PLANT LIFE

1977

AMARYLLIS
YEAR BOOK

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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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All editorial correspondence should be addressed to: Dr. Hamilton P. Traub, *Editor, The American Plant Life Society, 2678 Prestwick Court, La Jolla, Calif. 92037.*

All persons and organizations interested in amaryllids, and other plants are invited to become members. The annual dues vary from (domestic $7.00 to $8.00; (foreign, $8.00 to $9.00) depending on the publishing costs. At present they are (domestic $7.00); (foreign $8.00) in advance which should be sent to:

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The American Plant Life Society
Box 150, La Jolla, California 92038

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EDITED BY

HAMILTON P. TRAUB

THOMAS W. WHITAKER

HAROLD N. MOLDENKE

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The cover features an electron microscope picture (X 51,500) of **Amaryllis** mosaic disease, showing numerous inclusion bodies visible in thin epidermis section of mosaic infested light green leaf strips. Note typical labeled **I** inclusion body at middle left center left. After Nowicki and Derrick, PLANT LIFE 1974, pp. 103-108.

PLANT LIFE, VOLUME 33, NO. 1, 1977—AMARYLLIS YEAR BOOK GENERAL AMARYLLID EDITION

PLANT LIFE, VOLUME 33, NOS. 2—4, INCL., 1977 GENERAL EDITION

ILLUSTRATIONS

CORRIGENDA

PLANT LIFE, Vol. 21, 1965, p. 96, under **Crinum amabile,** change **"cuperfolium"** to **"cuprefolium".** PLANT LIFE, Vol. 31. 1975, p. 63, under **Crinum asiaticum**, change **"cuperfolium"** to **"cuprefolium".**

PLANT LIFE, VOL. 33, NO. 1, January, 1977

AMARYLLIS
YEAR BOOK
1977

Year Book of

The American Amaryllis Society

44th Issue

General Amaryllid Edition

EDITED BY

Hamilton P. Traub

Thomas W. Whitaker

Harold N. Moldenke

THE AMERICAN PLANT LIFE SOCIETY
Box 150, La Jolla, California 92038

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.

I. THE AMERICAN AMARYLLIS SOCIETY

A Committee of the American Plant Life Society

DR. THOMAS W. WHITAKER, Executive Secretary

Box 150, La Jolla, Calif. 92038

AUXILIARY SOCIETIES

Correspondence about auxiliary membership of regional and local societies in the Society should be addressed to: Dr. Thomas W. Whitaker, Executive Secretary, Box 150, La Jolla, Calif. 92038.

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Amaryllis Society of Mobile, Mr. John R. Clark, **Pres.,** 4456 Bush Hill Lane, Mobile, Ala. 36619.

The Dallas Amaryllis Society, Mrs. E. P. Carpenter, **Pres.,** 6224 Tremont St., Dallas, **Texas.**

The Shasta Garden Club, Mrs. Oran H. Anglin, **Pres.,** 8434 Hidden Meadow Lane, San Antonio, Texas 78230.

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Men's Amaryllis Club of New Orleans, Dr. Tim Calamari, 1016 Rosa Ave., Metairie, La. 70005.

The Coastal Bend Amaryllis Society, Mr. Fred B. Jones, **Pres., 521 Vaky St., Corpus** Christi, Texas.

The Greater Houston Amaryllis Club, Mrs. Sally Fox, **Corr. Secy.,** 1527 Castle Court, Houston, Texas 77006.

The Southern California Hemerocallis & Amaryllis Society, Mrs. Dorothy Rose, **Secy.,** 10300 Rosewood Ave., South Gate, Calif.

The Amaryllis Society of Baton Rouge, Louisiana, Dr. Joseph K. Mertzweiller, 9266 N. Parkview Dr., Baton Rouge, La. 70815.

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(**AMERICAN AMARYLLIS SOCIETY,** continued on page 129.)

PREFACE

This 44th issue of THE AMARYLLIS YEAR BOOK is dedicated to Mrs. Emma D. Menninger, a great orchid fancier and breeder; who is famous as an outstanding *Nerine* breeder. Her large collection of *Nerine* hybrids has served as the basis for her extensive *Nerine* breeding in various flower colors. She is particularly famous for her white *Nerine* hybrids which are universally appreciated and sought after. She has also investigated the chromosomes of *Nerine* hybrids, and has published various articles in the *Nerine* field, particularly, her "Catalog of Hybrid *Nerine* Clones, 1882-1958" (see PLANT LIFE *16*: 63-74. 1960) which is always in great demand. She has served as Registrar of *Nerine* Hybrid clones for the American Plant Life Society in the past. For her outstanding contributions toward the advancement of *Nerine* breeding, including white hybrids, Mrs. Emma D. Menninger was awarded the William Herbert Medal for 1977, an honor richly deserved, by the Board of Directors of the American Plant Life Society.

We are sad to report the death of one of our outstanding members, William Quinn Buck, Herbert Medalist in 1969, who passed away suddenly on February 28, 1976. His friend, Frederick C. Boutin, was with him in his greenhouse collecting orchid pollen and making crosses and anticipating future crosses one evening and the next morning he had passed on—busy to the last in his life-long devotion to the improvement of cultivated plants. He always had a warm place in his heart for The American Plant Life Society; his sister had served as Secretary, and he was Chairman of the Daylily Committee. His two reports for 1975 and 1976 (see Vol. 32. 1976) were his last contributions; and unexpectedly, aside from his personal effects, he willed the residue of his property to the American Plant Life Society.

Again, we have a rich harvest of contributions to this issue of PLANT LIFE. Prof. Narain contributes a valuable article on the systematic position and taxonomic treatment of the Indian *Amaryllis* cultivars. Dr. William D. Bell writes about more potentials in *Amaryllis* breeding, Charles B. Ledgerwood describes how *Amaryllis* may be photographed in motion, and Dr. Cage writes about pot culture of *Amaryllis aglaiae.* Mrs. Jones describes her repeat-blooming *Amaryllis.*

Randell K. Bennett writes about two copper-colored Crinums, L. S. Hannibal reviews Verdoorn's paper on the Crinums of South Africa, and the need of *Crinum* seeds and bulbs for cancer research.

Donald D. Duncan writes about a variegated *Alstroemeria ligtu,* and describes a new *Alstroemeria* hybrid.

Mrs. Marcia Clint Wilson favors us with her annual report on the Zephyrantheae. Mr. Shields reports on *Hymenocallis* culture in Indiana. Dr. Zoellner describes the new Genus *Chrysocoryne.* Mr. Bauml reports on the Dr. Howard 1972 Mexican plant collecting trip, and Dr. Howard contributes brief accounts of his 1973 through 1976, Mexican plant collecting trips. There are reports on the annual Amaryllis shows, and still other interesting articles as shown by the

Table of Contents.

Contributors to the 1978 issue of the Amaryllis Year Book are requested to send their articles by August 1, 1977, 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 even 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-and-white prints made, and to submit these with their articles.*

January 15, 1977,
2678 Prestwick Court,
La Jolla, California 92037

Hamilton P. Traub
Thomas W. Whitaker
Harold N. Moldenke

TRIBUTES TO WILLIAM QUINN BUCK, 1908-1976

A copy of the **Hemerocallis Register,** Spring, 1976, published by and for **Regions 7** (Arizona, California, and Nevada) **and 8** (Hawaii, Oregon and Washington) of **The American Hemerocallis Society,** has been received.

The main feature in this publication is an **In Memoriam** article with tributes from Mrs. Kenneth Boldt (Fullerton, Calif.), Frances Kuhs (Bakersfield, California), Dr. Hamilton P. Traub (La Jolla, Calif.), Jim Marsh (Chicago, Ill.) and Jack Romine (Calif.), Hubert C. Lloyd, (Monrovia, California), Joseph E. Werling and Gladys L. Williams, **(Southern California Hemerocallis and Amaryllis Society).**

Hubert C. Lloyd, of Monrovia, who co-authored with Hamilton P. Traub and W. Quinn Buck in producing **The Second Decade of Hemerocallis Washingtonia,** Jan. 1, 1959-Dec. 31, 1968 (PLANT LIFE 29: 124-140. 1973, in his tribute to Mr. Buck writes,—

About twenty years ago, I saw many daylilies in bloom at the Los Angeles State and County Arboretum in Arcadia and I asked at the gate house about them. I was told to see a Mr. Buck who worked there as head propagator. That was the beginning of years of visits with him at his home and at the Arboretum.

After his retirement, he devoted all of his time to hybridizing and growing new named varieties of daylilies and caring for a greenhouse filled with orchids and Amaryllis. It was a treat to see his seedlings bloom each year and my visits were more frequent then. He had many beautiful seedlings, some that he considered fine enough for further testing and eventual introduction.

The last time I visited him, a little over two weeks before his death, he said as I was leaving that he hoped to live to be one hundred years so as to see how much daylilies could be improved. How sad that he did not have a few years more.

Dedicated to
Emma D. Menninger

HERBERT MEDALIST—EMMA D. MENNINGER

EMMA D. MENNINGER

An autobiography

I was born in Indiana in 1891, during the last days of horse-drawn street cars in our small town. The usual grade and high school days passed, and, as I had always aspired to be a teacher, I enrolled in a college course in the Indiana State Normal School. There, I was thrilled by taking all of the available courses in botany and zoology. Part of one of these courses required the collection of pressed plants with the proper herbarium sheets. Gathering weeds and wild flowers and preserving them, was an enjoyable task.

I taught for a few years in the local grade schools; the first was a one-room school with few pupils and eight grades. I surmise that I learned more that first year than any of my pupils!

In 1919, after World War 1, I moved to Los Angeles with my Mother and sisters. A year's course in Library Science with credit at the University of Southern California, led to a position in the Science Department of the Los Angeles Public Library. There, my work was pure joy.

Later, after my marriage to Elmore W. Menninger, whose work involved architectural research, I worked in Los Angeles as a high school librarian until my retirement in 1947.

My husband and I had both been charmed by the new cult of Cymbidium orchids. A number of these plants in full flower had been entrancingly displayed at the Bel Air and Pasadena flower shows. From that time on, horticulture became the main focus of our lives, embracing the culture of Nerines, Cattleyas, Cymbidiums, and tropical plants.

Both Nerines and Cymbidiums were nearly unobtainable in the United States during World War II. However, we imported both genera from England because greenhouses there were required to devote much of their space to food-bearing plants.

Over the years, we did extensive hybridizing and we learned to plant orchid seed asceptically. Most of this endeavor was my responsibility. Many of our hybrid Cymbidiums are registered by the Royal Horticultural Society in the name of Greenoaks.

By a rigorous process, and with the help of a fine microscope and a few published articles, I learned the technique of counting chromosomes in Nerines and Orchids. In Cymbidium species, the somatic chromosome number is 40.

In the genus Nerine, however, the somatic chromosome number varies from species to species. There are diploid numbers of 22, 23, and 24, as indicated in the article included in the Journal of the Royal Horticultural Society for October, 1951. Therefore, I found the chromosome numbers in Nerine hybrids difficult to determine. Most Nerine hybrids seem to be fertile. The only tetraploid Nerine was said to be 'Inchmery Kate', with 44 chromosomes. There is some doubt concerning this matter, and, in the few slides I had time to make using root-tips of this variety, the count of 44 chromosomes was not verified. Using pollen of 'Inchmery Kate' to set seed on other varieties, is probably more successful than when trying to use 'Inchmery Kate' as the seed parent.

In Cymbidiums, triploids usually are not fertile, while most diploids and tetraploids are. When I started counting chromosomes, there were only three reported tetraploid Cymbidiums. I was able to find a dozen or more tetraploid Cymbidiums, including the fragrant tetraploid Early Bird 'Pacific,' to serve as a nucleus for breeding finer and early-flowering hybrids.

My husband and I made a number of trips around the world—to England, South Africa, and Southeast Asia. On some of these visits, we were delegates to various World Orchid Conferences. I became a member of the International Orchid Commission on Classification, Nomenclature, and Registration which usually met in conjunction with the World Orchid Conference.

During these visits to various countries, especially while in England, we added volumes to our horticultural library, such as a complete set of CURTIS'S BOTANICAL MAGAZINE, a run of the GARDENERS' CHRONICLE, a beautifully bound copy of Mrs. Loudon's ORNAMENTAL BULBOUS PLANTS and many other horticultural books. In 1955, in England, we photographed on film strips, all 509 original paintings of the Cymbidiums which had received awards from the Royal Horticultural Society.

Before 1952, we had imported South African bulbs from Kate Stanford and Nerines from England. In 1952, we purchased a duplicate collection of the Exbury Nerines from the Rothschild Estate. These were flowered out-of-doors in pots, and were later hybridized. By interbreeding the few white hybrids, we flowered a fairly large number of white seedlings. Of these, about 90% appear to be pure white, although certain clones, when grown in full sunlight, do develop a faint tinge of pink. During years past, the white seedlings were segregated in a small greenhouse, but they are now grown out-of-doors in pots, on benches.

A list of my favorite Nerine hybrids, would have to include the Exbury varieties 'Ben Hills' - cherry color, 'Susan' - pink, and 'Wisley Bridesmaid' - another pink. Among my own hybrids, 'Cimmerian' - dark, smoky fuschia, 'Firewheel' - flame, and 'Skyrocket' - tall, deep pink. But choosing favorites is difficult; Nerines are nearly all beautiful. Many colors are represented, including red, scarlet, blue, pink, coral, and white, with various combinations of these. So far as I know, there are no yellows or golds, although one could wish for Nerines in shades of gold such as that found in *Lycoris traubii.*

I have concluded that, while bees visit the Nerines for nectar, they do not disturb the pollen. A small fly—I believe it to be the bee-fly—does appear to pollinate the flowers.

In the early fifties, after my husband and I had both retired, we moved to seven oak-covered acres in Arcadia, California. We called our place, Greenoaks. My husband designed a small house, two large glasshouses, and a shade house for the orchids. The Nerines were grown outdoors on benches. They were all grown in pots.

During these many years, I have enjoyed the pleasure of writing articles on Nerines for PLANT LIFE, including NERINES ARE BEAUTIFUL, 1959, CATALOG OF HYBRID NERINES, 1960, and BREEDING WHITE NERINES, 1973. Also, I have written on a variety of orchid subjects for the Orchid Review (England), American Orchid Society Bulletin, Cymbidium Society News, Orchid Digest, and other periodicals. I aslo compiled a CATALOG OF CYMBIDIUM SPECIES.

Two of my favorite endeavors in Cymbidium hybridizing, have been the raising of many miniature-bowered and early-flowering types. By means of treating Cymbidium backbulbs with colchicine, I produced, to the best of my knowledge, the first flowered tetraploid orchid that originally had been a diploid.

In 1971, as the result of injuries sustained by both of us in an automobile accident, my husband did not survive. This was a severe loss. Only the sympathy and advice of relatives and friends, such as that of W. Quinn Buck and Charles Hardman in the Amaryllis field, and Lambert Day and Ernest Hetherington in the orchid field, was I able to continue my horticultural pursuits. For, despite the passing of the years, and regardless of some ill health, my interest in horticulture is as enthusiastic as ever.

IN MEMORIAM - WILLIAM QUINN BUCK, 1908-1976

I.

The members of The Southern California Hemerocallis and Amaryllis Society, and The American Plant Life Society, were shocked to hear of the sudden death of William Quinn Buck on February 29, 1976. Frederick C. Boutin visited with him on the evening of February 28, when they collected pollens which they planned to use in plant breeding later. That night he passed away peacefully in his sleep. He had been busy with his horticultural activities to the very last. He had sent in his 1974-1975 Daylily Reports, as Chairman of the Daylily Committee, for publication in the 1976 PLANT LIFE, and these were his last contributions to horticultural literature.

Mr. Buck was among the three pioneers in breeding tetraploid daylilies as is shown in the literature (1, 2, 3, 4, 5, 6, 7, 8, 9). His contributions extended to elaborate methods for polyploidizing (2). He devoted most of his time since the 1950's to the breeding of tetraploid daylilies, and leaves a large collection which he has willed to The American Plant Life Society along with most of his estate as shown by the following Last Will and Testament:

LAST WILL AND TESTAMENT

OF

W. QUINN BUCK, also known as WILLIAM QUINN BUCK

I, W. QUINN BUCK, also known as WILLIAM QUINN BUCK, a resident of the City of Arcadia, County of Los Angeles, State of California, do hereby make this, my Last Will and Testament.

FIRST: I revoke all Wills and Codicils to Wills heretofore made by me.

SECOND: I declare that I am unmarried; and, that I have no children either living or deceased.

THIRD: I give and bequeath to MARY SHREVE of Atascadero, California, all of my personal effects, furniture, furnishings, paintings, books and jewelry.

FOURTH: All of the rest, residue and remainder of my estate, I give, devise and bequeath to the AMERICAN PLANT LIFE SOCIETY, P. O. Box 150, LaJolla, California 92037.

FIFTH: I nominate and appoint MARY SHREVE as Executrix of this, my Will, to serve without bond. In the event that she is unable to act, I nominate and appoint LANETTE HURDLE of Norco, California, as her alternate and successor, likewise without bond. I authorize my Executrix, or her alternate, to lease, encumber and sell the property of my estate, subject to such confirmation of law as may be required.

IN WITNESS WHEREOF, I have hereunto set my hand this 24th day of April, 1974.

W. QUINN, BUCK, also known as WILLIAM QUINN BUCK

The foregoing instrument, consisting of two (2) typewritten pages, including this page, was at the date thereof by the said W. QUINN BUCK, also known as WILLIAM QUINN BUCK, subscribed at the end thereof and published as, and declared to be, his Last Will and Testament, in the presence of us, who, at his request and in his presence, and in the presence of each other, have subscribed our names as witnesses thereto.

Dexter D. Jones, residing at 675 Hampton Rd., Arcadia, Calif.

Helen L. Gains, residing at 516 Santa Cruz Rd., Arcadia, Calif.

The Buck tetraploid daylily collection will be carefully evaluated under the expert hand of Frederick C. Boutin, Botanist, Huntington Botanical Gardens, San Marino, Calif. The very best hybrid seedling will be named in honor of Mr. Buck, and the germ plasm of the collection will be available for daylily breeders who are members of the Southern California Hemerocallis and Amaryllis Society and The American Plant Life Society. Other fine seedlings will be tested, named and released.

In recognition of Mr. Buck's outstanding contribution to the breeding of daylilies and other amaryllids, The American Plant Life Society awarded him the prestigious WILLIAM HERBERT MEDAL in 1969. The 1969 issue of PLANT LIFE was dedicated to him; and to which he contributed a charming autobiography with portrait (3), and his annual Daylily Report (4).

LITERATURE CITED

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3. Buck, William Quinn. - An autobiography. Plant Life **25:** 6-8. 1969.

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5. Schreiner, Robert. - 1951 Daylily Catalog.

6. Traub, Hamilton P. - Colchicine poisoning in relation to Hemerocallis and other plants. Science **110:** 686-687. 1949.

7. Traub, Hamilton P. - Colchicine induced Hemerocallis polyploids and their breeding behavior. Plant Life **7:** 83-116. 1951.

8. Traub, Hamilton P. - The First Decade of **Hemerocallis washingtonia.** Plant Life **15:** 69-79. 1959 (Part One); **16:** 111-120. 1960 (Part Two). Also reprinted in the Hem. Jour. **14(2):** 65-75. 1960 (Part One); **17(2):** 77-86. 1963 (Part Two).

9. Traub, Hamilton P., W. Quinn Buck, and Hubert C. Lloyd. The second decade of **Hemerocallis washingtonia,** Jan. 1, 1959—Dec. 31, 1968. Plant Life **29:** 125-140. 1975.

Mr. Buck devoted his life to the breeding of plants, particularly daylilies. His charming personality and unselfish devotion to horticulture, and his outstanding tetraploid daylilies, will stand as a fitting monument to his memory.—**Hamilton P. Traub**

II.

The sudden death of Quinn Buck, a longtime and esteemed friend of my husband and myself, was sad indeed. From the time in the forties when he was a technician in the Floriculture Department of UCLA, through the years at The Los Angeles State and County Arboretum and later during his work with his beloved daylilies, he was a source of inspiration and advice to us.

His interests and ours crossed in various pursuits: in growing Nerines and other Amaryllids, in growing Orchids, especially Cymbidiums and in the culture of flowering trees, including the gorgeous Chorisias. In his methods of doubling the chromosome numbers of various plants by the use of the alkaloid colchicine, Quinn had adapted an ingenious method of treating daylilies that enhanced both the substance and the size of the flower.

What better memorial for him than the flowers he loved and improved—his legacy to us!—*Emma D. Menninger*

III.

Quinn Buck and I first became acquainted some 13 years ago when we were both employed by the Los Angeles County Department of Arboreta and Botanic Gardens. At the time I was aware of Quinn's intense interest in the Amaryllidaceae and the breeding work he was doing with *Amaryllis, Cyrtanthus,* and *Hemerocallis,* but it was 10 years before I began working with the members of this family. For the last three years our mutual interest in *Amaryllis* brought us together many times to plan crosses and exchange plants and seed. The evening before he passed away we spent in his greenhouse collecting pollen and making crosses and anticipating future crosses. Many of his hybrid amaryllis will be in display plantings in the Huntington Botanical Gardens and will be used for breeding future generations of hybrids.—*Frederick C. Boutin*

1976 HERBERT MEDAL PRESENTATION

At a ceremony in the Mayor's Parlour at Roodepoort Town Hall, Transvaal, on Thursday evening, February 5, 1976, the Mayor, Clr. W. J. de Vos, read the citation in connection with the award of the 1976

WILLIAM HERBERT MEDAL to Mr. Floor Barnhoorn, of Little Falls, Transvaal, South Africa, in recognition of his outstanding work in breeding Hybrid *Amaryllis* for the world wide commercial trade. The Medal presentation scene is shown in Fig. 2.

Fig. 2. The 1976 **William Herbert Medal** presentation scene, Mayor's Parlour, Roodepoort, Transvaal, Thursday evening, February 5, 1976. Mr. Floor Barnhoorn, **left**, addresses the gathering while the Mayor, Clr. W. J. de Vos, **right,** who presented the Medal, and others present, listen. Photo **West Rand Times en Wesrander**

THE EDITOR'S MAIL BAG

On January 28, 1976, we enjoyed a visit with Frederick C. Boutin, Botanist, from Huntington Botanical Gardens, San Marino, Calif.

The editor enjoyed a visit on February 3, 1976, with T. D. Jacobson, Botany Department, Washington State University, Pullman, Wash.

We are saddened to record the death of Dr. Philip G. Corliss of Somerton, Arizona and San Diego, Calif., on April 11, 1976.

At its June 2, 1976 New Orleans meeting, the Botanical Society of America, awarded to Dr. Thomas W. Whitaker its Certificate of Merit in recognition of his distinguished achievements and contributions to the advancement of Botanical science, particularly his contributions to the understanding of economic plants, notably their improvement, and for a unique contribution in expressing this understanding in terms of their domestication and their influence on the development of civilization.

LINNAEUS BICENTENNIAL IN 1978. Dr. Armando Mencia, Hotel Tamanaco, Apartado de Correos 467, Caracas, Venezuela, wrote to Mrs. A. C. Pickard, Alvin, Texas, about naming an outstanding hybrid Amaryllis clone in honor of Linnaeus on the occasion of the Bicentennial of Linnaeus' death in 1978.

Under date of May 27, 1976 he wrote to Mrs. Pickard as follows: "Some years ago, I visited Uppsala, Sweden, to pray at Linnaeus' grave in the subperb Uppsala Cathedral. I also went to his home at Hammerby, a fascinating place, now used as a museum. I have the greatest admiration for Linnaeus, and feel that the tribute of having an Amaryllis clone, preferably a double one, named for him on the occasion of the Bicentennial of his death in 1978 would be a well-deserved honor to this great botanist. Since this event is two years in the future, there will be ample time to select a suitable Amaryllis hybrid to bear his name."

Amaryllis breeders are requested to bear this in mind and if possible name an outstanding Amaryllis Hybrid in memory of Linnaeus in 1978. Dr. Mencia states that he will be delighted to hear from the American Amaryllis Society members regarding his suggestion, and other matters concerning Amaryllis .

1. REGIONAL ACTIVITY AND EXHIBITIONS

THE 1976 AMARYLLIS SHOW SEASON

The 1976 Amaryllis Show Season began on April 3 with the *New Orleans Intra-Club Amaryllis Show,* and was followed on April 10-11 with the *Greater Houston Amaryllis Show.* Two shows were staged on April 10-11, the *Corpus Christi, Texas, Amaryllis Show,* and the *Greater New Orleans All-Horticulture Amaryllis Show.* The *Houston Amaryllis Show* was held on April 11. The *Southern California Hemerocallis and Amaryllis Show* and *The Amaryllis Society of Alabama Show,* were staged on April 24-25. The show Season closed with the *Spring Extravaganza* at the California Arboretum Foundation and the Los Angeles State County Arboretum at Arcadia, California on May 22-23.

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.

1976 NEW ORLEANS INTRA-CLUB AMARYLLIS SHOW

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

On April 3, 1976 The Men's Amaryllis Club of New Orleans held its fourth annual Intra-Club all horticulture Amaryllis Show at the City Park Backer Room. Each year the interest shown by Club members in this Show increases. From the greatest number of entries thus far, trophies were awarded as follows: (1) best 4-floret specimen, a 'Summertime' displayed by George Merz, Jr.: (2) best 3-floret specimen, a *red seedling* by Holly H. Bowers, Jr.: (3) best 2-floret specimen, 'White Christmas' by Albert Touzet.

The Club's regular annual Show, open to the public, was held on April 10-11 and is reported separately.

GREATER HOUSTON AMARYLLIS CLUB SHOW, 1976

Mrs. Sally Fox, *Corresponding Secretary,*
1527 Castle Court, Houston, Texas 77006

The Greater Houston Amaryllis Club opened the Garden Center, in Houston, Texas to the public to view its Amaryllis show on April 4th, 1976.

A six foot cardboard replica of the Liberty Bell covered with red and white Amaryllis was the Club's tribute to the birthday of our Country, and carried out the theme "Amaryllis Bicentennial Celebration". There were eight amaryllis floral arrangements in keeping with the theme which made our show very attractive to the visitors.

Judging was done by Accredited Amaryllis Judges, whose selections were:

'Golden Triumphator' shown by Mrs. G. D. Everett, who received an Award of Merit. She was presented the Club's tray for this specimen.

'Picotee' with two four-bloom scapes was the outstanding entry of Mrs. Edwin Marek. She earned an Award of Merit and the Ludwig Challenge Cup.

Mrs. G. D. Everett also won a silver plate for an 'American Hybrid', along with an Award of Merit. This was the second consecutive win, so the trophy is hers permanently.

Mrs. W. J. Snow entered a perfect 'Senorita' in the Specie Division, and was presented a silver plate.

Another repeat winner, whose silver trophy is now hers, was Mrs. Robert M. Rucker, Jr. for the best 'Dutch Seedling' entered. The coloration was very different from most red shades since it shaded from deep orange into light red. This was a real beauty, with two scapes in bloom. She is also again the proud possessor of the Preliminary Commendation Award from the American Amaryllis Society.

'Sweepstake' award of the Warnasch tray went to Mrs. P. A. Froebel for most blue ribbons in the show.

Other sections had too few specimens for competition so no other trophies were given out.

Again the "Educational Exhibit" prepared by Mrs. A. O. Aschenbeck was a focal point as many visitors were especially interested in methods of propagation, which the Hostesses discussed freely.

Our "Dutch Seedling" section boasted more specimens than any of our previous shows and the number of high scores indicated it was difficult for the Judges to make their selection for the Preliminary Commendation Awards. We are gratified that some of our members are being so successful in their hybridizing programs.

The weather conditions in the Gulf Coast area are always a challenge to those of us who grow our Amaryllis in open beds, and it was a relief to have an abundance of specimens this year for our show. Even our "Invitational" section had seven entries and the top score went to Mr. Ray Stevens for a near perfect scape of 'White Witch'. This silver plate becomes a permanent possession for the winner of this section each year.

As a result of our show we added three new members to our roster, which helped fulfill our goal of promoting interest in growing Amaryllis.

Mrs. A. O. Aschenbeck and Mrs. Sally Fox served as Chairmen of the show.

CORPUS CHRISTI (TEXAS) AMARYLLIS SHOW, 1976

MRS. CARL C. HENNY, *Corresponding Secretary,*
Coastal Bend Amaryllis Society, P. O. Box 3054,
Corpus Christi, Texas 78404

Our Coastal Bend Amaryllis Society members were quite pleased to have had 48 entries within our Amaryllis exhibit, despite a very warm winter and very little rain during the winter months. The "Festival of Flowers" of Corpus Christi, Texas, was held on April 10th and 11th in the City Coliseum in which we participated. The Theme for the show was "HAPPY BIRTHDAY, U. S. A." commemorating our National 200th Anniversary. A very large Birthday Cake, illuminated with 200 electric candles, was displayed at the entrance of the Show.

Ludwig named and registered Amaryllis entered were: 'Bouquet', 'Apple Blossom', 'Carina', 'Gipsy Giant', 'Fire Fly', 'Picotee', 'Franklin Roosevelt', 'Royal Dutch', 'Voodoo', and 'White Favorite'. Many of the named varieties had bloomed early or were late bloomers for the show. Mrs. Carl Henny was fortunate to have *Sprekelia formosissima* to enter as a specimen.

Mr. Duane Eckles was awarded the "SILVER BOWL" given club members for receiving the greatest number of blue ribbons received in the Ludwig Registered and Named Amaryllis. His entries were 'Royal Dutch', 'Franklin Roosevelt', 'Voodoo', 'Gracilia', and 'White Favorite.' He received an Award of Merit, given by the American Amaryllis Society for his entry of 'Voodoo' which scored 96 points.

A *"SPECIAL TROPHY"* was awarded to *Mr. J. M. Mabe,* non-club member, for his entry of 'Gipsy Giant' which scored 93 points.

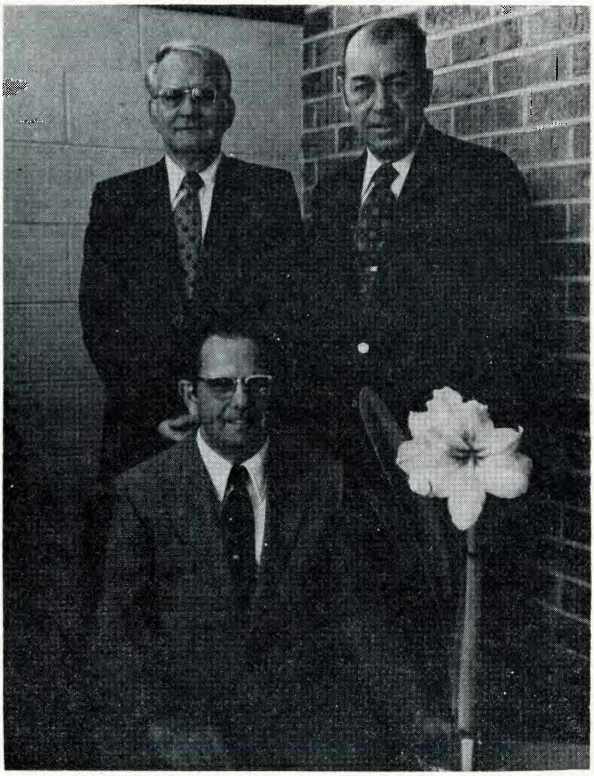

Fig. 3. New Orleans 1976 All-Horticulture Amaryllis Show—some Show winners, **standing, from left to right,** Vincent J. Peuler, winner of "Best in Show Award," and A. T. Diermayer, Co-Chairman and winner "Best Double Specimen" award; **seated,** L. W. Mazzeno, Jr., winner of Mahan Trophy for best named and registered specimen.

Mrs. Carl C. Henny, club member, received a "SPECIAL TROPHY" for receiving the greatest number of blue ribbons in the "BREEDERS CLASS".

Miss Winnie Joiner, club member, received an "AWARD OF MERIT", given by THE CORPUS CHRISTI COUNCIL OF GARDEN CLUBS for her entry of 'Apple Blossom' which scored 96 points.

Mrs. Elsie Balke, club member, and *Miss Winnie Joiner* both received "Awards of Merit" from the American Plant Life Society and American Amaryllis Society, for their entries of Bouquet (score 95 points) and 'Apple Blossom' (score 96 points).

PRELIMINARY COMMENDATION AWARDS; given by the American Amaryllis Society, were awarded to *Mrs. Sheriton Burr* for her unnamed hybrids—scoring 95 and 96 points, and to *Mrs. Earl Jones,* non-member, and *Miss Gladys Sandefer,* non-member, for their garden grown unnamed hybrids, which scored 95 points.

Our Coastal Bend Amaryllis Society also constructed a Sales Booth in the concourse of the Coliseum, illustrated with posters displaying the colorful *Amaryllis* blossoms, and instructions in regard to their culture. Potted *Amaryllis,* in bloom, were potted previously by club members, and then displayed and sold to the public. This added feature helped to publicize the beauty of the *Amaryllis.*

Judges for our Amaryllis Exhibit were Mrs. G. Browning Smith, of Harlingen, Texas; Mrs. M. F. Locke, of Kingsville, Texas, and Mrs. D. L. W. Carter, of Corpus Christi, Texas.

1976 GREATER NEW ORLEANS OFFICIAL ALL-HORTICULTURE AMARYLLIS SHOW

L. W. Mazzeno, Jr.
944 Beverly Gardens Drive, Metairie, Louisiana 70002

For its seventeenth annual all-horticulture Amaryllis Show, the Men's Amaryllis Club of New Orleans chose the beautifully appointed mall of the Lake Forest Plaza in New Orleans, La. The Show was held on April 10-11, 1976, and again the public was invited to participate in and view this spectacular display of Amaryllis at their peak of bloom. Total entries were 364, with 62 coming from non-members. The latter accounted for 16 blue ribbons and one trophy.

For the first time in the history of this Show an F_1 species hybrid won the award for the "Best-in-the-Show." with this bloom Vincent Peuler also won the Amaryllis, Incorporated award for best species specimen. Mr. Peuler's hybridizing ability was further displayed in his capturing the coveted Robert Diermayer memorial award for the best breeder's hybrid. For the second consecutive year Holly H. Bowers, Jr. won the greatest number of trophies and awards in the Show: the T.A.C. Construction Co. Award for best unnamed, unregistered hybrid, the Reuter Seed Company, Inc. Award for best cut flower with an 'Orion,' the George Merz, Jr. President's Trophy for most blue ribbons (22) won by a Club member, the Amaryllis Society of Baton Rouge Inc. Trophy for the best unnamed single floret specimen, the O. J. Robert, Sr. Trophy for best potted three-floret registered hybrid 'Fantastica,' the Nola Luckett Trophy for best two-floret potted specimen, the Laurence Mazzeno Trophy for best miniature hybrid 'Firefly,' and two Sweepstakes Rosettes. The James Mahan Memorial Award for best registered and named hybrid was won by L. W. Mazzeno, Jr., with a beautiful 'Hellas.' George Merz, Jr. took the W. J. Perrin Memorial Award for runner-up in this category with an 'Orion.' His 'Apple Blossom,' a perennial favorite and champion bloom, took the Ludwig Challenge Cup for best registered Ludwig hybrid. Co-Chairman of the Show, Mr. A. T. Diermayer, added to his collection of silver with the Lester Laine Trophy for best potted specimen double flower and the Edward F. Authement Memorial Award for runner-up to the T.A.C. Award. The Vincent Peuler Award for the best registered single floret went to L. W. Mazzeno, Sr's 'Glorious Victory'. Harold Reinhardt won the Member's Choice Rosette for another striking 'Apple Blossom.' Rounding out the trophy winners was Cathy Gautier, a non-member, who captured the Southern Seed and Popcorn Co. Inc. Trophy for runner-up in the breeder's class.

Other Club members meriting blue ribbons were T. A. Calamari, Jr., Emile Flauss, Al Touzet, Jerome Peuler, O. J. Robert, Sr., Vincent Pannell, and Lester Laine.

It would be impossible to list all the individuals who helped make this Show the success that it was. Some must be singled out, however, for special attention: Emile Flauss, Chairman, for his attention to the myriad of details involved; A. T. Diermayer, always the "work-horse," the Co-Chairman and Publicity Chairman. Mr. Diermayer's efforts resulted in articles and announcements in all the major gardening magazines, radio and TV coverage including personal appearances by Club members on one show aired through 13 Southern States. Special thanks go to all participants in the Show and special appreciation to our judges, donors of the trophies and other awards and to the members of the Amaryllis Society of Baton Rouge for their assistance.

1976 HOUSTON AMARYLLIS SOCIETY SHOW

Mrs. A. C. Pickard, *Offcial Show Chairman,*
1909 Alta Vista, Alvin, Texas 77511

"Amarysso" was the theme of the Houston Amaryllis Society's Bicentennial Flower Show on April 11, 1976. Mrs. L. E. Morgan, President and Show Chairman along with Mrs. R. L. Culpepper, Staging Chairman arranged a very beautiful show which aroused great public interest. A fine job was done by Mrs. Troy Wright, Awards Chairman and Mrs. Leo Hellman, Plant Sales Chairman.

Awards were given by Nationally Accredited Amaryllis judges to the following: Mrs. L. E. Morgan, receiving awards for Ludwig's 'Maria Goretti,' "Queen of the Show" and the Award of Merit for 'Apple Blossom', Mrs. J. W. Isaacs for Flora Queen in possession less than one year, Mrs. E. E. Koon receiving the high award in the Gracilis Division, Mr. Duncan Thomas was awarded highest score in the Breeders Class for a beautiful Leopoldi type seedling and Mrs. L. E. Morgan won the Sweepstakes Award for her fine efforts. The Invitational Class (not in competition with society members) exhibits were beautiful Dutch named hybrids. The winner in this division was Mrs. Francis Peltier.

Potted plants and cut specimens with two florets per scape with no evidence of another were exhibited as display. These exhibits received special awards that do not count as points toward a higher ribbon or prize award (so states A. A. S. Horticultural rules). The class for non registered named clones (unclassified) received regular ribbon awards and cannot be counted as points toward prize awards.

The excellent Educational exhibit was presented by Mr. and Mrs. E. E. Koon. As usual this exhibit was the center of interest, with information and displays on the Amaryllis Family, showing the different stages of growth from seeds to blooming plants.

The Theme of the show and historic background was presented in the Artistic Section using Amaryllis blooms in each class. Mrs. E. H. Blankenship was Chairman. The various classes were—Class I ''Sweet Land of Liberty'', Red, White and Blue; Class II ''Glorious Freedom'' using all fresh plant material; Class III ''This is my own Native Land'' with fresh and dried materials.

A great deal of thanks are due to Mrs. A. A. Brittain, Publicity Chairman. Her editorials in news papers, major magazines, radio and television coverage of the show prompted Amaryllis lovers, nuserymen, commercial growers and landscape architects never to forget the fact that the *Amaryllis* is the most versatile and beautiful spring flowering bulb to grow in the garden or pot culture.

SOUTHERN CALIFORNIA HEMEROCALLIS AND AMARYLLIS SOCIETY SHOW, 1976

C. D. Cothran, *1733 North Gibbs St., Pomona, CA. 91767*

The twelfth annual show was presented this year by the Society on Saturday, April 24, and Sunday April 25 with the very appropriate theme ''Beauty on Parade''. As usual the show was staged in the Lecture Hall of the Los Angeles County and State Arboretum at Arcadia, with Mrs. Forrest Rosen as the chairman.

There were eleven exhibitors taking part in the show, with more than one hundred entries in the various classes. In addition we had several hundred field grown blooms from Mr. E. A. Angell of Loma Linda, and Mr. Bruce Claflin of Upland. The weather had been excellent for some time, and all blooms had developed extra size, color, and quality. The flowers had the sparkle which enchanted the visitors, and brought exclamations of delight as they entered the Lecture Hall from above.

