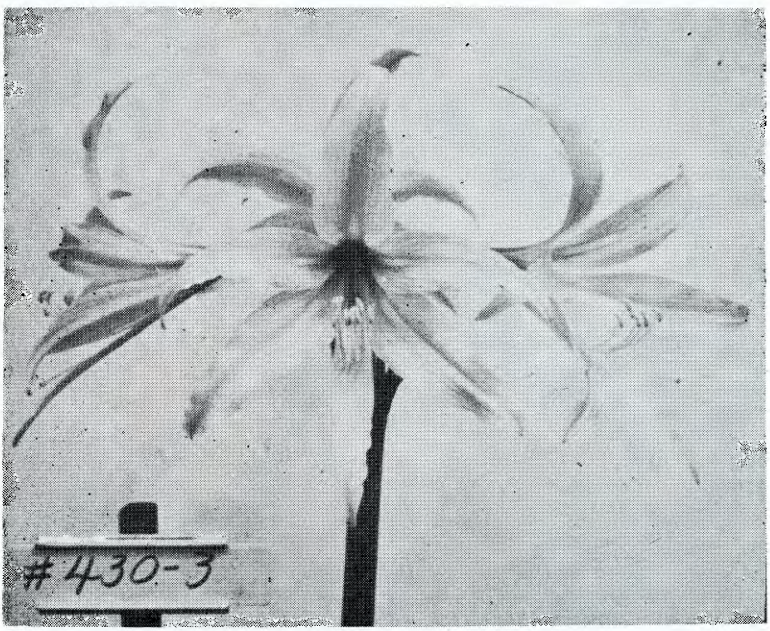


Fig. 2. Hybrid **Amaryllis** clone "Peaches & Cream" produced by C. D. Cothran.

twisted. They bloomed precociously, and early in the season. They are bright and cocky, and make a great show in the glasshouse or bed. It is to be noted that the best flowers were produced with 'Senorita' pollen on the Dutch type flowers. 'Senorita' sets seed poorly, and very few when it does set seed, and the resulting flowers are not very interesting.

A salmon colored Dutch type hybrid from Mr. Carlton of San Diego was selfed and yielded a large number of seedlings which were all the way from red to white when they bloomed. One of the whites with a few strong red splashes was crossed with 'Senorita' pollen and yielded strong growing seedlings. When they bloomed most of them had large blooms on 30 inch scapes. Only a few of the blooms were interesting,

but one had blooms which were eight and a half inches in diameter, on a tall stout scape. The four blooms were produced almost simultaneously, and had a slight cock similar to 'Senorita'. The blooms were of a salmon color, with deeper salmon veining, a yellow green throat, and yellow bars along the ribs. It will quickly fill a pot with offsets, and several of them along with the mother bulb will bloom the following season. Usually the second scape is in bloom before the first is finished, and they never fail to attract attention.

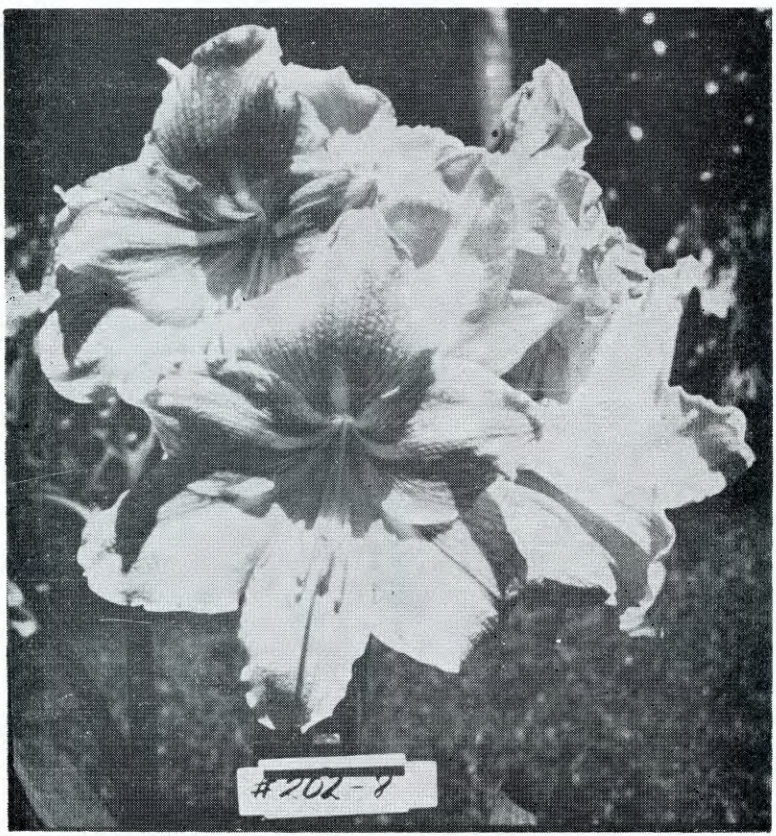


Fig. 3. Hybrid **Amaryllis** clone "Favorite" produced by C. D. Cothran.

Leonard Doran gave me some seed of a cross he had made, A. starkii x (EAxE). When they bloomed most of them were pinkish, but one of them was yellow, very much the same color as A. evansiae. It was suggested that I cross it with A. fosteri pollen which was available at that moment. This was done, seed were set, and in due time bloomed. The bulbs were quite small, but the scape up 30 inches or more, and four

flowers opened almost at once. They were about five inches in diameter, ruffled and recurved. The color was a peach pink with a pale yellow throat, and yellow bars along the ribs about 1½ inches long. The segs were rather narrow, about one inch wide, with deeper pink veining widely spaced. The color suggested the name "Peaches and Cream" (Fig. 2). The flower is really lovely, but other than the flower, the plant inherited all of the bad characteristics of both parents. The bulbs rot easily, can be expected to go dormant at any time, and grow when they

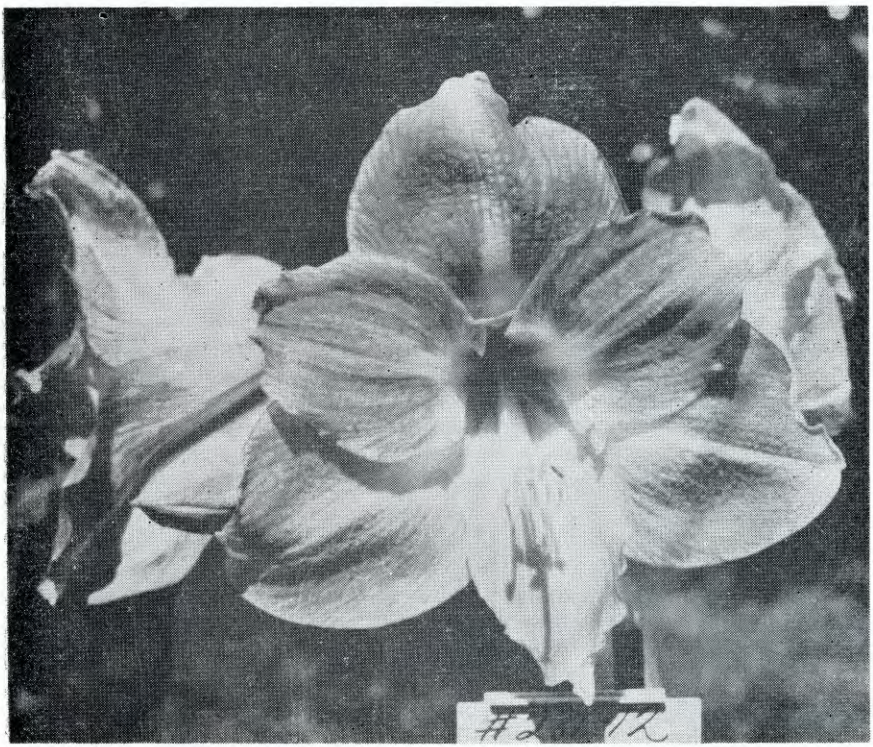


Fig. 4. Hybrid **Amaryllis** clone "Dutch Charm" produced by C. D. Cothran.

feel like it. Several of the bulbs have been lost shortly after they bloom from a little bare bulb. However, the flower is worth all of the trouble and when more is known about the plants, one can probably avoid the bulbs rotting.

The Dutch clone 'Glorius Victory' has yielded some of the best new hybrids. A particularly good cross was made with a medium size white (Goedert's Picotee x 'My Fair Lady') and pollen from Glorius Victory. This yielded a number of good seedlings, one of which was entered in the 1976 Southern California Hemerocallis and Amaryllis

Society show. It was about eight inches in diameter, with very broad segs and triangular shaped blossoms (Form B), pale rose and white, with some shiny gold markings. It received a blue ribbon in its class, and then won the popularity poll with an impressive majority. For this reason it was called "Favorite" (Fig. 3). Several offsets were removed from the plant and potted separately, and then lost in a greenhouse accident. The parent plant is still in good condition, but has not put out any more offsets.

'Golden Triumphator' is another Dutch clone that has produced some excellent offspring. One which I called "Dutch Charm" (Fig 4) is a cross of 'Golden Triumphator' and 'White Giant'. It usually has two scapes blooming almost simultaneously with eight inch flowers on a strong eighteen inch scape. The flowers are orange red with green throat, succeeded by a white area and white bars on the ribs. The flower is quite flat, with very broad segs. It was displayed at the Festival of the Los Angeles County and State Arboretum in Arcadia in 1976, and attracted very favorable comment. It is a vigorous clone, and apparently will put out offsets often enough to insure its perpetuation.

The Dutch clones 'Baruta' and 'Belinda' produce some beautiful reds of some six to seven inches in size. This progeny is usually dark red, with petaloids, and ruffles, and a glistening red throat. The flower is round (Form A), very short tube, and thick, heavy substance. However, many of the seedlings have only two flowers to the scape. Although cherished, none of these have been named.

Most white Dutch clones have become white through a long breeding program. Some of these will not set seed themselves, but their pollen is good. However, you may find, as I did, that if two whites are crossed you may get a number of plants with red stripes, blotches of red, and some almost red blooms. It shows that red is in the ancestry of the flowers. It may prove difficult to get a pure white without back crossing several times, but it is possible to obtain some very lovely whites in this way. It is not necessarily true that whites are less vigorous than red clones. Some whites are very vigorous and strong.

Crosses among the Dutch hybrids, or with other hybrids, usually yield a very low percentage of large show type flowers. However, do not be discouraged by this fact. Such crosses do yield some very interesting colors, markings, and forms. Some of these forms may in the future become a type that is recognized, and regarded as highly desirable. Once in a while the genes form a combination that produces a most remarkable flower. The possible gene combinations are so great as to stagger the imagination. Very little of the possible has been done so far, so lets get out the brush and pollen capsule, and let the imagination roam freely.

One of the nice things about hybridizing is the number of people who offer help, freely and generously. Leonard Doran, and his mother, Mrs. Cora Doran have helped me greatly. Bulbs, pollen, advice, encouragement, their help has been of the greatest value to me. The late Quinn Buck offered many good suggestions. Sterling Harshbarger

and Fred Boutin also helped and discussed some of the work. I had several very useful conversations with Robert Goedert of Jacksonville, Florida. Many other people have offered a timely suggestion, and to them I am gratefull, as I also am to Plant Life, and its editor, Dr. Hamilton Traub, for the many articles over the years that bear directly on hybridizing.

THE QUEST FOR LARGE YELLOW-FLOWERING HYBRID **AMARYLLIS**

C. D. COTHRAN, *1733 North Gibbs Street, Pomona, California 91767*

INTRODUCTION

Seeds have a strange fascination for me. I can have the glass house so full of plants that the walls are being pushed out, and if someone offers me some seed I will take it and plant it. Perhaps this quirk accounts for the continued interest in hybridizing amaryllis.

In the 1979 PLANT LIFE and in the autobiography, I have given an account of the work I have done to date in developing a yellow amaryllis. To recap some of this, a Senorita, which is a cross of A. evansiae and A. striata, was crossed with a White Dutch which was very stylish. A number of plants were obtained from this cross, some with a fair amount of yellow, others more red than yellow. Leonard Doran had crossed A. evansiae with A. aglaie, and the resulting cross with A. evansiae again. The result was a nice yellow flower, somewhat larger than A. evansiae. I had some seed of this cross, and when they bloomed I crossed them back on themselves. I got a few seed, and one of the plants was quite a nice yellow and somewhat over five inches in diameter. This plant furnished the pollen for one of the yellowest plants of the Senorita/White Dutch plants above. Seed resulting from this cross make up my 339 and 340 series.

As often happens, these plants do not set seed freely. I have found them rather unreceptive to self or sibling pollen, in fact to any pollen at all. Several of these #339 and #340 plants are rather good yellows, and one can just imagine what a cross with a big, stylish White Dutch would do for it. I finally did get two siblings to cross, and got a few poor seed from them. A few of the seed were viable, and produced my #591 series. See Fig. 6, 'Yellow Pioneer' (#591-4), and Fig. 5, #591-1.

The #591 series has larger flowers, and mostly more yellow than the #339 or #340 series. They look more like Dutch, and less like A. evansiae. But the best thing about them is that they will self, or cross with other plants quite readily. I suspect that the chromosomes got squared around with this cross. I do not yet consider this series a finished product, and with this rather unexpected fertility, the question is what further crosses should be made to both enhance the yellow color, and the size and form of the flowers.

THEORETICAL CONSIDERATIONS

Regarding the matter of color Bell (1977) reports that "Yellow or green are the result of a different pigment system, plastids in the subepidermal cells of the floral segments. Four species have been of interest in breeding for yellow flowers, A. evansiae, A. aglaiae, A. parodii, and A. anzaldoi. Progeny from crosses among the above have flowers of a pale yellow color. The yellow is masked in crosses of these species with others containing anthocyanins in the epidermis. An

Fig. 5. Large Yellow-flowering Hybrid **Amaryllis** #591-1 produced by C. D. Cothran.

induced tetraploid form of A. evansiae has flowered, but the pigmentation is visibly no deeper than that of the original diploid species. —The limit of yellowness has probably been reached for hybrids restricted to the 4 species above. —To enhance yellowness, one must seek to increase the number of plastids in the floral segments. Green flowers, which also contain the plastids, and those species with a prominent green or yellow throat markings are logical choices for this breeding program."

To comment further on the subject of color, I would like to quote from Grant (1975) directly: "Paris, Haney and Wilson (1960) sur-

veyed 75 plant species in which flower color had been analyzed genetically. Their objective was to search for common denominators in the different specific gene systems for flower color. They found that most cases of flower color inheritance can be described in terms of the six genes with epistatic interactions.

"The six genes as designated by a uniform gene nomenclature are W. Iv, y, B, P, Dil. Their actions are as follows: W switches color production on and off. Iv and Y control ivory and yellow colors respectively. Genes B and P produce anthocyanin pigments which have purple, blue or red colors. Gene Dil, in one allelic form or another acts as an intensifier or bleaching factor Paris, Haney and Wilson, 1960).

"The dominant and recessive alleles of these genes have the following phenotypic effects:

W	colored	ww	white
Iv	nonivory	iv iv	ivory
Y	Nonyellow	yy	Yellow
B	purple or violet	bb	blue
P	purple or violet	pp	pink, rose, red
Dil	intense color	dil dil	dilute color

"the six color genes form an epistatic series running from W, the top epistatic member, to Dil the bottom hypostatii member."

It would seem that Bell, Paris, Haney, Wilson, Grant, et al have given us much of the information needed to breed a large Dutch type yellow with considerable intensity of color. However, some of the steps suggested are rather difficult, and not entirely obvious. A. neoleopoldii, A. papilio, crossed with A. evansiae have produced progeny with quite a bit of yellow in them, in some cases a deeper yellow than A. evansiae, but these hybrids are very stubborn about crossing with anything else. Crosses with A. starkii produce pale, orange colored flowers. I do not have much in the way of Dutch type green flowers, but I did make two crosses with off colored white flowers, and the seed are now ready to plant. At one time I had a Houdyshell cross with a large amount of yellow green, but it was lost with the cold weather last year. Mr. Ernest Angell also had two or three very yellow green amaryllis. They were not very good form, however, at his death the whole collection was dispersed, and it is doubtful if they exist now.

#591 YELLOW HYBRID SERIES

Eight #591 siblings have now bloomed. They have two, three, and four flowers per scape. The flowers vary in size from just under seven inches to eight inches in diameter, and most are open faced and flat. The yellow color is quite good, but in some of them a flush of pale pink becomes evident after two or three days. Two of the siblings have four flowers per scape, but are poorly imbricated. One of the best yellow colored ones had two flowers and produced them one at a time. All of them seem to be fertile, to their own pollen, to pollen of their siblings, and from other hybrids. They bear large seed pods, and the seed have been up to 100% viable. A few of them have offsets which are still

small, but should be ready to hand out in 1980. What should be the next step? Suggestions from other amaryllis growers and hybridizers would be very much welcomed.

So far, only one sibling has been named, 'Yellow Pioneer' (#491-4). See Fig. 6. A brief description follows:

Fig. 6. Large Yellow-flowering Hybrid **Amaryllis** clone #591-4, 'Yellow Pioneer' produced by C. D. Cothran.

'YELLOW PIONEER'

The clone 'Yellow Pioneer' is a complex hybrid involving *Amaryllis evansiae, A. striata, A. aglaiae* and a white Dutch clone.

Description.—*Bulb* 4.5 cm. high by 5.7 cm. wide, tunics brown, rhizomatous. *Leaves* 6 to 9, bright green, 4.5 cm. wide, 50 cm. long, lanceolate, margins slightly rolled. *Scape* emerges from the bare bulb, or with a few old leaves, 46 cm. tall. *Spathe* 2-valved, lanceolate. *Pedicels* 7.8 cm. long. *Umbel* 3-4-flowered. *Flowers* held horizontally, 18.5 cm. in diameter, with tepalsegs 6.3 cm. wide at greatest width. *Tepaltube* short, tepalsegs well imbricated. *Style* white, about half the length of the tepalsegs. *Stigma* shortly trifid with lobes slightly rounded. *Capsule* triangularly lobed, larger and rounder than in *A. evansiae*. *Seeds* many, large, shiny black.

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1980 ALSTROEMERIA COMMITTEE REPORT

DONALD D. DUNCAN, *Chairman, Alstroemeria Committee, P. O. Box 238, Sumner, Washington 98380*

I have read in florist periodicals that *Alstroemeria* is being studied in such widely separated places as New Zealand, Canada, and Israel. This beautiful cousin of the Amaryllis is finally beginning to come into the spotlight. It is interesting to see it appear more often, not only in florist shops, but also on greeting cards and as a decoration in advertisements for such things as jewelry, silverware, and cosmetics.

In the United States it was once better known than it is now. At one time *A. pelegrina* was featured on the cover of Sunset magazine and Mr. Harry Stinson in Seattle had gathered together an interesting collection of species. (See Plant Life 1952, Second Alstroemeria Edition.) These were available to the public not only from him but also from Oakhurst Gardens, owned by Mr. J. N. Giridlian, of Arcadia, California. Both of these fine plantsmen are now deceased and their collections of *Alstromeria* are lost.

As for myself, 1979 was a disaster for the out-of-door plantings. The Seattle area suffered through the most prolonged cold spell ever recorded. In an area where three to four inches of frozen soil is a hard winter, it froze ten to fourteen inches deep! The cold not only killed an entire field of *A. ligtu* hybrids that had been started in the spring of 1978 and planted into the field that summer, but also killed some established plantings of *A. aurantiaca.* This latter was a surprise to me because I though that the plants were deep enough and hardy enough to survive, but not all did. That's how we learn.

The field of *A. ligtu* has been replanted this past summer and has been heavily mulched with sawdust, leaves and evergreen branches. This should bring them through their critical first winter. If they survive, they will grow deep enough during the summer so that a light mulch would carry them over a normal cold spell.

I would like to ask everyone who has grown or is growing any Alstroemerias to write me a note teling me what your soil is like, what your summer high and winter low temperature is and what special care (mulches, watering, mounding, etc.) that you have taken to insure that they survive in your garden. Also please let me hear from those of you who may be growing Alstroemerias in pots. What size pots do you find best? What is the temperature of your greenhouse or home? What fertilizers and sprays do you use? Please include as much information as possible. It may be of great help to someone who wants to try growing these beautiful flowers.

A SHERLOCK HOLMES OF BIOLOGICAL NOMENCLATURE

HAMILTON P. TRAUB

William Louis Tjaden, of Welling, Kent, received his higher education at the London School of Economics, University of London; taking his Bachelor of Science degree (B. Sci.) in 1934. He was employed in the British Civil Service until his retirement in 1973. In accord with *English tradition,* he had engaged in gardening since childhood, and pursued his rewarding interest in plants as a main avocation, beginning in 1945, and full time since his retirement 1973.

Since 1945, one of his specialties has been the determination of the correct *Latin names* of the plants he grows, on the basis of the *International Code of Botanical Nomenclature.*

Among the various ornamental plants which he cultivates are large-flowering *Amaryllis* Linn., hybrids which contain some genes from the AMERICAN BELLADONNA, *Amaryllis belladonna* Linn. (1753). He also attempted to grow the South African CAPE BELLADONNA, *Brunsvigia rosea* (Lam.) Hann., a species not suited to the English climate. In searching the literature about these species, he soon noted the "incredible assumptions" intertained by some botanists since the late 1930's concerning the application of the name, *Amaryllis belladonna* Linn. (1753). With keen perception of the facts in the case, he has brought the discussion *back to reality* by *discovering the definitive clue* (not found by doubting Thomases) *left by Linneus himself in Hortus Cliffortianus* (1737). In the *true tradition of English fair play,* he has *laid the background* for resolving the unfortunate controversy to the satisfaction of all concerned on the basis of the *facts in the case* (Tjaden, 1979). This should appeal to all true scientists whose objective it is to search for the truth. Truly, a Sherlock Holmes come to judgement: "Elementary, my dear Dr. Watson!"

Modern botanical nomenclature had its beginning with the publication of Linnaeus' *Species Plantarum,* ed. 1. 1753. In it appears the plant name, *Amaryllis belladonna* Linn., which has been applied differently by two groups of workers.

One Group, led by Sealy (1939), Dandy & Fosberg (1954), and others claims on the basis of unsupported assumptions, that the name refers to the South African or Cape Belladonna, with a solid flower scape. The other group led by Uphof (1938), Traub & Moldenke (1949), and Traub (1954, 1958, 1963, 1970), and others, is certain, on the basis of the text, that the name has to be applied to the American Belladonna in accordance with the priority rule in botanical nomenclature.

Linnaeus, in *Species Plantarum* (1753), under *Amaryllis belladonna* Linn., cites six authorities (direct or indirect, including three figures, one a color plate), and the habitat in America. All except the citation to Linnaeus, *Hortus Cliffortianus* (1737), are accepted by both groups as referring to the AMERICAN BELLADONNA. Thus, the correct interpretation of this one citation is of prime importance.

Those favoring the CAPE BELLADONNA, have studied the text and have concluded, on the basis of assumptions, that since Linnaeus, in *Hortus Cliffortianus* (1737), at the end of the five species descriptions under the Genus *Amaryllis* Linn., states that all of the species have beautiful flowers, but that the most beautiful of all are those of the second species listed (as printed in the book). This they claim rules out the AMERICAN BELLADONNA. Their claim is predicated on the color value of the flower.

However, it is now apparent that these workers carried out only very superficial research, or readily accepted the results claimed by such workers, and thus *missed a definitive clue* planted in the text of *Hortus Clicortianus* (1737) by Linnaeus himself, thus missing the *key to their confusion.*

Recently, the keen eyes of Tjaden (1979) have noted that Linnaeus planted the clue—*Docte describit Amaryllidem 2dam*—under the citation to Douglas (#61) 1725, in the bibliography, devoted to the Guernsey Lily. This outstanding detective work at last reveals that their assumptions are pure speculation, and thus brings them back to reality.

It has to be indicated that due to Linnaeus' heavy work load (see Tjaden, 1979), during the preparation of the massive *Hortus Cliffortianus* (1737), *he did not base* his conclusions upon *the un-annotated specimen* of the Cape Belladonna in the Clifford Herbarium (Tjaden, 1979). (The nomenifer or type-method of typifying plant names was not instituted until much later.) Linnaeus in 1737 *based his ideas about Amaryllis belladonna* Linn., *upon texts in the Clifford Library,* which he listed in the bibliography. Again, due to the heavy work load Linnaeus failed to make *the necessary shifts* in the text: the AMERICAN BELLADONNA to first place, and the GUERNSEY LILY, *Nerine sarniensis,* the most fair of all, to second place (*2dam*), to conform to his note under Douglas (#61) 1725. Note the clue—*2dam!* Thus, Linnaeus, omitted the CAPE BELLADONNA from *Hortus Cliffortianus* (1737), and the name, *Amaryllis belladonna* Linn. 1753, must be attached to the AMERICAN BELLADONNA.

The plant species which Linnaeus singled out as the most beautiful of the five *Amaryllis* species turned out not to be *Amaryllis belladonna* Linn., The AMERICAN BELLADONNA, *in the intended first place* in the text, but the GUERNSEY LILY, *Nerine sarniensis, in the intended second place* (*2dam*). Beauty is in the eyes of the beholder. The CAPE BELLADONNA *omitted* was not the fairest of all in the eyes of Linnaeus, but the GUERNSEY LILY, and the house of cards collapses.

The above very brief summary of progress toward solving a knotty problem, and correcting *a very great miscarriage of justice,* will serve as an introduction to the following announcement.

In recognition of his definitive research as very briefly and inadequately summarized above, W. L. Tjaden, of Kent, England, will receive the 1981 William Herbert Metal. His outstanding research provides a common ground for the final settlement of the unfortunate controversy. It can now be resolved to the satisfaction of all concerned

on a rational basis, unaffected by emotional issues. After all, true scientists are amenable to the recognition of the facts in the case, and will he guided accordingly.

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EDITOR'S MAIL BAG

Miss Margot Williams, Horticulturist, U. S. Plant Introduction Station, Glenn Dale, Maryland 20769 is working on the caryology of *Paramongaia weberbaueri* and wants to include *Pamianthe peruviana* and *P. cardenasii* in the study in order to determine the relationship of these two genera. Anyone having stock of the *Pamianthe* species is requested to write to Miss Williams.

Mrs. Lester Rountree, of Carmel Calif., the plant scientist and naturalist of international renoun, America's first woman environmentalist, died five days after her 100th birthday, Nov. 21, 1979. She is survived by three grandchildren and eight great-grandchildren. On her 100th birthday, she received congratulory messages from Governor Brown of California, and Queen Eliabeth II. She was known as "the seed Lady" for her donations of seeds to botanical gardens throughout the United States and Britain. She reported on The Desert Lily, *Hesperocallis undulata* in HERBERTIA 8: 149-151. 1941.

Your editor enjoyed a visit with Messrs. Randell K. Bennett of Pasadena, Calif., and James A. Bauml of Huntington Botanical Gardens, San Marino, Calif., on October 6, 1979.

Under date of December 20, 1979, Dr. William D. Bell, of Gainesville, Florida, writes "that on the evening of November 29, 1979, we had a tragic fire here. I had the use of one of my neighbor's two fiberglass greenhouses; both were totally engulfed in flames in less than two minutes. The fire was apparently due to a kerosene heater explosions within the greenhouses.

My losses were hundreds of my best Amaryllis species and a large number of fourth generation species hybrids; estimated for the latter in thousands of dollars, because all had pedigrees accessioned and would take years to duplicate. None were insured.

However, since the fire spread so rapidly, a number were dumped on the ground in the potting mix, but all plastic pots with labels were burned. When I saw the 30-foot flames I thought the hybrids were a *total* loss. But I now have confidence that at least some of the breeding lines can be reconstructed. I hope to identify them from floral traits, and whether or not the saved plants are fertile. Plants in that greenhouse represented a variety of crosses where I had been sucessful in transferring genes from low ferylilty "mules" through backcrossing, etc., to establish fertile populations.

I still have substantial numbers of plants in other breeding lines and did not lose species which were dormant at the time."

Your Executive Secretary, Dr. Thomas W. Whitaker, under date of March 3, 1980, was notified that he had been chosen as *Distinguished Economic Botanist,* to receive a suitably inscribed certificate at the forthcoming Annual Meeting of the *Society for Economic Botany.* Your Editor rests assured that he expresses the sentiment of all the members of the Society in congratulating him on the well-deserved honor for his helpful services as Economic Botanist to the peoples of the world.

In 1979 Dr. Whitaker, received another well-deserved honor when he was notified that his biography would henceforth be included in *Who's Who in America.*

ANTICARCINOGENETIC PROPERTIES OF **CRINUM** SPECIES

L. S. Hannibal, *4008 Villa Court, Fair Oaks, California 95628*

For many years it has been reported from Zanzibar and Tropical Africa that the natives there used crushed *Crinum* bulbs as a poultice or the juice as an antiseptic in treatment of tropical sores and tumors. Recent cancer screening tests by the USDA and the National Cancer Institute at Beltsville, Md., have found that several *Crinum* species contain traces of anticarcinogenetic compounds which show significant effects on mouse glandular leukemia. The latter is one of the best test-types used in the cancer screening processes.

One of the better *Crinum* species found was *C. amoenum* from northern India and Nepal, particularly the Napalese variant. Then in late 1979 examples of the South African Cape 'Belladonna Lily' were

tested with excellent results. This now opens up eventual tests on all allied genera including *Nerine, Bouphone, Ammocharis, Cybistetes* and *Brunsvigia.* It has been stated that Zephyranthes also indicate some benefit.

We understand that the bulbs are sliced and dried. And that the active agents are extracted with various organic solvents. Further details are not available but any effective anticarcinogenetic products will have world wide medical use. Those interested in Crinum may find some information of value in the Louisiana Society of Horticultural Research 'Crinum Bulletin'. The writer still has a few copies available. It describes the better known garden species and hybrids and indexes some 150 species and variants.

1. REGIONAL ACTIVITY AND EXHIBITIONS

1979 AMARYLLIS SHOW SEASON

The 1979 Amaryllis show season began on March 5-6 with the Amaryllis Society of Mobile Show, and continued on April 7-8 with the Amaryllis exhibits at Corpus Christi (Texas) of the Costal Bend Amaryllis Society. The Greater New Orleans Amaryllis Show was staged by the Men's Amaryllis Club of New Orleans on April 21st, and the Southern California Hemerocallis and Amaryllis Society Show took place on April 21-22. The Houston (Texas) Amaryllis Society Show was staged on April 22, and the Amaryllis Society of Alabama show was held on April 28-29. The 1979 show season ended with the New Orleans Intra-Club Amaryllis Show on May 5. Mrs. Humphrey's reports on Amaryllis at Western Australian Flower Shows.

NOTE TO AMARYLLIS SHOW ORGANIZERS

It is important to designate some one to write a *brief* review of the official show, and to send this promptly to Dr. Hamilton P. Traub, Editor. Amaryllis Year Book, 2678 Prestwick Court, La Jolla, Calif. 92037. *Your plans are not complete until this appointment has been made.* Only in this way is a permanent international record of your show assured.

GREATER HOUSTON AMARYLLIS CLUB

Mrs. Sally Fox, *Corresponding Secretary,*
Houston, Texas 77006

Most amaryllis growers in the Gulf Coast area enjoy the greatest amount of blooms around the first week after Easter Sunday, so when such a date is reserved for our annual amaryllis show we feel that we will have an abundance of entries. This year our Winter months were a seesaw of extremely cold then quite warm days. As a result, the amaryllis buds popped up early and at show date most of us had only a few blossoms left in our gardens. Since it takes many blooms from which to select a few that are show quality there just weren't sufficient entries to stage a show.

THE AMARYLLIS SOCIETY OF MOBILE 1979 SHOW

Mrs. Nell Keown, *Showperson,*
2210 Pratt Drive, Mobile, Al. 36605

The twenty-fifth annual show of the Amaryllis Society of Mobile was held on May 5-6, 1979 at Bel Air Mall, Mobile, Alabama.

We had to change the date of our show again this year because of prolonged cold weather. Since we don't advertise nationally and everything is done locally, we're fortunate to be able to reschedule our show.

The original date was for Apr. 14-15, but when it approached with very few blooms we reluctantly accepted the next open week-end which was May 5-6. One week earlier would have been perfect but as it turned out we had one of the largest & best shows that we've ever had.

This years "Best in Show" trophy went to Miss Mildred Laughlin for Ludwig's 'Picotee'. It had 3 scapes of slightly different heights with 12 open blooms. It also won the Ludwig Trophy.

Mr. & Mrs. C.E. Tagert won six trophies. The T.J. Swetman Trophy for a beautiful pale orange double seedling, the Claude H. Moore Trophy for a cut specimen of Apple Blossom, and four Amaryllis Society of Mobile Trophy's for the most blue ribbons in different categories.

Nell Keown won the Joseph S. Norton Sweepstakes Trophy in the horticulture division and two in hybridizers division.

'Orange King' won a silver trophy for Mamie Wiggins for the best named and registered, other than Ludwig, specimen in the show, and she also won an Amaryllis Society of Mobile Trophy for the best cut American specimen in the show.

Lois Koontz won the Wesley J. Marshall Sr. memorial Trophy for the most blue ribbons in the Dutch hybrid cut division.

Charlie Pierce, a non-member, who is becoming quite a hybridizer entered six potted seedling of the Leopoldii type and won blue ribbons on all six, one on the winners table.

Some of the blue ribbon winners were, Snow Queen, Minerva, Purple Queen, Golden Triumphator, King of Orange, Vintage and Margaret Rose.

We had more doubles seedlings this year than ever before. Some of them were real beauties.

We added a table this year for other amaryllids such as Clivias, Sprekelia etc. The single florets, for display only, was such a success last year that we had them again this year. Rosettes were awarded to the exhibitors for these.

Because it was our Twenty-Fifth show and we wanted it to be something special we arranged in the center of a table, beautifully decorated with green crepe paper, a huge arrangement of pink Amaryllis of all shades with green leather fern. In front of this there was a six inch "25th" with streamers made of glittering silver. On each end of the table were smaller displays of fern and small pink blooms. It was beautiful and drew a lot of attention.

From the interest shown by the public we feel that our Twenty-

Fifth Show was a real success. We hope it will continue for another twenty-five. Many thanks go to all those who participated in the show, and a special thanks to the judges.

