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DAYLILY HANDBOOK

A Special Issue on Hemerocallis

GEORGE M. DARROW, Editor

The American Hemerocallis Society

FREDERICK G. MEYER, Editor

The American Horticultural Society

CORRECTIONS

Attention is called to the following corrections to be made in the *Daylily Handbook,* Volume 47, Number 2 of the *American Horticultural Magazine*:

Covers—Photo captions on the front and back covers are reversed: Photo on the front cover is GREEN VALLEY; photo on the back cover is BURIED TREASURE.

Color Plate 27—Insert FRANCES FAY for photo on upper right.

Color Plate 32—Change "Louise Rockett Garden" to "Louis Rockett Garden."

Front Cover: GREEN VALLEY (Hubert A. Fischer 1959)—dormant; scape 36″; flower 6½″; *Award of Merit 1962; President's Cup 1961; Silver Medal, Vienna, 1964.* Photo Hubert A. Fischer.

Back Cover: BURIED TREASURE (Steve Moldovan 1962)—dormant; scape 32″; *Award of Merit 1966.* Photo John A. Bartholomew.

The 32 pages of color in the DAYLILY HANDBOOK are provided through the courtesy of members and friends of the American Hemerocallis Society.

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EDITOR'S PREFACE

This handbook has been written at a time of great change and advance in the kind and quality of the daylilies that we grow. It is hard to realize that it is only about 30 years ago that the daylily was a rare flower in gardens of the U.S.A. The chief kinds known were 'Europa', the Tawny roadside and the Lemon daylilies. Now the number of cultivars exceeds 12,000. Such an extension of this flower into garden and landscape use must be due to inherent great and useful qualities as well as fewer undesirable traits. There also had to be able breeders.

The daylily had the benefit of a lifetime of research by Dr. A. B. Stout, botanist, geneticist, and plant breeder of the New York Botanical Garden. Dr. Stout through Dr. Steward, students and others introduced new species from Eastern Asia that had new qualities, and he himself originated many daylilies with these new qualities. As important as originating new cultivars, he carried on research in breeding, physiology, and morphology of the daylily so that other breeders could work more intelligently. There were also many other able breeders who helped make this fine flower still finer—Dr. E. J. Kraus, Dr. R. A. Griesbach, Prof. J. V. Watkins, Mr. O. Fay, Mr. Hall—among the great ones. Better still, there are just as able ones to continue the work now.

The earlier breeders utilized many of the qualities of the species introduced 30 to 40 years ago. The able breeders doing this work fortunately were and are living in widely different regions—from Florida and Texas to northern New England and Minnesota and to the Pacific Coast—so that fine daylilies are adapted to all regions.

Now, 1968, seems to be the year of a big advance in the introduction of tetraploid daylilies, an advance made possible by the intense interest and industry of a few breeders with vision of what might be. The first tetraploids were produced by Robert Schreiner while a student at the University of Minnesota, by Quinn Buck, at the University of California in Los Angeles, and by Dr. Hamilton Traub with the help of Dr. Haig Dermen at Beltsville in the late 1940's. Mr. O. Fay of Chicago with the help of Dr. Griesbach of DePaul University began intensive work in the 1950's, and Dr. Virginia Peck of Tennessee in the early 1960's. There were as of July 1, 1967, 66 tetraploid cultivars grown from seed and 17 induced tetraploids by colchicine treatment registered by The American Hemerocallis Society. The richness of the colors due to the thicker tepals and the ability of the many breeders working to improve the tetraploid insures their becoming important.

Able breeders are also working at the diploid level, breeding for just the qualities—thicker tepals, larger flowers, strong erect stems—that make the tetraploids so superior. On the diploid level already hundreds of beautiful pinks, apricots and reds of many shades are in the trade. And now really fine lavender cultivars have been originated. The first near-blue daylilies have been introduced; these first near-blues may not have great beauty, but they are the forerunners of finer ones to come. And then there are breeders of double-flowered, miniatures, very large, late-flowering, evening-flowering, 2-day instead of 1-day flowering, reblooming, continuous blooming, gold-edging, white-flowered, etc. So each new year will bring its list of new daylilies qualities for our enjoyment.

This Preface would not be complete without the acknowledgement of the generous cooperation of the many authors, especially of the able and fine editing of Dr. Frederick G. Meyer, co-editor representing the American Horticultural Society, and the great assistance and encouragement of Dr. Richard Peck in the planning and making of the Handbook. And there have been scores of others who have given information, reviewed articles and furnished photographs and who have made possible the color plates.

Glenn Dale, Maryland — GEORGE M. DARROW

PRESIDENT'S INTRODUCTION

Several years ago when Dr. Richard C. Peck, then President of The American Hemerocallis Society, introduced me to Mrs. Grace P. Wilson, acting Secretary-Treasurer of the American Horticultural Society, they told me of the plans for the publication of a daylily handbook. Little did I realize that today I would be writing an introduction for it. There were other things I did not realize then. The most important, perhaps, is the scope of this manual. An attempt has been made to discuss as many facets of the *Hemerocallis* as present knowledge and the limitations of space permit. So far as I am able to tell, few, if any, items of fundamental importance have not been touched upon. Another is the wonderful contributions and the cooperation of all the people who worked together to make this handbook possible. On pages 46-48 you will find a list of these contributors with a short resume of their accomplishments. Modesty prevented this section from growing to seven or eight pages, as none allowed all his credentials or horticultural achievements to be reported. Special thanks must go to Dr. George M. Darrow who assembled the contents and serves as Editor of the handbook; Dr. Richard C. Peck, Chairman of The American Hemerocallis Society Publications Committee; and Mrs. Arthur Parry, Editor of The American Hemerocallis Society publications. Thanks are also due Mrs. Grace P. Wilson, formerly acting Secretary-Treasurer of the American Horticultural Society and Dr. Frederick G. Meyer, co-editor representing the American Horticultural Society.

The modern hybrid daylily is relatively new to the American garden and is still unknown to millions of gardeners. To many their only acquaintance is *Hemerocallis fulva,* the tawny daylily that grows naturalized along roadsides in many rural areas. Those who decide to grow their first modern hybrid daylily after reading this Handbook will find that its adaptability and range of types are truly amazing. They will find there are cultivars adapted to all the climatic conditions found in any part of this country. Granted the clone that performs best in the frost-free areas of Florida may not perform well after a Montana winter with the mercury below zero for thirty days, but there are cultivars that prosper after such frigid winters. Likewise there are plants that thrive with very little moisture as well as others that tolerate near swamp conditions. Most daylilies bloom in the middle of summer, but there are early ones blooming with the last daffodils. Some late-season ones bloom until frost. Daylily flowers vary in a wide range of sizes, colors, and shapes. No attempt is made in this Handbook to describe or name all daylily cultivars available or, even, all the newer ones. This is not feasible as over 12,000 named daylilies have been registered and about 800 new ones are added each year. Only a sampling of different daylilies is listed, described, or pictured in this Handbook. The ones that are included have been chosen by the Editor and his staff because of outstanding performance characteristics. Many additional good performing cultivars are listed in catalogues of commercial growers and nurserymen.

No doubt many gardeners contemplating the purchase of their first daylily are confused by prices ranging from 50¢ to $5 to, occasionally, over $50 for a single plant. The $50 plant is undoubtedly ten times more scarce than the $5 one and a hundred times more so than the 50¢ plant. But it is very unlikely that it is 100 or even 10 times better; it is just many times newer and more scarce. Many of the newer hybrids show marked improvements over the older ones. All of the very new daylilies described or pictured in this handbook will, ten years from now, be just as good as they are today, but the hybridizers of tomorrow will have introduced even better plants in the interim. Maybe those of tomorrow will have bigger flowers, colors yet unknown today, plants that will bloom from frost to frost, or a universal plant that will thrive under many or most of the climatic conditions in this country.

In Chapter 16, Mrs. Lacey recounts the founding of The American Hemerocallis Society at a 1946 gathering of daylily enthusiasts at the Henry Field Nursery in Shenandoah, Iowa. She and Mrs. Purnell (Chap. 17) trace its growth in activities and membership up to today, now over 3900 members strong. Members reside in all but three, Alaska, Nevada, and Wyoming of the 50 states. Foreign members range from nearby Canada to Japan, Europe, Africa, and South America. Some of these 3900 members grow daylilies in backyard gardens on 50-foot city lots. Others grow vast numbers on the landscaped grounds of large estates. Others, such as myself, hybridize daylilies in modest numbers as amateurs. Still others hybridize on a large scale as commercial enterprises and conduct nursery businesses. Finally, there are research scientists probing into the plant's breeding characteristics or studying the few insects or diseases that attack daylilies. All of these members share one thing in common, their love for the modern daylily. May I extend an invitation to you to join this group of daylily lovers?

GEORGE T. PETTUS

Saint Louis, Missouri
January, 1968

CULTIVAR VS. VARIETY

Readers of this Handbook will note the consistent use of *cultivar* instead of *variety* to designate clones of *Hemerocallis.* Reasons for its use are spelled out because cultivar is a relatively new term still not universally accepted by horticulturists.

From time to time, interested groups in our own and other countries have tried to work out rules to govern the naming of horticultural plants. Horticultural societies throughout the world, including the American Horticultural Society, have agreed to use cultivar in preference to variety for named clones and for some kinds of seed propagated plants of horticultural importance.

It is important to end confusion that has existed in horticultural writings to distinguish wild plant varieties, such as *H. fulva* var. *rosea* and var. *disticha,* from clones, such as daylily 'Luxury Lace' and 'Cartwheels' of garden origin, and others, such as *H. fulva* 'Kwanso' and 'Major' of obscure origin but otherwise cultivated. According to botanical usage the term variety applies to wild plants with reference to a population of closely related individuals and not to a clone propagated vegetatively from a single plant. With these quite separate meanings, variety cannot apply as a category for both cultivated plants and wild plants.

A *cultivar,* according to the International Code of Nomenclature for Cultivated Plants 1961) may be: (1) vegetatively propagated as a clone (usually named, as 'Luxury Lace') and originally derived from a single plant (including chimeras) ; or (2) seed propagated, as in a *line,* e.g., *Petunia* 'Rosy Morn' and reconstituted hybrids of corn, onion, tomato, snapdragon, petunia, zinnia, and others. To date, no named cultivars of daylily have been propagated by seed.

The Code recommends two methods of citing cultivar names in horticultural literature, e.g., daylily or *Hemerocallis* (1) cv. Cartwheels or (2) 'Cartwheels'.

While this action of the International Code changed long established custom in the use of the term variety, there is growing acceptance, among horticulturists and others working with cultivated plants, of the term *cultivar.*

Frederick G. Meyer

CONTRIBUTORS TO THE HANDBOOK

TORU ARISUMI, Beltsville, Md. Co-author of Chap. 6, *Tetraploid Daylilies.*
Born and raised in Hawaii; B.S. Univ. of Hawaii, 1947; Ph.D. Univ. Illinois 1951. Plant Geneticist for shade trees and shrubs in Ohio 1955, and since 1960 U.S.D.A. Beltsville, Md. in charge of research for African violets and daylilies.

F. M. BENZINGER, Ruckerville, Va. Chap. 9, *Propagation of Daylilies.*
Graduate in floriculture, Univ. of Maryland, 1950. Operates greenhouses, teaches extension courses in horticulture at Univ. of Virginia. Began breeding daylilies in 1958 and inducing tetraploids in 1964; raised seedlings from over 40 induced tetraploids and has named several.

MRS. ELIZABETH T. CAPEN, Boonton, N. J. Chap. 14, *Daylilies in Flower Arrangements.*
Native of Connecticut. B.S. in chemistry. Began gardening with father in Conn.; now gardens with husband in Vinalhaven, Me., and Boonton, N. J., and most recently Vieques, Puerto Rico. Chief interests: daffodils and daylilies, grows about 1,000 cultivars of each; outdoor flower arrangements, lecturer for 30 years. Flower show judge.

PHILIP G. CORLISS, San Diego, Calif. Chap. 4, *Cultivars of Daylilies* and Appendix 5, *Recommended Cultivars.*
Born and raised in New England. Graduate of Dartmouth and of Harvard Medical School 1930. Physician and Surgeon in Arizona 35 years. Breeder of daylilies, spuria and La. iris, amaryllis. Author of book "Hemerocallis, the Perennial Supreme," and many articles. Horticultural photographer and lecturer. Former vice-president, Am. Hort. Soc. and Am. Hem. Soc.

JOHN L. CREECH, Carrollton, Md. Chap. 18, *Exploring for Daylilies in Japan.*
Born in Rhode Island; Ph.D. Univ. of Maryland 1952 in botany. Since 1947 with the U.S.D.A., Supt. Plant Introd. Station, Glenn Dale, Md. Since 1966, chief New Crops Research Branch, Beltsville, Md. Three exploration trips to Japan, one each to Taiwan, Nepal, and U.S.S.R.

GEORGE M. DARROW, Glenn Dale, Md. Editor of Daylily Handbook; *Editor's Preface.*
Fruit Specialist, U.S.D.A. for 46 years, breeder of blueberries and strawberries. Retired 1957, now consultant. Author of book "The Strawberry," also numerous research papers. Began breeding daylilies 1960. Partner with son in "Darrow Brothers Pick Your Own Strawberry Farm."

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Native of Texas, and graduate of Baylor University, on staff Baylor Hospital several years. Operates private classes in creative arts. Interested in other flowers, especially daffodils. National Flower Show and Awards and Honors Judge. Exhibition chairman for past 5 years.

HUBERT A. FISCHER, Hinsdale, Ill. Chap. 19, *Daylilies in Other Countries.*
Charter member of Am. Hem. Soc., Pres. 1959-1961. Now Foreign Secretary. Awarded Helen Field Fischer gold medal for service to Am. Hem. Society. Growing and breeding daylilies for over 30 years, has introduced about 50 cultivars and flowered tetraploids of own breeding.

WILMER B. FLORY, Logansport, Ind. Chap. 12, *Daylilies in Landscaping and for Erosion Control.*
Charter member of Am. Hem. Soc., Pres. 1957-1958. Editor Publications 5 years. Originator 15 daylilies, recipient of Helen Field Fischer award for service to the Am. Hem. Society. Began teaching at 16, retired 1948. Interested in daylilies since 1922.

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Native of Louisiana, graduate of La. State University, and Ph.D., Cornell. Majored in diseases of ornamental plants. Taught Ornamental Horticulture at La. State University. Since 1941 pathologist for ornamental plants with U.S.D.A.

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D.S. in botany, University of Chicago, 1955. Asst. Professor Biology, DePaul University since 1952. Specialized on seed dormancy of daylilies; with O. Fay devised methods of inducing polyploidy in daylily seedlings. Breeding tetraploids, especially reds. Also has bred some 50 gladiolus.

MRS. JULIA B. HARDY, Mt. Olive, Ala. Appendix 3, *Breeders of Tetraploid Daylilies.*
Native of Georgia, Tiff College, Univ. of Georgia and Chicago Musical College. Began growing daylilies 1935, commercial growing 1945. Began hybridizing 1942. Present interest: breeding tetraploids.

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Dental chief at Touro in New Orleans for 48 years before retiring. Also professor Oral Surgery. First interested in La. iris and camellias, then daylilies. Originated many camellias and daylilies. Chairman of Scientific Com. of Am. Hem. Soc.

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Native of Texas. Ph.D. Rutgers Univ.; Research Nematologist U.S.D.A. since 1964, first at Tifton, Ga. now at Weslaco.

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Lived in Kansas and Missouri, since 1947 in Florida. Interest in daylilies began in early 1940's. Charter member of Am. Hem. Soc., Secy. of Society 1959-1964. Helen Field Fischer award in 1965. Other interests: garden clubs, subtropical plants.

SHIU-YING HU, Cambridge, Mass. Chap. 1, *An early History of Daylily;* Chap. 2, *The Species of Hemerocallis;* Chap. 13, *Uses of Daylily as Food and in Medicine.*
Born and reared in China, Ginling College, Lingnan University; Ph.D. in biology, Harvard University 1949. Student of Dr. A. N. Steward in China. Professor of Botany, West China Union University 1938-1946. Since 1949 on staff of Harvard University. Author many scientific articles and especially that on holly species in Holly Handbook (Am. Hort. Soc., 1948).

W. A. KING, Bethesda, Md. Chap. 5, *Breeding of Diploid Daylilies.* Appendix 5a, *Long-lived Daylily Bluebloods.*
Born a horticulturist; inherited from father a love of ornamentals; majored in plant pathology and landscaping, Univ. Md. Bought first daylily in 1937. Hobbies painting beautiful pictures with landscapes of living ornamentals; perennials, especially phlox and daylilies. Originator of daylily 'Lovely Lea' and others.

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Mrs. Arthur W. Parry, Signal Mountain, Tenn. Appendix 1, *Hybridizers and Commercial Growers;* also responsible for assembling color plates of Handbook.
Charter Member and Editor of *The Hemerocallis Journal.* With husband "Scotty" and children, Arthur and Laurel Anne, operates the Parry Nurseries (Daylilies). For a time operated an orchid nursery in England. Received the Helen Field Fischer award in 1967.

Mrs. Virginia Peck, Murfreesboro, Tenn. Co-author Chap. 6, *Tetraploid Daylilies.*
Ph.D. Vanderbilt Univ.; taught at Ala. State Teachers College; now Prof. of English, Middle Tenn. State Univ. With husband Dr. Richard Peck, breeds tetraploid daylilies, and does research on cytology of daylily; authority on use of colchicine in making tetraploids.

George T. Pettus, St. Louis, Mo. President of Am. Hem. Soc. 1967-1968 *President's Introduction.*
Native of Missouri and grew up a gardener. Grad. Harvard 1944. Real estate business in St. Louis. Began growing daylilies in 1956 and hybridizing in 1958. He and his wife Jane grow and hybridize tetraploids and have introduced several daylilies; interested in daffodils, also hunting.

Mrs. Hugh A. Purnell, Dallas, Texas. Chap. 17, *A Salute to our Founders.*
A native Texan, a retired teacher, Judge for Am. Hem. Soc., as well as an iris, daffodil, and amaryllis judge. Garden club lecturer and teacher. Received the Helen Field Fischer award for service to the Society 1966.

Jack S. Romine, Walnut Creek, Calif. Appendix 2, *Tetraploid Daylilies.*
Native of Missouri. Degree in English, Univ. of Mo.; Prof. of English and American literature; author textbooks of English. Chief interests writing, gardening, hybridizing; grown daylilies since 1942.

Floyd F. Smith, Beltsville, Md. Chap. 11, *Insects and Related Pests of Daylilies.*
Born in Ohio. Ph.D. 1929, Ohio State University; research on insects of flowers, Penna. State Dept. Agric., 1924-1929. Since 1929 with U.S.D.A. on insects of garden flowers, ornamental plants. and greenhouse plants (now leader). Specialties: Plant virus vectors and plant resistance to insects and mites.

Wm. P. Vaughn, Chicago, Ill. Chap. 10, *Culture of Daylilies.*
Member Board Directors, Am. Hem. Soc. Gardener and breeder of dwarf and miniature daylilies, iris and amaryllis. Other plant specialties: house plants, daffodils, sedum, wild flowers, sempervivum, azaleas, old roses.

Paul D. Voth, Chicago, Ill. Co-author Chap. 3, *Developmental Anatomy and Physiology of Daylily.*
Taught biology at Texas Tech. 1930-1932. Prof. of Botany, University of Chicago since 1933. Student of E. J. Kraus. Specializes on "Anatomy of ferns and gymnosperms and cultures and physiology of mosses and liverworts."

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Ph.D. Univ. of Chicago in 1965, where he now teaches. Research interests—Morphology of vascular plants.

Miss Melinda Warner, Dallas, Texas. Chap. 5a, *Breeding of Miniature Daylilies.*
Native of Texas, student at Southwestern Univ., Georgetown, Texas. Began hybridizing when 11 and grows about 1,000 seedlings yearly. Introduced 'A Go Go' and 'Zippety'. Other interests, organ and choral music. State winner 1967 Science Talent Search.

MAKERS OF THE MODERN DAYLILY

There were three experts who helped most to make the daylily into the great American perennial flower of the 1960's—A. N. Steward, who collected the native species in China; A. B. Stout, who studied and used the material in breeding; and E. J. Kraus, who further refined the material into fine cultivars. They might be called the "fathers" of modern daylilies. These three have been followed by worthy "sons" and now "grandsons" in breeding the great cultivars of the present and the far greater ones of the future.

Arlow B. Stout (1876-1957) was born in Ohio and reared in Wisconsin; graduate and instructor of botany, Univ. of Wisconsin, 1909-1911 and from 1911 to 1957 at the New York Botanical Garden. He received the Ph.D. degree from Columbia University in 1913. He began his studies of daylily in 1911 and continued this work throughout his life. He "transformed the daylily from a minor garden plant to one of the most varied and reliable of perennials." He also worked with hybrid poplars, avocadoes, seedless grapes, potatoes, and other plants.

Albert N. Steward (1897-1959) was born in California, reared in California and Washington; graduate of Oregon State University and Harvard; professor of botany at Nanking University, China and later at Oregon State University, Corvallis, Oregon. He collected widely in Kwangsi, Hunan, and the lower Yangtze valley and sent over 50 shipments of *Hemerocallis* seeds and plants to the United States from China. (See p. 83 for further details.) These introductions Dr. Stout studied systematically, intercrossing the species and varieties and year after year publishing the results of his studies for others to use.

Ezra J. Kraus (1885-1960) was a native of Michigan; on the faculty of Oregon State College (now University) from 1907 to 1919; professor of botany at the Univ. of Wisconsin 1919-1927; professor of botany, Univ. of Chicago 1927-1949. After 1949 he continued his breeding work at Oregon State University, Corvallis, Oregon. Though chiefly known for his hybridizing of chrysanthemums and daylilies, he also bred clematis, azaleas, oriental poppies, tree peonies, flowering crabapples, lilacs, and tritomas. He grew hundreds of thousands of seedlings in selecting out the best combinations (see *Hemerocallis Yearbook,* 1961).

Williamsburg-type arrangement by Mrs. William H. Frost. Winner of the Mabel Yaste Tri-Color Trophy Contest entered in the Blue Grass Hemerocallis Society Show in Lexington, Kentucky. Combines daylily 'Sweet Refrain', Tootie', and 'Pink Orchid' with pink roses, pink snapdragons, coral bells, white columbine, angel breath and leaves of curly mint and *Artemisia ludoviciana* in an antique silver cake stand. Photo, Lexington Herald Leader.

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An Early History of Daylily

SHIU-YING HU

In the early 1930's, Dr. A. B. Stout, Director of Laboratories at the New York Botanical Garden, applied modern experimental methods and cytological studies to the genus *Hemerocallis* which resulted in the production of numerous ornamental forms. Thus, Stout initiated a new era of research on *Hemerocallis* in the 1930's which brought about a natural break in the history of the daylily. Some of Stout's friends and many of the first generation participants in the "Better Hemerocallis Movement" are living among us today; moreover, many activities and accomplishments of American *Hemerocallis* scientists and amateurs already are in print and more readily available than the ancient Chinese classics, the medieval herbals, and early European botanical literature. The present account on the history of *Hemerocallis* covers the period up to the work of Dr. Stout.

PART I. EARLY CHINESE HISTORY*

The use of the daylily by the ancient Chinese people began before the development of written language. The earliest records report the plant's use for food. The flower buds were palatable, digestible, and nutritious. As a medicine, the root and crown were found to be a good pain reliever. Thus the utilization of daylily for food and medicine became a part of the tradition of the Chinese people. (See also chap. 13.)

The first written Chinese record about daylily appears in one of the canonical writings of Confucianism, *The Classic of Songs (Shih-ching).* This book contains a collection of ancient folk songs, occasional pieces, religious odes, and dynastic hymns. It is said that Confucius (551-479 B. C.) was responsible for selecting the inclusions and for editing the manuscript. In a poem describing the misery of one's separation from the beloved in war time, the daylily is mentioned in *Wei-fêng,* a section of *The Classic of Songs,* describing the custom of the State of Wei.

> O my brother, you must go
> As a warrior of the king,
> Guard the crown, unflinching
> May the daylily (*Hsüan Ts'ao*) behind the tree,
> Save me from my misery,
> Affectionately my thoughts go to you,
> Constantly my aching heart forever true.

Apart from the ancient historical reference to the daylily, this reference conveys two other facts, namely the geographical background of daylily and its ethnobotanical significance to people.

The geographic reference of *Wei-fêng* may be pin-pointed, since we know exactly the location of Wei. During the Chou Dynasty (1122-255 B.C.) Wei was a feudal state in the North China Plain (Map 1-1). This state was bounded by Tai-hang Range on the West and the Yellow River on the South, located about 125 miles from the coast of the East China Sea (approximately Long. 115°E., Lat. 35°N.). A comparable location in the United States would be Charlotte, North Carolina, with a climate

* In this section dealing with Chinese records, the transliteration of localities and vernacular names from the Chinese follows the system used in the revised edition of Mathews' *Chinese-English Dictionary* published by the Harvard University Press in 1950.

Map. 1. (1-5). Areas where daylilies were recorded in ancient Chinese literature. 1. Feudal state of Wei where daylily entered into the songs of the people before 500 B.C. 2. The ancient state of Shing, and 3. of Ch'u, where striped and spotted daylily flowers were first reported about 304 A.D. 4. The state of Wu where people brought a gift of red-golden daylily to the grieving and melancholy. 5. Hanchow, the land of the Flower Mirror where the double-flower daylily was first recorded in 1688 A.D. (a-d). Type localities of modern species and varieties. a. *Hemerocallis citrina.* b. *H. multiflora.* c. *H. altissima.* d. *H. fulva* var. *rosea.*

slightly different from that of the Chinese locality mentioned above where the temperature in January averages about 30°F, and rainfall averages about 10 inches annually, four-fifths of which falls from mid-June to mid-August. This is the relatively dry country where wheat, millet, and soy bean are major crops. There the yellow daylily, *H. lilioasphodelus, (H. flava)* grows spontaneously in the margins of woodland as depicted by the poem. These details are given because the native home of one of our well-known species, *Hemerocallis citrina,* has similar climatic conditions not far to the west of this area (Map 1-a).

In the North China Plain where daylily grows spontaneously, its primary effect on the people was emotional—an outlet for grief. It is true that the bright flower is cheerful and uplifting to the spirit. Perhaps that is why daylily and forget-worry are synonymous in Chinese literature. Yet there is another phase to this matter. In Wei, the daylily is called *Hsüan Ts'ao.* One peculiarity of the Chinese language is that one sound carries many characters and each connotes a specific meaning. One meaning of *Hsüan,* for example, is to push aside or to forget. *Ts'ao* means an herb. Daylily is called *Hsüan Ts'ao* in reference to the hallucination effect from eating a heavy dosage of the tender young shoots.

A Prefect of Hsing Yang, Chi Han, in the first decade of the fourth century (ca. 304 A.D.), prepared a booklet called

An Introduction to Daylily. In this treatise he reported, "The people of Ching (western part of Hu-peh, Map 1-2) and Ch'u (Hu-nan, Map 1-3) call the plant *Lu Tsung,* and use it as a vegetable. There are some people who maintain that the flower of *Lu Tsung* has stripes and spots. In this respect, the plant is different from that of *Hsüan Ts'ao.* This is not true. Actually in fertile soil the plant bears scapes with thicker floral segments, deeper and more striking color, striped and spotted. In poor soil it has lighter flowers with thin segments."