The Cecil Houdyshell sweepstakes trophy was won by C. D. Cothran of Pomona, but this year there was no Ludwig Challenge Cup winner. In the hybridizer section C. D. Cothran beat out Henry Myers to win the best Leopoldii seedling (see Fig. 4.) and the same one was judged the best overall seedling. Furthermore, our visitors placed it first in the popularity poll. (It is to be registered and called 'Favorite')

The best Belladonna in the hybridizers section was a beautiful small pink developed by Mr. Sterling Harshbarger. The Reginae class was won by C. D. Cothran with a lovely red derived from the Angell strain.

The best flower in the show, Judges Award, went to 'Cupido' which was exhibited by C. D. Cothran. This bloomed at exactly the right moment to be crisp, wide open, and sparkling.

Fig. 4. Southern California Hemerocallis and Amaryllis Society Show, 1976. **Upper, In Memoriam** to the late Quinn Buck, designed and placed by Mrs. Barbara Gardner; note **HERBERT MEDAL** (center); **lower,** C. D. and Mildred Cothran, with "Cupido" with Judges' Award. Photo by Phil Rosoff

Preliminary commendations were given to Henry Myers for a large white and apricot blend Leopoldii type seedling which, not surprisingly, was runner up for the most popular flower in the show, and also to Henry Myers for a very lovely pink; to C. D. Cothran for a large white

Fig. 5. Southern California Hemerocallis and Amaryllis Society 1976 Show. **Upper,** Best seedling Leopoldii type **(tall flower scape, upper right hand of picture)**, given Overall Judges' Award, and popularity Poll Winner, placed by C. D. Cothran. **Lower,** Dr. Thomas W. Whitaker, Secretary of the American Plant Life Society, and Mrs. Gladys Williams, senior Judge. **Photos by Phil Rosoff**

with orange spots, and a dark ring in the throat, and for a large white with red freckles. All four of these flowers were very fine, and were much appreciated by the show visitors.

Ribbon rosettes were given both to Mr. Angell and to Mr. Clafflin for their background flowers with the beautiful colors, size, and sparkle. A ribbon was also given to Mrs. Robert Melton for her lovely flower arrangements, and to Henry Myers for a fine specimen of *Clivia* in full bloom.

Methods of germinating seed were shown in a display by Fred Boutin, and since packets of seed were given to all visitors who wanted them, the display attracted much attention. Addresses of bulb suppliers were also available. A very large number of people visit the Arboretum on Saturday and Sunday, and most of them visited the show. Their genuine interest was shown by the fact that quite a large number asked to join the Society. The popularity poll again proved its worth by making the visitors look at each entry very carefully. There were numerous low voiced debates over this flower, or that one, and many visitors felt they had to tell a host why they voted the way they did.

Mrs. Gladys Williams was senior judge, and judges Roger Fesmire, Joseph Werling, and Jack McCaskill assisted.

THE AMARYLLIS SOCIETY OF ALABAMA INC. SHOW—1976

Mrs. Velma Thompson, *President,*
Box 17, Mt. Vernon, Ala. 36560

The Amaryllis Society of Alabama Inc., held its Eighth Annual Spring Show at the Civic Center on Grant Street in Chickasaw, Alabama on April 24th and 25th, 1976. The theme of the show was "Rainbow of Amaryllis." There was much interest shown in both the horticulture and artistic arrangement divisions. Mr. Fred Fambrough of Eight Mile was the Show Chairman this year.

Mrs. Velma Thompson, Mt. Vernon, Alabama, won the American National Bank Trophy, for best named Dutch Potted Specimen. In addition, Mrs. Thompson won the following trophies: Claude H. Moore Memorial Trophy: for most outstanding horticultural specimen, potted Dutch Amaryllis. Division III. Silver Tray. Wilmer Smith Trophy: for most outstanding potted bulb specimen in show. Silver Pitcher.

Mr. Dewey Hardy, Eight Mile, received the Cecil Bates Trophy, Educational Display.

Mr. C. E. Tagert, Mobile, the following trophies: Chavis Furniture Comany Trophy: winner, most blue ribbons, Divisions I-VIII. Large Silver Tray with handles. Mr. & Mrs. H. P. Wheat Memorial Trophy: winner, most blue ribbons in potted and cut seedling divisions, VII and VIII. Large Silver Tray with handles. Emile Scheurmann, Sr. Memorial Trophy: winner, most blue ribbons; combined horticulture and artistic arrangement divisions. Silver Champagne Cooler. Amaryllis Society, Ala., Inc., Trophy: winner, most blue ribbons in cut Dutch

Division, Division IV. Silver Tray. First National Bank, Mobile Trophy: best specimen, Division VII. Silver Paul Revere Bowl. Merchants National Bank Trophy: most blue ribbons, horticulture Divisions I-VII. Silver Tray. T. J. Swetman Trophy: most blue ribbons, Division III. Large Ceramic Tray. Vincent Kilborn Sr. Memorial Trophy: most blue ribbons, Division IV. Silver Bowl. Mae Brown Trophy: most outstanding potted bulb specimen, named American Amaryllis. Crystal Bowl. C. E. Tagert, Sr. Trophy: most blue ribbons, single bloom unnamed division . Small Silver Bowl. C. E. Tagert, Sr. Trophy: most blue ribbons, single bloom division-novelties. Small Silver Bowl. C. E. Tagert, Sr. Trophy: most blue ribbons, single Bloom named division. Small Silver Bowl. Claudine Pierce Trophy: most outstanding collection, three scapes, Division X. Book Ends.

Mr. Fred Fambrough, Eight Mile, won Central Bank of Mobile Trophy: most blue ribbons, American potted Amaryllis, Division I. Silver Tray.

Mrs. Claudine Pierce, Mt. Vernon: Little Glass Shack Award: most outstanding cut miniature Dutch Amaryllis. Crystal Vase.

Mrs. Irene Massingill, Chickasaw won: Sully's Drive-In Trophy: winner, most blue ribbons artistic arrangement division. Silver Bread Tray. Mittie Young Trophy: most artistic design, amaryllis, elements other than fresh plant material predominating. Silver Award. Velma Thompson Trophy: most outstanding artistic arrangement in show. Relish Dish. West Department Store Award (Chickasaw): most blue ribbons, artistic arrangements Division XI. Ladies Timex Watch.

Mrs. M. W. Lauderbough, Chickasaw: Inez L. Palmer Trophy: garden club winner, Division X, Section 43. Silver Compote

The Judges for the show were from Hattiesburg, Mississippi and Pensacola, Florida. The Hattiesburg Judges were: Mrs. E. R. Trussel, Mrs. Mollie Fowler, Mrs. Luther N. Davis, Mr. Luther N. Davis. The Pensacola Judges were: Mrs. J. T. Barfield, Mrs. J. E. Haynes.

After the judging of the show, the Judges were guests of The Amaryllis Society of Alabama, Inc., at a luncheon at a Mobile Restaurant.

1976 SPRING EXTRAVAGANZA

C. D. Cothran, *1733 North Gibbs St., Pomona, Calif. 91767*

The California Arboretum Foundation and the Los Angeles State and County Arboretum at Arcadia, California presented their "Spring Extravaganza" on May 22 and 23 of this year, and the Southern California Hemerocallis and Amaryllis Society was again invited to put in a display in the Lecture Hall. C. D. Cothran was chairman, and was assisted by Bob Melton, Gladys Williams, Sterling Harshbarger, Gertrude Rosen, Fred Boutin, and Joe Werling. About forty scapes of *Amaryllis,* several potted *Hemerocallis,* and several trays of cut *Hemerocallis* were tastefully arranged on four large tables. The Dutch clones

'Dutch Doll', 'Wedding Bells', 'Apple Blossom', and 'Eastern Dream' were among the *Amaryllis* blossoms, most of the remainder being Cothran seedlings.

Catalogs, Ludwig's color catalog, seedling growing instructions, and tiny seedlings in a growing planter were displayed. Packets of seed were available to all who wanted them, and at least two Society hosts or hostesses were present the entire time during the two days. Hundreds of people took seed, asked questions, and a number asked to become members of the Society.

It was estimated that more than twenty thousand visited the Arboretum during the two days, and apparently about half of them stopped at our exhibit to look and ask questions. It certainly is a fine way to make the gardening public aware of high quality *Amaryllis* and *Hemerocallis.*

PROPOSED CHANGE IN POINT SCALE FOR JUDGING AMARYLLIS SHOWS

Submitted by MRS. A. C. PICKARD, *Amaryllis Judging Instructor, 1909 Alta Vista, Alvin, Texas 77511*

I would like to express my viewpoint on the proposed change in point scale for judging Amaryllis which appeared in the 1976 Plant Life.

The judging of Amaryllis is governed, or should be, by rules formulated by the American Amaryllis Society. It has been the experience of Judging Instructors, Judges, and authorities on any subject to find that experts do not necessarily agree. However, we would fail to meet our goal of perfection in judging if we did not voice our views, however different they may be, and constructive criticism.

Breeders and hybridizers are constantly producing new varieties, increasing the color range and improving disease resistant types. Here again it becomes necessary to assure that no important points are overlooked to facilitate equitable standard judging. I agree with some of the other judges regarding the present method. Rating points for color are rather high; giving more points to perfection of flower shape would be in order.

Form may be defined as to the shape, symmetry and depth of bloom. Each floret should be symmetrical due to balance or harmony of all parts of the bloom.

Symmetry means beauty due to balance of harmony or parts and may be broken down into two categories: (1) trueness to type (2) development, which covers overmaturity. These blooms are known to change form as the bloom continues to mature. Maturity is to be considered the ideal symmetrical form.

Flower forms of Amaryllis blooms range from long trumpet-like Easter Lily form to hugh open-faced Dutch hybrids, from the irregular orchid shapes to double forms. Rating is strictly within the Division Standard on the basis of beauty of form. The six tepal segs in each blossom make up the characteristic form of the bloom. The lower center pet seg is smaller than the other two inner pet segs and are very often inclined to a slight turn. The tepal segs tips should be uniformly pointed or rounded and all reflexing approximately the same degree. While not circular, the Amaryllis blossom should be symmetrical with the same size segs approximately the same distance apart on each side of the bloom. Any twisting of any segs or the whole bloom should require point deduction. The National Council of State Garden Clubs, Inc. in their "Handbook for Flower Shows", defines form as "a well-proportioned, symmetrical, and graceful shape of a flower or inflorescence. Also the shape or habit of growth of a plant".

The suggestion of Mr. Mazzeno, Jr., in the 1976 *PLANT LIFE*, page 38, is a timely one. As shown in my article in 1971 *PLANT LIFE*, page 26, the points for *floret shape* (15), are a little low; those for floret color (45), and length and character of scape (15), rather high. I would suggest the compromise solution as shown in the following table:

PROPOSED SCALE OF POINTS

		POTTED PLANTS	
	Single specimen	Single scape	2 or more scapes
Perfection of floret *shape*	20	20	15
Conformity to floret *color* standard	30	30	25
Flower *size*	15	15	15
Pose (symmetry of florets in umbel)	10	10	10
Length and character of scape (stalk)	5	5	5
Number of scapes per plant			10
Number of florets per scape	6	6	6
Fragrance	2	2	2
Foliage		2	2
Condition of exhibit	12	10	10
	100	100	100

AMARYLLIS JUDGING—ACTION OF EXECUTIVE COMMITTEE, JAN. 4, 1977

Mr. L. W. Mazzeno, Jr., is to be congratulated for his timely suggestion for a change in the scale of points for judging Amaryllis exhibits at the official shows. Mrs. A. C. Pickard is to be commended for suggesting a workable compromise which gives due weight to Mr. Mazzeno's suggestion, and it is approved by the Executive Committee.

If after a period of years, any further adjustments should appear to be needed, then the judges should suggest further changes.—*Hamilton P. Traub, Secretary, Executive Committee*

Mrs. E. H. Blankenship, 811 LeGreen, Houston, Texas 77008, writes under date of January 19, 1977:

Congratulations! The American Amaryllis Society's new scale of points for judging Amaryllis (approved by the Executive Committee Jan. 4, 1977) is just the very one we needed.

Our leader, Mrs. A. C. Pickard, sent our Houston Amaryllis Society members a copy of the scale and I am very happy. The new scale of points will provide a better way to handle the overall judging. We appreciate having this excellent guide.

Mrs. H. Ward Blair, President, The Houston Amaryllis Judges Council, writes under date of Feb. 2, 1977:

The Houston Amaryllis Judges Council wholeheartedly endorses the change in the point scale for judging Amaryllis Shows.

LOCAL NEWS LETTERS

The Mens' Amaryllis Club of New Orleans, Inc., NEWS LETTER, Vol. 19. No. 6. February 1977 has been received. It is a mine of valuable information on Amaryllis culture and breeding.

The Southern California Hemerocallis and Amaryllis Society, NEWS LETTER for January 1977 has been received. It contains a report on the January meeting at the Los Angeles State and County Arboretum, Arcadia, Calif. The dates for the annual Amaryllis Show are April 22, 23, and 24, 1977.

PLANT LIFE LIBRARY—continued from page 127.

GARDENING WITH PERENNIALS, MONTH BY MONTH, by Joseph Hudak. Quadrangle/New York Times Book Co., 10 E. 53rd St., New York, N. Y. 10022. 1976. Pp. xvi + 398. Iluus. $13.50. This attractive book by a landscape architect is devoted to the cataloguing the majority of the attractive and reliable hardy perennial plants, including winter hardy bulbs, for the United States and Canada, and other countries with similar climates. Most of the book (pp. 3-332) is devoted to a **Monthly Calendar,** listing the plants by months, beginning with March; including color values, brief descriptions, culture and pests. **Hardy Ferns** are listed separately (pp. 335-352). **Useful Lists,** including perennials with blooming periods of eight weeks or more; perennials with bonus foliage, with or after blooming; perennials tolerant of dry conditions; perennials with persistent winter foliage or with showy fruits (pp. 355-377). A brief bibliography; common and scientific name index completes the volume. Highly recommended.

THE COMPLETE BOOK OF GREENHOUSE GARDENING, American Edition, by Ian G. Walls. Quadrangle/New York Times Book Co., 10 E. 53rd St., New York, N. Y. 10022. 1975. Pp. x + 447. Illus. $14.95. First published in Great Britain (1973), this American Edition begins with some useful definitions about special compounds, potting mixtures; accessories and materials; methods and terms and a brief Preface to the

PLANT LIFE LIBRARY—continued on page 84.

2. LINEAGICS

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

TWO COPPER-COLORED CRINUMS

Randell K. Bennett, *3820 Newhaven Road, Pasadena, California 91107*

The taxonomy of the copper-foliaged Crinums is to say the least confusing. I first became acquainted with this group while in Hawaii several years ago. Varieties with the copper foliage could be seen growing wild among the normal green types in mass groupings. These groupings were often found very close to or on the beaches in sandy soil. The large fruit of the crinum was commonly found on the beach and in the tide, demonstrating one of the natural methods by which seed of this genus is distributed. Crinums of immense size were seen growing on basal stumps. In many cases the root system would be half way out of the ground due to wind or erosion with no ill effect on the plant.

When I returned to the mainland, I was fortunate to acquire two copper-foliaged species: *Crinum amabile* forma *cuprefolium* and *C. asiaticum* forma *cuprefolium* (Traub, 1975). These were the names in use at the time. Doubt remains whether the form "*cuprefolium*" should be designated for *C. amabile* since this coloration may be the norm, not the exception. These two species are considered to be native to Asia and Polynesia but have spread in cultivation to many adjacent areas. The aquatic distribution of the fruit allows for this wide habitat. In these two species the red coloration is found in new leaves, fruit, flower stock, and flowers. The young leaves forming in the center of the rosette contain the copper pigment, turning green with maturation. The whole effect is of a two-toned plant, green on the outside and red in the center. The flower stock is a bright red throughout the flowering period, fading to green when the fruit begins to mature. The fruit seems to retain the red coloration throughout its growth. The color of the flowers undoubtedly varies according to environmental factors, especially humidity. In this area the individual flowers are white, frosted with red. The red tint is especially strong on the under side of the tepals. The tepal tube is completely red, as is the stigma, style, and filament. Anthers of *C. amabile* are a bright yellow, in contrast to the overall color scheme. It can be seen that the copper coloration is in no way limited to the foliage.

Crinum asiaticum forma *cuprefolium* Traub and *C. amabile* forma *cuprefolium* are of easy culture, provided they are protected from cultural extremes. Neither species will tolerate much frost and a relatively high humidity is desirable. They have adapted amazingly, however, to the low humidity of this section of Southern California.

I am currently growing my specimens in 20″ tubs where they make outstanding specimen plants. *Crinum asiaticum* forma *cuprefolium* Traub is characterized by a huge rosette of long, wide, accutely-pointed leaves of a succulent nature. Commonly, over 20 leaves will be found. Unlike *C. amabile,* my specimen of *C. asiaticum* has yet to produce an offshoot, although it is attaining large size. This variety appears to be developing the horticulturally desirable trait of free blooming habit with maturity. The 30 or more flowers per umbel will probably be produced throughout the year as the plant matures. In addition, this is the first year some of the fruit is fully developing.

Crinum amabile forma *cuprefolium* is characterized by longer, thinner foliage than *C. asiaticum.* It is quick to form clumps. My specimen, estimated to be the same age as *C. asiaticum,* has ten offshoots. It has bloomed in all seasons of the year, and will undoubtedly be ever-blooming eventually. Foliage has a strong midrib and is of a succulent nature, like *C. asiaticum.* Because of its long, thin foliage (40″ or more) this species should be protected from strong winds. This is a good idea for *C. asiaticum* also. Wind can quickly destroy the appearance of a fine specimen by bending and breaking the leaves.

Both of these copper-colored varieties are highly recommended for their foliage and flowers. *Crinum asiaticum* forma *cuprefolium* Traub, in particular, is one of the most spectacular of the Amaryllids for its foliage alone. A good, rich soil mix is sufficient. Because of their natural habitat they appreciate an abundance of water when the weather is warmest and should never be allowed to become dry due to the evergreen habit. Fertilization several times a year or use of a slow-release fertilizer is recommended. Exposure would vary according to area. In hot summer localities afternoon shade or filtered light would be preferable. Mealybugs have been the only insect pest observed so far. These are easily controlled with an alcohol solution. If left untreated this pest can stunt and distort growth.

Other copper-colored Crinums have been named; most growing naturally near the two discussed here. Due to natural hybridization this group may never be straightened out taxonomically but they remain of great horticultural interest.

LITERATURE CITED

Traub, Hamilton P. *Crinum asiaticum* forma *cuprefolium* Traub, PLANT LIFE 31: 63. 1975. See Corrigenda, PLANT LIFE, Vol. 33. 1977, p. 4, change *"cuperfolium"* Traub, to *"cuprefolium."*

Syn.—Traub, Hamilton P., *Crinum asiaticum* var. *cuprefolium* Traub, PLANT LIFE 16: 93-94, fig. 25. 1960; *Crinum amabile* var. *cuprefolium* Traub, PLANT LIFE 21: 96, 1965. See Corrigenda, PLANT LIFE Vol. 33. 1977, p. 4, change *"cuperfolium"* to *"cuprefolium"*.

THE GENUS **CRINUM** IN SOUTH AFRICA BY I. C. VERDOORN

L. S. Hannibal

An outstanding study concerning *The Genus Crinum in South Africa* by I. C. Verdoorn, Government Botanist for the Republic of

South Africa, Pretoria, S. A. appeared in *Bothalia,* Vol. II part 1 & 2, 1973. Historically Miss Verdoorn has been collecting, growing, identifying and researching the South African Genus *Crinum* for many years. Her report with its many excellent color plates was issued as she retired from active service. It does much to clear up the confusion concerning many species which have been described over the past two hundred years. Many of the past botanists, including Linnaeus, had little opportunity to see or compare the several score of species native to this vast area, consequently many misidentifications exist. We can only summarize her findings here.

We have two minor comments to make concerning her study: First, Miss Verdoorn relates *C. moorei* to *C. americanum* and *C. jagus* (Ex *C. giganteum*). She does not state the reason but since all three species are garden grown in Florida and the Gulf many of us know these species well. Each obviously belongs to a different archetype as seed, foliage and blossoms are quite morphologically distinct. The fault probably lies in the early descriptions and plates which lack many of the basic distinctions, or the fact that the plants may produce semifertile hybrids, but such is no indication of close affiliation.

Secondly, the report does not distinguish varients or subspecies so we have no means to determine the diversity one may encounter within a number of the species. For example, she states that *C. gouwsii* (Chromosome number 2n=72) is a synonym of *C. macowanii.* The writer has grown both, but the small stature, bulb form, environmental requirements and spicy floral fragrance of the former set it quite apart from the many larger variants of *C. macowanii.* In fact the two forms will not cross. In a like manner no mention is made of the numerous *C. bulbispermum* variants which range from *album* to *roseum* and to the deep red 'Orange River Lily' form which is a hexaploid with a count of 2n=66. The diploid (2n=22) *album* forms are far hardier than the hexaploid and the two when cross-pollinated fail to give fertile seed. We will not go into the complicated genetics involved but latent incompatabilities exist which are worth noting.

Thus in using Miss Verdoorns study one can place the normal run of *Crinum* from the wild, but when one receives a bulb from a Japanese collector presumably of Natal origin but possibly Kenya, one may have difficulties. First, it took 10 years to flower the bulb, secondly the blossoms bore some resemblance to *C. campanulatum* as to the attachment of the filaments, but the tepals were shorter and heavier. And finally the foliage was far taller and heavier that *C. campanulatum.* It is the same *Crinum* as seen along the river banks in the opening scene of the original motion picture 'Born Free' where the lion rushes the native girl. Since we have no clue to the diversity of *C. campanulatum* we do not know if the 'Born Free' *Crinum* is a subspecies or an unrecognized species.

Miss Verdoorn's synonyms for *C. kirkii* are of interest as J. D. Hooker in *Flora Indica* lists these plants as variants of *C. latifolium* or *C. l.* var. *zeylanicum.* In Zanzibar and Pemba *C. kirkii* is a salt water marsh plant with rather heavy rigid foliage since it is subject to much wind and competition from reeds. It would be difficult to grow such a tropical species at Pretoria, let alone have normal foliage and flowers. Unfortunately no really detailed descriptions of *C. kirkii* exist so obviously some confusion exists between it and the many forms of *C. latifolium* scattered about the Indian Ocean. It is a moot question if the plant has ever been grown in Florida despite having been listed in Pliney Reasoner's Royal Palms Nursery catalogue of 1900.

Miss Verdoorn's list of described species follows.

Crinum baumii Harms.
  Syn ? *Ammocharis* baumi (Harms) Milne-Redhead & Schweick.

C. nerinoides Baker.
  Syn. ? *Ammocharis* spp. Solch.

C. bulphanoides Welw. ex Baker.
  Syn. *C. leucophyllum* Baker.

C. crassicaule Baker.

C. euchophyllum Verdoorn.

C. campanulatum Herb.
  Ex. *C. aquaticum* Burch.

C. paludosum Verdoorn.
  C. forbesii sensu van der Waldt.

C. rautanenianum Schinz.

C. carolo-schmidtii Dinter.
  Syn. *C. occiduale* Dyer.

C. moorei Hooker.
  Syn. *C. imbriaticum* Baker.
  Syn. *C. macowanii* Baker ex part Fig. only.
  Ex. *C. colenso* (Old Hort. trade name)
  Ex. *C. natelensis* (Old Hort. trade name)

C. kirkii Baker.
  Syn. *C. ornatum* (Aiton) Bury.
  Ex. *Amaryllis ornata* Aiton.
  Syn. ? *C. sanderianum* Baker ex Bury.

C. acule Baker.

C. minimon Milne-Redhead.
  Syn. *C. parvibulbosum* Dinter ex Overkott.
  Syn. *C. walteri* Overkott.

C. lineare L. f. Supp.
  Syn. *C. revolutum* (L'Heriter) Herb.
  Syn. *C. revolutum* var. *gracilor* Ker-Gawler.
  Syn. ? *C. angolense* Herb.

C. variable (Jacq.) Herb.
  Ex. *Amaryllis variable* Jacq.
  Syn. *C. crassifolium* Herb. nonen nudum.

C. foetidum Verdoorn.

C. graminicola Verdoorn.

C. delagoense Verdoorn.

Syn. ? *Amaryllis forbesi* var *Purpurea* Lindl.
Syn. ? *C. forbesianum* Herb.
Syn ? *C. forbesianum* sensu Baker.
(Note. descriptions of Forbes Crinum inadequate)

C. lugardiae N. E. Brown.
Syn. *C. polyphyllum* Baker.
Syn. *C. crispum* Phillips.

C. macowanii Baker.
Syn. *C. gouwsii* Traub (More likely a polyploid subspecies of *C. lugardiae*. L.S.H.)
Syn. *Amaryllis revolutum* sensu Jacq.
C. macowanii subsp. *confusum* Verdoorn.

C. bulbispermum (Burm.) Milne-Redhead & Sch.
Syn. *Amaryllis bulbispermum* Burm. f.
Syn. *Amaryllis longifolia* sensu Jacq.
Syn. *C. asiaticum* sensu Linn. in Mantissa Pt.
Syn. *C. longifolia* var. *riparia* Ker-Gawler.
Syn. *C. riparium* Herb.
Syn. *C. capense* Linn. = Hypoxis capensis.
Syn. ? *C. capense* Miller. (Identity questionable = *A. belladonna*?)
Syn. *C. capense* sensu Herb. = *C. b. roseum* or *album*.
Non *C. longifolium* (Linn.) Thungberg = *Cybistetes longifolia*.

Note! Plants marked "Syn. ?" indicate original descriptions and plates too vague to permit accurate determinations. The status of *C. baumii* and *C. nerinoides* requires further study as to their identification under *Crinum* or *Ammocharis*.

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 Crinadonna,** 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 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, 1976

Registered by Dr. John M. Cage, 1041 Ruth Avenue, Yuba City, California 95991.

Amaryllis clone **'Careless Love'** (Cage, 1976); **A-1010;** U-4 fld; 26" h; perigone 3" long, 8½" across; intense red stripes on pure white upper ⅔, lower third white; 2 scapes in winter and recurrent; 5a type.

Amaryllis clone **'Flagred'** (Cage, 1976); **A-1011;** brilliant postoffice red (BCC), RHS 45B; perigone 3" long, 9½" across; filaments and style same intense color; florets held slightly upward; long lower petseg gives orchid impression; free blooming in winter and spring with tall scapes.

Amaryllis clone **'Jennie'** (Cage, 1976); **A-1012;** U-4 fld; 2 scapes 28" in winter; perigone 2 3/2" long and 8½" wide; color is soft orange-red (like water color on canvas) with stamens same; petaloids.

Amaryllis clone **'Pink Haze'** (Cage, 1976); **A-1013;** U-4 fld; 27" h; perigone 3" long, 8½" across; slightly recurved face; white brushed lightly with hazy pink overlay; blooms winter and sometimes mid-summer; petaloids; 5a type.

Amaryllis clone **'Royal Flush'** (Cage, 1976); **A-1014;** U-4 fld; perigone 2¾" long and 8½" wide; recurved, dark currant red brushed heavily and symmetrically on white ground; solid picotee; slightly lighter lower half; stamens same color; blooms winter and spring; 5a type.

Registered by Koninklijke Algemeene Vereeniging Voor Bloembollencultuur, (raiser G. van Staalduinen, 's Gravenzande), Onder Bescherming Van H. M. de Koningin, Parklaan 5, Postbus 175, Hillegom.

Amaryllis clone **'Helsinki'** (1976); **A-1015;** Flower is ivory white in color with the throat being somewhat yellowish green.

CORRECT NAME AND NEW SYNONYMS FOR SOME AMARYLLIDACEAE OF THE NORTHERN HEMISPHERE

Pierfelice Ravenna, *Universidad de Chile*

CRINUM LITURATUM (REICHENB.) RAV., COMB. NOV.

Amaryllis liturata Reichenbach, Icon. Desc. Pl. 1: tab 82, 1822.—*Crinum ornatum* Bury, Hexandr. Pl.: tab. 18, 1831-34 (fide Baker).—*Crinum sanderianum* Baker, Gard. Chron. n. ser. 22: 102, 187, 1884; excl. syn.: *Crinum broussonetianum* Herb. var. *pluriflorum* Herbert, Amaryll.: 260, 1837 (= *C. yuccaeflorum* Salisb.).

This charmy species inhabits Sierra Leona, in north-western Africa. It had for long been confused with *Crinum yuccaeflorum,* a native of the same country. The latter, however, is easily separable by its nonundulated, firm textured, linear leaves.

ZEPHYRANTHES GRANDIFLORA LINDL.

Lindley, Edwards' Bot. Reg. 11: tab. 902, 1823.—*Zephyranthes carinata* Herbert, Curtis' Bot. Mag. 52: tab. 2594, 1823.—*Amaryllis concinna* Morris, Fl. Conspic.: tab. 44, 1826.—*Zephyranthes tsouii* Hu, in Hu & Woon-Young Chen. Icon. Pl. Sinic. 1: 50, 1927.

Amaryllis concinna Morris, and *Zephyranthes tsouii* Hu, are additional synonyms for the species; the latter was found in craggy places south of Yengtang Shan, in the province of Chekiang, Southeastern China. *Zephyranthes grandiflora* is a native of Mexico, Guatemala and the West Indies, but shows a clear tendency to escape from culture and establish elsewhere. Dr. F. Vervoorst (Instituto Miguel Lillo), have sent me color-slides of the species growing as a true wild on the Sierra de San Javier, Tucumán, Argentina. Dr. João Angely (*in litt.*) found it in São Paulo, Brazil. It was also gathered as an escape in Peru (see specimen cited).

Specimens: Peru, dept. Junín, Huacapistana, entre rocas cerca de la casa, 1800-1900 m; leg. R. Ferreyra 11418, 24-IX-1955 (USM).

ZEPHYRANTHES CHLOROSOLEN (HERB. EX LINDL.) DIETR.

Dietrich, Syn. Pl. 2: 1176, 1840.—*Cooperia chlorosolen* Herbert ex Lindley, Edwards' Bot. Reg. sub tab. 1835, Febr. 1, 1836; Herbert ex Hooker, Curtis' Bot. Mag. tab. 3492, Apr. 1, 1836.—*Cooperia drummondii* Herbert ex Lindley, Edwards' Bot. Reg. tab. 1835, 1836.—*Zephyranthes herbertiana* Dietrich, Syn. Pl. 2: 1176, 1840.—*Cooperia brasiliensis* Traub, Herbertia 12: 39, 1945.—*Zephyranthes brasiliensis* (Tr.) Traub, Pl. Life 7: 42, 1951.

Although the citation of the literature and author of *Cooperia chlorosolen* (the basonym) was incorrect, Dietrich's combination *Zephyranthes chlorosolen* must be accepted by implication. In fact, the article in the Botanical Magazine, which he mentions, did not include the original description but a subsequent one on the same species; moreover, it is signed by Herbert, as it is the earlier in the Botanical Register where the species was proposed.

Herbert (1837, pp. 178 and 179), says that the plant "is so variable, that three bulbs sent by Drummond separately, and perhaps from different localities, flowered at Spofforth, one with the style shorter than the tube, one longer, but shorter than the stamens, and the third longer than the stamens; the difference of stature and colour was also considerable, but the first of the tree bulbs having produced, in space of three months, five successive scapes, has itself exhibited successively all the diversities which were at first supposed to distinguish the three bulbs, and it is vain to separate them". It seems, therefore, that the binomial *Zephyranthes herbertiana* Dietr. given to the form with wine-tinged tube, is a true synonym of this species. *Cooperia chlorosolen* Herb. ex Lindl. has the priority over *Zephyranthes herbertiana* Lindley.

Cooperia brasiliensis Traub, found by Mulford B. Foster about 100 miles northeast from Curitiba (State of Paraná), apparently is a further synonym of the present species, as stated by Flory and Flag in a determination label on the type-sheet (deposited in the U.S. National Museum).

I have found *Z. chlorosolen* at the Ejido Las Yucas, NW of Aldama, in the State of Tamaulipas, Mexico. The plants, which agreed with the typical form, were growing in crevices on the apparently basaltic, rocky banks of a small river. Not far from the banks, there was a xerophile vegetation with *Beaucarnea recurvata, Ceratozamia mexicana,* or similar, Leguminosae, and others. Pressed specimens are found in the writers herbarium, the major part of it being still in Buenos Aires.

LITERATURE CITED

Herbert, W. 1837, Amaryllidaceae (with an introduction by H. P. Traub), facsimile edition by J. Cramer, Verlag, 1970.

CYTOGENETICS OF GARDEN **AMARYLLIS**

PRAKASH NARAIN,
National Botanic Gardens, Lucknow, India

I. SYSTEMATIC POSITION AND TAXONOMIC TREATMENT OF INDIAN CULTIVARS.

Amaryllis L. (Tribe *Amarylleae*) is the type genus of the family Amaryllidaceae. The genus is native of tropical and subtropical America being distributed from Mexico to West Indies, southward to Chile and Argentina. Only one species *(A. reginae)* crosses the ocean to the African continent where it grows in Princes' Island in estuary of Congo River in West Central Africa. The maximum concentration of species is in Amazon River Basin of Brazil, Bolivia and Peru, an area which may legitimately be looked upon as the centre of diversity and dispersal of the genus (4).

It is a bulbous genus with linear or lorate basal leaves and a hollow naked peduncle bearing one to two, or many flowered umbel subtended by only 2 valved spathe that separates to the base. It contains nearly 67 species and is homogenous both morphologically and cytologically (x=11). Out of these only 10 have been involved in the origin of the present day garden cultivars of *Amaryllis* (2) which are universally acclaimed for their beautiful flowers with wide range of colours ranging from orange, yellow, green, purple, pink, red and scarlet to pastel shades to pure white (4). The flowers may be large or small and long drooping trumpet shaped, large, flat and open faced or orchid shaped. They are used is gardens in beds or borders in pot culture or for interior decoration as cut flowers.

The genus has been divided into 5 subgenera by Traub (4). These are *Macropodastrum* Baker, *A. species,* Figure 6 *(5), Lais* (Salisb.) Baker, *A. vittata,* Figure 6 *(1), Amaryllis* Linn., *A. belladonna,* Figure 6 *(2)., A. stylosa,* Figure 6 *(3), Omphalissa* (Salisb.) Baker; and

Sealyana, Traub, *A. reticulata,* Figure 6 *(4).* Similarly, the cultivated tpyes have been divided into 8 groups: Cultivated wild *Amaryllis* (D-1). Long trumpet *Amaryllis* hybrids (D-2), Belladonna type *Amaryllis* hybrids (D-3), Reginal type *Amaryllis* hybrids (D-4), Leopoldii type *Amaryllis* hybrids (D-5), Orchid flowering *Amaryllis* hybrids (D-6), Double *Amaryllis* hybrids (D-7) and Miniature *Amaryllis* hybrids (D-8).

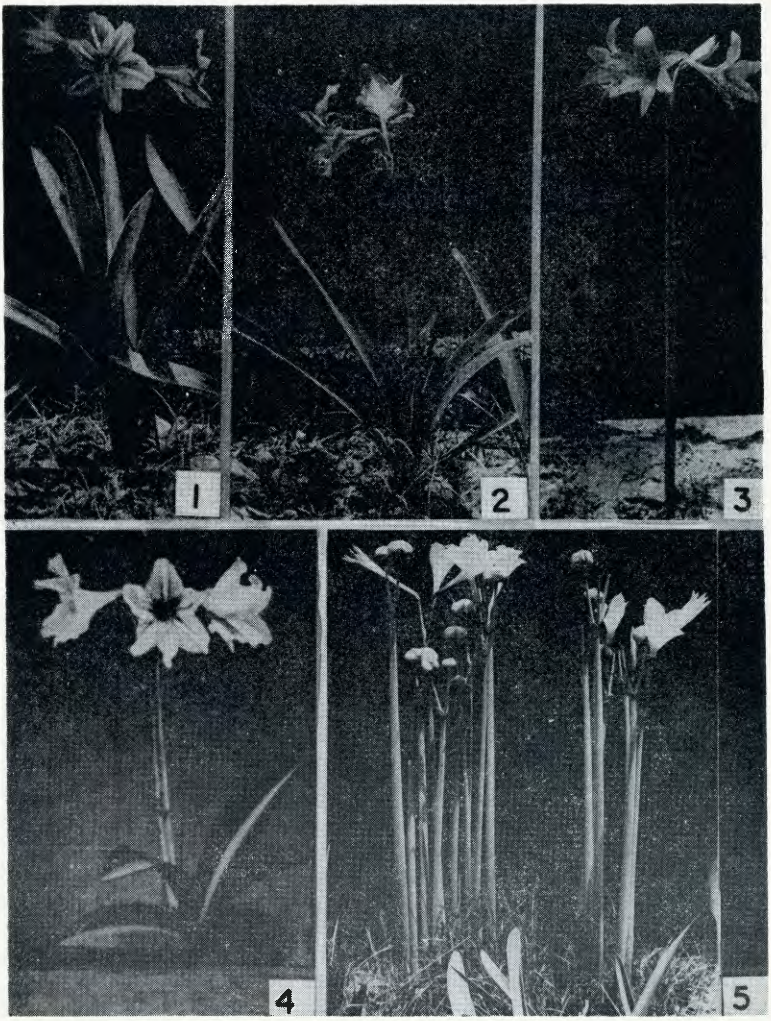

Fig. 6. **Amaryllis** species (1.) **Amaryllis vittata,** (2.) **Amaryllis belladonna,** (3.) **Amaryllis stylosa,** (4.) **Amaryllis reticulata,** and (5.) **Amaryllis** species.

There are nearly 137 cultivars in the National Botanic Gardens, which are neither registered nor are their exact ancestry documented (3, and personal communication). Some of these have been obtained from nurseries in Sikkim and Kalimpong. These cultivars together with the ancestral species form a single complex and their proper classification, though difficult is never the less essential. In this connection it may be stressed that while botanical species need to be classified as per rules of "International Code of Botanical Nomenclature" i.e. using categories like genus, species, subspecies variety and forms, the cultivars should be classified on the basis of 'International Code of Nomenclature for cultivated Plants' based on the cultivar concept (1). A cultivar (cv) is not to be confused with a botanical variety. It is the result of man's selection and "denotes an assemblage of cultivated individuals which is distinguished by any character-morphological, physiological, cytological, chemical or others—significant for the purpose of agriculture, forestry or horticulture, and which, when reproduced (asexually or sexually) retains its distinguishing features" (Article No. 5).

A workable classification of cultivars should aim at stressing the agro-horticultural use, or to fulfil a purpose in field, garden or even in exhibition, than stress discrete botanical differences which is the basis of a botanical classification. From this point of view, the cultivars in NBG have been classified following the system suggested by Traub (4).

1. *LONG-TRUMPET AMARYLLIS HYBRIDS*: Pedicels relatively long, flowers drooping, tepaltube very long (11-15 cm.). Flower like Easter lilies. *Diploids* (2n=22): 'Becon' and 'Sneezy'.

II. *BELLADONNA-TYPE AMARYLLIS HYBRIDS*: Pedicels relatively long, flowers usually drooping but not always so. Tepal-tube shorter than above.

Diploids (2n=22): 'Achilles', 'Adonis', 'Amazon', 'Aphrodite', 'Bashful', 'Beauty', 'Bride', 'Bridesmaid', 'Brilliant', 'Buccaneer', 'Cardinal', 'Cerberus', 'Ceres', 'Coquette', 'Diana', 'Dopey', 'Fresta', 'Flora', 'Glorious', 'Hysperian', 'Itene', 'Jenus', 'Jenny', 'Leo', 'Lucifer', 'Melpomone', 'Mercurius', 'Morpheus', 'Neptune', 'Nesta', 'Olymphus', 'Orion', 'Orthello', 'Percy Lancaster', 'Prima Donna', 'Prime Minister', 'Sleepy', 'Star of India', 'Tara', 'Uranus' and 'Vesta'.