John Keown was club President. Lois Koontz was Co-Chairman.

THE CORPUS CHRISTI (TEXAS) AMARYLLIS SHOW, 1979

Mrs. Carl C. Henny, *P. O. Box 3054, Corpus Christi, Texas 78404*

The Coastal Bend Amaryllis Society held it's annual Amaryllis Exhibit on April 7th and 8th, 1979, in conjunction with the Council of Garden Clubs "Festival of Flowers".

We, too, as in other states, had a very cold winter—including a hard freeze which affected many of our hardy plants within our yards. However, we were pleased to have 29 entries brought in by club members and non-members.

In the Pot-Grown—named and registered section, Mr. Duane C. Eckles scored 97 points for his entry of "Fantastica"; Mrs. Bill Miller scored 98 points for her entry of "Apple Blossom". Mrs. Miller also entered a potted plant named "Carina".

Mr. J. M. Mabe received the most blue ribbons in the Ludwig named potted plants—with his entries of "Gypsy Giant" and "Fire Fly", thereby receiving our "Silver Bowl Award".

Other named and registered specimens entered in our show were: 'Cardinal', Little Sweetheart, Sparkling Gem, Pixie, and 'Wedding Dance'.

Mr. Duane Eckles received an "Award of Merit" for his entry of "Fantastica" which was given by the American Plant Life Society. Also, Mrs. Bill Miller received an "Award of Merit" for her entry of "Apple Blossom," which was given by the American Plant Life Society.

Our Amaryllis Exhibit helped to make the "Festival of Flowers" Show more colorful. The "Rose Society" Display also had many beautiful specimens for the public to enjoy. Each year we hope to have a better display but, as you know, no one can control the weather—winter or summer.

1979 GREATER NEW ORLEANS OFFICIAL ALL-HORTICULTURE AMARYLLIS SHOW

L. W. Mazzeno, Jr.,
944 Beverly Garden Drive, Metairie, La. 70002

The Men's Amaryllis Club of New Orleans reached a milestone this year with its twentieth annual Amaryllis Show staged on April 21, 1979 in the Lakeside Shopping Center Mall in Metairie, Louisiana.

This year we no longer were besieged by the ravages of winter, although it was a cold one, nor an early Show date. As a result we were

rewarded with our greatest number of entries in several years, 250. Over half of the members of the Club were exhibitors. Thirty-two entries were made by non-members.

Our perennial winners, E. M. Beckham, A. T. Diermayer and Holly H. Bowers, Jr. had another field day carrying off 15 of the 22 trophies and awards.

Fig. 7. New Orleans 1979 Amaryllis Show. **Standing,** Mr. L. W. Mazzeno, Jr. Gen'l Chairman, Annual Show; **Seated,** Mr. A. T. Diermayer, Publicity Chairman & Special Award winner for most 1st place ribbons & most entries.

E. M. Beckham, with an exquisite "Picotee Petticoat", won the judges "Best-in-Show rosette and the Holly H. Bowers, Jr. Trophy. This specimen also netted the Milo C. Virgin Award for best-in-show selection by the members, the James E. Mahan Trophy and Award of Merit Rosette for the best registered and named hybrid, and the George Merz, Jr. Trophy for the best specimen registered and named in Amaryllis Division 4 and 5. His other awards included: the Edward F. Authement Trophy for runner-up to the best unnamed and unregistered hybrids; the T. A. Calamari, Jr. Trophy for most blue ribbons won by a Club member; and, the Sweepstakes Ribbon for most blue ribbons in the registered specimens categories.

A. T. Diermayer with 44 entries captured the W. J. Perrin Memorial Award for runner-up to the best registered and named hybrid with his "White Christmas". He also won the Reuter Seed Company, Inc. Award for best unregistered, unnamed hybrid. With a ruffled peach F_1 hybrid he was awarded the Amaryllis, Inc. Trophy; for best unregistered 2-floret potted specimen, the Nola Luckett Trophy. For his overall participation and accomplishment he was given a special Sweepstakes Ribbon for most first place ribbons and most entries in the Show.

Holly H. Bowers, Jr. still one of our most prolific exhibitors with 29 entries, was awarded the Gautier Family Trophy for best 2-floret registered specimen "White Cat", the Oscar J. Robert, Sr. Trophy for best potted 3-floret specimen "Glorious Victory", and the Sweepstakes Ribbon for most blue ribbons in the unregistered categories.

The most prestigious award, the Robert Diermayer Memorial Trophy for best breeder's hybrid went to Oscar J. Robert, Sr. There could not have been a more fitting recipient than the grandfather of the honoree.

Other awards were: the Laurence Mazzeno, Jr. Trophy for best gracilis, to T. A. Calamari, Jr. "Melody Lane"; Lester L. Laine Trophy for best potted specimen doubleflower to Albert Touzet, Jr.; Southern Seed and Popcorn Co. Trophy for best cut flower to Albert Touzet, Jr.; Vincent Peuler Trophy for best registered single floret to T. A. Calamari, Jr. "Floriade"; Jerome Peuler Trophy for best unregistered single floret to Walter Latapie Sr. for a beautiful double specimen; Victor Pannell Trophy for runner-up to the best registered 2-floret specimen to L. W. Mazzeno, Jr. "Apple Blossom".

In addition the following won blue ribbons: Club members: Jake Schmidt, Emile Flauss, Vincent Peuler, Victor Pannell, Lester L. Laine, L. W. Mazzeno, Sr., Jerome Peuler; non-members: Carl Decker, Mrs. J. McCaskill, Timmy Calamari, Mrs. Catherine van Geffen.

As General Chairman of this year's Show I extend grateful thanks to all who had a part in this Show. It is only through the efforts of many people that such a venture can be successful. Again, A. T. Diermayer skillfully handled publicity coverage in major national gardening magazines, local newspapers, radio and television stations. Mr. Diermayer and I appeared on the Garden Show on public television station WYES in New Orleans to describe Amaryllis and their culture.

To my Co-Chairman, Jerome E. Peuler, who handled so many chores to make my job easier and to so many others too numerous to mention here, my sincere thanks. Each year we are fortunate in having dedicated judges who perform so admirably. And, to the donors of our trophies also we give thanks. These trophies are really the frosting on the cake. They make the Show. Last and by no means least to our long suffering wives who put up with us fussing over the flowers for weeks prior to the Show we offer our appreciation. As one wife put it, she would like to be pampered for two months like the Amaryllis are.

And now, to all members of the American Plant Life Society and our many other friends we extend a hearty invitation to you to attend our next Show scheduled for the same location on April 19, 1980.

SOUTHERN CALIFORNIA HEMEROCALLIS AND AMARYLLIS SOCIETY SHOW, 1979

KENNETH MANN AND ED PENCALL, *Show Co-chairmen, 2195 E. Orange Grove, Pasadena, Ca. 91104*

The fifteenth annual show of the Southern California Hemerocallis and Amaryllis Society was held at the Los Angeles State and County

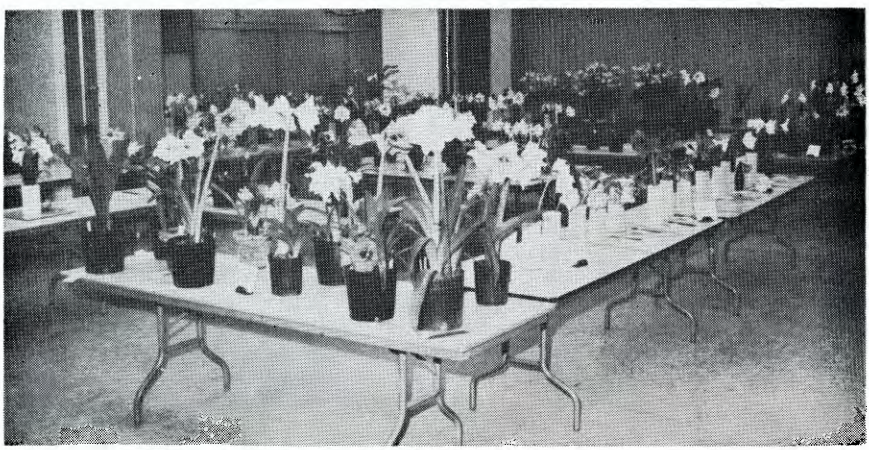

Fig. 8. Exhibits at Southern California Amaryllis Show, 1979. Photo by Philip Rosoff.

Arboretum Lecture Hall in Arcadia on April 21 and 22. Due to the cold weather the number of flowers entered was smaller than usual, and they were not of their normal quality. Even the amaryllis grown in greenhouses were in limited supply. The greenhouse at the Huntington Botanical Gardens, for example, was only able to provide ten en-

tries. On many of the entries grown outside, the first scape would be very short and the flowers small, while the second scape, if any, would be normal. It was determined by the Senior Judge, Gladys Williams,

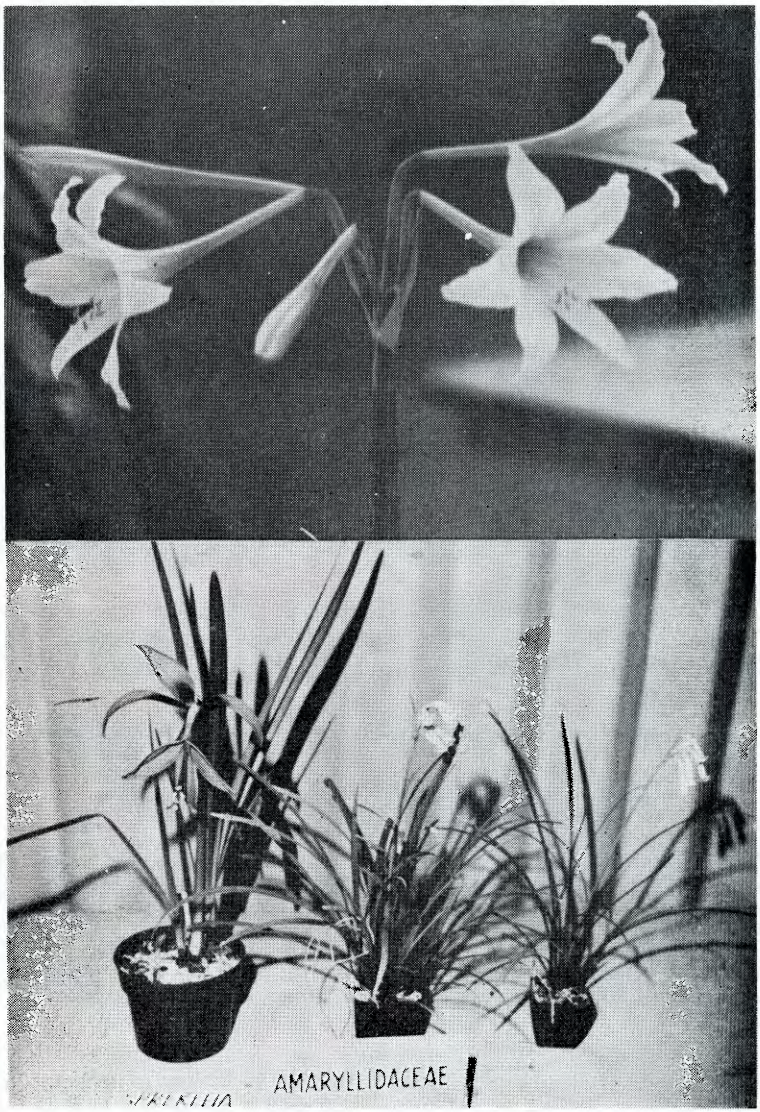

Fig. 9. Exhibits at Southern California Amaryllis Show, 1979. **Upper, Amaryllis fragrantissima** exhibited by Leonard Doran; **Lower, Sprekkelia formasissima** forma **williamsli,** and **Cyrtanthus** sp., exhibited by Fred Boutin of Huntington Gardens. Photos by Philip Rosoff.

with full concurrence of the Co-chairmen, that the Show would not be accredited.

There were approximately eighty flowers exhibited, and of these Dee Cothran, with his usual marvelous touch, provided forty. When no one else can do it, he sure can. He does all this with one small greenhonse which he built himself! Ed Pencall provided twenty entries, Fred Boutin ten. Additional entries came from Herman Mathis, Sterling Harshbarger, Leonard Doran, and Kenneth Mann. (The exhibit is displayed in Figure 8).

Two awards were presented for the Show: Fragrantissima, exhibited by Leonard Doran, won the Judge's Award for the best flower in the show as shown in Figure 9. Dee Cothran won the Hybridizer's award for the best seedling. Each received a Limoges vase as a prize.

Dee Cothran's 'Double Beauty' won the popularity poll.

First place ribbons were awarded to entries exhibited by Dee Cothran, Leonard Doran, Fred Boutin, and Ed Pencall.

Herman Mathis provided a large number of background flowers which were sorely needed this year. Additional background flowers came from the Huntington Botanical Gardens.

Ed Pencall and Fred Boutin donated plants to the Society for sale at the Show.

Fred Boutin exhibited several plants in bloom of the Amaryllidaceae family from the Huntington Botanical Gardens. Among these was a deep red *Sprekelia formosissima* f. *williamsii,* as shown in Figure 9.

Pictures were provided by Phillip Rosoff.

While the judges did not think the flowers were of show quality, the visitors found the Show to be very pleasing and exciting.

HOUSTON AMARYLLIS SOCIETY SHOW, 1979

Mrs. A. C. Pickard, *Official Show Chairperson, 1909 Alta Vista, Alvin, Texas 77511*

The Houston Amaryllis Society official Annual Show was beautifully staged at the Garden Center, Houston, Texas April 22, 1979. Honorary Chairperson, Mrs. Troy Wright (President); Flower Show Chairperson, Mrs. Ward Blair (Vice-President); Staging Chairperson, Mrs. R. L. Culpepper; Artistic Chairperson, Mrs. E. W. Blankenship; Classification Chairperson, Mrs. L. E. Morgan; Entries, Mrs. W. W. Birch; Publicity, Mrs. A. A. Brittian.

Theme of the Show, "Yesterday, Today and Tomorrow". The goal of the Society is knowing, growing, showing and sharing. After surviving over a period of 22 years the many uncertain weather conditions conducive to growing show material, the Society showed courage and horticultural skills in their efforts to stage a surprisingly educational show. Many specimens were blue ribbon winners, judged by official Amaryllis judges and staged according to the nine divisions, as

defined by the American Amaryllis Society, with separate sections for new bulbs and those in possession more than one year.

The length of possession for Breeders class is not a requirement but must be raised by exhibitor from seed. A special feature was the impressive section of Amaryllis arrangements, non competitive under the direction of the Artistic Chairman, Mrs. E. W. Blankenship.

The Educational special exhibit, as usual, was a great attraction. A bountiful display of all methods of bulb propagation from seed to clone, with some plants of the Amaryllidaceae family added for contrast. Mrs. A. L. Hammond, Chairman.

The awards and blue ribbon winners were: Queen of Show—Picotee Petticoat, Div. 4A—award to Mrs. A. F. Legaski. Apple Blossom, Div. 5—award to Mrs. L. E. Morgan. Rilona, Div. 5—bulb less than one year possession—award to Mrs. Troy Wright. Little Sweetheart, Div. 8—Miniature Gracillis, Mrs. E. H. Blankenship. Johnsonii, Div. 3—Mrs. A. A. Brittian.

In Breeders Class, blue ribbon awards were made to Mrs. Troy Wright, Mrs. L. E. Morgan, Mr. Duncan Thomas.

Other blue ribbon winners with a score over 90 were awarded to Mrs. John Williams, Mrs. L. E. Morgan, and Mrs. A. C. Pickard for a miniature.

Successful exhibiting demands early preparation, regardless of weather. Potted plants may be easily timed as to blooming date. By good selection, careful handling and following a systematic procedure from bulb to bloom, one can make exhibiting fun.

An Amaryllis clone deserves knowing, growing, showing and sharing.

THE AMARYLLIS SOCIETY OF ALABAMA, 1979 SHOW

Mrs. H. R. (Mittie) Young, *President,*
303 Hillside Dr. Chickasaw, Ala. 36611

After two weeks postponement, THE AMARYLLIS SOCIETY OF ALABAMA, INC., held its nineth annual show, April 28th and 29th 1979, with two hundred and two (202) entries and the largest attendance we have ever had.

The following trophies were awarded to Mrs. C. E. Tagert: Chavis Furniture Co., trophy, Claud H. Moore Memorial trophy, for outstanding horticultural specimen, a beautiful double orange seedling. Emile Scheurmann Memorial trophy. The Amaryllis Society of Ala. Inc. trophy, Martha Burdette Memorial trophy, T. J. Swetman trophy, Vincent Kilborn Memorial trophy, C. E. Tagert Sr. trophy, The Little Glass Shack trophy, C. E. Tagert Sr. trophy, and The Amaryllis Society Of Ala. Inc. trophy. The following trophies were awarded to Mrs. Lois Koontz: President's award, for an outstanding Dutch seedling. The Wilmer Smith trophy, for the most outstanding potted specimen in the show (seedling). American National Bank trophy, for the best named Dutch potted specimen in show, 'Golden Triumphator. Mr. and

Mrs. H. P. Wheat trophy, First National Bank of Mobile trophy, Merchants National Bank of Mobile trophy, C. E. Tagert trophy, Claudine Pierce trophy.

The following trophies were awarded to Mrs. Massingill: Sully's Drive In trophy, Mittie Young trophy and Velma Thompson trophy. The following trophies were awarded to C. Pierce: Central Bank of Mobile trophy and Mae Brown trophy.

The following trophy was awarded to Nell Keown: The Amaryllis Society Of Alabama, Inc. trophy. Continuing their success as in the past, Mrs. Tagert won the most awards and Mrs. Koontz was second.

Other Club Members and friends winning blue ribbons were, Velma Thompson, Fred Fambrough, Jimmie Dean, Marie Cantrell, Wilmer Smith and Vivian Smallwood.

Thanks to Mr. Dewey Hardy for setting up a very educational hobby table, for which he was awarded the Mae Allen trophy.

I wish to thank all the people who helped to make our show a success. I especially wish to thank our Sponsors, for with out their help, we could not have had a show. And, thanks to all our Mississippi Judges. I also wish to thank the city of Chickasaw, Ala. for making the Civic Center available to us for our meetings and our show each year.

Thanks to the Club for my past President plaque. I will cherish it always.

Footnote: We organized our club in Sept. 1967 and elect new officers every two years. All our past Presidents attended our 1979 Show. Inez Palmer 1967-1969, Dewey Hardy 1969-1971, Cecil Bates 1971-1973, Mae Allen 1973-1975, Velma Thompson 1975-1977 and Mittie Young 1977-1979.

1979 NEW ORLEANS INTRA-CLUB AMARYLLIS SHOW

L. W. Mazzeno, Jr.
944 Beverly Garden Drive, Metairie, La. 70002

One of the highlights of the monthly meetings of the Men's Amaryllis Club of New Orleans is the annual Intra-Club Show. This year, our seventh Show, was held on May 5, 1979, in the Backer Room at City Park. This Show is always held in a relaxed style. Without the hustle and bustle that goes on at the formalized annual Show, the members can take it easy and just enjoy the flowers. Entries were down from last year because of the late date of the Show. However, there were enough blooms to make it interesting.

Winners were: best 4-floret specimen, A. T. Diermayer's "Bianca"; best 3-floret specimen, George Merz Jr's "Apple Blossom"; best 2-floret specimen, Vincent Peuler's "Queen of Sheba". The Club's annual Show was held on April 21, and is reported separately.

AMARYLLIS AT WESTERN AUSTRALIAN FLOWER SHOWS, 1979

EVELYN HUMPHREYS,
23 Colin Street, Redlands 6009, Western Australia

American Amaryllisarians may be interested to know that my Hybrid *Amaryllis,* tetraploids included, proved very successful at the recent spring shows. I won the Championship with four pots at the Royal Show, an annual affair akin to your State Fairs, I believe; and five firsts and one second, Champion pot, and Champion cut out of six classes at the State Gladioli and *Amaryllis* (Hippeastrum) Championships; also three firsts; one second and one third (to myself) at the Iris and Amaryllis (Hippeastrum) Show. These were mostly flowers from small bulbs which Prof. Ten Seldam brought back from Holland in 1976, but some of my own seedlings were included.

When the presentations were being made at one of the shows, it was remarked that there has been a great upsurge of interest in Amaryllis (Hippeastrums), undoubtedly sparked by the introductions from overseas. Some exhibitors had been showing the same bulbs, not modern hybrids, for forty years, but they now feel very much out of it, since they are judged together. Now the general opinion seems to be that growers are not going to be bothered growing the older types now that they have been exposed to the modern hybrids.

It might be of interest to know that the Amaryllis (Hippeastrum) which takes everybody's fancy—someone took some of the anthers at the Royal Show—is a dark velvety red, selfstriped, merging to satin in the throat. This I grew from Van Tubergen seed in 1971; flowering it in 18 months, a feat which I haven't managed to equal since. There are still some unflowered seedlings, so I am hoping for pleasant surprises.

NEW FORM FOR OFFICIAL AMARYLLIS JUDGE'S CERTIFICATE

HAMILTON P. TRAUB

The late Mrs. W. D. Morton of New Orleans furnished the form for the Official Amaryllis Judge's certificate and it has served its purpose well. We are indebted to Mrs. Morton for her contribution. However the time has arrived to simplify the process.

The new form is reproduced on the following page. The Official Amaryllis Examinations instructors will make copies of this form by the inexpensive xerox process which is now easily available. After the examinations have been held, the necessary data for those completing the tests satisfactorily, will be entered in these copies which will be sent on to the Executive Secretary or Editor. The needed data will be copied for reporting in PLANT LIFE. The signed certificates will be numbered and sent back to the instructors for delivery to the judges.

THE AMERICAN AMARYLLIS SOCIETY
AFFILIATED WITH
THE AMERICAN PLANT LIFE SOCIETY
Box 150, La Jolla, Calif. 92037

OFFICIAL AMARYLLIS JUDGE'S CERTIFICATE
OF THE AMERICAN AMARYLLIS SOCIETY

TO WHOM IT MAY CONCERN: This is to certify that

_____

HAVING SATISFACTORILY PASSED THE EXAMINATION FOR THE AMARYLLIS JUDGE'S CERTIFICATE, is hereby designated as an OFFICIAL JUDGE IN THE AMARYLLIS GROUP.

Check: Horticulture only ..... Flower arranging .....

Examination date ..... Signed: .....
Official Judging Instructor

Issued on the ..... day of .....

CERTIFICATE NO. ..... Signed: .....
Executive Secretary or Editor

Fig. 9a. The new form for the Official Amaryllis Judge's Certificates. This form will be used by the Official Amaryllis Judging Instructors as explained in the article on the preceeding page.
This caption is to be covered when xerox copies are made.

SUGGESTED STANDARDS FOR JUDGING DOUBLE AMARYLLIS

WALTER R. LATAPIE, *Amaryllis Grower & Hybridizer, 3737 Elysian Fields Avenue, New Orleans, La. 70122*

To begin with, these Amaryllis are just now coming into their own, inasmuch as some breeders are now experimenting with them. The doubles should be appearing more and more in shows. Therefore, it is now necessary to acquaint the judges with their characteristics and features.

SIZE OF FLOWER

Single or Regular .....6 petsegs and setsegs (normal ovary)
Semi-Double .....9-11 petsegs and setsegs (normal ovary)
Double .....12-17 petsegs and setsegs (normal ovary)
Super Double .....18 & over petsegs and setsegs (normal ovary)

SIZE OF SCAPE

The size of the scape on Double Amaryllis is generally 10″ to 15″ in height; however, they do have longer scapes at times.

CHARACTERISTICS

Generally, about 90% of the doubles will have two florets to the scape. The first floret will open to near maximum before the second one opens. Never should the judges expect to find less than two florets on a scape. Also, the floret may not have a normal pistil and pollen anthers.

The entry can be judged as perfect when it has two florets if one floret is open and the second in bud or starting to open. In cases where the first floret passes its peak before the second reaches its peak, this flower should not score a blue ribbon.

Care should be exercised not to judge a twin-ovary flower as a double, and also not be fooled by some freak flowers.

EXECUTIVE COMMITTEE ACTION, 1979

The Executive Committee of the American Plant Life Society has duly considered Mr. Walter R. Latapie's recommendation with reference to scoring double hybrid Amaryllis at official Amaryllis Shows, and has endorsed it in essence as follows:

DIVISION 7. DOUBLE HYBRID AMARYLLIS (D-7)

This division includes the following major exhibition classes, which are to be subdivided into color subclasses: (a) Semi-double class, 9-11 segs per floret, and the fully double exhibition classes (b) 11-17 segs per floret, and (c) 18 or more segs per floret.

The classes are rated according to the 1977 Score Card (see Picard, Plant Life 1979, pp. 38-40), excepting that *2 or more florets per umbel* are acceptable, and the characteristics indicated by Mr. Latapie above are to be considered in judging.—*Hamilton P. Traub*

AMARYLLIS JUDGE'S CERTIFICATES

Since the last report in the 1979 PLANT LIFE (page 41), the following numbered Amaryllis Judges Certificates have been issued:

At the November 15, 1979 Amaryllis Judge's School, New Orleans, Louisiana, the following named persons passed the examination and certificates have been issued:

204. Dr. Timothy A. Calamari, Jr., 1016 Rosa Ave., Metairie, Louisiana 70005. Horticulture only; refresher course.

205. Mrs. W. Alvin Caserta, 1502 Florida Ave., Slidell, Louisiana 70458. Horticulture only, refresher course.

206. Mrs. Felix de Boisblanc, 6925 Colbert St., New Orleans, Louisiana 70124. Horticulture only, new Amaryllis judge.

207. Mrs. Ernest L. Joubert, III, 6229 Carlson Dr., New Orleans, Louisiana 70122. Horticulture only, new Amaryllis judge.

208. Mrs. George E. Jones, 4969 Metropolitan Dr., New Orleans, Louisiana 70126. Horticulture only, new Amaryllis judge.

209. Mrs. John J. Kieffer, 6501 Weurpel St., New Orleans, Louisiana 70124. Horticulture only, refresher course.

210. Mrs. E. F. Lehrmann, 2201 Paris Road, Chalmette, Louisiana 70043. Horticulture only, refresher course.

211. Mrs. E. F. Rathke, 2337 Killdeer St., New Orleans, Louisiana 70122. Horticulture only, refresher course.

212. Mrs. Louis Ruello, 7800 Mullet St., New Orleans, Louisiana 70126. Horticulture only, new Amaryllis judge.

213. Mrs. F. J. Steckler, 4556 Marque Dr., New Orleans, Louisiana 70127. Horticulture only, new Amaryllis judge.

At the March, 1980 examinations held by Mrs. Gladys L. Williams, Rosemead, Calif., the following qualified for the Judge's Certificate:

214. Mr. Earl E. Martin, 649 North Lake Av., Pasadena, Calif. 91101. Horticulture only.

215, Mrs. Alice Hanson, 2305 W. Silverlake Dr., Los Angeles, Calif. 90039. Horticulture only.

216. Mr. Endicott Hanson, 2305 W. Silverlake Dr., Los Angeles, Calif. 90039. Horticulture only.

217. Mr. C. D. Cothran, 1733 N. Gibbs St., Pomona, Calif. 91767. Horticulture only.

2. LINEAGICS

[BIOEVOLUTION, DESCRIPTION, DETERMINING RELATIONSHIPS, GROUPING INTO LINEAGES]

THE SUBGENERA OF THE GENUS **AMARYLLIS** L.

HAMILTON P. TRAUB

Baker (1888) based his grouping of the large-flowered species of his Genus *Amaryllis* L. upon the earlier work of Salisbury (1866), and Traub (1958) elaborated on the Baker base so as to follow an evolutionary sequence on four levels:

(1) Trumpet-shaped to funnel-shaped, campanulate and finally to markedly irregular flowers;
(2) Flowers without a paraperigone, or with a paraperigone of inconspicuous bristles, etc., to a conspicuous incurved paraperigone closing in the throat;
(3) Stigma trifid to stigma shortly 3-lobed (capitate) or rounded (capitate); and
(4) Ovules and seeds flat, many per locule, or ovules and seeds round, few or 1 or 2 in each locule.

According to these evolutionary patterns, the following grouping is indicated in the key to the subgenera:

1a. Flowers extremely long, trumpet-shaped:

I. SUBGENUS **MACROPODASTRUM** (Salisb.) Baker

Stigma trifid or capitate.

1b. Flowers shorter, funnel-shaped, campanulate or extremely irregular:
2a. Ovules and seeds flat, numerous in each locule:
3a. Paraperigone, if present, then inconspicuous bristles, scales etc.
4a. Stigma trifid:

II. SUBGENUS LAIS (Salisbury) Baker

4b. Stigma shortly triangularly 3-lobed (capitate) or rounded (capitate):

III. SUBGENUS **ASCHAMIA** (Salisbury) Baker

3b. Incurved paraperigone closing in the throat of the perigone:

IV. SUBGENUS **OMPHALISSA** (Salisbury) Baker

2b. Ovules and seeds few, round, or round, 1 or 2, in each locule:

V. SUBGENUS **SEALYANA** Traub (1938)

The foregoing remarks are to serve as an introduction to the discussion of the basic characters to be used in describing new *Amaryllis*

species. Unfortunately, in the past various species have been described without indicating essential features. Over the years, the following named species were described without indicating the paraperigone, *A. harrisonii, A. canterai, A. crociflora, A. flammigera,* and *A. scopulorum.* The nature of the stigma is not indicated for *A. kromeri* and *A. fusca.*

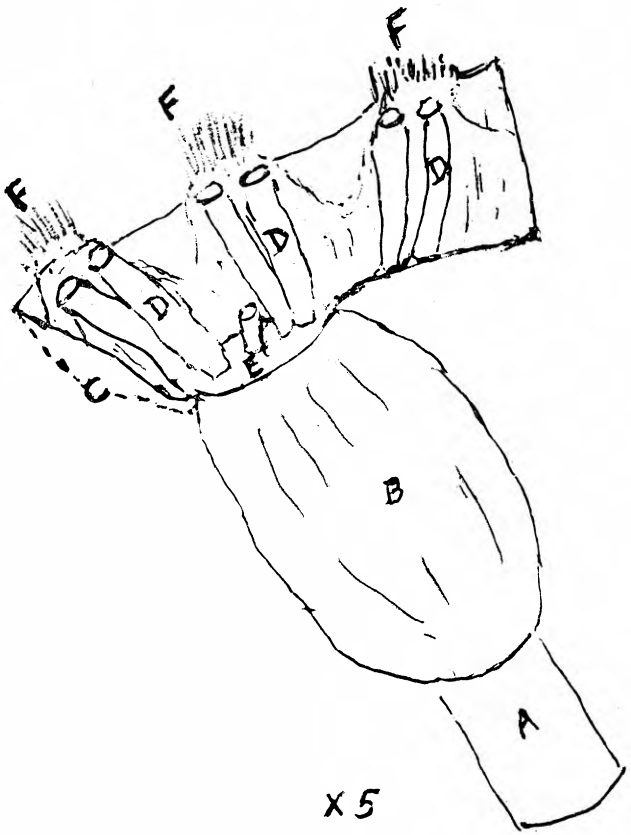

Fig. 10. **Amaryllis angustifolia** (Pax) Traub & Uphof. **A,** top section of **pedicel; B, ovary; C,** basal section of **tepaltube,** cut at the base, bottom in front half, and opened to the right; **D, basal sections** of **stamen filaments; E, basal section** of **style;** and **F, paraperigone** of **bristles** inside the tepaltube.

Thus, these species have to be placed tentatively under subgenera awaiting the publication of the missing data.

IMPORTANCE OF THE NATURE OF THE PARAPERIGONE

Recently it has been suggested that *Amaryllis angustifolia* belongs in the Subgenus *Omphalissa* on the basis of the irregular flowers.

As shown in the key to the subgenera of the Genus *Amaryllis* above, the character of the *irregular flowers* is not decisive in this instance. It is the presence of the *obscure paraperigone of bristles* as shown in Fig. 10, together with the trifid stigma that places it securely in the Subgenus *Lais*. It could never be placed in the Subgenus *Omphalissa* which would require an *incurved paraperigone closing in the throat.*

This led the writer to investigate the nature of the paraperigone in *Amaryllis cybister* which revealed that it has a paraperigone of obscure bristles, and a shortly 3-lobed (capitate) stigma. Thus, it too has to be transferred *from* the Subgenus *Omphalissa* to the *Sub*-genus *Aschamia.*

Those who describe new *Amaryllis* species should not consider their obligations completed until the paraperigone, if present, is deliniated as shown in Fig. 10. If possible, the whole flower with ovary intact, and upper part of pedicel attached should be selected. This is cut lengthwise at the middle beginning at the large petepalseg on through to the middle of the lower narrower setepalseg and spread out between two small plastic sheets, and dried between blotters under pressure as recommended by Traub (1950, 1951). With this preparation as the basis, the paraperigone, if present, may be drawn as shown in Fig. 10.

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SECTIONS AND ALLIANCES, GENUS **HYMENOCALLIS** SALISB.

HAMILTON P. TRAUB

Since my article on the grouping of the subgenera, alliances and species of the Genus *Hymenocallis* Salisb., was published (Traub, 1962), Ravenna (1969) has transferred the Genus *Hyline* to the Genus *Griffinia,* and the new *Quitoënsis Alliance* (Traub, 1975) has been recognized. These changes make it desirable to present a *definitive classification* of the sections and Alliances of the Genus *Hymenocallis.* The grouping of the sections, alliances and species of this genus ranks among the more difficult problems in lineagics.

I. CARYOLOGICAL AND OVULAR CONSIDERATIONS

It is evident (Traub, 1962, 1963, Flory, 1975) that the chromosome number of *Hymenocallis quitoensis,* 2n=24 (n=12) contrasts markedly with the chromosome numbers in the rest of the species, 2n=38, 40, 44, 46, *48* and higher, indicating that *Hymenocallis quitoensis* 2n=24 is the one remaining relict and x=12 is the basic number of the Genus *Hymenocallis.* This fact is further reflected in the primitive *18—20* ovules per locule (*54—60* ovules per 3-loculed ovary) in *Hymenocallis quitoensis* as contrasted with *1—10* ovules per locule (*3—30* ovules per 3-loculed ovary) in the rest of the species.