This record extends the range of daylily southward several hundred miles. The geographical and climatic conditions that support *Lu Tsung* are very different from those that support *Hsüan Ts'ao.* The Ching and Ch'u of ancient China are in the present Hu-peh and Hu-nan provinces of Central China, of the middle Yangtze River Region, approximately Long. 118-113°E., Lat. 28-32°N. The January temperature of this region averages 35°-40°F and the rainfall varies from 40 in. in Ching on the north to 50 in. in Ch'u in the south, relatively evenly distributed throughout the year. Compared with Wei, this is the warm and moist rice country. Three well-known species of *Hemerocallis, H. multiflora, H. altissima,* and *H. fulva* var. *rosea* are native not far to the east of this area (Map 1-b, c, d). It is worthy of note that variations in the size of flowers, thickness of floral segments, and markings and spots were observed in plants growing in this mid-Yangtze Region of ancient China.

Daylilies in Chinese Herbals

Materia Medica. The Chinese herbals called *pên-ts'ao* (*pên* means origin and *ts-ao* means herbs), refer to the Materia Medica and also the emergency food guides.

Herbals containing the Materia Medica were prepared as government projects, compiled under direct control of the head of state by his medical advisers, historians, and pharmaceutical officers. The philosophical background of Chinese herbals relates to love the emperor has for his subjects and his concern for their well-being as a father for his children. Mobilization by the Emperor of his health department for the preparation of an herbal for the cure of the ailments of his subjects is a showy way to express such parental love. According to records as early as 2697 B.C. the Emperor Huang Ti instructed Chi Pai to try various plants for their medicinal properties and to compile a guide of remedies for the conservation of health and the curing of ailments of his people. The Materia Medica ascribed to the author Shên Nu (The Divine Plowman) is said to be the first Chinese one. It was revised many times. With each revision new articles were added. The daylily was first mentioned in a materia medica published about 656 A.D., in T'ang Dynasty. The following is a translation of this account:

> *Hsüan Ts'ao,* also called *Lu Tsung,* occurs everywhere in fields and woods. It has a sweetish taste and is not poisonous. It quiets the five viscera (the heart, lung, liver, kidney, and stomach), benefits the mind and strengthens the will power, gives happiness. reduces worry, lightens the body weight and brightens the eye. The flowers are gathered in mid-June-July and the roots are harvested in October. Now people often collect the young shoots and serve as a pot green. It gives a pleasant feeling in the chest.

The Materia Medica compiled in Sung Dynasty (about 1059 A.D.) ascribed more specific properties to the root:

> The root of daylily is cooling and non-poisonous. It is diuretic and is advised for curing incontinence and dysuria. The juice extracted from fresh root after pounding is administered internally to patients suffering from cirrhosis and jaundice. Boiled young shoots are also advised. The plant is also called Lu Tsung (Lu = deer, Tsung = onion). The flower is called I Nan (I = fitting, Nan = male). According to the *Annals of Customs* when a pregnant woman wears the flower, the child is going to be a boy.

Fig. 1. The first published illustration of daylily in China; from *Materia Medica* of the Sung Dynasty (1059 A.D.).

Evidently by this time folktales and legends had been developed by people in their association with the daylily. Later, an illustrated edition of the same *pên-ts'ao* was published. Eventually this became the first published illustration of daylily. A facsimile copy of the account is presented above (Fig. 1).

In the illustration of daylily from Materia Medica of 1059 A.D. a special prescription is given for high fever and hemorrhage. The fresh root is cleaned, washed, and ground. A full jigger of extracted juice from the root and half a jigger of fresh ginger juice are mixed together and sipped slowly by the patient.

The most widely quoted Chinese herbal in botanical and medical literature is Li Shih-chên's *Pên Ts'ao Kang Mu* (*Outline of Materia Medica*), published in 1590, during the Ming Dynasty. After quoting all earlier publications, Li presented the following observations of his own:

> Daylilies prefer moist places. They are mound-like and the leaves persist in winter. The shape and texture of these leaves are intermediate between those of cat-tail flag *(Typha latifolia)* and garlic, but more flexible. Since new leaves replace the old ones, the plant appears green throughout the year.
>
> The scapes emerge in June. A flower has six radiate parts and four pendant appendages. [He must have the anthers in mind. Evidently he overlooked the two short stamens.] It opens in the morning and withers by night. A plant continues to bloom until late autumn. There are red, yellow, and purple forms. The 3-angled fruit contains many shining black seeds.
>
> The root is fleshy, enlarged, spindle-shaped like that of certain asparagus. It is very easy to propagate.

As to origin and meaning of the vernacular names *deer-onion* (Lu Tsung), *forget-worry* (Wang Yu), *red-thorn* (Tan Chi), and *curing-melancholy* (Liao Ch'ou), Li added:

> In the *Book of Longevity,* Li Chu-hua, wrote that after eating the pot green prepared from the tender shoot of daylily, one is apt to feel confused and stupid as if one is drunk, hence the name *forget-worry.*
>
> The cooked shoot has the flavor of creamed onion. Among the plants eaten by deer are nine kinds with the property of nullifying the effects of poisonous material. Daylily is one of them, hence the name *deer-onion.*
>
> The people of Wu [Kiangsu and Chekiang Provinces, (Map 1-4)] have a custom of taking daylily with red-golden flowers to call on friends who are grieving, melancholy or mournful. Therefore in Wu the daylily is called Liao Ch'ou (Liao = to cure, Ch'ou = grief). The gift is called Tan Chi (Tan = golden red, Chi = a mourner or a thorn).

Li Shih-chên recorded five uses of daylily root in Chinese medical practice: (1) for abscess (cancer ?) of the breast. The root is pounded and soaked in gin. The tincture is taken internally and the residue is applied as a poultice; (2) for dropsy. One-fifth of an ounce of powdered dry root is taken with rice before meals; (3) for anuria. Tea made by boiling daylily root is sipped at frequent intervals; (4) for discharge of blood after bowel movement. A mixture of gin and daylily root roasted with ginger in oil is taken internally; and (5) for arsenic poisoning. Juice of daylily root is taken internally as a counter-poison.

Fig. 2. Daylily in Emergency Food Guides: a. From the *Famine Herbal* (1409 A.D.). b. From the *Extensive Treatise on Edible Wild Plants* (1621 A.D.).

Emergency Food Guides. Unlike the Materia Medica which were compiled through governmental support, herbals written as guides to emergency foods were prepared by individuals. Short text and clear illustrations are two prominent features of these emergency food guides. There the daylily is classed among plants supplying edible leaves. The facsimile production of two of the better known ones are presented in Fig. 2.

The *Famine Herbal (Chiu-huang Pên-ts'ao)* of Chu Hsiao was published in 1409 A.D. The author was the son of the first Emperor of Ming Dynasty. In Honan, he had a large garden where he grew over 400 species of edible wild plants for observation and trial. Regarding the daylily Chu Hsiao wrote:

> The plants are wild in woods and hillsides . . . Most people plant some in their gardens. The leaves are basal and 2-ranked. The scapes emerge from among the leaves. The flowers are golden yellow, sweetish and not poisonous.

The *Extensive Treatise on Edible Wild Plants* (Yeh-ts'ai Po-lu) was prepared by a Buddhist Monk, Pao Shan, pen-name as Master of the Fragrant Woods, published in 1621. The text and illustrations of each plant are very similar to those in Prince Chu's *Famine Herbal,* but Pao Shan gave detailed instructions for the preparation of plants for food. For daylily he wrote, "The tender shoots are scalded in boiling water, soaked, washed, drained and dressed with salt and sesame oil." Perhaps the scalding, soaking and washing processes reduce the hallucination effect reported by ancient authors. It is worthy of note that the cooking procedure described here is not very different from the common method used in preparing poke-weed shoots for food in eastern United States.

Daylilies in the Flower Mirror. The *Flower Mirror* (Hua Ching), published in 1688, is a well known treatise on Chinese gardening. The author, Chên

Hao-tzu, was a gentleman gardener in the British manner. He looked upon gardening as an art and the most exalting and superior way of life. He had a garden in Hanchow, a land considered by the Chinese as paradise on earth (Map 1-5). His account of daylily is quoted as follows:

> Daylily (Hsüan Hua) . . . prefers moist soil, tufted, scape devoid of secondary axes, with buds close to each other; leaves arching; the flower when it first appears, resembles the beak of a crane, then it opens with six radiant segments, yellow dusted red, opening in the morning and withering by night.
>
> There are three forms. The form with double flowers blooms in early summer. Its slender scapes bear no fruit. The simple-flower form blooms later. Its stout scape bears fruits containing round black seeds. The third form bears smaller fragrant flowers with honey-like color. This form is good for bonsai. However, it is shy of flower and requires rich soil and good care. . . . . There is another form that flowers in late autum. This is very rare.
>
> People who have large gardens should have abundant plantings of daylilies. In the spring the young shoots can be eaten as pot greens. In the summer, the flowers are also good food. However, the parts of plants bearing double flowers should not be eaten. These are deadly poisonous.
>
> Daylilies are propagated by crown divisions. The ramets should be planted far apart, for after one year the space between plants would be covered up. The plants multiply fast.
>
> People in the East gather the flower buds and dry them for the market. The product is called Huang Hua Ts'ai (Huang = yellow, Hau = flower, and Ts'ai = vegetable).

PART II. EARLY EUROPEAN RECORDS

The history of the daylily in Europe has been difficult to unravel, because of difficulties in the interpretation of the written record and also because of inaccuracies of various authors.

In 1937 G. P. Baker (*Jour. Roy. Hort. Soc.* 62: 399-411) wrote:

> . . . the Day Lily, is a very old eastern European garden plant, taking us as far back as the first century of the Christian era, . . . Pliny, . . . refers to the plant . . . it is in Dioscorides, a Greek physician, who . . . wrote a celebrated work in Materia Medica in which we find, not only a description of the plant, but also the medical properties of the bulbous roots and leaves . . . the lemon-flowered *H. flava* [*H. lilioasphodelus*] was not only known to the Greeks twenty centuries ago, but was also known to the Romans, the Egyptians, Africans, and other races whose names have disappeared from history.

There is no truth in this account.

The facts are these: (1) In 1753, Carolus Linnaeus applied the name *Hemerocallis,* first proposed by Mattioli in 1544, for the plant we know today as daylily; (2) The Linnaean name *Hemerocallis* is only a transliteration of EMEROKALLIS of Dioscorides. Actually, the species of *Hemerocallis,* in the sense of Linnaeus, are unrelated to the Mediterranean plant or plants depicted in the Materia Medica of Dioscorides; (3) Evidence indicates that the Linnaean species of *Hemerocallis* were not introduced to the Mediterranean countries before the middle of the sixteenth century.

Emerokallis of Dioscorides

What is the Dioscoridean EMEROKALLIS? To answer this question we need to know a little about Dioscorides and his book. Born in Cilicia, an ancient division of Asia Minor (now part of Turkey), north of Tarsus, Pedacius Dioscorides was a physician who traveled extensively and was a compatriot of Saul of Tarsus (St. Paul). Dioscorides traveled in Asia Minor, Greece, Italy, and Provence, and wrote a Materia Medica about 70-80 A.D. This work was copied repeatedly and translated into many languages and dialects. Before the birth of modern science, the Materia Medica of Dioscorides became the highest authority of the medical profes-

sion in countries around the Mediterranean Region and to the north. Information not included in this work was not considered official. An early copy of Dioscorides, known as the *Anician Codex,* illustrated and preserved in Vienna, was written about 512 A. D. by a Byzantine artist. An excerpt of the description of EMEROKALLIS clearly does not fit the daylily of our time (English translation in *The Greek Herbal of Dioscorides* by R. T. Gunther, 1934) :

> The plant has leaves and a stalk similar to that of lily, but the green leaves look like those of leek. It has three or four flowers at every break. The segments of the flower are similar to those of lily but the color is like that of the ochre. The root of the plant has the appearance of a great bulb, which, after pounding, the juice is taken either internally or applied with honey in wool, for drawing out water or blood. The ground leaves are applied to reduce inflammation of the breast and of the eyes. Both the root and the leaves are applied to burns.

The illustration of EMEROKALLIS in the *Anician Codex* of Dioscorides, is not the Linnaean *Hemerocallis* (Fig. 3). The *Hemerocallis* of today was unknown not only to Dioscorides and the ancient Greeks, but it was unknown also to herbalists of the Mediterranean region before the mid-sixteenth century. This fact is proved by the absence of daylily in herbals of the time prepared in the Mediterranean area.

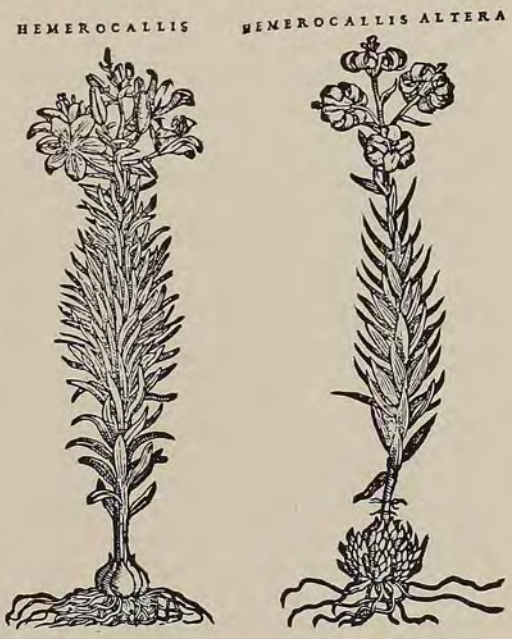
In 1544, Pietro Andrea Mattioli, a Venetian doctor, published *Commentarii in sex libros Pedacii Dioscoridis.* In this work the generic word *Hemerocallis* appears in botanical literature for the first time (Fig. 4). As used by Mattioli, *Hemerocallis* referred to species of *Lilium* of the Mediterranean Region, and not to the daylily we know today.

Daylily in the Low Countries

References to daylily in Europe first appeared in the herbals of three herbalists: Rembert Dodoens (Dodonaeus, 1517-85), Charles de l'Écluse (l'Escluse, Clusius, 1526-1609) both born in Belgium, and Mathias de l'Obel (de Lobel

Fig. 3. Not a daylily. Emerokallis of Dioscorides as illustrated by a Byzantine artist about 512 A.D. (redrawn from the Anician Codex).

Fig. 4. Both illustrations of *Hemerocallis* are from Mattioli's *Commentarii . . . Dioscoridis* (1544). Actually the plants are kinds of true lily or Lilium.



or Lobelius, 1538-1616) born in Lille, France. These three were bound by "so intimate a friendship that they freely imparted their observations to one another, and permitted the use of them, and also their figures, in one another's books." The woodcuts of their illustrations were published between 1570-1583 by their friend, Christophe Plantin of Antwerp, who often used cuts made for one in the publication of the other while the former was waiting for his manuscript to be published. Because of these conditions, it is hard to pin-point the exact person who first worked on daylily in Europe. In this discussion, the references will be entered in chronological order of publication.

In European herbals of the sixteenth century, daylily first appeared as *Liliasphodelus, Liriosphodelus,* and *Lilium non bulbosum.*

Pena and Lobel—New Handbook of Plants. For projecting the history of daylily onto the political background of Europe, it is worthy of note that de Lobel was born in Flanders and became physician to William the Silent. After the assassination of the Stadtholder, he migrated to England with his friend and co-author, Pierre Pena. His principal work was dedicated to Queen Elizabeth, and he eventually became Botanist to James I.

In 1570 Pena and de Lobel published *Stirpium adversaria nova.* On page 45 of this work *Luteus Liliflorus* (*Lilium luteum*) has been ascribed to daylily as follows:

> Liriosphodelus grows luxuriantly in nature, no less elegant when old than young. We saw the most superior one in Venice, and later in the office of our celebrated friends of Antwerp, Guillielmi Driesch and Petri Coldenberg. The roots were white like those of asphodel but smaller. The stems are about 27 inches tall. The leaves arise immediately from the root. They are leek-like but more slender. The extremity of the stem divides into branches each bearing three or four yellow or orange lilies, which are followed by angular capsules containing shining black oblong seeds like those of Peony. In the Pharmacopoeia of Venice this is called *"Lilium luteum"* or "Asphodelum".

It is worthy of note that (1) Pena and Lobel described the yellow daylily flower (*Luteus Liliflorus*); (2) they introduced the word 'Liriosphodelus' for the first time; (3) they had seen the material (plant or the parts used as medicine) in Venice and Antwerp; and (4) the descriptions of the root, the height and the manner of apical branching of the scape, the color of the flowers and the color and size of the seeds fit the characters of our yellow daylily. However, the statement about their personal acquaintance with the plant is very vague. It does not tell whether they had seen plants growing in a garden or whether they had seen merely the medicinal product in the stores of Venice and Antwerp. Moreover, this *Stirpium adversaria nova* is illustrated. The absence of an illustration for the *Luteus Liliflorus* seems to indicate that when their manuscript went to press, they had not seen the plant. This situation can be better understood in the light of the following work.

de Lobel—Natural History of Plants. In 1576, Lobel published the *Plantarum seu Stirpium Historia,* in two parts bound in one volume. Part I under the subtitle, *Matthiae de Lobel stirpium Observationes,* contains Lobel's additional personal observations on plants, and Part II is a reprint of *Stirpium adversaria nova.* On page 47 of Part I, there appears a beautiful figure of our modern yellow daylily (*H. lilioasphodelus* (*H. flava*)) under the name *"Liliosphodelus luteus liliflorus"* (Fig. 5-left). A marginal reference opposite this figure refers to *Lilium non bulbosum* of Dodonaeus. On page 48 of Part I, there is a description of *Liriosphodelus phoeniceus* (*H. fulva*), an excerpt of which appears as follows:

> This form has yellowish red flowers. Its leaves are more vigorous and broader than those of *Liriosphodelus* or white asphodel, and retuse. The stems are rounded, rougher 2 or 3 to a plant, 18 inches or more tall. At the summit, there are the striped liliaceous flowers which are more or less equal to those of the small puniceum lily. The

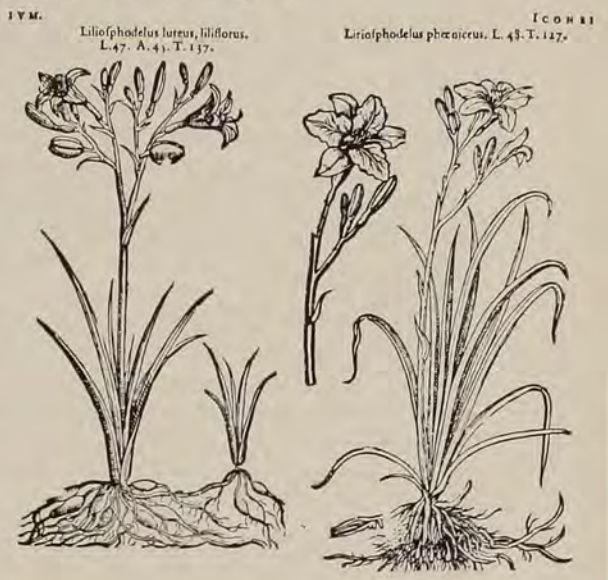
roots are tuberous, round and smaller than those of yellow asphodel.

The plant just referred to was not illustrated in the body of the work by Lobel, but by the time the entire work was published an illustration was ready for this *Liriosphodelus phoeniceus* (*H. fulva*). This illustration, with nine other figures, was added to the end of Lobel's book with a reference to page 48 of the *Observationes* on the margin opposite the figure (Fig. 5-right). This woodcut illustrates an entire flowering plant and a detached branch with one flower and a few buds on the upper left hand corner. Regarding this figure, G. P. Baker stated, . . . the first European illustration of the plant in Lobel's *Plantarum Historia* . . . a wood cut, showing an entire plant of the lemon daylily under the name of *Liriosphodelus phoeniceus,* a single flower of a cinnabar red colouring, this plant being the *H. fulva* Linn. of today." In this statement Baker was again confused. This illustration has nothing to do with the lemon daylily, which was illustrated on page 47 by an entirely different figure. In Lobel's *Plantarum Historia* there are two woodcuts one illustrating the yellow daylily and the other the tawny daylily. These appear in different parts of the book as explained above.

From Lobel's accounts, especially from the two figures, we know that by 1576 two daylilies had already been introduced to Europe. Lobel gave no indication of his source of material, which leaves room to question whether his records represented his personal observations or whether they were communications from a friend. These figures could have been produced by his artist, or they might have been sent to him or to his publisher by a friend. We may ask further whether by this time the two daylilies described by Lobel had been introduced to the Netherlands, or were from another source. We may be able to answer some of the questions after reviewing the works of Clusius and Dodoens.

Clusius—Observation on the Natural History of Rare Plants (1583). Clusius

Fig. 5. The first illustration of *H. fulva* (right) in European herbals, from Lobel's *Plantarum Stirpium Hitsoria,* 1576. On left, *H. lilioasphodelus* (*H. flava*) was illustrated by Dodoens in an earlier work (see Fig. 6).



was an unusual person living at an unusual time. Being "an enthusiastic adherent of the reformed faith . . . he suffered from religious persecution which brought . . . martyrdom to . . . . his relatives . . . he was deprived of his property . . . . He passed a nomad existence. . . . The university of Leyden finally appointed him to a professorship." With this background, we can proceed to review his personal experience with daylilies.

In 1579-80, as a guest of Baron Balthasar de Batthyany, Clusius lived in the Chateau de Gussing in Hungary. On page 143 of his *Rariorum aliquot Stirpium, per Pannoniam, Austriam, & vicinas quasdam Provincias observatarum Historia,* published at Antwerp in 1583, he gave an account of the daylily as seen in Hungary (the plant is figured on p. 44):

> *Liliasphodelus luteus* with yellow fragrant flowers, the *Hemerocallis* of Dodonaeus, grows abundantly in nature and being at its best in the moist meadow opposite the well-protected Nemethwywar where I have examined it with de Batthyan in 1579-80. There

it flowers in late May and early June. The Hungarian name is *Zeöd liliom.* The Croatians also brought me a white-flowered form which they called *Illyan Zwet.*

In 1601 Clusius published *Rariorum Plantarum historia.* This is a combination of his earlier publications on the observation of rare plants in Spain in his *Rariorum aliquot Stirpium per Hispanias observatarum Historia* (1576) and in Austria and Hungary (1583). On page 137 of his book *Clusius* (1601) mentioned two daylilies in the following manner:

> Liliasphodelus that has purple-red flowers, the *Hemerocallis* of Dodonaeus, grows very luxuriantly in all of Austria, in German gardens even more. The fragrant yellow kind has flowers which do not dry readily (caducous). It was not known in Austria before my introduction there. This one grows spontaneously and copiously in moist meadows not far from the well fortified Nemethwywar, west of the castle of Balthasar de Batthyan. I saw it in 1579-80. Then it was neglected by the inhabitants. Batthyanus adored the elegant and fragrant flowers and had many clumps of the plant dug and brought in baskets into his garden.

The daylily that Clusius saw in the moist meadow of Nemethwywar in 1579-80, during a visit to Hungary, was an escape associated with the castle. The introduction of the yellow daylily into Hungary as a cultivated plant is recognized by Gustav Hegi in his *Illustrierte flora von Mittel-Europa* (2: 204, 1908), in which he says that "North of the Alpine Chain *H. fulva* and *H. flava* never occur truly wild. Here and there these two species are seen as escapes and ornamental plants. They are found especially near monasteries, old castles and vineyards."

Clusius seems to have introduced the daylily to Austria and to gardens of western Europe from material brought from Hungary.

Dodoens. Rembert Dodoens, Professor of Medicine at Leiden and Physician to the Emperor Maximilian II and also to Rudolph II, was the oldest of the trio of

Fig. 6. The first known illustration of *H. lilioasphodelus* (*H. flava*) in European herbals, from Dodoens *Cruydeboeck* (1554).

Belgian herablists. His *Cruÿdeboeck* (1554) was the first herbal published in the Netherlands. It was almost immediately translated into French by his friend Clusius and was published in 1557 as the *Histoire des Plantes en laquelle est contenue la Description Entiere des Herbes.*

A translation into English, entitled *A Niewe Herball* by Henry Lyte was published in 1578 (see below).

In Dodoens' *Cruÿdeboeck* appeared the first known illustration of *H. lilioasphodelus* (*H. flava*), under the name *Lilium luteum,* to appear in European herbals (Fig. 6). This was the first known illustration of *Hemerocallis* to appear in European literature. The following account is a translation from *Cruÿdeboeck* (p. 78):

> . . . these lilies have long narrow leaves which come forth from the roots. Between these comes forth the stem approximately 2 ft. high which is bare and without any leaves. Then it di-

vides into other stems on the top of which the lilies appear. . . . Of color very light yellow and very sweet of fragrance. The roots of these are many together. . . . The yellow lily is at this time called *Lilium luteum.* Another name at this time is not known. Some want to make it *Hemerocallis,* which as Athenaeus writes, is a flower which appears in the morning with the rising of the sun and disappears at night. . . . The yellow lilies are strangers for this country and have not been found except in gardens of herb collectors.

It is of interest to note the reference to *Hemerocallis* as a possible alternate name at this early date of 1554, twenty-two years prior to the work of Lobel who figured the yellow and fulvous daylily in his *Plantarum seu Stirpium Historia* (1576).

A cherished desire of Dodoens was to produce his herbal in Latin. Christophe Plantin of Antwerp undertook the publication of a much modified Latin translation of the *Cruÿdeboeck* with new blocks engraved for it. Dodoens supplied the artists with fresh plants and superintended their labor. The work was published in 1583 under the title, *Stirpium historiae pemptades sex siue libri xxx.* This work contains the same wood blocks of daylilies used by Lobel in his *Plantarum seu Stirpium Historia.* It is worthy of note that this last work of Dodoens eventually became the base of Gerard's famous *Herball* in English.

The absence of records on daylilies in the early editions of Dodoens' *Cruÿdeboeck* and the lack of new material in his *Pemptades* are all negative evidence to indicate that (1) The daylilies were rare in European gardens of 1554, and they were unknown to botanists in the Netherlands before the middle of the sixteenth century; and (2) new forms were not added to the gardens in western Europe before the 1580's.

Daylily in the German Herbals

The German herbalists were pioneers in the field of descriptive botany. Their illustrated handbooks were useful guides and an inspiration to botanists in the Netherlands in their work on the natural history of plants. Among the four German Fathers of Botany whose published herbals appeared in the sixteenth century, only Tabernaemontanus illustrated the daylily.