Tetraploid (2n=44): 'Admiral', 'Admiration', 'Aeneas', 'Aetna', 'Alexander', 'Andromeda', 'Apollo', 'Aries', 'Autocrat', 'Beautiful', 'Bridegroom', 'Bright Red', 'Charon', 'Chaste', 'Circe', 'Cordelia', 'Dainty', 'Definace', 'Deepakaul', 'Denslow', 'Dimovd', 'Flame', 'Ganymede', 'Gracilis', 'Hannibal', 'Hayward', 'Heliose', 'Invincible', 'Ivy', 'Juliet', 'Juno', 'Kadam Rasul', 'Lalkilla', 'Maharaja', 'Mars', 'Mary', 'Mentor', 'Meteor', 'Minerva', 'Mother's Day', 'Mount Everest', 'Nizam', 'Peacefulness', 'Perseus', 'Pilgrim', 'Pinkie', 'Plauto', 'Princess', 'Rose Queen', 'Salmon Beauty', 'Saturn', 'Sheba', 'Shiela Kaul', 'Silver Lining', 'Sieren', 'Spitfire', 'Star', 'Starway', 'Styx', 'Sweetheart', 'Venus', 'White Queen', and 'Wyndhan'.

III. *REGINAE-TYPE AMARYLLIS HYBRIDS*: Pedicels usually relatively shorter than the above two. Flowers rather drooping, horizontal, or slightly upright. Moderately open faced. Tepal-tube short.

(a) *Markedly imbricated type: Tetraploids* (2n=44): 'Begum Secundra', 'Black Prince', 'Emperor', 'Glory', 'Gorgeous', 'Prof. Kaul', 'Shah Nazaf', and 'Taurus'.

(b) *Less marked imbricated type: Tetraploids* (2n=44): 'Aurora', 'Charming', 'Day break', 'Edith', 'Enchantress', 'Fiery Bett', 'Grumpy', 'Heba', 'Picture', 'Snow White', and 'Thora'.

IV. *LEOPOLDII-TYPE AMARYLLIS HYBRIDS:* These are similar to III except that flowers are wide open, apparently flatish and held horizontally.

(a) *Markedly imbricated type: Diploids* (2n=22): 'Ida' and 'Sybil'. *Tetraploid* (2n=44): 'Doc'.

(b) *Less marked imbricated type: Tetraploid* (2n=44): Unnamed, (c.v. 35).

V. *SEMIDOUBLE HYBRIDS:* Flowers are semidouble in this group *Diploid* (2n=22): 'Firefly'.

From the foregoing classification, it is clear that most of the cultivars fall in Belladonna group followed by Reginae and Leopoldii groups. These are the most important classes as they constitute the bulk of the cultivars important in the trade.

There are 10 major ancestral species which seem to be involved in the origin of garden *Amaryllis* through rampant hybridization followed by selection (2). Taxonomically they fall as under:

1. *Subgenus*; *Lais*: *A. vittata, A. striata.*
2. Subgenus; *Amaryllis: A. leopoldii, A. reginae, A. espiritensis,* and *A. belladonna.*
3. Subgenus; *Omphalissa: A. leopoldii, A. pstittacina, A. aulica,* and *A. pardina.*
4. Subgenus; *Sealyana: A. reticulata.*

As is clear, these species belong to four out of the five subgenera suggested for the genus by Traub (4) who has also given their diagnostic characters.

ACKNOWLEDGEMENTS

I thank Dr. T. N. Khoshoo, Director, National Botanic Gardens, Lucknow, for guidance and interest in this study. I am also grateful to Late Mr. S. Percy Lancaster for providing the material and Mr. T. K. Sharma for illustrations.

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4. Traub, H. P. 1958. The *Amaryllis* Manual. Macmillan, New York. U.S.A.

II. INTERCHANGE HETEROZYGOSITY IN **A. STYLOSA** (HERB) SWEET.

This species is a native of Guiana and Northern Brazil and was introduced in England around 1821 (Traub, 1958). The present material came from (Royal) Agri-Horticultural Society, Alipore through the courtesy of the late Mr. S. Percy Lancaster, former Senior Technical Assistant. Earlier it was studied cytologically by Neto (1948) and Mookerjea (1955) and was found to have 2n=22. The present study based on both somatic and meiotic chromosomes shows it to be an interchange heterozyote.

METHODS

Karotype was studied from the fresh roots collected and pretreated with aquous saturated solution of paradichlorobenzine for 3 hrs.

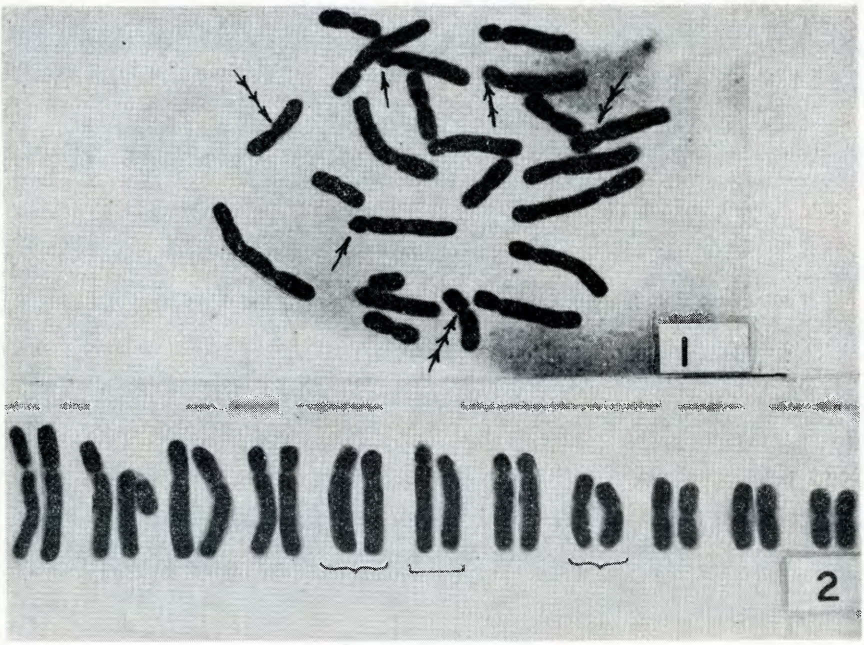

Fig. 7. Mitotic complement of **A. stylosa** (Sat. and heteromorphic pairs are marked). x1250. (1) Mitotic complement of **A. stylosa** (2n=22). (2) Photo-idiogram of **A. stylosa.** Note heteromorphic pairs (V and VIII).

The roots were fixed in 1: 3 acetic alcohol and heated in a mixture of 1 percent aceto-lacmoid and N Hcl (9:1) for few seconds and then squashed in 1 percent aceto carmine. The individual chromosomes were cut from the enlarged microphotographs and arranged in pairs in the descending order of their length. Karyomorphological analysis was determined according to the standards laid down by Battaglia (1955).

Meiosis was studied from the pollen mother cells after fixing buds in carnoy's fluid for 24 hrs. and then squashed in 1 percent aceto-carmine. Young buds were fixed after sacrificing a large number of bulbs as in *Amaryllis,* pollen mother cells undergo meiosis while the scape is hidden inside the bulbs.

RESULTS

Karyotype: As is clear from the foregoing account and also the studies of earlier authors, that the somatic chromosome number in this species is 22. Four of these have centromeres, nearly in median, 11 submedian and 7 in subterminal position, Fig. 7 *(1-2).* Two subterminal chromosomes possess satellites on short arm and form a heteromorphic pair (VI). Out of the remaining 10 pairs, 8 are homomorphic leaving four chromosomes which can be sorted out in two heteromorphic pairs (Nos. V and VIII).

Meiosis: The normal meiosis of diploids are characterised by 11 bivalents, but out of the 54 cells studied in this taxon only 3.62 show 11 bivalents, while the remaining 96.38% possess an interchange multiple of 4 chromosomes, Fig. 8 *(3-7).* Out of the latter, 94.36% are rings (Figs. 3-6) while only 1.85% are chains, Fig. 8 *(7).* All chains and majority of the rings segregate disjunctionally. The remaining (3.62%) rings are non-disjunctional (Table I). Chiasma frequency per cell ranges from 24 to 26 and average being 24.7±0.45, out of these nearly 17.2 are terminalized at metaphase I. The interchange multiple has generally 4 chiasmata, 3 of which are completely terminalized while one is interstitial, Fig. 8 *(4-6).* In cells with 11 bivalents, there are 10 ring and one rod type and chiasma frequency ranges from 25 to 27, average being 26 per cell.

Anaphases are perfectly normal with 11:11 segregation Fig. 8 *(8).* and subsequent stages of meiosis though perfectly normal result in nearly 56% pollen fertility.

Pollen mitosis: An analysis of pollen mitosis was made. Upon matching the haploid karyotypes from pollen grains, two types are recognizable, which, besides the satellited chromosome, differ in two pairs, Fig. 9 *(9, 11, 10, 12).* Two such karyotypes when compounded, Fig. 9 *(13),* give the diploid karyotype of the *A. stylosa,* Fig. 7 *(2).*

Table - I

Chromosome associations at metaphase I in *A. stylosa*

Associations	Segregations (%) Disjunctional	Non disjunctional
R4 + 9 II	90.74	3.62
C4 + 9 II	1.85	—
11 II	3.62	—

DISCUSSIONS

The consistent presence of one or more configuration of 3 or more chromosomes in otherwise a diploid species may be a marker of the inter-

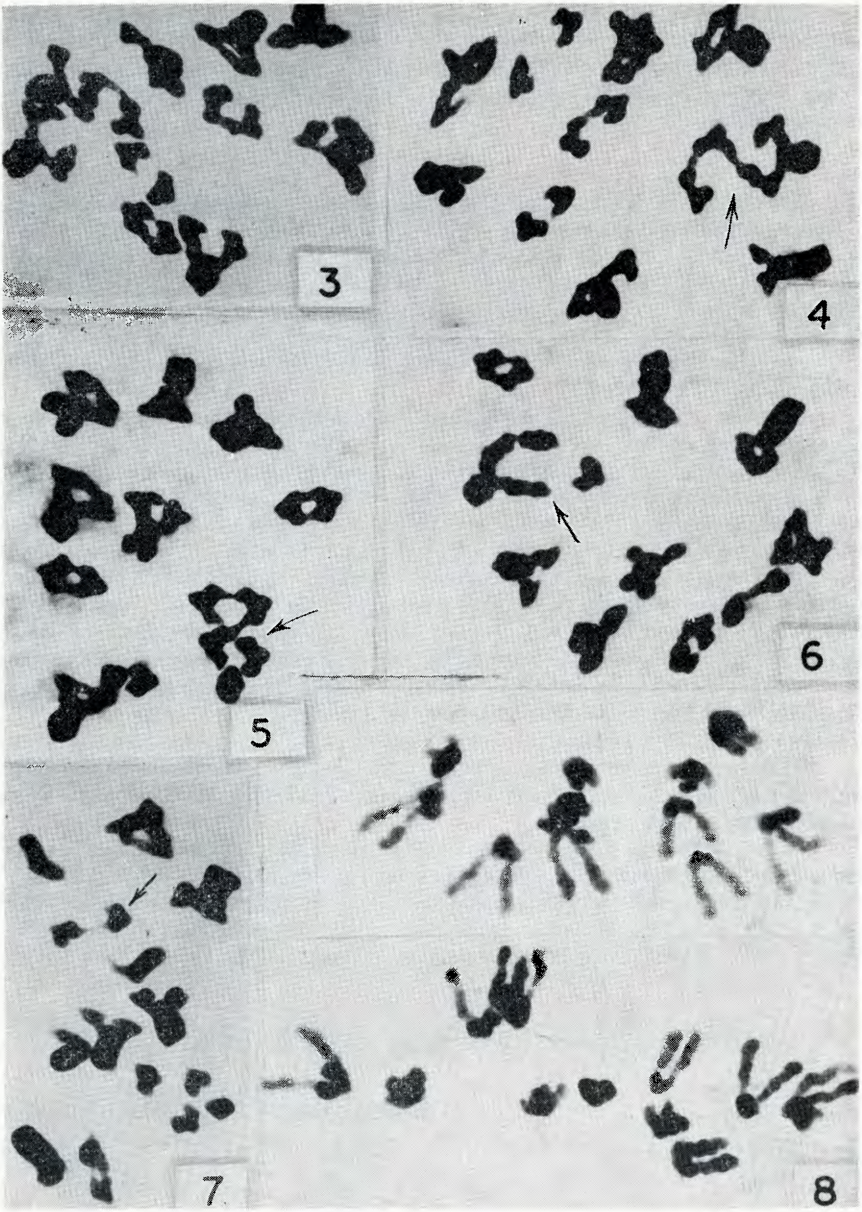

Fig. 8. **(Nos. 3-8).** Male meiosis in interchange heterozygote **A. stylosa** (n=11); (Interchange multiples are marked) x1250; (**3.**) Homozygote cell, 11 II; (4-6.) R4 + 9 II; (7.) C4 + 9 II; and (8.) Anaphase I, 11 : 11 chromosomes.

change hybridity. This is aptly true of the present taxon in which over 96% cells contain either a ring or a chain of 4 chromosomes plus 9 bivalents. An analysis of the interchange multiple shows that it is composed of four chromosomes, two of which are small and have a centromere in median-submedian position, while the remaining two are long with centromere in subterminal position. The latter often has an interstitial chiasma in the long arm, while the remaining chiasmata are terminal. This tallies with the karyomorphological analysis wherein apart from the heteromorphicity in satellited pair, two other pairs of more or less the above morphology have been identified. The frequency of disjunctional orientation in this interchange heterozygote is far greater (92.99) than those that are adjacent (Table I) as is the case in a number of interchange heterozygotes like *Campanula* (Gairdner and Darlington, 1931) *Periplenata* (Lewis and John, 1957) *Oenothera,* Rhoeo (Sybenga, 1968), etc. In the present case, the predominant associations are ring multiples and chains occur in about 1.85% cases. These results are in line with earlier findings of Gairdner and Darlington (1931) in *Campanula* and Muntzing and Prakken (1941) and Sybenga (1968) in rye, etc. However, Lewis and John (1963), Khoshoo and Mukerjee (1966) and Zadoo and Khoshoo (1968) observed that alternate disjunction was prevalent only in chains, and rings were always found segregating non-disjunctionally. They attributed it to the small size of rings and greater rigidity in the centromeric regions of small chromosomes which do not permit their centromeres to orientate alternately in the rings. However, such rigidity is lesser in the chains which orient in a zig-zag fashion.

The fertility of an interchange heterozygote largely depends upon number of factors, particularly morphology of chromosomes, nature of interchange multiples, frequency of multiple orientations, their disjunction at metaphase I, presence or absence of interstitial cross overs (Burnham, 1956) and capacity of genotype to withstand rearrangements. (Zadoo and Khoshoo, 1968). Plants with an interchange showing equal frequency of adjacent and alternate orientation have approximately 50% pollen and ovule fertility. This is due to the fact that alternate orientations produce viable gametes, whereas adjacent reduce fertility as they carry deficiency and duplications in the gametes that cause sterility. Therefore, with the increase in the rate of alternate orientation, there will be increase in fertility. However, it is not true in the case of *Bougainvillea* (Zadoo and Khoshoo, 1968) where nearly 80% interchange ring multiples orientated non-disjunctionally but resulted in 65% pollen fertility. This indicates that the deficiencies and duplications caused by non-disjunctional segregation do not cause serious physiological effects on the pollen grains because its genome is capable of withstanding rearrangements. In the present case, 92.59% interchange multiples show alternate disjunction but result in only 56% pollen fertility. The reduced fertility seems to result from the presence of an interstitial chiasma in the interchange multiples, Fig. 8 *(3-6),* which cause the transfer of larger segments leading to inviability. This agrees with the results of Blakeslee (1927-1928) in *Datura* (Vide

Burnham, 1956) where majority of the ring multiples with a chiasma in the interstititial segments, though with alternate disjunction (a configuration of figure of eight) result in 50 per cent fertile pollen grains.

A survey on the frequency of the multiple associations in the amaryllis heterozygote indicates that the chain associations are lower

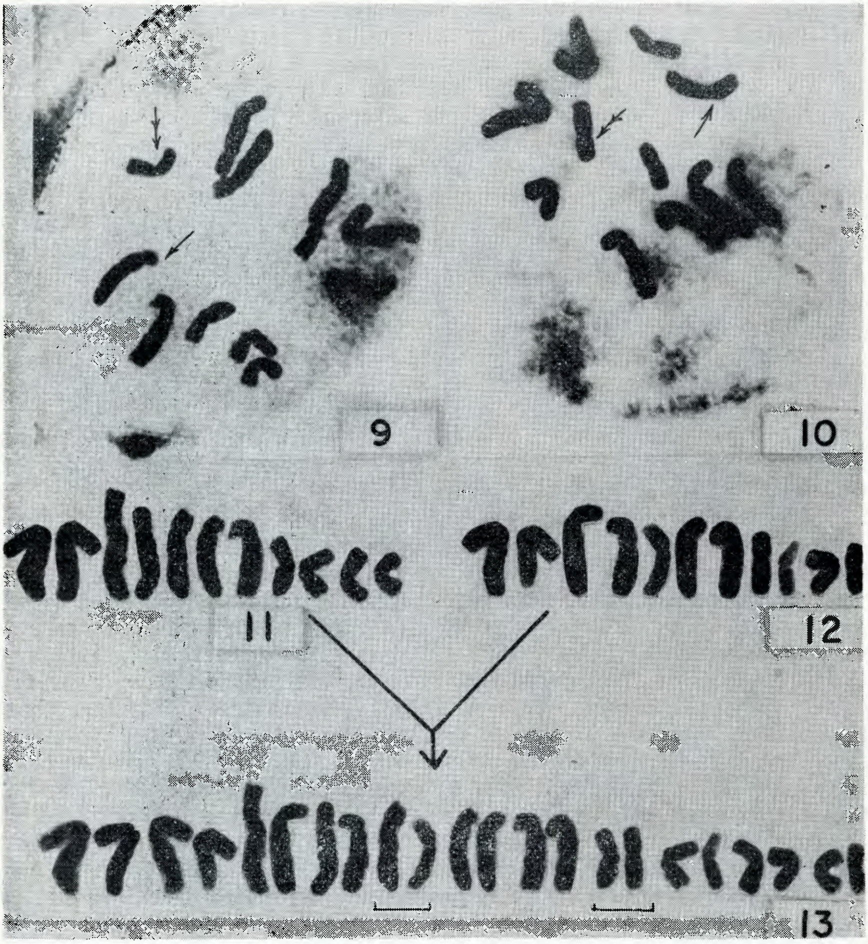

Fig. 9. **(Nos. 9-13).** Pollen grain mitosis in **A. stylosa** (n=11); (Heteromorphic chromosomes are marked) x112.5; **(9-10)** Pollen grains containing two types of chromosome complements; **(11-12)** Haploid photo-idiograms of the same, and **(13)** The two sets taken together tally with the normal somatic complement of **A. Stylosa** (see Fig. 7) **(2)**.

(1.85) than the rings (94.36%). This may be ascribed to the lack of terminalization in the interchange multiples which prevents a regular formation of chain. The higher the frequency of alternate orientations in ring multiples, the greater are chances of chains because of shifting of one of the terminal chiasmata.

It is apparent from the karyotypic analysis that 4 chromosomes are non-homologous. These 2 heteromorphic pairs (V and VIII) in this heterozygote apparently fit very well with the occurance of rings or chains of 4 chromosomes. This indicates that only one interchange has been involved in this heterozygote. However, the presence of heteromorphic chromosomes in the interchange heterozygotes of *Chrysanthemum carianatum* could not be found (Rana, 1965-66; Rana and Jain, 1965). Therefore, it is apparent that the karyotypic heteromorphicity is not an essential marker of interchange heterozygosity. The origin of this taxon is not very clear but the heterozygosity is maintained efficiently by propagation.

SUMMARY

Male meiosis of *A. stylosa* has revealed it to be an interchange heterozygote. Meiosis is characterised by formation of a ring or chain of 4 chromosomes and 9 II, in 96.38% pollen mother cells, at metaphase I. The interchange multiple is also karyotypically detectable because of the heteromorphic nature of 2 pairs of chromosomes. Though 92.59% interchange multiples show alternate disjunction yet there is only 56.0% pollen fertility. The reduced fertility seems to result from the presence of an interstitial chiasma in the interchange multiples. However, vegetative reproduction not only conserves high level of heterozygosity but also circumvents high level of sterility.

ACKNOWLEDGEMENTS

I thank Dr. T. N. Khoshoo, Director, National Botanic Gardens, Lucknow, for guidance and interest in this study. I am also grateful to Late Mr. S. Percy Lancaster for providing the material and Mr. T. K. Sharma for illustrations.

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III. CHROMOSOMAL VARIATION

INTRODUCTION

So far nearly 22 species of the genus *Amaryllis* have been studied cytologically by Inariyama (1937), Sato (1938), Baldwin and Speese (1947), Neto (1948), Ficker (1951), Schmidhauser (1954), Mookerjea (1955), Sharma and Jash (1958), Traub (1958), Narain and Khoshoo, (1968), Burnham *et al* (1971) and present report (Table I). The chromosome numbers are clearly indicative of a basic number of 11 which forms a series from 2x through 3x, 4x, 6x to 7x.

In the present case, out of 137 horticultural varieties growing in the National Botanic Gardens, Lucknow; only 50, including species like *A. vittata, A. belladonna, A. stylosa. A. reticulata* and *A. speries* and 45 garden cultivars were studied. Thirty were found to be diploids, one triploid and 14 tetraploids. Among the species *A. stylosa A. reticulata* and *A. species* were dipliod, whereas *A. vittata* was found to be both diploid and tetraploid and *A. belladonna* was found to have 3 races namely diploid, triploid and tetraploid.

MATERIALS AND METHODS

The present study is based on 5 species and 45 garden cultivars of *Amaryllis* growing at National Botanic Gardens, Lucknow. Majority of the species and cultivars were introduced by the late Mr. S. Percy-Lancaster from Messers Chandra and Pradhan nurseries, Kalimpong (Sikkim). Besides this a large no. of hybrids raised by Percy-Lancaster (Personal communication) at the (Royal) Agri-Horticultural Society, Alipore (Calcutta) were also added. Further, in absence of a regular name the cultivars were numbered.

Karyotypic analysis was made from root-tip mitosis. Fresh growing roots were collected and pretreated with aqueous saturated solution of paradichlorobenzene at 15°C for 3-4 hours, followed by a thorough wash in tap water and fixation in 1:3 acetic-alcohol for 24 hours. The roots were subsequently heated in a mixture of 1 per cent aceto-lacmoid and N.Hcl (9:1) for few seconds and squashed in 1 per cent aceto-carmine. For preparing Photo idiogram, the individual chromosomes were

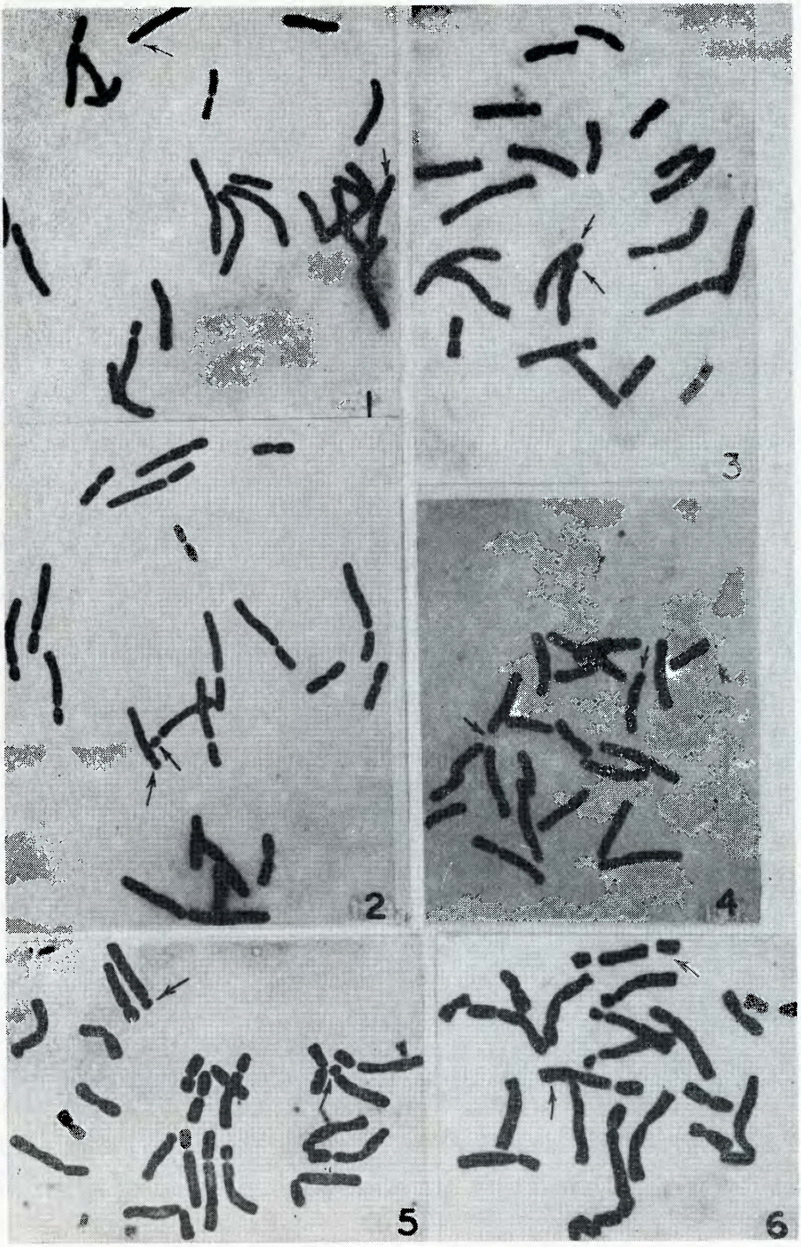

Fig. 10. Mitotic complements of diploid (2n=22) species and cultivars of **Amaryllis** (Sat. pairs are marked): (1) **A. vittata;** (2) **A. belladonna;** (3) **A. reticulata;** (4) **A. species;** (5) cv.131; and (6) cv. 52.

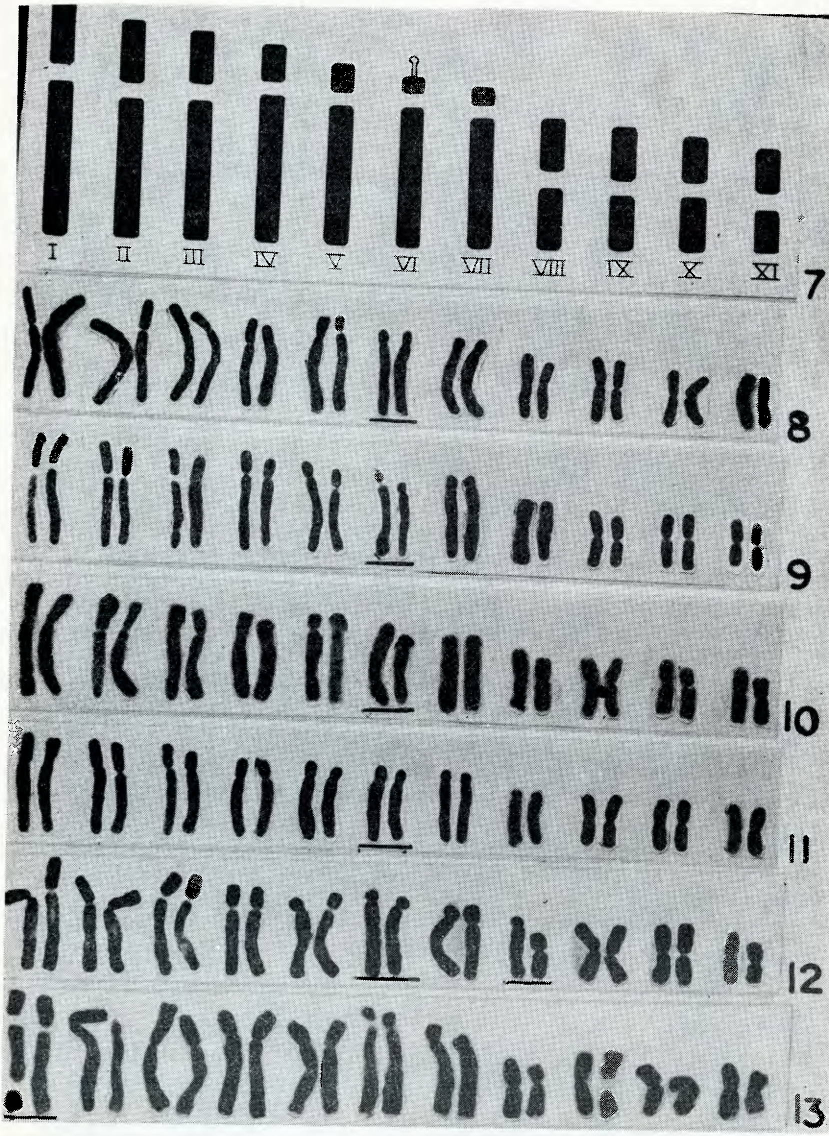

Fig. 11. Photo-idiograms of diploid (2n=22) species and cultivars of **Amaryllis** (Nucleolar and heteromorphic pairs are marked): (7) Idiogram of **Amaryllis;** (8) **A. vittata;** (9) **A. belladonna;** (10) **A reticulata;** (11) **A. species;** (12) cv.131; and (13) cv. 52.

cut out from enlarged photomicrograph, matched and arranged in pairs, whenever possible in descending order of their length. The ratio of long and short arm (L/s) of the chromosome enabled the determination of the centric position. The classification of chromosomes into matacentric (V, 1:1), submetacentric (L, >1:1 - <1:3), subtelocentric (J, 1:3 - <1:0) and telocentric (I, 0:1) was based on the standards laid down by the Battaglia (1955).

Meiosis was studied from pollen, mother cells for which young floral buds were collected and fixed in the carnoy's fluid (Darlington and Lacour, 1947) for 24 hours then stored in 70 per cent alcohol in refrigerator. After 2 days, material was squashed in 1 per cent iron-acetocarmine. In *Amaryllis,* pollen mother cells undergo meiosis while the scape is still hidden in the bulb and bulbs had to be cut in order to fix young anthers, still one was not sure if the proper stages were available. Therefore meiosis could be studied only in those taxa, where good number of plants were available.

RESULTS

Karyotype: Somatic complements of the diploid species, Fig 10 *(1-4),* consist of 22 chromosomes which can be resolved in most cases into 11 pairs. A basic karyotype, Fig. 11 *(7),* containing 2 chromosomes with median (V), 5 with submedian (L) and 4 with subterminal (J) centromeres can be recognized, Fig. 11 *(8-10)*; see Table II. The basic karyotype is shown in Fig. 11 *(7)* and chromosomes have been arranged according to descending order and their length. It is evident from the idiogram that chromosome Types 1, II and III are comparatively long and have submedian (L) centromeres, while Types IV, V, VI and VII possess subterminal (J) centromere but differ in the size of long/short arm ratio (Table II). Furthermore, among the short chromosomes, Types IX and XI possess a median (V) while Types VIII and X submedian (L) primary constriction. In the entire somatic complement of 22 chromosomes, only 2 satellited chromosomes were observed. A detailed analysis of the basic karyotype shows that the species can be divided into 2 groups which differ in the location of centromere in the VIII pair. In *A. vittata,* Fig. 10 *(1)*; Fig. 11 *(8)*; *A. belladonna,* Fig. 10 *(2)*; Fig. 11 *(9),* and *A. reticulata,* Fig. 10 *(3)*; Fig. 11 *(10),* this pair has centromere in median to submedian position, while in *A. species,* Fig. 10 *(4)*; Fig. 11 *(11),* it is highly subterminal in position. Accordingly, the karyotype in *A. belladonna, A. vittata* and *A. reticulata* is rather uniform in comparison to *A. species* and in particular to *A. stylosa.* The last taxon possesses 2 heteromorphic pairs which can be correlated with its being an interchange heterozygote (Narain, 1975).

The size of chromosomes varies in elemental species and cultivars. In the diploids it varies from 4.57 μ to 12.2 μ whereas in tetraploids from 3.71 to 10-67 μ. The longest pair is about 2.6 times longer than the shortest pair in the karyotypes. Sometimes, in most of the taxa, a minor but consistent difference in the size of the two members of a chromosome pair has been noted. This difference in size, whenever,

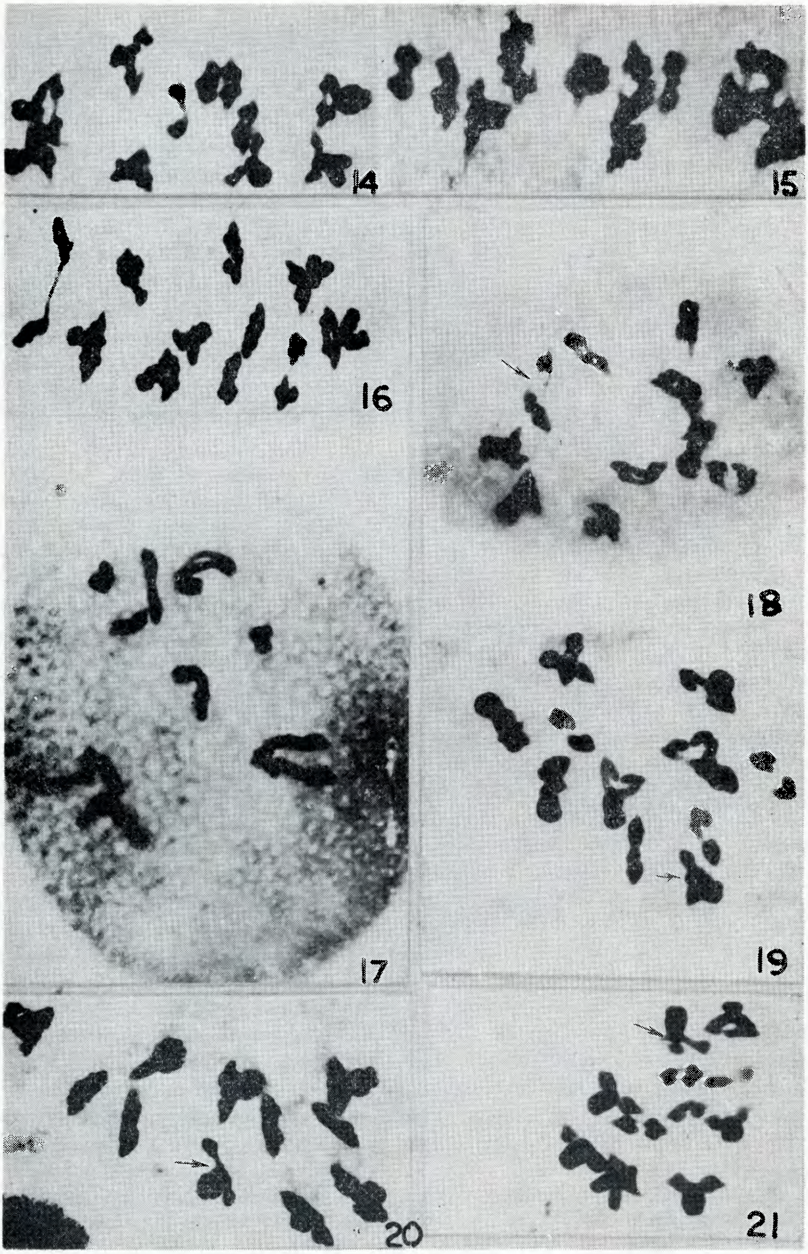

Fig. 12. Male meiosis and pollen grain mitosis in diploid (n=11) species and cultivars of **Amaryllis.** (Heteromorphic bivalents are marked)—(14) **A. vittata** metaphase I, 11 II; (15) **A species** metaphase I, ii II; (16) **A. belladonna** metaphase I, 11 II; (17) Pollen grain mitosis of **A. belladonna** (n=11); (18) cv. 26 metaphase I, 11 II; (19) cv. 18 metaphase I, 11 II; (20) cv. 88 metaphase I, 11 II; and (21) cv. 10 metaphase, I, 11 II.

present was found between the length of short or long arms. Evidently, the long/short arm ratio in the two members of the pair varies to a small but perceptible degree (Table II).

Meiosis: Male meiosis was studied in *A. vittata*, *A. belladonna* and *A. stylosa* and *A. species.* Except in *A. stylosa* which is a translocation heterozygote (Narain, 1975) all the rest show regular meiotic behaviour and 11 bivalents were always observed, Fig. 12 *(14-16)*. The number of ring bivalents varies from 9 to 10, while those of rods from 2 to 1. Chiasmata frequency per cell ranges from 25.3±0.2 *(A. belladonna)* to 21.57±0.34 *(A. vittata)* and 20.0±0.26 *(A. species)* i.e. 2.3, 1.96 and 1.81 per bivalent respectively (Table III). Normal segregation of 11:11 chromosomes at anaphase I was regularly seen and no bridges, laggards or other abnormalities were observed in any species. Anaphase II and tetrad formation was normal with perfect pollen grains. Pollen grain mitosis revealed the occurrence of the expected number and morphology of chromosomes, Fig. 12 *(17)*.

Pollen fertility in the elemental species is fairly high and ranges from 56 to 80% except in *A. species,* which is totally male sterile but fully female fertile. The size of pollen grains varies from 70.3 Ч to 75.04 Ч and number of seeds per capsule ranges from 40-60.

GARDEN CULTIVARS

Forty five distinct horticultural varieties were included in the present investigation. Majority of them are hybrid of complex origin and due to the lack of adequate records, their exact ancestory could not be ascentained. They may be at diploid, triploid or tetraploid level.

DIPLOIDS

Karyotype: Thirty cultivars out of the 45 studied were found to be diploid with 2n=22 in their sematic complements, Fig. 10 *(5, 6)* and Fig. 11 *(12, 13)*. Actual arm ratios have been worked out in 24 cultivars and data are summarised in Table II. The basikaryotype of 4V + 10L + 8J is recognizable only in 29% of cultivars, while in the remaining 71% there is a variable number of V and in particular L and J chromosomes. The number of V chromosomes varied only in 3 cultivars (12.5%), out of which in 2, the number was 2 while in one it was 3 instead of the usual 4. On the other hand, the number of L and J chromosomes varied from 11 to 7 instead of the normal 10L and 8J chromosomes (Table II). Further, the 22 chromosomes do not fall in 11 hemomorphic pairs but there are 1 to 5 heteromorphic pairs (Table II).

Evidently, there is much karyotypic heteromorphicity in the garden cultivars of amaryllis and broadly speaking two groups are recognizable. In one group (e.g. 'Achilles' cv. 52, Fig. 10 *(6)* and Fig. 11 *(13)*, the karyotype though heteromorphic resembles *A. belladonna* type in as much as the VIII pair is composed of chromosomes with median to submedian centromeres. In the second group (like cv. 18) which constitute the, Fig. 10 *(5)*, bulk of cultivars, the karyotype is highly heteromorphic with variable number of V, L and J chromosomes and

VIII pair is always composed of one V or L and the other J chromosomes (Table II).