II. BREEDING BEHAVIOR

As indicated (Traub, 1962), crosses between species of the subgenera and sections within the genus have been made, indicating close relationship. This helps to explain the relatively small variations in morphology within the Genus *Hymenocallis.*

III. MORPHOLOGICAL DIFFERENCES

As shown by the difference in the number of ovules per locule above, the species of *Hymenocallis* rank among the most difficult to classify on the basis of morphological characters. These are in many cases quantitative, subtle and often elusive. It is only after living with these species for over a half century that these are now better understood—number of ovules per locule, sessile and petioled leaves and variations in between, straight or reflexed staminal cup, upright or pendulous flowers, stamens straight or incurved, anthers introrse or extrorse; ovary globose or oblong, and other subtle variations.

IV. GENUS **HYMENOCALLIS** Salisb.

In Trans. Hort. Soc. 1: 338. 1812; Herb. Amaryll. 209-240. 1837; Baker, Amaryll. 120-127. 1888; Sealy, Kew Bull. 201-240. 1954; Traub, PLANT LIFE *18*: 55-72. 1962; Traub, Gen. Amaryll. 74-76. 1963.

Syn.—*Pancratium speciosum* L. f. ex Salisb., in Trans. Linn. Soc. 2: 73, pl. 12. 1794: *Ismene* Salisb., in Trans. Hort. Soc. I: 342. 1812; *Choretis* Herb. Amaryll. 219-222. 1837; *Nemepiodon* Raf. Fl. Tellur.

4: 1836 (1838); *Siphotoma* Raf. *i. c; Tomodon* Raf., *i. c; Troxistemon* Taf., *i. c.* 23: *Elisena* Herb. Amaryll. 201-202. 1837: *Leptochiton* Sealy, Bot. Mag. 160, pl. 9491. 1937; *Pseudostenomesson* Velarde, in Rev. Cienc. 51: 47. 1949.

Nomenifer: *Hymenocallis speciosa* (L. f. ex Salisb.) Salisb., in Trans. Hort. Soc. *1*: 340. 1812; syn.—*Pancratium speciosum* L. f. ex Salisb., in Trans. Linn. Soc. *2*: 73, pl. 12. 1794.

KEY TO THE SPECIES

The Key to the Species (Traub, 1962) is still valid, and those interested in their identification should consult the earlier article. Species described since 1962 will be found in PLANT LIFE issues published after that date.

KEY TO THE SECTIONS AND ALLIANCES OF THE GENUS **HYMENOCALLIS** SALISB.

The purpose of the present article is to provide a key to the sections and alliances of the Genus *Hymenocallis* on a sound basis from an evolutionary viewpoint. All the background material will be included in the text on the Amaryllidaceae now in preparation.

KEY TO THE **SECTIONS** AND **ALLIANCES** OF THE GENUS **HYMENOCALLIS**

1a. Stamens more or less straight (**except** incurved in **Quitoensis Alliance** see 4a. below):

2a. Flowers **not** pendulous:

3a. Staminal cup always straight, never deflexed:

SECTION I. HYMENOCALLIS

4a. Ovules 18—20 per locule, umbel 1-flowered; stamens incurving, chromosomes 2n=24, staminal cup extremely wide. leaves sessile:
Ecuador .....**ALLIANCE 1. QUITOENSIS**

4b. Ovules 1—10 per locule, umbel 1—20-flowered, stamens straight, chromosomes 2n=38—74 and higher:

5a. Leaves sessile; never with well-developed petioles; at most sub-petiolate in **Mexicana Alliance,** in lower part, and then usually variable on the same plant:

6a. Leaves **not** narrowly or broadly elliptic, or broadly oblanceolate or sub-petiolate:

7a. Anthers extrorse, versatile; leaves usually evergreen, rarely deciduous; suboblong, or broadly oblong-sword-shaped or oblong oblanceolate or sword-shaped; apex acute or obtuse or rounded; tapering downwards below the middle to lorate in basal part; 2—10.6 cm wide at the greatest width:

8a. Tepalsegs **not** shortly adnate to the base of the staminal cup; leaves 3.5—10.6 cm. wide, ovules 2,3,4,5,6, per locule. So. Amer. Guat. W. I., penninsular and w. Fla. .....**ALLIANCE 2. CARIBAEA**

8b. Tepalsegs shortly **adnate** to the base of the staminal cup; leaves 1.4—7.4 cm. wide, ovules 4,5,6,7,8,10 per locule. Colombia, Guiana, Mexico, escaped in W. Afr. .....**ALLIANCE 3. LITTORALIS.**

7b. Anthers introrse, more or less erect at anthesis, **not** versatile; leaves deciduous, linear, or linear-lorate to broadly lorate or ensiform, or oblanceolate, shortly tapered to the base, or tapered below the middle and noticeably narrowed in lower part, **or** rarely long oblong, biflabellately arranged; (0.8)—1.3—4.6 cm. wide at the greatest width:

9a. Ovary globose, rarely somewhat oblongish; **ovules 1—2, rarely 3 (in 1 species 4—5) per locule.** Ala., Ga., Tex., Okla., Ark., Mo., La., S. C., N. C., Tenn., Ill., w. Fla., Ky. .....**ALLIANCE 4. CAROLINIANA**

9b. Ovary oblong or somewhat pyriform; (1.4)—1.8—2.5— cm. long; **ovules 6—9, rarely 3—5, per locule.** Cuba, Peninsular, e. and coastal Fla. .....**ALLIANCE 5. HENRYAE**

6b. Leaves deciduous, sub-linear, bluntly acute, or broadly-elliptic, shortly acuminate, cuenate at base, or elliptic-lorate, obtuse or oblanceolate, bluntly acute, or suboblong, apex obtuse, or oblong-ensiform or oblong-elliptic, or oblong-ensiform, acute, tapering to a sub-petiolate base, but not constant; **ovules usually 2, rarely 3, per locule. Mexico** .....**ALLIANCE 6. MEXICANA**

5b. Leaves with well-developed petioles; **ovules 1—2 per locule.** So. Amer., Brasil, W. I. Guat. Mex. ..**ALLIANCE 7.SPECIOSA**

3b. Staminal cup at first straight, but finally permanently deflexed at right angles with the tepaltube and the ovary. Peru: Ecaudor:

SECTION 2. **ELISENA** (Herb.) Traub, **comb. nov.**

Syn.—Genus **Elisena** Herb. Amaryll. 201-202. 1837; subgenus **Elisena** Traub, PLANT LIFE **18:** 68. 1962; Gen. Amaryll. 76. 1963, PLANT LIFE **21:** 96. 1965. Ecuador, Peru.

2b. Flowers pendulous, relatively small, green or whitish green. Peru

SECTION 3. **ARTEMA** Traub. **sec. nov.**

Generis Hymenocallis Amaryllidacearum nov. floribus parvis viridibus albido-viridibusve; species typica Hymenocallis morrisonii (Vargas) Traub. Nomenifer: **Hymenocallis morrisonii** (Vargas) Traub, PLANT LIFE **21:** 96. 1965. Syn.—**Stenomesson morrisonii** Vargas, Nat. Hort. Mag. Oct. 1943, p. 132, pl. 3. Peru. Syn.—Genus **Pseudostenomesson** Velarde, in Rev. Cienc. **51:** 47. 1949; Subgenus **Pseudostenomesson** (Velarde) Traub. PLANT LIFE **18:** 68. 1962; Traub, Gen. Amaryll. 76. 1963, PLANT LIFE **21:** 96. 1965.

1b. Stamens incurved. Peru, Bolivia, Andes:

SECTION 4. **ISMENE** (Herb.) Traub, **comb. nov.**

Syn.—Genus **Ismene** Salisb. in Trans. Hort. Soc. **1:** 342. 1812; subgenus **Ismene** (Salisb.) Bak. ex Traub, PLANT LIFE **18:** 69. 1962; Gen. Amaryll. 76. 1963; PLANT LIFE **21:** 96. 1965. Peru and Bolivia.

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A **CRINUM** FROM NEPAL

Q. M. Stephen-Hassard

On December 4, 1971 with a party of seven Americans and Sherpas, we camped the first night of a trek to the Annapurna Mountains at a place called HYANGIA pronounced and sometimes spelled HENJA. It is situated about 4 miles northwest of POKHARA. A detailed map gives its altitude as 2,997 feet. It is the gateway to the western Himalayas for travelers coming from Kathmandu. About 2 miles southwest of town is the airport and nearby Lake Pokhara at 2,572 feet.

I wrote in my diary "We are camped in a little cultivated area surrounded by rocks. The foothills are above us and the mountain - Machupachari - beyond them. The climb up here was a good workout, with the hot sun beating down. With the sun set, it is cold now. We are on a main road (actually a jeep trail) which passes through many villages with much travel. We were never alone on the road." The map gives the altitude of Henja as 3,500 feet. *There was no frost.* Our latitude was about 500 miles south of San Diego.

That night I was sick, as were most of the other members of the party, so next morning I did not look around before leaving. We camped again here on December 25, 1971, on our return. I wrote "As I climbed over the wall into the camping area (a dry rice paddy) I spotted some leaves which had been eaten by goats, but there was no mistaking their amaryllid-like appearance. I obtained 2 good bulbs. They were difficult to dislodge from under the rocks. I gave 2 mutilated bulbs to Lillian (one of our party who took them to Arizona where I heard she passed them on to someone else since they did not grow for her.) I found no more bulbs though I did not have time to make an extended search in the morning. I believe the bulbs grew originally in the area of the rice paddy and, when it was cleared, the bulbs were tossed aside along with the rocks. They probably had not bloomed for many years since the animals would not have been likely to let them reach full growth.

There was no rain during our trip and I do not think there is much before the arrival of the monsoon in the spring. At that time I have read that the weather becomes very hot and humid in Pokhara.

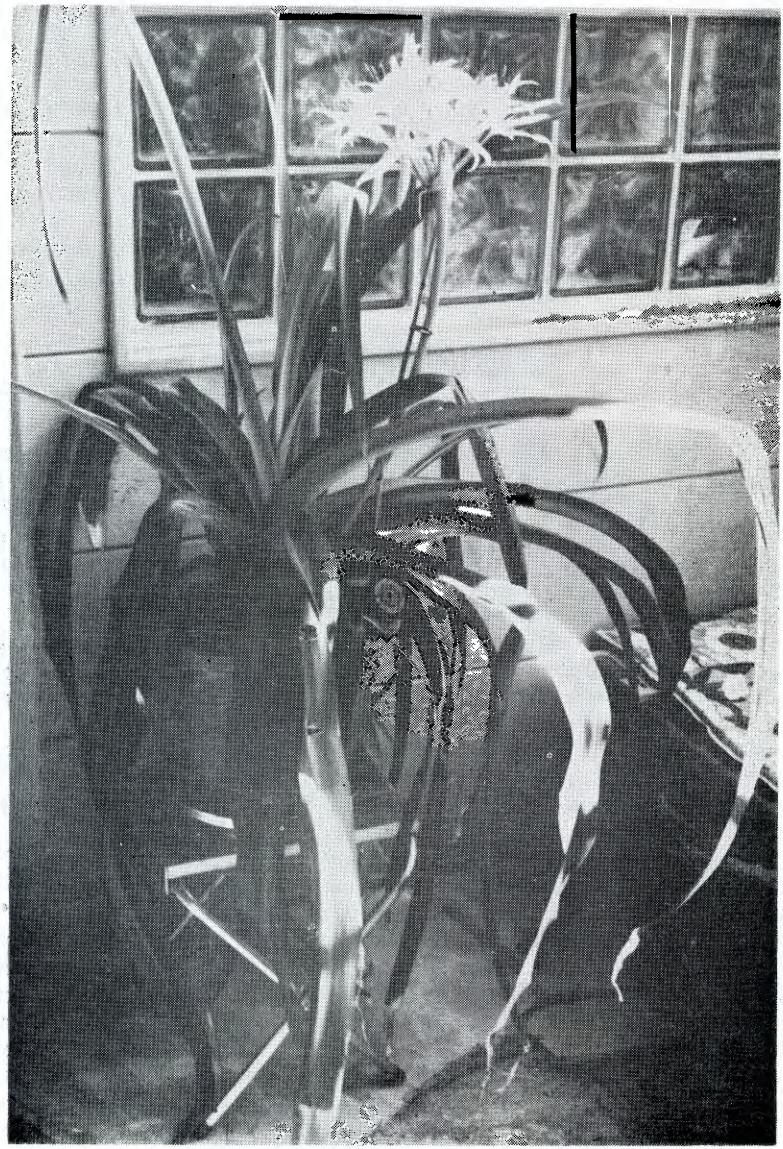

Fig. 11. **Crinum defixum** forma **stephenhassardii** Traub, native to Nepal. Collected by Dr. Q. M. Stephen-Hassard of La Jolla, Calif. in 1971.

It was my general impression that the country around Henja looked rather dry but there were trees and bushes in profusion, and it was not nearly as dessicated as our own foothill country.

CRINUM DEFIXUM FORMA STEPHENHASSARDII f. nov.

HAMILTON P. TRAUB

Dr. Stephen-hassard, of La Jolla, California, has given the writer the privilege of preserving a specimen of a *Crinum* form which he collected on his trip to Nepal in 1971, as indicated in the previous article.

A search in the literature (Baker, 188; Uphof, 1942) has revealed that the Stephen-hassard collection deserves to rank as a form of *Crinum defixum* Ker-Gawl. (see Fig. 11). It has been named appropriately for the discoverer, *Crinum defixum* forma *stephenhassardii.*

Crinum defixum Ker-Gawl., belonging in the Subgenus *Stenaster* Baker, is a lowland species found in the "muddy and swampy banks and rivers about Calcutta and through Peninsular India", flowers in October. It is related to *C. wattii,* Baker an upland species (alt. 4000 ft.), and is found in "grassy places."

The Neapal form of *C. defixum* is distinctly more vigorous than the type, having up to 12 leaves per bulb, and a 19-flowered umbel as contrasted with 6-8 leaves per bulb, and 6-15 flowers per umbel, in the lowland type, and differs from it also somewhat in other characters.

Crinum defixum forma **stephenhassardii f. nov.** (Fig. 11)

Haec forma a typica et formis terrarum humilium speciei validior et in terris altis vivens recedit.

DESCRIPTION—*C. defixum* forma *stephenhassardii* Traub, *forma nov. Bulb* large. Leaves medium green, up to 12, the longest leaves up to 175 cm. long, up to 7.5 cm. wide at the base, narrowing to 6 cm. at the middle, and to an acuminate apex, glabrous, deeply channeled in lower half. *Scape* light green, flattened, edges roundish, 1.9 x 1 cm. diam. at the base, narrowing to 1.5 x 1 cm. near the apex. *Spathe* light green at anthesis, 5.6 cm. long, 2.2 cm. wide at base, apex roundish; bracteoles very narrow, light greenish. *Umbel* 19-flowered, flowers white, tepaltube green, most opening at once, three opening a little later. *Pedicels* very short, 5-7 mm. long, light green. *Ovary* light green, 8 mm. long, 6 mm. diam. *Tepaltube* 8 cm. long, light green. *Tepalsegs* narrow apex acutish: *Setsegs* 1 cm. wide at the middle; petsegs 1.2 cm. wide at the middle. *Stamens* up to 5.4 cm. long, shorter than the tepalsegs, filaments white in lower fourth, purple above, anthers 1.2 cm. long, pollen orange-yellow. *Style* 7 cm. long, white in lower fourth purple above, overtopping the stamens, slightly shorter than the tepalsegs. *Stigma* minutely 3-lobed (calitate).

HOLONOMENIFER No. 1236 (TRA), 9-24-79, cult. at La Jolla, Calif. from bulbs collected in 1971, in Nepal, at Hyangia (Henja), alt. 3,500 ft.), 4 miles northwest of Pokhara. According to the collector, "the bulbs were difficult to dislodge from under the rocks . . . (apparently they) grew originally in the area of the rice paddy and, when it was cleared, the bulbs were tossed aside along with the rocks."

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MINIATURE CRINUMS

Hamilton P. Traub

Dr. Inger Nordal of the Botanical Laboratory, University of Oslo, P. O. Box 1045, Blindern, Oslo 3, Norway, has kindly sent me a reprint of an article by Nordal on, "A New Species of *Crinum* (Amaryllidaceae) from Northern Kenya." This refers to one of the smaller African species, *Crinum piliferum* Nordal. The following summary is quoted from the Nordal article in the Norweigian Journal of Botany, Vol. 26: 149-154, figs. 1-8. 1979.

"*Crinum piliferum* Nordal, a new species from northern Kenya, is described as being slender, 1-2 (rarely 3)-flowered with narrow leaves and infundibuliform red-keeled corolla, it resembles the West African taxa *C. distichum* Herb. (syn.-*C. pauciflorum* Bak.) and *C. humile* A. Chev, and also the southern African taxa *C. minimum* Milne-Redhead, *C. acaule* Bak. (? syn. *C. parvum* Bak.) and *C. parvibulbosum* Dinter ex Overkott. The species delimitation within this group is discussed."

It is interesting to note in this connection that Mrs. Marcia C. Wilson, of Brownsville, Texas, has received stock of a miniature *Crinum* species, apparently in the Subgenus *Platyaster,* from the West Indies (Caribbean Region). See next article. It is most likely in the *Crinum americanum* (American Gulf Coast region and Florida)—*C. strictum* (Texas) Alliance. The plant is stoloniferous, propagating rapidly by this means. As indicated by Mrs. Wilson, this new material should create a lively interest in the breeding of miniature Crinums. This is especially true, now that African miniatures may be available.

Mr. James A. Bauml, Huntington Gardens, San Marino, California, has been designated to follow up this Caribbean find, and name the plant, if new, once its native habitat has been established.

Mrs. Wilson's article, with an illustration of the very lovely flower of this species, follows.

A MINIATURE CRINUM FROM THE CARIBBEAN

Marcia C. Wilson, *255 Galveston Road, Brownsville, Texas 78521*

In the spring of 1979, I was sent samples of several bulbous plants by Conrad D. Fleming of the Virgin Islands. Included were two *Crinum* species: one small native of the Island, probably *C. caribea* or allied, and six tiny bulbs (less than ½" diameter) of a "miniature." The larger *Crinum* was planted in a 6" standard pot and given "swamp" culture (placed in a tray with water). The six bulblets were also planted in a 6" std., sandy mix, and watered frequently with CLF solution. When a bud appeared on the "mini" in July, I thought I was seeing things—it looked like a Rain Lily!

Fig. 12. Miniature **Crinum** sp. from the Caribbean; received by Marcia Clint Wilson, Brownsville, Texas.

The plant flowered July 23, 1979, opening very early in the morning. The inflorescence was less than a foot (30.5 cm.) tall, including scape. *Scape* 15 cm. long. *Ovary* 1 cm. long. *Pedicel* 1 cm. long, *Tepaltube* 9.2 cm. long. *Tepalsegs* width 9 mm., length 5 cm. *Filamentsca* 3.5 cm.long, reddish ½ out, *Style* 5 cm. long. Pollen golden. The longest leaf was 22 cm. long, 1 cm. wide. A distinctive flat center ridge appears on each leaf. The plant is self fertile, a seed being 1.5 cm. in diameter. The plant is native to one of the Caribbean islands and we are trying to locate the exact source. Typical of *C. americanum* type, the plant is rhizomatous and could be grown in bright light on a window sill.

THE CHROMOSOMES OF **HABRANTHUS MARTINEZII, H. ROBUSTUS,** AND THEIR F_1 HYBRID[2]

W. S. Flory and G. L. Smith,[1]
Wake Forest University

The genus *Habranthus* was described by Herbert in 1824. Of the 21 or 22 species of the genus recognized by Herbert in 1837 several are now considered to belong to *Amaryllis, Rhodophiala, Zephyranthes,* or perhaps even to other genera. In 1937 Sealy recognized only 10 species as belonging to *Habranthus.* In more recent years several new species have been discovered in Mexico by Mrs. Morris Clint, Dr. Thad Howard and others. Most notably, Sr. Pierfelice Ravenna has described numerous new *Habranthus* species from South America during the last seven or eight years. In the issues of PLANT LIFE for 1972, 1974, 1975 and 1978 alone, Ravenna has described 24 new *Habranthus* species. The number of known species of the genus now approaches 40, or about twice the number given for the genus by Airy-Shaw in the seventh edition (1977) of Willis' Dictionary. Additional species of this taxon are still being described rather regularly.

Ravenna (1972) reported and described the newly recognized species *H. martinezii,* from Argentina, Uruguay, and the Martin Garcia Island, in the Rio de la Plata between those two countries. The author of the small, dainty, but attractive *H. martinezii* rapidly made it available to North American workers.

Mrs. Marcia C. Wilson was good enough to send us a small bulb of *H. martinezii* in April of 1972. Before this had flowered for us, a bulb of the hybrid *H. martinezii* X *H. robustus* was received on October 29, 1973, from Mrs. Wilson; a bulb which we believe was indicated as having resulted from a cross made by the late Alex Korsakoff. Since that time we have repeated this same cross ourselves, several times. The two species are quite interfertile, and a number of seedlings from this cross are now at hand.

In both parental species $2n = 12$, but there are significant differences in the karyotypes of *Habranthus martinezii* and *H. robustus,* and the differing chromosomes of these two species can readily be picked out in the first-generation hybrids (Figs. 13 and 15; Table 4).

METHOD OF CHROMOSOME PREPARATION AND STUDY

Clear, translucent, rapidly-growing root tips were collected during mid to late mornings of sunny days. They were placed directly in .2% colchicine and pretreated in this solution for from 3 to 4 hours for the spindle-inhibiting effect of the alkaloid. The tips were then prepared for squashes either (1) by following Gerstel's (1949) technique; or (2) by fixing the tips in Carnoy's solution (95% alcohol - 3 parts; glacial acetic acid - 1 part; chloroform - 2 parts) overnight, or longer. Fol-

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[2] Work supported by a grant from the Research and Publications Fund of Wake Forest University.

lowing this fixation the tips were squashed, after softening them first - if necessary - in a solution of HCl of determined efficient concentration. Well spread metaphase divisions were photographed, and the slides were then often made permanent by use of Blackwood's (1958) method.

An index figure correlated with the position of the centromere was secured for each chromosome. This index figure was secured by dividing the length of the short arm of the chromosome by its total length (SA/TL), as indicated in Table 1. An index figure of .50 indicates an exactly median centromere. The lower the index figure (the nearer it is to 0, or to .10), the closer the centromere is to the end of the chromosome, etc.

Table 1. Derivation of the index figure indicating centromere positions on the chromosomes.

$$\frac{\text{Length Short Arm}}{\text{Total Length}} \text{ of Chromosome} = \text{Index}$$

Chromosome Constriction	Index
Median centromere	.47-.50
Submedian centromere	.30-.47
Subterminal centromere	under .30

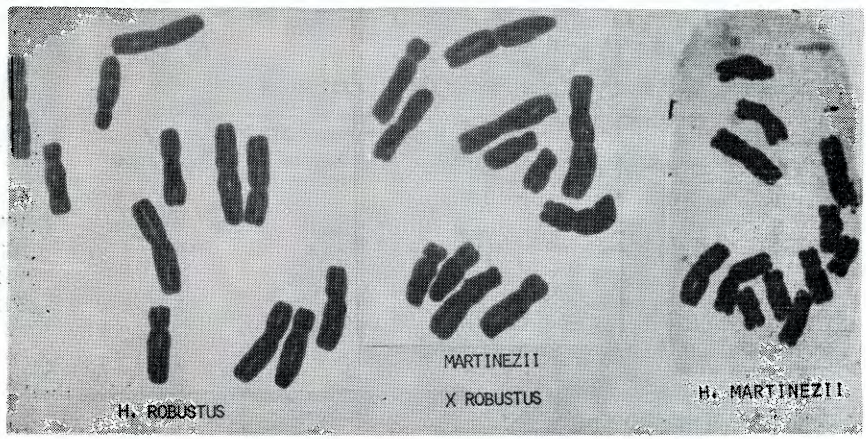

Fig. 13. Metaphase chromosome complements from root tip squashes of **Habranthus robustus** (left; X 1800); **H. martinezii** (right; X 1700); and, of the F_1 hybrid of **H. martinezii** X **H. robustus** (center; X 2100). (Differences in size of similar chromosomes, from complement to complement, are slightly exaggerated by the varying magnifications.)

THE CHROMOSOMES OF **HABRANTHUS MARTINEZII**

Microphotographs of the chromosomes of *H. martinezii* are shown in Figure 13 (right), where a complete complement is shown, and also in the bottom three lines of Figure 14—where the individual chromo-

somes have been cut out and arranged in length (from right to left) and in pairs.

Data concerning the chromosomes of this species are presented in Table 2, where lengths of each chromosome, and of each arm of each chromosome, are listed as averaged from measurements taken from five well-spread metaphase figures prepared as described above. Based on length measurements the SA/TL index has been computed for each chromosome. Once this is done it becomes obvious that the chromosome complement is easily divided into groups of definite characterization. Each of these groups have been numbered, and designated as Types. The indices for each group of chromosomes are shown in the right hand column of Table 2. The chromosome types described below for *H. martinezii* will later be compared with the types found in *H. robustus*.

It will be noted that in *H. martinezii* there are 2 comparatively long chromosomes with their SA/TL index indicating the centromeres to be near median in position; these are designated as Type 1 chromosomes. Two somewhat shorter chromosomes, also with near median centromeres, are indicated as being Type 3. Another pair, of about the same length as the Type 3 ones, have decidedly submedian centromeres, and are designated as Type 4 chromosomes. Then there are 4 chromosomes of about equal or somewhat shorter length—than Type 4 ones—having subterminal attachment constrictions, or centromeres; these two pairs are designated as being Type 5. Finally, the shortest pair of chromosomes—which have submetacentric centromeres—are indicated as being Type 6 ones.

Table 2. Karyotype data for **Habranthus martinezii** (2n=12).

Chromosome Type	Number	Chromosome Length in Microns			S.A. T.L.
		Total	Long Arm	Short Arm	
1	2	10.0	5.3	4.7	.470
3	2	8.6	4.6	4.0	.465
4	2	7.6	4.8	2.8	.368
5	4	6.8	4.8	2.0	.294
6	2	5.1	3.3	1.8	.352

Type Description

1—long, metacentric
3—medium-lengthed, metacentric
4—medium-lengthed, submetacentric
5—medium-lengthed, subterminal
6—short, submetacentric

THE CHROMOSOMES OF **HABRANTHUS ROBUSTUS**

The chromosomes of this species were described some years ago (Flory, 1938), with a statement in a later paper to the effect that "while the six (chromosome) pairs (of the species) may be distinguished, there are three groups of two pairs each, in which the four chromosomes are quite similar" (Flory and Flagg, 1958).

In the clone of *H. robustus* available now some slight differences are found in the chromosome complement, from the chromosomes in the clone available to us in 1938.

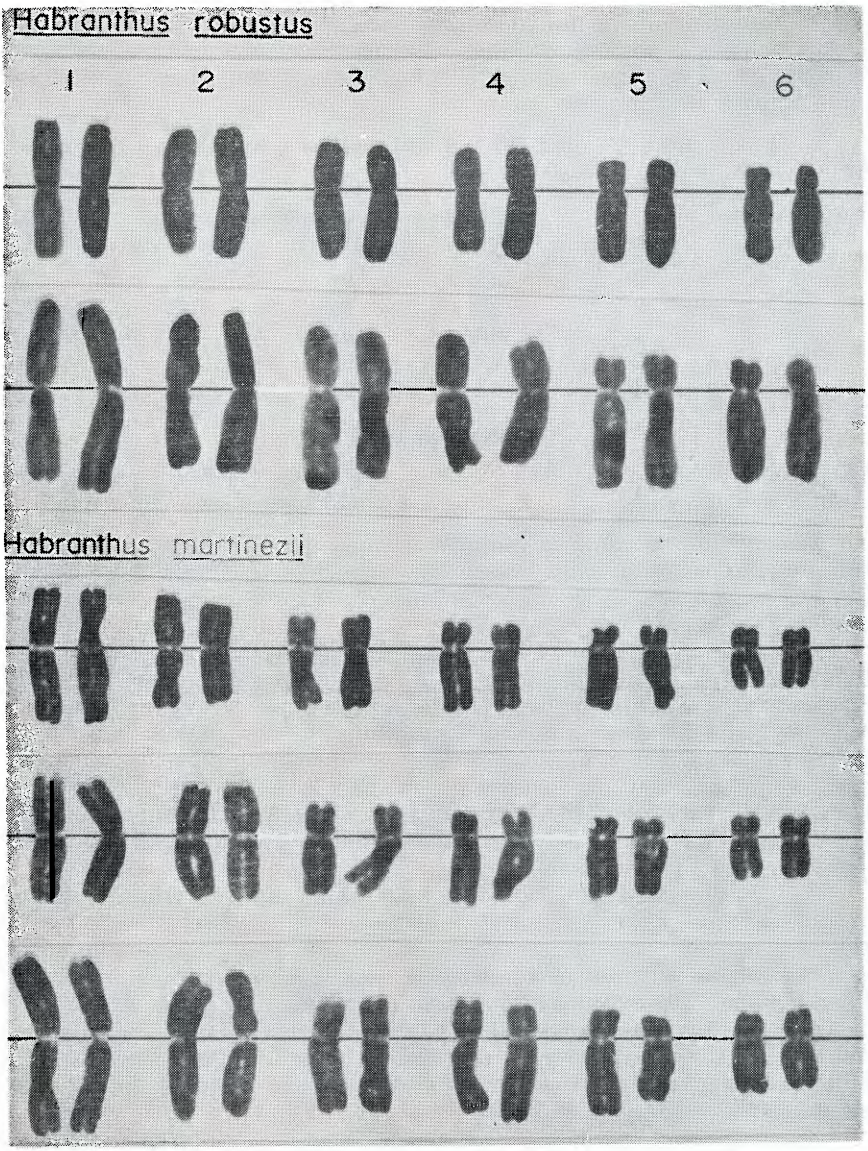

Fig. 14. The 12 somatic chromosomes, from root tip squashes, of each of 2 cells of **Habranthus robustus** (top 2 lines), and from each of 3 cells of **H. martinezii** (lower 3 lines). In each complement (that is, on each line), the chromosomes are arranged by pairs, with the longer pair to the left—and graduating downward to the shortest pair on the right.

Information on the chromosomes of the *H. robustus clone* presently worked with is presented in Table 3. Lengths of the chromosomes, and of each arm of each chromosome, are listed again as averaged from five well-spread metaphase figures.

Table 3. Karyotype data for the **Habranthus robustus** (2n=12) clone used.

Chromosome Type	Number	Chromosome Length in Microns			S.A. T.L.
		Total	Long Arm	Short Arm	
1	2	12.8	6.7	6.1	.476
1	2	11.0	5.8	5.2	.472
2	2	10.1	6.1	4.0	.396
4	2	8.4	5.0	3.4	.404
5	4	8.1	5.9	2.2	.271

Type Description

1—long, metacentric
2—long, submetacentric
4—medium-lengthed, submetacentric
5—medium-lengthed, subterminal

Microphotographs of *H. robustus* chromosomes are shown in Figure 13 (left), and individually in the top two lines of Figure 14. These Figures, together with the data in Table 3, furnish a good characterization of the karyotype.

It will be noted from Tables 3 and 4 that in *H. robustus* there are 4, rather than just 2, comparatively long, near-median centromered chromosomes belonging to the group designated, above under *H. martinezii*, as Type 1. There are also 2 additional rather long chromosomes in *H. robustus*, these with submedian centromers. These long, submedian centromered chromosomes comprise a new—Type 2—group. Then, as *H. martinezii*, *H. robustus* has the 2 shorter medium-lengthed and submedian Type 4, as well as the 4 shorter medium-lengthed, subterminal, Type 5 chromosomes.

It will be noted that both *H. martinezii* and *H. robustus* have chromosomes of Types 1, 4, and 5—although *H. robustus* has 2 more Type 1 chromosomes than does *H. martinezii*. That is, the 2 species both have 6 essentially similar chromosomes. While *H. robustus* has 2 Type 2 chromosomes (long; submedian), this Type is lacking in *H. martinezii*. However, *H. martinezii* has 2 chromosomes each of Type 3 (medium-lengthed; median centromeres), and also of Type 6 (short; submedian), while no chromosomes of either Type 3 or Type 6 are found in *H. robustus*.

Since more of the longer chromosome types occur in *H. robustus*, and more of the shorter types are found in *H. martinezii*, this results in a greater total chromosome length in *H. robustus* than in *H. martinezii*. The average total chromosome length per complement of the 5 metaphase figures measured of *H. robustus* is 117 microns; the comparable figure for *H. martinezii* is about 90 microns. Thus, the total length of the 12 chromosomes of *H. robustus* is approximately 30% greater than that for the 12 chromosomes of *H. martinezii*.