Tabernaemontanus. Jacob Theodor, with the pen name of Tabernaemontanus, was a German physician with botany as a hobby. In 1588 his book, *Neuw Kreuterbuch* was published, and in 1590 the *Eicones Plantarum* (*Iconum Stirpium et Plantarum*) containing beautiful figures with no text was published. On page 652 of the *Eicones* appears a figure under the name *Asphodelus liliaceus rubeus* (Fig. 7-left). This figure represents a plant with spindle-shaped fleshy roots, broad and stout leaves the outer ones arching, bracteate scapes about the same height as the leaves, bifurcate and each secondary axis bearing many crowded subsessile flowers. On page 653 of the *Eicones* appears *Asphodelus liliaceus luteus* (Fig. 7-right). This figure represents a plant with spindle-shaped thickened roots, creeping rhizomes, narrow more or less erect leaves, bracteate scape branched repeatedly and the inflorescence loose and the flowers evidently pedicellate. These figures indicate that in the 1590's there were certain forms of daylily in German gardens which were different from the specimens the artist had for making the illustrations first published in Lobel's *Plantarum Historia* (1576). The figures in Tabernaemontanus also appeared in the first edition of Gerard's *Herball* (1597) (Fig. 7).

Daylily in the English Herbals

The early records about daylilies in English herbals are primarily translations of Dodoens' *Cruÿdeboeck* and his *Pemptades,* but enlarged by additions of new material and translators' comments. In American horticultural literature daylily and hemerocallis are used interchangeably. Daylily was first used by English herbalists. It is from their writings that we can trace the changes which took place in the development and application of the name Daylily.

Lyte—A Niewe Herball. Henry Lyte was the first person who wrote about


Of Yellow Lillies. Chap. 66.

* The kindes.

BIcauſe we ſhall haue occaſion heereafter to ſpeake of certaine Cloued or Bulbed Lillies, we wil in this chapter intreat onely of another kind not Bulbed, which likewiſe is of two ſorts, differing principally in their rootes; for in flowers they are Lillies, but in rootes Aſphodils, participating as it were of both, though neerer approching vnto Aſphodils than Lillies.

1 *Lilium non bulboſum.* The yellow Lillie.

2 *Lilium non bulboſum Phœniceum.* The Day Lillie.

* The

Fig. 7. Daylilies in Germany. Illustrations that first appeared in Tabernaemontanus' *Eicones Plantarum* (1590) *H. lilioasphodelus* (*H. flava*) (left), and *H. fulva* (right). From Gerard's *Herball* (1597).

daylily in English. He was a man of means and traveled extensively. His copy of Clusius' French translation (1557) of Dodoens' *Cruÿdeboeck* now preserved in the British Museum, was carefully annotated and corrected. Thus Lyte's *A Niewe Herball,* or *Historie of Plantes* published in 1578 contains more than a translation of Dodoens' work. On page 204 of Lyte appears the description of *Lilium non Bulbosum* (*Lillie non bulbus*) with an illustration which was used by Lobel for his *Liriosphodelus luteus Liliflorus.*

Gerard's Herbal. Gerard was the first English herbalist who used the name daylily to designate the Chinese Hsüan Ts'ao. His *The Herball or Generall Historie of Plantes* was first published in 1597. It is recorded that the printer John Norton of London commissioned a Dr. Priest to translate Dodoens' *Pemptades* (1583) into English, but Priest died before the work was finished. According to Agnes Arber (*Herbals* 108-109, 1912) "Gerard simply adopted Priest's translation, completed it, and published it as his own, merely altering the arrangement from that of Dodoens to that of l'Obel . . . Gerard did not know enough about botary to couple the wood-blocks of Tabernaemontanus with their appropriate descriptions and de l'Obel was requested by the printer to correct the blunders."

Page 90 of the first edition of Gerard's

herbal (1597) appears as Figure 7 in this Handbook. Above the figures are the names he adopted both in Latin and in English. The woodcuts from Tabernaemontanus' *Eicones* were obtained from Frankfurt in Germany by John Norton the printer of Gerard's Herbal. Gerard gave lengthy descriptions and notes about the two daylilies. He began the description for number two (Fig. 7) as follows:

> The Day Lily hath stalks and leaves like the former . . . of an orenge tawnie colour . . . in the morning his bud, . . . at noone in full blowen . . . in the evening it is rotten and stinking, as if it had been trodden in a dunghill a moneth togither in foule and rainy weather.

Gerard had a garden in Holborn, then the most fashionable district of London. Regarding the daylilies in his garden he wrote, "These Lillies do growe in my garden, and also in the gardens of herbarists and lovers of fine and rare plants."

Gerard tried to bring all the synonyms of the *Lilium non bulbosum* together. In so doing he attached the *Hemerocallis* mentioned in a Greek symposium literature, the *Deipnosophistai* of Athenaeus, to the daylily. The old herbalists distinguished "two kindes of *Hemerocallis,* the one a shrub or woodie plant, as witnesseth *Theophrastus* . . . *Plinie* . . . the leaves whereof onely do serve for garlands . . . The other *Hemerocallis* which they set downe, is a flower which perisheth at night and buddeth at the sunne rising, according to

1. *Liliaſphodelus phœniceus.* The gold red Day Lilly.

Becauſe the rootes of this and the next, doe ſo nearely agree with the two laſt recited Aſphodils, I haue ſet them in this place, although ſome doe place them next after the Lillies, becauſe their flowers doe come neareſt in forme vnto Lillies; but whether you will call them Aſphodils with Lilly flowers, as I thinke it fitteſt, or Lillies with Aſphodill rootes, or Lillies without bulbous rootes, as others doe, I will not contend.

The red Day Lilly hath diuers broad and long freſh greene leaues, folded at the firſt as it were double, which after open, and remaine a little hollow in the middle; among which riſeth vp a naked ſtalke three foot high, bearing at the toppe many flowers, one not much diſtant from another, and flowring one after another, not hauing lightly aboue one flower blown open in a day, & that but for a day, not laſting longer, but cloſing at night, and not opening againe; whereupon it had his Engliſh name, The Lilly for a day: theſe flowers are almoſt as large as the flowers of the white Lilly, and made after the ſame faſhion, but of a faire gold red, or Orange tawny colour. I could neuer obſerue any ſeede to follow theſe flowers; for they ſeeme the next day after they haue flowred, (except the time be faire and dry) to bee ſo rotten, as if they had lyen in wet to rotte them, whereby I thinke no ſeede can follow: the rootes are many thicke and long yellow knobbed ſtrings, like vnto the ſmall yellow Aſphodill rootes, but ſomewhat greater, running vnder ground in like ſort, and ſhooting young heads round about.

2. *Liliaſphodelus luteus.* The yellow Day Lilly.

I ſhall not neede to make a repetition of the deſcription of this Day Lilly, hauing giuen you one ſo amply before, becauſe this doth agree thereunto ſo nearely, as that it might ſeeme the ſame; theſe differences onely it hath, the leaues are not fully ſo large, nor the flower ſo great or ſpread open, and the colour thereof is of a faire yellow wholly,and very ſweet, which abideth blowne many daies before it fade, and hath giuen blacke round ſeede, growing in round heads, like the heads of the ſmall yellow Aſphodill, but not ſo great.

Cluſius hath ſet downe, that it was reported, that there ſhould be another Liliaſphodill with a white flower, but we can heare of none ſuch as yet; but I rather thinke, that they that gaue that report might be miſtaken, in thinking the Sauoye Spider-wort to be a white Liliaſphodill, which indeede is ſo like, that one not well experienced, or not well regarding it, may ſoone take one for another.

Figure 7a

Fig. 8 Daylilies in England a. Parkinson's gold-red Day Lily (see text for explanation). b. *Lilium luteum asphodeli radice* and c. *Lilium rubrum asphodeli radice* (redrawn from Morison, sect. 4, Tab. 21).

Athenaeus, and therefore is called the Day Lillie, or Lillie for a day." In confusing etymological similarities with biological realities, Gerard fell into an error which has been indiscriminately reproduced in botanical and horticultural literature related to *Hemerocallis* for almost four centuries.

The 1633 edition of Gerard's Herbal was enlarged and amended by Thomas Johnson. The illustrations of the daylilies in this edition were changed to those which first appeared in Lobel's *Plantarum seu Stirpium Historia* (1576).

Parkinson—Paradisi in Sole. John Parkinson was the first person to use daylily in a generic sense and added modifiers to distinguish the forms. He was the Apothecary of James I and later received the title of Botanicus Regius Primarius from Charles I. He had a large garden in London. It has been suggested that the title of his book, *Paradisi in Sole Paradisus Terrestris* (1629) forms a pun upon his name for it may be translated to *Park-in-sun.* On page 148 of this work he gave his personal observation of the two forms of daylily in his garden. In order to avoid lengthy explanation, his account is reprinted below (Fig. 7a):

Parkinson's illustration of the yellow daylily is evidently redrawn from Lobel's *Liliosphodelus luteus Liliflorus.* The illustration for the gold red daylily represents a form with short flower axes and obscure bracts (Fig. 8-a).

Morison—Plantarum Historiae. Robert Morison was an English physician and King's botanist. In his *Plantarum Historiae Universalis Oxoniensis,* part two, published in 1680, page 412, Morison gave an outline which contains three forms of *Lilium radice Asphodeli* or *Liliosphodelus.* These are 1. *Luteus major* illustrated as *Lilium luteum asphodeli radice;* 2. *Luteus minor,* and 3. *Puniceus* or *phoenicus,* illustrated as *Lilium rubrum asphodeli radice. Luteus minor* was not illustrated. He compared the two yellow-flowered forms and described 'Minor' to be half as large as 'Major', especially with regard to the size of the leaves and height of the stem. *Luteus major* shows a plant with a branched scape with leafy bracts, and prominent bractlets below each flower, the flowers are smaller and several of them open at the same time from the branched scape of a single ramet. *Luteus major* represented a daylily hitherto unknown in European gardens.

Ray—Historia Plantarum. John Ray in his *Historia Plantarum* (1688) drew heavily on Parkinson for information on the daylily. On page 1191 (vol. 2) of that work Ray listed *Liliasphodelus luteus* of Parkinson as The Day Lily. The red Day Lily was listed as *Liliasphodelus phoe-*

Table I. Variation in Spelling and Application of the Name 'Daylily' in England

Time	Author	English Names	Color of Flower	Latin Names
1597	Gerard	Yellow Lillie	yellow	Lilium non bulbosum
		Day Lillie	gold red	Lilium non bulbosum Phoeniceum
1629	Parkinson	Yellow Day Lilly	yellow	Liliasphodelus luteus
		Gold red Day Lilly	gold red	Liliasphodelus phoe niceus
1688	Ray	Day Lily	yellow	Liliasphodelus luteus
		Red Day Lily	gold red	Liliasphodelus phoe-niceus

niceus of Parkinson.

Variation in early daylily nomenclature is shown in Table I.

Daylily in the Swiss Herbals

Records of daylilies in Switzerland and France are found in the herbals of the brothers Bauhin. Medicine was the traditional profession of the Bauhin family. The father was a French doctor who moved to Switzerland to avoid religious persecution. Jean Bauhin was born in 1541, and later attended universities in Basle, Tübingen, Zurich, Montpellier, and Lyons. His chief work was the *Historie universelle des plantes,* but he died before the work was published. His son-in-law, Jean H. Cherler, also a doctor, published the work in 1650-51 as *Historia Plantarum Universalis.* In volume II, page 699, of this work Bauhin gave a detailed description and a figure of *Lilium persicum siue susianum,* to which plant he added *Hemerocallis* as a synonym. On page 700 appears *Lilium asphodeli radice luteum* [*H. lilio-asphodelus*]. Following a detailed description, he discussed the work of all former herbalists on this plant. Then under the subtitle 'place and time', he remarked, "from foreign country to Belgium . . . First seen in Basle, Switzerland in the garden of Dr. Foel Plater. My brother Gaspard brought me one from Triuesan."

On page 701 of the same book appears *Lilium radice asphodeli phoeniceum* [*H. fulva*]. He commented that this plant is not very different from the one above, except all parts of the plant are larger, the leaves broader, more carinate, the flower one-third red, the rest gold and with a medium longitudinal yellow line. He added that he had seen the plant in the gardens of Dr. Foel Plater, and E. C. Wirtemb. Montbelgard in France, on the junction of Rhine and Rhone. Both species in Bauhin's work are illustrated, from figures evidently redrawn from Lobel.

Gaspard Bauhin, also a physician, was 19 years younger than his brother Jean. He attended schools in Basle, Montpellier, Paris Tübingen, and Italy. His interest in plants caused him to make observations and collections everywhere he went, and he built an herbarium containing four thousand plants, some from Egypt and India. In 1623 he published the *Pinax Theatri Botanici,* in which he tried to convert chaos into order and prepared the "first complete and methodical concordance of the names of plants." On page 80 of the *Pinax,* under the title *Lilium asphodeli radice,* the yellow daylily is listed as *I. Lilium luteum asphodeli radice* and the tawny daylily as *II. Lilium rubrum asphodeli radice.*

Summary of Daylily History Before Linnaeus

The herbals published between 1554-1576 clearly indicate that two daylilies were grown in European gardens during

this period, the yellow daylily (*H. lilio-asphodelus* (*H. flava*)) with smaller leaves, yellow flowers and fruits and the tawny daylily (*H. fulva*) with larger more carinate leaves, golden red flowers and no fruit.

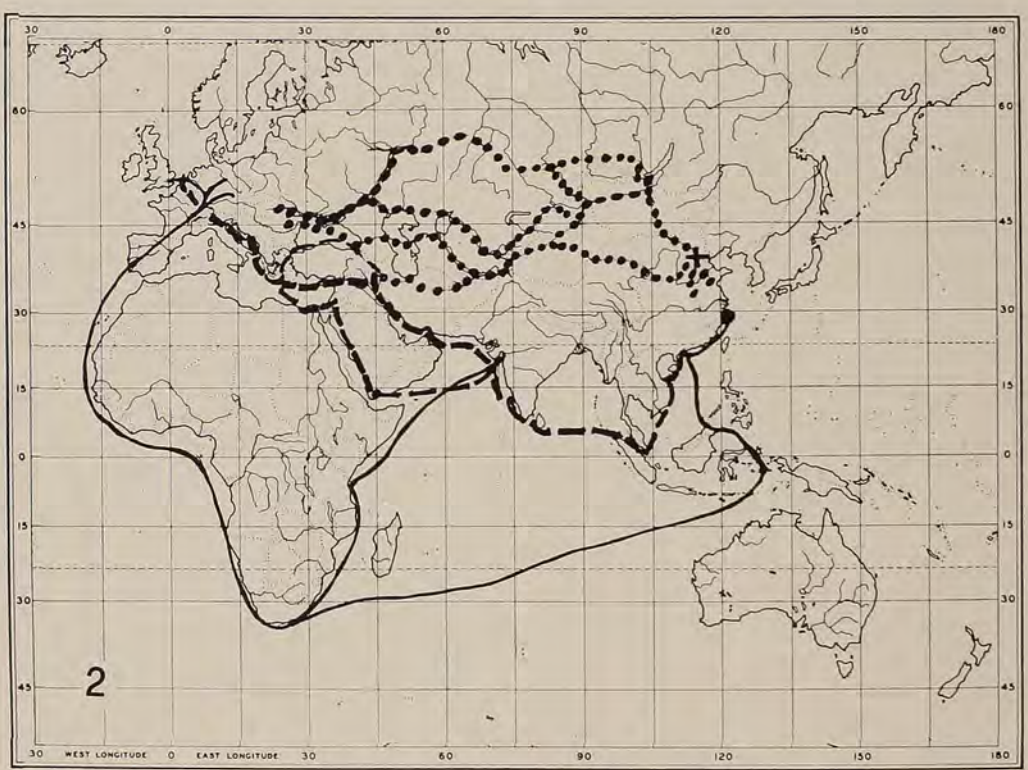
The tawny daylily seems to have had a potential for somatic changes. By the 1590's, there was a form in Germany with a more crowded inflorescence on obviously bracteate scapes (Fig. 7, right). In the 1620s, another form with a crowded inflorescence on scapes with obscure small bracts appeared in London (Fig. 8-a).

The fertile fruit-bearing yellow daylily seems to have had a potential for genetic segregation. By the 1680's two forms were recognized in British gardens. The tall form with a loose inflorescence on a branched scape with elongated leaf-like bracts (Fig. 8-b) and a low form only half as tall and perhaps shy flowering.

The introduction of daylilies to European gardens took place through two routes. The route of the yellow daylily begins in Hungary, from plants brought there by Asians. The tawny daylily route began either in Lisbon or Venice, through international trade of Europeans and Asians (Map 2).

PART III. HEMEROCALLIS OF LINNAEUS

The starting point for binomial nomenclature, e.g., the scientific names of flowering plants and ferns in modern usage dates from *Species Plantarum* of



Map. 2. Possible routes of daylily introductions to Europe: Dotted lines (. . . . .) represent overland trade routes the yellow daylily was introduced to Hungary by medieval Mongol settlers. Broken lines (- - - -) represent the route Chinese-Arabian-Phoenician traders might have introduced the tawny daylily to Venice. Solid lines (———) represent the route Portuguese traders might have brought the tawny daylily to Lisbon.

Carolus Linnaeus published in 1753. This important work is of basic importance to botanists throughout the world. *Hemerocallis* appears on page 324 of the first edition of *Species Plantarum* with two species.

A correct understanding and proper interpretation of the Linnaean species of *Hemerocallis* is of fundamental importance in the study of the species of the entire genus. From the review of daylily in European gardens as depicted in various herbals, we know that by the end of the seventeenth century different forms in each color group of daylily already existed.

Perhaps Linnaeus saw daylilies first in the garden of George Clifford, a wealthy banker of Hartekamp between Leiden and Haarlem in Holland. On September 13, 1735, Linnaeus became Clifford's physician and superintendent of his garden and lived like a prince in a great garden containing numerous plants and a large library. In 1737 he published the first edition of *Genera Plantarum* and the next year he published *Hortus Cliffortianus* a descriptive work about the plants in Clifford's garden.

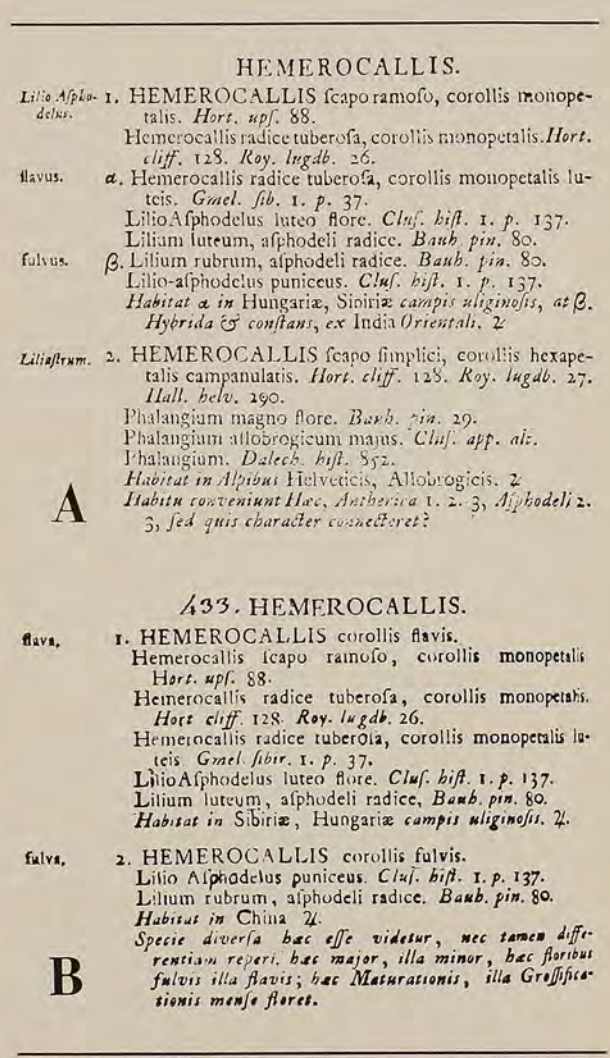
In 1737, Linnaeus in *Genera Plantarum,* described *Hemerocallis* based largely upon an interpretation of *Institutiones Rei Herbariae* of Tournefort published in 1700. In *Genera Plantarum, Hemerocallis* consisted of two groups, (a) *Lilio-asphodelus* and (b) *Liliastrum* groups erected by Tournefort.

In 1737 Linnaeus, in *Hortus Cliffortianus,* referred to the daylily as (p. 128) *Hemerocallis radice tuberosa, corollis monopetalis,* two kinds being listed: α *Lilioasphodelus luteo flore* of Clusius and β *Lilio-asphodelus puniceus* of Clusius. In addition to these descriptive phrases he cited all the synonyms that appeared in Dodoens, Caesalpino, G. Bauhin, J. Bauhin, Morison, and Ray.

Linnaeus, in *Species Plantarum* (1753) recognized two species under *Hemerocallis.* A facsimile of the portion on *Hemerocallis* in the first and second editions of *Species Plantarum* is shown in Figure 9.

In the first edition of *Species Plantarum* (1753), Linnaeus designated *flavus* and *fulvus* by the Greek letters alpha and beta (varieties in the modern sense), of the species *Hemerocallis lilioasphodelus.* A second species, *H. liliastrum,* listed in the first edition of Linnaeus, was transferred to another genus, *Paradisea liliastrum,* in the second edition of *Species Plantarum,* published in 1762.

In the 1762 edition, *flava* and *fulva* were erected to full specific rank with no mention of *lilioasphodelus.* In the his-



HEMEROCALLIS.

Lilio Aſpho-delus. 1. HEMEROCALLIS ſcapo ramoſo, corollis monopetalis. *Hort. upſ.* 88.
Hemerocallis radice tuberoſa, corollis monopetalis. *Hort. cliff.* 128. *Roy. lugdb.* 26.

flavus. α. Hemerocallis radice tuberoſa, corollis monopetalis luteis. *Gmel. ſib.* 1. *p.* 37.
LilioAſphodelus luteo flore. *Cluſ. hiſt.* 1. *p.* 137.
Lilium luteum, aſphodeli radice. *Bauh. pin.* 80.

fulvus. β. Lilium rubrum, aſphodeli radice. *Bauh. pin.* 80.
Lilio-aſphodelus puniceus. *Cluſ. hiſt.* 1. *p.* 137.
Habitat α *in* Hungariæ, Sibiriæ *campis uliginoſis, at* β. *Hybrida & conſtans, ex* India *Orientali.* ♃

Liliaſtrum. 2. HEMEROCALLIS ſcapo ſimplici, corollis hexapetalis campanulatis. *Hort. cliff.* 128. *Roy. lugdb.* 27. *Hall. helv.* 290.
Phalangium magno flore. *Bauh. pin.* 29.
Phalangium allobrogicum majus. *Cluſ. app. alt.*
Phalangium. *Dalech. hiſt.* 852.
Habitat in Alpibus Helveticis, Allobrogicis. ♃

A *Habitu conveniunt Hæc, Antherica* 1. 2. 3, *Aſphodeli* 2. 3, *ſed quis character connecteret?*

433. HEMEROCALLIS.

flava. 1. HEMEROCALLIS corollis flavis.
Hemerocallis ſcapo ramoſo, corollis monopetalis *Hort. upſ.* 88.
Hemerocallis radice tuberoſa, corollis monopetalis. *Hort cliff.* 128. *Roy. lugdb.* 26.
Hemerocallis radice tuberoſa, corollis monopetalis luteis. *Gmel. ſibir.* 1. *p.* 37.
LilioAſphodelus luteo flore. *Cluſ. hiſt.* 1. *p.* 137.
Lilium luteum, aſphodeli radice, *Bauh. pin.* 80.
Habitat in Sibiriæ, Hungariæ *campis uliginoſis.* ♃

fulva. 2. HEMEROCALLIS corollis fulvis.
Lilio Aſphodelus puniceus. *Cluſ. hiſt.* 1. *p.* 137.
Lilium rubrum, aſphodeli radice. *Bauh. pin.* 80.
Habitat in China ♃.
Specie diverſa hæc eſſe videtur, nec tamen differentiam reperi. hæc major, illa minor, hæc floribus fulvis illa flavis; hæc Maturationis, illa Groſſificationis menſe floret.

B

Fig. 9. The Linnaean species of *Hemerocallis* as proposed in *Species Plantarum:* A. First edition, 1753. B. Second edition, 1762.

tory of daylily this situation poses a dilemma as to the correct name of the yellow daylily, which is *H. lilioasphodelus,* for the plant that botanists and growers of daylily have long known as *H. flava.* The decision as to the valid name is determined by Article 53 of the *International Code of Botanical Nomenclature* which says: "When a species [*H. lilioasphodelus*] is divided into two or more species [*H. flava* and *H. fulva*] the specific epithet [*H. lilioasphodelus*] must be retained for one of them or, if it has not been retained, [as it was not in the 1762 edition of *Species Plantarum*] must be reinstated for one of them [that is, *H. lilioasphodelus*]."

By comparing A and B in Fig. 9, it is clear that one of the descriptions used in 1753 for the species *H. lilioasphodelus* is placed under *H. flava* in 1762. For this reason *H. lilioasphodelus* becomes the legitimate and valid name and *H. flava* becomes a synonym.

Gmelin—Flora Sibirica. This was one of Linnaeus' source books for his *Species Plantarum.* Linnaeus' citation of this reference complicated the matter of the typification of *H. lilioasphodelus* which we have just clarified. Joanne Georgio Gmelin was the first European to report daylily in its natural setting. In the *Flora Sibirica* (1: 37. 1747) Gmelin recorded seeing *"Hemerocallis radice tuberosa, corollis monopetalis luteis"* in the countryside east of the Obi River to Ochotense frequently in fields eastward to the sea. He cited *Lilioasphodelus luteo flore* Clus. and *Lilium luteum asphodeli radice* G. Bauh. as synonyms. Philip Miller described this plant as *H. minor.* Gmelin further reported the economic use of the dry leaves saying, "The Tartars of Krasnoiar and Tome collect the leaves as they dry with age, rub them between hands and obtain a coarse fiber for making rough covers called Kárgatschetschak."

Material of daylily was introduced from Siberia to the gardens of London about 1800. The identification of this species will be discussed later.

PART IV. HEMEROCALLIS AFTER LINNAEUS

The latter half of the eighteenth century was the grand period of gardening in western Europe when magnificent gardens were laid out in nearly every country. Yet, during this period little new stock of *Hemerocallis* was added to European gardens. Daylilies introduced into western Europe were obtained from gardens in Russia where Siberian plants were in cultivation.

Colored Illustrations. The first colored illustrations of *Hemerocallis* in Europe were rather crude hand-colored impressions published by J. H. Kniphof in *Botanica in Originali seu Herbarium Vivum. H. fulva* (*Centur.* VII plate 30. 1769), was followed in volume 10 of the same work by *H. lilioasphodelus* (*H. flava*) (Centur. X plate 51. 1772); the latter was illustrated in an earlier German edition (plate 10, 1734).

During the last quarter of the eighteenth century the technique of botanical illustrations improved. Among the finest color illustrations of the period were those produced under the supervision of the famous Dutch-Austrian botanist Nicolaus Joseph von Jacquin. In his *Hortus botanicus Vindobonensis* (1: t. 139. 1772) appeared *Hemerocallis lilioasphodelus* (*H. flava*) showing the underground structures, leaves, flowering branch, and a portion of a fruiting branch.

In England, William Curtis founded the *Botanical Magazine* in 1787 for the purpose of illustrating in color and describing "the most ornamental foreign plants cultivated in London." A colored plate of *H. lilioasphodelus* (*H. flava*) appears in the first volume (1: t. 19. 1787) and *H. fulva* in volume two (t. 64. 1788).