Meiosis: Since meiosis takes place inside the bulb it could be studied in such cultivars in which there were a reasonable number of bulbs to spare. Nearly 20 analysable pollen mother cells in each cultivar were studied. The data are summarised in Table III. In general,

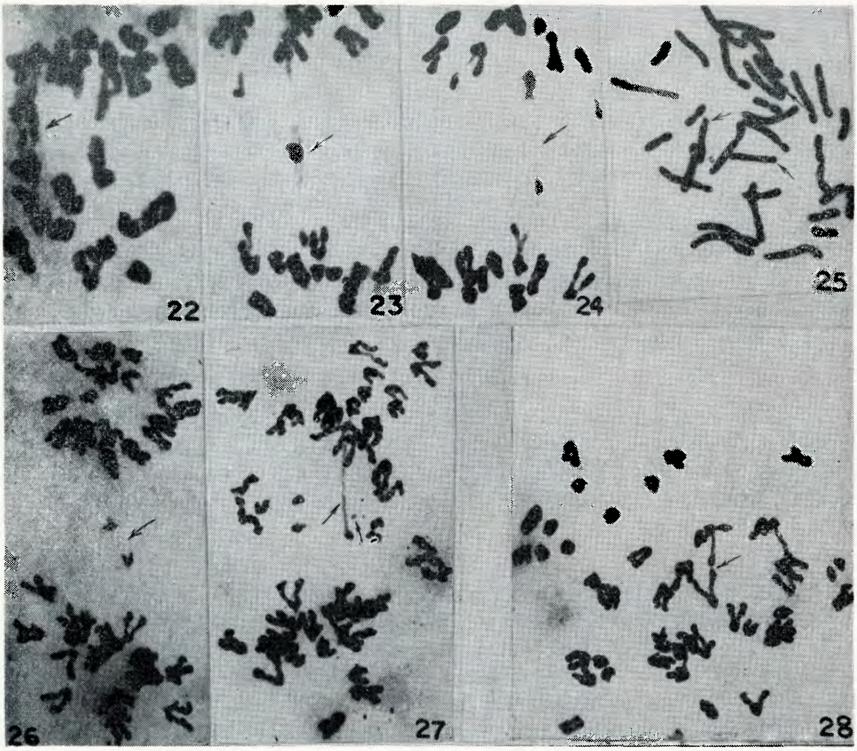

Fig. 13. Male meiosis and pollen grain mitosis in diploid (n=11) species and cultivars of **Amaryllis** (Heteromorphic bivalents are marked): (22) cv. 18. Anaphase I, 11:11 (Note late disjunction of one bivalent); (23) cv. 18. Anaphase I, 11:11 (Note chromosome bridge without fragment); (24) cv. 26. Anaphase I, 11:11 (Note bridge and non termalized Segment); (25) Mitotic complement of triploid (2n=33) cultivar of **Amaryllis** (Sat. chromosomes are marked); (26) cv. 35. Anaphase I, 22:22 (Note precocious division of the bivalent); (27) cv. 1. Anaphase I, 22:22 (Note bridge and fragment), and (28) cv. 16. Anaphase I, 22:22 (Note late disjunction in one IV).

there were 11 bivalents at metaphase I, some of them were rather heteromorphic, Fig. 12 *(18* to *21)*. This is expected on the basis of karyotypic heterogeneity. There is considerable variation in number of chiasmata per cell. The maximum being 27.0 ± 0.42 (which is even more than the species in cv. 17) to 18.4 ± 0.33 in cv. 18, which is one of the more karyotypically heteromorphic cultivars. Other cultivars fall in between (Table III). There was regular segregation of 11:11 at anaphase I, in most cases. However, cv. 18 was characterised by bridges without fragments, Fig. 13 *(22-24)* and such other abnormalities as laggards. Such bridges appear to be result of nonterminalization.

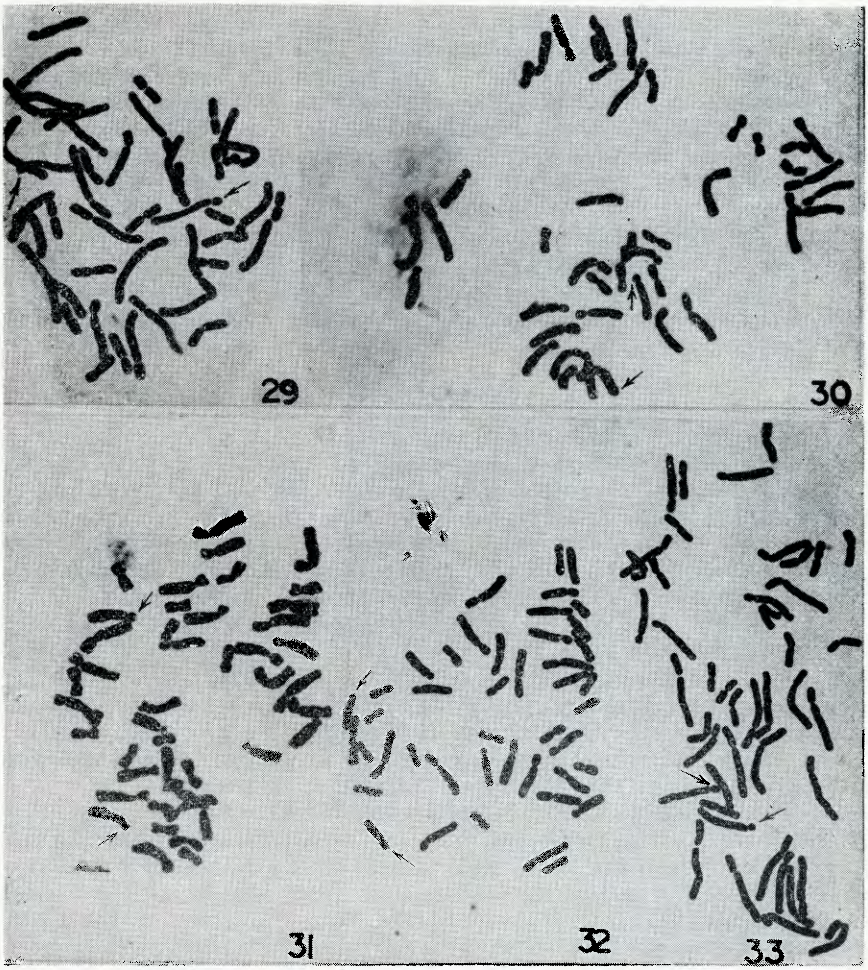

Fig. 14. Mitotic complement of tetraploid (2n=44) species and cultivars. (Sat. pairs are marked): (29) **A. vittata;** (30) **A. belladonna;** (31) cv. 1; (32) cv. 9; and (33) cv. 93.

There is a great variation in the range of pollen fertility which varies from 20.0 to 64.0%. The number of seeds per capsule varies from 15-45 but the germination is poor and very few seeds are viable.

TRIPLOID

Karyotype: Only cv. 110 is a triploid with 2n=33, Fig. 13 *(25)*; the somatic complement of 33 chromosomes is composed of 6V and 15L + 12J chromosomes, Fig. 15 *(34)*; (Table II) indicating that the basic karyotype of 2V + 5L + 4J is represented thrice. However, an analysis of the arm ratio shows that, of the three sets, two are rather homologus and the third differs at least in some of the chromosomes. As expected, there are 3 satellited chromosomes (Table II).

Meiosis: Meiotic analysis of the triploid cultivar has shown a preponderance of trivalent configurations both at diakensis and metaphase I, Fig. 16 *(40-43)*. These range from 11 III to 6 III + 5 II + 5 I, Fig. 16 *(40* to *43)*, Table IV. The former are present in 40% cells. The average number of trivalents is 9.75 ± 0.41 associated with a relatively low number of bivalents (1.15 ± 0.40) and univalents (1.45 ± 0.71). The meiosis has autoploid characters and anaphase I was characterised by unequal segregation, ranging from 16:17 in 80% cells to 15: 18 and 14: 19 in the remaining 20% of cells. Nearly 46% pollen found stainable but the taxon N is otherwise both pollen and seed sterile.

TETRAPLOIDS

Karyotype: Fourteen cultivars including those referable to *A. vittata* and *A. belladonna* are tetraploids (2n=44). Analysis of somatic chromosomes of *A. vittata*, Fig. 14 *(29)* & Fig. 15 *(35)* and *A. belladonna,* Fig. 14 *(30)* and Fig. 15 *(36)*, shows that the basic karyotype of 2V + 5L + 4J is represented four times. However, contrary to the expected number of 4 satellites, there are only 2 satellited chromosomes. These are situated on the short arms of the two subterminal chromosomes. In the remaining 11 cultivars, analysis of somatic chromosomes has shown that the basic karyotype may or may not be recognizable, Fig. 14 *(31* to *33)* and Fig. 15 *(37* to *39)* and Table II. One of the chief reasons for heteromorphicity is that instead of 4 chromosomes of each of the 11 types of chromosomes there may be 2 or 6 (Table II). Furthermore, the arm ratio of a particular chromosome type may differ probably indicating that they came from different parents.

Meiosis: Meiotic analysis of 10 tetraploid taxa has been presented in the Table V. The species and some cultivars possess relatively higher quadrivalent frequency 9.4 ± 0.61 to 5.6 ± 0.26 per cell with a range of 1 to 11. The remaining chromosomes form bivalents, there being no univalents, Table V, Fig. 16 *(44, 45, 47)*. However, on the other extreme, there are cultivars where the frequency of quadrivalents goes down from 4.75 ± 0.32 to 2.8 ± 0.18 per cell accompanied by 4.0 ± 0.20 to 6.4 ± 0.40 univalents, Fig. 16 *(46)*. The range of quadrivalents in the latter is only 2 to 6. These results indicate that while some cultivars show more autoploid characters, others are segmental alloploid in character.

The chiasmata frequency varies from 41.0 ± 0.27 to 48.0 ± 0.46 per cell in the first group, while from 37.6 ± 0.19 to 42.0 ± 0.39 in the latter. The highest number of chiasmata (48.0 ± 0.46 per cell) was found in cv. 27, which had the maximum average number of quadrivalents (9.4 ± 0.61) per cell; whereas the lowest number was 37.6 ± 0.10 per cell in which case there were 4-8 (6.4 ± 0.40) univalents (Table V).

Quadrivalents and bivalents disjunct regularly at anaphase I while in the cultivars with univalents there is random distribution of univalents which causes a numerical difference in the daughter cells. The lagging univalents have a tendency to divide, Fig. 13 *(26* to *28)*, leading to irregular anaphases often accompanied with bridges and fragments.

Pollen stainability in cultivars with higher frequency of quadrivalents, varies between 80 to 90%, while those with univalents it is from 30 to 54%. Similarly seed setting was much more higher in former than the latter. The size of pollen grains on an average was found to be 101.0.

Fig. 15. Photo-idiograms of triploid (2n=33) and (2n=44) species and cultivars: (34) cv. 110 (2n=33); (35) **A. vittata;** (36) **A. belladonna;** (37) cv. 1; (38) cv. 9; and (39) cv. 93.

NUCLEOLAR CHROMOSOMES

Several authors (Inariyama, 1937; Baldwin and Speese, 1947; Ficker, 1951; Schmidhauser, 1954) have not recorded nucleolar chromosomes in *Amaryllis.* Sato (1938) studied *A. vittata* and *A. rutila* and observed only one satellited chromosome in an entire complement of 44 chromosomes. The satellite was situated on the long arm of submedian chromosomes.

In the present investigation, nucleolar organisers in *Amaryllis*

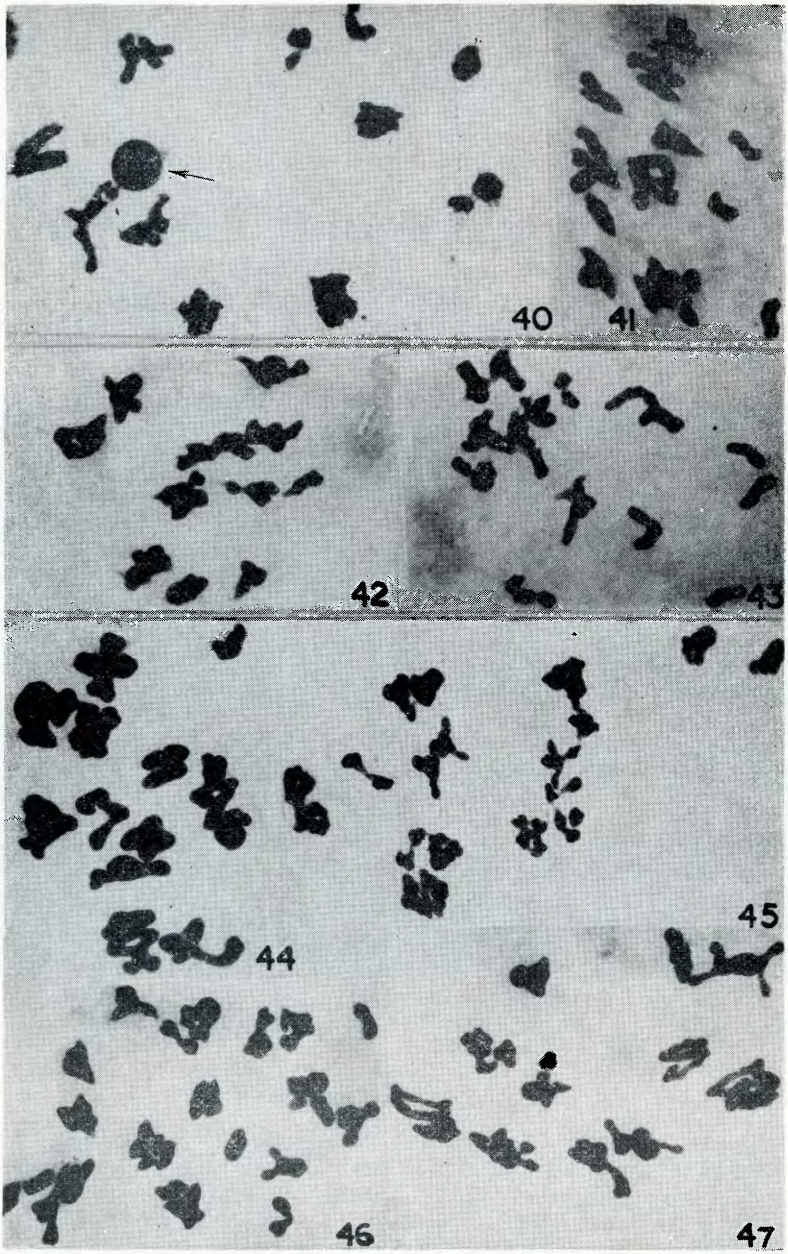

Fig. 16. Male meiosis in triploid (2n=33) and tetraploid (2n=44) species and cultivars of **Amaryllis:** (40) Diakinesis (Note nucleolar 11 III organisor is associated with trivalent); (42) Metaphase I 11 III; (41 and 43) 18 III + 3 II + 31; (44) 27 Metaphase I, 10 IV + 2 II; (45) cv. 25. Metaphase I, 6 IV + 10 II; (46) cv. 1. Metaphase I, 3 IV + 14 II + 4 I; and (47) cv. 16 Metaphase I, 9 IV + 4 II.

species have been observed in the form of both satellites as well as secondary constrictions. Satellited chromosomes were much common being found in the majority of the cultivars and are located on the shorter arms of the subterminal (J) chromosomes.

Mookerjea (1955) and Sharma and Jash (1958) have not found satellites but have observed consistently much higher number (8-9) of secondarily constricted chromosomes. However, in the present investigation, neither in the diploids nor polyploids there were found more than 2 satellited or secondarily constricted chromosomes except in one triploid cultivar where three chromosomes were found with satellites. Furthermore, while the satellites are situated on the short arm of subterminal chromosome, secondary constrictions were found in the longer arms of first pair of chromosomes in cv. 'Achilles', Fig. 10 *(6)* and Fig. 11 *(13)*, with submedian centromere.

DISCUSSION

Out of 67 species belonging to the genus *Amaryllis* 22 have been studied so far cytologically (Table I). In addition, 50 cultivars of garden *Amaryllis* have also been studied. These data are summarised in Table I. to V. A perusal of the same shows that the genus is monobasic (x=11), the polyploids ranging from 3x to 7x are all based on this number. The only exception is *A. aulica* which has 2n=23 (Schmidhauser, 1954). This species evidently may be 2x + 1 in constitution and does not represent a new basic number.

The present results together with some of the earlier accounts (Table I) reveal the existence of a basic karyotype of 11 chromosomes composed of 3 medium to large submedian, 4 medium subterminal and 4 small median to submedian chromosomes. The basis karyotype is often recognizable even at triploid and tetraploid levels. However the only exception is *A. species*, in which case VIII pair is highly subterminal instead of median to submedian in *A. belladonna* and other taxa. Coupled with such a cytological divergence, *A. species* is distinctive because flower is narrow, long and bell shaped in appearance. Tepal tube is very long (8-10cm) and perianth is equal, white and obovate. In contrast, *A. vittata, A. belladonna* and *A. reticulata* have flattened open faced flowers, with short tepal tube (1 to 3cm) and six unequal, broad and lancee—ovate to obovate perianth in variable colours. In *A. species* only 2-4 deformed anthers are produced which never dehisce. Filament and styles are shorter and remain inside the perigone. The ovary is normal and produces fruits whenever pollen is applied artificially. The morphological characteristics shows that *A.* species belongs to subgenus *Macropodastrum* of the genus *Amaryllis* (Traub, 1958).

There is also a general decrease in chromosome size with increase in ploidy level. However, at any one level the longest chromosome pair is about 2.6 times longer than the smallest pair in a complement. Decrease in size with increase in level of ploidy has been recorded in a number of genera like *Allium* (Ved Brat, 1965) *Crinum* (Raina and Khoshoo, 1971), etc. According to Darlington (1963) this tendency helps to resolve nucleolar-cytoplasm ratio near the diploid level and may be due to decrease in level of polynemy (Darlington 1958) or loss of duplicate material.

One of the significant markers in chromosomes is the position of centromere. Based on this, arm ratios were calculated for each chromosomes and Zygotic complements were resolved on the basis of length of chromosomes and the arm ratio. On this basis, complements of the diploid species more often resolved in more or less 11 homomorphic pairs. However, in the complement of many of the diploid cultivars there is a varying number of heteromorphic pairs, often one such pair is nucleolar. Karyotypic analysis of cv. 18 and large number of cultivars (Table II) indicates that they possess an intermediate complement of two basikaryotypes.

Two genomes A (2V+5L+4J) and B (2V+4L+5J) as represented by *A. belladonna* and *A. species* or their allies appear to have been involved in the origin of the cultivars. If the two haploid genomes are compounded, the resultant diploid complement tallies, on karyomorphological grounds, with the karyotype of the cultivars. Karyotypic heterozygosity was also found in the natural populations of *A. elegams (Hippeastrum solandriflorum)* by Baldwin and Speese (1947) and in the five progeny plants they found only one was homomorphic. Such heteromorphicity can easily come about by hybridization involving taxa with chromosomes differing in arm ratios. Alternatively, they may be the result of karyotypic alterations like unequal interchanges involving non-homologous chromosomes or para- and pericentic inversions. An analysis of meiosis of some of the taxa like *A. stylosa* (Narain 1975) shows quite clearly the role of interchanges.

Another important marker of chromosome complement is the number and location of nucleolar organisers, which as shown by the present and Sato's (1938) investigations are generally in the form of satellites located on the short arm of one of the subterminal chromosome pairs. Only in one cultivar ('Achilles') the nucleolar organisers were found in the form of a pair of secondary constrictions located in the long arm of the longest submedian pair of chromosomes. The number of the nucleolar organiser does not increase with the polidy level. In fact, in the triploid taxon 3 chromosomes were satellited, while tetraploids generally retained the same number as the diploids. This together with the karyotypic heteromorphicity may again mean the involvement of hybridization in the origin of the polyploid amaryllis in which case a genome with stronger satellites suppressed the one with a weaker one i.e. the phenomenon of amphiplasty (Navashin, 1934). If such polyploids were autoploid, they would have had a number of nucleolar organisers commensurate to the level of ploidy.

Meiotic analysis of species and cultivars at diploid, triploid and tetraploid levels shows that chromosomes associate as bivalents, trivalents and quadrivalents, respectively. All the diploid cultivars investigated exhibit complete pairing associated with varying degree of sterility. The solitary triploid shows some differentiation into AAB on the basis of karyotypic analysis. Predominant trivalent formation in triploid and quadrivalents in tetraploids would indicate autoploid characteristics. There are some tetraploid cultivars in which frequency and range of quadrivalents is low, indicating that they may be segmental allotetraploid. That hybridization has been involved in the origin of the diploid, triploid and tetraploid cultivars is well known and is apparent from the karyotypic analysis. However, the character, of meiosis in all the cultivars shows that differentiation between the parental genomes is weak resulting in bivalents in diploid, trivalents in triploid and quadrivalents in tetraploid, cultivars. The only evidence of some difference of genomes is found in a few tetraploid cultivars in which quadrivalent frequency is lower and is associated with increase in number of univalents. It looks that the genomes in this genus have not differentiated, sufficiently so that polyploids, natural or artificial, have still segmental allo-or autoploid characters. Thus external stability of karyotype by way of similar morphology reflects in this case internal homology except in cases like *A. stylosa* where interchanges have taken place.

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Table I. Chromosome numbers in **Amaryllis** species

Species	Chromosome number n=	2n=	Reference
Subgenus I. Macropodastrum			
Amaryllis immaculata	—	22	Schmidhauser (1954)
A. elegans (as **Hippeastrum solandriflorum**)	—	22	Baldwin & Speese (1947)
A. species (Unidentified)	11	22	Present work
Subgenus II Lais			
A. maracasa	—	22	Schmidhauser (1954)
A. striata	—	44	Sato (1938)
var. **crocata**	—	22	Schmidhauser (1954)
A. blossfeldiae	—	44	Burnham et al (1971)
A. vittata	—	44	Inariyama (1937) Sato (1938) Schmidhauser (1954) and Mookerjea (1955)
	11	22	Present work
	22	44	Present work
Subgenus III: Amaryllis			
A. barreirasa	—	22	Schmidhauser (1954) and Traub (1958)
A. belladonna	—	22	Ficker (1951) Sharma and Jash (1958)
	—	33	Schmidhauser (1954)
	11	22	
	11 III	33	Narain and Khoshoo (1968)
	22	44	Present work
A. evansiae	—	22	Nelson and Fletcher (vide Traub, 1958)
A. stylosa	—	22	Neto (1948) Mookerjea (1955)
	R_4 + 9II	22	Narain (In press)
A. traubii	—	22	Traub (1958)
A. reginae	—	33	Neto (1948)
	—	44	Nelson and Fletcher (vide Traub, 1958)
var. **albertii**	—	22	Schmidhauser (1954)
A. apertispatha	—	66	Traub (1958)
A. yungacensis	—	22	Burnham et al (1971)

Subgenus IV. Omphalissa				
A. aulica var. **aulica**	—	23	Schmidhauser (1954)	
var. **robusta**	—	22	Mookerjea (1955)	
A. calyptrata	—	22	Neto (1948) and Traub (1958)	*
A. fosteri	—	22	Traub (1958)	
A. oconequensis	—	22	Schmidhauser (1954)	
A. pardina	—	22	Nelson & Fletcher (vide Traub, 1958)	
Subgenus V. Sealyana				
A. reticulata	—	22	Sharma and Jash (1958) and present work	
A. blumenavia	—	77	Sato (1938)	

Table II. Arm ratio and karyomorphology in **Amaryllis** species and cultivars

	L/S Ratio			Karyotypic
Amaryllis	Long	Medium	Short	formula
Diploid species:				
vittata	2.14-2.5	3.5 -7.0	1.0-1.4	10L+ 8J+4V
belladonna	2.14-2.28	4.0 -8.0	1.0-1.12	10L+ 8J+4V
reticulata	2.28-2.66	3.5 -8.5	1.0-1.5	10L+ 8J+4V
stylosa	2.2 -2.83	2.11-5.66	1.0-1.33	11L+ 7J+4V
species	2.16-2.4	3.0 -7.33	1.0-6.0	8L+10J+4V
Diploid cultivars:				
cv.5	2.33-3.0	3.0 -7.5	1.0-1.5	10L+ 8J+4V
cv.10	2.0 -2.75	2.8 -7.0	1.0-7.5	11L+ 7J+4V
cv.11	2.0 -3.25	2.25-6.5	1.0-1.5	10L+ 8J+4V
cv.8	1.86-2.8	3.25-7.0	1.0-1.75	20L+16J+8V
cv.9	1.6 -2.2	3.0 -3.6	1.0-1.3	20L+16J+8V
cv.16	2.2 -3.66	3.3 -5.0	1.0-1.33	16L+20J+8V
cv.35	2.6 -2.8	3.28-6.5	1.0-1.5	18L+18J+8V
cv.80	2.3 -2.4	3.25-6.0	1.0-1.5	20L+16J+8V
cv.Andromeda	2.2 -4.0	2.5 -5.5	1.0-1.71	20L+16J+8V
cv.13	1.05-4.2	1.8 -7.0	1.0-7.0	11L+ 9J+2V
cv.17	2.5 -5.33	3.0 -9.0	1.0-5.5	10L+ 8J+4V
cv.18	1.5 -6.0	3.5 -6.5	1.0-5.0	9L+ 9J+4V
cv.19	2.22-3.4	3.4 -6.66	1.0-7.0	9L+ 9J+4V
cv.20	2.5 -3.5	2.4 -6.5	1.0-6.0	8L+10J+4V
cv.23	2.3 -3.0	3.0 -5.00	1.0-5.0	9L+ 9J+4V
cv.26	2.28-3.75	2.6 -7.5	1.0-5.5	9L+ 9J+4V
cv.33	2.00-5.0	2.4 -6.0	1.0-5.3	8L+10J+4V
cv.38	2.4 -6.5	5.0 -6.5	1.0-5.33	7L+11J+4V
cv.52(Achilles)	2.6 -7.0	2.8 -8.5	1.0-1.5	10L+ 8J+4V
cv.53	1.85-3.33	2.4 -6.5	1.0-1.66	11L+ 7J+4V
cv.62	2.14-3.5	4.5 -8.0	1.0-6.5	8L+10J+4V
cv.86	2.0 -2.8	3.0 -7.5	1.0-1.5	10L+ 8J+4V
cv.87	2.3 -2.5	3.2 -7.5	1.0-5.0	9L+ 9J+4V
cv.88	1.67-3.4	3.0 -8.0	1.0-5.0	8L+11J+3V
cv.99	2.16-3.25	2.4 -6.5	1.0-6.0	8L+10J+4V
cv.107	2.28-2.83	1.16-9.0	1.0-5.0	10L+ 8J+4V
cv.109	1.5 -3.2	2.25-8.5	1.0-5.0	7L+11J+4V
cv.123	2.14-3.0	3.0 -7.0	1.0-5.0	7L+11J+4V
cv.131	1.6 -3.3	3.0 -6.0	1.0-6.0	8L+10J+4V
cv.132	2.0 -2.6	3.0 -6.5	1.2-5.5	11L+ 9J+2V
Triploid cultivar:				
cv.110	2.12-2.8	1.5 -8.5	1.0-1.5	15L+12J+6V
Tetraploid species:				
vittata	2.42-2.8	3.0 -6.0	1.0-1.4	20L+16J+8V
belladonna	2.2 -2.85	3.6 -5.0	1.0-1.6	20L+16J+8V
Tetraploid cultivars:				
cv.1	1.2 -2.7	3.0 -4.5	10.0-1.3	20L+16J+8V
cv.2	1.6 -2.8	3.5 -8.0	1.0-1.3	20L+16J+8V

Table III. Meiotic analysis of diploid species and cultivars of Amaryllis

Amaryllis	Total number of cells	Number of Xta per cell: Range	Mean	Terminalization coefficient
vittata	20	16-25	21.57±0.34	0.52
belladonna	20	24-27	25.3±0.23	0.67
stylosa	20	24-26	24.7±0.45	0.69
species	20	18-24	20.0±0.26	0.38
cultivars				
cv.10	20	20-30	26.8±0.24	0.66
cv.12	20	22-27	25.8±0.40	0.72
cv.17	20	25-30	27.0±0.42	0.73
cv.18	20	15-21	18.4±0.33	0.65
cv.19	20	23-27	25.0±0.39	0.68
cv.26	20	22-30	26.8±0.29	0.56
cv.87	20	20-25	20.8±0.27	0.73
cv.88	20	21-24	23.5±0.22	0.75

Table IV. Chromosome associations at metaphase I in triploid cultivar (cv. 110).

Associations	Combinations observed						Total number	Average number
Trivalents	11	10	9	9	8	6	390	9.75±0.41
Bivalents	—	1	2	1	3	5	46	1.15±0.40
Univalents	—	1	2	4	3	5	58	1.45±0.71
Number of cells	16	8	6	4	4	2	40	—

Table V. Meiotic analysis of some tetraploid species cultivars of **Amaryllis**

Amaryllis	Chromosome associations: Quadrivalents Range	Quadrivalents Mean	Bivalents Range	Bivalents Mean	Univalents Range	Univalents Mean	Xta frequency per cell
Tetraploids species:							
vittata	6-11	9.4±0.61	2-1	3.2±0.20	—	—	48.0±0.46
belladonna	8-10	9.2±0.19	2-6	3.6±0.41	—	—	45.0±0.29
Tetraploid cultivars:							
cv.16	7-9	8.8±0.79	4-8	4.4±0.17	—	—	46.8±0.24
cv.25	3-9	7.0±0.37	4-16	8.0±0.11	—	—	41.0±0.27
cv.21	4-8	6.2±0.46	6-14	8.6±0.25	—	—	47.5±0.40
cv.8	2-11	6.1±0.21	2-18	9.8±0.26	—	—	45.0±0.51
cv.39	2-11	5.6±0.26	2-18	10.8±0.61	—	—	44.3±0.62
cv.35	4-6	4.75±0.32	9-12	10.5±0.26	2–6	4.0±0.20	42.0±0.39
cv.1	3-4	3.4±0.43	12-14	13.0±0.34	4–6	4.4±0.18	40.0±0.21
cv.2	2-4	2.8±0.18	12-15	13.2±0.13	4-8	6.4±0.40	37.6±0.19

GILLIESIEAE LACK ALLIACEOUS SCENT

Under date of December 19, 1976, Dr. Otto Zoellner writes from Chile that he is familiar with the Genera *Gilliesieae, Miersia, Gethyum,* and *Ancrumia* of the Tribe Gilliesieae, and he has not observed the presence of the alliaceous scent in these plants. He has promised to send bulbs of *Miersia* sp.

3. GENETICS AND BREEDING

MORE POTENTIALS IN AMARYLLIS BREEDING

William D. Bell, *Miami, Florida*

SPECIES HYBRIDIZATION

Through the years, an amazingly diverse group of *Amaryllis* species has been described. It is equally amazing that with this wealth of diversity, so few of the species have been incorporated into the makeup of the commercial hybrids. But, most of the species are diploid whereas the widely available hybrids are nearly uniformly tetraploid, so a genetic barrier exists for the easy incorporation of new germ plasm. Triploid hybrids can be made and used for further breeding, but the genetic potential of the diploid species is diluted rapidly by this method (*1*).

Breeding among the species is easy. By ordinary refrigeration, freshly shed pollen will generally remain viable throughout the spring breeding season. The chief frustration is that most species have incompatibility factors in seed set, so a smaller percentage of successful crosses result than when pollinating the tetrapliod hybrids. However, by repeating the pollinations daily as long as the style remains firm, a success rate of over 50% can be achieved. When pollen can be obtained from more than one clone of a species, the success rate is even higher. Tetraploid hybrids can usually be self pollinated. Only a few species and species hybrids set seed in this way. Two examples are *Amaryllis reticulata* and *A. papilio,* but the hybrid between these species was self sterile.

Hybridization among the diploid species offers a number of advantages. Seeds are usually smaller than those of the larger hybrids, but if planted soon after ripening. flowering plants can often be obtained in 18 months. Space for breeding is usually at a premium, so a more diverse group of seedlings can be grown in the space taken by the larger hybrids. And, in a mass planting, the smaller hybrids are as showy as their larger counterparts. Even the windowsill gardener can be a successful plant breeder with the diploid *Amaryllis.* Many of the species hybrids can be flowered in a 4- or 5-inch pot. The Korsakoff hybrids (2) are ideally suited for this purpose.

Perhaps you may think that 2 or 3 years are too long to wait for the results of *Amaryllis* hybridization. The solution is a simple one. Start seedlings for 3 successive years. Or, obtain some started seedlings from an established breeder. This is a certain path to an addictive hobby. One cannot stop with the flowering of the first species hybrid. Freshly shed pollen is easily mailed and maintains viability when refrigerated on arrival, so the next step is to seek pollen from other breeders for your special hybrids. Contributors to PLANT LIFE are usually eager and willing collaborators in this venture. When a choice plant flowers, it can produce progeny a hemisphere away—by air mail.

It must be noted that a few species hybrids display low fertility and often will not set seeds. The cytology of this condition might provide us with clues to using these plants more efficiently in breeding. If scant pollen production is associated with the low fertility, one can often obtain good seed set by applying the pollen to a more fertile plant. If only a few per cent of the pollen grains are viable, these are often sufficient for good seed set whereas a like proportion of infertile ovules can result in abortion of the entire seed capsule. Because of this, one can sometimes get good seed yields on a tetraploid using pollen produced on a triploid. *Embryo culture* can sometimes be used to advantage to produce hybrids between 2 plants of low fertility.

The *Amaryllis* species offer excellent opportunities for the study of inheritance patterns. Traits of diploids are mathematically simpler to evaluate than those in a tetraploid population. Although there is some variability in species material, plants from wild sources are usually sufficiently uniform in genetic characters that some predictions can be made of traits expected in the primary crosses. With a record of the pedigree of the species hybrid, predictions can be extended to the following generation with some degree of accuracy. The unpredictable surprises add to the fun of plant breeding.

FLORAL PIGMENTS

Most floral colors in *Amaryllis* have been reported to be determined by the presence or absence of 2 anthocyanin pigments (*3*). These are the water-soluble pigments located almost exclusively in the epidermal layer of the floral parts. The cyanidin (pink to rose) component appears to be dominant over pelargonidin (salmon to scarlet), following the inheritance pattern reported for other plants (*4*). Expected classic ratios were obtained in crossing diploid *Amaryllis* with these floral colors. All of the primary crosses I have flowered of *A. reticulata* have had rose to rose-lavender flowers. Using pollen of a backcross, *A. reticulata* x 'Mrs. Garfield,' progeny produced from a salmon-flowered seed parent (Goedert's SA63-17) were pink or salmon in a 1:1 ratio. A sibling of this pollinator could yield all pink flowers or the same ratio in this cross. Since 'Mrs. Garfield' is a hybrid of *A. reticulata*, it appears that one of the other species in the background of this hybrid had the genetics for salmon flowers. Scarlet and deep rose are probably intensity variants of the identical pigments, but further evidence is required to substantiate this.

Yellow or green are the result of a different pigment system, plastids in the sub-epidermal 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 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 marking are logical choices for this breeding program. Preliminary evidence from crosses made by several breeders suggests that yellowness vs. greenness is not a simple dominant/ recessive inheritance pattern. Hybrids of *A. evansiae* x *cybister* generally have an overall color effect between the parent species. Among species to be considered would be *A. fosteri* and the others with bright yellow throats. Then, at least 2 generations will be required to minimize the anthocyanins (*A. evansiae* has the genetic potential for salmon flowers, but the pigment is restricted). However, delightful sunset combinations of the 2 pigment systems appeared in the cross (*A. evansiae* x *yungacensis*) x (*A. evansiae* x *cybister*). In *A. reticulata,* there seems to be a factor inhibiting plastid content in the inflorescence. A 10x or 20x hand lens is a useful tool for inspecting pigment distributions in the floral segments.

FOLIAGE

Foliar pigments in higher plants are surprisingly uniform in composition and proportions. The few exceptions in healthy plants are usually mutations with a lighter than normal green color. One can question the term healthy since these plants are, as a rule, less efficient in the photosynthetic process.

In*Amaryllis,* there is a species, *A. reticulata,* with leaves visibly a deeper green than other species. This appears to be a difference in leaf structure rather than pigmentation. This species has few, if any, stomata or pores on the upper leaf surface. All of more than a dozen primary hybrids of this species had stomata on the upper surface and were of the lighter green color associated with other species.

The white midrib leaf stripe of *A. reticulata* var. *stratifolia* acts as a simple dominant gene with modifiers for the shape and intensity of the stripe. One of the few species to produce seeds by self pollination, a selfed plant yielded progeny in the ratio of 3 striped: 1 plain green. In recent crosses, plants of this variety of the species, visibly similar for the stripe, yielded either 50% or 100% in hybrids. The primary hybrids also yielded 50% striped progeny when crossed with non-striped plants.

FLORET NUMBER AND THE SCAPE

Higher floret number appears to be dominant, but not inherited as a simple trait in the classic ratios. Useful here as breeding material for high floret number are such species as *A. cybister, A. fosteri, A. angustifolia* and *A. reticulata.* Even the second-generation hybrids of *A. cybister* tend to retain the high floret number. In 30 of the latter involving other species which usually have only 2 florets, only 4 had the low floret number.

A trait considered undesirable for pot plants is the long scape length found in species such as *A. cybister, A. angustifolia* and *A. fosteri.* The hybrids *A. evansiae x cybister* had the tall scapes of *A. cybister,* but succeeding generations of these varied in scape length. Again, no clear pattern of inheritance was noted.

Flowering season also appears to be controlled by multiple factors. But, with pollen storage and the occasional off-season bloom, hybrids can be made with the few which are autumn flowering with the vast majority which flower during the spring months. Hybrids of *A. reticulata* are useful for autumn flowering (5) but seem to inherit the lack of hardiness of this species. I have recently crossed a hybrid of *A. reticulata* with a hybrid of *A. aulica* in an attempt to recover autumn flowering in a more hardy background.

The species have definite adaptations to flowering during the optimal environmental conditions in their native habitats. Among crosses involving species which flower during dfferent seasons, we can expect to find plants which will extend the flowering season. Again, several generations may be required to obtain the proper combinations. This may also be the path toward repeated flowering during a single season. Carbohydrate storage in the bulb is usually adequate for more than one flowering per season.

Related to the flowering season is the selection which has taken place in the breeding of existing hybrids. Most hybrids of European origin have been bred for relatively cool greenhouse conditions. These hybrids and some of the species probably do not receive enough winter chilling for reliable flowering in areas like South Florida. An objective in a breeding program must be a selection among hybrids for local growing conditions.

Nodding or down-facing florets probably protect the pollen and stigma from rain in the native habitats of species which display this trait. However, this is not considered desirable in pot plants if it can be eliminated by breeding. This is a characteristic of *A. reticulata* and, unfortunately, of many of its hybrids. But, selections which are 1/4 cr 3/16 *A. reticulata* have some of the desirable traits of this species with flat-facing florets.

GENERAL CONSIDERATIONS

Polyploid induction must be encouraged. Many attempts resulting in failures are probably because the treated material was already tetraploid! The large tetraploid hybrids came about through the use of natural tetraploids, but as noted earlier, this excluded much diploid germ plasm from the gene pool of these hybrids. It is worth repeating that much of the genetic potential of the diploid species remains to be utilized.

Primary crosses are sometimes a disappointment. After waiting perhaps 3 years for flowering, anticipation has risen to lofty heights. This has been especially true of hybrids of *A. evansiae.* This species has factors which seem to dilute the anthocyanins of other species. Remember, though, that such hybrids have the breeding potential of the parent species plus the recombination of their traits.

A breeding plan which I favor is to cross species *a* with *b* and *a* with *c*. Then cross (*a* x *b*) x (*a* x *c*). If species *a* is *A. angustifolia,* this tends to concentrate a desirable trait such as the *Sprekelia*-like floret in a new background with hybrid vigor and adaptions to new growing conditions. This may be quite important in species like *A. angustifolia* because this species seems to be nematode susceptible. Primary hybrids of this species can be flowered with comparative ease, but few growers have flowered the true species. Such a plan seems suited for breeding for the showy blotch of *A. papilio.* The plan might be for more than 2 florets per scape and different colors of the floral marking.

The plea must be made to maintain the species in their original forms. Hybridization tends to concentrate some germ plasm while some is lost, especially through inbreeding. It is important to maintain more than one clone of a species so that, if necessary, the species can be seed propagated to eliminate virus. The amateur gardener can help to maintain the species. I was unsuccessful in locating a source of *A. andreana* in Colombia and understand that other species may soon no longer exist in their original habitats. We take almost for granted that our food crops will always be available at the local market. But germ plasm resources have saved our major grain crops on a continuing basis. Our conservation efforts must also include our ornamentals before it is too late.