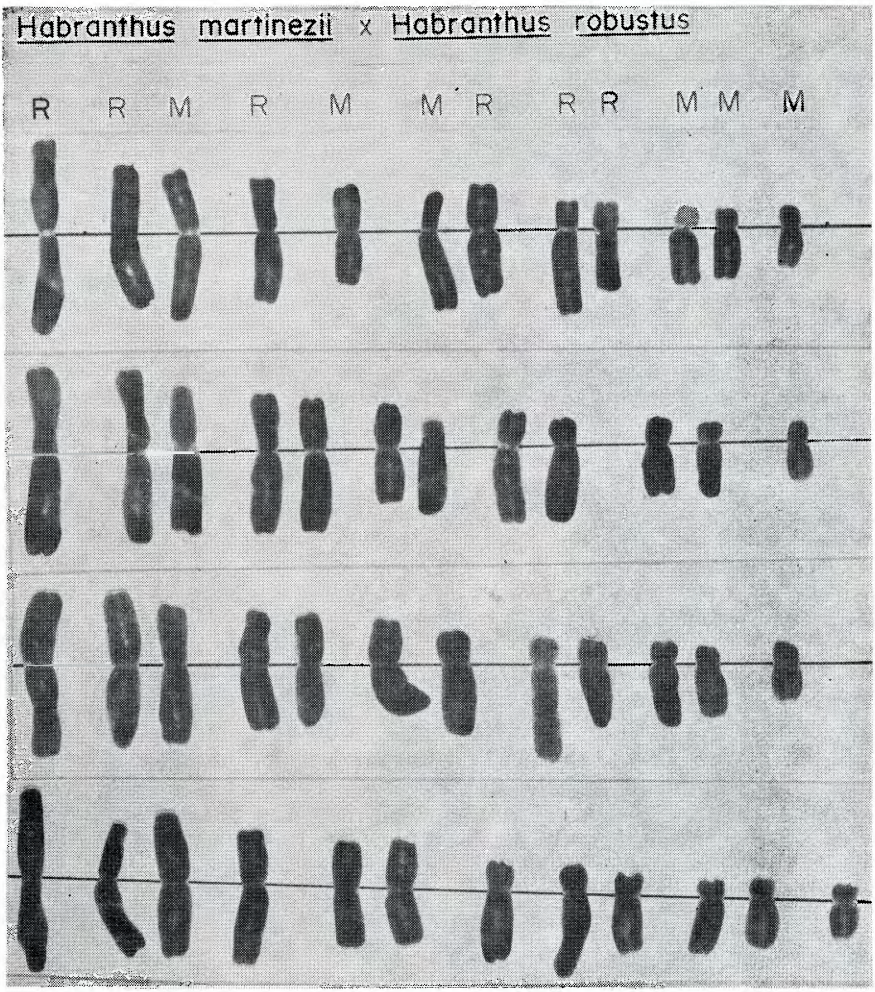

Fig. 15. The 12 chromosomes from each of 4 different root tip cells in metaphase division of the F_1 hybrid of H. martinezii X H. robustus, arranged linearly. The chromosomes from each cell are arranged with the longest chromosome to the left, and the shortest on the right. Indication is made of the chromosomes apparently tracing to each parent.

THE CHROMOSOMES OF THE HYBRID OF H. MARTINEZII X H. ROBUSTUS

The chromosomes of the first generation hybrid of *H. martinezii* X *H. robustus* are pictured in Figure 13 (center), and also in Figure 15, where each chromosome of photographs of four different somatic complements of the hybrid have been cut out, and arranged in order—and pairs—so far as possible.

Table 4 presents data comparing the types of chromosomes occurring in the parents and their hybrid. This Table presents data for a comparison of chromosomes in *H. martinezii* and *H. robustus*—as described to some extent when considering the chromosomes of *H. robustus*. Further, it details the number of each type of chromosome present in the parents, as they occur in the hybrid.

Table 4. The numbers of each type of chromosome in **Habranthus martinezii, H. robustus,** and the hybrid between them.

	Type	martinezii	robustus	martinezii X robustus
1	Long metacentric	2	4	3
2	Long submetacentric		2	1
3	Medium metacentric	2		1
4	Medium metacentric	2	2	2
5	Medium subterminal	4	4	4
6	Short submetacentric	2		1

To be more specific, it is evident that chromosomes of Types 1, 4 and 5—which are quite similar in both parents, also occur—as expected— in the hybrid. Since the same numbers, 2 and 4 respectively, of both Types 4 and 5 occur in each parent, it is not unexpected to find these same numbers of both chromosome types in the hybrid. Also, since in the case of the Type 1 chromosome only 2 are found in *H. martinezii* while 4 occur in *H. robustus*, it is to be expected that 3 of Type 1 would occur in the hybrid, and such is the case.

But the remaining three chromosomes in the hybrid are each of a different type. There is one chromosome of Type 2 (from *H. robustus*), and one chromosome each of Types 3 and 6 (from *H. martinezii*). Thus, while there are 5 chromosome types in *H. martinezii,* and only four in *H. robustus,* 6 different types occur in the hybrid. The differences would seem sufficient to render the hybrid plants sterile, but a definite answer to this point must await experimentation.

DISCUSSION

Plants of *Habranthus robustus* from Buenos Aires were described by Sweet (1830) with Herbert apparently furnishing the present binomial in 1837. It was more than a century and a third later when Ravenna (1972) described *H. martinezii* from roughly the same area—Argentina, Uruguay, etc. A rather closely related species, *H. brachyandrus,* was described by Baker (1888) as having been received at the Royal Botanic Gardens, Kew, in 1883. This last species was said to

have been collected in Paraguay "on the Parana," a long river which runs through southern Brazil, then between Argentina and Paraguay, and on through northern Argentina, emptying into the Rio de la Plata above Buenos Aires. Thus, while recent records on the natural distribution of neither *H. robustus* nor *H. brachyandrus* are available to us, it is obvious that these species—along with *H. martinezii*—are native in roughly the same areas of South America. Accordingly, it would not be too unexpected to find that these species have evolved along much the same evolutionary paths; or, that they share some of the same genes, along with an overlapping genetic background.

Such is indicated by the fact that *H. robustus* crosses readily with *H. martinezii*—as already described here; and also by the fact that *H. robustus* crosses readily with *H. brachyandrus* (Traub, 1951). *Habranthus brachyandrus* and *H. martinezii* will effectively pollinate each other, but it is still questionable if effective fertilizations can be secured between them. A few years ago Mrs. Marcia Wilson sent us a few seed of this cross, but none germinated. In 1978 we used *H. brachyandrus* pollen on *H. martinezii* and obtained a lop-sided capsule. This contained many chaffy seed, along with a few obviously containing embryos, and two seedlings resulted. However, in both of these seedlings $2n = 12$, with all the chromosomes being those of *H. martinezii*. Obviously, the *H. brachyandrus* pollen had induced apomictic development of seed, and both of the seedlings were clearly maternals—suggesting that unreduced eggs occur in *H. martinezii* at times. In 1979 several reciprocal crosses between *H. martinezii* and *H. brachyandrus* have been made, and capsules have set and matured, although they have been small and abnormal in appearance in every case. Practically all the 1979 seed have appeared chaffy, and no seedlings have resulted to date.

It has been pointed out earlier that in *H. robustus* $2n = 12$, while in *H. brachyandrus* $2n = 24$, and that in some clones of these the chromosomes of the two species appear identical—except that there are twice as many of each type in *H. brachyandrus* as in *H. robustus* (Flory and Flagg, 1958). Since these two species hybridize readily, and since *H. martinezii* and *H. robustus* also cross easily, it seems likely that persistent repetition of the *H. martinezii* times *H. brachyandrus* cross is likely to eventually bring together enough compatible genes to result in hybrids between these two species.

Our first flowers of the hybrids between *H. martinezii* and *H. robustus* appeared just recently. These have a bright pink to rose-red color which is essentially the same as that of *H. robustus*—with none of the flower color (white to pale pink tepalsegs, which are purple-brownish in the lower third) of *H. martinezii* being apparent. The flowers of the hybrids, however, are about intermediate in size between the comparatively large flowers of *H. robustus* and the much smaller, and daintier, ones of *H. martinezii*.

As already mentioned, *H. robustus* and *H. brachyandrus* cross readily—and in both directions. The hybrid (named *H. floryi* by Traub, 1951) is almost self-sterile. In the first place, it forms but scant pollen—and much of that is abnormal or aborted. Occasionally selfed

flowers will develop seed capsules which are usually mishapen and abnormal in appearance. In early 1977 an unusually normal-appearing capsule was secured, from a selfed flower of the F_1, and from its seeds two seedlings resulted. Instead of these having 18 chromosomes, as in the F_1 hybrid, both are essentially $2n = 24$ plants. The first of these two seedlings has just flowered (July, 1979). The flower appears rather as a small and poor specimen of an *H. robustus* flower. The scape is crooked at several places and only about half the height of the flowers on the F_1 maternal plants. Very little pollen is present, but the flower has been self-pollinated as effectively as was possible. The stigma of the flower has also had pollen of *H. robustus* and of *H. brachyandrus* applied to it. It seems doubtful, however, that any capsule, or seed set, will result.

SUMMARY

This paper is chiefly a report on the chromosome types encountered in two South American $2n = 12$ *Habranthus* species, *martinezii* and *robustus,* as well as on the chromosomes of the first generation hybrid between them. The two parental species apparently share three chromosome types (2 in the same, and 1 in different, proportions). There is one chromosome type in *robustus* which does not occur in *martinezii,* and two types in *martinezii* not found in *robustus.* All 6 types occur in the anticipated numbers in the F_1 hybrid.

Some discussion of the possible relationships between *H. martinezii, H. robustus,* as well as of the rather closely related *H. brachyandrus,* is developed, based on a consideration of (1) species distribution; (2) chromosome number; (3) hybridization results; and (4) the morphology and fertility of hybrid progeny.

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HIGH CHROMOSOME NUMBERS IN SEVERAL ZEPHYRANTHEAE TAXA[2]

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Originally each of the three taxa dealt with here were thought to be hybrids. It now seems likely, however, that one, and probably two, of these are apomictic maternals, and that these two taxa actually represent natural species rather than hybrids. The reasons for this will become clear as the data is presented. The chromosome numbers encountered in all three taxa are unusually high for representatives of Tribe Zephyrantheae. Because of this, and also because of the apparent apomictic phenomena illustrated, it seems desirable to present a report on the high-numbered chromosome complements of these taxa.

Many representatives of the six genera in Tribe Zephyrantheae have comparatively low numbers of chromosomes. Species in which $2n = 48$ occur rather frequently, but this is the highest number which is found often in this tribe. There are a number of tribal taxa with lower somatic numbers than 48, and also some with higher numbers.

Among 29 different species with known chromosome numbers in *Zephyranthes,* for example, the following 2n numbers occur (and in the frequency indicated by the bracketed numbers) : 18 (1), 22 (1), 24 (7), 25 (1), 28 (2), 36 (1), 38 (1), 48 (13), 60 (1), and 67 + 1 fragment (1). Another species, *Z. arenicola* from Baja California, has been reported to have over 100 chromosomes (Flory, 1968). In *Habranthus* it was long felt that low numbers predominated, when it was known that $2n = 14$ in one species, while the numbers $2n = 12$ and $2n = 24$ had each been reported for several different species. This conclusion concerning *Habranthus* became less evident as more recently discovered species from Mexico proved to have mostly higher numbers—with one having 108 somatic chromosomes (Flory and Flagg, 1958; 1959). The monotypic *Haylockia* has only 18 chromosomes, while the known numbers in *Pyrolirion* run from 26 through 34 and 51 to 54 (Flory and Flagg, reported in Flory, 1968). Three of the 30 or so species of *Rhodophiala* have been studied cytologically, with $2n = 18$ in two species, and $2n = 16$ in the third (Schmidhauser, 1954). Only the monotypic *Sprekelia,* of this tribe, with $2n = 60$, ca. 120, ca. 150 and ca. 180 (Bose and Flory, 1965) has consistently high chromosome numbers.

CHROMOSOMES OF AN ATTEMPTED **HABRANTHUS** X **ZEPHYRANTHES** CROSS

This report deals with a description of the number and types of chromosomes occurring in 3 seedlings, sent to us in early 1978 by Mrs. Marcia Wilson. The seedlings are a derivative of an attempted cross made by the late Alek Korsakoff: his cross number G119. It involved the pollination of Mrs. Morris Clint's *Habranthus* No. 829 (from Ma-

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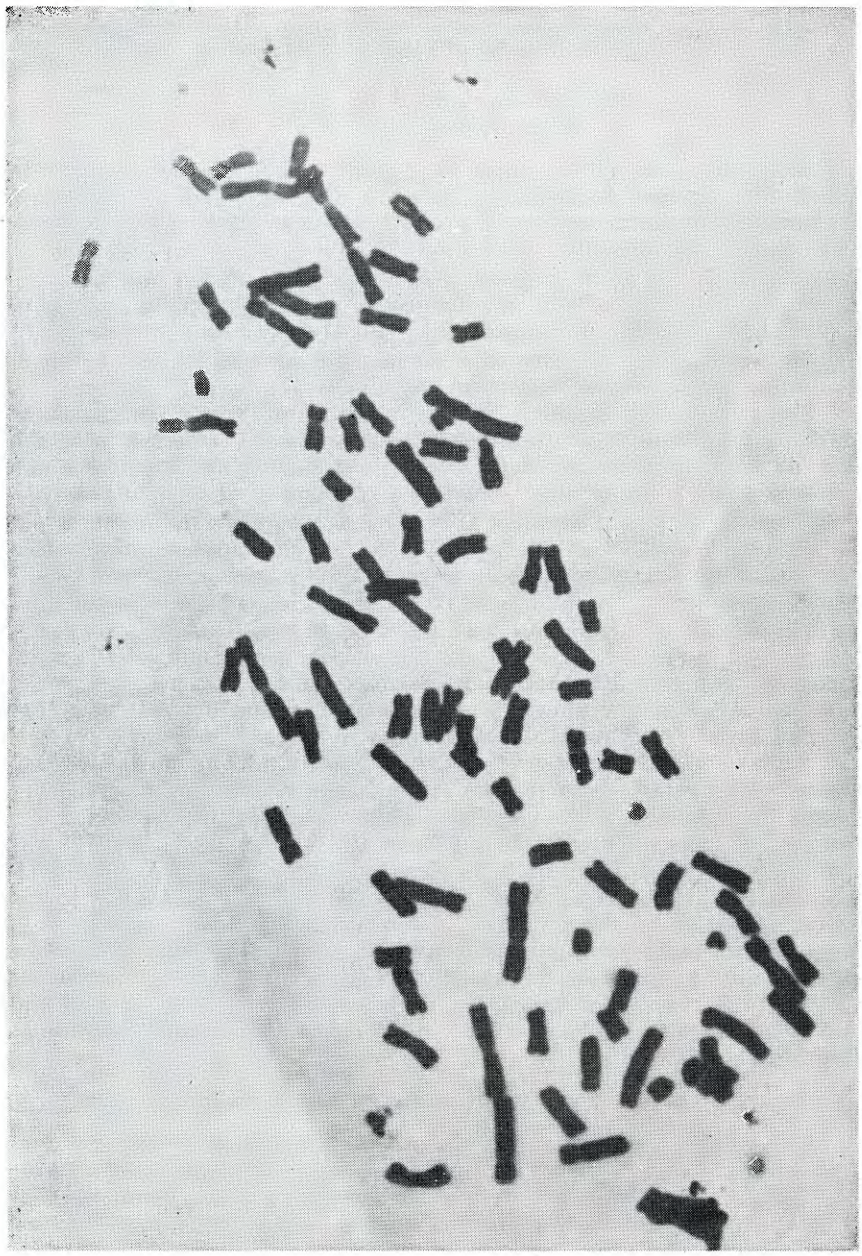

Fig. 16. Chromosomes from a root tip cell of seedlings of Alek Korsakoff's hybrid: G119. The attempted cross was **Habranthus** sp. Clint 829 (as seed parent), with pollen of Howard's **Zephyranthes** 'Jacala Crimson.' In the seedlings from this attempted cross 2n=90.

maulique Pass in the Sierra Madre Orientale Mountains just north of Monterrey, Mexico) by *Zephyranthes* 'Jacala Crimson,' collected by Dr. Thad Howard and being his number 62-6. Mr. Korsakoff made his cross May 19, 1968.

This taxon has 90 somatic chromosomes (Figure 16). Several mitotic metaphase figures with this number of chromosomes were observed in cells with unbroken walls, or in which it was obvious that a complete complement was present.

The types of chromosomes observed in this taxon are listed in Table 1. As indicated, a majority of these (54) are of "medium length," with 18 being longer, and 18 shorter, than the medium lengthed ones.

Table 1. Numbers and types of chromosomes in seedlings from the attempted cross of Clint's **Habranthus** No. 829 with Howard's **Zephyranthes** 'Jacala Crimson.'

Comparative Length	Centromere Position			
	Median	Submedian	Subterminal	Terminal
Long	6	2	10	—
Medium	8	12	28	6
Short	6	4	2	6

Two-armed chromosomes (all approaching the metacentric condition) predominate, with 78 being of this type. About half (40) of these have subterminal centromeres, while the others are about evenly divided between those with median (20) and those with submedian (18) attachment points. The remaining 12 chromosomes are telocentric (that is with terminal centromeres) : of these 6 are quite short, while the remaining 6 are somewhat longer—being about, or at least approaching, medium length.

The chromosome number of Mrs. Clint's *Habranthus* 829 has not been determined as yet. It seems likely, with our present information, that the three seedlings from Mr. Korsakoff's cross, or attempted cross, are apomictic maternals—in which case they have the same generic and cytological make-up as Mrs. Clint's taxon. We have determined that in *Zephyranthes* 'Jacala Crimson' $2n = 48$. Thus, if the seedlings studied here should be hybrids Mrs. Clint's No. 829 would be expected to have 132 chromosomes (since 90 is the intermediate number between 132 and 48). Through the courtesy of Mrs. Marcia Wilson we now have additional material of Mrs. Clint's No. 829. Hopefully we can soon determine the number of this taxon. Knowledge of this chromosome number will furnish very suggestive evidence as to whether the derivatives from Mr. Korsakoff's cross are true hybrids, or apomictic maternal seedlings.

THE CHROMOSOMES OF KORSAKOFF'S **ZEPHYRANTHES** 'HJALMAR SANDRE'

On May 7, 1966, the late Alek Korsakoff crossed *Zephyranthes howardii* with pollen of *Z. grandiflora.* The first hybrid seedling bloomed in 1969 and looked good. It bloomed again in 1970 and looked better, and at that time was named *Zephyranthes* 'Hjalmar

Fig. 17. Chromosomes from a root tip cell of Alek Korsakoff's 1968 hybrid named **Zephyranthes** 'Hjalmar Sandre.' This plant resulted from a cross between **Zephyranthes howardii** (seed plant) and **Z. grandiflora.** There are 200+ chromosomes in this hybrid.

Sandre' (Korsakoff, 1970).

'Hjalmar Sandre' contains the greatest mass of chromosomes, encountered in any of the species or hybrids which we have studied in the Zephyrantheae. There are something over 200 chromosomes in the root tip cells of this plant. Figure 17 is a photograph of one of the best 'spreads' of chromosomes which we have secured of this hybrid. One hundred eighty-seven (187) chromosomes can be distinguished, plus the mass of chromosomes clumped along the cell wall at one side of one end of the cell. By careful study and focussing under oil, at 2700X magnification, from 15 to 18 chromosomes could be discerned in this clumped mass. In addition there could possibly be from 3 to 5 additional chromosomes somewhat hidden among the 187 better spread and more easily seen elements. Thus it seems evident that there are approximately 200 chromosomes present, and possibly a few more than this. The best approximation of the chromosome number which can be made at the present time is that $2n = 200$ plus 5 or 10—most likely 200 plus a few.

Certainly the cell shown in Figure 17 is about as full of chromatin bodies as is ever seen. Although the photograph is viewed in two dimensions, while the cell actually occurs in three dimensions, it is still obvious that the proportion of chromatin to cytoplasm is unusually high. Other cells of this taxon in division show essentially the same high number of chromosomes, and the same high proportion of chromatin to cytoplasm.

No fair approximation of the types of chromosomes, nor of the numbers of each type can be made from the preparations available at present. It can be told, however, that the same types of chromosomes (long, median; long, subterminal; short, median, etc.) as occur in other Zephyrantheae are present, and that they are roughly in the same proportion as might be expected. There do seem to be an unusually high number, and proportion, of telocentric chromosomes; up to 20—or more—of these can be discerned in some figures, with apparently about the same number of both rather short and of longer ones being present.

The chromosome number of one parent, *Z. howardii*, has yet to be determined—with certainty, at least. The other parent, *Z. grandiflora*, has 48 somatic chromosomes in its fertile forms. One possible explanation for the high chromosome number of *Z.* 'Hjalmar Sandre' is that *Z. howardii* may have 76—or more—chromosomes. If these were added to the 24 of the male parent *(Z. grandiflora)*, a sterile hybrid with 100 or more chromosomes could have been formed. Then, if at some time during the development process a doubling took place—to give 200 or more chromosomes—a fertile form could have resulted from the hybrid. Such fertile allopolyploids—tracing to hybrid crosses—are becoming increasingly known from nature, and several dozen of them have been produced through artificial hybridization and manipulation. A supporting argument for such a supposition is found in Korsakoff's (1970) statement that: "The hybrid is easily propagated by offsets and is self fertile."

If the above hypothesis should prove correct, then this fertile hybrid would actually be a new, sexually self-producing, species, and would warrant description as such—just as many naturally occurring allopolyploids have been described as new species.

THE CHROMOSOMES OF **ZEPHYRANTHES ARENICOLA** × **Z. MACROSIPHON**

In late May of 1961 Dr. R. O. Flagg and W. S. Flory—in company with Mrs. Morris Clint and the late Mr. Clint—collected a pink-flowered, white-eyed, *Zephyranthes* in the State of Hidalgo, Mexico, at K300 along Mexico Route 85. This was essentially the same site at which Mrs. Clint's widely used M-30 *(Z. macrosiphon)* was originally collected. It was evident that the May 24, 1961, collection belonged to this same species. This 1961 collection was given trip number FF-1 and was accessioned as No. 15267-61 in the cultures of the University of Virginia's Blandy Experimental Farm.

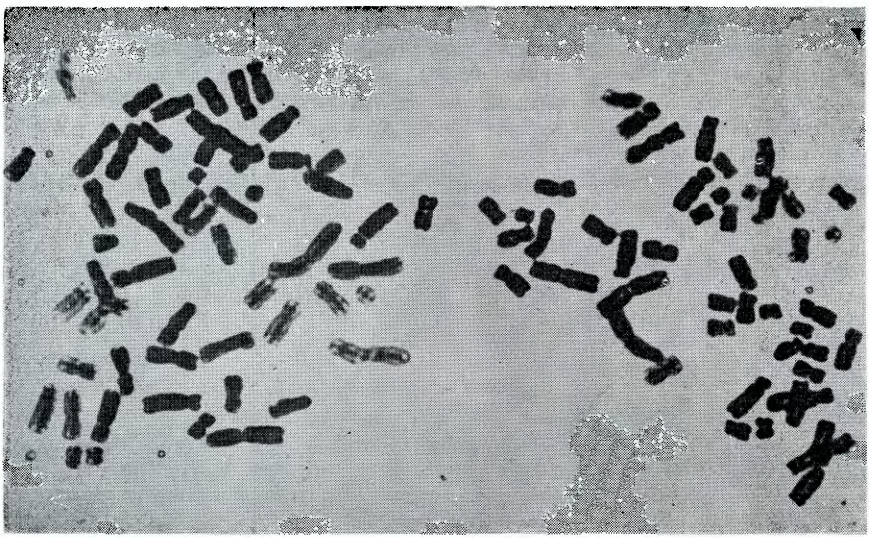

Fig. 18. Chromosomes from a root tip cell of a seedling from an attempted cross of **Zephyranthes arenicola** (seed plant) with **Z. macrosiphon.** This seedling has 2n=102 chromosomes.

Bulbs of this accession were carried to Wake Forest University in 1963. Several years later, in 1968, bulbs of *Z. arenicola,* collected in Baja California by Dr. Annetta Carter of the University of California at Berkeley, were sent by her to W. S. Flory at Wake Forest. At that time Dr. Ruth Phillips was a co-worker on this project. When *Z. arenicola* flowered, Dr. Phillips applied the pollen of several species to its large white flowers. Among the pollen plants used *Z. macrosiphon* (15267-61) was included. Several seedlings resulted from the cross of

Z. arenicola X *Z. macrosiphon*, and it is the chromosomes of these seedlings which are being reported on here.

There are 102 chromosomes in the root tips of the seedlings. Figure 18 is a photograph of one of the metaphase squash preparations in which the chromosomes were spread best, and in which they could be most readily studied.

The types of most chromosomes in the cells of these seedlings can be rather readily determined. The data on the several types is presented in Table 2. Many of the chromosomes are close enough in size to make difficult, in some cases, exact divisions between large and medium-sized ones, and between medium-sized and short ones. It is obvious, however, that half—or somewhat more than half—of all chromosomes (54 as listed in Table 2) are of intermediate size. There are about as many (20) longer chromosomes, as shorter (20) ones. If some of the chromosomes, designated in Table 2 as telocentric, should be found with further study to be metacentric—then the number of chromosomes now placed in the "short" group would be increased somewhat.

Table 2. Numbers and types of chromosomes in seedlings from the attempted cross of **Zephyranthes arenicola** with **Z. macrosiphon.**

Type (Length-Centromere)	Number	
Long-median	10	
Long-submedian	4	
Long-subterminal	6	20
Medium-lengthed		
Medium-median	6	
Medium-submedian	18	
Medium-subterminal	30	54
Short-median	12	
Short-submedian	4	
Short-subterminal	4	20
Apparently telocentric		
-short	4	
-comparatively long	4	8
Totals		102

While the chromosome number, and essentially their division into types, are known—there is somewhat less certainty as to the real genetic constitution of the seedlings.

It has been reported, based on earlier work by Phillips and Flory, that the chromosome number for *Z. arenicola* is something over 100 (Flory, 1968). Actually it was thought in 1968 that the somatic number for this species was perhaps 108, or even as high as 120. It had already been determined, much earlier (Flory, 1940), that in *Z. macrosiphon* $2n = 48$, and this has been reconfirmed at intervals since then.

Thus if seedlings from the attempted cross between *Z. arenicola* X

Z. macrosiphon were true sexual seedlings, with a chromosome number intermediate between that of the parents, a number somewhat in excess of 2n = 74 (at least 50 plus 24) would be expected for them. However, if the seedlings, with 2n = 102 chromosomes, were true hybrids—the most likely number for the *Z. arenicola* parent would be 2n = 156 (156/2 + 48/2 = 78 + 24 = 102).

We have now secured several young seedlings of *Z. arenicola* from Mrs. Marcia C. Wilson. From these we have been able to get clearer division figures than we were able to secure from our 1968 bulbs (which are now lost), and it is evident that our present *Z. arenicola* material has in the neighborhood of 100 chromosomes.

Accordingly, the evidence indicates, here again, that in the attempted hybridization of *Z. arenicola* with *Z. macrosiphon* the resulting seedlings are apomictic maternals. If this is the true situation, then these seedlings are not hybrids—but are really seedlings of *Z. arenicola,* probably produced from unreduced eggs stimulated to develop when the pollen from *Z. macrosiphon* fertilized the endosperm (but not the egg cell) of *Z. arenicola.* If this is the true situation, then the chromosome number for *Z. arenicola* is 2n = 102, the undoubted number for the seedlings studied.

DISCUSSION

It is well known that chromosome numbers vary widely in plants, and in fact in all living organisms. In a small composite plant of our western plains, *Haplopappus gracilis,* there are only two pairs of chromosomes (Jackson, 1957). In contrast some plants have quite high numbers, such as: the black mulberry, *Morus nigra,* in which 2n = 308 (Thomas 1942); one form of *Kalanchoe waldheimii* which has approximately 500 somatic chromosomes (Baldwin, 1938); and especially some of the tropical ferns, among which is *Ophioglossum reticulatum* 2n = 1260 (Abraham and Ninan, 1954). The highest chromosome number known for a European plant is also that for a fern, *O. azoricum,* which has 2n = 720 chromosomes (Löve and Kapoor, 1967). Among animals, *Ascaris megalocephala* var. *univalens* has long been known to have only a single pair (2n = 2) of chromosomes in the germ line (Wilson, 1925), while at the other extreme Belar (1926) reported a radiolarian, *Aulacantha,* to have about 1600 somatic chromosomes.

The great majority of plants, however, have basic chromosome numbers essentially in the 5, 6, and 7 range, and with somatic numbers being multiples of these basic numbers, or deriving from such numbers in various ways.

We know that in the Zephyrantheae 6 is apparently the (or a) basic chromosome number, and that we have species whose chromosome numbers occur in the euploid series 12, 18, 24, 36, 48, and 60. Further, that aneuploid numbers such as 25, 28, 38, etc., occur due to the loss or addition of one or a few chromosomes. With the exception of *Sprekelia,* where the lowest 2n number known is 60—and the highest about 180, most chromosome numbers for members of Zephyrantheae are comparatively low.

Among the genera *Habranthus, Haylockia, Pyrolirion, Rhodophiala* and *Zephyranthes* in Zephyrantheae, chromosome numbers are now known for 55 different species. These chromosome numbers (with the number of species in which they occur) are 12 (2), 14 (2), 16 (1), 18 (4), 22 (2), 24 (14), 25 (1), 26 (1), 28 (2), 34 (1), 36 (2), 38 (1), 43 (1), 48 (15), 51 (1), 54 (2), 60 (1), 90 (1), and 108 (1). The mean (or average) for these somatic chromosome numbers is approximately 36. The median numbers are 34 and 36. (The mean and the median frequently are not this close to each other.) It can be seen that 32 of the 55 chromosome numbers are 36 or lower, and that 49 of the 55 numbers are 48 or lower.

The numbers of 90, 102 and approximately 200, for the 3 taxa whose chromosomes are discussed in this paper, are comparatively quite high—considered along with other chromosome numbers for the genera of Zephyrantheae, excluding *Sprekelia.*

Stebbins (1971) summarizes the "overwhelming body of evidence" indicating that in the case of most polyploid series the lower numbers are primitive and the higher numbers are derived from the lower ones. There are various factors involved in polyploidy, and in the derivation of polyploid series of plants—often resulting in the evolution and derivation of new species. Hybridization, followed by chromosome doubling, results in allopolyploids—which are often different enough from the original parents to warrant establishment of them as new species.

We have available in our cultures 75 different taxa resulting from interspecific or intergeneric crosses among members of the Zephyrantheae. Analysis of taxa from this group, to date, suggest that about half of these are true hybrids, while about half of these progeny are apomictic—and essentially like the seed parent.

Both polyploidy and hybridization, as well as the two phenomena combined, play important parts in plant evolution. Studies on the hybrids, and perhaps especially of the high polyploid hybrids, are gradually furnishing additional information concerning both relationships and evolution within Zephyrantheae.

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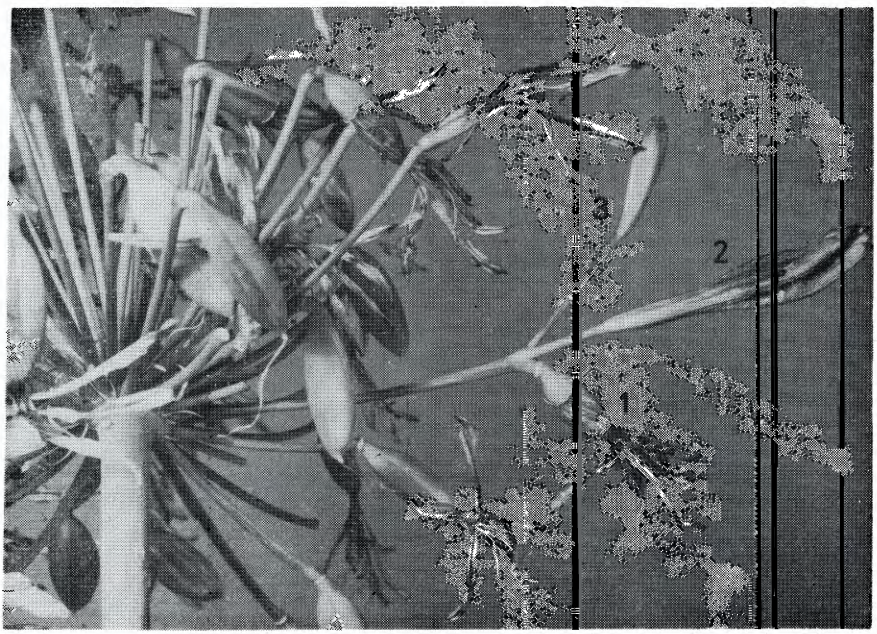

Fig. 19. Pseudo-umbellula (= peduncled helicoid cyme) within an umbel of **Agapanthus praecox** subsp. **orientalis** with the flowers 1, 2 and 3.

NOTES ON THE INFLORESCENCE OF AGAPANTHUS

Dietrich Mueller-Doblies, *Pedagogical High School for Systematic Botany and Plant Geography, Free University, Berlin*

Turning the leaves of old volumes of Herbertia I came across an article by Hannibal, "Mutations in Amaryllids", in which he shows a photo of *Agapanthus orientalis* with a branched pedicel (Herbertia 10 : 127. 1943). As he states that "Secondary branching of pedicels is quite common", I thought that it ought to be no real teratology, but that it might be related to the normal thyrsoid structure of the inflores-

cence. Next morning I passed by the Agapanthus collection of our botanical garden in Berlin-Dahlem and the first umbel of *Agapanthus praecox* Willd. subsp. *orientalis* Leighton showed such an umbellula or rather pseudo-umbellula within a normal inflorescence (Fig. 19). It is true that none of the other numerous *Agapanthus* inflorescences possessed such a structure, but the analysis proved to be clear enough to be convincing. If Hannibal (1943) states that this phenomenon is common, we must add that it is very unevenly distributed, since we only saw it seldom in the meantime among hundreds and hundreds of plants in South Africa.

Indeed, while such a pseudo-umbellula is an exceptional structure in *Agapanthus,* it is no unexpected teratology. It is what I call a morpholysis, i.e. the disintegration of a structure according to certain principles. Not seldom such a phenomenon may be of help for the understanding of the normal complex structure.

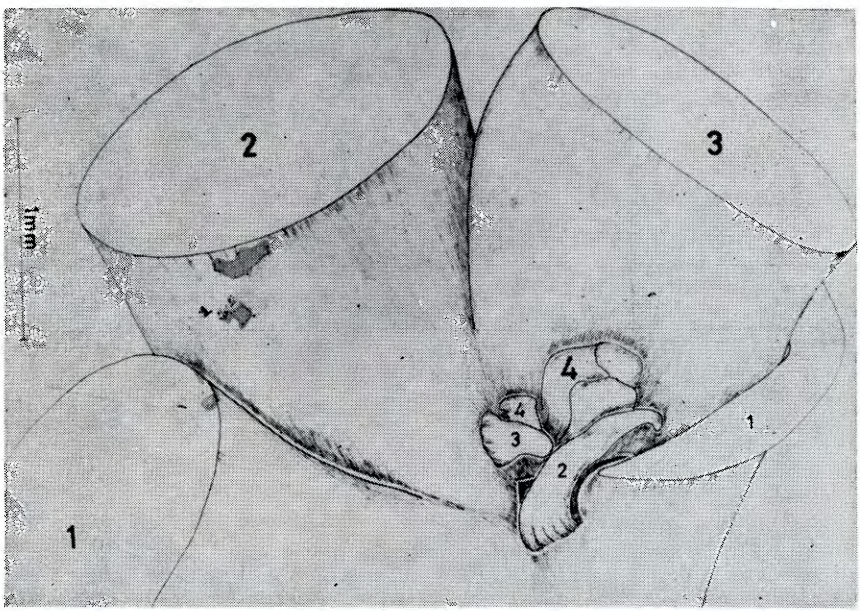

Fig. 20. Branching point of the pseudo-umbellula of Fig. 19 at high magnification showing the rudiment of the fourth flower (4) and the different prophylls '1 to '4.