Introduction and Nomenclature. Botanical records of the eighteenth century indicate that only two introductions of *Hemerocallis* into western European gardens were made during this period. *Hemerocallis minor* was the first species described after publication by Lin-

naeus of *Species Plantarum* (1753). Described in the *Gardeners Dictionary* by Philip Miller in 1768, *H. minor* was based on specimens cultivated in the Chelsea Physic Garden in London. According to Miller, this species occurs spontaneously in Siberia, and produces fruit and seed in London. (additional details in Chapt. 2 of this handbook.)

Carl Peter Thunberg, a student of Linnaeus, collected plants in Japan (1775-1776) and records in his *Flora Japonica* (p. 142. 1784) that *H. fulva* was cultivated there, and flowers in June and July. He observed both single- and double-flowered forms, and plants with uniformly green leaves and those with white-variegated leaves.

In a revision of Linnaeus' *Species Plantarum* (*Sp. Pl.* 2: 197. 1779), Carolo Ludovico Willdenow of Germany observed that mutations had occurred in *H. fulva*. He reported that some plants produce larger flowers than others, and some flowers were so pale they approached the flower color of *H. lilioasphodelus* (*H. flava*).

Hemerocallis in the Nineteenth Century

During the first two decades of the nineteenth century the new species described and illustrated were introductions made in the preceding century.

A few introductions of new material of *Hemerocallis* were made in European gardens, especially in the later part of the ninetheenth century; with the exception of two cases the records of these introductions are obscure. All the known species of *Hemerocallis* were introduced into America via European gardens. No record of these introductions are available.

By the last quarter of the nineteenth century, the sterility of *H. fulva* attracted the attention of pioneer cytologists. Investigations of the behavior of the pollen mother cell and the development of pollen in this species were made by botanists in Germany and Austria. These works eventually triggered the explosive exploration of the genus made by American botanists in the next century.

New records of old introductions. In 1802, Henry C. Andrews, a botanical artist, published *H. graminea* in his serial publication, *Botanists' Repository* (4: t. 244) as the first published species in the nineteenth century. The colored plate was based on a plant cultivated in the Oxford Botanic Garden, introduced earlier by John Sibthorpe, Prof. of Botany at Oxford University (1783-1795).

Also in 1802, Pierre Joseph Redouté, a French botanical artist, illustrated *H. lilioasphodelus* (*H. flava*) and *H. fulva* in *Les Liliacées* (plates 15 and 16 respectively). As objects of art these plates are very attractive, but as presentations of science, they fall short of being true. There are too many flowers opening simultaneously.

In 1805, J. Sims illustrated *H. graminea* in Curtis's *Botanical Magazine* (22: t. 873) from a plant supplied by Conrad Loddiges raised from seeds sent from Siberia.

The second species of *Hemerocallis* described in the nineteenth century was *H. disticha.* (*H. fulva* var. *disticha*). Our earliest record about it was published in a list of plants introduced to Cambridge Botanic Garden, England before 1804. In 1812 Sims in Curtis's *Botanical Magazine* (35: t. 1433) informed us that a picture of this species, painted by a Chinese artist in 1793, existed in the collection of flower paintings of Joseph Banks. We know that Henry Bradley, an officer of the East India Company stationed at Macao sent Banks specimens and botanical paintings. By piecing together these fragmentary facts, we know that this species was introduced from southern China. The plant did not flower until 1823, when Robert Sweet prepared a full description and a colored illustration of it in *British Flower Garden* (1: 28).

In 1848 Ludovicus Reichenbach published a magnificent colored illustration of *H. lilioasphodelus* (*H. flava*) and *H. fulva* in *Icones Florae Germanicae* (10: 29. t. 510. fig. 1112, 1113). This is one of the best treatments of the species in European floras. He pointed out that perianth-segments and their veins fur-

nish good distinguishing characters for the species. Accordingly, *H. lilioasphodelus* has flat perianth-segments with the veins subequal and *H. fulva* has much broader inner perianth-segments with nervose margins.

Introductions of the nineteenth century. During the latter half of the eighteenth century and the first part of the nineteenth century all foreign trade with China was restricted to Macao and Canton. Some Jesuit missionaries became establshed in Peking. All botanical specimens, seeds and living plants from China were introduced to Europe from these small areas. By the latter half of the nineteenth century travel restrictions in China were relaxed and Europeans travelled freely in the country.

A great opportunity opened for the importation of Chinese plants into British gardens. With all the plants introduced from China to European gardens and botanical institutions during the nineteenth century, there is only one definite introduction of *Hemerocallis* from China to Europe by an Italian missionary. Perhaps two species and a double-flowered cultivar of daylily were introduced from China to British gardens. We cannot be positive of these because we have no available records. However, the evergreen habit of one species, the distribution of another species, and the relationship of Charles Ford in Hong Kong with the firm of Veitch in England seem to support our supposition.

The small number of *Hemerocallis* introduced to western European gardens is a reflection of the law of supply and demand. When the trading activities of Europeans were limited to Canton and Macao, the plants shipped to Europe, especially to Britain, were obtained from Chinese nurseries at Fa-ti or Hua-ti = Flower Land. These were favorite Chinese garden plants, especially cultivars of *Chrysanthemum, Camellia, Paeonia, Rhododendron, Rosa,* and *Wisteria,* the subtropical orchids and oranges. Paintings by Chinese artists of the local flora in Macao and Canton included *Hemerocalis;* British residents sent these to London as guides for orders.

At the time when the interior of China was opened to westerners, European plant collectors, such as Delavay, Farges, Henry, were encouraged to collect and dry a large number of plants. Since species of *Hemerocallis* make poor herbarium specimens, collectors failed to prepare specimens of daylily. Consequently the *Hemerocallis* introduced during the nineteenth century were from the periphery of the range of distribution of the genus to the then horticulturally less prominent center.

Species introduced from Japan. The first species of *Hemerocallis* introduced to European gardens in the nineteenth century was *H. dumortieri* brought to Holland from Japan by Philipp Franz von Siebold about 1830. The species was distributed to horticulture from a garden at Ghent in Belgium. This species is a very outstanding introduction that contributed to the development of our early flowering garden forms with semi-dwarf habit, orange flowers, and firm perianth, such as *H.* 'Aureole', *H.* 'Bay State', *H.* 'Chrome Orange'.

The second introduction of *Hemerocallis* from Japan was *H. fulva* 'Kwanso' (Regel). Positive evidence of the introduction of this plant was a color illustration, and a note published by Regel in *Gartenflora* (66. t. 500. 1866), but he did not indicate the source of his plate. Presumably the introduction was made by Carl Maximowicz who was in Japan from 1860-64. While in Japan, he trained a native collector Tschonoski who collected about 800 specimens from the interior of the country not accessible to foreigners. According to the illustration Regel's specimen has some well-formed stamens. By Stout's definition (*Herbertia* 12: 113-123), the typical *H. fulva* 'Kwanso' is a para-double type.

Species introduced from China. The first introduction of *Hemerocallis* in the nineteenth century from China was *H. fulva* 'Flore Pleno'. Louis van Houtte presented a color illustration of this form under *H. disticha flore pleno* (*Flore des Serres* II. 8: 111. t. 1891. 1869). In a note he reported that this form was introduced by Veitch & Sons

with the help of Rev. Ellis from China via India. This illustration shows a plant with large flowers the center of which are crowded with petaloid stamens. According to Stout's definition, this form belongs to the super-double type.

The second introduction of *Hemerocallis* from China was *H. citrina*. A plant of this species was sent from Shensi by a Catholic missionary, Guiseppe Giraldi, to Antonio Biondi in Italy in 1890. Prof. Dr. E. Baroni of the Museum of Botany at Florence saw the plant and described *H. citrina* in 1897. Later the nurserymen K. L. Sprenger and W. Mueller distributed the species. *Hemerocallis citrina* was a very important introduction with respect to devlopment of modern hybrid forms. In hybrids, *H. citrina* contributes the night-blooming habit, and the fragrant large yellow flowers. A triploid form of *H. fulva* was imported to Italy along with *H. citrina* and later named by Baroni as *H. fulva* var. *maculata*. Sprenger and Mueller were also responsible for its distribution.

Species introduced from Siberia. In 1843-44 Alexander Theodor von Middendorff explored northeastern Siberia. A new *Hemerocallis* in his collection was described as *H. middendorffii* by E. R. von H. Trautvetter and C. A. Meyer in 1856. Very likely it was introduced to the Botanical Garden at St. Petersburg, between 1854-1864 by Carl Maximowicz.

In 1866, Eduard Regel, Director of the Botanical Garden at St. Petersburg published a black and white plate in *Gartenflora* (t. 522. 1866) of *H. middendorffii* showing three flowers of an inflorescence opening simultaneously and an inflorescence with the perianth removed, showing the head-like structure and the broad hood-like overlapping bracts with ruffled margin. This was an important introduction in modern daylily breeding, contributing the desirable characters of dwarf habit, hardiness, early blooming, and orange flower with firm broad perianth-segments. In the 1880's *H. middendorffii* was misidentified as *H. dumortieri* in British gardens (*Garden* 31: 280. t. 589. 1887).

Species introduced of uncertain origin. Two species of *Hemerocallis* were introduced into British gardens between 1860-1890, namely *H. thunbergii* Barr emend. Baker (1873) and H. × *aurantiaca* Baker (1890). No exact date of introduction is available. From the data on geographical distribution of *H. thunbergii* we know this species could have been introduced either from China or from Japan. From the evergreen habit of *H.* × *aurantiaca* it seems most likely that this species was introduced from southern China. According to Ohwi (*Fl. Jap.* 292. 1965) *H.* × *aurantiaca* was introduced from China to Japan.

From the standpoint of the production of new garden daylilies both *H. thunbergii* and *H.* × *aurantiaca* are very important introductions. Stout used both species in his extensive hybridiza-

Introductions into the New World from Europe. No published record exists to indicate when species of *Hemerocallis* were first introduced into North America. In the first flora of eastern North America by Asa Gray, *H. fulva* was recorded as "escapes from gardens, where it is common, and sparingly naturalized in damp grounds, Penn., & c." and *H. lilioasphodelus* (*H. flava*) was recorded as "commonly cultivated" (Gray, *Manual* 492. 1848).

Importation of *Hemerocallis* was explained to me by Mrs. Ethel Hinckley Hausman, author of *Beginner's Guide to Wild Flowers*. She informed me that in the 1630's the ships carried more plants than passengers. At some point, date unknown, *Hemerocallis* reached the shores of America from Europe. Early residents grew daylilies in their gardens. As the homesteaders moved westward they carried the daylilies with them and for this reason *H. fulva* to some people is homestead lily.

The earliest American horticultural reference to daylily traced is a catalogue of perennial flowering plants annexed to Bernard M'Mahon's *The American Gardener's Calendar* (pp. 346, 603. 1805).

KEY TO ABBREVIATIONS

J.C. —Junior Citation, a minor award focusing attention on promising, unintroduced cultivars.

H.M. —Honorable Mention, awarded to introduced cultivars of excellent quality and performance.

A.M. —Award of Merit, cultivar eligible after having received H.M.; only 10 per year .

For the next 4 awards, only 1 per year may be given:

Stout Medal —the Society's highest cultivar award; eligible only after having received Award of Merit.

President's Cup—most outstanding daylily clump in National Convention gardens.

Fischer Cup —Donn Fischer Memorial Cup for miniature cultivars (3″ or less in diameter) .

Giles Award —Annie T. Giles Award—for small-flowered cultivars (over 3″ to 4¼″ in diameter) .

F.C.C. —First Class Certificate

R.H.S. —Royal Horticultural Society

s.f.t. —selected for trial at R.H.S. Gardens, Wisley, England

Plate No.		Photo credit
1.	**Wild Key** (Wild 1966)—dormant; scapes 26″; small-flowered, 4-4½″	Wild & Son
	Suzie Wong (Kennedy 1962) —dormant; scapes 24-26″; small-flowered, 3½″ *A.M. 1967*	Wild & Son
2.	**Sea Gold** (Hall 1964) —dormant; scapes 22-24″; flower 5-6″; *H.M. 1966; President's Cup 1966.*	Wild & Son
	Winning Ways (Wild 1966)—dormant; scapes 32-34″; flower 7-8″; *J. C. 1963.*	Wild & Son
3.	**Sugar Plum Fairy** (Hall 1965) —dormant; scapes 30″; medium flower; *J.C. 1961.*	Wild & Son
	Town Hall (Hall 1966) —dormant; scapes 34-36″; flower 7-8″.	Wild & Son
4.	**Chartreuse Triangle** (Grovatt 1967) —evergreen; scapes 34-36″ flower 5½-6″.	Edward Grovatt
	Solo (Branch 1961) —dormant; scapes 32″; flower 5½-6″; *A.M. 1966.*	Scotty Parry
	April Breeze (Lester 1959) —dormant; scapes 30″; *J.C. 1959; A.M. 1963.*	Riley Barron
5.	**Bold One** (Lenington 1968) —semi-evergreen; scapes 40″; flower 7″; *J.C. 1967.*	George Lenington
	Jake Russell (Russell 1956)—dormant; scapes 36″; small-flowered, 4½″; *J.C. 1955; A.M. 1959.*	R. W. Schlumpf
	Angel Robes (Taylor 1961)—evergreen; scapes 30″; flower 5½-6″; *J.C. 1960; A.M. 1965; President's Cup 1964.*	E. B. Woodbery
6.	**Melon Balls** (Wild 1962) —dormant; scapes 32″; small-flowered; *J.C. 1960; A.M. 1965; Giles Award 1966.*	Wild & Son
	Sweet Harmony (Hall 1964) —dormant; scapes 32″; medium flowers; *J.C. 1962; H.M. 1966.*	Wild & Son
7.	**May Hall** (Hall 1962)—dormant; scapes 32″; flower 5½-6″; *J.C. 1962; A.M. 1965.*	Wild & Son
	Little Skipper (Wild 1967) —dormant; scapes 24″; miniature, 2½-3″.	Wild & Son
8.	**Lady Inara** (Hall 1959) —dormant; scapes 30-35″; small-flowered *J.C. 1957; A.M. 1962.*	Wild & Son
	Step Forward (Hall 1965) —dormant; scapes 30″; flower 5-6″; *J.C. 1964; H.M. 1967.*	Wild & Son

Wild Key

Suzie Wong

Sea Gold

Winning Ways

Sugar Plum Fairy

Town Hall

Chartreuse Triangle

Solo

April Breeze

Bold One

Jake Russell

Angel Robes

Melon Balls

Sweet Harmony

May Hall

Little Skipper

Lady Inara

Step Forward

In this list M'Mahon called *H. fulva* orange day-lily and *H. lilioasphodelus* (*H. flava*), yellow day-lily.

The first record on the naturalization of *H. fulva* in America occurs in Thomas Nuttall's *The Genera of North American Plants and A Catalogue of the Species to the Year 1812* (1: 219. 1818). Nuttall observed, "Naturalized in moist meadows around Philadelphia, and also in secluded situations on banks of the Schuylkill. . . . I have introduced it into American Flora to mark its future progress which is already such, as easily to impose upon a stranger for an indigenous plant." This observation may have a bearing to indicate the introduction of *H. fulva* through the Bartram-Collinson relationship.

On the bank of the Schuylkill River John Bartram built a house in 1731 and developed a garden for the acclimatization of American plants before shipping them to England, primarily to Peter Collinson, an influential cloth merchant and a keen gardener living near London. Collinson's wide business connections enabled him to obtain seeds and plants from many parts of the world and these he shared with Bartram (*Hunt Bot. Cat.* 2 (1): LXXXII. 1961). Frederick Pursh, a noted botanist, resided in the Philadelphia area from 1802-1805, and knew the gardens of Bartram and of William Hamilton. Pursh remarked that these gardens were "rich in plants from all parts of the world" (Pursh, *Fl. Am. Sept.* VII-VIII. 1814). The escaped plants of *H. fulva* on the banks of Schuylkill might have a connection with the activities of the Bartram garden. Neither Pursh in the *Flora Americae Septentrionalis* (1814), nor Henry Mühlenberg in the *Catalogus Plantarum Americae Septentrionalis* (1813) mentioned *Hemerocallis*. Mühlenberg's catalogue was devoted to listing "the Hitherto known Native and Naturalized Plants of North America." Evidently the interval between 1813 and 1818 marks the crucial period for the beginning of the naturalization of *H. fulva*, which occurred not far from the Bartram Garden.

The escape records of *H. fulva* became very numerous in the listing of local floras published in the last quarter of the nineteenth century. In 1887 N. A. Cobb recorded it in *A List of Plants Found Growing Wild Within Thirty Miles of Amherst*. In 1888 J. L. Bennett reported it as an escape in the *Plants of Rhode Island* and L. L. Dame and F. S. Collins reported both *H. fulva* and *H. lilioasphodelus* (*H. flava*) as naturalized from Europe, locally established in *Flora of Middlesex County Massachusetts*. In 1896 N. L. Britton and A. Brown in *An Illustrated Flora of the Northern United States, Canada and the British Possessions* recorded *H. fulva* to have escaped from cultivation in meadows and along streams from New Brunswick and Ontario to Virginia and Tennessee. Evidently *H. fulva* was widely cultivated in North American gardens by the latter half of the 19th century.

By 1890 all the known species of *Hemerocallis* except *H. minor* and *H. graminea* were introduced to American gardens. Writing about *Hardy Plants for Cut Flowers*, E. O. Orpet reported (*Gard. and Forest* 3: 264-5. 1890), "various kinds of *Hemerocallis* are also in bud, and earliest, *H. dumortieri*, has already opened some of its bright orange-colored flowers . . . *H. middendorffii* (Middendorfiana) will soon follow . . . *H. lilioasphodelus* (*H. flava*) with lemon-yellow fragrant flowers . . . *H. thunbergii* which flowers in August, but is similar in color to *H. flava*, . . . These are the four best of the *Hemerocallis* for cutting . . . the unopened buds expanded in water."

In 1895 C. S. Sargent reported on the cultivation of *Hemerocallis minor* in Boston (*Garden & Forest* 8: 296). He observed that the species "is less stately than *H. lilioasphodelus* (*flava*), but . . . very beautiful . . . pale yellow fragrant flowers clustered on slender stems two feet or more tall. It has been in bloom now (July 24) for the last two weeks and is one of the best and hardiest of summer-flowering . . . plants suitable to decorate a border . . . or to naturalize in some half-wild woody glade. The flowers when cut last a long time."

Special studies. In the nineteenth century there were three important publications on *Hemerocallis,* two by German botanists and a third by a British botanist.

In 1853 D. F. L. Schlechtendal published an article titled *Bemerkungen über die Gattung Hemerocallis und deren Arten* (*Abk. Nat. Ges. Halle* 1 (3): 1-18). In this article Schlechtendal gave an extensive review of literature on the generic characters, distribution and special characters of the species, and described a new species *H. graminifolia* based on a specimen obtained from a nursery, Gerbr. Booth in Hamburg. He suggested that the species is closely related to *H. graminea* but evidently Schlechtendal's specimen is *H. minor.*

In 1871 J. G. Baker prepared *A Revision of the Genera and Species of Herbaceous Capsular Gymnophyllius Liliaceae* (*Jour. Linn. Soc. Bot.* 11: 349-436). He placed *Hemerocallis* in TRIBUS I *Hemerocallideae.* Baker gave a lengthy generic description for *Hemerocallis* and a key to five species, using odor and color of the flowers as primary distinguishing characters, the texture and venation of the inner segments as the next important characters, and the width of the leaves, the length of the perianth-tube, the length of pedicels and the width of the inner segments for separating closely related species. Baker prepared the first key to the species of *Hemerocallis* in botanical history. In Baker's treatment of daylily species, he cited a wide range of literature, lumped species on superficial characters, provided concise descriptions, and gave untrustworthy ranges.

In 1888 W. O. Focke published *Bemerkungen über die Arten von Hemerocallis* (*Abk. Nat. Ver. Bremen* (10: 156-158). After reviewing all the literature about the characters of different species, he described *H. serotina* on its yellow flowers blooming late in the season. He obtained the specimen from Haage and Schmidt Nursery. Evidently Focke had *H. thunbergii.*

Early cytological investigations. In the last two decades of the 19th century, three cytologists observed irregularities of the division of the pollen-mother cells in the formation of pollen grains of *H. fulva.* Eduard Tangl, Professor in Czernowitz, Austrian Poland in 1882 published *Die Kern- und Zellteilung bei der Bildung des Pollen von Hemerocallis fulva* L. (*Denkschr. Kais. Akad. Wiss. Wien* 45: 73. 1882) and reported about irregularity in cell division. In the same year, Eduard Strasburger, Director of the Botanical Garden at Jena and Professor of botany and cytology at Bonn reported similar observations in an article, *Ueber den Teilungsvorgang der Zellkurne und das Verhältnis der Kernteilung zur Zellteilung* (*Arch. Mikr. Anat.* 21: 476-590). Their observations were confirmed by H. O. Juel in 1897 who investigated the cell division of the pollen mother cell of *H. fulva* (*Jahrb. Wiss. Bot.* 30: 205-226).

Early hybrids of Hemerocallis. The first known hybrid of *Hemerocallis* was produced by an amateur British gardener George Yeld, a school teacher and an experienced mountain climber. In 1892 he announced the production of *H.* 'Apricot' made from a cross of *H. lilioasphodelus* (*H. flava*) and *H. middendorffii.* His second hybrid, *H.* 'Francis' made in 1895 from a cross of *H. minor* and *N. dumortieri,* won him an Award of Merit in the flower show of the Royal Horticultural Society. He announced several other named hybrids in 1906.

In 1900, the nursery firm of Wallace and Sons at Colchester, England distributed *H.* × *luteola,* as a hybrid of *H. thunbergii* and *H.* × *aurantiaca* 'Major'.

Another nurseryman, Amos Perry also began to breed daylilies in the 1890s. He named about 35 seedlings in the early 1900's.

Hermann Basel von Christ observed a spontaneous hybrid which appeared in his garden at Liestal in Germany. In 1897 he described *H.* × *flavo-citrina* (*Abh. Nat. Ver. Bremen* 14: 273-274, 494, t. I-II) showing its intermediate position between the two parent species *H. lilioasphodelus* and *H. middendorffi.* which were both in his garden.

Hemerocallis in the Early Twentieth Century

Introductions from China. During the period of greatest activity in Chine the best known collectors were Ernest Wilson (1899-1910), George Forrest (1904-1932), Frank Kingdon-Ward (1911-1939) and Joseph Rock (1922-1954). These professional collectors each discovered in his own way that the River Gorge country in Western China is the plant hunters' paradise. The recorded introductions of *Hemerocallis* made by these collectors are *H. forrestii, H. nana,* and *H. plicata* discovered by Forrest between 1904-1916, and Rock's plants and seeds of *H. nana* sent to Stout in 1922-1923.

On the taxonomy of Hemerocallis. In England George B. Mallett wrote accounts covering the various species common in British gardens; the production of a new hybrid *H.* × *luteola,* and the introduction of *H.* 'Aureole' (*H. dumortieri* × *H. middendorffii*) from Japan (*Garden* 63: 38. 1903). In Italy Charles (Karl Ludwig) Sprenger, owner of Hortus Vomerensis and his nephew Willy Müller reported their success in producing seven named hybrids (*Gard. Chron.* III. 34: 122. 1903). They imported *H. fulva* 'Cypriani' and *H. fulva* 'Hupehensis' through Padre Cypriani, an Italian missionary who was stationed in Hupei (Hupeh) Province, China (*Bull. Soc. Tosc. Ort.* 31: 204-205, 1906; *Gard. Chron.* III. 40: 159. 1906).

In time there was a gradual shift of activities in the study of *Hemerocallis* from Europe to other countries. In 1928 B. Y. Morrison published an illustrated pamphlet, *The Yellow Day Lilies* (*U.S.D.A. Circular* no. 42).

In 1930 L. H. Bailey published a monographic treatment of the genus *Hemerocallis* (*Gent. Herb.* 2: 143-156, fig. 80-86). He prepared a key to the species and grouped the species into two sections: *Euhemera* and *Dihemera.* Both this key and the sectional names were adopted by Stout in his treatment of the species of *Hemerocallis.*

Meanwhile Japanese botanists worked independently. Gen'ichi Koidzumi in 1925 described *H. esculenta* from the alpine region of Shinano (*Bot. Mag. Tokyo* 39: 28). In 1932 Nakai published a revision, *Hemerocallis Japonica* (*Bot. Mag. Tokyo* 46: 112-123). He recognized 13 species for Japan and Korea and arranged them in six sections: Aurantiacae, Fulvae, Capitatae, Anthelatae, Flavae, and Citrinae.

Chromosomal abnormality and sterility. The sterility in *Hemerocallis* posed a strong appeal to cytologists. First H. Höffder, L. Jost, and P. N. Schürhoff in Germany investigated the condition of sterility in *H. fulva* and *H. lilioasphodelus* (*H. flava*). In 1921 Stout published his first article on the fertility and sterility in *Hemerocallis* (*Torreya* 21: 57-62). For the next thirty years *Hemerocallis* became a dominant factor in the life and work of A. B. Stout.

Contacts in China. After the Chinese Empire was forced open to western powers, explorers, custom officers, businessmen, and professional plant collectors were able to travel into the interior but they could not reach the hearts of the people. They were treated with fear and suspicion and they were called foreign devils. They could collect in the wilderness but they were not invited to the gardens of the people of respect or to the fields of the farmers where there are good *Hemerocallis.*

Later establishment of missionary universities and colleges helped change hardened attitudes of the Chinese people. These colleges invited qualified foresters, botanists, horticulturists, pomologists, as professors. Dr. Albert Newton Steward (Fig. 12) was one of these specialists who went to China in August 1921 with his wife and two small children. He was assigned to teach botany in the University of Nanking where he served until 1950.

While in Nanking the Stewards' home was the meeting ground of people of all ages and backgrounds. During that period, half of China's botanists were Dr. Steward's students. Those who did not study with him were his friends. The

Stewards respected the Chinese people and in return they received love and trust. By cultivating the friendship of the people Steward was able to reach the gardens of the rich as well as approaching the farms of the poor. He was able to obtain what the botanical explorers did not even have a chance to see. The establishment of the Steward-Stout connection was just ideal for the development of the knowledge of *Hemerocallis*.

Stout remarked that in 1924, 27 living plants and seeds were received from central China. Mrs. Celia B. Steward wrote me on November 28, 1967 saying, "Well do I remember when he would be in the field and bring various plants which he would plant in our garden until the proper time to send them to the United States. And the daylilies were one group of these plants." In another publication Stout recorded that between 1920-1942 he had received more than fifty importations of living plants and seeds of *Hemerocallis* from China.