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A VARIEGATED **ALSTROEMERIA LIGTU**

DONALD D. DUNCAN, *Chairman, Alstroemeria Committee, R1, Box 309, Sumner, Washington 98390*

Two years ago in a group of *Alstroemeria ligtu* hybrid seedlings I spotted one that appeared to have variegated foliage. This seedling was later planted out in the ground and well marked in order to keep track of it. The plant continued to grow and produce more variegated leaves through that first season but did not flower.

This past spring I anxiously waited for the first leaves to push through the cool damp earth. To my delight the plant was even more beautiful than the year before. The foliage stems, that appear first, were much more abundant this year and the edge of each leaf was marked with a narrow band of creamy-white, making a very attractive and unusual sight.

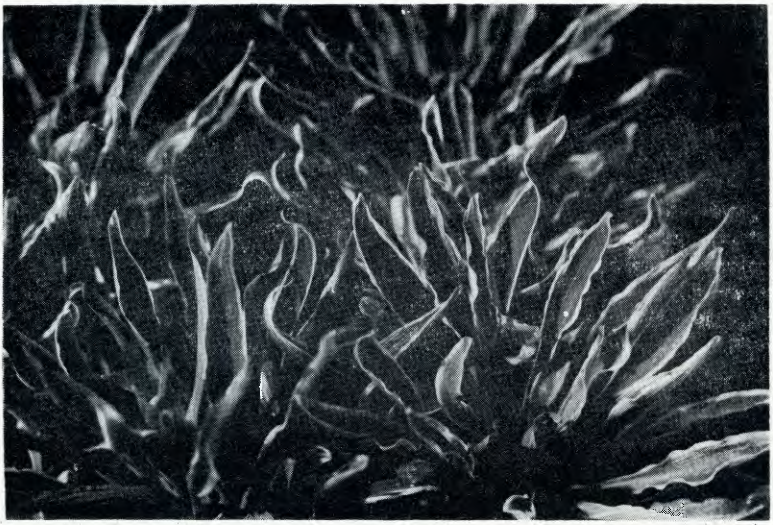

Fig. 17. A variegated form of **Alstroemeria ligtu.**

The leaves on the flower stems that popped up a few weeks later showed no variegation at all. The flowers that were produced looked normal in every way, showing no signs of variegation, streaking, or mottling. The color of the flower was a medium pink, pretty, but of no special merit. It set a fair number of seed this summer and I am eager to learn whether or not the progeny will exhibit the same variegation.

I feel that there must be many of you growing Alstroemerias who have also had interesting and unusual variants in your seedlings and I would greatly like to hear from you. Also, I wish to hear from more of you who are growing various species of *Alstroemeria* so that I can compile a list of *Alstroemeria* species in cultivation. If you do not know what species you are growing, please write anyway and describe the growth habit, type of flower, color, blooming time, etc. If possible, include a photo and/or a pressed specimen of the foliage and the flower and I will do my best to identify it.

ALSTROEMERIA X DAVISIAE

DONALD D. DUNCAN, *Chairman, Alstroemeria Committee, R1, Box 309, Sumner, Washington 98390*

After several years of trying to cross *A. pelegrina* and *A. pulchella,* I have been successful. The resulting hybrid is a robust plant with a flower of good color, substance, and size.

This beautiful new flower is being name *Alstroemeria* x *davisiae* in honor of Catherine Mills Davis of St. Paul, Minnesota, who has been a life long plant lover and active garden club participant. Her son and

Fig. 18. **Alstroemeria x davisiae. (lower left and right)**, a cross between **A. pulchella ♀ (upper left)** and **A. pelegrina ♂ (upper right)**. Reproduced from color photos.

daughter-in-law, Mr. and Mrs. Frederick W. Davis, are close friends of mine and have given me much help and encouragement over the years.

The flower is approximately 2 inches (5cm) long and 1⅜ inches (3.5cm) wide. It is a blending of both parents, taking on much of the color of *A. pelegrina* and the spots and streaking of *A. pulchella.* It is much less tubular than *A. pulchella* but not nearly so spreading as *A. pelegrina.* The color of the flower is nearest to 69-A (red purple group) with the blotch on the two outer petals being nearest to 73-A (red purple group) and the upper two petals show a pale yellow blotch close to 8-C (yellow group), when compared with the Royal Horticultural Color Chart.

The plant itself, grown in a ground bed in a fiberglass greenhouse under cool house conditions, reaches a height of 3 feet (91 cm). I have yet to test *A.* x *davisiae* outside and realize that the color, height, and hardiness have yet to be determined in the open. It would seem safe to assume that in mild climates it would survive most winters. Within the next few years the plant will be tested outside.

Fig. 19. **Amaryllis** hybrid, clone 'Osceola'; apparently of **Amaryllis reticulata** L'Herit. ancestry (the other parents involved unknown) which blooms in February and again in June—a repeat-bloomer.

A REPEAT BLOOMING HYBRID **AMARYLLIS**

MRS. GLADYS HURT JONES, *308 Barbourville Drive, Tallahassee, Florida 32301*

I was first introduced to benlate by Mr. Eugene Ellis of Tallahassee Nurseries. In 1972, he advised that I use a combination of benlate and isotox to spray my roses for fungus and insects. The solution worked so well, I began using benlate for many of my flower problems. One of my *Amaryllis* flower scapes was almost eaten through with red blotch. I made a paste of benlate and water and painted the spot. The disease was halted and the seeds grew to maturity. I dusted a bulb with benlate-rootone mixture, after it lost its root system through my faulty watering habits and the bulb began growing again. In 1975, I decided to try and grow Tall Bearded Irises, which normally do not grow in Florida. I am using the benlate solution on them and am obtaining good results.

Through routine buying, I purchased a Dutch Hybrid *Amaryllis* which blooms in February and repeats in June. That following February after my purchase, the first scape was blown away from the plant during a thunderstorm. The bulb was planted under a tree and the scape was tied to a stake. The *Amaryllis* failed to bloom that February but bloomed instead in June. I thought this to be unusual, but assumed that the bulb would be back on schedule the next year. Instead, for five consecutive years, the bulb *bloomed both in February* and *in June.* There are two scapes in February and in June there is usually one scape, except one summer, there were two. The Amaryllis has also produced one bulblet which reblooms. My daughter says that perhaps lightening struck the bulb and resulted in a mutation, which causes it to rebloom. Is an *Amaryllis* which blooms twice a year a natural rebloomer or mutation? I have crossed the bulb with many other named Dutch Hybrids, back crossed and selfed. Not yet being able to determine whether any of the crosses that I have made will be rebloomers (the bulb must reach maturity before it reblooms), I have made preparation for the task of cuttage by cutting several bulbs.

I did study botany in high school and college, but had forgotten so much. With the help of Dr. Bell, Mr. Doran and Dr. Whitaker, I was able to perform the above experiments. I wish to thank Mr. Doran and Dr. Bell for the plants and many seeds they sent to me.

SHIELDS—**HYMENOCALLIS CULTURE**—continued from page 80.

If so, they are both probably from the same clone; and perhaps this is a case of either self-sterility or of a sterile clone. Accordingly, anyone who would be willing to provide bulbs of *H. amances* clones known to be of wild origin, or to provide pollen of such clones in season, is urged to contact the author. Is it really necessary that a beautiful flower like *H. amances* remain so rare in our gardens?

4. AMARYLLID CULTURE

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

MEET THE AMARYLLIS

Charles B. Ledgerwood,
3862 Carlsbad Blvd., Carlsbad, Ca. 92008

During my High School years I became interested in Horticulture and promptly decided that some phase of plant culture would be my life work. From my home in South Pasadena I would take trips around Southern California to visit nurseries and flower farms that I had learned about from magazine and news reports. On one of these trips in 1922 I was deeply impressed by the beauty of a 4 acre field of *Amaryllis* in full bloom in Montebello, grown by the Howard & Smith Nurseries. That was the beginning of a life long love for what I considered to be the "King of Flowers."

In my early years I was employed in the flower seed and bulb department of a large Los Angeles seed firm, and later as a plant breeder for a large canning company. Then followed 43 years in my own seed and farm supply business during which time I always had some *Amaryllis* among my seed fields.

In the 1950's I became interested in photography as a hobby and built several motion picture processing machines during the following years. As my love for *Amaryllis* became rekindled it was only natural that the two hobbies of *Amaryllis* growing and collecting and motion pictures should be wedded into a burning urge to make a film about the subject of *Amaryllis*.

In 1968 I undertook the production of a film that has turned out to be the most popular one that I ever produced. "Waltz of the Flowers" illustrated through time lapse photography the rhythm of plant growth and matched the movements of plants and flowers to the rhythm of the waltz and ballet. It has been shown to Garden clubs, schools, nature groups, service clubs and others for years and receives an eager response wherever shown.

Since movie makers are always on the prowl for good subject matter, the success of "Waltz of the Flowers" turned my thoughts to the making of a film about the *Amaryllis* family of plants and so I started in earnest to collect specimens suitable for time lapse photography. Plants for this work must be grown in pots and since many Amaryllids bloom well when pot bound it was not too difficult to get subject material. When ready to bloom the potted plants are brought into the dark room where completely controlled light conditions can be maintained day and night continuously for weeks at a time. When making "Waltz of the Flowers" I learned that many plants simply will not bloom under photographic light conditions. Gloxinias, purple Wandering Jew, and squash were notable in this regard. During the many years that I grew Zucchini squash for seed I was always impressed by the delicate beauty of the Zucchini flowers in the light of the early sunrise. In a matter of a few hours this beauty faded and withered away in the heat of the morning sun.

I thought I might capture this show in time lapse, so I grew some Zucchini plants in 5 gallon tubs. When they started to bloom I brought them into the dark room and set the camera and lamps to record the blooming process. But as soon as the photo lamps came on, for only 8 seconds out of each 6 minutes interval, the flowers shriveled and curled and died.

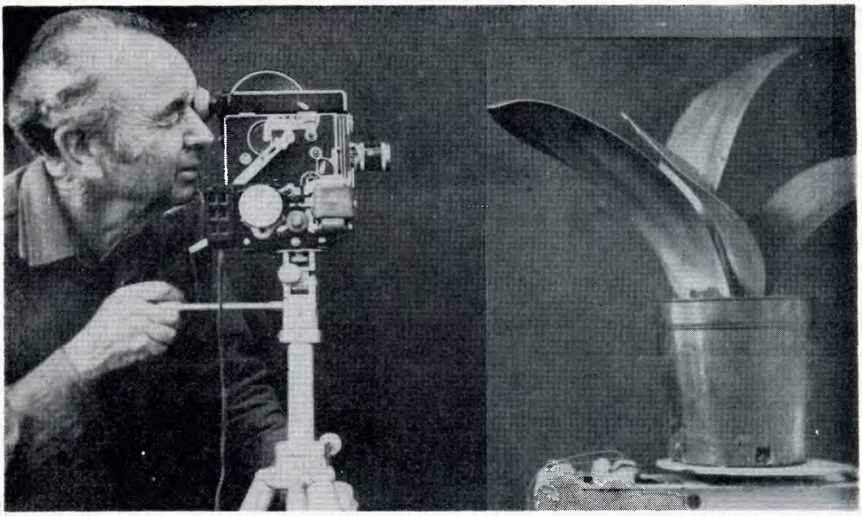

Fig. 20. **Belex Rex 4 Camera** with wide angle lens and **Stevens Interval Timer** set to take a picture every 6 minutes to study growth of **Heamanthus coccineus.** Camera with Stevens Interval Timer can be used to film plant on an electrically operated **turn table** to view all angles of plant as it **grows,** flowers and sets fruits containing seeds.

Amaryllids seem to enjoy the light of photo lamps, and I have not had trouble with the natural blooming of any specimens under these conditions. Many interesting features of plant growth can be closely watched on the screen since most plants grow so slowly that their changing development can not be given comparative observation day and night. Under time lapse the growth time is speeded up damatically. My Stevens Interval Timer (Fig. 20) is always set to take one 16 mm frame or picture every 6 minutes. When the same film is shown on the screen it runs through the projector at the speed of 24 frames per second. This action compresses 24 hours of plant growth into 10 seconds and gives graceful movements to flower opening. Many unexpected movements occur as in the proud gestures of day lilies and the ballet like swell of *Iris* petals. A pot full of various colored Tigridias flowers opening, swelling and closing in unison is a breathtaking sight. The graceful flare of the *Hibiscus* as the petals wave in waltz time and the intermittent opening and closing of *Ranunculus* in perfect rhythm day and night, the gentle sway of Anemones nodding from side to side all add to the wonder and beauty of the plant world.

Music and plants seem in complete accord. Easter and other Trumpet lilies swell to the sweet strains of trombone soloist and band playing "Ave Maria". Godetias open and close like swirling ballet skirts to the tune of "Les Sylphides". *Billbergia* petals curl and recoil and *Amaryllis* pollen sacs split and reverse in harmony with a Chopin Etude. *Philodendron* leaves sway and shake open their tightly packed folds to the lilting tunes of the waltz.

Presently I am working on "Meet the Amaryllids", in which all the actors are specimen potted plants of the *Amaryllis* family. Beset by seemingly endless failures—wrong exposures, flowers that grow out of the expected picture area, lamps that burn out during the photography of an irreplaceable specimen, wrong filters or errors in lighting color, or lamps that fade in color during a run, all make time lapse films many times more difficult than straight camera run motion pictures.

The difficulty in acquiring specimens and the lack of communication between those who grow *Amaryllis* for sale are also serious drawbacks. Another problem for me has been in getting potted specimens to bloom at all. I still need better pictures of Nerines, *Agapanthus, Crinums, Galanthus, Griffinia, Haemanthus, Hymenocallis, Ismene, Ixiolerion, Leucocoryne, Leucojum, Pancratium, Pyriolirion, Vollata* and *Worsleya.* Many of these above named are in my collection but have not bloomed, others, such as *Worsleya* and *Vollata* rot soon after I plant them, and for many others I have not found a source of supply. The high cost of specimens is certainly a deterrent to increasing my collection, but I buy them as funds are available if and when I can find them. I would appreciate receiving catalogs and price lists from any growers who have various Amaryllids for sale.

There are many faces on the cutting room floor of Amaryllid flowers that didn't pass inspection, but when the last trumpet blares to the opening of *Cyrtanthus lutescens* the garden clubs of Southern California will have a chance to view the results of an engrossing hobby.

1976 ZEPHYRANTHEAE REPORT

Mrs. Marcia Clint Wilson, *Chairperson, Zephyrantheae Committee, 255 Galveston Road, Brownsville, Texas 78521*

It is difficult to begin a report when my own collection of Zephyrantheae has performed so poorly. The last of my Galveston Rain Lilies were dug in February '76 while I was in town to move my furniture. All of the labels that had been buried in the ground with just the tip showing were in good shape. They had been marked with a plastic label maker and a soft lead pencil. The charts I had kept on all bulbs planted in the ground were a great help in identifying the few bulbs with missing labels. I did have one upsetting experience for which there is little help. Before the soil was settled in one box of one-of-a-kind hybrid bulbs, a dog dug from one end of the narrow area to the other. I now have a large garden plot that is fenced from rabbits and dogs, but hesitate to use it for bulbs until my schedule permits regular weed control.

For those of you who are looking for inexpensive containers, visit a busy aquarium shop. Tropical fish are usually shipped in styrofoam boxes that are ideal for growing a number of small bulbs. The ones I found measured 16″ x 16″ and were sold for fifty cents each. Thad Howard has had great luck with these and he uses the lids for cold protection. His initial experience with aquatic plants has been equally good. He makes no drain holes and keeps about an inch of water above soil level.

John D. Fellers of Mobile, Alabama is collecting and studying the numerous forms of *Z. atamasco* from different localities. His hybridizing work is well underway with a 1967 X Sydneya (*Z. atamasco* x *H. robustus*) and various other crosses using special forms of *Z. atamasco*. A 1971 *Z. atamasco* x *zephyranthes* sp. gave him four scapes from one bulb that were most interesting. The flowers were somewhat *Habranthus*-like with some nodding or trumpet shape and anthers which appeared to have a 3/3 configuration. Hybridization is an important tool in studying relationships among species and between closely related genera. *Zephyranthes albiella* has flowers that are slightly nodding and filaments of several lengths and I am sure that there are more *Zephyranthes* species that share one or more *Habranthus* characteristics. The late Alex Korsakoff used another eastern U. S. native, *Z. simpsonii* as both seed and pollen parent. A bulb of his *Z. clintiae x Z. simpsonii* bloomed for the first time and it was an astonishingly beautiful peppermint stripe of dark rose and rose red. The rather large flower was normal in all respects; so I'm hoping that the pronounced two-toned effect is permanent. The bulb that bloomed was quite large. Is it going to take a forced rest period to bloom some things?

CRINUM SEEDS AND BULBS NEEDED FOR CANCER STUDY

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

The National Cancer Institute is urgently in need of 3000 or more *Crinum* plants (bulbs). The type specified is 'Milk and Wine' but since this name is so vague and applies to *C.* x *herbertii, C. zevlanicum* hybrids and other forms common to Florida and the Gulf we are uncertain as to what form is desired or if this makes much difference.

For many years it has been known through tropical Africa that *Crinum* juices were particularly effective in curing tropical sores. In fact the Portuguese explorers learned this when they started exploiting the African Gold Coast back in the early Sixteenth century. When placer gold was found near Sao Paula and Rio Janeiro toward the end of the sixteenth century Gold Coast negroes were taken to Brasil to work these placer deposits. Their local food and medicinal plants were also taken to Brasil and this included *C. jagus* (Syn *C. giganteum*) where it became an escape. The same plant was also taken to Goa, India and into the Malay area as well as the Philippines due to its curative values. As a consequence several variants are scattered widely through the tropics.

Similarly, *Amaryllis evansiae* has been found to have tumor inhibiting properties. Possibly Beltsville, Md. can give us more information on their discoveries. All in all it is particularly interesting that the medicinal benefits of the Amaryllidaceae have been recognized and it is possible that the entire group may be subjected to extensive research.

POT CULTURE OF **AMARYLLIS AGLAIAE**

JOHN M. CAGE, *1041 Ruth Avenue, Yuba City, California 95991*

In a personal communication, Leonard Doran noted that *Amaryllis aglaiae* tends to set its bulb deeply in the ground and therefore is difficult to grow well in conventional pots. Mr. Doran had cleverly used a length of clay drain tile as a pot in his glass house to produce satisfactory bloom on this species. In ordinary pots, the bulbs would pull themselves to the bottom and produce offsets instead of blooms.

It seemed that *A. aglaiae* needed to be planted very deep to bloom well, but I conceived another possible explanation of the observed behavior. Perhaps. I reasoned, the bulb of the species did imbed itself deeply, but perhaps the poor bloom in pots was caused by something else. Maybe a bulb growing at the bottom of a pot simply did not have enough room underneath for good root growth.

To test my idea, I placed enough growing medium in a plastic one-gallon nursery can to leave about 2-5 inches of space at the top. Then I cut a disc of ⅜-inch galvanized hardware cloth (wire mesh) and laid it on top of the soil. Next, six *A. aglaiae* seedlings were planted on top of the wire mesh in more soil, with irrigation space at the top.

In less than two years, the plants bloomed very well indeed, and the bulbs were still near the surface of the soil. They could not dig themselves through the strong metal mesh, but their roots were not impeded. Now, another season later, the bulbs are still barely covered, and they are quite large and healthy.

Several other *Amaryllis* species, as well as other amaryllids, have the undesirable tendency of growing at the very bottom of pots. I hope that other growers will test the technique described above on some of these stubborn deep-diggers. A few candidates that come to mind are *A. reticulata, A. parodii,* and some of the rain lilies, as well as *Hymenocallis.*

I have observed, however, that a long neck on a species does not *necessarily* indicate that it wants to grow far below the soil surface.

For instance, *A. pardina, Amaryllis calyptrata, Worsleya rayneri* (the Blue Amaryllis), and similar species seem content to stay at the surface, even though some have fine long necks.

HYMENOCALLIS CULTURE IN INDIANA

James E. Shields,
7229 Wynter Way, Indianapolis, Indiana 46250

For the past several years, a number *Hymenocallis* species have been grown with some success in central Indiana. Two methods have been used, depending on the requirements of the particular species. The first type to be tried was the ubiquitous commercial variety 'Festalis', and it was grown by the so-called "gladiolus culture" method. That is, the bulbs are planted in late spring or early summer and dug in early fall, to be stored bare through the winter in open boxes at 55° ± 5°F. Under this method, 'Festalis' has increased so rapidly that many smaller offsets are discarded annually due to lack of garden space and lack of takers among the author's circle of gardening friends.

This same cultural technique has been found to work well for *H. amances*, 'Helios', *H. longipetala*, and 'Pax' The species *H. acutifolia, H. eucharidifolia, H. glauca* (Zucc.) Roem., *H. horsmanii, H. littoralis, H. occidentalis*, and *H. riparia* have done less well when grown in the above manner. For some of the these, a second method has proved somewhat better, as described below. For a few, such as *H. horsmanii, H. littoralis*, and *H. riparia*, no method is totally satisfactory here.

The evergreen forms *H. caribaea* and 'Tropical Giant' are grown the year round in pots, with very infrequent repotting. The plants are grown in full sun from late spring till cool weather returns in autumn. They are then stored at about 50-60°F at west windows. Relatively little water is given during storage. The older leaves gradually turn yellow and dry out, but these two forms invariably retain some live foliage throughout the entire period of dormancy.

Several of the previously noted deciduous species seem to do best if grown in pots year round. They do not, of course, require light during storage. This group includes *H. acutifolia, H. azteciana, H. eucharidifolia*, and *H. glauca*. The last three species are, however, repotted every year or two. *Hymenocallis acutifolia* have not been disturbed in their pots for several years now. A few seedlings of *H. acutifolia* are handled by the "gladiolus" method, due to space limitations, and they are not so vigorous as their constantly potted siblings.

Seedlings of the collection No. 74-40 (Bauml, tentatively identified as *H. latifolia*) did less well kept in pots than those stored bare. These plants are still too small to bloom, so definitive conclusions on their culture in this area must wait.

The bulbs of *H. graminifolia* are so small that they are grown in pots in spite of the fact that it appears as if they might prefer "gladiolus" culture. They could too easily be overlooked in the haste of the fall digging season. The species *H. liriosme* is kept potted, but unlike the others, it is never allowed to remain completely dry for any extended periods. The pots are kept in plastic buckets during the growing season, and some water is usually kept standing in the buckets. Results are equivocal—one successful scape in 1975, none in 1976. Advice from other growers of *Hymenocallis liriosme* is earnestly solicited.

FERTILITY

Very few types of *Hymenocallis* have set seed reliably as grown here. Only *H. acutifolia* and *H. eucharidifolia* do so regularly. The small species *H. horsmanii* did so just once, and that was fortunate. The mother bulb subsequently died, and only those seedlings survive to represent *H. horsmanii* in the author's collection. They are still quite small, and are kept continuously potted. The species *H. acutifolia* appears to be apomictic. Usually, seed are set without the intervention of the author; but on one occasion, a pot of *H. acutifolia* bearing a new scape was brought indoors. As the florets opened, they were pollinated with fresh pollen collected from 'Festalis Zwanenburg' growing in the garden. Two seeds were obtained, and these two both yielded plants which appear indistinguishable from the pod parent.

Attempts to set seed on *H. amances*, 'HELIOS', 'FESTALIS', *H. caribaea, H. longipetala,* 'PAX', and 'TROPICAL GIANT' have been uniformly unsuccessful. Here, too, the author would be grateful for suggestions from growers who have achieved successful hybridizations with *Hymenocallis.*

NEW DIRECTIONS

Following the suggestions of various persons recommending that one should attempt to utilize the late Len Woelfle's method of leaving *Hymenocallis* bulbs permanently planted outdoors (next to the foundation on the southern exposure of his house in Cincinnati), a few bulbs of 'Festalis' were planted next to a permanent clump of *Tigridia,* close to the southeast foundation of the house. These plants bloomed after two winters in the ground! The last two surviving bulbs of *H. occidentalis* were therefore planted nearby. Their foliage came up late in the summer, and was still green in mid-November after several days of 20-degree weather. The adjacent leaves of 'Festalis' were already dead. Just to be extra safe, the ground there has been mulched with oak leaves. Perhaps the *H. occidentalis* will survive here too.

The rather delicate species *H. amances* thrives here on "gladiolus" culture. The bulbs are plump and getting bigger, and they bloom reliably each summer. So far, however, they have shown no tendency to produce any offsets. These plants were obtained from a well-known dealer in rare bulbs, and may have originated in Holland, by cuttage.

SHIELDS—**HYMENOCALLIS CULTURE**—continued on page 73.

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EDITED BY

Hamilton P. Traub

Thomas W. Whitaker

Harold N. Moldenke

THE AMERICAN PLANT LIFE SOCIETY

Box 150, La Jolla, California 92038

POLIANTHES X BLISSII WORSLEY

THAD M. HOWARD, *13310 San Pedro Av., San Antonio, Texas 78216*

Mr. Luther Bundrant, of Texas, recently repeated this cross which from information received from Mrs. Susan Verhoek Williams was first made by the late Arthington Worsley (J. Roy. Hort. Soc. *36*: 603-605). It is a hybrid between *Polianthes geminiflora* x *P. tuberosa.*

This hybrid is essentially intermediate between its parents, having the delicious fragrance of *P. tuberosa* combined with the rich rose pink color of *P. geminiflora* (Bravoa geminiflora). The hybrid has been made on still another occasion. Richard E. Harrison in his book A HANDBOOK OF BULBS AND PERENNIALS FOR THE SOUTHERN HEMISPHERE, written for New Zealand and Australia spoke of such

Fig. 21. **Polianthes** x **blissii** Worsley, a cross between **P. geminiflora** ♀ and **P. tuberosa** ♂. Reproduced from color photo.

hybrids having once existed when he said "Hybrids have been raised with the tuberose (and Bravoa), but these seem lost to cultivation" (1963). Some coloured forms of the popular scented tuberose would be a great asset; Perhaps someone will again attempt to cross them again in this country (New Zealand).

The writer once discussed this possible hybrid with Luther Bundrant, and he was enthusiastic to begin such a project as he especially favored the scent of tuberoses. Supplied with living material of P. geminiflora, he embraked on a large program of hybridizing various new *Polianthes* species with the tuberose and with one another. The main objective was to create colored flowers having the tuberose fragrance.

In only two years he has flowered the first of these hybrids. There are many new seedling combinations now growing and soon we may be flooded with a myriad of new *Polianthes* hybrids. *Polianthes tuberosa* not only crosses freely with other *Polianthes,* but also with *Manfreda* and *Prochnyanthes.* Mrs. Susan Verhoek Williams, currently monographing *Polianthes* and *Manfreda,* has flowered a cross between *Manfreda virginica* x *P. tuberosa.* The hybrids are said to be fragrant, but with greenish flowers. The plants previously known as the genus *Brovoa* have been united with the *Polianthes* section, and this seems logical and is supported by the finding of much new material in recent years.

History of Luther Bundrant cross:

Summer 1974—pollenation program begun. Polianthes tuberosa was attempted on all flowers (10 scapes), of *P. geminiflora.* A total of six seed pods were obtained, one was insect damaged. Three pods on one scape, two pods on another, one pod on the third. 25 Aug. 1974—Thirteen seeds were planted from two pods of one scape. Seeds began germination in ten days. 23 Sept. 1974—ten seeds have germinated, all of which bulbs still survive (1976). 2 Oct. 1974—39 seeds planted, 22 bulbs surviving (1976). (described flower from this group).

1976—Total of 32 bulbs in growth. 4 Aug. 1976—First scape identifiable at about 15cm height. 25 Aug. 1976—First flower opened. 31 Aug. 1976—Second scape in group emerged from crown. 9 Sept. 1976—Last (26th) flower opened.

An equal number of the reverse cross were attempted with no success.

Polianthes x **Blissii** Worsley

J. Roy. Hort. Soc. 36: 603-605.

DESCRIPTION.—Flower began opening at 5:00 o'clock p.m. CST 25 August 1976. Paired, tilt upward at 30 - 45 degrees from horizontal. Lower half of tube curved on a 2.5 cm to 3.8 cm radius, upper half straight. Tube 2.8 cm long. Tepals 0.6 cm long uniting to form a tube. Ovary 0.6 cm long. Pedicel 1.2 cm long. Flare of tepals 1.1 cm to 3.8 cm.

Flowers are uniformly colored dark pink (reddish pink) throughout with very fine ivory stippling, slightly glaucesent exterior, interior is pinkish ivory. Another closely clustered together at top of tube interior extending to tepal end of tube. Pollen bright yellow. Fragrance is like P. tuberosa but slightly less intense.

Floral bracts one per pair of flowers, 0.3 cm at base tapering 0.6 cm to 1.2 cm to acute point. Base colored pink to white, tip green.

Scape 1.2 m long, flowers paired radially with second set (buds) 8.9 cm above first flowers. Scape from crown to first flowers 0.9 m. Total of 27 flowers and buds.

Thirteen leaves in rosette, 1.1 cm to 1.7 cm wide and 45 cm to 55.5 cm long, the more narrow leaves being longer and younger. All leaves channelled, but the younger leaves channelled more deeply than the older ones. Moderately dark dull green. The typical leaf tapers from midway (widest point) to an acute point. Leaves semi-erect, stippled reddish to reddish-brown on lower surface to 1/3 their length, upper surface of this individual is not stippled.

SPECIMEN: *Polianthes x blissii* Worsley, No. 1133 (TRA)

PLANT LIFE LIBRARY—continued from page 30.

American Edition, and a General Preface. The main body of the book is in two parts. **Part I** is devoted to the design and running of greenhouses, giving complete details from site selection to vegetative propagation. **Part II** is concerned with the growing of plants in greenhouses, including vegetables, ornamentals, cacti, ferns, and alpines; and control of plant pests and disorders. An appendix and index complete the volume. Highly recommended to all greenhouse gardeners.

SMALL FRUIT AND VEGETABLE GARDEN, by Jacqueline Heriteau. Sterling Publ. Co., 419 Park Av. So. New York, N. Y. 10016. 1975. Pp. 192. Illus. Trade Edition $4.95. The author recommends not to "overlook any space, no matter how unlikely for starting a garden." The book is in four parts. **Part I** deals with little gardens for food, the space required, climbers, hanging baskets, miniature vegetable and fruit gardens, and planting plans. **Part II** is devoted to soils, watering, weeding, mulching and tools. **Part III** is in the nature of a dictionary of food plants for early, mid and late spring; herbs in small places and orchard and bramble fruits. **Part IV** concerns the matter of keeping the garden healthy. Recommended to those who must do with small garden spaces.

STARTING FROM SCRATCH: A GUIDE TO INDOOR GARDENING, by John Whitman and Mary Mcguire. Quadrangle/New York Times Book Co., 10 E. 53rd St., New York, N. Y. 10022. 1976. Pp. ix + 211. $8.95. This book has been written for the beginning gardener. The first part of the text is devoted to plants easiest to grow (Chapter 1); plants somewhat more difficult to grow (Chapters 2 and 3), and plants such as bananas, lychees, etc., exotics, delicate plants that demand patience and skill to maintain (Chapter 4). The final part is concerned with basic questions about successful gardening (Chapter 5). Recommended to beginning gardeners.

FOREST AND GARDEN, by William H. White, Jr. Sterling Publ. Co., 419 Park Av. So., New York, N. Y. 10016. 1976. Pp. 96. Illus. Trade Edition, $4.95. This fascinating little book describes "the natural processes that create and maintain the forest, and the artificial techniques by which man creates and maintains the garden. He examines the typical life forms to be found in each habitat. The book is in five sections—**The Forest,** the plants and animals; succession; life cycle of the forest. **The Garden,** annuals and perennials; recycling animal matter, and fertilizers. **THE FOREST GARDEN INTERFACE.** Dwellers in the interface; interface flora. **SOME ANIMAL COMMUNITIES,** earthworms, molluscs, insects, arachnids and vertebrates. A brief section on **CONCLUSIONS,** and an index complete the volume. Highly recommended.

AN EARTHWORM IS BORN, by William White, Jr. Sterling Publ. Co., 419 Park Av. So., New York, N. Y. 10016. 1975. Pp. 80. Illus. $4.50. This fascinating little book describes the life cycle of the earthworm, its habitat, reproduction and life span; its anatomy, nervous and digestive, and circulatory systems; its ecology; and function in aerating the soil; the ingestion and digestion of decaying vegetative matter (humification); earthworm castings which are a factor in humus formation; method of observing earthworms, and raising earthworms. Everyone should be required to read this mighty little book to learn about the beneficent role the earthworm plays in the economy of nature. Highly recommended.

LYSINE SYNTHESIS PATHS AND THE BIOEVOLUTIONARY COURSE

Hamilton P. Traub

Abstract. (1) The available data on lysine synthesis paths DAP and AAA corroborate the Traub 1964 grouping of higher phylons of cellular organisms (cellular biology), requiring only a minimum of revision in details. (2) The untenable nature of the "Kingdom Protista or Protoctista" concept is revealed. (3) The segregation of the archi-, and meso-period eucaryotic heterotrophs (parasites and saprobes) of Subkingdom 1. *Plantae* under Subkingdom 2. *Mycotae* is no longer tenable since neo-period heterotrophs, *Cuscuta* (Dodder), etc., were formerly retained under *Plantae,* and archi-, or meso-period heterotrophs, Phylum *Hydotophyta,* are now recognized under *Plantae,* and the phototrophic Phylum *Euglenmycota,* has been placed under *Mycotae.* Other conclusions are included at the end of the paper.

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I. INTRODUCTION

This paper *(1)* is gratefully dedicated to the authors of the following cited papers,—R. Y. Stanier and J. S. Van Niel (*2*), R. Y. Stanier, M. Doudroff and E. A. Adelberg (*3*), H. J. Vogel, J. S. Thompson and G. D. Shockman (*4*) and R. Y. Stanier (*5*), whose scientific publications inspired the writer.

With still some *mediaeval* thinking about the subject of linoclassification (grouping) of living things on earth in the scientific journals, it is considered a duty to speak out for a return to the reality of science in the field of *lineagics.*

Due to space limitations, the following historical review is not exhaustive, and emphasizes some high lights. By the end of the 19th and the beginning of the 20th centuries, the grouping of organisms had reached a standardization of sorts as shown in Grouping No. 1.

GROUPING NO. 1

Kingdom 1. **Plantae.** According to the Bergen & Davis 1906 outline **(6)**
- Division 1. Thallophyta: algae, including the Blue Green Algae, Fungi and Bacteria.
- Division 2. Bryophyta
- Division 3. Pteridophyta (ferns)
- Division 4. Spermophyta (gymnosperms and angiosperms)

Kingdom 2. **Animalia.** According to the Thomson 1895 outline **(7)**
- Subkingdom 1. Protozoae
- Subkingdom 2. Metazoae

The workers with Kingdom *Plantae* (botanists) were often not on

* Numbers in parentheses refer to references and notes at the end of the articles.

speaking terms with those working in the field of *Animalia* (zoologists) and *vice versa,* and each was fighting to obtain exclusive right to deal with borderline groups. The zoologists had done a better job in grouping *Animalia* and the main groups were mostly established. The botanists were quite hazy about placing certain groups under *Plantae,* which included also *Fungi, Bacteria* and *Blue Green Algae.*

It had been known for a long time that there were two kinds of cellular organization—the *procaryotic* and *eucaryotic* types. However, the great significance of these facts was not realized and inaccurate grouping of organisms in part persisted.

Since the 1880's, attempts had been made to find out how the nucleated cell originated from the non-nucleated cell: in 1882, Schimper (*8*); 1890, Altmann (*9*); 1905, 1910, 1920, Meschkowsky, (*10, 11, 12*); 1907, Famintzen (*13*); 1927, Wallin (*14*); 1961, Ris (*15*); 1962, Ris & Plaut (*16*); 1963, Nass, M. & S. Nass (*17*); and 1963 Nass, S. & M. Nass *(18).* With none of these workers did this search become an obsession.

In 1937, Chatton (*19*) characterized the *procaryotic* and *eucaryotic* patterns of cellular organization. In 1956, Copeland (*20*) recognized *Procaryotae* under the term *Monera.* In 1957, Simpson et al, (*21*) adopted a three kingdom system—1. *Protista,* 2. *Plantae* and 3. *Animalia.* Their Kingdom Protista includes bacteria, flagellates, rhizopods, *Plasmodium, Ciliophera* (classes—Ciliata and Suctoria) and *Myxomycetes* (slime molds). The Blue Green Algae were placed under Kingdom *Plantae.*

In 1960, Cronquist (*22*) earned the distinction of placing the bacteria and Blue Green Algae at last in a single separate division under *Plantae.*

In 1962, Stanier and Van Niel (*2*) clarified the concept of the bacterium; in 1963, Stanier, Doudroff and Adelberg (*3*) published the stimulating second edition of *The Microbial World,* and suddenly the skies cleared with a full realization of the importance of the two cell types—procaryotes and eucaryotes.

In 1964, Traub *(23)* at last was able to envision the broad outlines of *earthbiology* as a whole, no longer in bondage to the mediaeval past, an ideal which he had been seeking for over a half century.

II. THE 1964 EARTHBIOLOGY HYPOTHESIS

Among the first attempts to bring the new outlook to bear in reconsidering the major phylons of living things on earth was that of Traub (*24, 23*) in 1963 and 1964. The solution would have to account for all living things on planet earth for the old fragmented method of presentation had stunted the outlook of the student in the primary, grammar and high school levels of education. Some students were exposed to only botany (an obsolete name for a confused outlook). Attempts to correct this condition spawned the movement toward presenting only texts in elementary biology below the college level, which was all to the good. This trend will have to be encouraged by presenting the whole overview of the science of *earthbiology,* so named to distinguish it from possible *exobiologies* treating of life on other planets in the universe. It would be declared a cardinal sin to fragment *earthbiology* below the college level.

As indicated (Traub, *23,* pp. 131, 140; *24, 25, 26*), earth organisms are either cellular or non-cellular on the primary level. Thus, there is the science of *Cellular Biology,* Superkingdom 1. *Cellularae,* contrasted with non-cellular organisms, Superkingdom 2. *Acellularae,* the science of *Virology,* which is placed second because the viruses require the enzymatic mechanisms of cellular organisms for reproduction, and apparently they have evolved from cellular organelles.

Due to lack of space, the *Science of Virology* will not be explored because this is a task that the virologists are trying hard to complete. Further discussion here will be concerned only with the Science of *Cellular Biology* for there the dead hand of the mediaeval past still is active even in this atomic age.

THE LAW OF LINEAGIC RELATIVITY. The law of lineagic relativity (Traub, *23,* Fig. 4, pp. 87-88) describes what is axiomatic, and some may believe that it is un-necessary. However, when some workers ignore it, and confuse lineagic groups that existed in an earlier age with groups in the contemporary period, the value of that law is readily apparent as a valuable deterrent. The keystone in the arch of the science of *lineagics* is the *theory of bioevolution,* and one of the main supporting arch stones is the *law of lineagic relativity.* It is applicable to that phase of lineagics which makes it clear that the chronological (time) factor is correlated with bioevolutionary changes in organisms. Thus, the lineagic groups of an earlier period evolve (change —advance or retrograde) with time (the factors are so many, and some unique, so that the odds against the same resulting lineagic product, from period to period, is overwhelming) and can never again be identical with later groups for the environmental conditions and the nature of the genes (nucleic acid) have changed from period to period. The law has other applications—the origin of heterotrophs, for instance.

It is due to the lack of awareness of the *law of lineagic relativity* that some workers confuse *relict* (used here to identify relatively undifferentiated organisms in the contemporary period) contemporary lineagic groups (*Chlorophyta, Euglenophyta, Sporozoa, Zoomastigina, Sarcodina, Ciliophora,* etc.) with their progenitors of an earlier time period, and come up with that mediaeval artifact, "Kingdom Protista". Such happenings can be explained as due to the unfortunate long history of *lineagics* as a discipline (*23*) which began with the early Greeks, muddled through the Middle Ages, was a discipline with emphasis on classification before the advent of the Darwinian theory of bioevolution, and is slowly surfacing as a modern science of *lineagics* based strictly on verifiable data and with the theory of bioevolution as its backbone. *Lineagics* could not start out with a clean slate in the early 20th century like *genetics,* and still has to finally divest itself of the last vestiges of mediavelism.