The normal inflorescence of *Agapanthus* is a pseudo-umbel (or pseudosciadium) consisting of many bostryxes (see Traub in Herbertia 10: 134. 1943). However, evidently this fact is not common knowledge, since Leighton states on p. 15 of her monograph of the genus *Agapanthus* (J. South Afr. Bot. Suppl. Vol. 4, 1965): "The inflorescence appears, except in some few-flowered forms, to be a compound racemose umbel with a central compressed raceme surrounded by a number of

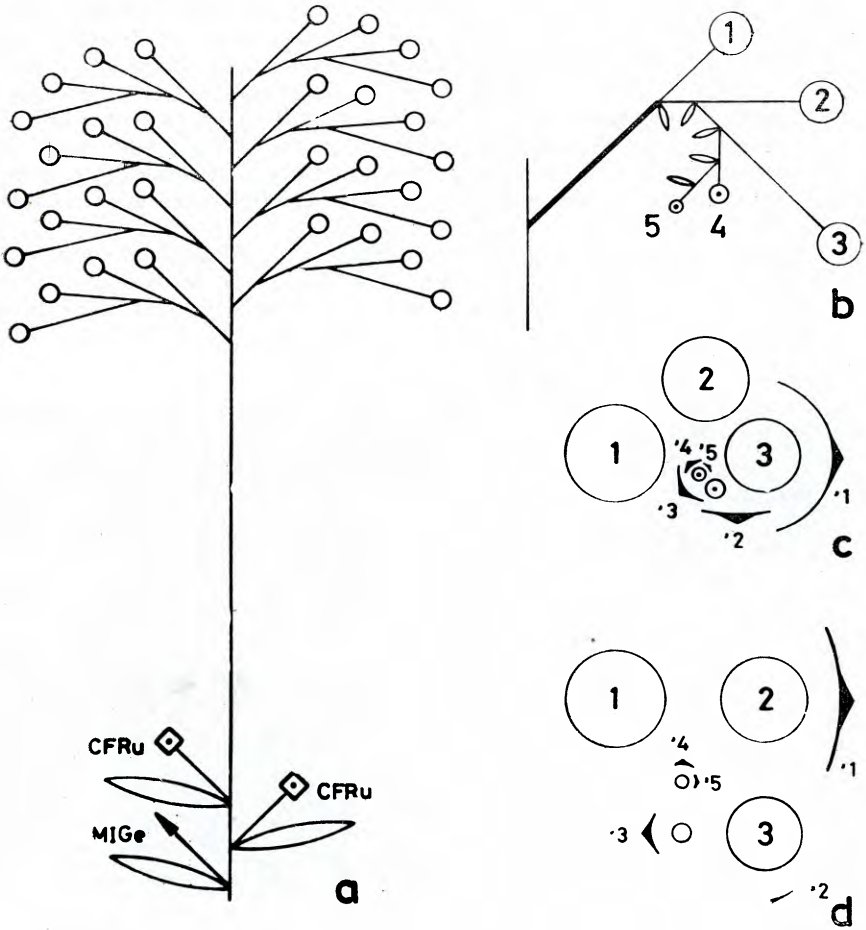

Fig. 21. Diagrams of an **Agapanthus** inflorescence. For sake of clarity all the internodes in longitudinal diagrams are drawn as elongated; those not elongated in reality are given, however, only a length of 5 mm. (**a**) longitudinal diagram of the thyrsic **Agapanthus** inflorescence above the main innovation bud (= MIGe, in latin **M**axima **I**nnovationis **Ge**mma), CFRu = rudimentary enriching inflorescence (**C**o**F**lorescentiae **Ru**dimentum). (**b**) and (**c**) longitudinal and ground-plan diagram of the pseudo-umbellula in Fig. 1 and 2; '1 = prophyll of flower n° 1 etc. (**d**) normal helicoid cyme with lateral prophylls at right angles.

similar racemes''. This means to say that the inflorescence is regarded by her as a twice racemose structure. In fact the *Agapanthus* pseudo-umbel is a compound inflorescence in which cymose partial inflorescences, namely helicoid cymes (= bostryxes), are arranged in a racemose order, hence it is a thyrse (thyrsus). A thyrse is an unfortunately little appreciated type of inflorescence which is of very frequent occurrence among the angiosperm families: a racemose main axis bears cymose branches.

Figure 21 shows a longitudinal diagram of an *Agapanthus* inflorescence. For sake of clearness all the internodes are represented as elongated, but with a quantitative difference. Those which actually remain undeveloped have been given only a length of 5 mm. In the whole inflorescence only two kinds of internodes are stretched, the other two remain extremely short:

1° The internode between the last vegetative leaf inserted on the rootstock and the spathe leaf of the inflorescence in elongated forming the scape.

2° The following internodes of the main axis, those between the numerous bostryxes, do not stretch.

3° The first internode of the lateral partial inflorescences (= hypopodium of the bostryxes) does not elongate either, nor do the hypopodia of all flowers within the helicoid cymes.

4° But the epipodium, the internode between the prophyll and the perianth, is stretched forming the pedicel.

The internodes N° 2 and 3 build up the center of the pseudo-umbel, they form a head-like swelling at the top of the scape. Thus we may sum up that the pseudo-umbel results by the development or suppression of consecutive internodes according to a rigid plan.

In the case of the pseudo-umbellula of Fig. 19 the plant has miscounted concerning one internode. Instead of elongating only the epipodium of the first flower of a bostryx, the plant has also stretched the hypopodium (i.e. the first internode of a lateral branch or in other words the branch portion below the first, in our case single, prophyll). Thus the prophyll of the first flower has been raised 70 mm above the umbel center and since the continuation of the bostryx takes places from the axil of this prophyll we may state that the whole bostryx has been lifted (fig. 21 b, the abnormally elongated internode is drawn by a bold line). Fig. 20 shows the pseudo-umbellula at a high magnification in order to make the rudiment of the fourth flower visible and the prophylls of the different flowers. At first view the spatial relationship between each flower and its prophyll is hard to understand, because the prophyll of the first flower is inserted at the base of the third flower and not at the base of the second flower as is to be expected from the text-book-bostryx shown in fig. 21 d, in which the continuation takes place at an angle of 90°. But if you realize that it is not only the second flower which is produced from the axil of the prophyll ('1) of the first flower but that the whole continuation of the bostryx with

the flowers 2—5 and their prophylls must be regarded as its axillary bud, the position of the prophyll of the first flower is no longer a problem (fig. 21 c). These relations become still clearer if you follow up the prophylls of the second until the fourth flower ('2 to '4) and finally you find the rudimentary bud of the fifth flower just between the fourth flower bud and its prophyll.

Hannibal (1943) speaks of a secondary branching of the pedicels. After the above demonstration, it may be self-evident that there is no branched pedicel, but that a peduncle has developed. The normal pedicels and the peduncle of our pseudo-umbellula are not homologous structures. Concerning the question, whether the structure described by us and that depicted by Hannibal (1943) are of the same type, I think, there cannot be any doubt about it. Let me enumerate the following points of circumstantial evidence: (I) An increase in length of the consecutive pedicels has been noted in both cases: 2 mm for the first flower, 16 mm for N° 2 and 32 mm for N° 3 of my specimen; and 4 mm, 15 mm, and 25 mm in Hannibal's report. (II) the threadlike prophyll of the first flower is visible on the photo by Hannibal (1943), in our fig. 2 only its cicatrice is depicted. (III) All the observed pseudo-umbellulas concurred even in the unimportant detail that they consisted of three flowers. *(to be continued)*

REGISTRATION OF NEW AMARYLLID CLONES

Mr. James M. Weinstock, *Registrar*
10331 Independence, Chatsworth, Calif. 91311

This department has been included since 1934 to provide a place for the registration of names of cultivated **Amaryllis** and other amaryllids on an international basis. The procedure is in harmony with the International Code of Botanical Nomenclature (edition publ. 1961) and the International Code of Nomenclature for Cultivated Plants (edition publ. 1958). Catalogs of registered names, as well as unregistered validly published names, will be published from time to time as the need arises. The first one, **"Descriptive Catalog of Hemerocallis Clones, 1893-1948"** by Norton, Stuntz and Ballard was published in 1949. Additional catalogs of cultivars have been published since 1949: **Catalog of Brunsvigia Cultivars, 1837-1959,** by Hamilton P. Traub and L. S. Hannibal, PLANT LIFE 16: 36-62. 1960; Addendum. PLANT LIFE 17: 63-64. 1961; **Catalog of Hybrid Nerine Clones, 1882-1958,** by Emma D. Menninger, PLANT LIFE 16: 63-74. 1960; Addendum, PLANT LIFE 17: 61-62. 1961: **The Genus X Crinodonna,** by Hamilton P. Traub, PLANT LIFE 17: 65-74. 1961: **Catalog of Hybrid Amaryllis Cultivars, 1799-1963,** by Hamilton P. Traub, W. R. Ballard, La Forest Morton and E. Authement, PLANT LIFE. **Appendix** i-ii + 1-42. 1964. Other catalogs of cultivated amaryllids are scheduled for publication in future issues. These may be obtained at $8.00 prepaid from: Dr. Thomas W. Whitaker, Executive Secy., The American Plant Life Society, Box 150, La Jolla, Calif. 92038.

The registration activity of the American Plant Life Society was recognized when at the XVIth International Horticultural Congress, Brussels, 1962, the Council of the International Society for Horticultural Science designated the American Plant Life Society as the Official International

CONTINUED ON PAGE 128.

3. GENETICS AND BREEDING

GUIDELINES FOR AMARYLLIS BREEDING

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The relatively long generation time for flowering amaryllis from seeds can seem discouraging for the beginning breeder of these plants. So, one who plans a breeding program should start with established plants, those available from dealers. With a few exceptions, allow a minimum of two years for the miniature species hybrids to flower and three years for the larger flowered sorts. The reward here comes from an established program. Some crosses can take five years or even longer, but from a continuing program, soon there are new forms flowering every year. I assure you that the satisfaction of flowering one's own hybrid far exceeds that of flowering a pre-treated imported bulb which requires little more than water for a floral display. You are hooked as a breeder once you have flowered your first seedling. When it is from your own cross, the joy is even more enhanced.

After obtaining some flowering size bulbs, learn the basic biology of the plant. Familiarize yourself with the floral parts involved in reproduction. And, since a prime concern will be the floral pigments, take a few minutes to observe these carefully. The large-flowered hybrids are excellent for this purpose. Tear a floral segment and observe where the pigments are located. Use at least a 10X hand lens and you will find that most of the pigments are located in the epidermal cells. The yellow and green pigments generally are not. This is an important point to note because the latter are inherited independently from those in the epidermis, the anthocyanins. A visit to a local educational institution can be rewarding if one does not have access to a microscope. A magnification of 100X will clearly show the cells containing the pigments. And, this basic understanding of the plant allows better planning of the breeding program.

Assemble your breeding collection with care. Chances of obtaining something strikingly new are slim indeed if you limit the collection to purchased bulbs from just one overseas breeder, such as the bulbs offered in most seed catalogs. These plants can be a very good start, but explore ways to increase your germ plasm base.

Use ingenuity here. In the Southern states, one often sees plants in gardens which have been grown for years in the same location. Do not overlook these plants. They have a quality you may not find in a purchased bulb, local adaptation! Floral quality may not be up to your standards, but this can be improved dramatically in just one generation. And your resulting hybrids should gain adaptation to your growing conditions. All you will need is a pollen sample, so prepare a few small plastic pots of your surplus seedlings to introduce yourself. I have found this to be infallible! But be prepared to ex-

plain amaryllis breeding. You may find someone who would like to share your interest.

Establish a liaison with other breeders. The geographic diversity of locations where amaryllis can be grown is an advantage. Species in particular can be very difficult to flower if the natural habitats cannot be reasonably duplicated. But someone else may have just the right conditions. Fortunately, amaryllis pollen is not like that of maize which generally loses viability the day it is shed. Amaryllis pollen can be mailed and stored. I have used gelatin capsules for this purpose but these are not always readily available now and do not survive well in the automated postal processing equipment. A glassine or other smooth finish paper is very suitable for sending pollen. I find glassine paper more suitable than aluminum foil because the latter can retain excess moisture on the pollen. Good pollen is as valuable as good plants so should be treated accordingly. Refrigeration over a drying agent will prolong pollen viability. If a commercial drying agent is not available, try powdered dehydrated milk, from a freshly opened package place in a tightly closed jar with the pollen. Plan trading of pollen and seeds just as you would in obtaining bulbs. If sufficient demand developed, dealers might offer pollen of select plants.

Trial and error can have rewards as well as careful planning. I reassessed some second eschelon species hybrids this past season when I noted that they had superior cold hardiness. Most variation will be found in advanced generation hybrids and it is not easy to predict for qualities such as cold hardiness and vigor. Primary crosses between two species tend to show uniformity among siblings, depending on the genetic diversity of those species as found in the wild. Traits then segregate in succeeding generations. So, it is suggested that the interested breeder attempt to make a few four-way crosses, just to observe the diversity that can be found in progeny where four different species enter into the lineage of a hybrid.

I find records of crosses essential because I am working on some traits which appear to be recessive. The objective is to bring these genes back together in new combinations. But the records are a highly individual matter. After several generations, the record keeping can swamp the breeding program. A species contribution of 1/32 can be almost meaningless in a plant with eleven chromosome pairs, even less important in tetraploid forms of the same plant.

Avoid self pollination as a general rule. This can easily be accomplished by removing the anthers before the pollen sheds. Amaryllis with supernumerous floral parts are rather rare so one can just count six anthers in removing them from an unopened bud. Inbreeding usually produces plants with less vigor, a point to note in seed propagation of those species which do set seeds by self pollination.

However, inbreeding has its place. The excellent hybrids of Dr. John Cage are a result of inbreeding to produce the stocks from which the hybrids were derived. Crosses among inbred plants of different genetic backgrounds are commonplace now in vegetables and many seed-grown ornamentals. Only by trial can one learn which crosses

from inbreds will yield the desired qualities and hybrid vigor. Chances of the hybrid vigor are much higher, though, when the inbreds have diverse origins.

Cull your junk. Subjective decisions must be made as a matter of personal taste. But do not cull just because a primary species hybrid does not live up to expectations. The hybrid has the genetic potential of both parents so may well prove more useful than either parent.

Do your homework. The novice breeder can limit potential by neglecting to read the more technical reports published in Plant Life and elsewhere. A report on chromosome numbers is pertinent to a good breeding program. If a species is reported to have 22 chromosomes (11 pairs), it may well set seeds with pollen of one of the tetraploid hybrids but will result in a triploid with little or no fertility. Such a plant may be a suitable objective as I reported in Plant Life in 1973, but the use of such triploids for further breeding is limited to those cases where the scant pollen produced by a triploid will set seeds on other plants. Knowing this, one can avoid disappointments.

Recently, I have emphasized breeding for cold hardiness in my own program. No clear pattern has emerged yet on which species contribute most to this desirable quality. It is certainly not something which can be described in terms of single gene effects. Diversity in the germ plasm which goes into the hybrids is an important consideration. One can then select from such hybrids for the multi-gene combinations which yield hardiness.

Avoid virus-infected plants. Reliable dealers should not offer infected plants for sale. Some virus-infected plants will flower, but the quality is generally less than the flowers from an uninfected plant. In some cases, there may be no alternative than to use an infected plant for breeding, but there have never been confirmed reports of the virus being transmitted by pollen or to the seeds produced on an infected plant. Virus-infected plants should be rigorously isolated from healthy stock.

END OF A BREEDING PROJECT

JOHN M. CAGE

As many friends and readers of *Plant Life* know, I have bred *Amaryllis* for about forty years with the consistent objective of creating inbred lines that are more or less homozygous for color, flower form and growth habit. Crosses between different inbred lines have often exhibited great hybrid vigor, fair uniformity, and a startling number of very fine show clones, such as 'Big Tex', 'Great Pumpkin', 'Jennie', 'Royal Flush', and 'Marlys'.

Considering the limited number of seedlings I could tend, the exhibition-quality clones compete well with the large Dutch and South African growers . Also, I had ample breeding stock of known lineage to supply a commercial venture. In spite of this promising situation,

however, commercial exploitation has not proved tenable, and since that was really my prime goal, I have terminated the whole project. I love *Amaryllis,* but without the satisfaction of commercial success, I might as well breed radishes.

This failure was not entirely unexpected. Mead, Houdyshel, McCann, and several other ambitious breeders have achieved fine results in their times, but their projects disintegrated and no one carried the projects forward. The reasons for failure are understood fairly well, but I shall not dwell upon them. My purpose here is to condense my findings for the benefit of everyone who wishes to use some of the methods. Eventually, some American will succeed commercially in *Amaryllis* culture.

First, the value of inbred parent stock is great if the inbreeding is carried far enough and selectively enough. A cursory look at the commercial vegetable and flower field shows the best varieties to be either highly inbred lines (the 'Marglobe' tomato, etc.) or crosses between different inbred lines ('Big Boy', 'Early Girl', etc.).

The problem with the inbreeding of large-flowered *Amaryllis* is that they have been interbred for so many generations. The Dutch have achieved uniformity of color lines, but no distinct family of homozygous lines seem to exist for achieving heterosis, or hybrid vigor. I would still recommend selfing as the ultimate inbreeding if one can grow very large populations, but self-sterility becomes a very severe problem after a few generations at most.

For the breeder with modest facilities, I recommend sibling crosses and back-crosses to work further and further toward the desired uniformity of characteristics. One should preferably start with stock that has already been inbred to some extent. At least two distinct lines of each desired color should be sought, although an inbred red, for instance, can produce excellent results when crossed on an inbred orange or salmon.

Another approach for the breeder who has only one inbred strain of a given color is to cross it on selected Dutch clones of the same color. I have found hybrid vigor to occur frequently in this case, and this seems to indicate further that considerable homozygosity exists in some of the Dutch lines.

If the breeder does resort to inbreeding by selfing, the following suggestions may be helpful. I have observed that when a hundred seedlings of a very good self-pollinated mongrel hybrid, such as 'Red Lion', are grown, only about one or two prove superior in form and color. The best two can usually be sib-crossed to yield the next generation, in spite of sterility tendencies, and then sibling crossing can be continued, or perhaps another selfed generation can be obtained. If a very good seedling is obtained after only *one* selfing, then I have usually found that seedling to be a far better breeding parent than the original mongrel. It may not grow vigorously, but crosses with a different line usually have outstanding vigor.

To introduce a new character (for instance, new color, new growth habit, or new size) to an inbred line, it is often desirable to cross with a

specimen outside the line. In this case, I recommend that the offspring be sib-crossed or back-crossed in the inbred line to retain all the traits of the inbred line *except* the new desired trait. It must be remembered, however, that the new desired trait may be recessive and that several more generations of sib-crosses may be required before the new trait appears. It may be masked by dominant genes so thoroughly that the breeder discards the wrong seedlings. Careful records and a touch of intuition are helpful here.

A special case of the above effort occurs when one wishes to introduce a trait of a species, say the dots of *A. pardina,* into a large-flowered inbred line. Most large hybrids are tetraploid and most species are diploid. The triploid progeny of hybrids between the two are often sterile. Besides, the desired diploid trait is diluted and often lost in the hybrids. Tetraploid mutants of the species would be highly desirable for this kind of breeding, and at least one competent professional is gradually working in this direction. For the present, I can say that the introduction of species traits is difficult but possible. Tetraploids will occasionally cross with triploids, and the beautiful 'Marlys' and her line relatives derive their color patterns of dots and flushings from *A. lapacensis.* Also, 'Great Pumpkin' gets its color and plant size from a form of *A. aulica.*

I have no remaining breeding stock or available clones. May my pets bring joy to those who now have them. One seedling (clone) I have tentatively called 'Scarlet Hero'. If this one does not win first awards at shows, I shall complain bitterly to its owner.

A FRAGRANT TRI-SPECIFIC AMARYLLIS HYBRID

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On January 6, 1972 Leonard Doran gave me a small vial with a just sprouted seedling in water. He said it was Dr. Cardenas' "Sumac Pinini", a cross of *Amaryllis neoleopoldii* and *A. pardina.* The name "Sumac Pinini" means "most beautiful flower" in the Aymara Amerind language of Bolivia and Peru. The tiny seedling grew very well, and in about three years produced blooms very much like *A. neoleopoldii,* a little larger but lighter in color, and with quite a few dots.

On April 4, 1975 a bloom of this plant was pollinated with pollen from *A. fragrantissima.* I had a very small amount of pollen, but it was successful to the extent that I got several viable seeds. These were planted and in April of 1978 the first one bloomed with two flowers. The bowers were *almost seven inches across the face,* and about six inches long from ovary to the bell, white in color, but with so many red dots it appears to be pink. The dots give way to red veining on the outer part of the segs, and a narrow red picotee is almost unnoticed. The exterior part of the segs is white with many red dots. It is altogether a very handsome flower, but I have saved the best part until the last; *it is very fragrant, deliciously fragrant.*

A second bulb of this cross bloomed this year, and it is very much

like the first. It seems to have more color in the throat, and fewer dots, but it has a very good fragrance. The bulbs are slow growing but seem to be sturdy. However, they do partake of the stubborness both parents seem to have about resuming growth after a period of dormancy. They bloom from a bare bulb, and are very slow to put out leaves, but when they do, the leaves come strongly in a large fan. It is believed that this is a very worthwhile addition to our *Amaryllis* germplasm pool.

FURTHER NOTES ON HYMENOCALLIS HYBRIDS

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Last year, the writer reported on several new *Hymenocallis* hybrids, some of which, at that time, had not yet flowered. Since then, a few of these hybrids have flowered, and it was felt that the readers of PLANT LIFE should be brought up-to-date on them. A few merit clonal names to identify the cross.

'Invicta' (T. M. Howard) H. species #57-3 (Jacala, Hidalgo, Mexico Cultivar) ♂ x *H. traubii* ♀ This hybrid lived up to all its genetic promises. The flowers are quite large and well shaped, and nicely typify what the *Hymenocallis* genus is all about. There were seven flowers in the umbel. The flowers themselves were well proportioned in relation of the cup to the segments. The cup was spreading and flat, and the segments spead and recurved slightly and gracefully. Substance was about as good as can be expected for the genus in general. Flowers opened one or two at a time with each flower lasting (in our very warm summer climate) about 2-3 days. Maximum display at any time was about four flowers. The flowers seem to be sterile. Compared to its parents, 'Invicta' has a vastly much more diminutive size overall, than #57-3 from the Jacala, Hidalgo, Mexico garden. But compared to *H. traubii,* its other parent, the bud count of the umbel has increased from 2-3, to about seven, while retaining most of the miniaturization of the plant. Individually, the flowers are a bit smaller than those of *H. traubii,* but this is hardly noticeable since the segments recurve quite a bit more. The new hybrid was christened 'Invicta'. This hybrid increases fairly rapidly by offsetting and by equal splitting of the mature bulb. It is felt that 'Invicta' will prove to be a valuable acquisition for pot culture, and in gardens as well. It has no major faults and an awfully lot of good things to make it desirable. The flowers are large enough and produced in sufficient quantity, with broad, flat, showy cups emitting a nice fragrance. The plant is hardier than most, since one of the parents is a native of upper mid-Florida, and this assures a garden-hardiness, at least in the lower to mid-south. The plant is dwarf enough to make it desirable for pot culture, where space needs must be considered.

'Excelsior' (L. Bundrant). *H. Narcissiflora* ♂ x *H. traubii* ♀ If ever a hybrid was spawned by more promise and optimism, and then lived up to every wish dream, 'Excelsior' is it! A few hybrids have

been achieved by combining the most desirable genes of the subgenus Ismene with the subgenus Hymenocallis, but it is doubtful if any have been as artistically successful as 'Excelsior'. Indeed, it has surpassed even the most optimistic dreams of those involved with it from the start! Experiments to date had shown that the few combinations of the subgenus Ismene with the subgenus Hymenocallis had somehow lost a bit in the transition, with Ismene sacrificing the most important charac-

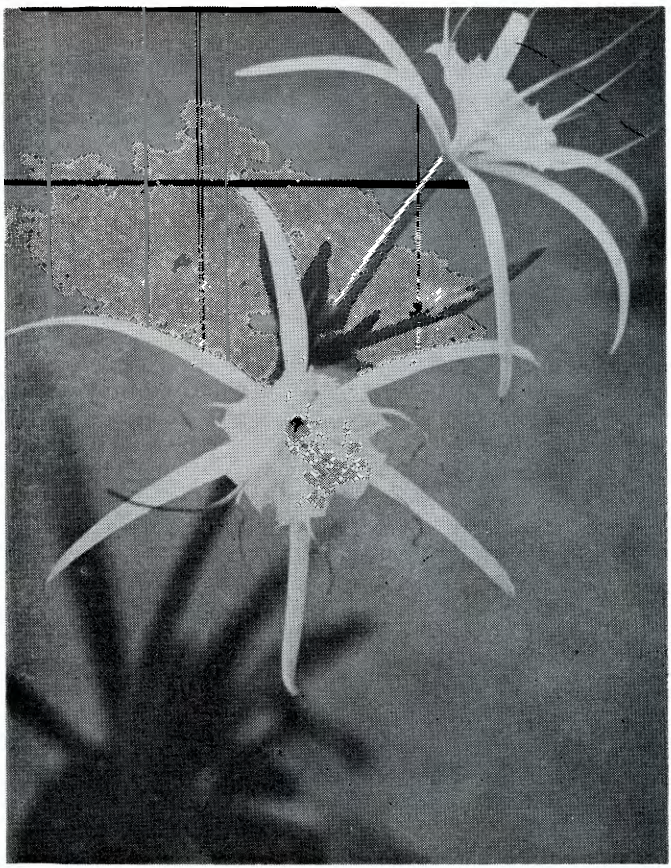

Fig. 22. Hybrid **Hymenocallis** clone 'Invicta' (Howard), **Hymenocallis traubii** ♀ x **H.** sp. #57-3 (Hidalgo, Mexico cultivar) ♂.

teristics in the process. Such is not the case with 'Excelsior'! Both parents have quite large flowers and it was inevitable that it and its siblings would likewise have large flowers. *H. traubii* is a relatively miniaturized plant (for the subgenus Hymenocallis) and relatively hardy, and thus it was no surprise to find that its hybrids inherit characters for miniature size and cold-hardiness. Thus it was a most

pleasant surprise that 'Excelsior' inherited the incurved Ismene-like stamens from *H. narcissiflora,* along with the short, curved floral tube, orange-yellow pollen, huge fringed cup, and slightly curved segments. The *H. narcissiflora* genes gave the flowers better-than-average substance, and the overall habit of the plant an Ismene-like appearance, psuedo-neck below the leaves, and all. The flowers are simply huge, compared to the overall proportions of the entire plant, with staminal cups nearly four inches in diameter. They are pure white, save for a yellow-green "eye" deep in the throat. The cup itself is artistically

Fig. 23. Hybrid Hymenocallis clone 'Excelsior' (Bundrant), **Hymenocallis traubii** ♀ x **H. narcissiflora** ♂.

formed with six lobes, each of which is delicately fringed. Segments are spreading and curved, but the upper segment slightly flops to one side instead of arching upward, due to its weight. Fragrance is quite sweetly pleasant.

'Excelsior' first flowered June 21, 1979 with seven buds in the umbel. The scape was 78 cm tall. The slightly curved tube was 9 cm long and slightly curved. The segments were 11.3 cm long and 1½ cm

wide, really impressive for a member of this genus. The cup itself was equally as impressive, being fully 9 cm wide and 7.5 cm long. Filaments are incurved, white, and 2½ cm long. The full spread of the flower is 19 cm (7½″).

'Excelsior' was the first of three siblings to flower, and was perhaps the best, although all three were essentially similar. They differed mainly in height of the scape, and in very minor floral details. All were exceedingly attractive and certainly this cross will prove a most welcome addition to the small field of *Hymenocallis* hybrids. Since *H. traubii* enjoys aquatic culture, it comes as no surprise that its hybrids do likewise. The culture is very simple. They can be potted in any good rich potting mix in a suitably sized small pot and the pot can then be set into a small container that will retain water. This will give them a good duplication of swamp conditions. In other words, they do not mind that their "feet" are wet.

We feel that both 'Invicta' and 'Excelsior' will prove to be welcome additions to the very small group of *Hymenocallis* suitable for growing the year round as pot plants. They take up no more space than most of the smaller Amaryllids, and they have an etherial, orchid-like quality that makes them unique. With 'Excelsior' we have combined the best of the subgenus Ismene with the best of the subgenus Hymenocallis giving a gorgeour Ismene-like flower on a very small plant and bulb.

Much less successful was a cross involving *H. narcissiflora* ♂ x *H. tenuiflora* ♀. The latter (seed parent) was collected by the writer in Guatemala in 1973, and is the true species. The cross was made by Luther Bundrant, but the results were apparently maternal. True, the foliage appears to be a bit more narrow and a bit more erect than that of *H. tenuiflora,* but the flowers were identical in all respects to the seed parent with no trace of the subgenus Ismene whatever. We are not yet positive if we have a weird hybrid, or simply a varient maternal seedling. Certainly we can find no evidence of *H. narcissiflora* in any of its habits or in its flowers at this time.

At this writing, a hybrid of the writers, involving *H. liriosme* x *H. narcissiflora* has yet to flower, but surely will do so in early summer of 1980. There are two siblings, and they show signs of genuine hybridity in the overall habits of the plants. Last winter they were left outside in an unusually cold spell (for us) and survived ten degree temperatures while frozen solid in a container with much water. This was not totally contemplated, as the cold spell was unusually early and unusually severe. Yet, the writer felt that since *H. liriosme* (a hardy native) was one of the parents of these hybrids, they should survive. They did. This might be considered a form of "trial by ordeal" but it does indicate that perhaps these hybrids may be a bit more flexible to cold than is generally supposed. Perhaps next year the writer can report on the flowering of these two clones. By then we should know if these hybrids are equal in beauty to Len Woelfle's 'Buckeye' and Luther Bundrant's 'Excelsior' while uniting the lovely subgenus Ismene with the hardier native North American members of the subgenus Hymenocallis.

ADVANCES IN CRINUM BREEDING

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Nearly a decade has past since Les Hannibal published his booklet on *Crinum* species and hybrids with its key on how to identify most of them. To be sure, this publication was not the last word, but it did indeed open new doors that gave us even more insight than before. For the author, Hannibal's article served as the needed stimulus to attempting some new and fresh approaches to the neglected field of *Crinum* hybridization. Where there might be reason for speculation as to the ancestry of some of the hybrids discussed by Hannibal, attempts were made to duplicate or simulate certain hypothetical pedigrees to see if the formulas would work. As a result, some of the conclusions were upheld, and some were not. But more importantly a whole new raft of information emerged. Not only were some old hybrids duplicated or simulated, but some new ground was broken with some strange new crosses perhaps never before attempted.

RED AND ROSE-FLOWERED HYBRIDS

For years, 'Ellen Bosanquet', and its offspring were the enigma of the *Crinum* world. The question had been posed as to how the red color was achieved. The reader is referred to my report in *PLANT LIFE* 1960, p 107, *HIGHLY COLORED CRINUMS AND A NEW HYBRID,* in which the writer discussed an interesting red-flowered clone achieved from a random cross of *C. scabrum* with an odd white-flowered form of *C. bulbispermum.* The clone was named 'Thaddeus Howard', in honor of my father. The cross was made in 1950 and first flowered in 1954. Though a very attractive clone, it had its drawbacks, which are too numerous to list. Acting on a whim, in 1962 the writer decided to try backcrossing the clone onto a different form of *C. bulbispermum.* Several siblings resulted, but the best of these flowered four years later (1966) and has proved to be one of the finest *Crinum* hybrids cultivated. Simply stated, the new hybrid had all of the virtues of its parent, but without the faults. As if this were not enough, there were some added features that made the clone unique, the most notable of which was a random variegation of the tepal coloring from one blossom to the next. This occurs in more or less a descending order, with the first flowers opening being the darkest and the last to open being the lightest in color.

Compared to 'Thaddeus Howard,' the new hybrid had a higher bud count, with the buds more resistant to scorching in the sun. Due to its variable variegation, the new clone was christened 'Carnival.' The name seemed apt for their is a festive look to the plant. The base color is a deep rosy-red with an even darker midrib and perhaps about a third of the flowers in the umbel will be so simply colored. The rest of the flowers will vary from the base color with only a stipling and stitching of narrow white or pink lines, to those having boldly stitched broad pink markings randomly placed to give a calico effect. A very

few (generally towards the end of the flowering) will even be pure white, with only a rosy-red stripe (like a typical striped form of *C. herbertii*) and often all of these patterns can be seen on the umbel simultaneously! The effect is a kaleidoscope of harmonizing colors with no two flowers exactly alike. Unlike its parent, 'Carnival' seems to have no faults. The increase is steady, the number of scapes produced is on par with other hybrids with 12-16 flowers, the scape is stoutly erect and never flops over, the flowers are sessile in the umbel and tilt upward, with up to nine open at one time making a large but compact bouquet. The color is bright and can be seen from quite a distance. Pollen is fertile and occasionally 'Carnival' will set a few seed. If it can be faulted at all, it is only that the robust bright green foliage can become a bit rank when well grown. Actually it is no worse in this regard than a host of other hybrids and species.

Several theories have been offered to explain the strange variegation of the flowers in 'Carnival'. Perhaps the most far-fetched explanation was that it is a chimera, that is, longitudinal variegation down the central axis of the plant from top to bottom. This would normally be seen in irregularly striated foliage, stems, and flowers. But this is not the case at all. Neither the foliage nor stems of 'Carnival' have any variegation whatever. The leaf color is an even bright shiny green and the stem is a slightly rusty green. The flowers seem to follow no pattern as to which are variegated and which are not, only that the first to open are the darkest and the last are the lightest. The variegation increases with the opening of each additional flower in the umbel, but the order of opening is random.