For collecting *Hemerocallis* plants and seeds Steward made many special trips to Men Shan (Long. 117° 15′E, Lat. 35°30′N) in Shantung, Ki-kung Shan (Long. 114° 15′E., Lat. 32°N) in Honan and Ku-ling (Long. 116°E, Lat. 29°30′N) in Kiangsi. In an article "*Hemerocallis* in eastern and central China" (*Herbertia* 6: 168-172), Steward wrote, "Dr. A. B. Stout . . . has for some years been so enthusiastic in stimulating interest in *Hemerocallis* that he deserves credit for the collections which have been made, as well as for the breeding and other experimental work by which the material from China . . . has been made to yield such striking and valuable ornamental forms." There is a Chinese saying, "The skillful cook can not make a rice dish when there is no grain." In the scientific study and the pioneer work for the development of beautiful horticultural forms of *Hemerocallis,* Stout was the skillful cook and Steward was the supplier of the grain. Both deserved credit.

Steward's most important discoveries were: 1) the diploid forms of *H. fulva* which set fruit thus facilitating hybridization and breeding; 2) the pink wild *H. fulva* var. *rosea;* and 3) new species *H. multiflora* and *H. altissima*. Horticulturally these new importations brought in rich genetic factors to hybridizers and breeders for new combinations and for the creation of new forms.

Era of A. B. Stout. A scientist of skill, originality, and industry, A. B. Stout established a new era in the history of *Hemerocallis.* His autobiography reviewing his life and work with *Hemerocallis* in his book (*Daylilies*), and his numerous technical and popular articles on *Hemerocallis* are available to all. His scientific training and skill in microtechnique were basic to his initial success with research in *Hemerocallis, e.g.,* in the investigation of the sterility and fertility in the species of *Hemerocallis* (*Torreya* 21: 57-61. 1921).

Stout's contributions to the botany and horticulture of *Hemerocallis* are numerous, but the most outstanding are (1) establishing scientific understanding of the biology of *Hemerocallis,* particularly in regard to the nature of flowering, the structure of the inflorescence, the kinds of incompatibility, and the causes of sterility, and (2) opening the door to future potential of *Hemerocallis*. Stout skillfully and patiently worked on hybridization of the species, systematically and fully recorded the pedigrees, and triumphantly demonstrated that man can extract from the gene pool of *Hemerocallis* "genetic factors which change the quality and the intensity of the red pigmentation and the patterns of distribution" and produce new combinations hitherto unknown in gardens and nature. He discarded all progenies of F_1 and F_2 hybrids preferring to name only the best of the progenies, with a half dozen species in their ancestry. In so doing he increased the momentum of the movement of hybridization in *Hemerocallis,* which is continued and greatly amplified by many workers of the present day.

The early history of *Hemerocallis* ends in the 1930's when Dr. A. B. Stout

initiated a new era in the history of the genus. A much needed task for the future would be the taxonomy of *Hemerocallis* which is fundamental to all horticultural knowledge of daylily. Now the taxonomy is very weak, yet we do not have enough data and material to correct that weakness. Stout was an experimental biologist, not a taxonomist. His photographs, line-drawings and paintings in the New York Botanical Garden are helpful aids to research in *Hemerocallis*. However, he left hardly any specimens to document his work for future study.

Table II. Introduction of *Hemerocallis* Species into Cultivation

Species	Date	Source	Introduced by
H. altissima	c. 1930	Kiangsu & Anhwei, China	A. N. Steward
H. × *aurantiaca*	1860–90	S. China	no record
'Major'	1890	Japan	Wallace & Son
H. citrina	1895	Shensi, China	Giraldi
	c. 1900	Hupei, China	Cypriani
H. coreana	1929–30	Korea	Dorsett & Morse
H. dumortieri	c. 1830	Japan	Siebold
H. esculenta	c. 1935	Japan	Nakai
H. exaltata	c. 1930	Tobi Shima, Japan	T. Susa
H. forrestii	1906	Yunnan, China	Forrest
H. fulva	before 1576	E. Asia to Europe	no record
	1924–35	Kiangsi & Kiangsu, China	A. N. Steward
var. *angustifolia*	—	E. Himalayan region	no record
var. *disticha*	c. 1789	S. China	no record
cv. Kwanso	c. 1860	Japan	?Maximowicz
var. *longituba*	c. 1930	China, Japan	A. N. Steward (China), Japan ex Stout
var. *maculata*	c. 1895	Shensi, China	Giraldi
var. *rosea*	c. 1924	Kiangsi, China	A. N. Steward
H. graminea	before 1795	Upper Amur region	no record
			Sibthorpe ex Hort.
H. hakunensis	—	Korea	no record
H. lilioasphodelus	before 1576	Temperate E. Asia	no record
(*H. flava*)	1930	North China	Dorsett & Morse
H. littorea	c. 1941	Japan	Nakai
	1956	"	Creech
H. × *luteola*	1900	Hort.	Wallace & Son
H. middendorffii	1860	Lower Amur region	Maximowicz
H. micrantha	—	Korea	no record
H. minor	c. 1748	E. Siberia	Gmelin
H. multiflora	1925	Honan, China	A. N. Steward
H. nana	1913	Yunnan, China	Forrest
H. pedicellata	—	Sakhalin	no record
H. plicata	1916	Yunnan, China	Forrest
	1922–23	" "	J. F. Rock
H. thunbergii	c. 1873	not recorded	Kew Gardens
	before 1929	Kiangsu, E. China	A. N. Steward
		N. China	Henry H. White
H. yezoensis	—	Hokkaido, Japan	no record

—2—

The Species of Hemerocallis

SHIU-YING HU

In 1941 Dr. A. B. Stout published a *Memorandum On A Monograph Of The Genus Hemerocallis* (*Herbertia* 8: 67-71). Unfortunately the plan to publish the folio monograph of *Hemerocallis* with colored plates and line drawings was prevented by Dr. Stout's untimely death. It was a great loss to horticulture and to daylily enthusiasts that the daylily monograph was never published.

Now is not the time for making any radical changes in the nomenclature and classification of *Hemerocallis*. Much of the homeland of *Hemerocallis* is closed for scientific communication, not to mention the exchange of literature, the loan of material, and the possibility of making additional field observations. There are many taxonomic problems which cannot be solved without extensive investigations of the plants in various localities in the homeland of the genus, e.g., China, Japan, and some of the off-shore islands, such as Sakhalin. We simply do not have sufficient material to support any major taxonomic change at this time.

Through the exceptional kindness of Dr. Bassett Maguire, Head Curator of the herbarium and Mr. John F. Reed, Curator of the Library of the New York Botanical Garden, I was able to examine

Fig. 1. Inflorescences: a. upper part of the inflorescence of a cultivar of *H. fulva*. b & c. 2- and 3-branched inflorescences of *H. fulva* 'Europa' after flowering. d. *H. multiflora* showing the main axis with 8 branches. These are progressively younger as their positions become lower. e-g. Inflorescences of *H. nana* showing its few branches and flowers. h. *H. minor* from Lake Baikal in Siberia also with a small inflorescence. i. Inflorescence of *H. exaltata* from Japan showing the crowded flowers on its very short floral axes. j. Inflorescence of *H. dumortieri* showing its much-reduced floral axes. k. Inflorescence of *H. middendorffii* showing its extremely reduced floral axes. l. Very short lateral branching of 'Tinker Bell'. Figures b-g and i-k redrawn from Stout, New York Bot. Gard.

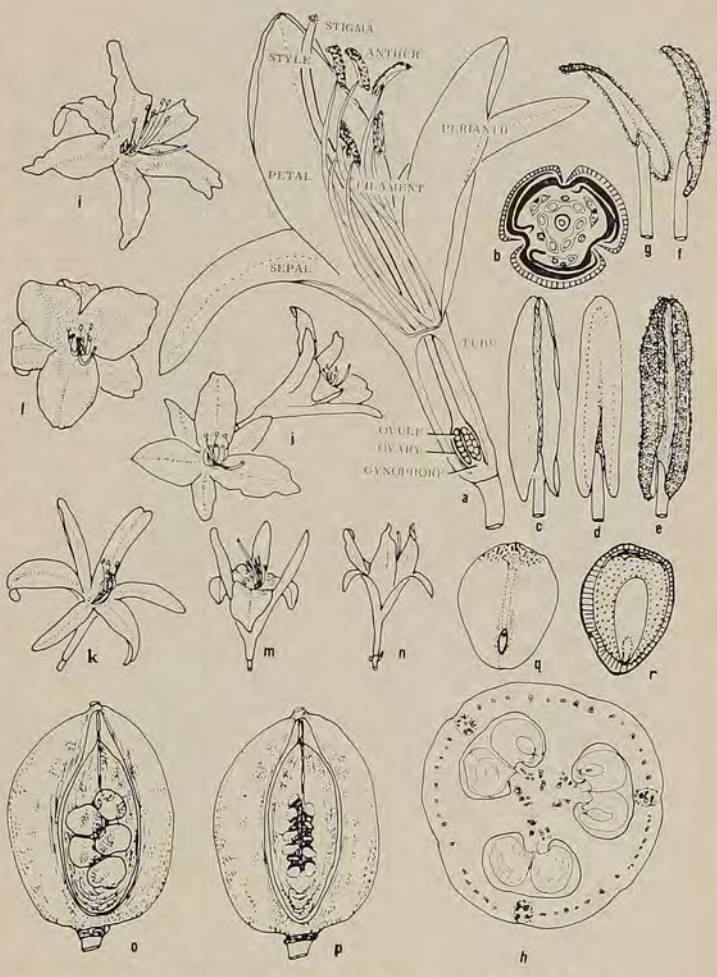


Fig. 2. *A-H. Flower Structure:* a. Diagrammatic sketch of a partially sectioned young flower showing floral parts. b. Transverse section of mature flower bud across anthers showing induplicate "sepals," imbricate "petals," six stamens in two whorls and the hollow style with subtriangular canal. c. Front view of anther before opening. d. Back view of same. e. Front view as anther opens. f. Lateral view of open anthers. g. Back view of anther resting on pinpoint tip of filament. h. Transverse section of ovary showing 3 chambers and 6 ovules, some in sections and others whole. *I-N. Flower Types:* i. Face view of wide-spreading flower of *H. fulva* 'Hankow' showing narrow recurved and slightly twisted segments with ruffled margins, especially of the inner. j. Face and side views of trumpet-type flower of *H. lilioasphodelus* (*H. flava*) showing slightly recurved segments a little wavy along margins. k. Spidery flower of 'Aureole'. l. Flower of 'Sweet Harmony' showing broad segments. m & n. Lateral views of two flowers, one with ascending "sepals" and recurved "petals", the other with recurved "sepals" and ascending "petals." Both redrawn from Marion Shull. *O-P. Longitudinal sections of seed chamber* of full-grown green fruit of *H. lilioasphodelus* (*H. flava*) showing full-grown seeds in O, and abortive ovules in p. *Q-R. Seed of H. lilioasphodelus* (*H. flava*) showing structure for the genus *Hemerocallis:* q. Seed face view. r. Longitudinal section through hilum showing black seed coat, a thick gray layer of soft tissue, endosperm (dotted) and central position of embryo.

Dr. Stout's drawings, photographs, and colored plates. Four-fifths of the species are illustrated with line drawings, the large portion of which were prepared by Eleanor Clarke under the supervision of Dr. Stout. I am grateful to the New York Botanical Garden for permission to publish the drawings included here.

Hemerocallis (daylily) belongs to the Lily Family (Liliaceae). Species may vary from seven to eight feet tall in *H. altissima* to less than one foot tall in *H. nana* (Fig. 4). As a liliaceous monocot, the *Hemerocallis* plant, in the broad sense, assumes the habit of some other clump-forming perennial monocots, such as certain grasses, sedges, bamboos, and palms.

The part of the plants and their functions are discussed in Chapter 3. Here to understand the description of the species figures 1, 2, and 3 are included—figure 1 illustrating inflorescences, figure 2 flower parts and flowers and figure 3 the color patterns of flowers.

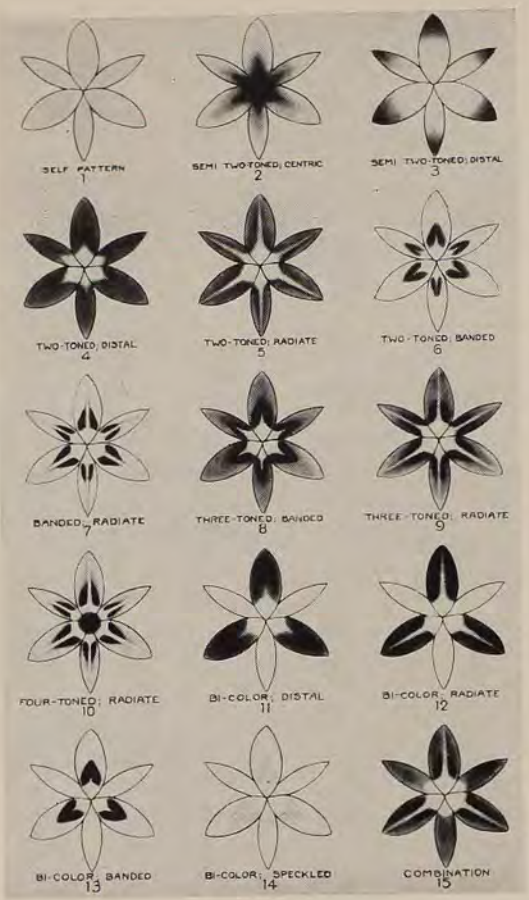


Fig. 3. *Coloration and Color patterns.* In 1941 Stout published a chart containing fifteen color patterns in daylily flowers as seen from the face view (*Jour. N. Y. Bot. Gard.* 42: 40-42). By courtesy of the New York Botanical Garden the original chart with explanations is presented here. Stout placed the fifteen color patterns in four classes. Class I represents the self-pattern (1) whereby the entire face of the flower is of one color, usually yellow or orange. Class II represents the concentric patterns which are subdivided into four groups, the semi two-toned graduated (2-3), the two-toned (4-7), the three-toned (8-9) and the four-toned (10). Class III represents the radial with "sepals" and "petals" of different color (11-14), and hence is called bicolor. The last class he called combination pattern with concentric coloring and radiate rays (5, 7,9,10,15). He observed that in the flecked pattern (14) the red coloring appears in irregular areas.

TAXONOMY

HEMEROCALLIS Linnaeus

Species Plantarum 324. 1753; *Genera Plantarum* ed. 5. 151. 1754. (from the Greek *hemera,* a day, and *callos,* beauty.)

Erect herbaceous perennials about 1 ft. (*H. nana*) to 7-8 ft. tall (*H. altissima*); ramets (fans) closely aggregated to form a dense clump (loosely spreading in *H. fulva* 'Europa'). Rhizomes usually short, 1 inch or less long (6-12 inches long in *H. fulva*), covered with membranous scales at the nodes when young. Roots fibrous or cord-like and often with conspicuous spindle-like thickenings. Leaves disposed in two ranks (*distichous*), and astride each other at the base, spreading to form a symmetrical fan, linear, sessile, 5-14 in. long in *H. nana* up to 2-4 ft. long in *H. altissima,* when young conduplicate (folded once lengthwise) or rarely irregularly plicate (folded lengthwise into plaits), strongly ribbed, entire, acuminate at the tip. Scapes slender, erect or ascending, usually much overtopping the leaves, smooth; inflorescence branched, consisting of a series of uniparous helicoid cymes (dichotomies), a *bostryx,* wherein the right- or left-hand branch is always the more vigorous. Flowers trimerous, consisting of a funnelform perianth, 6-parted limb (3 outer segments and 3 inner segments), 6 protandrous stamens inserted on the throat (3 short stamens opposite the outer segments and 3 longer stamens opposite the inner segments), basically regular (actinomorphic) becoming bilaterally symmetric (zygomorphic) in response to geotropic and phototropic stimuli, diurnal and non-fragrant, nocturnal or extended-flowering and fragrant; anthers introrse; filaments and style long, free, declined and ascending; perianth-segments uniformly colored or bicolored (inner and outer segments of different color), yellow, orange, red, in various intergrades. Fruit rather fleshy at first becoming dry and dehiscent at maturity (capsule), 3-angled, 3-locular, with several black rounded or somewhat angled seeds. Somatic chromosome number 2n = 22.

Distribution: Roadside swamps, seashores (*H. littorea*), near springs, dry cliffs and ledges, mountain meadows and steppes, up to 9,000-10,000 ft. alt. China (western Yunnan, Kwangtung, Kwangsi, Honan, Shensi, Shantung, Kiangsi, Chekiang, Kiangsu, Anhwei, Hupei, Hunan, western Szechuan, Kansu, Manchuria, Amur region, Korea, Mongolia, c. Siberia, Sakhalin, Kurile Islands, Japan, and Khasia in northern India.

Key to the Species*

The species are numbered in the numerical sequence of the text. The Japanese and Korean species of which I have seen no authentic specimens are placed in parentheses below those with which they share some characters.

A. Flowers large, the perianth 3-6 in. long, coloration various; inflorescence various.
  B. Flowers opening in the afternoon or night, often remaining open one to three days, yellow and fragrant.
    C. Plants with extended flowering, the flowers open from 2 P.M. to 10 P.M.; flowering period lasting 24 up to 63 hours; perianth-tubes 1 in. (rarely more) long.
      D. Flowering May and June; perianth uniformly yellow, rarely orange; capsules ellipsoid or obovoid.
        E. Bracts subtending the flowers ovate, inconspicuous; flowers distinctly stalked; perianth yellow; tubes cylindrical, about 1 in. long.
          F. Roots fleshy, with spindle-shaped enlarged portions; rhizomes often spreading; scapes branched, many-flowered; capsules broadly ovoid-ellipsoid. ..... 12. *H. lilioasphodelus*
(4. *H. coreana*)
          FF. Roots cord-like, rarely clavately enlarged and club-like at the end; rhizomes short, suberect; scapes bearing 2 or 3, rarely more, flowers; capsules narrowly ellipsoid. ..... 17 *H. minor*
(20. *H. pedicellata*)
        EE. Bracts subtending the flowers lanceolate, conspicuous, 2 in. long; flowers sessile; perianth orange, the outside brownish; tubes broad and short. ..... 10. *H. graminea*
      DD. Flowering July and August; perianth lemon yellow, greenish at the throat; capsules obovoid, truncate and notched at the rounded apex. 22. *H. thunbergii*
(14. *H.* × *luteola*)
(23. *H. yezoensis*)
    CC. Plants flowering only at night, beginning from 5 P.M. to 9 P.M., ending between 4 A.M. and 11 A.M.; perianth-tubes elongated, 1 5/16-2 in. long.
      G. Scapes 4-6½ ft. tall; perianth-tube ½-¾ the length of the segments; July to October. ..... 1. *H. altissima*
      GG. Scapes 3-3¾ ft. tall; perianth-tube ¼-⅓ the length of the segments; mid-summer. ..... 3. *H. citrina*
  BB. Flowers diurnal, opening only in the daylight hours; orange to fulvous.
    H. Scapes branched and/or bracteate on the upper ¼ or ⅓, the first two bracts far apart; flowers golden yellow, overlain fulvous in various patterns; pedicels evident, sometimes long.
      I. Scapes 3-4 ft. tall; pedicels ⅛-⅜ in. long; perianth-tubes distinct, ¾-1½ in. long, cylindrical and abruptly broadened to the throat; perianth-segments wide-spreading and recurving, the inner wavy or ruffled along the margin, the marginal veins branched.
        J. Plants dormant in winter; flowers usually strongly fulvous or rosy red, with distinct mid-zones and median longitudinal stripes. ..... 9. *H. fulva*
(13. *H. littorea*)
        JJ. Plants evergreen; flowers with delicate fulvous overcast. ..... 2. *H.* × *aurantiaca*
      II. Scapes 1-1½ ft. tall; pedicels ¾-1⅝ in. long; perianth-tubes indistinct, short, 5/16-⅜ in. long, gradually broadened to the throat; perianth-segments ascending, the inner without wavy margins, the marginal veins unbranched.
        K. Scapes pseudo-dichotomously branched, bearing 4-6 flowers. ..... 8. *H. forrestii*
        KK. Scapes usually bracteate but not branched, bearing solitary flowers on elongated pedicels. ..... 19. *H. nana*

*A recent survey of the Japanese species by Michio Matsuoka and Mitsuru Hotta: "Classification of *Hemerocallis* in Japan and its vicinity" (*Acta Phytotax. Geobot.* 22(1-2): 25-43. 1966) came to the author's attention after the present study was completed.

HH. Scapes branched and/or bracteate only at or near the top; the first two bracts overlapping or close; flowers orange, subsessile.

L. Plants semi-dwarf, flowering May and June; scapes 1-2 ft. tall, unbranched, bearing 2-4 (up to 10 in *H.* × *aurantiaca* 'Major') flowers.

M. Roots fleshy; scapes shorter than the leaves, spreading; flower buds tinged with brownish red; flowers light orange, the inner segments lanceolate; capsules subglobose. ..... 5. *H. dumortieri*

MM. Roots cord-like, fibrous; scapes longer than the leaves, erect; flower buds greenish yellow; flowers orange, the inner segments spathulate; capsules ellipsoid. ..... 15. *H. middendorffii*
(6. *H. esculenta*)

LL. Plants robust, flowering July and August; scapes 4-5 ft. tall, with coarse short branches rather closely grouped at the apex, bearing 15-25 flowers. ..... 7. *H. exaltata*

AA. Flowers small, the perianth 2½ in. or less long, orange; inflorescence branched, often repeatedly.

N. Scapes 34-40 in. tall, the apical ¼ branched, bearing 75-100 flowers. ..... 18. *N. multiflora*
(16. *H. micrantha*)

NN. Scapes 9-21 in. tall, bearing 5-11 flowers. ..... 21. *H. plicata*

Fig. 4. Variation in size of *Hemerocallis* showing tallest species *H. altissima* and shortest, *H. nana*, both on same scale. From Stout, New York Bot. Gard.

1. **Hemerocallis altissima** Stout
(Figs. 4 & 5-a) in *Herbertia* 9:103. 1943.
PURPLE MOUNTAIN DAYLILY, TSU-KIN-SHAN DAYLILY

Plant with medium-coarse ascending-spreading leaves. Roots coarsely fibrous, few, with slight spindle-shaped enlargements. Pseudobulb erect, rhizomes short. Leaves 2-4 ft. long, ¾-1 in. wide, wiry in autumn, overwinter in a conspicuous mound. Scapes 4-6½ ft. tall, stiff, erect, branched in the upper ¼-⅓; bracts foliaceous, the lowest 2½-4 in. long, becoming brown when first flowers open, falling off later. Flowers July-September, nocturnal, fragrant, inception of flowering 3 P.M. to 5 P.M., fully open 5 P.M. to 9 P.M., end of flowering 5 A.M. to 8 A.M., pale yellow, trumpet-shaped, 3 in. in diameter; the tube 1½-2 in. long; perianth-segments 2¾-4 in. long. Capsules widest at summit, immature ones ⅞ in. long. ¾ in. in diameter.

Distribution: Native of the lower Yangtze Valley. The original specimen was transplanted from the Purple Mountain (Long. 110°E, Lat. 32°N) outside of Nanking, Kiangsu Province, to the New York Botanical Garden. Authentic seed material was imported from Chu Chow (Long. 118°20′E, Lat. 32°20′N), Anhwei Province, to the same garden, by Dr. Albert N. Steward of Nanking University. Coe in 1958 (*Hem. Yearb.* 12: 154) wrote that *H. altissima* "occurs abundantly in the region around Nanking." This is untrue. In 1930, I was in Dr. Steward's class of systematic botany, and participated in field trips with him to Purple Mountain and to Chu Chow. Wild daylilies do not exist in the lower Yangtze

Region. The vegetation in these places is all secondary growth, and daylilies are cultivated or escapes. It is very likely that Dr. Steward got his specimens from the farmers in that region.

In the Daylily Demonstration Plot at the Arnold Arboratum there are two plants of *H. altissima,* with different flowering habits and color patterns. The plant in Row F, No. 31, is nocturnal flowering with yellow flowers that bloom from July to September. The tallest scape is 5½ ft. tall. The clump in Row A. No. 9, is diurnal flowering, with a light fulvous yellow perianth, a yellow throat, and median longitudinal lines and a faint brown mid-zone. The tallest scape is 6½ ft. tall. It began to bloom on August 10 and remained blooming until the first frost.

2. **Hemerocallis × aurantiaca** Baker (Fig. 5-b) in *Grad. Chron.* III. 8:94. 1890.

ORANGE DAYLILY, GOLDEN SUMMER DAYLILY, ORANGE FULVOUS DAYLILY

Leaves dark green, robust, 6-8 to a ramet, 30 in. long, ½-¾ in. wide, stiffly ascending and recurving. Scapes about 3 ft. tall, suberect, coarse, branched near apex; apical bracts ¼-½ in. long. Flowers 6-8, about 5 in. across, subsessile or on short pedicels, diurnal; tube cylindric, about 1 in. long; throat orange; perianth-segments recurving, orange and delicately tinged red, firm, glistening in sunlight, 3 in. long, the outer nearly 1 in. wide, the inner slightly wider, wavy along the margin. Stamens ½ the length of the perianth-segments; anthers dark gray. Capsules oblong, about 1¾ in. long, about 1 in. wide, obtuse at the apex.

The name was based upon a plant cultivated at the Royal Botanic Gardens, Kew, in England. The type specimen contains a ramet with leaves, a scape, two withered detached flowers, a sepal and a flower-bud. Mallett in 1903 (*Garden* 63: 38) remarked, "A plant seen in various parts of the country, but without name or history . . . It is a better plant than var. *major* in light dry soil."

Hemerocallis × aurantiaca was introduced into Italy through Sprenger (*Gard. Chron.* III. 34: 122, 1903) who observed that it bloomed from April to November and was the first and also the last to bloom in Naples.

The first published record of its existence in American gardens appears in Morrison's report (*USDA Circ.* 42: 1, 9. 1928). Morrison remarked that the plants occurred under "various trade names, all of which rather closely approximate the description of the species." He also observed, "The true species is very similar to *H. fulva* in its general habit but is neither stoloniferous nor sterile . . . flowers bright orange, large, opening so widely as to appear starry. . . . July-August."

Bailey in 1930 (*Gent. Herb.* 2: 153) expressed his opinion on the species: "I do not understand Baker's characterization of this species and have not recognized the plant in any of the cultivated material I have seen." Evidently Bailey was confused by (1) an error in the original description which indicated 1 in. as the width of the leaves of this plant, and (2) Baker's description of a withered flower about the segments of which he wrote, "outer oblong-lanceolate, 1 in. wide, firm, thick; inner narrow and

Fig. 5. a. *H. altissima* showing upper part of floral scape, flower with slender elongate perianth-tube and detached withered flower. b. *H.* × *aurantiaca* showing habit of plant and four inflorescences, two at beginning of flowering and two after flowering ceased. From Stout, New York Bot. Gard.

thinner." In a normal fully opened flower of *Hemerocallis* the inner perianth-segments are always wider than the outer segments.

Stout published a colored plate of *H.* × *aurantiaca* in 1929 (*Addisonia* 14: 25, pl. 461), and remarked that the hybrid has been propagated by division and all the plants cultivated in Europe and America belong to one clone. In 1941 (*Herbertia* 8: 96) Stout again remarked that *H.* × *aurantiaca* was a name given to a single clone with pale fulvous (reddish yellow) flowers. It is self-sterile and heterozygous for fulvous color and evergreen habit. Stout suggested that it is a chance hybrid originating at Kew. In 1942 (*Herbertia* 9: 161) Stout came to the conclusion that *H.* × *aurantiaca* "can not be considered a good species. But the origin of the plant is obscure. It is evidently a hybrid . . . it will be considered as a horticultural clone and designated as the Aurantiaca Daylily."