THE 1964 EARTHBIOLOGY HYPOTHESIS. Constructed in 1964 (*23*), it is based on scientific facts with inferences about the bioevolutionary course and was to be tested against additional available experimental evidence.

For the present discussion, the postulated conditions under which life originated five or more billions years in the past (*23*), will not be considered. More than a million species of organisms with the cellular organization have been described, including those with the *procaryotic* and *eucaryotic* cellular structure *(23),* and with many more remaining still to be discovered and described.

(a) Kingdom 1. *Procaryotae.* In this main lineage, there is the contemporary Subkingdom 1. *Procaryotae* with offshoots: Subkingdom 1. *Autobacae,* autotrophic lineages, including Infrakingdom 1. *Chemoautobacae,* and Infrakingdom 2. *Photoautobacae* (containing among other, the ex Blue Green Algae) ; and Subkingdom 2. *Heterobacae* (bacteria) which apparently have originated from the former kingdoms (see Grouping No. 2).

The first phototrophic *eucaryotic* cell apparently originated from some *Photoautobacae* ancestor, as evidenced by the presence of *chlorophyll* in ancestor and offspring. The difference in cellular organization is sufficient to warrant recognizing a separate kingdom—Kingdom 2. *Eucaryotae.*

(b) *Kingdom 2. Eucaryotae.* The original eucaryotic cell apparently had pontentialities for evolution in the direction of plant-like features, giving rise to subkingdom 1. *Plantae* under Kingdom 2. *Eucaryotae* (see Grouping No. 2).

The heterotrophs that developed from the main *Plantae* lineage during the meso-period developed into Subkingdom 2. *Heteroplantae* or fungi.

However, early in its history in the archi-period, a mutant lineage with potentialities of evolving in the direction of animal-like features appeared as an offshoot from the *Plantae* main lineage. This very soon branched out becoming ever more animal-like and produced Subkingdom 3. *Animalia.*

This hypothesis is summarized in Grouping No. 2.

GROUPING NO. 2. THE 1964 EARTHBIOLOGY HYPOTHESIS
(23, 24, 25, 26)

Superkingdom 1. **CELLULARAE** (CELLULAR BIOLOGY)
Kingdom 1. **PROCARYOTAE**—organisms with the procaryotic cellular organization.
Subkingdom 1. **AUTOBACAE** *—obligate or facultative procaryotes and related neoheterotrophs
Infrakingdom 1. **CHEMOAUTOBACAE**—obligate or facultative chemoautotropha, and related neoheterotrophs
Infrakingdom 2. **PHOTOAUTOBACAE**—obligate and facultative photoautotrophs, and related neoheterotrophs

* Out of respect and gratitude to the outstanding bacteriologists who demonstrated in detail the nature and difference between the procaryotic and eucaryotic cell structure, the suffix—**bacae** has been adopted for the groups in the **subkingdom** through the **class** levels (see 23) so that future workers will know and honor the pioneers.

Subkingdom 2. **HETEROBACAE,** archi- and meso-heterotrophic procaryotes (Bacteria)

Kingdom 2. **EUCARYOTAE**—organisms with the eucaryotic cellular organization

Subkingdom 1. **PLANTAE**—obligate or facultative photoautotrophic eucaryotes, and related neo-heterotrophs

Infrakingdom 1. **ENEMBRYOPHYTAE**—includes the algae

Infrakingdom 2. **EMBRYOPHYTAE**—includes bryophytes and tracheophytes or vascular plants

Subkingdom 2. **HETEROPLANTAE**—includes mesoheterotrophic eucaryotes or fungi

Subkingdom 3. **ANIMALIA**—includes archi-heterotrophic eucaryotes or animals?

SUPERKINGDOM 2. **ACELLULARAE**—(VIROLOGY)—consisting of the stuff of life—a nucleic acid (DNA or RNA) core enclosed by a protein coat, but lacking the capacity for independent self-replication; they reproduce only by requisitioning the enzymatic mechanisms of cellular organisms.

The 1969 report, in the journal SCIENCE, by Whittaker (*27*), concerned in part with the outmoded "Kingdom Protista" concept, was challenging in part to the Traub 1964 (*23*) *earthbiology hypothesis.* Whittaker had apparently not read *Lineagics* (*23*).

III. LYSINE SYNTHESIS PATHS AND THE BIOEVOLUTIONARY COURSE

Ever since 1964, the writer had been looking for a comprehensive set of data for use in *testing* the original *earthbiology hypothesis* (*23*), but without success until 1970, when he opened the pages of a book to the most stimulating article by Vogel, Thompson and Shockmen (*4*), and Eureka!—he had found it! This is a summary of very expensive research, using labeled radiocarbon tracers, begun by the senior author in 1953, and by one of the co-authors in 1963. The three authors applied their results in charting the bioevolutionary course in cellular biology on the basis of lysine synthesis paths DAP and AAA, which are to be explained later in the present paper.

The objective in this Section is to test the 1964 *earthbiology hypothesis* (*23*) on the basis of the Vogel et al (*4*) data concerning organisms with the DAP and AAA lysine synthesis paths.

AN OVERVIEW OF EARTHBIOLOGY IN ONE FIGURE. Too often in the past, the field of *lineagics* has been fragmented by too early specialization. It is hoped that by providing an overview of the whole field of *earthbiology,* this deficiency can be corrected.

In 1964, Traub (*23,* p. 140) had constructed a figure representing organisms on earth evolving in the time frame. Figure 1 of the present report represents an updated version retaining the time dimension and adding also the lysine synthesis paths DAP and AAA data from Vogel et al (*4*) as markers or tracers, which are to be discussed later.

Figure 1 represents an attempt to convey most economically a maximum package of information in the least possible space—an overview of the entire field of *earthbiology* with which the student should *begin his search.*

Beginning at the top of Figure 1, it is to be noted that on the primary level, Superkingdom 1. *Cellularae,* the *Science of Cellular Biology,* is contrasted with Superkingdom 2. *Acellularae,* the *Science of Virology,* which latter science is not to be considered further here for lack of space, but it should never be out of the students' mind.

On the secondary level, under Superkingdom 1. *Cellularae* (Cellular Biology), two possible kingdoms are recognized for it would be irresponsible to make more since all have the cellular organization, one group having the *procaryotic* cellular structure, Kingdom 1. *Procaryotae,* the *Science of Procaryology,* and the other the *eucaryotic* cellular organization, Kingdom 2. *Eucaryotae,* the *Science of Eucaryology.* This should end the *free for all scramble* for three or more kingdoms proliferation.

Due to space limitations, the consideration of Kingdom 1. *Procaryotae* had to be considerably curtailed, ending with the subkingdom level, but a reference source of further information is given. Under Kingdom 2. *Eucaryotae,* consideration extends to the phylum level for Subkingdom 1. *Plantae,* the *Science of Phytology;* and Subkingdom 2. *Mycotae, the Science of Mycology,* but again for Subkingdom 3. *Animalia,* the *Science of Zoology,* for lack of space, consideration extends only to the infrakingdom level—*Protozoae* and *Metazoae,* with reference to a source of further information.

LYSINE SYNTHESIS PATHS DAP AND AAA AS TRACERS. Lysine is one of the so-called essential life sustaining amino acids. *Procaryotes,* and of the *eucaryotes,* plants *(Plantae),* fungi *(Mycotae)* and among animals (*Animalia*), most *Protozoae* but not *Metazoae,* including *Homo sapiens,* can *synthesize* lysine, one of the 20 essential amino acids that sustain life.

Vogel et al (*4*) consider a case where different pathways lead to a metabolite, *lysine,* which is common to *procaryotes* and *eucaryotes* alike. Two different lysine paths are known, the key intermediate in one is *a-E-diaminopimelic acid,* (DAP), and in the other, *a-aminoadipic acid* (AAA). The reader will realize at once by a glance at Figure 1, that with these biologic tracers present in both *procaryotes* and *eucaryotes,* it will be possible to detect the evolutionary course, revealing relationships among cellular organisms (Cellular Biology)—Kingdom 1. *Procaryotae* (DAP) and Kingdom 2. *Eucaryotae* (DAP & AAA).

Kingdom 1. *Procaryotae* (DAP) and Subkingdom 1. *Plantae* (DAP) (in Kingdom 2. *Eucaryotae*) both have the DAP path, tying these two groups together.

Subkingdom 2. *Mycotae* or fungi (AAA) is tied to Subkingdom 1. Plantae (DAP) by the common bond of the presence of *chlorophyll* (Phylum *Englenmycota* in *Mycotae*).

It happens ideally in this case that path AAA occurs within Subkingdom 2. *Mycotae* (AAA) and Subkingdom 3. *Animalia* (AAA), tying these two subkingdoms together.

All three subkingdoms are bound together by the common bond of the *eucaryotic cellular organization* showing that they all belong to

Kingdom 2. *Eucaryotae.*

With this efficient tool of the lysine paths DAP and AAA, the 1964 earthbiology pypothesis will be tested in even greater detail in the following discussion in order to correct any discrepancies.

LINEAGES EVOLVING IN THE TIME FRAME. In Figure 1, the evolving lineages of cellular organisms are plotted against elapsed time; in a theoretical diagram not drawn to scale. The archi-, meso-, and neo-periods indicate periods in time, when phototrophs gave rise to heterotrophs. The time factor is also necessary to *banish forever* the slovenly habit of piling lineages upon lineages as is often the practice in presenting figures. Surely, the time dimension is of the essence and cannot be omitted in considering bioevolutionary events (history). In the next revision, an attempt will be made to draw the time dimensions *approximately* to scale.

Line D-D represents the contemparary period. Therefore all lineages below this line are extinct and in the field of Paleo-cellular-biology.

All slanting and vertical lines within the rectangular figure A-D-D-A, beginning with the point of origin of life, represent *an indefinite number of lineages* evolving in the time frame, the *bold lines* standing for the *main lines* of evolution, and the *lighter lines* for offshoots.

Above the endings of the evolutionary lines (line D-D), appear the names of the major contemporary phylons,—Subkingdom 1. *Chemoautobacae,* etc.

Under Kingdom 1. *Procaryotae,* it will be noted that dotted lines with arrows connect the evolving autotrophic lineages with the "artificial lineage" Subkingdom 3. *Heterobacae* (bacteria), indicating that the points of origin of the latter (heterotrophic lineages) are unknown.

The designated biologic tracers, DAP and AAA, indicate the lysine synthesis paths as already explained.

RESEARCH IN ARCHI-, MESO-, and NEO-PERIODS. Research about the evolution of organisms—paleo-cellular biology—the possible origin of life under simulated Archi-Period conditions; on the basis of the fossil record, and inferences drawn from the study of *relict* lineages surviving into the contemporary period, are to be encouraged but always with due caution as stipulated by Stanier (*5*), never to allow speculation to become an obsession.

The archi-period is mostly a question mark. No consideration is given here to the accumulation of non-biologic "organic" matter prior to the origin of life as a basis for nurturing the first life until enzymatic mechanisms for obtaining energy independently with the aid of chemicals or light had been gained. The question as to which originated first, *chemoautotrophs* or *photoautotrophs* has still to be answered. Some claim that the photoautotrophs came first. The question is asked again in Figure 1. Investigations to determine how the *eucaryotic* phototrophic cell originated from the *procaryotic* phototrophic cell, since 1882, have not revealed how this happened. Here again, we should heed the caution of Stanier (*5*) that in such investigations speculation may do some good, unless it becomes an obsession for such speculation is usually partly in the field of metascience.

CORROBORATION OF THE 1964 EARTHBIOLOGY HYPOTHESIS. When the figure of organisms evolving in time by Traub (*23,* p. 140) is checked against the Vogel et al (*4*) data (see Figure 1), there is a good agreement, requiring a minimum of changes in details.

Part of the *Phycomycetes* (DAP), those which make anteriorly flagellated or biflagellated spores have the DAP path of lysine synthesis, and were formerly under Kingdom 2. *Mycotae,* now under the new name, Phylum *Hydotophyta* (Gr. *hydor,* water, *-otos,* mold-like, *-phyticos,* plants), Water Mold-like Plants, *Achlya bisexualis, Sapromyes elangatus, Sirolpidium zoophthorum, Pythium ultimum, Hydrochytrium catenoides, Saprolegniales, Leptomitales, Peronosporales and Hyphochytriales,* had to be transferred to Subkingdom 1. *Plantae* with the DAP lysine path.

Those *Phycomycetes* (AAA) which produce non-motile spores, or spores with a posterior flagellum use the AAA path and must remain in Subkingdom 2. *Mycotae* with the AAA lysine path: *Rhizophylctis rosea, Allomyces macrogynus, Monoblepharella laruei, Rhizopus stolonifer, Chridiales, Bastocladiales, Monoblepharidales* and *Mucorales.*

Turning to Subkingdom 1. *Plantae,* the Phylum *Euglenophyta* with the AAA lysine path, under a slightly changed name, Phylum *Euglenmycota,* has to be transferred to Subkingdom 2. *Mycotae* (AAA).

These are the main changes in details required by the application of the Vogel et al (*4*) data to the 1964 *earthbiology hypothesis,* which has been corroboroated in major part.

As a result of these changes, Subkingdom 1. *Plantae* (DAP) has gained the arch-, or meso-heterotrophic Phylum *Hydotophyta* (Water Mold-like Plants), giving the first insight into the nature of the earliest plants (see Figure 1).

The transfer of the phototrophic Phylum *Euglenmycota* (AAA) to Subkingdom 2. *Mycotae* (AAA) gives this subkingdom at last a main-stem lineage reaching back to its origin in the archi-period (see Figure 1).

In the past, phototrophs, organisms that *synthesized* carbohydrates by means of chlorophyll and light, the *photosynthesizing* organisms, were strictly segregated under Subkingdom 1. *Plantae,* with one exception. The heterotrophs (food absorbers) that originated in the neo-period, *Cuscuta,* (Dodder), etc., were quixotically retained in that Subkingdom also.

The rest of the food *absorbers,* or heterotrophs (parasites and saprobes) that originated under the archi-, or meso-periods, if any were to be found, were to be placed under subkingdom 2. *Mycotae* (Fungi).

This practice is no longer tenable since the arch-, or meso-heterotrophs (Phylum *Hydotophyta,* DAP), are now recognized in Subkingdom 1. *Plantae* (DAP), and archi-phototrophs, Phylum *Euglenmycota* (AAA) in Subkingdom 2. *Mycotae* (AAA). However, in Subkingdom 3. *Animalia,* all are food *ingestors* (archi-heterotrophs), with partial loss of the lysine path AAA in *Protozoae* and total loss of the AAA path in *Metazoae.*

LYSINE SYNTHESIS PATHS DAP AND AAA AND THE BIOEVOLUTIONARY COURSE. Turning to Figure 1, it is now apparent that by means of the tracers, lysine paths DAP and AAA, it is possible to chart the bioevolutionary course of Superkingdom 1. *Cellularae,* cellular organisms—Kingdom 1. *Procaryotae* and Kingdom 2, *Eucaryotae,* tying them together.

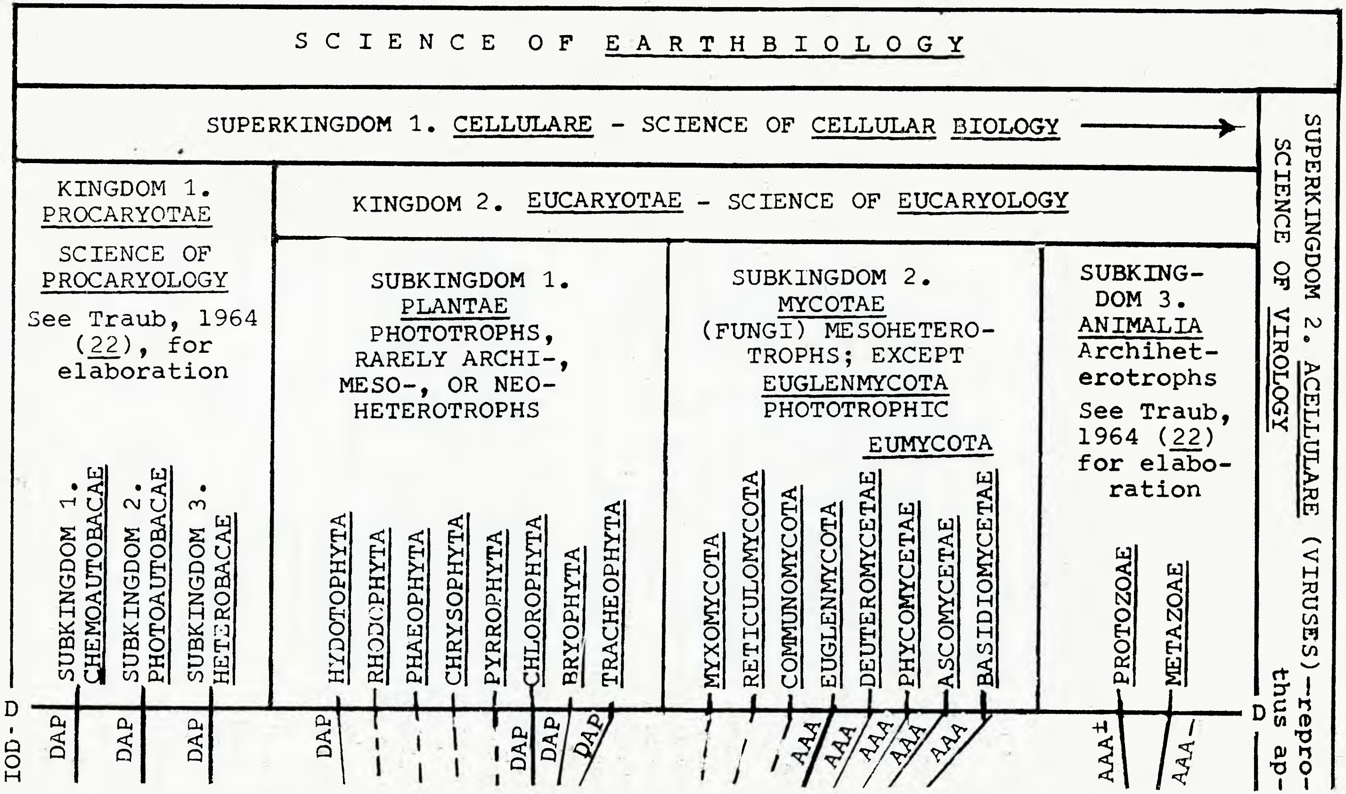
The more structurally primitive lineages, as indicated in Figure 1, originated early in the archi-period and developed the DAP path in two main stem lineages, Subkingdom 1. *Chemoautobacae* (DAP) and Subkingdom 2. *Photoautobacae* (DAP), and also the artificial Subkingdom 3. *Heterobacae* (bacteria) AAA, with roots in the two autotrophic lineages just mentioned.

Subkingdom 2. *Photoautobacae*(DAP), including also Phylum *Cyanobacae* (ex Blue Green Algae), with the *procaryotic* cellular structure, gave rise to the *eucaryotic* cell—the details as to how this happened we may never know. We infer that this did happen because phylum *Cyanobacae*(DAP) of Kingdom 1. *Procaryotae*(DAP), and the main stem lineage, Phylum *Chlorophyta* (DAP) of Subkingdom 1. *Plantae* (DAP), (of Kingdom 2. *Eucaryotae*) both synthesize lysine by the DAP path, and contain chlorophyll.

The main lineage, the *embryo* Phylum *Chlorophyta* (DAP), with inherent potentialities for evolving in the direction of plant-like characteristics, evolved into the future Subkingdom 1. *Plantae*(DAP), with spectactular success, becoming ever more plant like, eventually giving rise to the very successful offshoot, Phylum *Tracheophyta*(DAP), providing for *Homo sapiens,* trees for building, herbs for food and medicine, and the beauty of the rose to edify his soul, but that is another story.

An an early stage (see Figure 1) in the evolution of the Subkingdom 1. *Plantae*(DAP) lineage, a mutant *phototrophic* lineage originated with potentialities for evolving in a pattern intermediate between plants and animals. This lineage lost the DAP path irreversibly according to the Vogel et al (*4*) hypothesis (see Figure 1). After a time, this phototrophic lineage regained the capacity for lysine synthesis but by the AAA path according to the Vogel et al *(4)* theory, and soon gave rise to an offshoot which maintained the potentialities for evolving into organisms intermediate between plants and animals. It eventually gave rise to the contemporary phototrophic Phylum *Euglenmycota*(AAA), but all of its AAA offshoots during the meso-period lost the phototrophic capacity and together these represent Kingdom 2. *Mycotae*(AAA) of Kingdom 2. *Eucaryotae* (see Figure 1).

The original AAA lineage with potentialities for evolution in the direction of animal-like characteristics—food ingestion, in the archi-period, gave rise to the protists that led to the main *Protozoae*(AAA) lineage (see Figure 1). In the meso-period this lineage became ever more animal-like and before reaching the contemporary period, some groups lost the AAA path. A major offshoot, the *Metazoae* lost the AAA


SCIENCE OF EARTHBIOLOGY
SUPERKINGDOM 1. CELLULARE - SCIENCE OF CELLULAR BIOLOGY
SUPERKINGDOM 2. ACELLULARE (VIRUSES)--reprothus ap-
SCIENCE OF VIROLOGY
KINGDOM 1. PROCARYOTAE
SCIENCE OF PROCARYOLOGY
See Traub, 1964 (22), for elaboration
KINGDOM 2. EUCARYOTAE - SCIENCE OF EUCARYOLOGY
SUBKINGDOM 1. PLANTAE PHOTOTROPHS, RARELY ARCHI-, MESO-, OR NEO-HETEROTROPHS
SUBKINGDOM 2. MYCOTAE (FUNGI) MESOHETEROTROPHS; EXCEPT EUGLENMYCOTA PHOTOTROPHIC
EUMYCOTA
SUBKINGDOM 3. ANIMALIA Archiheterotrophs
See Traub, 1964 (22) for elaboration
SUBKINGDOM 1. CHEMOAUTOBACAE
SUBKINGDOM 2. PHOTOAUTOBACAE
SUBKINGDOM 3. HETEROBACAE
HYDOTOPHYTA
RHODOPHYTA
PHAEOPHYTA
CHRYSOPHYTA
PYRROPHYTA
CHLOROPHYTA
BRYOPHYTA
TRACHEOPHYTA
MYXOMYCOTA
RETICULOMYCOTA
COMMUNOMYCOTA
EUGLENMYCOTA
DEUTEROMYCETAE
PHYCOMYCETAE
ASCOMYCETAE
BASIDIOMYCETAE
PROTOZOAE
METAZOAE
IOD-D
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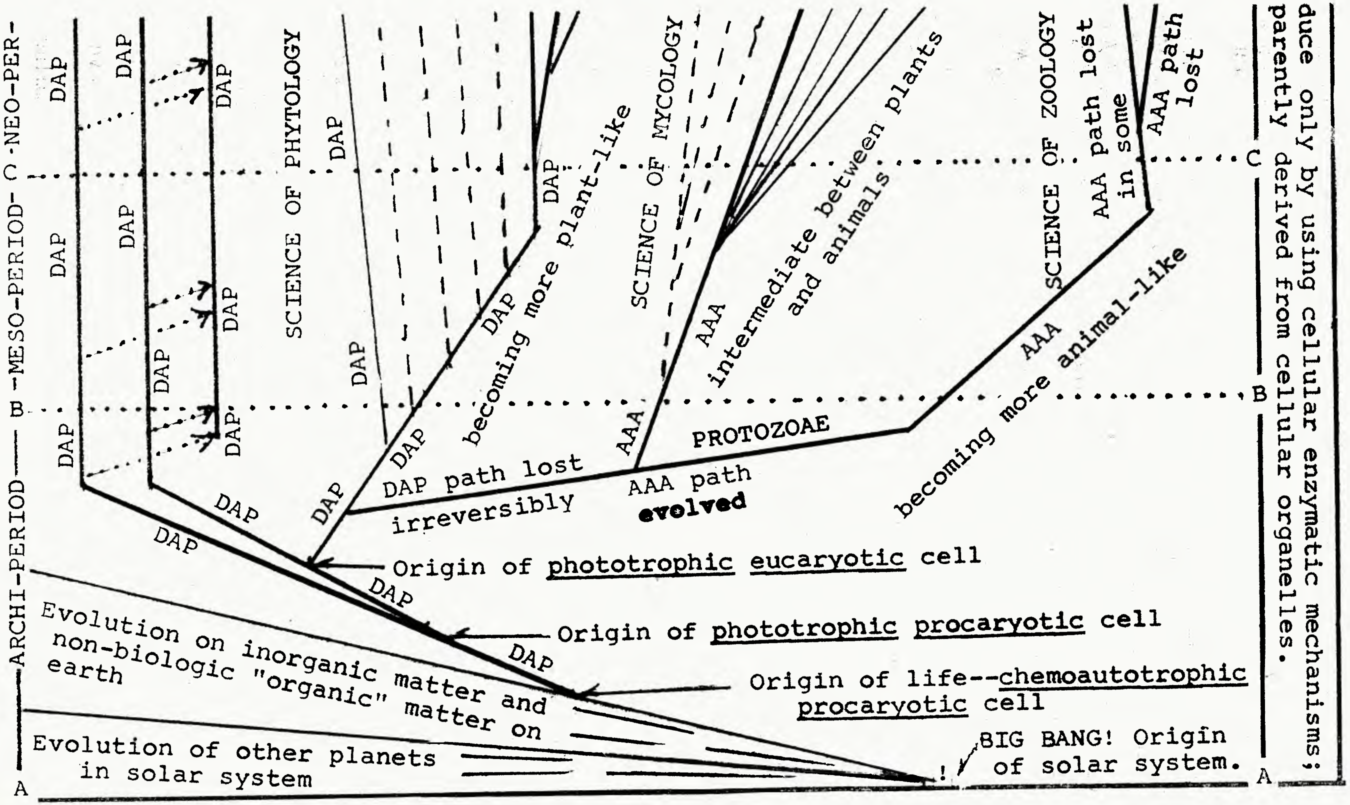

Figure 1. An overview of the 1964 Traub **earthbiology hypothesis (23)** as revised after corroboration by checking against the 1970 Vogel et al (4) lysine synthesis paths DAP and AAA data (as tracers) with minimum required changes in details. For further explanation of Figure see text discussions, pages 89-97. **Corrections:** the line for **Metazoae** is incorrectly drawn; it should originate from the **Protozoae** line below the B-B line; for "Traub, 1964(22)," read (23); for "evolution on inorganic", read "(of inorganic").

path altogether as the organisms became ever more animal-like, eventually culminating in the contemprary period *Arthropoda, Echinodermata* and *Chordata,* including in the last named, the higher mammals, with man, the reasoning mammal represented in the Genus *Homo.*

Thus the original Kingdom 1. *Procaryotae*(DAP) spawned Subkingdom 1. *Plantae* (DAP) (of Kingdom 2. *Eucaryotae*). Subkingdom 2. *Plantae*(DAP) spawned a lineage which lost the DAP path irreversibly, but which regained the capacity to synthesize lysine by the AAA path. An offshoot of this lineage became Subkingdom 2. *Mycotae*(AAA), intermediate between plants and animals.

The original AAA lineage evolved into the *Protozoae* lineage, with loss of AAA in some of its offshoots. One offshoot gave rise to the *Metazoae* with total loss of the AAA path.

The populations of these lineages in the contemporary period are represented on line D-D in Figure 1, including Kingdom 1. *Procaryotae* DAP, the Science of *Procaryology,* and Kingdom 2. *Eucaryotae* (DAP & AAA), the Science of *Eucaryology* (see Figure 1).

"PROTISTA" (OR "PROTOCTISTA", OR UNDER ANY OTHER GUISE) NEVER A KINGDOM MAKE! The primitive organisms that existed in the archi-period are properly referred to as protists (Protista), Gr. *protistos,* the first of all (*28*), and *protistology* is the science dealing with these early primitive forms of life, now long extinct, that evolved later into the contemporary lineages, line D-D in Figure 1. Some of these lineages (populations) advanced to a lesser degree above the primitive forms (protists). In the present paper, these are referred to as *relicts* (L. *relictus,* left behind). Thus we may speculate on the basis of *relicts* as to the nature of the earlier progenitors; however, we must not allow the imagination to run wild, but use such inferences with caution.

The study of the science of lineagics(*23*), the bioevolutionary process, the origin of the first lineage, its long history of branching to the present contemporary organisms, and their proper grouping, is a most difficult task to say the least, when the fossil record is scanty and reliance has often to be placed upon man's lively and sometimes not so consistent imagination.

He sometimes forgets that the contemporary *relict* populations (represented by line D-D in Figure 1) are no longer the same *protists* as the earlier forms, in the archi-period, from which they evolved, and cannot be picked out horizontally across line D-D (Figure 1) and collected in a mixed bag of relicts to form a realistic "Kingdom Protista" in the contemporary time frame.

Bioevolution means change *forward or retrograde* but the product will never again be the same at any future time. The genes and environmental factors are many in each case, and the odds against the possibility that these will ever again be the same at any future time are overwhelming!

The major phylons (phylum, subkingdom, etc., named earlier, above, line D=D in Figure 1) represent units at the contemporary point in time with a long lineage back of each, and should never be confused with population groups at a different point in time, B-B, and C-C, for instance. Protista belong below line B-B, and should never be confused with contemporary lineages (population units) on line D-D. To confuse these involves a kind of reasoning outside the field of lineagics.

Those who propose "Kingdom Protista" err in confusing the groups in the contemporary time frame, along line D-D in Figure 1, with extinct groups below line B-B, and compound the error by selecting sometimes distantly related contemporary groups with the DAP or AAA lysine synthesis paths to form an unrealistic "Kingdom Protista."

IV. FUTURE COURSE OF RESEARCH IN LINEAGICS

It is clear that the future course of lineagic research has to banish the dead hand of the mediaeval past and boldly face the realities. Such a relatively new science as *genetics* could start out with a clean slate with a unified outlook, but this contrasts markedly with the science of *lineagics* (*23*).

The outmoded discipline of classification was instituted in an age when it was believed that organisms had been arbitrarily created and all that remained was for man to classify these fixed objects. The voice of a Mauterpuis to the contrary was unavailing (*23*). The emphasis was on the cart-before-the-horse classification.

With the advent of the theory of *bioevolution,* the study of this phenomenon is often considered as a separate discipline when in fact it is the back-bone, the very essence of the new science of *lineagics,* with the objective of tracing out the evolutionary *history* of living things, and on the basis of these facts eventually to arrive at not any classification but a *linoclassification* which is the end product. Thus, the emphasis is on *lineages, always lineages (23),* not on the end product primarily. Thus, workers in this field are no longer classifiers alone, but first of all *seekers for lineages,* and thus *lineagicists.* This parallels the rediscovery in 1900 of Mendel's discovery of the principles of particulate inheritance in 1865. The geneticists benefited from Mendel's discovery and the science of *genetics* was born. The cart-before-the-horse classifiers failed to benefit from Darwin's "Origin of Species" (1859), and remained short-sighted classifiers, and missed a rendevous with science. The full significance of Darwin's contribution has only recently been tardily relized by those engaged in the field of *lineagics.*

Thus, it is clear that the future course in lineagic research is bound up with seeking out basic facts and basing conclusions on such data as the lysine synthesis paths DAP and AAA (Volgel et al, *4*). Our hypotheses have to be tested against such basic facts.

Lineagicists must ever be on the outlook for clues. For instance, the structural unit in fungi is a fine tube which grows apically, and this feature is found also in *a group* of the Grass Green Algae, the Order *Siphanales.* We, as lineagicists, immediately draw inferences and reason that Order *Siphonales* may be out of place in Phylum *Chlorophyta* and probably branched off from Phylum *Euglenmycota*(AAA) and may not belong in Subkingdom 1. *Plantae*(DAP) but in Subkingdom 2. *Mycotae* (AAA). Only a test for the *presence or absence* of lysine path AAA in Order *Siphomales* can answer this question. It is hoped that someone with the required facilities will follow up this challenging lead.

It is also to be noted, as shown in Figure 1, lysine synthesis path data, under Subkingdom 1. *Plante*(DAP), are missing for four phyla of Algae, *Rhodophyta, Phaeophyta, Chrysophyta,* and *Pyrrophyta;* and under Subkingdom 2. *Mycotae*(AAA), for three phyla, *Myxomycota, Reticulomycota,* and *Communomycota.* It is hoped that some one with the needed research facilities will supply the missing information.

It is only by such laborious steps in the future that we can perfect the linoclassification of living things, never by mediaeval reasoning.

V. DISCUSSION

It was indicated earlier that the 1969 Whittaker report *(27)* was challenging in one particular to the 1964 Traub *(23)* lineagic hypothesis concerning earth organisms. The present paper should have appeared in 1971 but first things had to come first and it was delayed *(1).*

In the meantime things have gotten somewhat out of hand with the considerable discussion about the grouping of the upper phylons of organisms on earth, started by the 1969 Whittaker report *(27),* in which the artificial concept of "Kingdom Protista" was championed in the journal SCIENCE, without any mention of the earlier 1964 opposing *earthbiology hypothesis* of Traub *(23),* which assumed the "Kingdom Protista" concept to be mediaeval and thus should have been dropped long ago.

During the period, 1963 to 1975 *(24, 23, 25, 26),* and in the present paper, the writer indicated that there are only two real kingdoms of cellular organisms on earth. On the primary level, there are cellular organisms. Superkingdom 1. *Cellularae* versus non-cellular organisms, Superkingdom 2. *Acellularae* (viruses). On the secondary level, there are two possible kingdoms, those with the *procaryotic* cellular organization, Kingdom 1. *Procaryotae* versus those with the *eucaryotic* cellular organization, Kingdom 2. *Eucaryotae.*

Grouping No. 2, given earlier in this paper, is *briefly* summarized here as Grouping No. 3 for convenient reference in the following discussion.

GROUPING NO. 3. Higher phylons of living things (Traub, 1964, **23**), See also Grouping No. 2.

Superkingdom 1. **Cellularae**—cellular organisms (primary level)
- Kingdom 1. **Procaryotae** (secondary level)
  - Subkingdom 1. Autobacae (tertiary level)
    - Infrakingdom 1. Chemoautobacae (quadrinary level), etc.
    - Infrakingdom 2. Photoautobacae
  - Subkingdom 2. Heterobacae (bacteria)
- Kingdom 2. **Eucaryotae**
  - Subkingdom 1. Plantae
    - Infrakingdom 1. Anembryophytae (Algae)
    - Infrakingdom 2. Embryophytae (bryophytes and tracheophytes)

Subkingdom 3. Animalia
Superkingdom 2. **Acellularae**—Viruses.

It was indicated as a caution *(26)* by Traub that the categories of the higher ranks of living things can be shuffled (by slipping in an extra category, for instance, the term Dominion) so as to make it appear that there are various numbers of so-called "kingdoms", but this is only a game of shadow-boxing or musical chairs, as shown by the Grouping No. 4.

GROUPING NO. 4. The higher ranks of living things shuffled so as to obtain five so-called "kingdoms" Traub (26) 1975.

Dominion 1. Cellularae
 Superkingdom 1. Procaryotae
  Kingdom 1. Autobacae
  Kingdom 2. Heterocacae (bacteria)
 Superkingdom 2. Eucaryotae
  Kingdom 1. Plantae
  Kingdom 2. Heteroplantae (fungi)
  Kingdom 3. Animalia
Dominion 2. Acellularae (Viruses)

It will be noted that nothing but confusion can be gained by such a maneuver. The so-called "Kingdoms" Plantae, Fungi and Animalia, which are given an unreal stature when they are in fact three kinds of organisms all having the eucaryotic cellular organization under the Kingdom *Eucaryotae (23)*; see Grouping No. 3.

In 1969, Whittaker *(27)* proposed a five-kingdom grouping of cellular organisms, as shown in the following bare outline.

GROUPING NO. 5. Adapted from the figure after Whittaker (27) Five-kingdom grouping. See also original paper (27).

Kingdom Plantae   Kingdom Fungi   Kingdom Animalia

Kingdom Protista

Kingdom Monera (=Procaryotae)

It is to be noted that this figure lacks the essential time dimension in the evolutionary process and it gives the impression that lineages are piled on lineages when in fact he is considering population units on line D-D in Figure 1 of Section III of the present paper which represents contemporary groups. The reader should consult also the original Whittaker figure *(27)* because it is not possible to include here the lines of descent for the various lineages.

In the following discussion, the lysine paths DAP and AAA have been added by the present writer. These serve as tracers.

Whittaker is correct in showing the origin of the *Chlorophyta* (DAP) lineage from lineage *Cyanophyta* (DAP) as the main line of descent for Plantae (DAP), but he fails to indicate that *Bryophyta* (DAP) and Tracheophyta (DAP) are later offshoots from the main stem for he has *Chlorophyta* as an offshoot of *Tracheophyta.*

Phylum *Euglenophyta* (=*Euglenmycota*) (AAA) is misplaced and mislabeled as "Protista" below Plantae (DAP). It should provide the main contemporary *relict* lineage leading to Fungi (AAA). See Figure 1 of the present paper.

The main *Animalia* lineage should be AAA, leading to *Protozoae* (partial loss of AAA), which is not shown. Instead *Zoomastigina, Sarcodina, Ciliiophora,* etc., are shown as Protista. The *Metazoae* (AAA lost) lineage should be shown branching off from the *Protozoae* (AAA), instead it originates separately, ending in *Arthropoda* and *Chordata.*

His Kingdow Protista includes Phylum *Euglenophyta* (AAA), belonging to Subkingdom 2. *Mycotae* (AAA); the algal phyla *Chrysophyta* and *Pyrrophyta,* belonging to Subkingdom 1. *Plantae* (DAP), and groups *Zoomastigina, Sarcodina, Ciliiophora,* etc., of the Infrakingdom 1. *Protozoae,* which have mostly the AAA path, *some* having lost it by evolution; all belonging to the Subkingdom 3. *Animalia.*

Most of the difficulties will be cleared up when he inserts the time dimension in his figure as shown by Figure 1 of Section III of the present paper. Then all populations of contemporary lineages will be on line D-D and the "Kingdom Protista" vanishes.

In 1967, Sagan *(29)* and later under the married name, Margulis *(30, 31)* entered the lengthy roster of those who since 1882 have sought to answer the question of the origin of the *eucaryotic* from the *procaryotic* cell. She also (Margulis, *32, 33, 34*) became an advocate of the 1969 Whittaker *(27)* 5-kingdom grouping including the Kingdom Protista.

In 1971, Margulis *(32)* offered a somewhat more hazy form of the Whittaker *(27)* grouping *without showing the time dimension, and without definite lines of descent,* and with Kingdom *Fungi* placed after Kingdom *Animalia* which is unrealistic because the Fungi are intermediate between plants and animals. Otherwise the same criticisms leveled against the original Whittaker *(27)* system apply here also.

Leedale *(34)* in 1974 proposed a grouping similar to that of the Whittaker *(27)* system but with Kingdom Protista removed.

GROUPING NO. 6. Adapted from 1974 Leedale **(35)**; see also original **(34)**.

Kingdom Plantae	Kingdom Fungi	Kingdom Animalia
	Kingdom Monera (=Procaryotae)	

Leedale is to be congratulated on eliminating Kingdom Protista and thus remaining on the right track. With the time dimension added, his figure will approximate in essence the 1964 Traub *(23)* grouping (see groupings Nos. 2 and 3 above).

In 1976, Margulis *(34)* proposed a further revision of the 1969 Whittaker *(27)* grouping.

GROUPING NO. 7. Adapted from Margulis (**34**) 1976 revision of the 1969 Whittaker system (**27**). See also original (**34**).