Others have suggested that a virus is the culprit, but I doubt that, as the foliage has been clean and healthy and there has been no hint of any malady, viral or otherwise. Still others have suggested that the variegation will "run-out" in time, and that the offsets will lose this character in time. We have not found this to be so. After flowering this clone for thirteen consecutive years, including third generation offsets, 'Carnival' is just as flashily variegated as the original bulb. We are inclined to think that the fantastic coloration is permanently a part of its character.

In 1974 the writer made a cross by applying pollen from 'Carnival' to 'Cecil Houdyshel.' Two seedlings were obtained, one of which flowered in 1978. In an indirect, round-about way, these hybrids united two old classic hybrids, *C.* x *powellii* and *C.* x *herbertii.* I had no idea what the new clone would look like other than at the very least it ought to be a very strongly colored pink with perhaps a red mirib. This was an understatement. After 28 years of hybridizing I had finally achieved that most illusive of all colors in *Crinum* breeding—a rich, dark wine-red, and without having to resort to 'Ellen Bosanquet' and its offspring! The new hybrid also had the incredible variegations of its pollen parent 'Carnival'. 'Ellen Bosanquet' was flowering at the same time, so it was easy to compare the new hybrid with it. The hybrid was dubbed 'Mardi Gras'. Compared to 'Ellen Bosanquet,' the flowers of 'Mardi Gras' are slightly smaller and shaped differently,

about the same coloring on the interior and a bit darker and waxier on the exterior. There is very little odor to the flower. The foliage of 'Mardi Gras' is like that of all the *C.* x Herbertii hybrids, but a very slightly duller green. 'Mardi Gras' joins that ultra-exclusive group of Crinum hybrids in which both parents are hybrids. Indeed, even one grandparent is likewise a hybrid. There are only a handful of known hybrids in existence in the Crinum world in which there are two hybrid parents, and where one or more grandparents is likewise a hybrid.

As for the future of 'Mardi Gras'? Well that remains to be seen how well it will be eventually accepted. It is colorful, lovely, and unique in its own right, and all who have seen it have admired it. But it IS the same color (with slight modifications) as the comparatively common (and cheaper) 'Ellen Bosanquet'. If for no more reason than economics, it is no threat to ELLEN BOSANQUET. MARDI GRAS does show just how far the gene for red can be carried and intensified from its origination in *C. scabrum.*

'Mardi Gras's' behavior has us puzzled for the moment. Initially, the flowers were as variegated as those of its pollen parent 'Carnival', being a deep wine red streaked with white lines and pink feathering along the edges. We concluded that the character was hereditary. In its maiden flowering voyage, floral substance was only fair, with the flowers withering in the late afternoon. Then in its second year of flowering all of this changed. The flowers were completely self colored with no trace of any variegation, and the substance was much better, with flowers lasting two nights and two days before withering. We are at a loss for an explanation as climate conditions and other environmental conditions were essentially the same both times.

CRINUM × WORSLEYI HYBRIDS

In 1974 the writer duplicated a very old cross, *C.* x Worsleyi, by pollinating *C. mooreii* var. *schmidtii* with pollen from *C. scabrum.* Actually, mine was the reciprocal cross, since the original hybrid had *C. scabrum* as the seed parent. Four seedlings resulted and two of these flowered in only an amazing *two* years! The robustness was unreal. The third year an additional clone flowered. The flowers are quite nice, of a dark rosy-red with a darker midrib. They seem to be intermediate between the two species parents. Of the three, one is taller, one shorter, and one intermediate in height. One has darker red flowers, one is lighter red, and one is again intermediate. One opens rather widely and looks like a deep pink form of *C. scabrum* and even smells like it. They seem to grow well, increase fairly well, and have the most luscious-looking leaves of a light, glossy green. This cross really needs to be fully probed through duplication by others. There is just enough variation between clones to justify selecting only the best. And few can boast of vigor resulting in flowering from seed in only two years.

In his publication, Hannibal suggested that the Australian hybrid, 'George Harwood' was a clone of *C.* x worsleyi. Actually neither the original description of *C.* x worsleyi by Arlington Worsley himself, nor

the more recent experiments in the duplication of this cross seem to support this. Foliage of the true *C.* x worsleyi of both breeders (Worsley & Howard) shows that it is intermediate between *scabrum* and *C. mooreii var. schmidtii.* The foliage of 'George Harwood' in contrast is very low, very narrow and spreading. The bud count is relatively low (about 6). The writers duplications have intermediate, heavier foliage that is more nearly erect and arching. It is taller and much wider. The bud count is double that of 'George Harwood', and the flowers are shaped more like *C. scabrum.* It is inconceivable that anyone could ever confuse these *C.* x worsleyi forms with 'George Harwood,' once having seen them in growth and in flower. We can only speculate as to the true parentage of the stalwart 'George Harwood.' That *C. mooreii* or *moorei var. schmidtii* played a part is a fairly safe assumption. My guess is that GEORGE HARWOOD has a fairly complicated pedigree with the likelihood of at least one parent being a hybrid, such as 'Bradley,' which is another Australian hybrid, with equally narrow foliage and somewhat similarly colored flowers which are even darker. Unlike 'George Harwood', the flowers of 'Bradley' show a much closer affinity to *C. scabrum.* Indeed, the flowers of 'Bradley' have all the earmarks of *scabrum* in the individual flower, including the red midribs. Hannibal has suggested that 'Bradley' may be the result of a cross between *C. scabrum* and *C. flaccidum.* In this instance I am inclined to agree. Regardless of its pedigree, 'Bradley' is one of the finer hybrids. Technically it is not "new" for it has been in existence for many decades, but it is only now getting into circulation with collectors.

In 1974 I back-crossed 'Bradley' pollen onto *C. scabrum.* The result was a very lovely little pinkish-red hybrid with a fine red midrib. The flowers were delicate and shaped much like *C. scabrum.* The first year it flowered the bud count was only three and then this year it "sky-rocketed" to only four. 'Tis a pity too, since there is much quality to be enjoyed in this flower, which otherwise resembles *C.* x worsleyii to some extent.

It appears that we now have enough data on the breeding habits of *C. scabrum* to give us some idea as to what we can expect from it. The color of the progeny really depends on the opposite parent, and therein lies the rub. *Crinum scabrum* itself can only do one of two things in transmitting its dark red stripe in its offspring: The pigmentation can either remain as an undilluted or partly undilluted stripe, varying in intensity, or it can break down and spread, giving a rosy-red flower with darker midribs. The opposite parent either allows the stripe to remain, or allows the breakdown and spreading of the pigment. The writer's experience is that there are no hard and fast rules. Ordinarily if *scabrum* is crossed with certain species having white flowers, one might normally expect a striped flowered hybrid. This has been experimentally done with crosses involving *C. americanum,* and *C. bulbi sperum alba.* But in one instance I got a red flowered hybrid ('Thaddeus Howard') using *C. bulbisperum alba.* Likewise, all crosses involving *scabrum* with *C. mooreii* var. *schmidtii* (=worsleyii) have been rosy-red with red midrib. Experiments of *scabrum* x. *loddigesianum*

likewise have given striped hybrids. These were somewhat similar to *C. submersum.*

Experiments using *C. scabrum* x 'Maiden's Blush' *(moorei* x *zeylanicum)* have given us a striped hybrid. This, in spite of the *moorei* genes which should have forced a pink color. When *scabrum* was crossed with 'Seven Sisters' *(americanum* x *bulbispermum),* a couple of very lovely little hybrids resulted having the color and form of *scabrum,* but smaller in size and having a different floral odor. They were really "mini-*scabrums*" and quite attractive. Flowers were only about half as large, and the bulb and foliage were likewise reduced by half. The flowers had the same startling coloring as *scabrum,* and appear as if they might make nice plants for a greenhouse where space is limited. Other *scabrum* crosses have been attempted but have not yet flowered. They will be reported on later.

The hybrid 'Cecil Houdyshel' has turned out to be a real surprise as a breeder. For years most of the work done with it had been of little importance since most of it involved backcrosses with other x Powellii forms and the result had been a host of varying forms of *C.* x Powellii. It was only when 'Cecil Houdyshel' was outcrossed with other hybrids and species that some uniquely fine new hybrids emerge. The late Mr. Cecil Houdyshel who created this venerable old hybrid first came up with an unusual new cross when he used the pollen of J. C. Harvey *(Mooreii* x *zeylanicum)* on it. The result was 'Virginia Lee.' This latter hybrid still exists but is very scarce. The flowers are a bright deep pink with a white center and there are many flowers open on the scape at one time.

The late Grace Hinshaw saw possibilities in using 'Cecil Houdyshel' as a breeder and attempted several hybrid crosses. The first, 'SUMMER GLOW,' was a result of 'Cecil Houdyshel' x 'Ellen Bosanquet.' This was a rosy-red hybrid of merit. It is not known if it still exists, but perhaps it may in someones private collection. The second cross was 'Cecil Houdyshel' x *C. americanum.* Mrs. Hinshaw got two seedlings, one white flowered and the other pink flowered. I have the pink one which she named 'Elina,' and it is very lovely with deep rosy-pink flowers the same color as 'Cecil Houdyshel,' and with flowers intermediate in form between the two parents.

Fred B. Jones of Corpus Christi, Texas, made a chance cross on 'Cecil Houdyshel' using pollen from 'Peach Blow.' On paper this was an outrageous cross and a very unlikely union of various *Crinum* genes! The hybrid 'Peach Blow' is steeped in enigma as to its parental origin. One authority has speculated that it is a *C. submersum* hybrid going so far as to state that any other possibility would be "nearly impossible". This in itself is an absurdity, since we really don't know if one or both of the parents of 'Peach Blow' were species or hybrids. Indeed, there are quite a few other possibilities. No matter. What really concerns us here is that Fred Jones got a seedling and gave it to me prior to its flowering. I flowered it in San Antonio, and it was a most impressive new hybrid which I named 'Emma Jones' in honor of Fred's wife. The flowers are huge, opening widely, with a rich rosy-

pink coloring and pleasing fragrance. Like 'Peach Blow,' the scape grows too tall and is inclined to flop to the ground with the weight of the flowers and requires staking. But 'Emma Jones' is a stunningly fine hybrid with many good habits.

And finally we have 'Mardi Gras,' (which we have already discussed). As a hybrid of 'Cecil Houdyshel' x 'Carnival.' In this case we got a dark wine-red flower with waxy texture. These crosses are only the tip of the iceberg. We must conclude that 'Cecil Houdyshel' is a very excellent breeder that can give us flexible crosses that are fully intermediate between it and the other parent. Such hybrids should be vigorous, fairly hardy, and easy to grow and flower. The reader must be warned that 'Cecil Houdyshel' is only moderately fertile and the percentage of seed harvested will be quite low. Often there will be no seed at all, or occasionally only one or two seed. But the efforts will be well worth it. The other parent can be a species, but it would be more fun to use the most frivolous hybrid to combine with it, such as 'PEACH BLOW', or whatever else comes to mind.

In 1961 the writer attempted reciprocal crosses between *C. moorei* and *C. zeylanicum*. One seed was obtained from each cross. It took almost fifteen years for them both to flower, although they seemed to have plenty of vigor as they pushed along. Ordinarily such a cross should have given pink-flowered hybrids, considering that *C. mooreii* was a parent. Such was not the case at all. Both hybrids were very similar save that one was taller than the other. The taller was named 'Maiden's Blush' and the shorter was named 'Old Maid'. The flowers were mainly white, with just a hint of pink in the exterior and a hint of a pinkish midrib. They are fragrant and look very much like white forms of the old 'J. C. HARVEY' save that they are a bit more robust. There has been some speculation as to the correct identity of the parents of 'J. C. Harvey.' Mr. Harvey, the originator declared the parents as *C. mooreii* x *C. kirkii,* but we now know that the bulb of the plants distributed under the epithet "C. Kirkii" at that time is what we now accept as correctly being *C. zeylanicum.*

Thus it is reasonable to assume that the correct emmended parentage of 'J. C. Harvey' should be *C. mooreii* x *C. zeylanicum.* In spite of all the pompous balleyhoo from the past, there is no evidence to prove that the true *C. kirkii* has played much, if any, part in *Crinum* hybrids developed in this country. It is *C. zeylanicum* that is the imposter. My own 'Maiden's Blush' and 'Old Maid' add weighty evidence to support this theory. One authority suggested that *C. yemense* x *C. moorei* created 'J. C. Harvey', using the depressed midrib of the leaf as the reason, since *C. yemense* has such a leaf. But so does *C. zeylanicum.* The writer has seen and grown both *C. zeylanicum* and *C. yemense* of late, and anyone seeing the two together can clearly see that all three of the above hybrids ('J. C. Harvey,' 'Old Maid', 'Maiden's Blush') more nearly resemble *C. zeylanicum* more in the leaf than they do to *C. yemense,* even though there is some similarity in the foliage of the two. It is apparent then, that when we speculate on unknown parentages of various hybrids, we are apt to read into them whatever

we choose, within the limitations of our experiences and knowledge. Such speculations are both fun and challenging, but they really lead nowhere unless we have the necessary proof to support them. There is no better proof than actually attempting a given cross and then successfully growing it until it can be flowered.

HYBRIDS OF **C. SCABRUM** WITH **C. AMERICANUM** AND ITS ALLIES

In 1974 the writer attempted to repeat an old hybrid cross, *C.* x digweedii, involving *C. scabrum* with *C. americanum.* In this case the *Americanum* form was var. *robustum* which served as the pollen parent. Hybridity was immediately evident in the numerous round seed produced, but the mortality rate of these reduced the population down to only a few seedlings. The seed rotted easily. Four years later, the writer was surprised to find one of the clones flowering late in the summer, and looking for all the world like *C. scabrum* from a little distance away. Closer examination showed it to be a new hybrid, intermediate in form and size between the two parents, but identical to *C. scabrum* in coloration . . . white segments with a scabrum-red stripe.

At about this same time, Luther Bundrant was making a somewhat similar cross, paralleling *C.* x digweedii, but substituting *C. loddigesianum* from Mexico instead of *C. americanum.* In this case, *C. scabrum* was the pollen parent. The first of these siblings flowered in 1978, and looked to be very much like *C. submersum* in appearance. Since then, several more siblings have flowered and all are similar with only minor variations. Basically the flowers are white with pink keels, fragrant, and opening widely. Some are reddish on the exterior. Foliage is a rich deep green and somewhat erect. Offsets are freely formed.

It is obvious that *C. scabrum* has been a useful tool in the creation of both red-flowered and striped hybrids. We have but barely tapped its full potential. Perhaps the best hybrids still are to be hybridized in the future, using *scabrum* as the seed parent with the pollens of various existing hybrids. The field is still wide open.

(This is the first installment of a two part article on *Crinum* breeding. The second installment will appear in the 1981 PLANT LIFE.)

STERNBERGIA CANDIDA AND NEEDED BREEDING PROJECTS

In the July THE GARDEN, The Journal of the Royal Horticultural Society, Vol. 104(7) : 302-303. 1979, Brian Mathew reports on the discovery of a white *Sternbergia.* Its nearest relative is *S. fischeriana* (Herb. Rupr.), a yellow spring-flowering species native to Turkey, Iraq, Syria and Transcaucasia., which usually has narrower tepalsegs less than 4 cm. long, and at most 1.3 cm. wide.

STERNBERGIA CANDIDA MATHEW & T. BAYTOP

In the Garden (J. Roy. Hort. Soc.) 104(7) : 302-303., color Fig. 1979.
Holonomenifer : Turkey C2 Mugla, near Fethiye, in Mugla vilayet

(province)/14.1.79, T. Baytop ISTE 41750. *ISONOMENIFER* E! ISTE. "As far as is known *S. candida* is confined to this small area of southwest Turkey. A collection made in 1975 by T. Baytop, C. D. Brickell and B. Mathew (No. 8364), further to the east in Antaya Province, may also be this species" but it had not flowered in cultivation by 1979.

Brian Mathew is stationed at the Royal Botanic Gardens, Kew, England, and T. Baytop is on the Faculty of Pharmacy, Istanbul University.

Description.—*Bulb* 2-3 cm. diam., with an elongate neck up to 15 cm. long. *Sheathing leaf* 1, membranous. *Leaves* synanthus, usually 4, lorate, flat, greyish green, 8-11 mm wide. *Scape* about 12-20 cm. long, slightly exceeding the leaves at anthesis. *Spate* 1-valved, 5-5.5 cm. long, completely enclosing the bud. *Umbel* 1-flowered; *flower* fragrant, white, funnel-shaped or sometimes with the tepalsegs more or less spreading. *Pedicel* absent. *Ovary* 1-1.7 cm. long. *Tepaltube* about 5 mm. long. *Tepalsegs* oblanceolate to obovate, obtuse, 4.3-5 long, 0.9-1.8 cm. wide. *Stamens* of slightly unequal lengths, *filaments* slender, white, 1.3-1.6 cm. long. *Anthers* yellow, 4-8 mm long, depending on age. *Style* slender, 4-4.5 cm. long, with capitate *stigma*. *Capsule* 2.5-3 cm. long and about 1-1.7 cm. wide. *Seeds* several, large, more or less globose, 4 mm in diameter with a fleshy aril about 3-4 mm long. *Flowering* January-February. In scrub and stony places at edge of *Cedrus* forest.

NEEDED BREEDING PROJECTS

It is high time that amaryllidarians begin *Sternbergia* breeding projects. Pollen of the spring-flowering species can be held over to fall under refrigeration in order to cross with the fall-flowering species and *vice versa*. The chromosome number in *Sternbergia* species can be doubled with colchicine treatment to obtain larger plants and an increase in size of flowers. This is an opportunity that has been missed so far. *Sternbergias* are of the easiest culture in the United States.

The following species of *Sternbergia* have been reported. The validity of specific rank for some of these requires confirmation :

1. *S. caucasica* Willd. in Ges. Naturf. Fr. Berlin Mag. ii. 27. 1808. Causacus.
2. *S. citrina* Ker-Gawl. ex Schult. f. Syst. vii. 795. Greece.
3. *S. colchiflora* Waldest. it. Pl. Rar. Hung. ii. 172. pl. 159.
4. *S. fischeriana* Rupr. in Regel Gartenfl. 100. pl. 576. 1868. Caucasus.
5. *S. lutea* Ker-Gawl. ex Schult. f. Syst. vii. 795. Medit.
6. *S. macrantha* J. Gay ex Boiss., Fl. Or. v. 148. 1884. Asia Minor.
7. *S. spoffordiana* Dinsmore in Fedde. Repert. xxiv. 302. 1928. Palestine.
8. *S. alexandrae* Sosn. in Trud. Bot. Inst. Akad. Nauk. SSSR Azerb. Fil. Baku. ii. 269. 1936. Azerbaijan.
9. *S. candida* Mathew & Baytop. The Garden (j. Roy. Hort. Soc.) 104(7) : 302-303. color fig. 1979. southwestern Turkey.

Apparently the best sources of *Sternbergia* species are from Botanical Gardens in the Soviet Union, Hungary, Greece, Turkey and other Middle Eastern countries. Kew Gardens may have *Sternbergia candida.*

Pollen of *Sternbergia* species in stoppered vials can be stored in the refrigerator for use in spring or autumn. —*Hamilton P. Traub*

DOUBLE AMARYLLIS UPDATE

JOHN WADE DEME,
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Since my last article, I have been evaluating my registered doubles for summer blooming doubleness. During the hottest part of the summer, doubles tend to go semi-double; in the fall and winter they become very double again. I have found several that seem to keep their full doubleness during this hot period. These doubles are now being used to make some crosses.

Fig. 24. Double **Amaryllis** clone produced by John Wade Deme.

I have a batch of F3's that bloomed in the spring of '79. I tagged about 10 out of 300 seedlings for a second blooming. I don't use the first bloom as final judgment. In a few cases I seem to have some that look better than their registered counterparts. The fall and winter tell the truth on these seedlings.

I was also able to make a few F4 crosses this spring. This past spring in the batch of 300 seedlings, I did find several semi-double seedlings that would set seed and I plan to make crosses on them.

4. AMARYLLID CULTURE

[ECOLOGY, REGIONAL ADAPTATION, SOILS, FERTILIZATION, IRRIGATION, USE IN LANDSCAPE, DISEASE AND INSECT CONTROL, ETC.]

REGENERATION OF **LYCORIS** PLANTLETS FROM LEAF AND PEDICEL TISSUES

MARGOT WILLIAMS

INTRODUCTION

Propagation of ornamental bulbs has traditionally been accomplished through various methods of cutting the bulbs and applying hormone-containing compounds to encourage the production of many small bulbs at the wound site. Although these methods are generally acceptable, there are a number of situations in which inflicting injury on the parent bulb is undesirable. For example, propagating enough material for distribution of a rare plant or new cultivar by this method is a time-consuming process and involves considerable risk. Tissue culture propagation can provide a faster, more efficient means of producing large numbers of plants from scarce stock. An important advantage is that the bulb need not be damaged to provide a source of explant material. Successful tissue culture propagation has been reported for a number of bulbous ornamentals, including members of the Amaryllidaceae, Iridaceae, and Liliaceae (Heuser and Apps, 1976; Hussey, 1975a; Hussey, 1975b; Hussey, 1976a; Hussey, 1976b; Hussey, 1976c; Lakshmanan and Janardhanan, 1977; Meyer, Fuchigama and Roberts, 1975; Meyer, 1976; Seabrook, Cumming and Dionne, 1976; Sheridan, 1968; Simmonds and Cumming, 1976; Simonsen and Hildebrandt, 1971). Tissue culture of *Lycoris* has not been previously reported.

Tissue culture experiments were undertaken with *Lycoris* for two reasons: 1) to devise a reliable method for rapid propagation of species and new hybrids for distribution which would not require injuring the parent bulb; and 2) to provide a supply of small bulblets for treatment studies with chemicals such as colchicine.

MATERIALS AND METHODS

Growth Regulators—This experiment was carried out in two parts, one using leaf tissue and the other using pedicel tissue. For the leaf tissue experiment, the medium contained 6-benzylaminopurine (BA) at 10 mg/1, and napthalene acetic acid (NAA) at 1 mg/1. For the pedicel tissue experiment, two media were employed: 1) using BA and NAA at the same concentrations as the leaf tissue experiment; and 2) using no growth regulators.

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Medium—Murashige and Skoog major and minor salts were used (Murashige and Skoog, 1962) with the following organic addenda:

	mg/1
Sucrose	30,000
Edamin **	1,000
Difco Bacto-Agar **	7,000
Meta-inositol	100
Adenine sulfate	160
Niacin	0.5
Thiamine-HCl	0.1

** Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture and does not imply its approval to the exclusion of other products that may also be suitable.

Method—For the leaf tissue experiment, explants were cut from the basal portion of young leaves of *Lycoris albiflora* and *L. squamigera,* following surface-sterilization by immersion in a 50% solution of commercial bleach (Chlorox**) for 3 minutes, followed by 1 minute in 70% ethanol and 3 rinses in sterile distilled water. Each explant was about 1 cm. long. Explants were inverted and inserted about ¼ of their length into the medium. The cultures were grown in a lighted growth chamber at 1200 lux under 16-hour illumination at 25°C. For the pedicel-culture portion, scapes of *L. squamigera* and *L. incarnata* were cut when the scapes had elongated to about 30 cm. above the ground and the spathe-valves had not yet separated. The flower bud was surface-sterilized in the same manner as the leaves in the preceeding experiment. Individual flower buds were dissected out, and slices 1-2 mm thick were cut from the pedicels. The explants were inverted and placed on the media. They were grown in darkness at 25°C and examined periodically, discarding those that were contaminated or dead. After 2 months, explants that were still living were transferred to fresh media and placed in a lighted growth chamber (1200 lux, 16-hour photoperiod) at 25°C.

RESULTS

Leaf explants—Callus formation was observed on the upper surface of explants of *L. albiflora* after one month. After 2 months, the formation of bulblets with leaves was observed (Fig. 25). At this point, the bulblets were removed from the callus and placed on basal medium (no growth regulators, 20 g/1 sucrose) for rooting. Root initials were observed 1 month after the transfer, and the plantlets were ready to transfer to sphagnum moss about 3 months after the transfer to basal medium. However, no activity was observed on *L. squamigera,* and all of those explants eventually died. At the time of this writing, callus cultures of *L. albiflora* have been maintained for 20 months. It was observed that the rate of plantlet production decreased somewhat as the callus aged. Placing the callus on basal medium for 1 or 2 months,

and then returning it to a medium containing BA and NAA at ½ the initial concentration proved successful in renewing profuse bulblet formation.

Pedicel explants—All explants of *L. incarnata* died without any growth activity and with no signs of contamination. Explants of *L. squamigera* on the medium containing BA and NAA also died. However, *L. squamigera* explants grown on the growth regulator-free medium callused on the cut surfaces. Although most of these explants died with-

Fig. 25. (left) **Lycoris albiflora** callus derived from leaf sections, showing proliferation of bulblets with leaves. (right) **Lycoris squamigera** callus derived from pedicel sections, showing formation of bulblets and leaves.

in 1 month of being transferred to light, one explant, which had produced a larger mass of callus than the others, continued to proliferate callus. This was divided and transferred to medium containing BA and NAA at 5 mg/1 and 0.5 mg/1, respectively. Following this treatment, small bulblets with leaves were produced (Fig. 25) which could be rooted on basal medium. Cultures derived from this explant have now been maintained for 1 year and are still producing shoots.

DISCUSSION

The different responses obtained for *L. albiflora, L. squamigera,* and *L. incarnata* suggest that the growth regulator requirements for successful regeneration of plants from excised tissues vary among *Lycoris* species. In addition, the part of the plant from which the explant is taken may influence growth regulator requirements. While plantlets were successfully regenerated from leaf tissues of *L. albiflora* and pedicel tissues of *L. squamigera*, it is clear that much further experimentation will be necessary before this means of propagation can be broadly applied to *Lycoris* species and cultivars.

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LYCORIS: FROM SEED TO FLOWER IN LESS THAN TWO YEARS

MARGOT WILLIAMS *

Breeding *Lycoris* can be rewarding, but requires patience since a seedling can take as long as 10 years to reach flowering size. Caldwell (1962) reported that he never had a seedling bloom in less than 6 years. A method by which generation time can be shortened would be a valuable tool for the *Lycoris* breeder. The investigation reported here was carried out to see whether a non-traditional method of germinating *Lycoris* seeds would shorten the time from seed to flower.

MATERIALS AND METHODS

A series of interspecific crosses was made in 1977 among plants in the *Lycoris* collection at the U.S. Plant Introduction Station, Glenn Dale, Maryland. A good seed crop was obtained. Immediately following harvest, seeds were sown in flats of shredded sphagnum moss which was moist but not soggy, and placed in a partially shaded lean-to greenhouse for germination. The seeds were placed on the surface of the medium and pressed in lightly; however, they were not covered by the medium. The seed flats were covered by a pane of glass raised about 1-½ inches from the edge of the flat by means of a wooden frame the size of the flat. This treatment effectively maintained a moist environment. The flats were watered as necessary to keep the sphagnum moist. Planting dates and germination dates were recorded for each Seedling. Seedlings were left in the seed flat until bulb-like thickenings were observed (2-3 weeks after germination), and were then transplanted to 2-inch pots, using shredded sphagnum moss as the potting medium. The young seedlings were planted so that only the basal 1/3 of the bulb and the roots were below the surface of the potting medium. After potting, the seedlings were placed in a hardening-off bench under intermittent mist (one 1-minute cycle per hour) for 1 week. The pots were then moved to a sunny greenhouse heated to 68°F at night, where the pots were plunged in a bench containing moist peat moss. No supplementary lighting was used.

When the roots emerged from the drainage hold in the bottom of the pot, the seedlings were transplanted into 3-inch pots containing a 1:1:1 mixture of sand, soil, and peat moss. The transplanting procedure to larger pots was repeated each time root growth emerged through the drainage hole, to a maximum pot size of four inches. At each transplanting, the bulbs were lifted so that only the basal 1/3 was covered by soil. *Lycoris* bulbs tend to work themselves downward in the pot after planting. When it was observed that bulbs in 4-inch pots were submerged in soil, they were again lifted and replanted in 4-inch

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pots. Two weeks after each transplanting, the seedlings were fertilized with Mag-Amp**, a granular 7-40-6 slow-release fertilizer, at the rate of 1 teaspoon per 3-inch pot. As the oldest leaves became senescent, they were removed from the plants.

RESULTS

All seeds germinated within 4 to 6 weeks after sowing in the flat. At 3 to 4 months after sowing, all seedlings had produced at least one pair of leaves. At the time of this writing (2 years after performing the initial pollinations), bulb sizes range from ½ inch to 1-5/8 inch in diameter. Two seedlings have flowered. One seedling, a cross between a hybrid *(L. elsiae* x *L. chinensis)* and *L. radiata,* reached the flowering stage in less than two years dated from the time the original cross was made. The second seedling to come into flower, a cross between *L. radiata* and *L. aurea,* flowered 27 months after the cross was made.

DISCUSSION

This treatment has potential for reducing generation time in *Lycoris.* It is hypothesized that light is a factor in inducing early germination since all other reports involve covering the seed. Creech (1952) reported that hybrid *Lycoris* seeds sown in a flat of sandy soil in October (immediately following harvest) germinated by the following spring, although foliage was not produced until the following October. Caldwell (1962) reported that sowing seeds 1 inch deep in a sand/soil/peat-moss mix in autumn resulted in bulblets by the following spring, but again, with few exceptions, leaves were not produced until the following autumn, nearly a full year after sowing. Light may also stimulate the early leaf formation observed in this experiment. A side effect of the treatment was the prevention of dormancy. As the oldest leaves on the seedlings senesced, new leaves were produced. A possible factor in the prevention of dormancy may have been the practice of removing dead leaves. It is known that senescing leaves produce ethylene, which in turn stimulates senescence in other leaves. At this time, seedlings have not been observed long enough to determine whether or not the observed inhibition of dormancy will carry through until flowering of all seedlings.

In addition to reducing generation time, part of this treatment (lifting the bulbs at each transplanting and maintaining in a warm greenhouse) may be useful to bring small offsets or tissue-culture-induced bulblets up to flowering size in a reduced period of time.

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THE AMARYLLIS RESEARCH INSTITUTE AT ONE YEAR

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The organization dedicated to the preservation of amaryllid species has existed for slightly over one year now, and we have enlisted about 75 contributing members. There has been one seed distribution to cooperating parties; and a second was planned for late 1979, including seeds of *Amaryllis cybister, A. evansiae,* and *A. neoleopoldii,* as well as *Zephyranthes chlorosolen, Z. longifolia,* and *Z. pedunculata.* The *Amaryllis* seeds were produced at the Amaryllis Germplasm Reservoir, in Indianapolis, while the *Zephyranthes* seeds were provided by Mr. Ray Shelton, of Marfa, Texas.

The germplasm collection has grown through the continued generosity of several individuals. In particular, we owe a debt of gratitude to J. L. Doran; to Marcia C. Wilson, of MARCIA'S of Brownsville, Texas; to Margot Williams, of the U.S. Plant Introduction Station at Glenn Dale, Maryland; to R. K. Bennett, of Pasadena, California; and to W. D. Bell, of Gainsville, Florida.

Most of the plants in the germplasm collection are too small to bloom, but several blooming size bulbs were purchased by the Shields Horticultural Gardens for the use of the Amaryllis Research Institute's seed production program. Among these were the A. cybister whose seed were announced. In addition, a number of donations of pollen were provided by several of the above parties.

An occasional publication has been initiated by the A.R.I. to provide a mechanism for communication with our cooperating friends. The first issue of the AMARYLLIS BULLETIN appeared in February, 1979; and a second was scheduled for the end of 1979. It is our hope that it can be brought out two to four times each year in the future. The appointment of Dr. W. D. Bell as regular editor for the BULLETIN is expected to allow us a firm schedule and a varied, high-quality, selection of articles.

A small tissue culture laboratory is still under construction at this writing. It is located on the property of the writer, and will be shared by the A.R.I. The laboratory should have long since been occupied by the time this appears in print. It should facilitate the propagation of such plants as the self-sterile Amaryllis reginae (cf. *miniata*). Indeed, Dr. Dudley has graciously procured bulbs of his original collection for the Amaryllis Germplasm Reservoir. We now have five distinct collections of this species, and we hope eventually to manipulate them into producing viable seedlings of "Dudley's Belladonna". There are numerous other single-clone species which will also be subjects for seed production in the future.

GENERAL AMARYLLID REPORT, 1980

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NOTES ON THE GENUS **CRYPTOSTEPHANUS** WELW.

Last year seeds of *Cryptostephanus vansonii* were received from South Africa. Seeds of this species, received the previous year, had failed to germinate, but the second accession resulted in three seedlings. A third packet of seeds was received several months ago, and hopes are high for germination of all of these. Consequently, this obscure amaryllid may gain a foothold into cultivation in this country and elsewhere.

My desire to obtain *Cryptostephanus vansonii* resulted from its placement by Dr. Traub in the Tribe CLIVIEAE of the Amaryllidaceae, the only other genus in this tribe being *Clivia* (Traub, 1963). Since I consider Clivias to be the ultimate amaryllids, the existence of a little-known, *Clivia* ally was intriguing. With that as an impetus, the research process was started, and seeds were finally obtained.

Following the successful germination of seeds, and the growth of the seedlings for about a year now, it was time to investigate this genus more in depth. Some notes about the genus *Cryptostephanus* follow.

Index Kewensis and its supplements list five specific epithets under *Cryptostephanus—C. densiflorus* Welw. ex. Baker, *C. haemanthoides* Pax, *C. herrei* Leighton, *C. merenskyanus* Dinter & G.M. Schulze, and *C. vansonii* Verdoorn, in order of appearance. I knew that *C. herrei* had been transferred to *Cyrtanthus* but I was to find out that *C. merenskyanus* had also been eliminated from the genus, leaving only three species to consider. The end result is that the genus is much more well-defined and uniform.