Coe in 1958 (*Hem. Yearb.* 12: 153) regarding the origin of *H.* × *aurantiaca* wrote that it "Grows wild in the vicinity of Mt. Ibuki in Japan." This statement contradicts the observations of contemporary Japanese botanists. J. Ohwi in "*Flora of Japan*," 1965 observed that *H.* × *aurantiaca* Baker is a "Chinese plant rarely cultivated in Japan."

Perhaps Coe's statement was made through a misinterpretation of Stout's record about Makino's identification of plate 13 in volume 6 of Yukusai Iinuma's "*Somoku-dzusetsu*." In the second edition Makino named this figure *H. aurantiaca*. Iinuma originally remarked that a daylily with golden flower occurs spontaneously at Mt. Ibuki as well as in cultivation. Iinuma's work was published 15 years before Baker's and it has nothing to do with Baker's species. The heterozygous genetic composition of *H.* × *aurantiaca* for evergreen habit and fulvous red coloration seems to indicate that the clone originated in a warm climate before it was introduced to British gardens. In all of Stout's breeding work he observed that *H.* × *aurantiaca* and its cultivar 'Major' have been contributors of the evergreen habit. During the period of 1790-1890 thousands of ornamental plants were introduced from Canton, Hongkong, and Macao to England. The introductions of most of these species were recorded, but no record exists for the introduction of *H.* × *aurantiaca* from China.

2a. **Hemerocallis** × **aurantiaca** var. **littorea** (Makino) Nakai = *H. littorea* Makino (see No. 13).

2b. **Hemerocallis** × **aurantiaca 'Major'** (Baker) in *Gard. Chron.* III. 18:62. fig. 14. 1895. syn. *H. sempervirens* Araki. in *Jour. Jap. Bot.* 27: 255. 1952.

Baker's description of this cultivar is brief. His material was originally imported from Japan to England by Wallace & Son. It "resembles *H.* × *aurantiaca* but the foliage is darker, flowers larger, fuller, uniformly orange without fulvous color." He suggested that it might be a chance seedling of an accidental hybrid.

The type specimen used by Baker has foliaceous bracts about 5 in. long, and the perianth is 5 in. long, the outer segments 3½ in. long, ca. 1 in. wide, the inner segments 4 in. long and 1½ in. wide.

In 1903 Mallett (*Garden* 63: 38) commented that this "is the finest plant of the genus." Its leaves "are arranged in broad distichous [2-ranked] tufts which never grow so dense that the distichous character of the plant is lost." Later he added a very interesting historical note, saying, "An English bulb merchant traveling in Japan had the flowers served to him as salad and he bargained with the host for the purchase of all the plants which grow among *Iris kaempferi*." It flowers in July. Sometimes a few flowers are produced earlier in the year and many often appear late in September. The scapes are 1½-2 ft. tall, bearing 5-10 flowers of fine rich orange color and with a spread of 8 inches.

Bailey in 1930 called cultivar 'Major' the "Golden Summer Daylily." In *Gent. Herb.* 2: 153, Bailey recorded the numerous spindle-shaped tuberous roots, strongly ribbed leaves about 1½ in. wide, prominent bracts, large flower with the tube about 1 in. long and with recurved segments. He questioned whether its possible relationship with *H.* × *aurantiaca* is genuine.

Stout in 1941 (*Herbertia* 8: 96) considered cultivar 'Major' a clone heterozygous for absence of fulvous coloring and for evergreen habit. He suggested that it might be a species distinct from *H.* × *aurantiaca*.

Hemerocallis × *aurantiaca* has been used extensively in breeding and hybridization experiments. Two early named cultivars are:

'Miranda' (Yeld) (*H.* × *aurantiaca* × *H. flava*)—growth vigorous; foliage mound about 30 in. across, scape 42 in. tall, bearing 9-24 medium yellow flowers, 4½ in. across, inner segments wavy; blooming from May to August.

'Sir Michael Foster' (Mueller 1904) (*H.* × *aurantiaca* × *H. citrina*)—foliage evergreen, bluish, red at base; scape 4 ft. tall; flowers clear yellow, fragrant, 6 in. across, the perianth-segments undulate.

3. **Hemerocallis citrina** Baroni
(Fig. 6) in *Nuov. Giorn. Bot. Ital.* II. 4:305. 1897.
CITRON DAYLILY, LONG-YELLOW DAYLILY

A stout plant of compact growth. Roots with many stubbed club-shaped tubers. Pseudobulbs producing lateral branches. Leaves coarse, dark green, suberect, dying in autumn, about 30-45 in. long, 1½ in. wide, keeled, glaucous in sunlight. Scapes stiff, erect, 40-45 in. tall, brittle, upper one-fourth branched, bearing 7-65 flowers; bracts 1-3 in. long, subulate at the apex. Flowers large, nocturnal, fragrant, pale lemon yellow, 5-6¾ in. long, the tube 1½-2 in. long; outer segments greenish on the outside and purplish at the tip, flat, ¾ in. wide, subacute and pointed at the tip; inner segments 1 in. wide, margin wavy, slightly reflexed at the tip, the veins distinctly reticulate. Capsules 3-lobed, obovoid, 1-1¼ in. long, obtuse and notched at the rounded tip. Seeds black, irregularly ribbed, subspherical, ⅛ in. in diameter.

Distribution: According to Baroni this species is a native of Sun-tun of Shensi Province. It was sent to him by an Italian Missionary, Guiseppe Giraldi in 1895. The plant flowered in the garden of the Museum of Botany in 1897. Charles Sprenger of Naples, Italy, obtained plants of *H. citrina* from the Museum for propagation and distribution. Later his nephew, Willy Mueller, continued his business after him. Most of the specimens in American gardens are from Mueller and are true to type.

In 1928 B. Y. Morrison first recorded the existence of *H. citrina* in American gardens. The species is semi-evergreen in Washington, D. C., and its flowers open about 6 P.M. and close before noon the next day. The plant has also been introduced into Puerto Rico.

Stout in 1930 (*Addisonia* 15: 3. pl. 482) published a colored illustration and a detailed account about this species. He discovered that *H. citrina* is self-incompatible; the pollen tube travels through the stylar canal normally, but fertilization does not occur. The incompatible reaction occurs in the ovary.

Hemerocallis citrina has been employed extensively in breeding. As early as 1903, Charles Sprenger reported (*Gard. Chron.* III. 34: 122) that he had used *H. citrina* as the seed parent in crosses with *H.* × *aurantiaca, H. fulva* var. *maculata, H. thunbergii, H. minor, H. fulva,* and *H. fulva* 'Flore Pleno'. *Hemerocallis* 'Baroni', a night bloomer and *H.* 'Parthenope' with wavy petals and fragrant flowers are cultivars from these crosses. *Hemerocallis* 'Citronella' (Farr) is a cultivar derived from *H. citrina* × *H. thunbergii,* and the cultivars 'Golden West' (Sass ex Fairmont) and *H.* 'Sunny West' (Sass) are cultivars from *H. citrina* × *H.* × *aurantiaca.*

The cultivar *H.* 'Citrina Sprengeri' is known in botanical gardens. Bailey and Stout both mentioned the name but failed to describe the plants. In the Arnold Arboretum 'Citrina Sprengeri' blooms from July to the end of August. It is of medium height, with good compact foliage, branched scape, and with yellow, medium-size, sessile, rather full flowers, the tube 1 in. long, the perianth-segments 3 in. long and wavy, with

Fig. 6. *H. citrina:* a. Habit of plant. From Stout, New York Bot. Gard.

the lateral veins reticulate, and the marginal veins branching. It fruits freely in open pollination. The capsules are rather small, obovoid, or oblong, ca. 1 in. long, ¾ in. in diameter.

Kraus observed that cultivars having traces of *H. citrina* in their ancestry are particularly defective because of the wilting and disintegration of the flower parts on a bright, hot humid day.

4. **Hemerocallis coreana** Nakai
in *Bot. Mag. Tokyo* 46: 123. 1932.

Roots horizontally rugose. Leaves 5-17 in. long, ¼-½ in. wide. Scapes 20-32 in. tall, apical end branched; lower bracts lanceolate, 4-12 in. long, upper ones ovate. Flowers subsessile, perianth yellow; tube 1-2 in. long, yellowish green, segments 2½-3 in. long; the outer ½ in. wide, the inner oblanceolate, ca. ¼–1 in. wide. Capsules ca. 1 in. long, ¼ in. across, rugose, nervose, apical end emarginate.

Distribution: Nakai examined seven herbarium specimens collected in Korea, China (Mukden), and Japan (Yezo). Ohwi (*Fl. Japan* 292. 1965) calls the specimen from Yezo *H. yezoensis.* All specimens I have seen from Korea can be identified as *H. lilioasphodelus* (*H. flava*) or *H. minor.* From Nakai's original description as translated into English in the foregoing paragraph. *H. coreana* seems to be a form of *H. minor* with elongate bracts on the scape.

5. **Hemerocallis dumortieri** Morren
(Fig. 7) in *Hort. Belge* 2: 195. pl. 43. 1834.
EARLY DAYLILY, NARROW DWARF DAYLILY, DUMORTIER'S DAYLILY

Plant with dwarf compact habit, ½-2 ft. tall. Roots conspicuously enlarged, club-shaped. Leaves stiffly ascending-spreading, 6-8 to a ramet, narrowly linear, attenuate toward the apex, about 1½ ft. long, ½-1 in. wide. Scape unbranched, slender, cylindric, arching, and disposed around the mound of foliage. Flowers 2-4, in pairs, subsessile, subtended by two overlapping basal bracts; buds strongly tinged with brownish red; perianth campanulate, tube short, the segments deeply divided, oval lanceolate, orange inside, the outer 1¾-2½ in. long, ¼-½ in. wide, the inner 2-2½ in. long, ½-¾ in. wide, slightly recurved. Capsules subglobose, ca. 1 in. long, ¾ in. in diameter.

Distribution: Hemerocallis dumortieri was first grown in Holland and Belgium about 1830 from plants brought from Japan by Franz Philipp von Siebold (Anderson, in *Gard. Chron.* III. 129: 52. 1951). Plants first brought to Holland were taken to Belgium by Siebold where the plant was introduced to gardens. M. Ch. Morren, Professor of Botany of the University of Ghent first described and illustrated the plant with a colored plate. Morren's illustration shows a plant with narrow leaves. Mallet in 1903 (*Garden* 63: 52) observed "leaves linear, slender, grass-like." Stout described the leaves as 1 in. wide. Herbarium specimens from Japan all have wide leaves. Morren's illustration shows a specimen with two small

Fig. 7. *H. dumortieri:* a. Above ground parts (redrawn from Morren). b. Two young inflorescences showing head-like appearance. c. Inflorescence with 2 bostryxes. d. one with 3 bostryxes. e. Inflorescence near end of flowering season, no capsules set. f & g. Fruiting scapes (b-g redrawn from Stout, New York Bot. Gard.)

bracts subtending the flowers and an empty bract on the scape. Apparently the size of the bract is variable. Stout in 1929 published a colored illustration of the species. He observed that the lower bract may be 2 inches long.

Ohwi in 1965 (*Fl. Japan*) observed that *H. dumortieri* is closely related to *H. exaltata*. It is distinguished by its leaves being ½-¾ in. wide, flowers in dense clusters, bracts ovate to oblong-ovate, subacute and membranous; perianth 2-3 in. long, with short tube ½ in. long and anthers black. He gave the distribution of the species as central and northern Japan, Korea, Manchuria, and E. Siberia.

Hemerocallis dumortieri has been used extensively in hybridization. In 1895 George Yeld selected *H.* 'Francis', from a cross of *H. minor* × *H. dumortieri,* which won the Royal Horticultural Society's Award of Merit.

In 1903 Mallett (*Garden* 63: 53) reported the introduction of *H.* 'Aureole' from Japan to England. He interpreted this to be a hybrid of *H. dumortieri* × *H. middendorffii*. The plant has linear-lanceolate leaves 1½ ft. long, in dense tufts 1 ft. in diameter, deep orange flowers 4½ in. long, with a 4-in. spread, 5 on an umbel, subtended by large clasping bracts surmounting the stiffly erect scape. The outer perianth-segments are a warm brown on the outside.

Marion Shull in 1941 (*Herbertia* 8: 127) observed that *H.* 'Aureole', *H. minor,* and H. *middendorffii* are all early bloomers in Maryland but with a wide variation in the time of development of their flower buds. In October *H. minor* and *H. middendorffii* have well formed flower buds, while in *H.* 'Aureole' there is no sign of a flower bud.

6. **Hemerocallis esculenta** Koidzumi
(Fig. 8) in *Bot. Mag. Tokyo* 39: 28. 1925.

Roots enlarged throughout, with no obvious tubers. Leaves 8-13 to a ramet, 20-33 in. long, ¾-1¼ in. wide, arching, minutely papillate along the margin. Scapes erect, 25-35 in. tall; bracts often occur above the first branching of the inflorescence, membranous, 1 in. long; flowers 5-6, trumpet-shaped, in two abbreviated branches; pedicels ¼-¾ in. long, subtended by ovate-lanceolate bracts ¼ in. long; perianth orange, 3¼-4 in. long, tube ¾-1 in. long, segments 2¾-3¼ in. long, the outer 1¼ in. wide, the inner 1¾ in. wide. Capsules oblong, about 1 in. long, truncate and notched at the rounded tip. Seeds ovoid, ca. ¼ in. in diameter.

Distribution: A colonizer in mountain meadows. Temperate regions from Kyoto northward to Hokkaido in Japan, and Sakhalin.

Japanese botanists differ in their interpretation of the status of *H. esculenta.* Koidzumi considered it close to *H. thunbergii* and distinguished it by its pale orange flowers, oblong perianth-segments, short tube, broad elliptic anthers with median longitudinal white stripe and lack of tuberous roots. In 1932 Nakai (*Bot. Mag. Tokyo* 46: 118-120) traced all known Japanese records of the plant from 1710-1929, and illustrated *H. esculenta* with two photographs showing habit and habitat of the plant. Ohwi (*Fl. Jap.* 292. 1965) interpreted it as a variety of *H. middendorffii.*

American botanists have not had sufficient material of *H. esculenta* to support a strong judgment on the status of this species. In 1930 Bailey (*Gent. Herb.* 2: 155) extracted from Koidzumi's description the characters of the species. In 1934 Stout (*Daylilies* 31) merely mentioned it in his

Fig. 8. Inflorescences of *H. esculenta:* From specimens cultivated in New York Botanical Garden. From Stout New York Bot. Gard. b. Same redrawn from Kitamura.

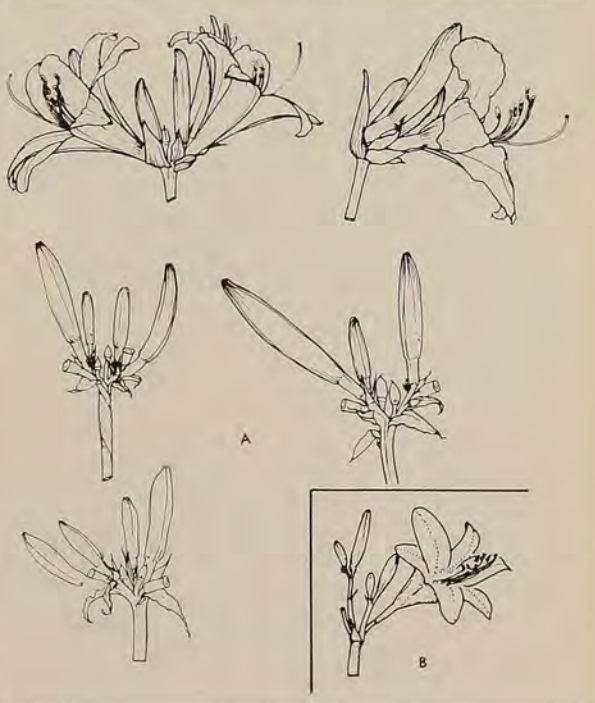


Fig. 9 Inflorescences of *H. exaltata*. From Stout, New York Bot. Gard.

Fig. 10. *H. forrestii:* Plant, 2 inflorescences and one fruiting scape. From Stout, New York Bot. Gard.

treatment of *H. fulva*. In 1941 (*Herbertia* 8: 96) he reported that he had obtained plants under this name from Japan, and seedlings both from selfing and crossing some having flowered. He observed that the flowers are all clear orange like that of *H. middendorffii*.

I have recognized *H. esculenta,* based on the abbreviated 2-branched inflorescence, the pedicellate flowers, and geographical isolation in mountain meadows.

7. **Hemerocallis exaltata** Stout
(Fig. 9) in *Addisonia* 18: 27. t.595. 1934.

Plant with robust arching foliage, compact crown, stout, branched scape. Rhizomes creeping. Roots thickened throughout or slightly enlarged and spindle-shaped. Leaves coarse, thick, 3 ft. long, up to 2½ in. wide. Scapes erect, coarse, stiff, 4-5 ft. tall, branched, the branches short and stout; bracts foliaceous, oval-lanceolate, 1½-2½ in. long. Flowers diurnal, June-July, light orange, 4 in. across; inner segments spathulate. Capsules ellipsoid, 1½ in. long, ⅞ in. in diameter, obtuse at the tip, corrugated with numerous short ridges. Seeds rounded and angular, ¼ in. in greatest diameter.

Distribution: Native of Tobi Shima, a small island off the west coast of Honshu, Japan. It was introduced to the New York Botanical Garden by T. Susa, Director of the Aomori Agricultural Experiment Station, Kuroishi, Japan, and flowered there in 1930. Stout mentioned that a type specimen is deposited with photographs of the plant in the herbarium of the New York Boanical Garden. I saw the photographs but not the specimen.

Kitamura in 1964 (*Col. Ill. Herb Pl. Jap.* 3: 143) interpreted *H. exaltata* as a variety of *H. dumortieri.* He described a plant with scape 25-45 in. long, bead-like inflorescence, pedicels ⅛-½ in. long, perianth-tube ¾ in. long, segments 3 in. long, fruit 1⅛ in. long, truncate at the apex. He remarked that in cultivation the plant is larger than the wild form.

Stout remarked that the color of the flower, the outline of the perianth-segments, and the size and shape of capsules of this species resemble those of *H. middendorffii.* The branched scape is also distinctive and I agree it is better to maintain *H. exaltata* as a distinct species.

8. **Hemerocallis forrestii** Diels
(Fig. 10) in *Notes Bot. Gard. Edin.* 5: 298. 1912.
FORREST'S DAYLILY

Foliage stout, medium green, about 1 ft. tall, basal portion covered by persistent fiber of dead leaves. Outer leaves of a ramet recurved, inner ones erect, ½-¾ in. wide, obtuse at the tip. Scapes axillary to a scale hidden by partially generated leaf-bases or to the outermost small leaf, 12-15 in. tall, dichotomously branched at the tip, naked or with foliaceous bracts ⅜-2½ in. long; pedicels ¾-1¼ in. long. Flowers red-orange, 5-8 (-10) to a scape, funnelform, tube ½-¾ in. long; segments 2½-2¾ in. wide, margin flat, without branching marginal veins. Capsules oblong 1½ in. long, ¾ in. in diameter, obtuse at the tip, slightly rugose.

Distribution: Dry cliffs and ledges in northwestern Yunnan (Long. 99°E, Lat. 27° 12'N), alt. 9,000-10,000 ft.

Field notes accompanying the herbarium specimens at the Arnold Arboretum indicate there are two color forms in nature, one with red-orange flowers as observed by George Forrest in June, 1906 and the other with orange flowers. Camillo Schneider collected both forms in 1914. Stout in 1930 (*Addisonia* 15: 1, pl. 481) reported that he had introduced living material from the Royal Botanic Gardens at Kew, and from the Royal Horticultural Society at Wisley, England. He observed that the flowers of these introductions are quite uniform and orange, having no fulvous pigments in the sap of the epidermis as do the flowers of *H. fulva.*

In 1934 (*Daylilies,* 16) Stout reported that he had obtained seed directly from Yunnan through Joseph F. Rock. The seedlings had fleshy roots and were winter dormant in a greenhouse. He observed that specimens planted in the open garden in New York had died while most of these kept in a cold frame lived. He reported crossing *H. forrestii* with *H. lilioasphodelus* (*H. flava*), *H. minor,* and *H. dumortieri,* but mentioned no named cultivars resulting from these hybridizations.

9. **Hemerocallis fulva** (L.) L.
(Fig. 11) *Species Plantarum,* ed. 2. 462. 1762. Syn. *H. lilioasphodelus* β *fulvus* L. *l.c.* ed. 1, 324. 1753.
TAWNY DAYLILY, FULVOUS DAYLILY, ORANGE DAYLILY

Leaves sea-green varying in height and habit. Roots with spindle-like enlargements. Rhizomes elongate-spreading. Leaves linear-keeled (V-shaped in cross-section), up to 3 ft. long, ¼-2 in. wide, outer ones of a ramet arching, inner ones erect. Scapes taller than the leaves, branched in upper quarter, bracts linear; flowers rusty orange, red to pink, in various combinations, tube ¾-1¼ in. long, perianth-segments recurved, margin wavy, marginal veins branched. Capsules oblong, 1¼ in. long, ¾ in. in diameter, tip truncate, often notched, with a short stipe at base. Seeds obovoid, ¼ in. long, and nearly as wide.

Fig. 11. *H. fulva:* a. Plants of *H.* 'Europa'. b. Plant introduced from China with more compact growth. c. Inflorescence with 2 bostryxes. d. Inflorescences having 2 bostryxes each. Roman numbers indicate sequence of flower opening. B = bracts.

Distribution: A very inclusive species with a long history in cultivation, covering diverse forms of wide geographical distribution. The area of distribution has never been firmly established.

Linnaeus in 1753 treated *H. fulva* as variety β of *H. lilioasphodelus.* Nine years later he elevated it to the rank of species. Lamarck in 1778 called it *H. crocea* (*Pl. Fr.* 3: 267). In 1799 Willdenow (*Sp. Pl.* 2: 197) observed that he had seen diverse forms in Germany, some big and others small, some with fulvous flowers and others with paler flowers approaching those of *H. lilioasphodelus.* In 1802, Redouté (*Les Liliacées* 1: 16) illustrated a form with 3-tone large purplish red flowers with petals ruffled along the margin.

Many of the cultivars are self-incompatible. Stout observed that some forms introduced from China to the New York Botanical Garden are self-compatible. For two to eight hours after artificial pollination, the pollen tubes advance at a uniform rate, but on reaching the base of the style, they are delayed for 12 hours, then they enter the ovaries where fertilization takes place.

Variants of **H. fulva**

9a. var. **angustifolia** Baker
in *Jour. Linn. Soc. Bot.* 11: 359. 1871.

Plant small with a scape about 1 ft. tall; leaves 12-18 in. long, ¼-½ in. wide, with narrow acute perianth-segments.

Distribution: Baker based this variety on material from northern India.

Unfortunately, Baker confused the matter and treated *H. longituba* Miq. from Japan as a synonym of var. *angustifolia* without having seen material of *longituba.* While *H. longituba* may be closely related to *H. fulva* var. *angustifolia,* because of the wide geographical discontinuity that separates them, I have kept var. *angustifolia* distinct from var. *longituba.*

In 1934 Stout (*Daylilies,* 27) summarized the essential points from Baker's earlier publication and suggested that no relationship exists between var. *angustifolia* and *H. fulva* but that var. *angustifolia* is allied to *H. forrestii, H. nana,* or *H. plicata,* species from western Yunnan, China. Stout's suggestion may be very realistic, since the floras of Khasia in India and western Yunnan are closely related. However, these species are poorly understood, and their relationships with *H. fulva* are not clear. Later, in 1942, (*Herbertia* 9: 161) Stout noted that *H. fulva* var. *angustifolia* is a clone with small flowers having a halo of red coloring in the face. It is rare in cultivation.

9b. var. **disticha** (James Donn) Baker
in *Jour. Bot. Brit. For.* 12: 3. 1874.

Plant with smooth glossy leaves 3 ft. long. Scapes emerging from the side of the shoot, 2-3 ft. long, forked, bracts foliaceous ¾-1½ in. long. Flowers six on each inflorescense branch, perianth campanulate, tube 1½ in. long, pale yellow, throat orange, segments lanceolate, undulate, acute, recurved, red-orange with clear orange median lines, and branched lateral veins.

About 1789 a shipment of daylilies arrived in England from Macao in South China. This material was distributed to botanical institutions, including the Cambridge Botanic Garden and the Royal Botanic Gardens at Kew. Later, several leading nurseries also obtained ramets. In 1804, *H. disticha* was listed by James Donn in *Hortus Cantabrigiensis,* a catalogue of the plants in the Cambridge Botanic Garden. The plant was merely listed as a hardy spreading perennial without further detail, and no mention of flower color. Likewise, Sims considered the plant distinct from *H. fulva,* and in 1812 (*Bot. Mag.* 35: sub. pl. 1433) without giving any reason, listed *H. fulva* of Thunberg's *Flora Japonica* and a daylily in Bank's *Collection of Paintings of Chinese Plants* under *H. disticha* and accredited the species to China and Japan. In 1823 Sweet (*Brit. Fl. Gard.* 1: pl. 28) provided a colored plate based on a potted plant in the nursery of Messrs. Allen & Co., with a detailed description of the plant. He mentioned that the plant grew very well for many years in the garden, without flowering. In 1874 Baker was the first to associate *disticha* as a variety of *fulva.* It should be noted that var. *disticha* grows well in subtropical South China. In London and vicinity in England this plant does not flower freely. Kraus had a similar experience with *H.* × *aurantiaca* 'Major' from material collected in Hawaii which refused to flower in a greenhouse in Chicago.

9c. **Hemerocallis fulva L.** 'Kwanso' (Regel)
in *Gartenflora* 15: 66, t. 500, 1866.

Plant robust, with leaves up to 2 in. wide, late blooming. Flowers double. Very common in gardens. Bailey reported collecting it in Rio de Janeiro. The first European record occurs in Kaempfer's *Amoenitatum Exoticarum*

published in 1712. Kaempfer was a German naturalist and officer of the Dutch East India Company stationed in Japan in 1690-1692. In his list of Japanese plants he gave both the Chinese character and the Japanese pronunciation. He reported that the vernacular name in Japan was *Quanso*, evidently a deviation of the Chinese *Hsuan-ts'ao*. Regel published the name Kwanso according to the German spelling. The plant is a triploid and it sets no fruit.

9d. var. **longituba** (Miquel) Maximowicz
in *Gartenflora* 34: 89. 1885. Syn. *H. longituba* Miq. in *Ann. Mus. Bot. Lugd.* 3: 152. 1867.

Plant with the crown wrapped by the fiber of its old leaves. Scapes 40 in. tall, bracteate above, bracts ovate-lanceolate, ½-¾ in. long. Flowers orange-yellow with slight fulvous tinges, perianth-tube long and narrow.