Superkingdom **Prokaryota**
 Kingdom Monera (=Procaryotae)
Superkingdom **Eukaryota**
 Kingdom Protoctista (replacing Protista)
 Kingdom Fungi
 Kingdom Animalia
 Kingdom Plantae

In general outline, when Kingdom Protista is deleted, this system is similar to the 1975 variation of the Traub *(23)* grouping (see groupings Nos. 2, 3 and 4, above). However, *Plantae* (DAP), spawned by the *Procaryotae* (DAP) is hopelessly out of place at the end after *Protista, Fungi* (AAA) and *Animalia* (AAA).

Margulis' Kingdom Protoctista contains *Euglenophyta* (AAA), *Chlorophyta* (DAP), etc. to the number of 31 phyla (the markers DAP and AAA have been added by the present writer). This is an aggregation of sometimes unrelated groups (DAP and AAA) and is not a natural biological kingdom.

The present writer has not been privileged to see the *(36)* Whittaker (in press 1975) report. However, from the discussion about it in the 1976 Margulis *(34)* report, it appears that no fundamental changes have been made in the Whittaker Grouping No. 5 already discussed.

It is obvious that the concept of Kingdom ''Protista'' or ''Protoctista'' is untenable and has to be abandoned following the lead of Leedale *(35)* to regain the right road.

VI. SUMMARY AND CONCLUSIONS

1. The available data on lysine synthesis paths DAP and AAA corroborate the 1964 Traub grouping of the higher phylons of cellular organisms (Cellular Biology), requiring only a minimum of revision in details.

2. The untenable nature of the ''Kingdom Protista or Protoctista'' concept has been revealed.

3. The segregation of the archi, and meso-period eucaryotic heterotrophs (parasites and saprobes) of Subkingdom 1. *Plantae* under Subkingdom 2. *Mycotae,* is no longer tenable since neo-period heterotrophs, *Cuscuta* (Dodder), etc., were formerly retained under *Plantae,* and archi-, or meso-period heterotrophs, Phylum *Hydotophyta,* are now recognized under *Plantae,* and the photo-autotrophic Phylum *Euglenmycota,* has been placed under *Mycotae.*

4. An overview of the higher phylons—Superkingdom, Kingdom, Subkingdom, Infrakingdom and Phylum levels—evolving in the time frame, has been presented in a single figure.

5. In fairness to the student, the Science of Earthbiology should be taught as a whole, never fragmented, below the college level.

6. A text unifying the entire Science of Procaryology is very urgently needed; and texts on Phytology, Mycology and Zoology should be

brought up-to-date on the basis of the unifying role of lysine synthesis paths.

REFERENCES AND NOTES

1. This paper was inspired by the 1970 paper of Vogel et al(**4**) and should have been published in 1971 when the first draft was made. However, in appreciation of the many benefits received by the writer in the climate of relative freedom existing over two centuries in the United States as a result of the statesmanship of the Founding Fathers, the writer was duty bound to take out several years to complete the seven-libretto operatic cycle, **The Call-of-Destiny,** the musical score to be provided by the composer. The Cycle details the grand panorama of **the American Epic,** the training of the charismatic leader Colonel Washington, in the French and American war, 1755-1763; the winning of freedom under the persevering General Washington; the formulation of the American Constitution on the basis of consensus and compromises, with checks and balances and the Bill of Rights to protect the rights of all, including the minority, and its adoption in 1788; the two-term presidency of President Washington, who presided over the first great successful experiment in self-rule over a continental area. After Washington's death in 1799, the role of the Judiciary being in danger, Chief Justice Marshall asserted the co-equal status of the Judiciary with Congress and the Presidency, completing the unique form of the American government. Under the Presidency of Thomas Jefferson, the future growth pattern of the American Republic was envisoned when he boldly purchased the vast French Colony of Louisiana from Napoleon in 1803, and sent out the Lewis and Clark Expedition which reached the Mouth of the Columbia River in 1805, assuring American expansion to the Pacific. The mold was set for the future functioning of the American Republic.

During the hiatus of the composition of the American Epic, the writer's research in plant science was somewhat curtailed, and the subject of the upper ranks of living things got somewhat out of hand when the mediaeval concept of "Kingdom Protista" was again taken seriously by some workers, from 1969 to the present. The writer begs to apologize for his absence and failure to help in checking this unnecessary discussion which took up so much valuable space in the scientific journals.

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January 15,1977,
2678 Prestwick Court,
La Jolla, Calif. 92037

ADDENDUM

After the above article was set up, separates of Prof. Margulis' publications were kindly furnished. One of these, "The Classification and Evolution of Procaryotes and Eucaryotes", Handbook of Genetics, edited by R. C. King. Vol. I. Plenum Press. 1974, pp. 1-41, was particularly helpful. In this Prof. Margulis does include figures 1 through 4 which show the time dimension in relation to the phylogenies (including the 5-kingdom Whittaker system) based on Margulis' *admittedly unverified "cell symbiosis theory"*, which it is claimed, leads to the 5-kingdom Whittaker type grouping (see her figure 4). This however is unrealistic in the light of the Traub earthbiology hypothesis which is verified on the basis of the 1970 Vogel et al *(4)* lysine synthesis paths DAP and AAA data.

CHRYSOCORYNE: A NEW CHILEAN GENUS OF AMARYLLIDACEAE

Catholic University, Valparaiso, Chile
OTTO ZOELLNER, *Professor of Botany*

Investigating the Chilean genus *Leucocoryne* of the Amaryllid-family, we detected some species which had been considered as *Leucocoryne*, but they differ notably from this genus. Analyzing them, especially fresh material, we could observe, that the 2 species, described by R. A. Philippi—*Leucocoryne oxypetala* and *Leucocoryne incrassata*—presented fundamental differences within the genus *Leucocoryne. Leucocoryne* has 3 fertile anthers, of elongated form, but in the two species mentioned above there are 6 fertile anthers of an oval form. In *Leucocoryne* there are 3 lobe-like filaments, inserted in the throat of tepaltube. They appear as a metamorphic structure, of three stamenoids. In the 2 species mentioned above, the 6 fertile stamens are distributed in 2 cycles, in the interior of the tepaltube. The 3 lobes, of a more broad and fleshy type, must be considered as a *paraperigone*, which is a very common structure in the Amaryllid-family and is observed in the Chilean genera: *Placea, Miersia, Phycella.* This paracorolla has a conic form or is bifid and has a dark orange colour. These differences induced me to establish the new genus *Chrysocoryne.* (chryso = golden; coryne = club.)

GENUS **CHRYSOCORYNE** ZOELLNER

Mus. Hist. Nat. Valparaiso. No. 6. 1973, pp. 17-30. Generic type: *Chrysocoryne oxypetala* (R. A. Phil.) Zoellner, syn.—*Leucocoryne oxypetala* R. A. Phil. type specimen: SGO 46765

Description: Herbaceous plant with bulb; *bulb* globose, pear-shaped, covered with dark brown tunics and fibres. Bulb with long subterranean neck. *Leaves* linear-striated, glabrous with obtuse apex. *Scape* slender, cylindric. *Spathevalves*, 2, lanceolate, of greenish colour, when dried whitish veined. *Pedicels* slender, cylindric. *Flowers* in umbels, formed by a funnel-shaped tube and 6 tepalsegs of white colour, reflexed. *Tepaltube* cylindric, veined longitudinally by six veins. *Tepalsegs* lanceolate with acute apex and of white colour. *Paraperigone* with 3 or 6 lobes, inserted in the throat of tepaltube, conic-shaped or bifid, fleshly, length is 1/3 of tepalsegs. The 3 greater excrescences in front of petepalsegs, the 3 smaller ones in front of the setapalsegs or are missing. Lobes dark orange coloured. 6 *stamens* in 2 cycles inserted on the inner side of tepaltube, without any filament, oval-shaped. The lower stamens in front of the 3 setepalsegs, the 3 upper stamens in front of the petepalsegs. One *style* with a *stigma* of capitate form. *Fruit* is a *capsule* with 3 valves and many black seeds.

KEY TO GENERA RELATED TO **CHRYSOCORYNE**

1a. Perfect stamens 6:
  2a. Tepultube without a paraperigone ....**Tristagma**
  2b. Tepultube with a paraperigone ....**Chrysocoryne**
1b. Perfect stamens 3, sterile stamens 3(stamenodes) ....**Leucocoryne**

KEY TO THE GENUS **CHRYSOCORYNE**

1a. Paraperigone 3-parted, lobes conic, apices obtuse, umbel 5—9-flowered, pedicels, unequal, tepalsegs lanceolate, yellowish-white ...1. **oxypetala**
1b. Paraperigone 3-parted, lobes conic, apices bifid, and lesser lobes 3, conic, often missing; umbel 2—4-flowered, pedicels unequal, tepalsegs elliptic, pure white ....2. **incrassata**

CHRYSOCORYNE OXEPETALA (R. A. Phil.) Zoellner

Anal. Mus. Hist. Nat. Valparaiso No. 6. 1973, pp. 20-22.

Herbaceous plant with bulb. *Bulb* globose pear-shaped, 2 cm high and 1.5—2 cm diameter covered with dark brown tunics and fibres. Bulb with long subterranean neck, length 8—15 cm *Leaves,* 2 or 3, linear, striated, with 13—16 parallel nerves, fleshy, glabrous, with obtuse apex, 15—20 cm long, 3.5—5.5 mm broad *scape* cylindric, glabrous, striated, with a diameter of 2—2.8 mm and a length of 15—25 cm 2 *spathes,* membranous, of lanceolate form, with acute apex, of greenish colour, when dried whitish, veined, 3—3.5 cm long and 4—4.5 mm broad. *Pedicels* cylindric, unequal, 5—9, 1.6—6.5 cm long. *Flowers* in umbels of yellowish white colour. Flowers formed by a funnel-shaped tube and 6 tepalsegs. *Tube* cylindric, striated with dark green nerves, tube 1—1.4 cm long and 1.5—2 mm in diameter. *Tepalsegs* in 2 cycles, reflexed 3 setepalsegs, lanceolate with acute apex, with a green nerv in the middle of *setepalseg,* 0.8—1.2 cm long and 0.25—0.3 cm broad. *Petepalsegs,* lanceolate, with acute apex, with a green nerv in the middle, tepalsegs 0.8—1.1 cm long and 0.25—0.3 cm broad. *Paraperigone* with 3 lobes, of conic form and obtuse apex inserted in the throat of tube in front of petepalsegs, 3.5—5 mm long 1.5—2 mm broad orange colour. The colour of the lesser lobes darkens by drying process. 6 *stamens* in 2 cycles without filaments. Upper anthers inserted in the funnel tube, in front of petepalsegs, of oval

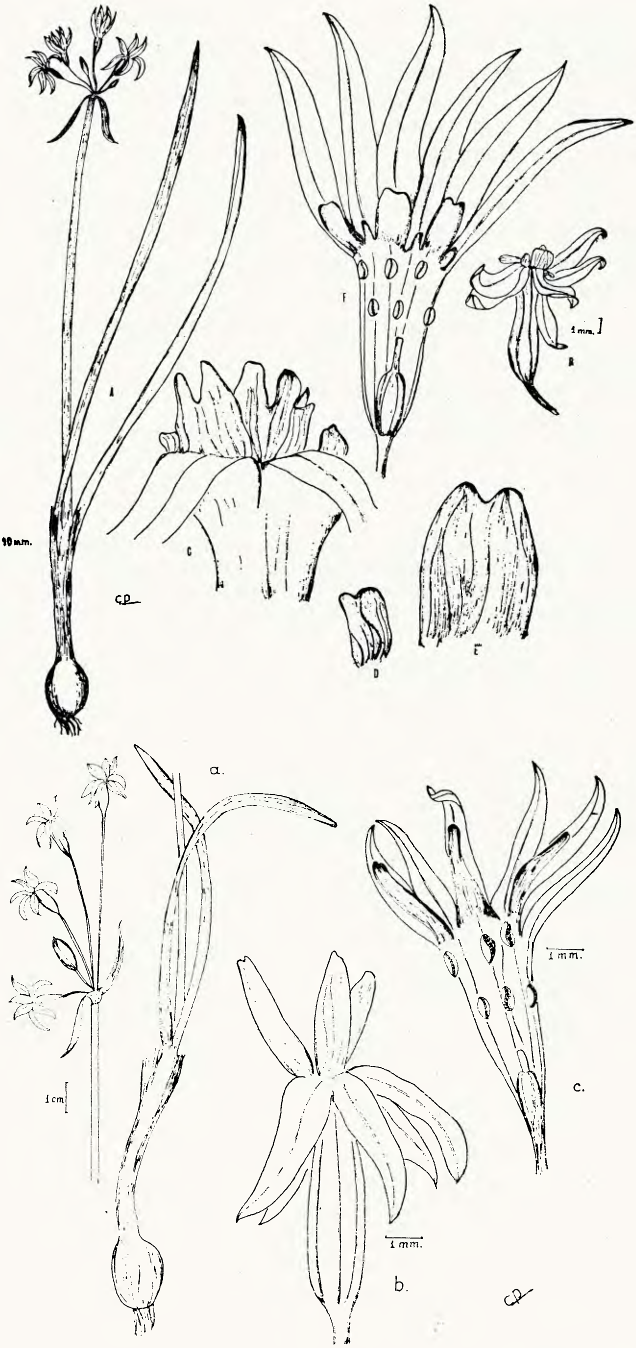

Fig. 23. Genus **Chrysocoryne** Zoellner. **Top - C. incrassata** (R. A. Phil.) Zoellner; **bottom - C. oxypetala** (R. A. Phil.) Zoellner.

form, of yellow colour, 1.5 mm long, 8—9 mm elevated above of the base of tube. Inferior anthers inserted in the tube, in front of the setepalsegs, oval formed, 1.5 mm long, of yellow colour, 6—6.5 mm distant from the base of tube. 1 *style, ovary* cylindric, striated by 6 nerves, ovary 4—5 mm high, *stigma* globose. *Capsule* cylintric, trivalved, with persistent style, glabrous, with 6—8 seeds in each valve. *Seeds* of black colour, 1 mm in diameter.

Type: This specimen has been collected in the North of province Coquimbo, in hills of Coastal Cordillera.

Leucocoryne oxypetala R. A. Philippi, Caldera, IX-1885 (SGO 46765), *type. Chrysocoryne oxipetala* (Phil.) Zöll. in Pass of Pajonales, 9-X-1965, O. Zöllner (Herb Zöll.-6401).

CHRYSOCORYNE INCRASSATA (R. A. Phil.) Zoellner

Anal. Mus. Hist. Nat. Valparaiso No. 6. 1973, pp. 22-25.

Herbaceous plant with bulb. *Bulb* pear-shaped with tunics, chestnut coloured. 1.2—1.6 cm in diameter and 1.5—2 cm high. Subterranean neck covered with dried leaves, 6—10 cm long. *Leaves,* 2 or 3, contemporary with the flowers, fleshy, linear, glabrous, striated, with obtuse apex, 3—4.5 mm broad 12—25 cm long. *Scape* cylindric, striated, 8—25 cm long and 2—3 mm of diameter. *Spathes,* 2, reflexed, lanceolate, striated, with acute apex, 3—3.5 cm long and 0.4—0.45 cm broad. *Pedicels* 2—4, subequal, cylindric, 1 mm in diameter, 1.3—3.5 cm long. *Flowers* funnel-shaped with six tepalsegs in 2 cycles. *Tepaltube* striated by 6 nerves which are elongated to the tepalsegs, of greenish colour. Tepaltube, 1—1.2 cm long, 2—3 mm in diameter. *Setepalsegs,* lanceolate, reflexed, white coloured, striated by a green nerve. Setepalsegs 1.1—1.5 cm long and 0.4 cm broad. *Petepalsegs,* lanceolate, reflexed, 1—1.2 cm long, and 0.3—0.4 cm broad. *Paracorolla* formed by 6 lobes, 3 greater ones, 3 smaller ones, missing often (these last ones), lobes bifid, the incision arqued or acute, inserted in front of petepalsegs, in the throat of the tepaltube, yellow to orange coloured 2—3 mm high, 1.5 mm broad. Smaller lobes conic, with acute apex, inserted in front of setepalsegs, 1 mm high and 1 mm broad. 6 *stamens,* fertil, in 2 cycles, without filaments, inserted in the wall of tepaltube, of yellow colour. Inferior anthers in front of setepalsegs, 4 mm above the base of tepaltube. Upper anthers in front of petepalsegs, inserted 7.5 mm above the base of Tepaltube. *Anthers* 1.6—2 mm long. 1 *style, ovary* cylindric, trivalved, 2 mm high. *Stigma* globose. *Capsule* cylindric, formed by 3 valves. 4—6 seed in each valve, of black colour.

Type: *Leucocoryne incrassata* R. A. Philippi, Vallenar Prov. Atacama, II-1883 (SGO.-46775). *Chrysocoryne incrassata* (Phil.) Zöllner: Taltal, prov. Antofagasta 17-IX-1967, O. Zöll. (Herb. Zöll.-6333). This specimen was observed in several places on the Coastal Range of Cordillera between Antofagasta and Caldra. The date which has given R. A. Philippi (February 1883) must be erroneous. The author has studied during several summers the zone of Vallenar, but could not discover any green bulbous plant in this semi-desertic region.

APPENDIX

Tristagma dimorphopetala C. Gay (Hist. Fis. Pol. Chile, VI:126) and illustrated in Atlas Bot, Lam. 69, cited in Herbertia 12:57. 1945 - is a *Chrysocoryne oxipetala,* for having 6 stamens and a fleshy paraperigone, 3-lobed, lobes conic.

DR. HOWARD MEXICAN PLANT COLLECTING TRIP, 1972

JAMES A. BAUML, *130 Melba*
San Antonio, Texas 78216

With the summer of 1972 came another opportunity for joining Dr. Thad Howard on a plant collecting trip into Mexico. Again I decided in the affirmative. Steve Lowe, a friend of Dr. Howard and me for several years, and a junior in horticulture at Southwest Texas State University, likewise received and accepted the invitation to take the two-week trip. We packed Dr. Howard's new VW bus with all the anticipated supplies and left San Antonio at 6:00 P.M., Friday, August 4.

ITINERARY

Our route had been designed to include travel through the state of Sonora, previously untraveled by Dr. Howard. We planned not only to obtain an idea of the composition of plant life, but also to attempt a collection of *Hynenocallis sonorensis* Standley, described from Alamos, southern Sonora, and Rio del Fuerte, in northern Sinaloa. From Sonora, we had plans for following basically the same path as last year through Nayarit, Jalisco, and Colima along the coast, and then across Michoacan to Guerrero and hopefully as far as Oaxaca.

NEW MEXICO AND ARIZONA

Saturday we had traveled through New Mexico, and we made our first plant investigation at Texas Canyon in Arizona. Though *Zephranthes longifolia* and *Brodiaea* could not be spotted, a two-foot yellow *Anthericum* and *Milla biflora* did appear though in very small numbers. East of Tucson, colonies of Ocotillo, Barrel Cactus and Sahuaro Cactus became more common.

SONORA

After lodging at Guaymas, our next day's journey took us to Navojoa and then to Alamos for the northern AMERINDIAN LILY *Hymenocallis.* No *Hymenocallis* could be found, and Alamos disappointed us as a town. We ate lunch there none the less and drove west and then south again on Highway 15 into northern Sinaloa.

SINALOA

Far from having given up our search for the northern AMERINDIAN LILY, we turned northeast from Los Mochis on the road parallel to Rio del Fuerte. The flashes of white in the roadside ditches a few miles south of El Fuerte told us we had found some kind if *Hymenocallis.* We pulled off the road to investigate. We found the plants in bud, flower and fruit. While I gratefully pressed specimens, Steve and Dr. Howard braved the muck and retrieved several bulbs. Variations among the flowers amazed us all, as cup size, anther color, tube length, petal length and even color differed considerably between extremes. This plant Dr. Howard had known as *H. sinaloaensis* from La Cruz, (southern Sinaloa). We continued through Los Mochis to Culiacan where we rested for the evening .

By 8 :30 the next morning we had commenced the drive to Mazatlan, and by noon we had arrived at the city limits. Outside the city, the road branched, so we took the road labeled ''Playa Mazatlin,'' the Mazatlan beach. This fortunate decision netted several finds, namely, *Milla biflora, Bessera elegans, Cipura, Hymenocallis sonorensis* Standley, and an escaped *Crinum* cultivar, ''Empress of India.''

NAYARIT

Into sandy lowland country we drove that afternoon to search for the interesting Irid, *Cypella rosei.* Both *Milla biflora* and a new *Bravoa* species appeared with *Cypella.* The day closed for us in Tepic where we stayed for the nigth.

Along the road to Puerto Vallarta the next day, we collected several interesting terrestrial orchids including a little yellow *Habenaria,* a four foot creme and purple Bletia-type, a bronzy-leafed orchid with tunicated corms plus a fragrant white Aroid. *Hymenocallis azteciana* Traub appeared along this road blooming both within sight of the highway and further back in the shade under thicketized vegetation. With interest we found some plants blooming without leaves, and we noticed that the characteristic white tube often contained an infusion of green in the lower portion. Two scapes exceeded four feet in height!

We relaxed in Puerto Vallarta at Jack's Restaurant before starting our return to Tepic. Aften dinner we almost left the state of Nayarit, but we decided to stay at Ixtlan del Rio. When I awoke the next morning from a deep sleep, Steve and Dr. Howard reported how the marching of a Mariachi band lead by its three gleeful inebriated parttime employers had disturbed their early morning slumbers. Old Mexico is quite a place!

Not far past the Nayarit-Jalisco state line we found with some difficulty the colony of exceptionally large *Hymenocallis horsmannii* Baker of the 1971 trip. At that late date seeds had dropped and foliage had begun to yellow. Likewise, a *Bessera* collection site of the previous year we located only by a few dried seed pods. At Km. 94 *Milla biflora,* a few *Polianthes* in bud and fruit, *Tigridia passiflora,* a *Manfreda* species, and an *Oxalis* appeared. The *Millas,* not ripening as quickly as *Bessera,* could still be spotted by their upright stalks.

Magdelena children greeted us with smiles and opals of all assorted shapes, sizes and colors as we pulled to a stop there. All three of us succumbed to the "fire" in the stones and bought several samples as souveniers. And just down the road at Tequila, home of several brands of the potent brew, we again lost pesos in the interest of science.

Guadalajara was beautiful, but time limited our sight-seeing. We headed south through Ciudad Guzman in lush orchid and begonia country toward Colima. At Km. 38 and a few kiometers further grew *Hymenocallis acutifolia* (Herb.) Sweet and *Hymenocallis* "hannibalii". Both were in flower. The late hours and darkness dictated that we wait for morning to collect them.

COLIMA

After breakfast the Volkswagon bus took us from Colima on the short route toward the coast. Only five km. south of the city in a plantation of unusual trees with very hard round shiny green fruits we found three species of *Tillandsia* bromeliads and one species of *Epidendrum.* At km. 18 were purple *Bessera,* the *Hymenocallis species,* terrestrial orchids in leaf, ferns and *Selaginella.* An interesting *Begonia* with an eighteen inch leaf, hirsite on the back, also grew here.

At km. 22.5 grew a Tradescantioid with colorful variegated leaves and a *Begonia sp.* with leaves speckled red. In the same little steep ravine we collected the dwarf *Sprekelia* in leaf and an Aroid with elephant-ear type leaves.

By late morning we turned back toward Colima. We easily spotted a colorful *Pinguicula* sp., the carnivorous butterwort, by its bright pink to rose-purple flowers, growing tenaciously along a flat lime stone face. Besides having colorful flowers, some individual rosettes assumed a bronzy tint. And just up the road we stopped to search for the yellow *Nemastylis convoluta* in the same location as in 1971. Its delicate deep stems made collection difficult, but a generous seed supply offset the dearth of obtainable bulbs.

After stopping again in Colima for a late lunch we headed north and climbed a "Microondas," a TV tower road, the first of several. Winding round and round up the mountain on the brick roadway we found a large *Bessera* colony in leaf along with a few isolated scarlet bloomers. A *Hymenocallis,* probably *H.* "Hanniballi" grew nearby. At the top, a church still under construction along with the television tower greeted us. On the descent back to road level, Steve yelled, "Bravoa!" and we quickly stopped and pulled to the side of the road to investigate. A *Bravoa* it was. This new species appeared very different from any other members of the genus. Distinct black stripes covered 1/3 the length of the tubular red and green flowers. Again I pressed specimens while Steve and Dr. Howard took a sample of the plants. Mature bulbs were long and slender, easily broken with digging.

Our last stop in Colima came at Km. 204 where the dwarf *Hymenocallis sp.* #65-48 had been found on earlier trips. Steve and I found the semi-dormant bulbs with yellowed leaves after scanning the ground carefully.

JALISCO

Another *Begonia* awaited our discovery at km. 191. Flowers ranged in color from white to red, and some plants had leaves with red margins. These grew in damp dark fluffy soil in shady spots above the road.

Outside the city of Pihuano we saw more *Tillandsias* and also a rainstorm and hail. Before km. 144, we had noticed *Bravoa gemniflora* and *Tigridia pavonia,* the Mexican Shellflower. At km. 140 grew *Hymenocallis acutifolia.* The weather had turned quite chilly by the time we stopped to eat supper in Manzanitla. With coats buttoned securely we sat down to eat at a small restaurant in the town square To add to the culinary pleasures of our meal, our waitress suggested ''crema'' for our food. The sour cream she brought did taste good on our pork and sweetbread, and we were introduced to another regional Mexican custom.

As another interesting sidelight here, an old lady with a beautiful collection of tuberous begonias allowed us to tour her garden when we showed great interest in the plants which covered her porch. Not only did she grow imported Begonias but also *Hymenocallis,* succulents. *Fuschia, Tigridia, Brunsvegia,* and others.

MICHOACAN

Passing through San Jose de Gracia, we stopped at another residence to inquire about yellow *Tigridia pavonia.* This lady too kept a nice garden and admitted that people often stopped to see her plants. She agreed to trade some *Tigridia* bulbs and seeds for an offset from our *Crinums* and a *Hymenocallis* bulb.

Outside the village, we began seeing bush morning-glory plants with deep purple flowers having a white throat. As no seeds had ripened on the plants, we were forced to leave with no hope of growing the beautiful bushes in our gardens. Scattered among the morning-glories grew a *Milla* species with short stem and long tube. We collected a few at km. 28.

At the site of the 1971 collection, a wet clay sloping hillside at km. 157, we again found *Hymenocallis mexicana.* Grazing had taken its toll of leaves and we spotted the nubs of leaf with difficulty.

Past the village of Zapoca we recollected a white-flowered stoloniferous *Allium sp.* It grew by the thousands in the damp ditches on both sides of the highway. Our next stop netted two species of tuberous begonia, one which pleased Dr. Howard a great deal with its fragrance. Both sported pink flowers but differed in leaf shape and coloring of the veins.

Between km. 85 and 86 we turned from the main highway onto a twisting road which eventually took us to a secluded cornfield where really beautiful tall corn plants thrived. While traveling this road we stopped to collect dark maroon Dahlias. Dr. Howard then spotted a tiny white terrestrial orchid, probably *Habenaria,* only about five inches tall. Steve enthusiastically dug samples and wrapped them in sphagnum moss for safekeeping. A glaucescent *Sprekelia* in leaf grew in the rocks at the road's end. In the same area were a strange Manfreda-type plant with pendant green flowers, a Bletia-type "hooded flower" orchid, *Bravoa geminiflora,* and a red-purple *Penstemon.*

The tasty native whitefish and native wares at Quiroga helped us decide to eat supper and shop in that city. All three of us unloaded many pesos on gifts and souveniers. We made one last collection before arriving in Morelia when Steve's eye caught the yellow, orange and red flowers of an *Echeveria* growing along the rock wall just outside the city.

After an early breakfast downtown, Dr. Howard drove us to the VW agency at the outskirts of town in order to leave the bus for its 1,000 mile check-up. We then hopped on a city bus which took us into town for sightseeing. In Morelia, we toured the cathedral and stumbled on the state museum of Michoacan with a large display of Indian relics. Back to the shop we went, and the bus was ready.

Not far from town at Puerto de los Capuertos, km. 233, a tall hillside, suspected home of *Tigridia multiflora,* called us upwards. By the time we reached the top of the steep grassy hill, the air was thin and cooler. Along our climb, we had seen the *Echeveria* of the previous day, a tiny purple *Nemastyllis sp., Calochortus barbatos* with its hairy yellow flowers, terrestrial orchids and *Bravoa geminiflora.* Slightly down the hill on the other side, we found *Tillandsia recurvata* and *T. atroviridipetala* and a large number of *Calochortus* in bloom. Carefully we made our way back down, loaded the bus, and drove on, confident of a solid sleep that night after the long hike.

A quick stop at km. 223 netted an Arisaema-type aroid with a speckled stem.

On the left at around km. 216 we stopped for snapshots of a beautiful waterfall. Its waters cascaded hundreds of feet into a lush, stream bed and ravine below. Rock walls along the winding mountain highway dripped with cool water and we saw ferns, begonias, and a yellow *Spiranthes* orchid. At km. 205 past El Alamo we came into pine forest and collected an *Echeveria species* growing on the rock faces of the roadside.

An interesting eating spot, the Quinta Mitzi, at km.123 provided excellent homegrown vegetables and Angus beef for lunch. Two women, a mother and her daughter from Chicago, both avid gardeners, owned the restaurant and gardens on the property. As gardeners will do, we traded interesting plants from one another's collections. They exchanged *Crinum augustum, Crinum moorei, Hedychium,* and a miniature *Gladiolus* for our *Besseras, Crinum, Milla,* and a *Hymenocallis.* Not far from this restaurant we stopped and collected *Tigridia meleagris.* Also, of special note, we found in bud a *Milla* species unflowered many years until 1972 under cultivation, which was here in bud. This form or species had what appeared to be stolons rather that offsets for vegatative increase, and resembled *Milla biflora* both here and at home.

MEXICO

Dr. Howard took Steve and me on an interesting side trip to an extinct volcano Nevado de Toluca. From pines we passed the Timber line to an altitude of low grassed and alpine flowers, past bleak rocks to more grasses and finally to the lakes at the top, Lake of the Moon and Lake of the Sun. Air had become cold and thin and clouds past in eerie procession across the lake from us.

MORELOS

Back down the highway we began finding more interesting plants beginning at km. 47. There we saw the bright red -purple flowers of a *Pinguicula* species against a rock wall. Four kilometers later two *Oxalis* species grew mixed among one another. *Oxalis deppei* sported green stems and basal offsets while the other species increased by stolons and had red stems. On the same stop we found a fantastic terrestrial orchid several feet tall, whose spike of yellow flowers covered a purple stem. Here, too, we saw the only tree fern of the trip.

Between km. 63 and 64 Steve's eyes brought the bus to a quick halt. He had spotted what appeared to be a tall, dark purplish-blue *Nemastylis.* In actuality, it turned out to be an uncommon Irid, *Sphenostigma longispathum,* never before collected by Dr. Howard. In the same area grew a bronzy-leafed terrestrial orchid with a big green lip, a member of the Crassula Family, perhaps *Cotyledon, Calochortus* in bud, and a *Manfreda* with narrow spotted leaves.

Since rain could be seen approaching, we had to cut digging short and move on toward Temascaltepec in search of *Hymenocallis Harrissiana.* One last stop outside the city netted *Bessera,* a wine and gold *Calochortus* species, and *Tigridia ehrenbergii.*

No *Hymenocallis* appeared on our drive south after dinner, so we drove back to Toluca and from there to Ixtapan de la Sal. Many *Milla* and *Bessera* and orange *Stenorynchus* orchids grew from km. 68-78. We voted unanimously to keep on driving toward Taxco, even though darkness had set in. We took advantage of being in this beautiful mountain city and ate well, enjoyed mariachi music, and the next morning toured the market place.

Past Iguala, in the vicinity of km. 45, we pulled off the road and searched through the wooded hillsides for *Dandya thadhowardii.* Dr. Howard found them, but the corms had already-withered leaves and we saw no bloomstalks.

An interesting phase of the trip began with our turning east from Chilpancingo toward Tlapa. At km. 5, we each took a bag and a pick or shovel and took off up a ravine from the roadway. We each found something exciting and different by the time we all met again about twenty minutes later. Among the plants were two different *Pinguicula* species, one with long thin leaves in a rosette rather than the normal flat wide leaves, at least six terrestrial orchids, an orange and red speckled *Achimenes, Bravoa gemniflora* and a giant *Bravoa* specimen, much larger in all its parts than any others on the hillside, a *Schoeno-*

caulen and many ferns.

Five km. further on a hillside with scattered *Agave* plants we collected a little white *Achimenes* with purple throat which grew into the light from under or out of cracks and holes of large rocks and a *Spiranthes* orchid species. In the vicinity of palmetto and ferns grew a succulent, *Thompsonella,* in both green and purple forms, *Sessilanthera,* and bromeliads.

We finally arrived at the out-of-the-way but very interesting city of Chilapa. For a day and a half we took a break from the routine by spending time in the marketplace, buying raspas, equivalent to our snow cones an Indian treat of crushed ice and syrup on a stick. The morning of our second day, a religious feastday, involved a great deal of fireworks, and historical street drama with local talent and an authentic Indian band with its blaring and banging repetitious accompaniment.

After the festivities we drove on looking for more bulb life. A *Tigridia* species in leaf and fruit, a spotted wide-leafed *Manfreda,* stoloniferous *Allium* and *Calochortus* in leaf grew under the pines at km. 71. An interesting find at km. 95 was a plant quite similar to *Milla biflora* but having approximately 2 mm. filaments in contrast to the usual 1 mm. or less. Search as we could, only three corms of this plant could be found.

Just beyond the village of Patatlan we saw growing up on a hillside what appeared to be a colony of *Bravoa geminiflora.* Instead we had seen an annual whose flowers bore a striking similarity both in color and form to those of the *Bravoa.* We gathered seeds and also dug *Hymenocallis choretis* which grew with the annual.

Soon after stopping to collect an interesting *Polypodium*-type fern and an *Oxalis* at km. 115, we drove through Chilapa back to Chilpancingo. Of note along this highway were several collections of *Sessilanthera latifolia* var. *heliantha* and perhaps a second species. From old flower stalks we could see that some had developed from out of the center of the fan of leaves and others from a point adjacent to the leaves.

The next day we drove south with Acaquizotla as our goal. In the summer of 1971 we had lost the opportunity of recollecting the indigenous *Petronymphe decora,* a plant in the *Milla* alliance with triangular leaves and an umbel of greenish, pendulant, tubular flowers. It prefers to grow high along rocky outcroppings near the village. On the route, we added more *Hymenocallis choretis* to the valuable load in the bus.

We first found a very hirsute Gesneriad with creme flowers spotted red. In addition we dug a few bulbs of *Hymenocallis eucharidifolia* which has become more difficult to find in the Acaquizotla area. For two hours we macheted and climbed through high vegation, first down to a creek bed, and then up the hillside to the rock ridge upon whose edge *Petronymphe* grew. By taking turns precariously balanced between rock and tree, we managed to knock loose a small collection, but a steep ravine with sides obscured by bush, kept us from reaching the main colony. This failure disappointed us considerably as the plant has refused to set seeds under cultivation, and vegetative propagation is rather slow. At Chilpancingo we spent the night again.

South of Igula the next day we left the main road to Teloloapan. At the same location as last year we stopped to find the white *Sessilanthera, S. latifolia* var. *latifolia.*

At Km. 37 grew a rose-purple *Achimenes,* the large one-leaf *Begonia* sp., the leaf about two feet across. Another Gesneriad in the same location displayed its flowers to us on stems arising from tubers back in the cracks between rocks. This plant had light purple flowers with white centers spotted yellow. We returned to our cutoff and drove through Iguala toward Cuernavaca on the toll road.

The long, round drooping leaves of *Milla magnifica* at Km. 84 compelled us to pull off the road and upturn a few corms for the collection bag. In the plant-collecting spirit we started up another Microöndes around Km. 79. Both *Tigridia meleagris* and *T. ehrenbergii* were spotted on our way to the top.

MEXICO

We slept in Cernavaca and drove to Cuatla by noon the following day. At Km. 81 we passed from Morelos into the State of Mexico. Dr. Howard treated us to another excursion along breath-taking volcano side roads. He took us to the end of the roads leading to both Popocatepetl and Itzacihuvatl. Once again, the chilly air carried clouds across barren valleys at eye level.

In Mexico City we stayed long enough to enjoy supper and then drove to Queretero before calling it a day.

GUANAJUATO

At Km. 13 we passed the Queretero-Guanajuato state line on Highway 57. Still another Microöndes beckoned us at Km. 72. After an hour of driving and finally reaching higher altitudes we saw interesting plants again. Here were rock ferns, *Milla biflora,* wild *Zinnia,* and *Tagetes, Castilleja, Sprekelia, Allium glandulosum,* a yellow *Dahlia, Anthericam, Bomarea,* and a shrub with tubular yellow flowers. We also discovered *Tigridia ehrenbergii* whose sepals were larger and more yellow and whose center had more purple color than those of any of the species we had collected earlier. After a quick tour of the charming city of Guanajuato with its many underground highway tunnels we continued on into the State of Jalisco.

JALISCO

On our second pass through Jalisco, Dr. Howard planned to recollect a white *Polianthes* sp. which disease had destroyed in his garden. On the road to San Juan de los Lagos we scoured the ungrazed roadside along the fence for any signs of bloom. When this proved unsuccessful, a quick search on foot turned up the missing plant. Lack of rainfall had stunted the bloomstalk height and made the plants difficult to see. Thus, few plants were blooming, and we dug in the hard dirt guided mainly by the leaves. In association with the *Polianthes* grew *Milla biflora* in excellent form with many fragrant flowers per umbel.

SAN LUIS POTOSI

Our first collecting in San Luis Potosi progressed in unorthodox form. We had passed through Aguascalientes and were within 34 Km. of the City of San Luis Potosi, when Dr. Howard began peering into the peripheral light of the bus headlight for night-blooming *Milla clintii* he knew grew in the vicinity. A tiny patch of white in the darkness disclosed the flowers and we stopped, backed up, and dug corms of the *Milla* by headlight illumination. This one was *M. biflora* though. This same procedure finally resulted in a stop during which *M. clintii* was found. Beside it was an *Allium,* assumed to be *A. potosiense.* We tried every acceptable hotel and motel in the City of San Luis Potosi, but none had available rooms. Out of necessity we continued to Matahala where we found accomodations in the wee hours.

NUEVA LEON

In the comparatively cool and dry environment of Nuevo Leon we felt in our back yard. On a rocky hillside north of the State Line we found only one bulb, a *Milla* in leaf, but Steve took a specimen of *Mammilaria candida* for a cactus collection.

Allium neuvoleonense along with *Yucca, Agave, Mammilaria, Opuntia,* among the rocks appeared the Microöndes "Cruz de Elorza", Km. 27. Despite the sun and the dryness, the pleasant temperature of the breeze kept us comfortable.

Between Km. 66 and 67 we followed a dirt road to the right off the main highway. Dr. Howard's sharp eyes noticed bulb leaves in the bare spots among the shrubs and grasses, and the plant turned out to be *Zephyranthes* "Matahuela Frost" with ripened seed capsules. In the soft chalky soil we had soon gathered a sufficient number for the garden. Steve again demonstrated his powers of observation by noting a different *Allium* species, another plant previously collected by Dr. Howard and lost in cultivation.

Echeveria strictaflora, unlike most of this genus we had found chose a flat place to grow, namely along the roadside at Km. 92. Its colorful red and yellow flowers made it prominent along the bleak vegetation.

Another interesting find was a terrestrial orchid growing in this cactus environment. At Km. 112, Dr. Howard stumbled upon the red *Spiranthes* during a cursary investigation of one hillside.