1. **Cryptostephanus densiflorus,** the type species, was named in 1878

Description—Rootstock a compact bulb-tuber. Leaves six to eight, contemporary with the flowers, lorate, glaucescent, glabrous, moderately firm in texture, finally a foot long, three-eighths to half an inch broad. Scape central, moderately stout, compressed, ancipitous, six to eight inches long. Bracts in a whorl, as in *Haemanthus,* unequal, lanceolate, greenish, membranous, an inch long. Flowers, twenty to thirty or more, in a dense globose head; pedicels very short. Ovary green, round-oblong, one-sixth of an inch long. Limb dark-purple, more or less curved, under half an inch long; curved tube a quarter of an inch; segments one eighth of an inch, slightly cucullate at the tip. Staminodia more than half as long as the perianth-segments. Anthers under a line long. Berry the size of a pea (about three-eighths of an inch diameter), bright scarlet.

Habitat—Angola, in Huilla in bushy places, in dry, sandy soil near Lopollo, in the temperature region (3800-5500 feet), flowering in October and November, fruiting in January.

Comments—Baker said the following about this species: "This is certainly the most interesting new plant amongst all the hundred and twenty new bulbs which Dr. Welwitsch discovered in his Angola expedition. Not to go beyond the order for a comparison, the general habit is much like that of a small Cyrtanthus, the narrowly funnel-shaped tube of the perianth being quite similar, and, as in that genus, curving more in the outer flowers of the umbel; but the structure is totally different from that of any Amaryllid already known. By its corona, distinctly, exterior to the whorl of stamens proper, the genus to which it approximates most of all is Narcissus. Here the staminodia palpably represent an outer whorl of stamens, for, as Dr. Welwitsch has noted, and one of his specimens shows, they casually bear a small abortive anther at the tip. The alliance, both in habit and structure, is very close with Tulbaghia, in Liliaceae. . . . In Tulbaghia, however, the fruit is capsular, whilst here it closely resembles that of Haemanthus." (Baker 1878)

The political situation in Africa such as it is, obtaining plants or seeds of this species from its native habitat will be difficult. I am not aware that *Cryptostephanus densiflorus* is in cultivation at present.

2. **Cryptostephanus haemanthoides,** the second species to be discovered, was named in 1893.

Description—Erect terrestrial herb to 40 cm. tall; rootstock rhizomatous, fleshy, subcylindric, up to 7 cm. long, 3 cm. diam. hidden by leafbases and roots; roots fleshy, cylindric, up to 40 cm. long, 8 mm. diam., white. Leaves about 12, rather fleshy, distichous, suberect to spreading, ligulate to linear-lanceolate, rounded at apex, 24-55 cm. long, 0.9- 4.5 cm. broad, dark green or glaucous. Inflorescence erect, 18-36 cm. tall, umbellate, many-flowered; peduncle strongly compressed, 1-3 cm. broad, narrower towards apex, slightly winged; bracts to 1.5 cm. long, clustered at base of umbel, linear, acuminate, subtended by one or two larger wedge-shaped bracts, up to 5.5 cm. long. Flowers 2.5- 3 cm. long, dark red to blackish purple with cream scales and anthers; pedicels slender, 1- 1.8 cm. long. Ovary globose, 5 mm. long; perianth-tube narrowly funnel-shaped, 2 cm. long; free terminal lobes 6, ovate-elliptic, subacute, 5- 8 mm. long, suberect-spreading to reflexed; scales 12, linear, up to 3.5 mm. long; stamens inserted towards apex of perianth-tube, exserted; anthers narrowly ovoid; style slender, 2.5 cm. long, exserted above perianth-tube.

Habitat—Kenya: Taita Hills, southeast of Tsavo National Park. Tanzania: more widespread, ranging from the Usambara Mts. in the northeast to the Ruaha National Park near Iringa in the south. It grows between approximately 1800 and 4000 feet elevation.

Comments—Phillip Cribb, in *Curtis' Botanical Magazine* had this to say about *C. haemanthoides:* "C. haemanthoides is a distinct and impressive plant readily recognized by its strong flattened peduncle and the semispherical mass of purplish black flowers at its apex. In flower-colour it corresponds closely with C. densiflorus but is altogether a larger and more floriferous plant with flowers in which the perianth

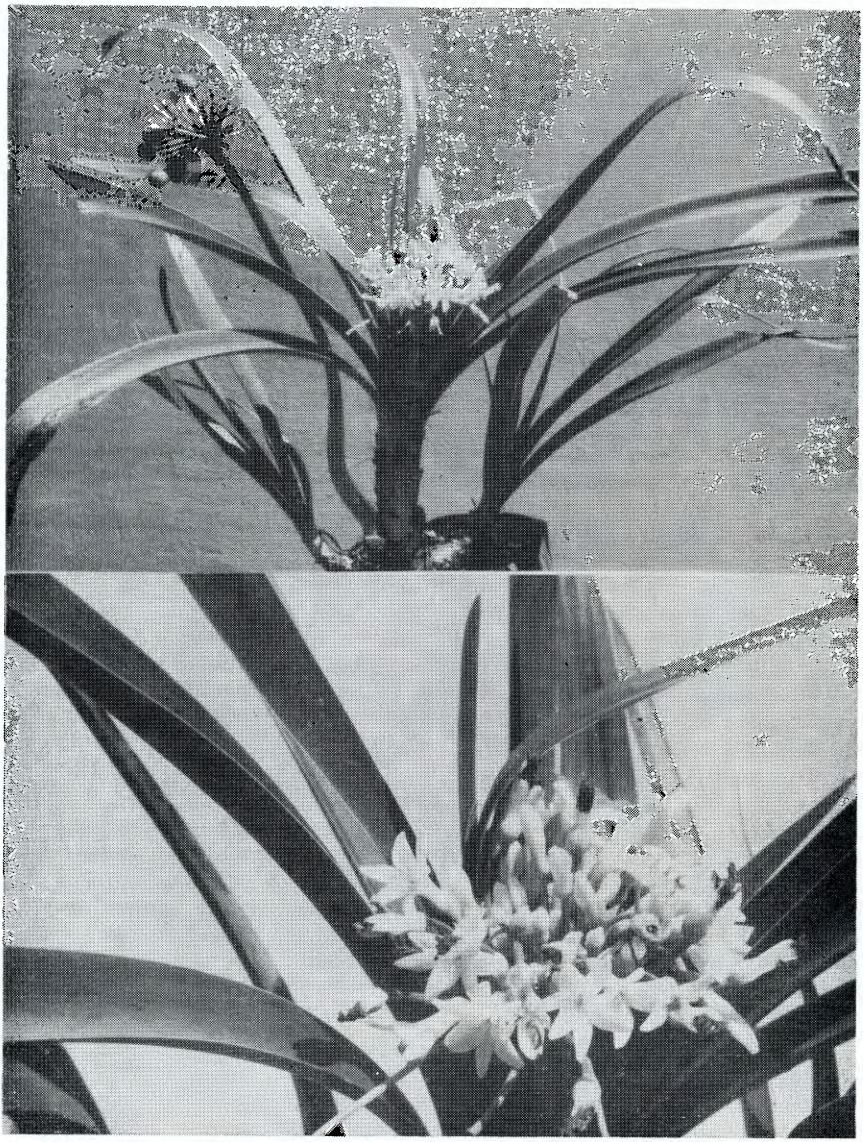

Fig. 26. **Crypostephanus vansonii** Welw. **Upper,** entire plant, about two feet tall. **Lower,** close up of inflorescence. Photos by Georges Delpierre.

lobes are not spreading and the stamens and the style are exserted. From C. vansonii it is readily distinguished by its flower colour and 12-rather than 6 partite corona. . . . In the wild, C. haemanthoides grows at altitudes between 600 and 1300 m. in open woodlands, deciduous thickets or grasslands where there is a marked and often long dry season on shallow red sandy soils and amongst rocks. It flowers from late December to early February at about the beginning of the rainy season. (Cribb, CLXXII)

3. **Cryptostephanus vansonii** Verdoorn, the most recently-discovered species, was named in 1943. (Fig. 26)

Description—Rootstock subbulbose, tunicated, about 10 cm. long and 2.5 cm. diameter, for the most part above ground; roots cylindric, 5 mm. diameter, creeping near soil surface and partially above ground. Leaves 12 to 18, distichous at base spreading above, lorate, up to 60 cm. long and 2.5 cm. broad, slightly narrowing towards base and apex, spreading, recurved. Peduncle about 20 cm. long, strongly compressed, ancipitous. Spathe-valves several, unequal, withered. Pedicels green, terete, up to 3 cm. long. Flowers about 30 in an umbel, white tinged with pink about the throat, the basal portion surrounding the ovary and partly fused with its walls, greenish; perianth-tube from above ovary 7 mm. long; segments about 8 mm. long, spreading; the 3 outer slightly narrower than the 3 inner and with more obviously hooded apices. Corona-lobes 6, bifid, each lobe inserted at the base of the perianth-segment, yellow or pink, about 3.5 mm. long. Anthers in 2 rows inserted in a tube; the 3 lower subsessile; the 3 upper with filaments less than 1 mm. long. Ovary 3-chambered ovules 2 to 4 in each chamber; style columnar, 3 mm. long.

Habitat—S. Rhodesia: Vumba Mts., 5500 Ft. altitude, Mozambique.

Comments—Cryptostephanus vansonii was described from a plant growing in the garden of Mr. G. Van Son, near Pretoria. Mr. Van Son stated that he saw many of the plants growing under trees and among rocks on a southern slope of the Vumba Mts. at about 5500 feet.

Verdoorn made the following comments about the relationship of *Cryptostephanus* to other genera, when discussing C. vansonii: "The flattened peduncle also suggests that genus (Clivia), but the flowers are more distinct with their spreading limbs, a corona in the throat, and the stamens inserted in two series. . . . Taking the corona as the most dogmatic character, the genus Tulbaghia had to be considered. In this genus (tulbaghia) a corona is present, the stamens are 2-serriate and the habit similar to our plant, but the ovary is definitely superior. . . . In our plant the perianth surrounding the ovary is intergrown with its walls and the ovary is considered as inferior." (Verdoorn, 1943)

Culture—Cryptostephanus vansonii seems to grow well in a standard, loose potting mix, such as the following: three parts loam, two parts perlite, two parts vermiculite, two parts redwood sawdust, and one part charcoal, with lime and superphosphate added. Benomyl

is applied monthly while Captan is substituted once or more a year. The plants are fertilized every two weeks with a half strength 15-30-15 solution. The plants have only been grown in pots, on the cooler side of the greenhouse, which may otherwise be considered a warm, humid house. The plants are lightly shaded at all times. Judging from the natural habitat of this species, it should prove to do well in climates where Clivias flourish, such as in coastal California. *Cryptostephanus vansonii* is probably the hardiest species in the genus, followed by *C. densiflorus* and *C. haemanthoides*—in that order. There is no reason to suspect that these latter two species would not grow well under the cultural conditions discussed above for *C. vansonii.*

4. *Synonyms*—After no small consideration, "Cryptostephanus herrei" Leighton was reclassified as *Cyrtanthus herrei* (Leighton) R. A. Dyer. This Namaqualand native closely resembles *Cyrtanthus obliquus* in gross morphology, appearing to be a large version of that species at first glance. It may also be closely related to *Cyrtanthus carneus,* and possibly *Cyrtanthus falcatus.*

"Cryptostephanus merenskyanus" was also considered to be a synonym for *Cyrtanthus herrei,* according to Merxmuller (Merxmuller, 1969).

5. *Summary*—The three *Cryptostephanus* species are handsome plants, Clivia-like in foliage, and reminiscent of *Tulbaghia* in flower. *C. haemanthoides* and *C. vansonii* have been described as being evergreen, and it can be assumed that *C. densiflorus* also has this quality. Dark purple flowers are found on *C. haemanthoides* and *C. densiflorus,* while *C. vansonii* has white flowers.

All three species seem to come from similar habitats, and consequently would require similar culture. In cultivation, *Cryptostephanus* would be suited to intermediate temperatures, a well-drained potting mix, some moisture throughout the year with a reduction of water during the winter, and partial shade.

Cryptostephanus holds an interesting taxonomic position. It has been related most closely to *Clivia* in the Amaryllidaceae but due to floral characteristics it shows a strong affinity to *Tulbaghia,* a genus which has been placed in at least three families.

An ongoing effort is being continued to bring more of these plants into cultivation. At present, *C. haemanthoides* and *C. vansonii* are being cultivated for certain. All three species should be grown by collectors of the finest amaryllids, who can provide these plants with a suitable environment.

II. An Unusual Crinum From the Marshall Islands

In 1978 Crinum plants were received from the Marshall Islands, labelled as *Crinum bakeri* Schumann. The plants had been collected on Rairok Island, one of the many islets of Majuro Atoll. Rairok Island is located 7° 04″ N. Latitude and 171° 17″ E. Longitude. The plants were growing in the beach sand.

The plants resumed growth quickly, taking on the appearance of small versions of *Crinum asiaticum* in habit. Unlike *C. asiaticum*

though, offsets were produced freely at the base. Additionally, one of the plants divided into two large plants, similar to *C. asiaticum*, while still producing offsets at the base. With the flowering of one of the plants in October, 1979, it was time to compare it with the description of *Crinum bakeri.*

Crinum bakeri was described as follows: Leaves linear, 1-1½ ft. long, 1¼-1½ in. broad, rather undulated on the smooth margin. Perianth-tube rather curved, 1½-2 in. long; segments linear, reddish, 2½-3 in. long, ¼ in. broad. Filaments rather shorter than the segments; anthers linear an inch long.

The habitat was listed as "Marshall's Island" (Baker, 1888).

Crinum bakeri seems out of place among the giant asiatic Crinums. Not only did its leaves not exceed 1½ feet but they were also linear. What's more, the flower segments were reddish, contrasting with the predominant white of the other asiatic species.

For a comparison to the description of *Crinum bakeri,* the plants received from Majuro Atoll had these characteristics: Leaves 12 or more, lanceolate, 3½ inches broad below the midpoint, tapering to a semi-acute point, 30 inches long, thick, smooth margins somewhat undulated. Scape 18½ inches tall, 5/8 inch broad at base, slightly compressed. Umbel 12- or more-flowered. Pedicels ½ inch long. Segments 3/8 inch wide, 2¾ inches long, recurved, white. Valves 2, ¾ inch broad at the base, tapering to a point. Tepaltube 2¾ inches long. Filaments 1¾ inches long, white at the base, turning to red below the anthers. Anthers one inch long. Pollen yellow.

The most unusual features of this first plant to flower were the abnormalities in the flowers, as summarized in Table 1.

TABLE 1

	Number of Stamens			Stigma Position	
Flower	Normal	Double	One Filament With Two Anthers	Below* Tepal Segments	Above** Tepal Segments
A	6	0	0		1.0 cm.
B	6	0	0	2.5 cm.	
C	6	0	0	0.5 cm.	
D	6	0	0		0.5 cm.
E	4	0	0	1.0 cm.	
F	6	0	0	3.0 cm.	
G	6	0	0	1.0 cm.	
H	4	1	0	1.5 cm.	
I	4	0	0	1.3 cm.	
J	4	0	0	0.3 cm.	
K	3	1	1	1.3 cm.	
L	3	1	0	0.5 cm.	

* Within tepaltube.
** Exserted above tepaltube.

The stamens were quite variable, as the table shows. The pistils

managed to emerge above the tepaltube on only two flowers. I have noticed an occasional flower of *Crinum amabile* with only four segments but this was the most unusual inflorescence on a *Crinum* yet; every flower differed from the expected in some way. The other two plants of this Marshall Islands Crinum have not flowered yet. It will be interesting to see if the same abnormalities occur in the flowers of those plants.

In the meantime, it can be concluded that the plants received from the Marshall Islands do not fit the description of *Crinum bakeri.* The mystery of that small, obscure species remains in tact for the time being.

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1980 ZEPHYRANTHEAE REPORT

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PLANNING A TRIP

From the numerous interesting accounts of plant collecting which have appeared in *Plant Life,* one would think the rural areas of Mexico and on to South America were paved with various bulbs in bloom. Well, one usually writes about successful trips—the rest go unreported. There are two ways to plan a successful collecting trip by car in Mexico. If going to a special area, one must know the approximate flowering season of the desired plant material and devise some means of finding out when the rains begin. A motel in the area can sometimes be of help. The second way is to plan a much longer trip and cover as much territory as possible. In this way one can quickly pass through areas that are dry, yet find a productive site several hours away. In both cases, it helps to have a wide interest in various plants.

NUEVO LEON

For many years I have wanted to collect some of the large pink *Zephyranthes* species that are found in the mountains from Monterrey to Victoria. This is a complex of early flowering species with fairly large flowers and very large bulbs. Howard 62-1 "Horsetail Falls" will sometimes achieve a diameter close to 4″ under optimum growing conditions, with leaves ¾″ wide. *Z. morrisclintii,* an attractive pink subgenus *Cooperia,* is thought to be a natural hybrid between a pink *Zephyranthes* and a white *Cooperia.* It is possible, however, that bulbs in the complex are more closely related, but the *Zephyranthes* characteristics are more dominant over *Cooperia.* In April 1978, on a camping

trip to the mountain *Potosi,* my brother found another interesting member of this clan. These were found growing in light shade at an elevation of 4,000 feet near San Roberto, N.L. Apparently they do not like any shade in Brownsville, for the bulbs have produced up to a dozen or more leaves during the growing season, but no bloom.

Fig. 27. Site 3, habitat of **Zephyranthes howardii,** near Mamauliques Pass, Nuevo Leon, Mexico.

Another highly interesting complex of Zephyrantheae grows in and around a small mountain group called Mamaulique Pass on the highway between Monterrey and Laredo, Texas. This complex centers around the yellow *Z. howardii* and one or both of the common white *Cooperias.* This is the only known habitat for this yellow rain lily and its bloom period is fairly well restricted to the month of May. This may extend to mid June with no earlier rainfall.

Why the special interest in these bulbs? They are not only attractive dependable bloomers, they could also be a decided asset in any *Zephyranthes* hybridizing program directed toward cold hardiness. They are also among the first to bloom in the spring (with *Z. atamasca*). The *Z. howardii* blooms slightly later as cited above. With storage of pollen, they could be hybridized with late summer or fall bloomers. "Horsetail Falls" will frequently bloom again in July or August in Brownsville with a heavy rain; however, the blooms are bleached almost white by the sun.

APRIL 1979

After waiting for several years to hear of a heavy rain in the Monterrey area, we made a trip in late April 1979. My mother, Mrs. Katherine L. Clint, was my collecting partner on both trips. Another family group went several days earlier and found the pink rain lilies at Horsetail Falls and at Chipinque Mesa—both near Monterrey. We saw nothing. However, the residents along the steep winding road up to Horsetail Falls had both *A. reginae* and *vittata* types in bloom.

Fig. 28. Site 4, approaching Mamauliques Pass, Katherine L. Clint digs for **Zephyranthes** in reddish sand.

We spent most of a day in and around Mamaulique Pass. The new highway cuts through the pass, but we were able to walk and drive the length of the old road that has been bypassed. No rain lilies, but we were well entertained with the unusual and colorful wildflowers. It is also an interesting area for *Agave, Dasylirion,* unusual *Cacti,* etc.

Earlier in the day we had parked the car at the base of the pass and worked up a steep hill on the left of the road. Collected some Bluebonnet seed and a few bulbs and seed of an *Allium* species. It was so dry we despaired of finding any rain lilies. However, as we reached the crest, I saw foliage under a thorn bush that looked like *Z. howardii.* I had forgotten to pack the rock pick and the bulbs were deep in rocky

soil. My daughter yelled that a police car had parked next to ours. By the time we scrambled down, the car had left. I returned to this location as our last stop in late afternoon, determined to get at least one bulb intact. I had taken along a gallon jug of water, which helped. As I finally lifted a bulb from an excavation over 15″ deep, I noticed something that had been missed before: a dried bloom scape. It was *Nothoscordum!*

MAY 1979

Numerous showers were again reported in late May. We made reservations in Laredo, left my two girls to swim at the hotel the next morning, and reached Cienega de Flores for gasoline shortly before noon. This is about 122 miles from Nuevo Laredo. We worked back south toward Mamaulique Pass, stopping to dig four different collections of *Zephyranthes.* We had seen *Cooperia* in bloom most of the trip up. Plants with foliage that appeared slightly broader grew more frequently at higher places near the fence line. This is where we collected.

Finally, on the third stop, we saw yellow flowers! They were over the fence. The photograph of that fence is deceiving. There was no way I could climb over or go under. The fence was too new and well made—the bottom wire was only about 12″ from the ground. It was too rocky to dig more room.

It began to sprinkle upon our last stop, but we dug a nice collection of bulbs with very broad foliage, much like *Zephyranthes drummondii (Cooperia pedunculata),* but not as glaucous. My parents have dug mixed collections before. There is simply no sure way to tell the difference unless the bulbs are in bloom.

In late August, a half dozen bulbs bloomed from our first two collections. They were the common small white *Cooperia.* The lack of bloom on the rest of the bulbs is a good sign, I hope.

Where does the yellow color come from in this complex that seems to be restricted to such a small dry elevation in Nuevo Leon? There are several theories to play with, but my guess is that *Habranthus concolor* was introduced into the area by Indians, it hybridized with *Cooperia* and did not persist. This could have happened hundreds of years ago, long before the conquest of Mexico by Europeans, or in more recent times. The current bulb population could have had a still different yellow ancestor that once grew on the escarpment and later disappeared. From outward appearances, the pink and the yellow rain lilies of Nuevo Leon are linked by one common ancestor: *Zephyranthes drummondii (Cooperia pedunculata).*

It is hoped that current studies will give some answers.

DROUGHT DWARFS HAEMANTHUS AT VICTORIA FALLS

EMMA D. MENNINGER

In 1957, from October 29th to 31st, my husband and I visited

Victoria Falls in Northern Rhodesia, now Zambia, and nearby Livingstone. The Falls, having a drop of 400 feet, is a part of the milewide Zambezi River near the border of Zambia and Southern Rhodesia.

It was a time of severe drought in a region of summer rain. In normal weather, it was said that the roar and mist of the Falls extended for twenty-five miles. Perhaps, because of the increased visibility at the time, we witnessed the gorgeous sight of the Falls, made more so because of the hundreds of red-flowering *Haemanthus* within sight of the Falls.

My short notes made at the time have refreshed my memory and quoting from them will help to describe the plants flowering under severe drought conditions, as follows:

"Victoria Falls, 1957. Saw hundreds of *Haemanthus* flowering on October 29th. With short stems—as season unusually dry—very few leaves starting. Mostly they were in rather dry heavy soil. Some were on level land, some on the side of a cliff—all ordinarily subjected to mist from the Falls, which are on the opposite side of the ravine, about a quarter mile away."

My husband had gone into the nearby forest to secure more direct motion pictures of the Falls, while I sat on a bench, in light shade, where the *Haemanthus* were flowering a few feet apart, in the space of about an acre. The bloom scapes were only a few inches tall and the sparse lack of leaves, and the small umbels were only about three inches across.

At the time I thought they were the *katherinae* species, for they resembled my plant at home, which I had always thought was *H. katherinae*. Apparently, this species and *multiflorus* are very similar and few differences are noted in the references that I consulted.

In Plant Life for 1964, pages 12-15 under the title: "Holiday in Southern Rhodesia" by Sidney Percy-Lancaster, he has an article on *Haemanthus* at Victoria Falls. The plants were in leaf, but not in flower and he designated them *Haemanthus multiflorus*. According to the references I consulted, *multiflorus* grows in Sierra Leone in upper Western Africa, while *katherinae* grows in Natal in Southern Africa near the Falls. No mention was made in any reference that either or both species grew both in Northern and Southern Africa.

In a recent article in the Journal of the Royal Horticultural Society: The Garden for December 1977, page 508, Mr. Anthony Huxley states: "The distinction between this [*katherinae*] and *H. multiflorus* is not clear."

One of the differences noted in the Botanical Magazine, vol. XL, t. 1884, the subject of *H. katherinae* is the venation of the leaves, where a sketch of the leaves shows prominent cross venation. The parallel and cross veins give a reticulated effect. In my plant, it is not so prominent unless the leaf is held to the light when the reticulated effect is very noticeable.

The Botanical Magazine, t. 1995, vol. XLV of 1818, states that *Haemanthus multiflorus*, a native species of Sierra Leone, shows only parallel veining, which one might judge that it is a characteristic of

multiflorus, except that it was said to have been drawn from a weak specimen.

I have never had an opportunity to compare the two species, but I am still inclined to believe mine to be *H. katherinae.*

The Gardeners' Chronicle for 1877, under the title *Haemanthus multiflorus* and Its Allies, pp. 655-6, describes several species including *multiflorus* and *katherinae* with only slight differences between them. The scape of *multiflorus* seems entirely spotted, while *katherinae* is spotted only at the base.

Many of the later discovered *Haemanthus* are quite different from the two discussed. What would seem to be a beautiful addition to the genus, is the Rhodesian *H. pole-evansii* with wide orange-red petals, illustrated in the Botanical Magazine, vol. 1708, n.s., t. 572 for July 1970.

I have consulted with Mr. Lambert Day, a successful *Haemanthus* and orchid grower. He flowers his *Haemanthus,* presumably *katherinae,* in a twelve inch tub under light shade. He believes they require at least two hours of sun a day. His tub is now, July, in flower with twelve scapes. It needs repotting since there are approximately thirty bulbs. He uses a Cymbidium compost. He believes that repotting prevents flowering the following year.

Haemanthus, which we believe to be *katherinae,* flower well in Southern California and produce the red seed which can be grown on successfully to mature flowering plants.

My own plant is not in flower at present, during July, since it has recently been planted in the ground.

AMARYLLID CULTURE IN MINNESOTA

RUSSELL H. MANNING, *717 Valley Av., Rt #1, Box 8, Spring Valley, Minnesota 55975*

This has been a newsy year for me as a fair number of Amaryllid correspondents have been writing and telling of their good things which can have an amazing effect on a fellow Amaryllid grower to perk up his morale and to incite him on to further endeavors. Further, some things have happened here, too, to fill in for better *Amaryllis* appreciation.

In the quest for the more "yellow" *Amaryllis,* there have been a number of happy "fall-outs" which should interest others to make the same hybrids or those of a similar type. As *Amaryllis evansiae* has been bred into a number of strains by several growers (Alek & Meta Korsakoff, Len Doran, Fred Boutin, C. D. Cothran and others), these are bases for hybrids which to each has given quite different results. Amongst the first in the breeding of the "spiders" were the Korsakoffs and the Harshbargers. This gave a fanciful and delicateness of form which few other *Amaryllis* share. Incidentally, as being well nigh pure *Amaryllis evansiae,* these failed to thrive here and soon dwindled-out. Believing that these should be "revived", a cross was made again this year of Dr. Bell's Korsakoff's *cybister* x Nelson's pigmented *cybister*

X Cothran's 8-petalled form of *Amaryllis evansiae*. Three weak seedlings are still hanging-in there and if they make it, the blooms should be a large yellow with a red throat of a wispy "spider" form . . . perhaps even heavily frilled as many of this type are. In some 6 to 10 years from now, they should be of bloomsize. Another group of these "yellow beauties" are from the workshop of Dr. Bell of which I have a number of different seedling-pots growing. He writes that they (mostly) grow like weeds for him and make huge *A. evansiae*-like plants. One of these is Bell's #77-48 which is a complex hybrid of *EAE, evansiae* and *parodii* and then interbred amongst themselves in selected forms. My pot of them contains all midgets except for 1 plant which does make a leaf to 12″ in length, but they are healthy and they do live and grow slowly. With patience, I fully expect to bloom them. As Mr. Cothran's #339-17 yellow grows as a weed up here (the only freely growing one that I know of), it has been tried in many crosses but fewest of them ever set good seeds and even fewer want to grow (BUT SEE: 1979 PLANT LIFE, Mr. Cothran's article which gives exceptional news on this). One clone of *#339-17 x Bell's best diploid evansiae* has bloomed and the color is a deeper yellow but the form is poor and back-crossing has failed. *#339-17 x Amaryllis arboricola* has given 3 weak seedlings which after some 3 months, just one new leaf has shown. *#339-17 x Bell's tetraploid evansiae* seedlings died on me although one grower wrote that these were surviving for him. I do not know what the results were like. There are three small seedlings from Dr. Bell's hybrid: *best diploid evansiae x tetraploid evansiae.* These are grown upstairs where the coolness holds-down the erratic growth cycles. In some 3 or 4 more years, they should bloom.

BUT *AMARYLLIS EVANSIAE* HAS ANOTHER ROLE TO PLAY and every form of it gives a different result. Beautiful, miniature hybrids which range from peach (x *espiritensis*), from rose-pink to raspberry (x *traubii*) to green *(cybister)* rival *Amaryllis* x *henryae* (See: Dr. Traub's *Amaryllis Manual's* frontis piece). Its beauty still enthralls me after 20 years of viewing it. I have been promised one of these hybrids and I'm raising some seedlings of others. The ones which I have are slow, steady-rate growers which with time and care will give these delightful results.

Again, mention should be made here of *Amaryllis arboricola* which I received under the name, *H. arboricolum* (but I'm a hardcore American, hence *Amaryllis*) whose pollen I was lucky enough to get a good dab of. A rare plant whose breeding potential is still unknown was used on just about every thing that bloomed. Mostly no results but it had a great affinity for 2 hybrids which had *Amaryllis reticulata striatifolia* in their bloodlines. These 2 gave bountiful seedsets and seedlings with a weedlike growing power. A few show evidence of a stripe. A little praise should be given to certain hybrids which have *Amaryllis reticulata striatifolia* as a parent. In the first place, these hybrids are not the "run of the mill" type; secondly, there is usually a surprise or two involved; thirdly, they are mostly vigorous and with TIME become even more so; fourthly many are reblooming and finally,

one should note that some of them are extremely drought hardy. My first hybrid made back in the 60's and "conserved" has this bloodline. Whilst I have made some since, Dr. Bell has made a wide range of hybrids involving this species. Mine which bloomed for the first time this Spring, I like best. It involved a mis-labeled Dutch bulb which for pink was "a red" of no great merit x *Amaryllis reticulata striatifolia* whose bloomchild was a pure white netted on the veins in pink—lovely and recalling blooms of *Brunsvigia* in cluster and form. The white didn't come from the Dutch bulb but *Amaryllis reticulata striatifolia* seemingly, according to Dr. Bell, has a suppressant gene. Some F_2 seedlings should test-out to just how far this may hold true. Mr. Harshbarger's choice hybrid *(papilio* x *r. s.)* is an unusually fine and different hybrid of this. A further hybrid was made using this as the pollen parent and *EAE parodii* as the pollen parent to test-out the suppressant gene as to whether the "what" will show forth. I hope that it may breakdown the barrier which holds back the deep throat colorants. This has happened in some *Lilium* hybrids and has been able to get rich dark colors previously unknown in *Lilium*. But it may take even an F_3 seedling to trip the balance.

Last Fall while digging the *Paramongaia weberbauerii* (Peruvian Daffodil), I sliced a bulb in two. Both pieces were saved and the toppiece was put into dry peat for wintering. During the Winter time, I checked it to see what might happen. It healed and then little blisters started to form which by Spring's time had gotten to mustard seed size or just slightly larger but not large enough to detach to grow alone outside. So the whole bulb was turned-upside down and planted with the little bulblets near the soil's surface. Growth has commenced so it is possible to increase stock through a cuttage method. The blue-green of these leaves is outstandingly beautiful but I'm still awaiting the first bloom to show . . . that with fragrance will be even more beautiful.

Those of you who like the *Zephyranthes* (Rain Lilies), I suggest you make a date with MARCIA'S for bulbs of *Zephyranthes macrosiphon Clint M-30* as it does well outdoors and can be outstandingly good indoors.

Have a good year. You'll have a better year if you'll write several others and let them know it . . . for there's always someone who will appreciate the good word. Also it will make the American Plant Life Society stronger.

AMARYLLID MARKETING NEWS

(Under this heading, the names and addresses of those who have Amaryllids for sale, retail or wholesale, and brief notes on items for sale, will be listed *when information is sent to the Editor.*)

Marcia's Amaryllidaceae, Proprietor, Mrs. Marcia C. Wilson, 255 Galveston Road, Brownsville, Texas 78521. Phone 512—541-2142. September 1978 catalog. Cultural notes, *Amaryllis* species and hybrids.

Mini-tensiometer. The 1979 Catalog was received later in the season. It includes an extensive listing of *Amaryllis* species and hybrids; *Ammocharis; Crinum* species and hybrids; Clivias, *Cyrtanthus; Urceolina* (Eucharis), Hymenocallis, etc., etc.

Sudbury Laboratory, Sudbury, Mass. 01776. Royal Dutch Hybrid *Amaryllis,* and soil testing equipment.

William D. Bell, (wholesale trade dealer), P.O. Box 12575, Gainesville, Fla. 32604, offers tetraploid *Amaryllis* stock for Amaryllis breeders, including all classes described in Traub's *Amaryllis Manual,* but it may be several years before most are available in any quantity. (See article in this issue of PLANT LIFE).

Randell K. Bennett, P.O. Box 305, Sierra Madre, Calif. 91024: has a limited quantity of *Clivia gardenii* for sale, and will have *Clivia caulescens, C. nobliis, C. miniata* and *C. cyrtanthiflora* for sale, and possibly other amaryllids, in the future.

Schultz Company, 11730 Northline, Maryland Heights, St. Louis, Missouri 63043. Schultz Instant 10-15-10 Liquid plant food.

Miss Casyn B. Ecker, Meadow Place, Carmel Valley, Calif. is interested in trading or selling seeds and offsets of rare *Amaryllis* species.

Mr. John Geraghty, 94 Avondale Road, South Croydon, Surrey CR2 6JB, ENGLAND, writes that he has for sale the *Crinum* species listed below. They are all of flowering size from the winter of 1979. Price list will be sent upon receipt of 2 international reply coupons. *C. amoenum; C. angustifolium; C. asiaticum; C. brachynema; C. bulbispermum; C. defixum; C. flaccidum; C. latifolium; C. longiflorum; C. macowani; C. mooreii; C. pedunculatum; C. pratense; C. thaianum; C. woodrowi; C. zeylanicum.*

Economy Label Sales Co., Inc. P. O. Box 350, Daytona Beach, Fla. 32015. Complete line of plant labels.