Distribution: A native of Japan growing near springs. The Japanese botanists, Nakai and Ohwi, treat var. *longituba* as a species. However, it seems better to keep the Japanese wild type as a variety of *H. fulva*. Of this L. H. Bailey remarked (*Gent. Herb.* 2: 151. 1930), "In the Lu-Shan Mountains, China . . . I have collected *H. fulva* in the wild with tube 4 cm. long." The Chinese specimens in the Gray Herbarium show the flower tube in *H. fulva* varies in length, from ¾ to 1¾ in. The colored photograph of Okuyama (*Wild Pl. Jap.* 2: pl. 176, fig. 3, 1960) and the colored painting of Kitamura (*Col. Ill. Herb. Pl. Jap.* 3: pl. 38, fig. 243, 1965) show plants with rather short perianth lobes.

Stout (*Addisonia* 15: 6. pl. 483. 1930) observed that the Chinese and Japanese plants of the *H. fulva* complex grow side by side in the New York Botanical Garden. They all have spreading rhizomes, oblong capsules and scapes standing high above the leaves. The Purple Mountain (Nanking, China) plants have much coarser foliage and the Japanese plants have more brownish red coloring in the flowers. The Kuling plants have more slender leaves of darker green and taller scapes. Some of the plants from each location have flowers with narrow segments and longer tubes. It is worthy of note that Stout's plate for this variety was made on the basis of a plant from China.

According to Nakai, the brownish red flowers figured in early Japanese records about daylily (Tachibana, *Ebon Noyamagusa* 3: pl. in folio 8. 1755) belong to the cultivar 'Kwanso'. Iinuma (*Somoku Dzusetsu* 6: t. 16) called it *Beni-Kwanso*, the Red Daylily.

In 1936 Satake (*Ic. Pl. As. Or.* 1: 28) described *H. exilis* alleged to be a hybrid between *H. fulva* var. *longituba* × *H. thunbergii*. According to Satake this plant has spreading narrow leaves, scapes 3 ft. high, bearing orange flowers that bloom in July and August.

In 1949 Owhi (*Bull. Nat. Sci. Mus. Tokyo* 26: 6) published *H. sendaica* and in 1965 (*Fl. Jap.* 292) he treated it as a synonym of var. *longituba*.

9e. var. **maculata** Baroni
in *Nuov. Giorn. Bot. Ital.* II. 4: 306. 1897.

A variety of robust growth with strong spreading rhizomes, and large flowers with broad inner segments. Leaves pale green, 40-45 in. long, ⅞-1¼ in. wide, apical ¼ stiffly recurved. Scape 4 ft. high, erect, stiff, coarsely 2- to 4-branched. Flowers 8-12 on a scape, pedicels ¼-⅜ in. long; bracts ½-3 in. long, tube 1⅜-1¾ in. long; throat cadmium yellow, limb golden yellow, glistening, with a 6 in. spread; perianth-segments recurving, the outer ¾ in. wide, the inner 5 in. long, 1⅜ in. wide with a clear red-purple eye-zone and yellow longitudinal median lines, tip twisted, margin wavy, nerves reticulate. Capsules obovoid-oblong, tip truncate and notched. Seeds obovoid-oblong, ¼ in. long and nearly as wide.

Distribution: Shensi, China (Long. 109°E, Lat. 33°N).

It was sent to Baroni in Florence by Giraldi in 1895. Charles Sprenger obtained the variety from Baroni and distributed it. It is a triploid, self-incompatible, and is propagated vegetatively. Stout (*Addisonia* 14: 25. pl. 461. 1929) used it for hybridization and breeding. He succeeded in obtaining 15 seeds in one capsule in a cross of *H. fulva* var. *maculata* × *H. citrina*.

9f. var. **pauciflora** Hotta & Matsuoka
in *Acta Phytotax. Geobot.* 22 (1-2) 43. 1966.

Leaves 8-12 in. long, ¼ in. wide. Scape 10-20 in. tall. Influorescence branched, branches few (1-3) flowered. 2n = 33.

Distribution: Japan. Honshu. Pref. Kyoto: Gomago-mura. I have not seen specimens. Gomagahara, Funai-gun, alt. ca. 600 ft.;

Note: The newly described var. *pauciflora*

is the fourth triploid daylily reported for *H. fulva* along with 'Europa', 'Kwanso', and var. *maculata*. (*Ed.*)

9g. var. **rosea** Stout
in *Addisonia* 15: t. 484. 1930.

Leaves dark green, rather narrow; rhizome creeping. Scapes high above the leaves. Flowers rose-red, with a spread of 4 in., tube 1 in. long, greenish yellow; perianth-segments recurving, the outer ½ in. wide, the inner ¾ in. wide with a conspicuous purplish red eye-zone and a median longitudinal line of lighter color, margin wavy. Capsules oblong, 1¼ in. long, ¾ in. in diameter, tip subtruncate. Seeds obovoid, ¼ in. in diameter, tip subtruncate.

Distribution: Native of Kuling in Kiangsi Province, China (Long. 116°E, Lat. 29° 30'N). It was sent to Stout by A. N. Steward in 1924.

In 1959, Traub (*Herbertia* 15: 72) without giving any reason made a new combination, *H. lilioasphodelus* var. *rosea* (Stout) Traub. The yellow daylily, *H. lilioasphodelus* (*H. flava*) is characterized by trumpet-shaped yellow flowers with extended flowering. *Hemerocallis fulva* var. *rosea* has rose-red flowers with spreading segments and diurnal flowering; its relationship with *H. fulva* is genuine, while the relationship with *H. lilioasphodelus* is relatively remote. Traub's new combination cannot be accepted.

Among Stout's seedlings of var. *rosea*, two cultivars were named:

'Charmaine' (Stout)—flowers with two-toned distal color pattern, without a band of intense coloring.

'Rosalind' (Stout)—flowers with three-toned color pattern, the petals strongly banded.

Both cultivars were distributed by the Farr Nursery in Pennsylvania.

Cultivars of H. fulva

The following alphabetic list of named cultivars of *H. fulva* from various sources are old color forms long cultivated, or recently selected from specimens sent directly from China, or from modern hybridization:

'Chengtu' (Stout)—flowers orange with scarlet mid-zone on inner segments. Leaves remain green until frost. Sent by Professor W. P. Fang of Szechwan University, Chengtu, China. (Long. 103°30'E, Lat. 31°N).

'Cypriani' (Mueller)—flowers coppery-red with a golden center and a well-marked golden median longitudinal line on the gracefully reflexed inner segment. It was sent to Charles Sprenger by an Italian Missionary Padre Cypriani who was stationed in Hupei Province in Central China.

'Europa' (Stout)—the most widely distributed daylily in cultivation over the world and the commonest in the United States. In the herbarium of the New York Botanical Garden I have seen specimens from Jamaica, Bermuda, Cuba, El Salvador, and Colombia. The flower is tawny (fulvous) over yellow, with an arching middle zone and reticulate veins of a darker shade. It is a highly sterile triploid and self-incompatible (Chandler in *Bull. Torrey Bot. Club* 67: 6, 50. 1940), sterility being caused by physiological incompatibility in fertilization and by abortion of microspores. 'Europa' has been used extensively in hybridization and is one of the contributors of genetic factors to many modern cultivars.

In 1958 Coe (*Hem. Yearb.* 12: 152) commented that 'Europa' has the "ability to generate healthy plants from almost any portion of one of the fleshy, tuberous roots." This is untrue. 'Europa' often has poor foliage. The outer leaves of the ramet become dead and unsightly in mid-summer.

'Festival' (Stout)—plants of a robust habit, with a coarse erect much-branched scape up to 4 ft. tall. Flowers with a 5 in. spread, an orange throat, orange and slightly reddish brown tinged outer segments and twisted and folded English red inner segments with a darker orange midstripe.

'Flore Pleno' (Veitch)—flowers double, large, orange, with a 6 in. spread, outer segments broad-recurved, prominently zoned; petaloid stamens and style much modified. It was sent to Veitch in England by Rev. Ellis from China via India before 1860 (*Gard. Chron.* 654. 1860). It is the earliest named cultivar with double flowers.

'Hankow' (Stout)—flowers large, 5½ in. across, rich yellowish orange, with a purplish red or scarlet mid-band. Blooms in July-August. It was sent to Stout by the Consul of the United States stationed at Hankow in Hupei (Hupeh) Province. First distributed by Farr Nurseries in 1939.

'Hupehensis' (Sprenger)—flowers with reflexed undulating perianth-segments,

bright coppery red-yellow on the throat. Sent to Charles Sprenger in Naples, Italy, by Padre Cypriani from Hupei (Hupeh) Province in central China.

'Margaret Perry' (Perry)—An F_1 hybrid of *H. fulva* × *H.* 'Cypriani'. Plants with coarse foliage, robust scape 54 in. tall and orange flowers with a cadmium yellow longitudinal line on each segment.

'Mikado' (Stout)—plant with a semi-robust habit, foliage mound 20-24 in. in diameter. Scape erect 30-35 in. tall. Flowers 5 in. across, with fairly broad, spreading recurving orange segments, the inner segments with a middle mahogany red zone and an orange longitudinal median line. Capsules ovoid. It is self incompatible. One of Stout's complex hybrids involving *H.* 'Europa', *H.* × *aurantiaca, H. lilioasphodelus,* and *H.* × *aurantiaca* 'Major' in its parentage (*Addisonia* 15: 13, pl. 487). In 1942 (*Herbertia* 9: 167) Stout reported that the Mikado Race has received genetic contributions from *H. thunbergii* and *H.* × *luteola.*

'Red Bird' (Stout)—seedling selection from 'Chengtu'. Flowers orange with scarlet mid-zone and rather narrow segments.

'Theron' (Stout)—leaves ascending-spreading. Scape erect about 30 in. tall. Flowers dark red with a pale yellow-orange throat. One of the most beautiful early daylily cultivars produced in America. Named for Mrs. Theron G. Strong.

10. **Hemerocallis graminea** Andrews (Fig. 12) in *Bot. Repros.* 4: pl. 244. 1802.

Plants of dwarf habit. Leaves about 30 inches long, linear, keeled, grass-like. Scape as long as the leaves, bending, bearing 2-3 flowers; bracts lanceolate, 2 in. long, brown after flowering. Flowers large, 4½ in. across, lasting 2-3 days; buds green with a brown tint; tube short and stout; segments broad, recurving, orange with a yellow throat, browning outside, the outer ¾ in. wide, the inner 1 in. wide, margin wavy.

Distribution: Introduced to Oxford Botanic Garden by Dr. Sibthorpe from the northern part of Europe. Only vague information exists about its origin. It cannot be a native of Europe. *H. graminea* was the first known dwarf daylily with orange flowers and extended flowering.

From the observations of Carl Maximowicz we know that this species is a native of Siberia. In a report of his observation of the flora of the Amur Region Maximowicz recognized two forms of narrow-leaved *Hemerocallis.* (*Primitiae florae Amurensis. Mém. Acad. Sci. St. Pétersb. Sav. Étrang.* 9: 284-7. 1859). He distinguished them by the length of the scape and pedicel and of the perianth-tube, and also by the color of the flowers. He named the plants with taller scape, paler flower, longer pedicel and elongated perianth-tube slightly enlarged at the base *H. graminea.* (Species with these characters should be *H. minor* Miller.) He named the plants with scape equal the length of the leaves, shortly pedicellate and intensely yellow flower and very short perianth-tube *H. graminea* f. *humilior.* (Plants so characterized should belong to *H. graminea* Andr.) Maximowicz further observed that the geographical distribution of these two species is very distinct. *Hemerocallis minor* occurs in the southern Amur Region, the Sungari River and the Ussuri River areas, while *H. graminea* occurs in the Upper Amur Region and thence westward to the Lake Baikal area.

Fig. 12. *H. graminea* Andr. Redrawn from Andrews *Bot. Rep.* 4: t. 244. 1805.

Fig. 13. *H. lilioasphodelus* (*H. flava*): Plant and inflorescences. From Stout, New York Bot. Gard.

In 1805 Sims (*Bot. Mag.* 22: pl. 873) proposed two elements under the name, *H. graminea*. He further confused the matter by placing *H. minor* Miller in the list of synonyms. In 1930, Bailey was the first person to question the identity of *H. minor* Miller and *H. graminea* Andrews (*Gent. Herb.* 2: 148).

In 1934 Stout (*Jour. N. Y. Bot. Gard.* 35: 5) considered *H. graminea* Andrews a dwarf form of *H. dumortieri,* based upon a plant received in 1926, and interpreted by him to be "a somewhat aberrant plant of *H. dumortieri* or a hybrid with this species as one parent." Leaves of this plant are 15 in. long, scape 1 ft. tall and drooping, in a compact 2- to 3-flowered cluster. It closely resembles *H. dumortieri,* but is more dwarf, and the root is less fleshy. He had crossed it with *H. nana.*

Hemerocallis graminea was described 30 years earlier than *H. dumortieri.* We do not have sufficient evidence to prove that they are biologically identical species. *Hemerocallis graminea* has broad perianth-segments and elongated bracts while the typical *H. dumortieri* has narrow perianth-segments and short bracts. Many specimens of *H. graminea* may exist in gardens that have been misidentified as *H. dumortieri* or *H. middendorffii.*

11. **Hemerocallis hakunensis** Nakai in *Journ. Jap. Bot.* 19: 315. 1943.

Leaves short, keeled, 25-30 in. long, 3/8-5/8 in. wide. Scapes 35-40 in. tall, branched, bearing 6-11 flowers; axis of the branches 3-5 in. long, bracts ovate 1/2-1 1/4 in. long. Flowers orange, tube 7/8-1 in. long; segments 2 1/2-3 in. long, 1/2-5/8 in. wide. Capsules broadly ellipsoid, 1 in. long, 3/4 in. in diameter, the tip with three elevated lobes, horizontally roughened.

Distribution: Native of Mt. Tüsan in South Korea. According to Nakai *H. hakunensis* differs from *H. esculenta* by its ramified inflorescences and ribbed fruits which are distinctly 3-lobed at the apical end.

12. **Hemerocallis lilioasphodelus** Linnaeus emend. Hylander (Fig. 13). *Species Plantarum* 324. 1753. Syn. *H. lilioasphodelus L.* α *flava* L. *l.c.; H. flava* (L.) L. *l.c.* ed. 2, 1762; *H. lutea* Gaertner *Fruct.* 2: 15. 1790.
YELLOW DAYLILY, LEMON DAYLILY, CUSTARD LILY

Foliage mound 30-36 in. in diameter, medium dark green. Roots partly fibrous and partly enlarged into spindle-like storage organs. Rhizomes short, occasionally medium long. Leaves 30 in. long, 7/8 in. wide, ascending-spreading. Scapes slender, stiff, exceeding the foliage, the upper 1/4 branched; bracts lanceolate, the lower ones 1-1 1/2 in. long; pedicels 1/8 in. long. Flowers nocturnal, fragrant, clear lemon-yellow, lasting for 20-67 hours; tube cylindric, about 1 in. long; limb 3-4 in. spread, perianth-segments overlapping. Capsules ovoid-ellipsoid, 3/4-1 1/4 in. long, apiculate with persistent base of style, pericarp often tuberculate, cross-wrinkled when dry. Seeds obovoid to sub-globose (Fig. 9-q).

In 1955, Dress (*Baileya* 3: 107) gave a full justification for the name *H. lilioasphodelus* as the Linnaean type species of the genus, and the earliest legitimate name for the species.

In 1928, Morrison (*USDA Circ.* 42: 8) ob-

served that the height of the scape and the number of flowers on each scape depend on the richness and moisture of the soil. He further added that it is more content in moist soil than *H. minor* and *H. dumortieri.* He also mentioned a stronger growing form with longer flowering season.

Hemerocallis lilioasphodelus has been used extensively in hybridization. A list of hybrids follows:

H. lilioasphodelus × *H.* × *aurantiaca*

'Corona' (Yeld, 1905)—leaves evergreen, coarse. Scape robust, 4 ft. tall. Flowers with a 4 in. spread, uniformly cadmium-yellow or yellow-orange.

'Soudan' (Stout 1932)—late blooming, diurnal. Leaves medium coarse, 2 ft. long. Scape 3 ft. tall. Flowers with a 4½ in. spread, clear empire yellow, gold-glistening. Petals with wavy margin.

'Vesta' (Stout 1929)—compact habit. Scape 30 in. tall. Flowers with a 4½ in. spread, segments broad, overlapping, deep orange with a slight trace of fulvous mid-zone.

'Wau-Bun' (Stout 1929)—a Winnebago Indian name meaning "early morning rising sun." Leaves evergreen. Scape 30 in. tall. Flowers large, segments recurving, folded and twisted, yellow, faintly fulvous. This cultivar and *H.* 'Vesta' show the inflorescence of *H.* × *luteola.*

H. lilioasphodelus × *H. dumortieri*

'Dean William' (Yeld 1906)—flowers orange, somewhat maroon on the back.

'Flame' (Yeld 1906)—flower buds deep maroon, perianth orange-maroon on the back.

'Gold Dust' (Yeld 1906)—early blooming semi-dwarf. Leaves compact, light green erect. Scape stout, stiff. Flower buds reddish yellow, flowers uniformly yellow with a 3 in. spread. In 1935 Stout (*Jour. N. Y. Bot. Gard.* 35: 7) called 'Gold Dust' a hybrid of *H. lilioasphodelus* × *H. nana,* but *H. nana* had not been discovered in 1906 when the cultivar was described.

'Sovereign' (Yeld 1906)—plant 30 in. tall. Scape 1- to 4-flowered. Flowers orange. Pollen sterile.

H. lilioasphodelus × *H. fulva*

'Gold Ball (Mueller 1907)—produced by the Botanical Gardens of Strasbourg University in France; lost in World War I.

'Orange' (Mueller 1910)—flower identical with *H. middendorffii.*

H. lilioasphodelus × *H. middendorffii*

'Apricot' (Yeld 1893)—early blooming, semi-dwarf. Leaves dark green. Scape erect, 30 in. tall, slightly shorter than the leaves. Flowers cadmium-yellow, with spreading segments, fragrant. In 1957 Traub named this cultivar *H.* × *yeldiana* (*Pl. Life* 13: 62) and in 1958 he renamed it *H.* × *yeldara* (*Pl. Life* 14: 59).

'Flavo-citrina' (Christ 1897)—flowers orange.

Fig. 14. a. Flowers of *H. multiflora* for decorative purpose (redrawn from a photograph). From New York Bot. Gard. b. Flowering scape of *H. multiflora* drawn from the type specimen in herbarium of New York Botanical Garden. × ½. c. *H. littorea* (redrawn from Kitamura).

Fig. 15. a. *H.* × *luteola* (redrawn from *Addisonia* plate 485). b. *H. minor.* From Stout, New York Bot. Gard.

Christ's colored plate shows its special characteristics.

H. lilioasphodelus × *H. nana*

'Miniken' (Yeld ex Stout 1934)—plant 30 in. tall, flowers yellow.

'Moidore' (Yeld ex Stout 1934)—plant 30 in. tall. Flowers rich orange.

13. **Hemerocallis littorea** Makino
(Fig. 14-c) in *Jour. Jap. Bot.* 6: 113. 1924.
SEA-SIDE DAYLILY

Roots spindle-shaped. Rhizomes elongated, light yellow. Leaves deep green, 35 in. long, 13/16 in. wide, smooth, firm, with several elevated nerves. Scapes stout, bearing proliferations in the axils of bracts, branched at the tip; bracts ovate to narrowly deltoid-ovate, the lower ones 2 in. long, lanceolate. Flowers few to many, subsessile or with short pedicels about 3/8 in. long; perianth dark orange-red or orange-yellow, 3 1/2-5 in. long, wide-spreading; tube 5/8-1 1/4 in. long; inner segments broad lanceolate, recurving, 13/16 in. wide, with dark brown eye-zone and light median longitudinal lines, margin membranous. Capsules oblong, 13/16-1 1/8 in. long, horizontally ribbed.

Distribution: Meadows near the sea, Kanto District of Honshu and Kyushu, Japan.

Flowers vary greatly in size and color, ranging from dark orange-red to orange-yellow.

Stout in 1941 (*Herbertia* 8: 96) reported two plants of *H. littorea* he had received from Nakai in Japan. Flowers of these plants were pale fulvous, similar to those of *H.* × *aurantiaca* and to plants of the *H. fulva* complex with capsules more typical of *H. fulva* than of *H.* × *aurantiaca.* Stout suggested that *H. littorea* is closely related to *H. fulva.*

14. **Hemerocallis** × **luteola** Jenkins
(Fig. 15-a) in *Garden* 57: 407. 1900.

A hybrid of compact growth, leaves 28 in. high, green until late autumn; leaves 30-36 in. long. Scapes ca. 4 ft. tall, much-branched, bearing 5-8 flowers on the summit of each branch; bracts lanceolate, the lower ones 1 in. long. Flowers clear golden yellow, ca. 7 in. long, with a 6 in. spread, segments recurved. Capsules oblong, 1 1/2 in. long, broadly truncate and notched at the apex, abruptly narrowed at base. Seeds oblong-obovoid, 1/4 in. long, 1/8 in. in diameter, angular.

In 1900 Jenkins reported *H.* × *luteola* as a hybrid of *H.* × *aurantiaca* 'Major' × *H. thunbergii* from a two-year-old plant he saw in the Temple Show, England. In 1903 Mallett (*Garden* 63: 52) gave a detailed description of this hybrid and remarked that it "embraces a very graceful lot of hybrids with broad leaves mid-way between the two parents." He also noted that "the inflorescences vary somewhat, some leaning to *H.* × *aurantiaca* 'Major' others to *H. thunbergii* in the tall imposing stem and pale-coloured

flowers." It was raised by Messrs. Wallace and Son at Colchester in England and distributed in 1900. Also, in 1900, Charles Sprenger of Naples, Italy (*Garden Chron.* III. 34: 122) reported the same hybrid.

In 1930 Stout (*Addisonia* 15: 9, pl. 485) published a colored illustration of this hybrid. He suggested use of 'Luteola' as a clonal name. The above historical review reveals that hybrids of the same parentage and with the same name with only slight variations in morphological characters were introduced by different nurseries about the same time.

Stout also remarked that *H.* × *luteola* sets no seed by its own pollen, but sets seed when pollinated by *H. thunbergii* or *H.* × *aurantiaca*. This hybrid fruited quite freely in the Daylily Demonstration Plot at the Arnold Arboretum.

In 1931 Stout (*Jour. N. Y. Bot. Gard.* 32: 27) reported using *H.* × *luteola* in hybridizing experiments. *H.* 'Cinnabar' (Stout) was a cultivar of *H.* × *luteola* × *H.* × *aurantiaca* with cadmium-yellow flowers, the outer half of the inner segments wine-colored to brownish red. It was distributed by Farr Nursery.

15. **Hemerocallis middendorffii** Trautvetter & Meyer (Fig. 16) in *Middend. Reise* I. 2 (3): 94 (*Fl. Orchst.*) 1856. Amur Daylily, Broad Dwarf Daylily, Middendorff's Daylily

Plant dwarf with many green leaves. Roots fibrous, cylindric, scarcely if at all enlarged. Leaves flat, ½-1 in. wide, smooth, reclined above. Scapes erect, 16-35 in. tall, unbranched; bracts foliaceous, overlapping, shell-like, broad-ovate, 13/16-1 in. long, ¾ in. wide at base, clasping, margin thin and colorless, prominently wrinkled, apex abruptly caudate-apiculate. Flowers deep orange, clear and luminous, almost scentless, cup-shaped with a 3 in. spread; tube ½ in. long; outer segments elliptic, 2¼ in. long, inner segments spathulate, 2½ in. long, at full flowering shortly acute and recurved. Capsules broadly ellipsoid, 1-1¼ in. long, 13/16-1 in. in diameter, corrugated with lateral ridges.

Distribution: Lower Amur Region, Sakhalin, and Hokkaido, Japan. This species was first collected in the Amur Region by Alexander T. von Middendorff and was described by E. R. von Trautvetter and C. A. Meyer of the Botanical Garden at St. Petersburg.

Hemerocallis middendorffii was introduced into cultivation in 1860 by Carl Maximowicz, a young botanist, commissioned to explore the Amur country in 1853.

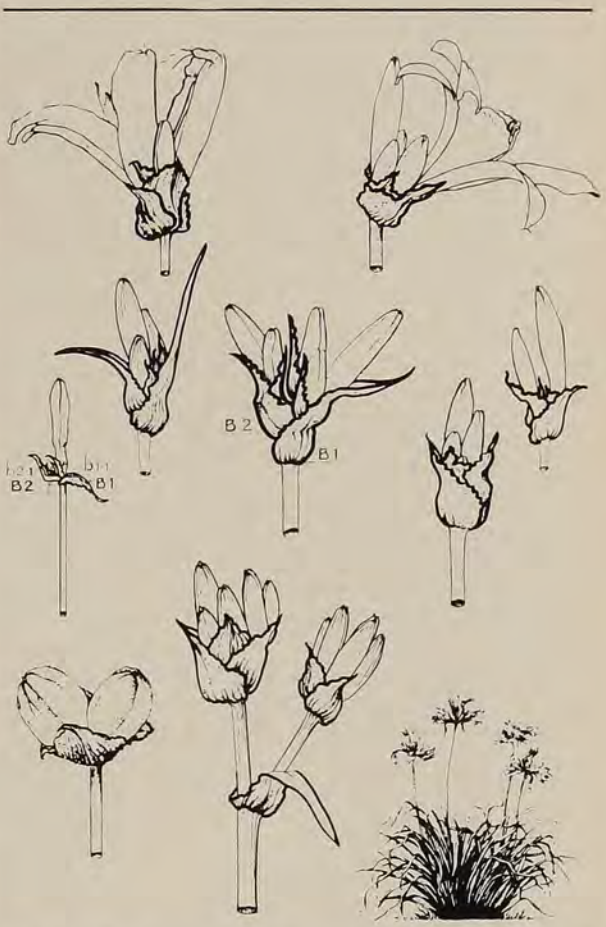


Fig. 16. *H. middendorffii:* Plant and various inflorescences. From Stout, New York Bot. Gard.

In 1866, Regel, then Director of the botanical garden at St. Petersburg, illustrated *H. middendorffii* (*Gartenflora* pl. 522. 1866), based upon a plant introduced by Maximowicz from Amurland. In herbarium specimens, the inflorescences of wild material from Amurland are crowded in a head-like cluster, similar to those depicted in Regel's plate, and it is possible to detect variation in the size of the flowers and bracts.

At the Case Estate of the Arnold Arboretum at Weston, Mass., there is a plant of *H. middendorffii* showing some inflorescences crowded at the top similar to those depicted by Regel's plate, and others with flowers 1½-2 in. below the apical cluster. Some inflorescences of the Arnold Arboretum plant have relatively long bracts. Of

interest also are the flowers which persist on the scape after flowering. The persistent flowers and inflorescence of the Case Estate plant are identical with the plate of *H. graminea* of Andrews (*Bot. Repos.* 4: pl. 244. 1802). The plant depicted by Andrews shows the lower flower subtended by a single lanceolate drooping bract, whereas the plant of *H. middendorffii* at the Case Estate shows the lower flowers on the scapes always subtended by a pair of clasping overlapping bracts.