We crossed the Nuevo Leon State Line into Coahuila to drive through Saltillo but soon returned to the former State at Km. 34. The final Microöndas of the trip left the highway as we did at Km. 36 or 37. When we stopped to collect *Allium ownbeyi* with its white and lavender flowers, Steve met up with a friendly little rattlesnake. Being a very shy individual, the snake only tried to hide in the rocks where he was perched above the road on a ledge and would not even shake his tail for us. *Echeveria simulans* was also found. At the TV tower at the top, the cool winds toyed with our balance in its powerful howling gusts. The view of the valley and mountains beyond was beautiful, and a rainbow in the distance added to the magnificence of the scene.

Despite the fact that the three of us traversed much of the countryside of the 1971 trip, we often came across a different variation of plant life because of the lateness of the summer and a few side trips. Steve discovered the interesting new *Bravoa* species. We collected *Sphenostigma longispathum,* a new plant for us. We brought back the few corms of the localized *Milla* sp. with 2 mm filaments. Dr. Howard relocated the Jalisco white *Polianthes* sp. and the Nuevo Leon *Allium* sp. And as usual, we saw the parts of Mexico few tourists visit, high up to dead volcanoes, into remote villages, and up TV tower roads. We look forward to enjoying this summer the fruits of our plant collecting in Mexico, 1972

MEXICAN PLANT COLLECTING TRIPS, 1973-1976

THAD M. HOWARD, *13310 San Pedro Avenue, San Antonio, Texas 78216*

1973 TRIP

Southern Mexico, Guatemala, and El Salvador were the focal points of my 1973 summer field trip. Jeff Fields, a college student accompanied and assisted me. As usual, luck seemed to be with me, and thus I was able to find several species of bulbous plants that may be new to science, as well as other rare things.

In the state of Oaxaca we collected a new *Polianthes,* tall and robust as a Tuberose, but with smaller flowers, slightly inflated in the tubular portion, light yellow within and with red exterior. Because of the inflated tubes, it appeared to be nearly intermediate between *Polianthes* and *Prochnyanthes.* The flowers are odorless and in cultivation they have sucessfully been hybridized with Tuberose.

A new *Hymenocallis* species was found in the mountains of Guerrero. This one flowers early, is fragrant and has linear leaves that are glaucous. It is a new addition to the Mexicana alliance.

A new *Allium* was found at the Hidalgo-Queretaro state line. It is a smallish thing, with pinkish-white flowers keeled purplish. Casually it is not too unlike our own Texas A. Drummondii, but closer inspection reveals that it is a member of the Mexicana *Allium* Alliance.

In Oaxaca I finally collected *Hymenocallis choretis* var. *oaxacensis* and was able to verify that it does indeed have shorter tubes (in some individuals) than the mainstream populations of this species found elsewhere.

1974 TRIP

The summer of 1974 gave me an opportunity to return to Oaxaca, by way of the Gulf Coast route via Veracruz. Jim Bauml accompanied me this time. The Veracruz area gave us a chance to collect *Crinum loddigesianum,* a plant I had previously mistaken for *C. americanum.* They are essentially very similar, but *C. loddigesianum* has slightly smaller flowers with much longer tubes, a slightly different fragrance, and occasonally a purplish tinge on the reverse.

In Oaxaca, near Huajuapan, I found yet another new *Polianthes* species with red and yellow flowers. The flowers were not too unlike those we found in Oaxaca in a different environment the previous year, but these grew at a lower elevation in dryer conditions, had narrow, glaucous leaves, and were only half as tall. With the finding of this plant, we now have added three new species to the genus *Polianthes* in the state of Oaxaca, where previously none were known.

Another highlight in Oaxaca was the finding of *Crinum cruentum* in a large colony in the highlands on a hillside near a small stream. From a distance they looked somewhat like *Hymenocallis*, save that they were pinkish. At close range they look a good deal like *C. loddigesianum*, but more colorful. Whereas *C. loddigesianum's* habitat is the tropical coastal regions in aquatic conditions, the habitat of *C. cruentum* seems to be much higher elevations where moisture is more seasonal and it is dependent on runoff seepage during the rainy summer season. Apparently *C. cruentum* replaces *C. erubescens* in Mexico and reports of *C. erubescens* should propably be relegated to *C. cruentum*. *C. cruestum* differs from *C. erubescens* mainly in having much longer tepal tubes.

Jim Bauml spotted another new *Hymenocallis* species of the Mexicana alliance in the state of Mexico, near Amecameca, not far from the base of Popocatepetl, the famous snow-capped conical volcano. This one had a small staminal cup. It seems that nearly every new trip to Mexico adds yets another *Hymenocallis* species to our ever-enlarging collection. We now know of nearly thirty species from Mexico.

1975 TRIP

My 1975 trip was very different from all previous trips and I did a minimum of collecting. I drove from San Antonio to Chihuahua City, Chihuahua, and caught the train to the coastal region of Los Mochis and Topolobampo, Sonora. The train ride goes through Tarahumara Indian country and the famed Copper Canyon. I was pleasantly surprised to see many colonies of *Sprekelia formosissima* in leaf and in seed in the rocky outcroppings along the railroad high in pine tree country, at around 6000 feet or so. I think that this may be about as close as *Sprekelia* comes to our Southern U.S. borders . . . only a few hundred miles below New Mexico.

After leaving Chihuahua City and returning homeward, I collected a few *Zephyranthes longifolia* and *Manfreda brunnea*. Upon returning, I was able to plant and flower a few *Z. longifolia* bulbs and fulfill an old dream of hybridizing them with some of my own hybrids. I now have seedlings of *Z. longifolia* x 'Helen Wyatt' and look forward to see what weird sort of critters they will mature into.

I won't go into details of the 1972 trip since I understand Jim Bauml will do this elsewhere in the Yearbook, but I will mention that we collected an unknown member of the Manfreda-Polianthes tribe in leaf somewhere in Nayarit of Jalisco that finally flowered in the summer of 1975. It appears to be a new *Prochnyanthes* species. The flowers are reddish outside and light greenish-yellow inside. It differs from *P. mexicana* in having numerous, narrow leaves, not unlike many

Polianthes. It flowers here in early autumn. We also found a stunningly different *Polianthes* in the state of Colima with unpaired pendant tubular flowers produced in profusion on a tall scape. The exterior color is principally red and green, with a black interior. It has recently been published as *P. howardii*. Luther Bundrant has successfully hybridized *P. howardii* with *P. tuberosa* and these should flower early in the summer of 1977.

1976 TRIP

In 1976 Jim Bauml again accompanied me on two trips to Western Mexico (Durango, Sinaloa, Nayarit, Jalisco, Aguascalientes, and Zacatecas). I will write more of these two trips later, but we found more important collections of many species of *Polianthes, Allium scaposum* and other *Allium* species, *Hymenocallis leavenworthii* (formerly dubbed *"Pancratium" leavenworthii* in error), a new *Hymenocallis* closely allied to *H. acutifolia,* growing in a riverbed in Sinaloa, a new yellow flowered *Tigridia* from Sinaloa and Jalisco, plus our usual assortment of varied Mexican bulb life. For us, 1976 was a banner year, botanically speaking.

PLANT LIFE LIBRARY

COMPLETE BOOK OF HOUSE PLANTS UNDER LIGHTS, by Charles Marden Fitch. Hawthorne Books, Inc. 260 Madlson Ave., New York, NY 10016. 1975. Pp. viii + 275. Illus. $9.95. Hawthorne Books, Inc. has made a notable addition to their series of useful, "Complete" and "How to", books about plants. The publication of Charles Marden Fitch's, "Complete Book of Houseplants Under Lights" (CBHL) is a significant addition to this list. Produced under the capable direction of Helen Wilson Van Pelt as Editor, CBHL will be a valuable reference for both amateurs and professionals attempting to grow plants under lights. More specifically, CBHL is aimed at those persons wishing to grow plants under lights in their homes or in small greenhouses. CBHL is organized into two parts: Part 1, "Basics of light gardening" and Part 2, "Plants to grow". Under, "Basics of light gardening", such subjects are discussed as: Gardens under lights; Light in nature; Fixtures for light gardens; The environment: air, humidity, temperature; Containers and methods of watering; Potting mixes and fertilizers; etc. Part 2, "Plants to grow", is essentially a list of plants adapted to culture under lights. But it is much more than a simple list of plants. For example, the distance the plant is to be placed from the light source is given. Also, included is such relevant information as where the species originated, its habitat, method of propagation, a short description of the plant, and other pertinent and interesting facts. These highly condensed paragraphs about each genus are loaded with information, and are actually one of the most instructive and enjoyable features of the book. There is a chapter on pests and diseases, and a most useful and inclusive chapter on Plant Societies and Sources of equipment. The latter chapter also lists retail sources of plants suitable for growth under lights. The book terminates with a Bibliography of 10 entries, and an Index of 14½ pages. Fitch is one of those rare people competent to write a book of this nature. A skilled plantsman, a world traveler, an excellent photographer, and a writer with experience in popular and scientific journalism, it would be difficult indeed to find a person so well equipped to produce a **vade mecum** of high caliber on this subject. The book is abundantly illustrated, and the prose, clear and entertaining. I have no doubt CBHL wil prove to be a reference work of great value. There are few flaws in the composition of the book, although reproduction of the photographs does not do justice to Mr. Fitch's elegant photography. There are surprisingly few typographical errors. The only major editorial error I could spot is the omission of the legends for the plants on page 175.—**Thomas W. Whitaker**

EDIBLE LEAVES OF THE TROPICS, by Franklin W. Martin and Ruth M. Ruberté. Published jointly by the Agency for International Development, Department of State, and the Agricultural Research Service, USDA. 1975 235 pp. illus. The authors of this "mine of information" are respectively, Director of the Mayaguez Institute of Tropical Agriculture and Laboratory Technician at the Institute, Dr. Martin has had seventeen years of experience in tropical agriculture, and is well known for his studies of edible and non-edible yams, and the genetics of incompatibility systems. His co-author is evidently knowledgeable in the field of biochemistry and nutrition. Their talents are merged beautifully to produce this important and original book of 235 pages.

In many ways the book is of great significance, mainly because it draws attention to the use of edible green leaves as food. Since edible green leaves are plentiful in the tropics, there is the potential of eliminating hunger and malnutrition over vast areas of the globe, providing people can be taught to exploit this resource. Plant scientists of temperate zones have little conception of the great number of tropical species with edible leaves. In the Appendix the authors have compiled, "A list of Tropical Plants with Edible Green Leaves." In this Table are listed approximately 1650 species scattered among 138 families—truly an incredible number. The authors have included much of their own research, but understandably they have derived much information from a thorough review of the literature.

One of the most important chapters in the book deals with, "Principal Edible Green Leaf Herbs of the Tropics" (Chapt. II). Here is a list of species with edible leaves segregated according to families. For each species the authors give much information of value, such as the parts of the plant eaten, notes on the history, culture, fertilization, and for some species preparation for the table.

In my opinion the authors have covered nearly every aspect of edible green leaves as the titles of the Chapters indicate. There are Chapters on "Some Fruits, Vegetables and Ornamental Plants with Edible Leaves"; "Common Weeds with Edible Green Leaves"; "Tropical Trees with Edible Green Leaves"; "Tropical Leaves as Spices and Teas"; "Temperate Zone Green Leaves in the Tropics"; and "Lettuce in the Tropics". The book concludes with and instructive Chapter on, "Tropical Leaves that are Poisonous"; and a useful Chapter on, "Culture and Care of Green-Leaved Vegetables".

Perhaps the weakest link in the book is the lack of nutritional information. This is by no means the fault of the authors. It simply indicates that here is one area of research where basic information needs to be developed.

There are some minor, but disturbing flaws in the book which gives one the impression that it was hastily assembled. One example is poor reproduction of the photographs. There are 56 photographs; few of them acceptably reproduced. Some are fuzzy, others lack sharp contrast, and have a washed out appearance. Some have both defects. A few are so poorly reproduced they do not adequately convey the author's message (Figure 38). There are the usual number of annoying typographical errors, and some awkward expressions. A more serious error is the misplacement of an entire paragraph. **Aleurites** species, and **A. fordii,** the source of tung oil are listed under the Compositeae. **Aleurites** is of course a genus of the Euphorbiaceae (pg. 99).

The reference to G. W. Purseglove's 4 volume work on Tropical Crops is improperly cited. One wonders why the book by G.A.C. Herklots, "Vegetables in South-East Asia" 1972, has not been cited in the Selected References Combining Edible and Poisonous Leaves. Herklots' book is probably the most informative treatise on tropical vegetables yet published.

In summary, "Edible Leaves of the Tropics", is an extremely useful book for the purpose for which it was intended. It could easily have been an outstanding one with more attention to the details of typography, and printing. Let us hope the authors will make plans to correct the unnecessary mistakes that plague the text, in a second edition, which most surely will be demanded within a short period of time.—**Thomas W. Whitaker**

BIBLIOGRAPHY OF PLANT VIRUSES AND INDEX TO RSEARCH. Compiled and edited by Helen Purdy Beale. Columbia Univ. Press. 562 W. 113rd St., New York, N. Y. 10025. Pp. 1-xii - 1495. $75.00. This is a monumental work. After a little more than a page of acknowledgements and a very brief introduction explaining the preparation of the Bibliography and Indexes the remainder of the book is in two main divisions—the Bibliography covering 1452 pages, and Index To Research covering pages 1453-1495. Its purpose is "not only to make the large number of articles on plant viruses more easily obtainable for reference, but to make this information as readily available as possible." In the Introduction Dr. Beale states: "entries are arranged alphabetically according to author and make up the **author file,** exceeding 29,000 entries from an estimated 6,500 periodicals." About half of the articles are in English, the rest in various other languages. The Subject Index appears to be the most useful portion of the Bibliography. It is divided into two parts. Part I is a list of about 500 viruses with their reaction to 5 subjects of general interest, namely, (a) electron micrography; (b) indicator or test plants; (c) intranuclear bodies and virus-like inclusions; (d) purified viruses; and (e) serum reactions. Part II is compilation of references of each virus applied to those beginning with A thru C, and to some under D, G and T. The author admits the Bibliography is incomplete in some respects, but it is unlikely that any individual will have the expertise, experience and stamina to compile a better one for many years to come.

MYCOGENETICS, by J. H. Burnett. John Wiley & Sons, 605 3rd Av., New York City 10016. 1975. Pp. xiv + 375. Illus. Paper $12.00.—Subtitled **"An Introduction to the General Genetics of Fungi,"** this outstanding book will be welcomed as a pioneering volume in this little cultivated field. The book is in four sections. **Section 1** is concerned with fungi as organisms for genetic study. **Section 2,** the longest part deals with formal; genetics—genetic markers; recombination segregation and linkage; recombination and segregation of nuclei and extrachromosomal elements; and quantitative inheritance. **Part 3** is devoted to population genetics of fungi; and in **Part 4,** applications of fungal genetics are discussed. An appendix, bibliography, author and subject indices complete the volume. This land mark volume cannot be too highly praised, and is very highly recommended to mycologists, pathologists and industrial users of fungi.

A TREATISE ON LIMNOLOGY, VOL. III. LIMNOLOGICAL BOTANY, by G. Evelyn Hutchinson. John Wiley & Sons, 605 3rd Av., New York City 10016. 1975. Pp. x + 660. Illus.—This massive volume on the scientific study of fresh waters—ponds and lakes—is devoted exclusively to "botanical matters," covering conventional ecology of the higher plants and benthic algae, with as much ancillary matter as is needed to make the ecological presentation comprehensible. The six chapters are devoted to **the lower rooted vegetation;** the nature and diversity of **aquatic trachophytes;** biological characteristics of **Tracheophytes of inland waters;** the **chemical ecology** of freshwater macrophytes; the distribution of Macrophytes **in lakes;** and **the algal benthos.** A bibliography and index of authors; index of lakes; index of genera and species of organisms; and general index, complete the volume. Highly recommended to all interested in limnology.

WATER AND PLANTS, by Hans Meidner and David W. Sheriff. John Wiley & Sons, 605 3rd Av., New York City. 10016. 1976. Pp. x + 148. Illus. Paper $5.95.—Written for undergraduate students, this concise treatment of plant-water relations will be welcomed. **Chapter 1** deals with the properties of water, molecular, solvent, etc. **Chapter 2** is concerned with water vapor and the atmosphere. In **Chapters 3 and 4,** water movement through the plant, and water in soils, are discussed. **Chapter 5** is devoted to water in cells and tissues, and **Chapter 6** deals with the role of water in the plant as a whole. An appendix, a very brief bibliography, and index, complete the volume. Highly recommended.

UPTAKE OF IONS BY PLANT ROOTS, by D. J. Bowling. John Wiley & Sons, 605 3rd Av., New York City. 10016. 1976. Pp. xii + 212. Illus.—This attractive book updates our knowledge of mineral ion uptake by plant roots; tracing the uptake of salts by the root, movement of salts to the root surface, uptake into the root, transport across the root and movement in the xylem to the shoot. Highly recommended to post graduate research workers in the plant sciences and soil sciences.

METHODS IN PLANT ECOLOGY, edited by S. B. Chapman. John Wiley & Sons, 605 3rd Av., New York City. 10016. 1976. Pp. viii + 536. Illus. $29.50.—Although written primarily for undergraduate students, this attractive symposium volume should also appeal to research workers generally. Following the listing of the 14 authorities who contributed the articles to the symposium, and introduction, the remaining chapters deal with the History of Vegetation, Description and Analysis of Vegetation, Production Ecology and Nutrient Budgets, physiological ecology and Plant Nutrition, Site and Soils, Climatology and Environmental measurement, chemical analysis, and Data Collection Systems. An index completes the volume. Highly recommended.

ENVIRONMENT AND PLANT ECOLOGY, by J. R. Etherington. John Wiley & Sons, 605 3rd Av., New York City. 10016. 1975. Pp. xii + 347. Illus.—Written for the undergraduate student, this attractive book is concerned with (1) the aims and development of plant ecology; (2) energy exchange and production, (3) soils, (4) chemical and physical properties of soils, (5 & 6) plant and water deficit—physiological and ecological aspects, (7) waterlogged soils, (8) mineral nutrition, (9) biogeochemical cycling and ecology of mineral nutrition, and (10) competition. A bibliography and index complete the volume. Highly recommended.

PLANTS: AN INTRODUCTION TO MODERN BOTANY, 3RD EDITION, by Victor A. Greulach and J. Edison Adams. John Wiley & Sons, 605 3rd Av., New York City. 10016. 1976. Pp. xii + 586. Illus. $13.50—This attractively made 3rd Edition of a standard text in plant science has been written for one-semester or one-quarter courses in general botany. The material is presented in six parts. **Part 1** is built around the theme of man's dependence on plants; the uses of plants by man—foods, raw materials for industry, textiles and cordage, medicines, insectocides, fuels, etc. **Part 2** Plant Classification is almost two decades behind the times. The argument made that groupings of living things are not necessarily natural does not hold for the primary subdivision of **procaryotes** and **eucaryotes** (cellular organisms without or with nuclei) is so fundamental that all research workers proceed on that basis and the student should start out with this fundamental conception **so that he will not be shocked when he reads scientific articles.** Since there are three types of **Eucaryotes—** Plantae, Heteroplantae (fungi) and animals, all with similar cells containing nuclei, the text is in fact concerned with **Procaryotes** (bacteria and Blue Green Algae), **Plants** and **Fungi** (both with the eucaruotic cellular organization; and omitting Animalia, with a similar cellular structure which would be included in a text on Biology (see Traub, 1963, 1964, 1971, 1975). The rest of the section is concerned with plants of the past. **Part 3** is concerned with the levels of plant organization—atomic, molecular, tissue and organ. **Part 4** deals with plants in action—absorption of nutrients, photosynthetic activity, transportation and use of organic substances in growth, etc., water relations of plants; and plant development. **Part 5** is concerned with the plant in its physical environment, other organisms, and the plant community as a whole. **Part 6** deals with plant reproduction, asexual and sexual; plant genetics, heredity and evolution. An appendix, a glossary and index complete the volume. Recommended to beginning students in plant science . (Literature cited: Traub, Hamilton P.—**Plant Life** 19: 160. 1963; **Lineagics.** 1964; **Plant Life** 27: 141-144. 1971; **Taxon** 24: 293-295. 1975); **Plant Life 33**: 85-104. 1977.

STRASBURGER'S TEXTBOOK OF BOTANY, by D. von Denffer, W. Schumacher, K. Maegdefrau & F. Ehrendorfer. **New English Edition** by Peter Bell and David Coombe. Longmans, 19 West 44th St., New York, N. Y. 10036. 1976. Pp. xvi + 877. Illus. $25.00. This English translation of the newest revision of Strasburger's classic text on plant biology, including **for the first time** a Part on the general principles of plant systemematics and evolution (lineagics) by four outstanding German and Austrian plant scientists, will be welcomed by all. The book begins with an all too short Chronology from c. 300 B. C. (Theophrastus) to 1957, which is followed by a brief introduction on the living state, origin of life, animals and plants, and the divisions of plant biology. The main text is in four parts—**Morphology, Physiology, Systematics** and **Evolution (Lineagics)** and **Plant Geography. Part One—Morphology** deals with cytology, morphological organization, plant tissues, morphology and anatomy of the plant body, and its modifications, and reproduction. **Part Two—Physiology** is concerned with metabolism, growth and movement. **Part Three—Systematics and Evolution (Lineagics)**, is devoted to the general principles and a survey of the Plant Kingdom. Although the general principles concerning the **primary** distinctions in plant life, the **procaryotic** and **eucaryotic** cellular organization, are mentioned incidentally in the text, this fundamental fact is not carried over into the organization of the text. A wrong impression is created when Division I. **Schizophyta** (=Kingdom I. **Procaryotae**) is given equal rank with Divisions **Phycophyta (algae), Mycophyta** (fungi), **Bryophyta** and **Spermophyta** (=subdivisions in Kingdom II **Eucaryotae).** Thus, a key showing these true relationships, made clear by recent recognition of the fundamental facts of cellular organization, bacteria, plants, fungi and animals, is needed for clarification. Plant biology has to be considered as a part of biology as a whole. **Part Four. Plant Geography,** is concerned with distribution patterns and their causes; plant commutities; history of the flora and vegetation; and floristics. There is an appendix concerning the fossil plant record, and a bibliography of selected references arranged by text divisions. A subject index completes the text. Highly recommended to students of plant biology.—**Hamilton P. Traub**

PLANT PATHOSYSTEMS, by Raoul A. Robinson. Springer-Verlag New York, 175 5th Av., New York, N. Y. 10010. 1976. Pp. 184. Illus. $19.70. Aimed mainly at the young scientist in plant protection and breeding who is looking for a new conceptional framework on which to orient his future career, and also to the more mature student, this book is concerned with plant pathosystems; vertical pathosystems analysis, and management; horizontal pathosystem analysis and management; polyphyletic pathosystems; crop vulnerability, and conclusions. A chapter on terminology, a bibliography and index complete the volume. Recommended to students and workers in the field of plant pathology.

FENNOSCANDIAN TUNDRA ECOSYSTEMS. PART 2. ANIMALS AND SYSTEMS ANALYSIS, edited by F. E. Wielgoliski. Springer-Verlag New York, 175 5th Av., New York, N. Y. 10010. 1975. Pp. 337. Illus. $57.00. This is part 2 of a **symposium** on the Fennoscandian Tundra Ecosystems and is concerned with research on productivity (cardon energy flows and nutrient cycling) and synthesis of these ecosystems.

RESIDUE REVIEWS: RESIDUES OF PESTICIDES AND OTHER CONTAMINANTS IN THE TOTAL ENVIRONMENT, edited by Francis A. and Jane Davis Gunther. Vols. **57** (1975), **58** (1975), **59** (1975), **62** (1976). $16.80 per volume. Springer-Verlag New York, 175 5th Av., New York, N. Y. 10010. $16.80 per volume.—In these four volumes contributions on the residue or other contaminants are published in the order in which they are received and the mass of information is indispensible to all who are concerned with problems caused by the use of pesticides, particularly those engaged in the production, storage, marketing, regulation and consumption of foodstuffs.

TREES AND MAN, by Herbert L. Edlin. Columbia University Press, 562 W. 113th St., New York City. 10025. 1976. Pp. xvi + 269. Illus. $25.00.—The author considers world wide forests from the viewpoint of conservation, an outlook that first took shape in the early 20th century. **Part 1** is concerned with the life cycle of trees; woody stem and its function, buds, shoots, leaves and roots; and reproduction. **Part 2** deals with forest ecology, and forest conservation. **Part 3** is devoted to the various kinds of forest trees, and **Part 4** is concerned with the raising of trees, for ornament; in agriculture, fruit and nut trees; for timber, and wood from trees; and trees as sources of sugar, rubber, resin, cork and chemicals. An index completes the volume. This instructive and delightful book is recommended highly to all interested in trees.

THE FOREST WORLD OF NEW ZEALAND, by J. H. Johns and C. G. R. Chavasse. Imported by Charles E. Tuttle Co., Rutland, Vermont 05701. 1975. Pp. 156. Illus. $23.95.—This wonderful book is profusely illustrated (no less than 64 illustrations), often in full color. The subject is concerned mainly with the forest and mountain landscape treated **"with a freshness and depth of feeling that will strike a chord in the hearts of all. . . ."** While the trees and mountain scenery are the main features, herbaceous plants, orchids, Fuschia, etc. are also shown. In addition, some of the spiders, insects (butterfly), frogs, reptiles, colorful birds, particularly the blue mountain duck and black swans, mammals (introduced deer and wild horses), are also pictured. The short text is somewhat disappointing. This outstandingly beautiful book cannot be too highly praised, and is recommended to all readers.

AUSTRALIAN EUCALYPTS, by Douglas Baglin and Barbara Mullins. Imported by Charles E. Tuttle Co., Rutland, Vermont 05701. 1966. Pp. 32. Illus. Paper.—This profusely illustrated pamphlet is concerned with 80 Australian Eucalyptus tree studies (all in full color), with notes on characteristics, uses, propagation, cultivation and pest control. Highly recommended to all readers.

THE SEEDLIST HANDBOOK (SECOND EDITION), by Bernard E. Harkness. Kashong Publications, Box 90, Bellona, New York 14415. 1976. Pp. 216. Paper, $5.00.—The purpose of this enlarged second edition is to furnish a guide to seed selection from the seed lists of the American Rock Garden Society, the Alpine Garden Society, and the Scottish Rock Garden Club. The literature references are keyed from 1 through 97, and at least one or more sources for more information are indicated for each of the plants listed alphabetically from **Abelia** through **Zygophullum** species. Highly recommended to all interested gardeners.

PRACTICAL INSECT PEST MANAGEMENT, by Theo. F. Mason, Leon Moore, and George W. Ware. W. H. Freeman & Co., 660 Market St., San Francisco, Calif. 94104. 1976. Pp. xvi + 196. Illus. Paper, $5.95. Subtitled **"A Self-Instruction Manual",** this book has been written for specialists in pest control, advanced high school students, federal and state officials, and concerned citizens. The five sections of the manual are concerned with the **Nature** and **Basic Elements** of insect pest control; the components of **Insect Pest Management;** insect pest management by means of **microbes, pheromones, chemosterilants** and **insect growth regulators;** and **implementing** insect pest programs. Recommended to all interested in insect pest control.

HIGH-YIELDING RICE CULTIVATION, by Seizo Matsushima. International Scholarly Book Services, P. O. Box 555, Forest Grove, Oregon 97116. 1976. Pp. ix + 367. Illus. $32.50. Subtitled **A Method for Maximizing**

Rice Yield through "Ideal Plants" (=ideal growth response) as contrasted with past recommendations to increase yield by improving soil conditions. His criteria for determining yield as a basis for "ideal rice plants" (=ideal growth responses) are the number of panicles per unit area, the average number of grains per panicle, the percentage of ripened grains and weight of 1.000 grains. On this basis be studied various factors in obtaining maximum yields. Recommended to those interested in rice growing.

THE VEGETATION SURVEY OF WESTERN AUSTRALIA: THE VEGETATION OF THE MULLARBOR AREA, by J. S. Beard. International Scholarly Book Services, P. O. Box 555, Forest Grove, Oregon 97116. 1975. Pp. viii + 104. Illus. including Vegetation Survey Map. $12.50. The survey is concerned with the vegetation of the Mullarbor Area of Western Australia—the natural regions, climate, geology, physiography, soils, human and animal influences, and the detailed description of the vegetation. A bibliography completes the volume. Recommended to all interested in the vegetation of Australia.

FASSETT'S SPRING FLORA OF WISCONSIN, 4th Edition revised and enlarged by Olive S. Thomson. University of Wisconsin Press, Box 1379, Madison, Wisc. 53701. 1976. Pp. ix + 413.—Fassett's classic manual, subtitled "A Manual of Plants Growing without cultivation and Flowering before June 15", 4th revised and enlarged edition by Olive S. Thomson will be welcomed. It contains over 100 new illustrations, and takes into account the changing distribution of species, and the introduction of new species into the state. Following the introduction, there follows a **key to the families,** the descriptive **Spring Flora** (pp. 23—379). A Glossary, Selected References, and an Index complete the volume. Very Highly recommended.

GUIDE TO THE VASCULAR FLORA OF ILLINOIS, by Robert H. Mohlenbrock. Southern Illinois University Press, P. O. Box 3697, Carbondale, Ill. 62901. 1975. Pp. xii + 494. Illus. $12.95.—This new Flora of Illinois will be welcomed. After a discussion of the **Natural Divisions of Illinois,** there follow the **GENERAL KEY TO GROUPS OF ILLINOIS VASCULAR PLANTS;** and the **DESCRIPTIVE FLORA** including **2,699 species, 265 lesser taxa and 83 hybrids** in Illinois. The entry for **Hymenocallis** (p. 184) should be reconsidered on the basis of specimens in the Missouri Botanical Garden. Highly recommended.

LIGHT AND PLANT DEVELOPMENT, edited by H. Smith. Butterworths U. S. A., 19 Cummings Park, Woburn, Mass. 01801. 1976. Pp. 516. Illus. $35.00.—This symposium volume of the 22nd University of Nottingham (England) Easter School in Agricultural Science (Apr. 7—10, 1975) is dedicated to the late Dr. H. A. Borthwick, and to Dr. S. B. Hendricks, pioneers in the field of photomorphogenesis. The symposium by outstanding authorities is presented under six heads: **I**—Light perception; **II**—the site of phytochrome action; **III**—Cellular Aspects; **IV**—Physiological Aspects of phytochrome Action; **V**—Photoperiodism, Endogeneous Rythms and Phytochrome, and **VI**—Ecological Aspects of Photomorphogenesis. A **list** of participants in the symposium and an **index** complete the volume. Very highly recommended to all interested in plants.

SMITHSONIAN CONTRIBUTIONS TO BOTANY. In this numbered serial publication the Institution publishes original monographs dealing with various plant groups. These may be obtained from Smithsonian Institution Press, Washington, D. C. 20402.

No. 23. FLORA OF THE MARQUESAS, 1: ERICACEAE—CONVOLVULACEAE, by Marie-Helene Sachet. Pp. 34. 1975. Brief introduction and taxonomic treatment with keys, synonymy, description, distribution of the families from **Ericaceae** to **Convolvulaceae**.

No. 25. REVISION OF THE LICHEN GENUS HYPOTRACHYNA (PARMELIACEAE) IN TROPICAL AMERICA by Mason E. Hale, Jr. Pp. 88. 1975. Includes revision of 77 "species" occurring in tropical America; 58 endemic to the New World.

No. 27. THE MOSSES OF JUAN FERNANDEZ ISLANDS, by Harold Robinson. Pp. 88. 1975. Keys and descriptions of 129 species, 73 genera and 32 families; 32 species recognized as endemic; four new combinations.

No. 29. A STUDY OF THE TRIBE GESNERIACEAE WITH A REVISION OF GESNERIA (GESNERIACEAE: GESNERIOIDES), by Laurence E. Skog. Pp. 182, 86 figures, 9 tables. 1976. A study of the tribe Gesnerieae, Family Gesneriaceae from the West Indies, with information on the history, anatomy, karketing, pollination, dispersal, hybridization in the tribe; and the taxonomy.

No. 30. A REVISION OF AMERICAN VELLOZIACEAE, by Lyman B. Smith and Edward S. Ayensu. Pp. 172, frontispiece, 53 figures, 37 plates. 1976. Systematics of 4 genera and 229 species of American Velloziaceae is brought up-to-date; with introduction, taxonomic keys, synonyms and species distribution.

No. 31. A MONOGRAPH OF THE LICHEN GENUS PSEUDOPARMELIA LYNGE (PARMELIACEAE), by Mason E. Hale, Jr. Pp. 62, 18 figures. 1976. A World monograph of the Genus Pseudoparmelia, with 76 species. New species are described, new combinations made.

No. 33. A MONOGRAPH OF THE LICHEN GENUS PARMELINA HALE (PARMELIACEAE) by Mason E. Hale, Jr. Pp. 60, 21 figures. 1976. The species of Parmelina are revised on a World level.

No. 34. NEW RECORDS OF MARINE ALGAE FROM THE 1974 R/V DOLPHIN CRUISE TO THE GULF OF CALIFORNIA, by James E. Norris and Katina E. Bucher. Pp. 22, 13 figures. 1976. Six species of benthic marine algae, one of Chlorophyta, two Phaeophyta, and three Rhodophyta, are newly reported from the Gulf of California. Species of Halicysitis, Sporochnus, Bonnemaisonia, Dudresnya and Sebdenia represent new genera to the Gulf, the last being new to North America.

NO. 35. THE GENUS COLPOMENIA DERBERS ET SOLUER (PHAEOPHYTA) IN THE GULF OF CALIFORNIA, by Michael J. Wynne and James N. Norris. Pp. 18, 11 figures. 1976. Four new species of the brown algal genus Colpomenia are recognized as occurring in the Gulf of California.

AQUATIC BOTANY, VOL. 1 (NOS. 1-4). This timely new periodical was launched by Elsevier Scientific Publishing Co., P. O. Box 211, Amsterdam, Netherlands as a quarterly in 1975. It deals with the fundamental and applied phases of research of submerged and floating plants in marine and fresh water ecosystems. The journal will serve as an outlet for papers on the consequences of the disturbance of aquatic ecosystems, including transplantation of aquatic plants, influence of herbicides and other chemicals; termal pollution, biological control methods grazing and diseases; the use of aquatic plants; conservation of resources and the aspects of production and decomposition of aquatic plants. In this age when the conservation of our aquatic resources is an important goal, this journal will surely be welcomed, and we wish for it all possible success.—Hamilton P. Traub

FROM SINGLE CELLS TO PLANTS, by E. Thomas and M. R. Davey. Springer-Verlag, New York, 175 Fifth Av., New York, N. Y. 10010. 1975. Pp. xv + 170. Illus. $7.20. This timely book on plant tissue culture will be welcomed. The authors begin with a brief history of tissue culture (Chapter 1). Chapter 2 is devoted to the basic materials and methods; Chapter 3 deals with the culture of plant organs; Chapter 4, with the culture of plant cells; Chapter 5, with higher plant protoplasts, their isolation and behavior; Chapter 6, with morphogenesis in cell cultures; Chapter 7, with the culture of haploid reproductive cells, and Chapter 8, with plant tissue culture. An appendix, taxonomic and subject indices, and a bibliography for further reading, complete the book. Highly recommended.

PLANT PATHOGENESIS, by Harry Wheeler. Springer-Verlag New York, 175 5th Av., New York, N. Y. 10010. 1975. Pp. 106. Illus. $16.00.

Intended as a text for advanced undergraduates and graduate students in plant science, this text deals with mechanisms of pathogenesis, plant responses to pathogens, disease resistence mechanisms, genetics of pathogenesis and the nature of the physiological syndrome. A bibliography and index complete the volume. Recommended to students of plant pathology.

SUNSET BOOKS PUBLISHED IN 1976. All edited by Editors of Sunset Magazine and Sunset Books. These may be obtained from Lane Publishing Co., Menlo Park, Calif. 94025.

SUNSET WESTERN GARDEN BOOK. Pp. 448. Profusely illustrated. $5.95. This is a mine of information and a great bargain. It begins with the description of the West's 24 climate Zones, including maps. The text is in two parts. HOW TO GROW PLANTS, soils and planting mixtures through to garden maintenance. **PLANT SELECTION GUIDE;** basic and special landscaping; situations; garden color; special effects, and problem areas; **GARDENERS' LANGUAGE (GLOSSARY);** and **WESTERN PLANT ENCYCLOPEDIA** of more than 175 pages, giving brief descriptions and cultural notes for more than 5,000 plants, arranged alphabetically by botanical names, common names also given. An INDEX to general subject matter completes this outstanding book, which every western gardener should own and have handly for ready reference. This outstanding book cannot be too highly recommended.

HOW TO GROW HOUSE PLANTS. Pp. 80. Profusely illustrated. $2.45. Gives directions on **indoor** year-round gardening; ins and outs of container gardening; meeting needs of house plants; keeping plants healthy, and plant selection guide. Index. Highly recommended.

GREENHOUSE GARDENING. Pp. 96. Profusely illustrated. $2.45. Brief **history** of greenhouses; **anatomy of a greenhouse,** shape, size, erection, etc.; **Greenhouse gardening,** specialty plants, controlled environment, pests and diseases; and specialty features. Highly recommended.

BONSAI, CULTURE AND CARE OF MINIATURE TREES. Pp. 80. Profusely illustrated. $2.45. Evoking **Spirit of Nature** styles, design, containers; creating **your own Bonsai,** kind of plants, planting and care. Highly recommended.

INTERCELLULAR COMMUNICATION IN PLANTS: STUDIES ON PLASMODESMATA, edited by B. E. S. Gunning and A. W. Robards. Springer-Verlag, New York, 175 5th Av., New York City. 10010. 1976. Pp. xiv + 387. Illus. $29.60. It is to be noted that 1961 marks the beginning of a new phase in the history of plasmodesmata. This important book on that subject is a symposium, including the editors among the authors of some of the 15 review chapters which deal with analogues of plasmodesmata; their presence in higher plants, algae and fungi and origin and development; plasmodesmatal transport; evidence of intercellular communication; viruses and plasmodesmata; transport of solutes, water and nutrients; and their role in growth and development. A bibliography, author and subject indices complete this outstanding volume. Very highly recommended to all interested in plant physiology.

PROGRESS IN BOTANY 37, edited by H. Ellenberg, K. Esser, H. Merxmueller, E. Schneff, and H. Ziegler. Springer-Verlag New York, 175 5th Av., New York City, 10010 1975. Pp. xvii + 402. Illus. $49.20. This 37th in the series is in the nature of a timely symposion, including reviews by competent authorities in the fields of **morphology, physiology, genetics,** taxonomy, and geobotany. The literature is cited following each review, and a general subject index completes the volume. Highly recommended.

PLANT LIFE LIBRARY—continued on page 30.

BESCHORNEREA YUCCOIDES C. Koch

HAMILTON P. TRAUB

In the 1950's Mrs. Clint Morris of Brownsville, Texas, sent small plants of *Beschornerea yuccoides* C. Koch, which had been collected in Mexico. Later in the early 1970's, when the writer distributed seeds of this fine plant, Mrs. Clint had forgotten about the gift she had made.

This is a most satisfactory member of the Order *Agavales.* It does not die after flowering as is the case with *Agave* species. The flower is red, marked with green, and the plant makes a fine showing each season without fail.

This brief note is inserted to make known *the name of the species* which had not been determined when the seeds were sent out. As indicated above, the name is *Beschornerea yuccoides* C. Koch [Vochensch. ii(1859) 337; iii(1860) 63; vi(1864) 186.]. Attention is directed to the note about this plant in *The Garden* (Jour. Roy. Hort. Soc. 101(5): 279. 1976) by John Newall, Ringwood, Hampshire, England: "The main parent plant [he apparently means stalk] dies after flowering and produces from the base a number of young plants which can be separated or left to grow into a large clump. I feel that separation will make better and more graceful single plants which will flower in two years."

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 Instructor for details, See Plant Life Vol. 27, 1971, Pickard Study Course, pages 22—27.

All accredited Amaryllis judges of the American Amaryllis Society are members of the Council.

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