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THE CHROMOSOMES OF **NOTHOSCORDUM MAHUII** TRAUB

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Dr. H. P. Traub has been interested in *Nothoscordum* for some time, as is evidenced by his diagnosis of the genus in 1954. In the early 1970's he received material from Sr. Manuel Mahu of Chile of a tiny, white-flowering, plant which was determined to be an undescribed species of *Nothoscordum,* and was described—naming it after the sender—as *N. mahuii* (Traub, 1973). Subsequent notes describing its bulb (Traub, 1974) and bulb-splitting in the taxon (Traub, 1975), followed.

In September 1974 Dr. Traub sent material of *N. mahuii* to the Wake Forest workers, with the request that they secure a determination of its chromosome number and types if possible. This proved to be an unusually difficult task. The plant proved difficult to culture, and it really never formed any bulbs with us, nor did we ever get it to flower. However, during the winter of 1977-78 mitosis was secured in root tips from this plant, and chromosome counts were made on metaphase figures from several cells. The findings encountered are described in this paper.

MATERIALS AND METHODS

The study with *N. mahuii* was incorporated with a study of chromosome numbers, variability, translocations, etc., in as many taxa of the genus *Nothoscordum* as could be obtained. The ten taxa studied, with some findings pertaining to them, are summarized in Table 1. Details for nine of the taxa are being prepared for another publication, while the information available for *N. mahuii* is given here.

[1] Present address: Department of Biology, University of North Carolina-Greensboro, Greensboro, N.C. 27412.

[2]Work supported in part by aid from the Research and Publications Fund of Wake Forest University.

Table 1. Chromosome numbers and types encountered most frequently in respective **Nothoscordum taxa.**

Taxa	2n	Chromosome type: Metacentric Single	Metacentric Pairs	Submetacentric Pairs	Subtelocentric Pairs	Telocentric Pairs	Range in length of chromosomes in mm. (Telocentrics not included)
inodorum	12		2	2	2		.03-.02
neriflorum	12		2	2	2		.03-.02
andicolum	12		2	2	2		.03-.02
FF-37[1]	17	1	5	2		1	.05-.03
bivalve-60[2]	18		5	2		2	.05-.03
bivalve-63[3]	19	1	4	2		3	.06-.03
FF-50[4]	19	1	4	2		3	.05-.04
fragrans	19	1	4	2		3	.05-.03
striatum	24		4	4	4		.04-.03
mahuii	40		6	7	7		.02-.01

[1] **Nothoscordum** sp. 15319-61 FF-37. Collected in the eastern part of the State of Michoacan, Mexico, on Mexico Route 15, K160, 5/13/61, by Walter S. Flory.
[2] **N. bivalve** 14767-60.
[3] **N. bivalve** 60-323 S-15467-63 Denmark.
[4] **Nothoscordum** sp. 15320-61 FF-50. Collected 11 miles south of Mexico Route 80, on Mexico 45, State of Jalisco, Mexico. 6/4/61, by Walter S. Flory.

Rapidly growing root tips were pretreated in colchicine (originally a 0.2% solution for 4 to 6 hours; later an 0.8% solution for 2 hours proved more effective) and then in 10% HCl at 60°C for 10 minutes. Tips were washed with tap water and left in 1% Gurr's acetic-orcein overnight; the next morning they were squashed in the same solution. This technique is a modification of Gerstel's (1949) and Pillay's (1969-1971) methods.

To promote the needed rapid growth of root tips it was found desirable, at times, to place plants in a growth chamber where optimum

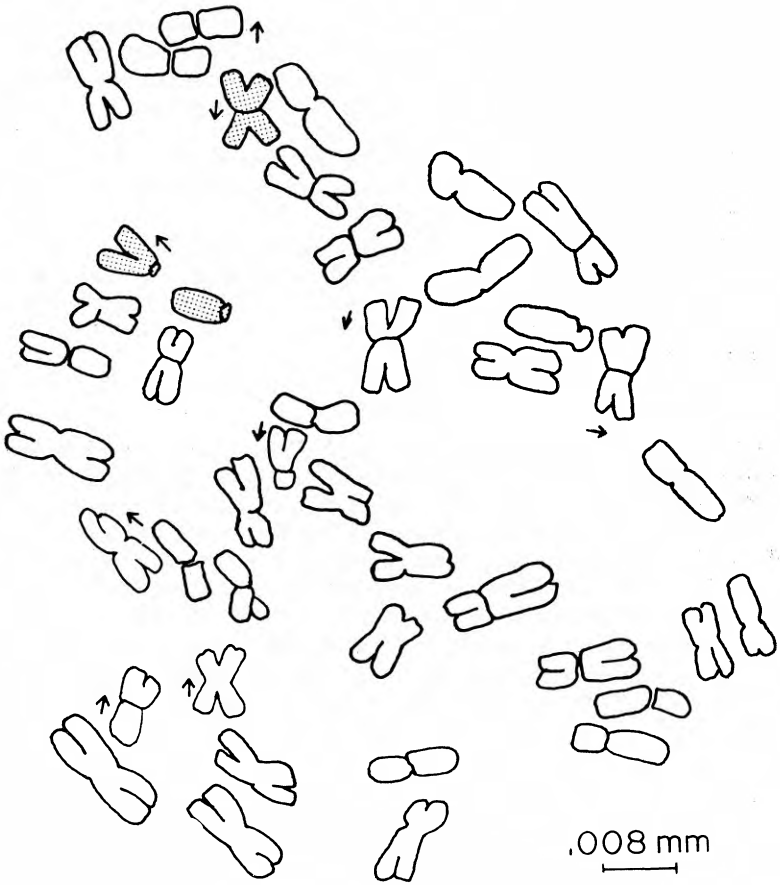

Fig. 29. The somatic chromosomes of a root tip cell of **Nothoscordum mahuii** Traub in mitotic metaphase. In this cell 2n=43. The three stippled chromosomes are those which appear additional to the apparently most consistent number (2n=40) for the taxon. (Nine overlapping chromosomes have been moved slightly—as indicated by the small arrows—in order to show each chromosome most distinctly.)

growing conditions could be facilitated. Here the daylength period was regulated to extend from 5 A.M. to 8 P.M.; temperature, during the light period, was 24°C and it was 18°C during the dark period.

For *N. mahuii* photographs were taken of the cells showing the best chromosome spreads at mitotic metaphase. The chromosomes were then traced directly from an enlarged image of the film projected on to the screen of a microfilm reader. This proved more feasible with this taxon than the making of camera lucida drawings, because the considerable number of chromosomes resulted in much overlapping of units which occurred at various field depths.

After photographs, and sketches, of the chromosomes were made for 10 different cells in mitotic metaphase, the lengths of each chromosome, and of each arm of each chromosome, were measured. From this data an index figure was obtained for each chromosome by dividing the length of the short arm, by the total length of the chromosome (S.A./T.L.). Chromosomes with index figures from 0.50 to 0.45 were considered metacentric; 0.45 to 0.37, submetacentric; and 0.36 or smaller, subterminal or subtelocentric.

A type idiogram was constructed, as a working basis, by averaging the arm and total lengths of each chromosome type. The index figure for each chromosome, as well as the total length of a chromosome, were considered when determining the chromosome type, and its position in the idiogram.

RESULTS

The ten cells of *Nothoscordum mahuii* in which the chromosomes were counted had the following numbers: 28, 33, 36, 36, 36, 38, 40, 40, 40 and 43, respectively. The best spread of chromosomes was secured in the $2n = 43$ cell, and it is a tracing of the karyotype of this cell which is shown in Figure 31. For reasons outlined in the Discussion $2n = 40$ appears to be the most consistent number for this taxon, and the chromosome number from which the others encountered deviate.

The chromosome numbers and types encountered most frequently in *N. mahuii* are presented on the bottom line of Table 1. (Similar data for the other 9 *Nothoscordum* taxa studied to date are also shown in this table for comparative purposes.)

Chromosome numbers deviating from a 2n of 40 are listed in Table 2, with the apparent causes for the deviations being listed. As indicated, the differing numbers are due to the lack, or addition, of one or of both members, of one or more pairs of chromosomes.

DISCUSSION

The several chromosome numbers observed in different cells of *N. mahuii* show it to be a variable aneuploid. The data indicate that the most consistent pattern into which all ten chromosome complements analyzed can be fitted is one in which $2n = 40$, with the causes for the deviates from this number being rather readily apparent.

Table 2. Varying chromosome numbers encountered in cells of **Nothoscordum mahuii** and apparent causes.

Cell Number	2n Number	Chromosome(s) lacking: One member of pair	Chromosome(s) lacking: Both members of pair	Chromosome(s) added: Single	Chromosome(s) added: Pair
1	43			Triplet of 6th ST pair	Additional ST
2	38		5th ST		
3	36		2nd ST; 5th M		
4	36		1st M; 4th M; 5th M		Additional ST
5	36		2nd ST; 6th M		
6	33	1st M	2nd ST; 5th M; 6th M		
7	28		2nd ST; 4th M; 5th M; 6th SM; 7th SM; 6th M		

M=metacentric
SM=submetacentric
ST=subtelocentric

Among the other nine *Nothoscordum* taxa examined the most frequent 2n numbers have been: 12, 12, 12, 17, 18, 19, 19, 19 and 24, respectively. A plausible and probable intergeneric pattern for these other nine taxa is apparent—but it is difficult to outline such a phylogenetic scheme satisfactorily including *N. mahuii.* There are other difficulties than just with chromosome number. The range of chromosome length among the other nine taxa ran from .02 to .06 mm. Chromosomes of *N. mahuii* are considerably shorter being .01 to .02 mm. long (Table 1). Also the leaves of *N. mahuii* are quite narrow, being only 1 to 1.5 mm. wide (Ravenna, 1978); leaves of the other *Nothoscordum* taxa studied range from 1 up to 10 mm. in width (this work and Traub, 1954). There are additional morphological differences between *N. mahuii* and the other *Nothoscordum* species available to us.

It is apparent that *N. mahuii* differs considerably from other taxa of the genus with which the current authors are familiar—in chromosome number, certain gross morphological features, the greater difficulty of inducing bulbing—as well as of culture in general. Sr. Perfelice Ravenna (in a personal conversation with W. S. Flory, August, 1978) expressed his opinion that this taxon might possibly belong to the closely related genus *Tristagma,* and could possibly be the same as the form

which he described as *T. subbiflora* (Ravenna, 1978). It seems evident that it is desirable to study additional material, both of this difficult to grow taxon, as well as of its closest affiliates in *Nothoscordum, Tristagma,* and perhaps other closely related genera. Such studies might possibly reveal *N. mahuii* as a generic bridging evolutionary entity.

SUMMARY

The present data show *Nothoscordum mahuii* Traub to be a variable aneuploid with somatic chromosome numbers of 28, 33, 36 (3 cells), 38, 40 (3 cells), and 43 having been observed in the ten root tip cells which have been studied and analyzed carefully. The data further indicates that $2n = 40$ is the number with the most consistent pattern into which all of the ten chromosome complements studied could be best fitted, and also from which the derivation of the variant numbers could be most easily explained. This taxon varies in several ways from other *Nothoscordum* species studied. Further cytological and morphological comparison of this taxon, with close relatives in this and other genera, is desirable for the more exact revealing of existing relationships.

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AN EVERBLOOMING **ALLIUM, A. EUROTOPHILUM**

HAMILTON P. TRAUB

In the mid-1970's, Dr. Reid Moran, the famous plant scientist at the San Diego Natural History Museum, collected plants of *Allium eurotophilum* Wiggins, which proved to be everblooming when grown in my garden in La Jolla, California. It is the first reported, and probably the only everblooming *Allium* species. Dr. Moran collected the plants in the mountains of northern Baja California, Mexico, in a mountain canyon in deep mucky leaf-mold. The species name, *eurotophilum,* denotes humus-loving.

The species is rhizomatous, with flattish leaves in green and glaucous forms; the flowers are light purple, usually 11-15 flowers to the umbel.

I have grown it outdoors in my garden and in containers, and have

found that it blooms repeatedly, a fact not previously known, so long as it is grown in a humus rich soil, and the scapes with faded flowers are removed. It is apparently the only known everblooming *Allium* species, and has great promise as breeding material for a series of hybrids in various colors when crossed with other species. Thus, at long last, the Alliums may become highly appreciated as garden, greenhouse and pot plants. Heretofore, the alliaceous odor of the whole plant, and the short blooming season, had reduced it to a secondary garden subject.

Stock of the species has been furnished to Marcia's Nursery, 255 Galveston Road, Brownsville, Texas 78521. In due course, this Nursery will have increase sufficient to supply the hybridizers, who may then begin the quest for the first fragrant, everblooming hybrid Alliums in a parade of colors.

The sub-basic chromosome numbers in *Allium* are $x=7$, $x_2=8$, $x_3=9$, and $x_4=10$, and crossing between plants, in this great diversity of sub-basics, will require that tetraploids be obtained by colchicine treatment, if not found in nature, in the hope of effecting crosses. Most likely in some cases, culturing the immature embryos in a nutrient solution would be necessary.

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Allium eurotophilum Wiggins, in Contr. Dudley Herb. 1: 164. pl. 12, fig. 1. 1933.

PLANT LIFE LIBRARY

VEGETABLE GROWING HANDBOOK—Principles and procedures for producing an abundance of quality vegetables, by W. E. Splittstoesser. AVI Publishing Company, Inc., Westport, CN. 1979. Pp. 298, 95 illus. $12.50

This Handbook or reference Manual is likely to become the **vade mecum** for present day vegetable gardeners. It is targeted for use by such diverse groups as the National Junior Horticultural Association, 4-H Clubs, Future Farmers of America, high schools, vocational community colleges, the beginning college level, and extension personnel. The book bulges with information about vegetables and vegetable gardening, arranged in seven chapters with such titles as: Planning the Garden; Plant Growth; Soils and Plant Nutrition; Pest Control; Harvest and Storage of Vegetables; Growing Individual Vegetables, and Growing and Preserving Herbs.

Splittstoesser has sprinkled the text with a generous number of well chosen illustrations. Unfortunately, many of them are hazy and not as sharp as they should be, probably because of faulty reproduction. There are forty tables, five of them in the Appendix. These tables are potentially useful for the veteran gardener as well as the novice. They summarize such topics as: Approximate composition of chemical fertilizers; Nutrients removed by the edible plant parts of vegetables; How to prepare vegetables for freezing, etc. A legitimate complaint can be made about some of the

tables, for example Table 3.2, "A key to the nutrient deficiency symptoms of vegetables". This Table literally contains too much information. As a result it had to be printed in very small type. This makes the table difficult to read, hence not as effective as it should be. Likewise, the map, Fig. 1.13, "The average dates of the first killing frost in the fall", is messy in appearance, and the numbers are mostly illegible without the use of a hand magnifier.

There is an Appendix of ten pages which contains much additional information. There are such dissimilar Tables as: Names and Addresses of Agricultural Experiment Stations; Names and Addresses of about three dozen Seed Companies; Nutritive value of vegetables; Vitamin content of the edible parts of vegetables, and Metric/English system conversions. The Index of twelve pages is detailed, but highly useful. At the end of each Chapter there are from 10-20 "Selected References", which will tempt those ambitious souls who wish to pursue a particular subject in more depth.

VEGETABLE GROWING HANDBOOK fills an obvious gap in the arsenal of those interested in vegetable growing in all its aspects. The The Handbook for Vegetable Growers by J. E. Knott is the only comparable publication in this field, but it is out of date, and does not contain the wealth of well organized information found in Splittstoesser's Handbook. Splittstoesser is to be commended for assembling a vast amount of scattered information, and making it accessible in clear and easily useable form.

Thomas W. Whitaker

AN ILLUSTRATED HISTORY OF THE HERBALS, by Frank J. Anderson. Columbia University Press, 562 West 113th St., New York, NY 10025. 1977. Pp. xiv + 270. Illus. $16.95. On the dust jacket of this neatly bound volume the claim is made that Frank J. Anderson has surveyed 32 of the most important works in the field of herbals. This appears to be true, although the work of Tabernaemontanus' (1591) Neuw Kreuterbuch is not mentioned. There may be others that were omitted for various reasons; nevertheless, the coverage is reasonably complete.

The herbals surveyed are all in the collections of the New York Botanical Garden Library. In this country only the Arnold Arboretum and the Missouri Botanical Garden have comparable collections of these charming and informative books that are essentially the historical basis of botany as a scientific discipline.

Anderson is a little vague about the audience he expects to capture with this book. He says "Those who already know and enjoy something of the special atmosphere and flavor of herbals will need no invitation to renew their acquaintanceship. And it is the hope of this book that those who are encountering herbals for the first time will be encouraged to seek still further and deeper." The layman who wishes to know more about these fascinating books will benefit most from this survey. Also, Anderson's book should be useful as a reference source for instructors teaching courses in the history of botany at the college or graduate level. The serious scholar will prefer to consult the originals for his work, although the Bibliography of almost 200 titles will benefit anyone planning in-depth studies of herbals.

The survey is based on the printed version of the herbals, rather than manuscript copies because, as Anderson explains, most herbal literature was developed shortly after the invention of printing. The illustrations which are the reason for the book are well chosen and are reproduced in acceptable style. I found the glossary interesting, as it defines some terms that are strangers to current botanical literature.

The writing is not as crisp and sprightly as the stimulating and provocative subject matter deserves. But understandably, comments on herbals are not adapted to the writing stlye of Time or Playboy magazines.

—Thomas W. Whitaker

FLOWERING TROPICAL CLIMBERS, by Geoffrey Herklots. Wm. Dawson & Sons, Ltd., Cannon House, Folkstone, Kent, England. Co-pub-

lisher Neale Watson Academic Publications, Inc., 156 Fifth Avenue, New York 10010. 1976. 194 pp. Illus. $40.00.

Geoffrey Herklots has several fine horticultural books to his credit. These books are primarily concerned with applied botany of the tropics, where he has spent most of his professional life. Dr. Herklots' "Flowering Tropical Climbers" would be an artistic and instructive ornament to living room coffee tables thruout the world, and should be on the shelves of all departmental libraries concerned with the teaching of plant science, particularly tropical botany. At first glance the book appears to be overpriced at $40.00 per copy however, with 16 beautiful color plates and many of Herklots' exceptionally fine line drawings, the purchaser of this book will be well rewarded for his investment.

Tropical climbers from 35 families and approximately 87 genera are discussed. The species treated are distributed for the most part between the Tropic of Cancer and Tropic of Capicorn. Dr. Herklots points out this distribution excludes as countries of origin: Europe, Northern Asia, most of North America, Southern Australia, and New Zealand. For the purposes of convenience the tropics are divided into 5 arbitrary geographical zones. These zones and the number of genera occurring in each zone are listed below.

Zone 1. Mainland S.E. Asia from India and Nepal to S. China. 22 genera.
Zone 2. Islands from the Philippines and Sumatra east of New Guinea and the Solomons and parts of Australia. 14 genera.
Zone 3. Tropical Africa south of the Sahara, and western islands of the Indian Ocean. 16 genera.
Zone 4. S. Mexico, Central America and the West Indies. 17 genera.
Zone 5. Northern S. America; (a) lowlands, (b) highlands. 18 genera.

There are very few overlapping genera among the 5 zones, but **Passiflora** is a prominent exception.

There is an excellent chapter, appropriately illustrated, analyzing "Methods of Climbing" displayed by tropical climbers. We can only marvel at the great array of structural modifications that have evolved to satisfy this function. There are 4 general methods of climbing: a. Scramblers; b. Hook and thorn climbers; c. Root climbers; d. Leaf climbers and tendril bearers. Examples of each method are given and illustrated.

For the individual species, citation of the type description, its geographic range, color of the flowers, notes on ecology, and other interesting observations are given. There is also a line drawing or a colored plate for each species. The book has a useful Appendix devoted to instruction on the cultivation of climbing plants in the tropics. The Bibliography of about 65 entries lists the more important books and articles that mention or are mainly concerned with tropical climbers. Also included is a short Glossary, defining technical terms used in the text. The book terminates with a good Index.

The thirty five families are treated in alphabetical sequence. Not all taxonomists will agree with Herklots' systematics. For example, **Bomarea** is placed in the family Amaryllidaceae. It is probably more properly placed in a separate family or in the family Alstroemeriaceae with the related genus **Alstroemeria** from the highland tropics of South America. Classification in this case is a matter of personal judgement, however, and does not detract from an otherwise very fine work. We are indebted to Dr. Herklots for sharing with us a labor of love. **Thomas W. Whitaker.**

SUNSET BOOKS OF 1979. All edited by the Editors of Sunset Magazine and Sunset Books. The paper covered books may be obtained from Lane Publishing Company, Menlo Park, Calif. 94025. All are profusely illustrated.

SUNSET NEW WESTERN GARDEN BOOK. Pp. 512. Illus. $9.95. Offers solutions to common garden problems in warm, hot and dry regions; in the 24 western climate zones, giving basic planting and care, for landscaping situations, special effects, and problem situations. It contains a **western plant encyclopedia,** treating 5,000 garden plants. A glossary, guide to botanical names, and a general index complete the volume. Profusely illustrated. Very highly recommended.

SUNSET LAWNS AND GROUND COVERS. Pp. 96., illus. $2.95. Comprehensive cultural instructions for lawns and ground covers. Index. Profusely illustrated. Highly recommended.

SUNSET IDEAS FOR PATIO AND DECKS. Pp. 80. Illus. $2.95. Directions for planning the patio, structural elements and finishing touches for the patio, and ideas for outdoor rooms. Index. Profusely illustrated. Highly recommended.

THE HERB QUARTERLY. Vol. 1, No. 1. April 1979. Pp. 48. Price $10.00 per year, single copies $3.00. Address: Green Road, Wilmington, Vt. 05363. Illustrated journal devoted to herbs in all their aspects. Highly recommended.

CLASSIFIED BIBLIOGRAPHY ON NATIVE PLANTS OF ARIZONA, Erwin M. Schmutz. Univ. of Arizona Press, Box 3398, Tucson, Ariz. 85722. 1979. Pp. 160. Paper cover $6.50, cloth $12.00. Introduction, instructions on how to use the book, and list of abbreviations, precede the biographical listings which are grouped under 30 categories. An index completes the book. Highly recommended.

RARE AND ENDANGERED BIOTA OF FLORIDA. VOLUME 5. PLANTS, edited by Daniel B. Ward. Univ. Presses of Florida, 15 Northwest 15th St., Gainesville, Fla. 32603. Pp. 175. Paper $5.00. Following the introduction, and description of the major terrestial and wetland habitats of Florida and species counts, the endangered species are detailed—descriptions, range, habitat, recommendations, and selected references. Highly recommended.

NATIVE HARVESTS, RECIPES AND BOTANICALS OF THE AMERICAN INDIAN, by Barrie Kavasch. Random House, 201 East 50th St., New York City. 10022. 1979. Pp. 202. Illus. Paper cover, $5.95; hard cover, $10.00. Following the introduction, the uses of native American plants etc., by the Amerinds are described—nature's seasonings; soups; vegetables, ferns, lichens, mosses, mushrooms, meats, saltwater and freshwater harvests, breads, beverages, medicines & cosmetics, smoking mixtures, chewing gums, and poisonous plants. A glossary, reference guide, botanical and general indices complete the book. Highly recommended.

GARDENS IN WINTER, by Elizabeth Lawrence. Claitor's Publ. Division, 3165 South Acadian at Interstate 10, P. O. Box 3333, Baton Rouge, La. 70821. Pp. 240. Illus. $6.50. Elizabeth Lawrence received the WILLIAM HERBERT MEDAL in 1943 (see Herbertia, Vol. 10. 1943) for her outstanding contributions toward the advancement of horticulture, particularly the amaryllids, as evidenced by her book, **A Southern Garden** (1942). The readers will be interested to hear that the second printing of her book, **Gardens in Winter** (1961), appeared in 1977. Those who did not acquire the book in 1961 may be interested in this chance to obtain a copy of this second printing.

DORMANCY AND DEVELOPMENTAL ARREST: EXPERIMENTAL ANALYSIS IN PLANTS AND ANIMALS, edited by Mary E. Cutter. Academic Press. 111 Fifth Av., New York City 10003. 1978. Pp. 316. Illus. This symposium by twelve outstanding scientists is concerned with dormancy mechanisms in both plants and animals—embryonic diapause in mammals, insect dormancy, control mechanisms in plant embryogeny, metabolic regulation of dormancy in seeds, environmental and hormonal control of dormancy in terminal buds of plants, sleep and torpor: homo-

logous adaptions for energy conservation, and dormancy and development. Text references follow each chapter. A general index completes the volume. Very highly recommended to all biologists.

PROGRESS IN BOTANY, Vol. 40, edited by Heinz Ellenberg, et al. Springer-Verlag New York. 44 Hartz Way, Seucaucus, N. J. 07094. 1978. Pp. 495. Illus. cloth, $74.00. This symposium by outstanding scientists, in the fields of morphology, physiology, genetics, taxonomy and geobotany, is an indispensable guide for the research worker in the respective fields of botany. A subject index completes the volume. Very highly recommended to all botanists.

THE HANDBOOK OF VERMONT SHRUBS AND WOODY VINES, by L. R. Jones and F. V. Rand. Chas. E. Tuttle Co., Rutland, Vt. 05901. 1979. Pp. 147. Illus. $3.95. This reprint of Bulletin 145, Vt. Agr. Expt. Sta. 1909, is devoted to the description of Vermont shrubs and woody vines. Following the introduction and keys to the plants, the shrubs and woody plants are described, under plant families, Coniferae, etc., including line drawings, and explanation of uses in woodcraft and handicraft. A general index completes the volume.

THE HANDBOOK OF VERMONT TREES, by G. P. Burns and C. H. Otis. Chas. E. Tuttle Co., Rutland, Vt. 05901. 1979. Pp. 244. Illus. $5.25. 1979. This reprint of Bulletin 194 of the Vt. Agr. Expt. Sta. 1916, is devoted to the description of the trees of Vermont, under plant families, Pinaceae, etc., including line drawings. A general index completes the volume.

BROMELIADS, FOR HOME, GARDEN AND GREENHOUSE, by Werner Rauh, with H. Lehmann, J. Marnier-Lapostolle & R. Oeser. English translation, edited by Peter Temple. Blandford Press. Sold by Sterling Publ. Co., 2 Park Av., New York City. 10016. 1979. This English translation of a monumental treatise on the Bromeliads will be welcomed by all gardeners. Following the introductory sections, the book is divided into two sections, Part I, Growth and Culture—native habitats, morphology, the living bromeliad, propagation, diseases and insects. Part II. Description of the Genera and Species, classification, the three sub-families, key for identifying the genera. A bibliography and index complete the volume. The book is profusely illustrated, a large number are pictured in natural color. Very highly recommended to all gardeners.

CHRYSANTHEMUMS—YEAR-ROUND GROWING, by Barrie Machin and Nigel Scopes. Blandford Press. 1978. Sold by Sterling Publ. Co., 2 Park Av., New York City 10016. Pp. 233. Illus. cloth, $19.95. This outstanding book will be welcomed by all who are interested in Chrysanthemums. Part I. is concerned with the control of the environment; Part II. deals with all phases of propagation; Part III. discusses culture, and Part IV. considers the light and temperature factors, nutrition and the interaction of these factors. The text is profusely illustrated. Appendices, references and an index complete the volume. Highly recommended to all interested in Chrysanthemums.

ORCHIDS AND THEIR CULTIVATION, by David Sander. Blandford Press. 1979. Sold by Sterling Publ. Co., 2 Park Av., New York City 10016. Pp. 177. Illus. Trade ed. $19.95; Library ed. $15.99. Completely revised and updated, this standard text will be welcomed by orchid growers. After the introductory sections, the following named subjects are considered: propagation; indoor culture, and culture of hardy orchids in gardens; fertilizing; breeding and pest control; breeding; monthly operations; collection and importation of orchids; greenhouse construction and automation. References, a glossary and an index complete the volume. Highly recommended.

ILLUSTRATED REFERENCE ON CACTI & OTHER SUCCULENTS. Vol. 5, by Edgar and Brian Lamb. Blandford Press. 1978. Sold by Sterling Publ. Co., 2 Park Av., New York City. 10016. Pp. 1499. Illus. Cloth, $17.50. This outstanding book will interest gardeners. The first part is devoted to cacti, and the second part, to succulents other than cacti. The numerous

species are described in detail, and are illustrated, many in their natural colors. A general index completes the volume. Highly recommended.

GARDEN FLOWERS IN COLOUR, by Brian and Valerie Proudley. Blandford Press. 1979. Sold by Sterling Publ. Co., 2 Park Av., New York City. 10016. Pp. 236. Illus. Trade ed. $8.95; Library ed. $7.19. Designed to slip into the pocket, or kept handily elsewhere for ready reference, this attractive book is divided into three parts—(1) garden design, uses of plants, etc.; cultivation, propagation, and control of garden enemies; (2) a section of 64 pages of color plates, showing 167 garden flowers in natural color; and (3) brief descriptions of garden flowers usually cultivated. A glossary, indices of Latin names and English common names, complete the volume.

NEW AMARYLLID CLONES, **continued from page 76.**

Registration Authority for the cultivars of **Nerine;** and this was extended to include all the **Amaryllidaceae** cultivars, excepting **Narcissus** and **Hemerocallis,** at the XVIIth International Horticultural Congress, 1966.

Only registered named clones of **Amaryllis** and other amaryllids are eligible for awards and honors of the American Amaryllis Society at Official Amaryllis Shows.

Correspondence regarding registration of all amaryllids such as **Amaryllis, Lycoris, Brunsvigia, Clivia, Crinum, Hymenocallis,** and so on, should be sent to Mr. Weinstock at the above address. The registration fee is $2.00 for each clone to be registered. Make checks payable to American Plant Life Society.

REGISTRATION OF NEW AMARYLLIS CLONES, 1979

Registered by Charles B. Cothran, 1733 N. Gibbs St., Pomona, CA.

Amaryllis clone **'Yellow Pioneer'** (Cothran, 1979); **A-1038;** D-5B, height of scape, 46 cm (18"); flower size, diam. across face, 18.5 cm (7.5"); flower length, flat; flower color, yellow; blooming season, April/May. Deciduous. A complex hybrid involving **A.** evansiae, **A.** striata, **A.** aglaiae, white Dutch hybrid. Introduced October 1779. This is the first yellow-flowered hybrid that I have seen which combines many of the characteristics of the large-flowered Dutch hybrids with the yellow color of the small yellow-flowered species. Develops a faint pink blush at the end of several days after opening.

THE AMERICAN PLANT LIFE SOCIETY

For the roster of the general officers of the Society, the reader is referred to the inside front cover of this volume.

1. THE AMERICAN AMARYLLIS SOCIETY

[A Committee of the American Plant Life Society]

[AMERICAN AMARYLLIS SOCIETY, continued from page 6.]

(c) REGISTRATION OF PLANT NAMES

Mr. James M. Weinstock, Registrar, 10331 Independence, Chatsworth, Calif. 91311

Correspondence about the registration of plant names should be sent directly to the Registrar, and a self-addressed, stamped envelope should be enclosed if a reply is expected.

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The Chairman and Secretary of the Council also function as Official Instructors.

Examinations.—Those desiring to take the examination for the Official Amaryllis Judges Certificate, should preferably apply to the Official Instructors for details, See Plant Life Vol. 35, 1979, Pickard Study Course, pages 34-41.

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Mr. N. Wm. Easterly, *Ohio*

III. PUBLICATIONS OF THE AMERICAN PLANT LIFE SOCIETY

BOOKS

1. **AMARYLLIDACEAE: TRIBE AMARYLLEAE,** by Traub & Moldenke (including the genera Amaryllis, Lycoris, Worsleya, Lepidopharynx, Placea, Griffinia, and Ungernia; Manila covers; 194 pages, incl. 18 illustrations. $8.00 postpaid.
This is required reading for every amaryllid enthusiast.

2. **DESCRIPTIVE CATALOG OF HEMEROCALLIS CLONES, 1893—1948,** by Norton, Stuntz, and Ballard. A total of 2695 Hemerocallis clones are included and also an interesting foreword, and explanatory section about naming daylilies. Manila covers; 100 pages (1—X; 1—90), includes a portrait of George Yeld. $5.00 postpaid.

3. THE GENERA OF AMARYLLIDACEAE, by Hamilton P. Traub. Includes a general introduction, a key to the subfamilies, infrafamilies, tribes, subtribes and genera of the Amaryllidaceae, and descriptions of all the genera. Every member of the Society should have this book for constant reference. Manila covers; publ. 1963; 85 pages. $8.00 postpaid.

4. LINEAGICS, by Hamilton P. Traub. This is the first outline text for the undergraduate student on the grouping of organisms into lineages. The text is divided into four parts: (a) the history of lineagics and lineagics as an integrated science; (b) basic lineagics, principles and procedures; (c) applied lineagics, principles and procedures; and (d) research methods in lineagics. Recommended for the student in biology. Publ. 194. Manila covers, 163 pages, incl. 8 illus. $8.00 postpaid.

PERIODICALS

(A) HERBERTIA, or AMARYLLIS YEAR BOOK [First series, 1934 to 1948, incl.], devoted exclusively to the amaryllids (Amaryllidaceae), and the workers concerned in their advancement. A complete set of these volumes is indispensable to all who are interested in the amaryllids. Libraries should note that this may be the last opportunity for complete sets.

COMPLETE SETS **OF HERBERTIA:**

Vols. 1-5 (1934-1938), $45.00, postpaid.
6-10 (1939-1943), $45.00, postpaid.
11-15 (1944-1948), $45.00, postpaid.

1-15 (1934-1948), $120.00, postpaid

SINGLE VOLUMES OF HERBERTIA:

Single volumes of HERBERTIA (1934-1948), when available may be purchased at $10.00 per volume postpaid.

Only a very limited number of sets, and odd single volumes are available. The price quotations are subject to prior sale.

(B) PLANT LIFE, including numbers on various plant subjects, 1945-1948; thereafter, 1949 to date, various plant subjects, **PLANT LIFE,** and the **AMARYLLIS YEAR BOOK** are combined in a single volume entitled, **PLANT LIFE.**

A limited number of volumes of **Plant Life,** including **Herbertia, second series,** are available, all quotations subject to prior sale.

COMPLETE SETS OF **PLANT LIFE:**

Vols. 1— 5, (1945-1949), $ 40.00, postpaid.
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