A form of *H. middendorffii* introduced into British gardens in the 1870's and illustrated in 1887 (*Garden* 31: 280. pl. 589) shows a plant with at least 10 crowded flowers subtended by two overlapping short ovate clasping bracts and flowers with spathulate outer segments well over 1 in wide. A similar form has been introduced to the United States. In 1928 B. Y. Morrison (*USDA Circ.* 42: 1, 6) observed that the 6-10 flowers of *H. middendorffii* are crowded in a head surrounded by conspicuous bracts. In 1934 Stout (*Daylilies* 37) listed *H. middendorffii* 'Major' and remarked that this cultivar is "somewhat more robust and the flowers are more numerous on a scape." The plant grown in Great Britain and the United States with 6-10 flowers in a crowded head may belong to cultivar 'Major'.

In 1934 Stout also mentioned that, "wild plants have been obtained from Japan . . . are somewhat different from the older type in culture. Some have slightly paler flowers; some have taller and more erect scapes. . . ." According to Kawano (*Canad. Jour. Bot.* 39: 667), *H. middendorffii* in Hokkaido grows in marshes and boggy areas and *H. yezoensis*, a species with lemon yellow flowers and long perianth tubes, colonizes on hill-sides. New roads and modern construction have disturbed their natural habitats and brought both species together under conditions favorable for hybrids to be produced. The hybrids of *H. middendorffii* and *H. yezoensis* display a continuous range of variation in flower color from orange to lemon-yellow and in other characters. Perhaps Stout's Japanese introductions were of hybrid origin.

Kawano investigated the chromosome composition of *H. middendorffii* grown in Hokkaido. He discovered two karyotypes among plants from three localities. In some plants two short chromosomes with submedian constrictions have satellites and in other plants chromosomes lack satellites. Kawano concluded that heterogeneity exists in *H. middendorffii* cytologically as well as morphologically.

In 1965 Ohwi (*Fl. Jap.* 292) made the combination *H. middendorffii* var. *esculenta* (Koidz.) Ohwi. In 1964 Kitamura (*Col. III Herb. Pl.*) made the combination *H. dumortieri* var. *middendorffii* (Trautvetter & Meyer) Kitamura.

In my opinion *H. graminea* (1802), *H dumortieri* (1832), *H. middendorffii* (1856), *H. esculenta* (1925), and *H. exaltata* (1934) represent a biological complex and a nomenclatural problem. I believe that no change in name should be made without a thorough understanding of every member of the complex, and the time for such understanding is still in the future.

In 1942 Stout reported (*Jour. N. Y. Bot. Gard.* 43: 242) that plants of *H. middendorffii* from Manchuria were imported and used in hybridization. These gave rise to many dwarf, semi-dwarf and early flowering forms, but Stout did not mention any named clones. The following cultivars were introduced by British breeders:

'Perry Pigmy' (Perry ex Stout 1934)—plants 18 in. tall. Flowers with a 3 in. spread, outer segments orange-yellow tipped green, inner segments orange-brown. Hybrid of *H. middendorffii* × *H. fulva*.

'Rose Queen' (Perry ex Stout, 1934)—leaves 35 in. tall, rather erect. Scapes 45 in. tall. Flowers resemble *H.* 'Europa' but smaller, pale fulvous with yellow-orange throat, striped and with a faint eye-zone. Derived from *H. middendorffii* × *H. fulva* 'Cypriani'.

'Tangerine' (Yeld, 1906)—semi-dwarf, early flowering, 20 in. tall. Scapes branched. Flowers orange, buds tinged with red. Capsules plump, rounded. Hybrid of *H. middendorffii* × *H. dumortieri*.

16. **Hemerocallis micrantha** Nakai
in *Jour. Jap. Bot.* 19: 315. 1943.

Leaves 34 in. long, 1¼ in. wide. Scapes above the foliage, branched near tip, the branches forked, 4-flowered; bracts ovate, long-attenuate, the lower ones 3 in. long, lanceolate. Flowers orange; tube ⅞ in. long, ⅛ in. thick; segments oblanceolate, 1½ in. long, ¼ in. wide, obtuse at the tip.

Distribution: Nakai reported this species from Tyosen, Keinan, Korea. The above description is based on Nakai's publication. I have seen no specimens. The small orange flowers on a branched scape suggests a rela-

tionship with *H. multiflora, H. plicata,* and with the cultivars *H.* 'Thumbelina' (Fischer, 1954), and *H. 'Tinker Bell'* (Stevens, 1955).

17. **Hemerocallis minor** Miller
(Fig. 15-b) *Gard. Dict.* ed. 8. 1768.
DWARF DAYLILY

Plants of low compact growth with the flowers well above the dark green leaves. Roots cord-like, some abruptly enlarged at the apical end, sometimes 5 in. from the pseudobulb. Leaves 15-18 in. long, weakly ascending, ¼-$\frac{5}{16}$ in. wide. Scapes slender, 1½-2 ft. tall, apical end branched, bearing 2-3 (-5) pedicellate flowers. Flowers nearly bell-shaped, fragrant, deep chrome to cadmium-yellow; tube ⅝-1 in. long; perianth-segments 2$\frac{5}{16}$-2½ in. long. Capsules ellipsoid, 1$\frac{5}{16}$ in. long, ½-⅝ in. in diameter. Seeds oblong.

Distribution: Steppes of northern China, Mongolia, e. Siberia, and Korea. The German scientist, Johann Gmelin spent from 1733-1743 in Siberia and documented *H. minor* in its natural habitat for the first time. He observed that the species had tuberous roots and fragrant flowers, and grew in the country east of the Obi River and Ochohodeli to the sea. The plant may have been introduced through a Dr. Heucke, a physician acquaintance of Gmelin in eastern Siberia. Although no published record proves that the introduction of *H. minor* was through this channel, circumstantial evidence seems to indicate the species was introduced through Gmelin's influence. *Hemerocallis minor* made its appearance in British gardens in the middle of the eighteenth century.

As early as 1680 Robert Morison in *Plantarum Historiae* mentioned 'Major' and 'Minor' forms of *H. lilioasphodelus* grown in British gardens. In Miller's first edition of the *Gardeners' Dictionary* (1730) he did not mention this 'Minor' form of yellow daylily. Miller did list this daylily in the third abridged edition of the *Gardeners' Dictionary* published in 1748, four years after Gmelin returned to Germany. In 1763 Miller (*Gard. Dict.* 5th ed. abridged) gave a detailed description of the small *Hemerocallis* which "grows naturally in Siberia, roots smaller than that of the yellow daylily, leaves not so long, half as broad, dark green color, scape 1 ft. tall . . . 2-3 flowered at tip, nearly bell-shaped, shorter pedicel . . . can be propagated by seed." The botanical name *H. minor* was validly published by Miller (*Gard. Dict.* ed. 8) in 1768. From this review we know that Miller definitely described a species from Siberia which had flowered and fruited in the Physic Garden at Chelsea in London.

Hemerocallis minor has extended flowering, which begins the first day between 3 P.M. and 6 P.M. with full flowering extending from 10 P.M.-2 P.M. the second day and completion occurring between 2 A.M. and 11 A.M. the third day. In 1942, Stout observed (*Jour. N. Y. Bot. Gard.* 43: 242) that the breeding behavior and the genetic composition of *H. minor* is close to that of *H. lilioasphodelus.* He mentioned no named clones. The following list includes older cultivars that have *H. minor* as the seed parent:

'Elemense' (Mueller 1903) — stoloniferous. Leaves loose, light green; scapes 3 ft. tall, bearing 10-12 canary-yellow, large, wide open fragrant flowers. Cultivar of *H. minor* × *H. citrina.*

'Francis' (Yeld 1895)—very dwarf. Leaves dark green. Flowers yellow. Cultivar of *H. minor* × *H. middendorffii.*

'Gracilis' (Stout 1933)—plants low. Flowers yellow, early blooming, good for rock gardens.

'Hippeastroides' (Sprenger 1903)—leaves light green, 2 ft. long, recurved. Scapes 2½ ft. tall, bearing 10-12 widely open, fragrant flowers with star-like horizontal, brilliant sulfur-yellow segments. Cultivar of *H. minor* × *H. thunbergii.*

18. **Hemerocallis multiflora** Stout
(Figs. 14-a & b) in *Addisonia* 14: 31. t. 464. 1929.
MANY-FLOWERED DAYLILY

Very floriferous, with compact foliage 15-18 in. high; leaves 30 in. long, ¾ in. wide, arching, wiry, becoming reddish brown in autumn. Scapes slender, 40 in. tall, erect, later bending by the weight of flowers and fruits, the upper half to third repeatedly branched, bearing 75-100 flowers; bracts foliaceous, the lower ones 2 in. long; pedicels ¼-½ in. long. Flowers orange or cadmium-yellow, with a spread of 3 in.; tube ½ in. long; perianth-segments recurving, gold, glistening in strong sunlight, the outer 2 in. long, ½ in. wide, tinged red on the outside, the inner 2$\frac{5}{16}$ in. long ¾ in. wide. Capsules ovoid-oblong or obovoid, barely 1 in. long, ½ in. in diameter. Seeds subglobose-obovoid, ¼ in. in diameter.

Distribution: Ki-kun-shan (Cock Mountain, Long. 114°20'E, Lat. 32°N), Honan Province, China. Fifteen plants were introduced to the New York Botanical Garden by Albert N. Steward in the autumn of 1925. I have seen a herbarium specimen in the New York Botanical Garden collected from Wu-chang, Hupei. Evidently it is common on farms of central China.

In 1943 Nakai described *H. micrantha* from Korea. From the characters given in his description, one judges that the Korean plant is closely related to *H. multiflora.* Another related species, *H. plicata,* occurs in the high mountains of Yunnan and Szechuan.

In 1942 Stout (*Jour. N. Y. Bot. Gard.* 43: 239) listed four cultivars of *H. multiflora,* 'Autumn Prince' (Stout), 'Boutonniere' (Stout), 'Hiawatha' (Stout), and 'Port' (Stout), but without descriptions. In the 1957 checklist, 'Autumn Prince' was listed as a hybrid of *H. altissima* × *thunbergii.*

Fig. 17. a. Plant of *H. nana* showing enlarged roots and unbranched scape with bract and solitary flower. × ½. b. Plant of *H. plicata* showing enlarged roots, folded leaves, branched scape, small flowers. × ½.

Other cultivars of *H. multiflora* are as follows:

'August Pioneer' (Stout 1939)—robust plant with scapes 34 in. tall, extending above the foliage. Flowers diurnal, 3½ in. across, chrome-orange, flushed fulvous over the outer half of the inner segments. Derived from *H. multiflora* × unnamed hybrid. Distributed by Farr Nursery in 1939.

'Thumbelina' (Fischer 1954)—leaves 60-80 in. tall. Leaves wiry, 18 in. long, ⅝ in. wide. Scapes 15-18 in. tall, branched near the top, bearing 7-10 flowers, bracts 1 in. long. Flowers small with spreading segments, uniformly orange, 2 in. long. Capsules small, oblong, ½-¾ in. long, ¼-⅜ in. in diameter.

'Tinker Bell' (Stevens 1955)—leaves arching, 16-18 in. long, 5/16-⅞ in wide. Scapes 10-24 in. tall, the short ones bearing 7-10 flowers in abbreviated subhead-like branches (Fig. 7-l), the tall ones branched repeatedly from the middle upward, bearing numerous flowers, proliferations 1 to several. Flowers orange, subsessile or pedicellate, 2½ in. long. Flowering June-October in Boston.

19. **Hemerocallis nana** W. W. Smith & Forrest (Fig. 17-a) in *Notes Bot. Gard. Edin.* 10: 39. 1916.
DWARF DAYLILY

Dwarf plant with a compact habit. Roots cord-like, club- or spindle-shaped at the apex. Leaves somewhat sword-shaped, ascending, 5-14 in. long, ¼-½ in. wide. Scapes 6-10 in. tall, bracteate, the bracts 1-2⅜ in. below the solitary flowers, ½-1½ in. long, rarely shorter, when in pairs the upper smaller one may subtend pedicels 1-2⅜ in. long, with abortive flower buds. Flowers orange to reddish brown outside; tubes short, ⅜-⅝ in. long; perianth-segments narrow and spreading, with a spidery appearance; outer segments lanceolate, 2½ in. long, ⅜ in. wide, inner segments slightly wider, 2¾ in. long, ½ in. wide.

Distribution: High mountains of western Yunnan, China. First collected by George Forrest in July 1913, at an altitude of 9,000-10,000 ft., on the Yangtze Bend (Long. 100°E, Lat. 27°45'N). In 1914, Camillo Schneider collected it about 25 miles northeast of this locality. In 1939 K. M. Feng collected it in association with pine forests on the eastern flank of the Haba Snow

Range. These collections show plants with solitary flowers. In 1934 Stout (*Daylilies* 1) remarked that in the dwarf habit and the flower characters, *H. nana* resembles *H. dumortieri,* but is less robust, and with less conspicuous bracts. Morphologically and phytogeographically, *H. nana* and *H. forrestii* seem to be closely related. They differ chiefly in the number of flowers per scape.

In 1941, Stout (*Herbertia* 8: 97), reported that *H. nana* had been crossed with *H. dumortieri* and *H. minor* reciprocally, and with *H. lilioasphodelus* and *H. middendorffii* as a pollen parent. All F_1 hybrids were sterile due to abortive pollen and egg abortion. When *H. nana* was used as a pollen parent in crosses with *H.* × *aurantiaca, H. citrina, H. exaltata,* and *H. fulva,* no seed was obtained.

The only named cultivar of *H. nana* as a seed parent is *H.* 'Nada' (Stout 1934). This hybrid is a dwarf form about 1 ft. high with a rather large flower, with a 4½ in. spread, rich morocco red and claret brown, blooming in June and early July; it sets no seeds.

According to Stout, *H. nana* and *H. forrestii* are not hardy in New York City.

20. **Hemerocallis pedicellata** Nakai in *Bot. Mag. Tokyo* 46: 117. 1932.

Leaves 30-35 in. long, ⅜-¾ in. wide. Scape 25 in. tall, 5/16 in. in diameter; bracts lanceolate or ovate, 1⅜-1¼ in. long, membranous; pedicels 1⅜-1⅞ in. long. Flowers red-orange; tube ⅜-1 in. long, segments lanceolate, 3 5/16-3¾ in. long.

Distribution: Known only from the original collection by H. Hara at Chikahora, Sakhalin. It has not been mentioned in recent floristic works. The above characters are taken from Nakai's original description.

21. **Hemerocallis plicata** Stapf (Fig. 17-b) in *Bot. Mag.* t. 8968. 1923.

A very distinct species with cord-like roots, spindle-shaped at the apex. Leaves 3½-15 in. long, usually conduplicate (folded), ¼-⅜ in. wide, the outer ones of a ramet recurved. Scapes 9-21 in. tall, the uppermost part irregularly branched bearing 5-11 flowers; bracts ovate-lanceolate, ¼-⅞ in. long, inconspicuous; pedicels ¼-⅞ in. long. Flowers orange-yellow, trumpet-shaped, tubes ½-⅝ in. long; perianth 2¼-2½ in. long; segments 1¾-1⅞ in. long. Capsules oblong, ¾ in. long, ⅜ in. wide, tip truncate and sharp-pointed.

Distribution: Subalpine forests and alpine meadows of southwestern and western China. First described from collections of A. Henry and George Forrest from Yunnan. Later its range has been extended from western Yunnan northward to western Szechuan and Kansu. It is very likely to occur in Khasia in northern India.

Hermerocallis plicata may be recognized by its small trumpet-shaped orange flowers with perianth-segments hyaline along the margin. Its true relationship is with *H. multiflora* from which it differs by its low stature and small number of flowers. The two specimens examined by Stapf have folded leaves but we know this is not a stable and distinctive character for the species. Plants of *H. plicata* from alpine meadows in western China obtained from areas periodically burned over to facilitate searching and digging of the valuable bulbs and roots of medicinal plants, and those collected from areas with very thin top soil, have folded leaves and often with the lower portion of the fans buried in the burnt stumps. Specimens collected from the edge of subalpine forests or places with rich top soil have normally arching leaves up to 30 in. long.

22. **Hemerocallis thunbergii** Barr emend. Baker (Fig. 18) in *Garden* 4: 132. 1873; *Gard. Chron.* III. 8: 94. 1890.
THUNBERG'S DAYLILY, LATE-YELLOW DAYLILY

Plants with compact growth habit, the ramet multiplies by suberect branches. Leaves dark green, forming a mound about 35 in. high; rather slender, ¼-¾ in. wide, ascending and arching. Scapes slender, stiffly erect, (20-) 40-45 in. tall, the apical ¼ branched, bearing 4-20 flowers; bracts linear-lanceolate, dilated at the base, the lower ones up to 3 in. long; pedicels ½-¾ in. long. Flowers nocturnal, lemon-yellow with a greenish throat, fragrant; tubes ½-1½ in. long, green; with a 3-4 in. spread; outer segments oblanceolate, obtuse and slightly pouched at the tip; inner segments subspathulate, 1⅜-1⅛ in. wide, obtuse and slightly notched at the apex. Capsules obovoid, 1-1½ in. long, ⅞ in. in diameter, truncate and notched at the rounded tip, abruptly narrowed at the base. Seeds ellipsoid, ¼ in. long.

Distribution: Native of North China and Japan, and extensively cultivated in Europe and America. The authorship of the species

Fig. 18. *H. thunbergii* in New York Botanical Garden raised from Chinese and Japanese seeds. From a painting, New York Bot. Gard.

long has been credited to Baker who published a detailed description for it in 1890 (*Gard. Chron.* III 8: 94). By this date the epithet *H. thunbergii* is antedated by *H. serotina* Focke (*Abhandl. Natur. Ver. Bremen* 10: 158. 1889) by one year. Bailey in 1930 pointed out this fact and he adopted *H. serotina* as the correct name for the species. He was followed by a few hybridizers of the 1930's. However, Peter Barr in 1873 validly published *H. thunbergii* with a short but sufficiently effective description to validate the specific epithet. His description was, ". . . plant . . . 3 ft. high," the flowers "clear beautiful yellow," and the source apparently developed in Kew."

Obscurity surrounds the origin of *H. thunbergii,* and its route into cultivation at the Royal Botanic Gardens, Kew. Baker's statement, "I believe that it comes from the mountains of Japan" seems to indicate that he might have been told of the importation of the plant from the Far East by members of the Garden Department at Kew.

In 1929 Stout (*Addisonia* 14: 21) recorded that seeds of *H. thunbergii* were sent to him by Albert N. Steward from Nanking, and by Henry N. White who saw "thousands growing wild all over North China." From these importations he had raised more than one hundred plants. These plants were rather uniform in the color of the flower, in the general character of the capsule, and in having tall branching scapes. But the segments of the flowers varied greatly in shape, in size and in width. None were better as garden plants than the clone of the species described by Baker . . . In the size and the fullness of flowers, in the relative height of leaves and scapes, and in general appearance . . ." Stout had a plate skillfully and artfully made showing the color of the flowers and the variation in the structure of the inflorescences and the size of the flowers of his Chinese and Japanese acquisitions of *H. thunbergii.* The lower left hand portion of the plate is cut off, perhaps for the illustration of *H. thunbergii* in *Addisonia.* The figure in the lower center represents a plant from Japan.

Nakai in 1932 (*Bot. Mag. Tokyo* 46: 121) published *H. sulphurea* on the basis of a plant cultivated in the Botanical Garden of the University of Tokyo. In 1943, Stout (*Herbertia* 9: 105) compared it with *H. thunbergii.* The characters of *H. sulphurea* given in Nakai's description of the species are within the limits of morphological variation in *H. thunbergii.* Like *H. serotina* Focke, *H. sulphurea* Nakai becomes a superfluous name.

In 1941, H. Hara (*Jour. Jap. Bot.* 17: 127) published *H. vespertina* for a nocturnal daylily native of Japan. I have very carefully compared the characters and the measurements of the plant described in his publication with those of *H. thunbergii* in our gardens and found no morphological nor physiological basis for retaining *H. vespertina* as a distinct species. *Hemerocallis thunbergii* is the accepted name for the species in North China, Korea, and Japan with a nocturnal blooming habit, large trumpet-shaped yellow flowers with a greenish throat.

Hemerocallis thunbergii has semi-extended flowering. The flowers open between 2 P.M. and 10 P.M. and close between 1 P.M. and 10 P.M. the next day. This species has been used extensively in hybridization. In 1903 Charles Sprenger (*Gard. Chron.* III. 34: 122) reported on reciprocal crosses he made between *H. thunbergii* and *H. citrina, H.* × *aurantiaca,* and *H. minor* 'Crocea'. Stout used *H. thunbergii* in his hybridization experiments (*Herbertia* 9: 161. 1942). In 1900 Jenkins (*Garden* 57: 407) in a report on some good hardy plants at the Temple Show in England, included *H.* ×

luteola (*H.* × *aurantiaca* 'Major' × *H. thunbergii*) as a novelty in the show.

According to Stout, the pollen of *H. thunbergii* is highly fertile. The species produces fruits and seeds readily in certain crosses. About one-third of all the flowers cross-pollinated yielded capsules bearing 1-8 seeds. The time for optimum growth of the pollen tube is 5-8 hours after flowering. The most fruitful crosses made by Stout were *H. thunbergii* × *H.* × *aurantiaca*. The named cultivars are listed alphabetically after the pollen parents:

H. thunbergii × *H.* × *aurantiaca*

'Chrysolite' (Yeld 1906)—flowers large, pale yellow.

'Halo' (Yeld 1906)—petals broad with a halo around the center.

H. thunbergii × *H.* × *aurantiaca* 'Major'

'Parthenope' (Sprenger 1903)—leaves 2 ft. long, narrow. Scapes slender, with many foliaceous bracts and 10-16 canary yellow, fragrant flowers. Fertile clone.

H. thunbergii × *H. citrina*

'Baroni' (Sprenger 1903)—leaves 2 ft. long, pink near the base. Flowers nocturnal, canary yellow, fragrant, tube green.

'Mulleri' (Sprenger 1903)—leaves narrow; scapes 2 ft. tall, somewhat angular, bearing 15 large canary-yellow fragrant nocturnal flowers with greenish yellow tubes.

'Ochroleuca' (Sprenger 1903)—scapes 2-3 ft. tall, much-branched. Flowers sulphur yellow, nocturnal, fragrant.

'Thelma Perry' (Perry 1926)—leaves erect. Scapes 3½ ft. tall, bearing 15-20 nocturnal flowers.

H. thunbergii × *H. fulva* 'Cypriani'

'George Yeld' (Perry ex Stout 1934)—flowers large with a 6 in. spread, pale fulvous.

H. thunbergii × *H. minor*

'Vomerense' (Sprenger 1903)—leaves 2 ft. long, very narrow, light green. Scapes 2 ft. tall, bearing 8-10 fragrant canary-yellow flowers deeply shaded on the outside. Fertile clone.

23. **Hemerocallis yezoensis** Hara in *Jour. Jap. Bot.* 14: 250. 1937.

Roots cord-like, thick. Leaves up to 30 in. long. ¼-⅞ in. wide, erect and recurved at the tip. Scapes 17-34 in. tall, bearing 4-12 flowers; bracts lanceolate, 2½ in. long, upper ones ovate-cordate. Flowers lemon-yellow, slightly fragrant, with a 2¾-4 in. spread; tube ⅞-1¼ in. long, greenish yellow, rarely brownish purple; perianth-segments 2⅜-3$\frac{5}{16}$ in. long, recurved; the outer segments oblanceolate, ½-⅞ in. wide, the inner segments obovate-oblong, ⅝-1¼ in. wide. Capsules oblong, rugose. Seeds ¼ in. long.

Distribution: Hokkaido, Japan.

Hara in his description of *H. yezoensis* remarked that it is closely related to *H. thunbergii*. He noted that the wild plant was exceedingly variable in the width of the leaves, size of the flowers, and shape of the capsules. In 1961 Kawano (*Canad. Jour. Bot.* 39: 667) observed that *H. yezoensis* hybridized readily with *H. middendorffii* in nature. He also found two karyotypes representing plants from different populations. Morphologically the characters given in Hara's description would seem to be within the limits of variation of *H. lilioasphodelus*. Ohwi in his *Flora of Japan* (1965) listed *H. yezoensis* next to *H. vespertina* (*H. thunbergii* in the present account). I have seen no specimens of this species.

EXCLUDED SPECIES

Hemerocallis alba (Andr. *Bot. Repos.* 3: t. 194. 1801) = *Hosta plantaginea* (Lam.) Ascherson

H. albomarginata Hort. ex Vilm. (*Fl. Pl. Terr.* ed. 1. 366. 1865) = *Hosta lancifolia* var. *albomarginata* (Hooker) Stearn

H. caerulea Andr. (*Bot. Repos.* 1: 6. 1797) = *Hosta ventricosa* (Salisb.) Stearn

H. chinensis Hort. ex Steud. (*Nom.* ed. 2. 1: 1821) = *Hosta glauca* (Miq.) Stearn

H. cordifolia Thunb. (*Fl. Jap.* 143. 1784) = *Cardiocrinum* (*Lilium*) *cordatum* (Thunb.) Makino

H. japonica Thunb. (*Fl. Jap.* 142. 1784) = *Hosta lancifolia* (Thunb.) Engler (1888).

H. japonica Thunb. (*Transc. Linn. Soc.* 2: 335. 1794) = *Hosta glauca* (Miq.) Stearn (1931).

H. japonica Redouté (*Les Liliacées* 1: t. 3. 1802) = *Hosta plantaginea* (Lam.) Ascherson

H. lancifolia Thunb. (*Trans. Linn. Soc.* 2: 335. 1794) = *Hosta lancifolia* (Thunb.) Engler

H. liliastrum L. (*Sp. Pl.* 324. 1753) = *Paradisea liliastrum* (L.) Bertol. (1839)

H. plantaginea Lam. (*Encycl.* 3: 103. 1789) = *Hosta plantaginea* (Lam.) Ascherson (1863).

H. sieboldiana Lodd. (*Bot. Cab.* t. 186. 1832) = *Hosta glauca* (Miq.) Stearn

H. speciosa Sweet (*Hort. Brit.* ed. 2. 516. 1830) = *Hymenocallis speciosa* (Salisb.)

H. undulata (Sieb.) Bailey = *Hosta undulata* (Sieb.) Bailey

Plate No.		Photo credit
9.	**R. B. Whitehead Garden,** Valdosta, Ga.	Dr. John Engle
	Walter Schroer Garden, Valdosta, Ga.	Joseph Janey Steinmetz by permission of *The Reader's Digest*
10.	**White Coral** (Fischer 1965)—dormant; scapes 32"; flower 6".	Ben Parry
	Bess Ross (Claar 1964)—dormant; scapes 36"; flower 6"; *Stout Medal 1962.*	Ben Parry
	Annie Welch (Claar 1964)—dormant; scapes 24"; flower 6"; *J.C. 1963; H.M. 1966.*	Ben Parry
11.	**Queen Eleanor** (Peck 1967)—tetraploid; dormant; scapes 32-34"; flower 5½".	Ben Parry
	Bonnie Barbara Allen (Peck 1967)—tetraploid; dormant; scapes 26-28"; flower 5½-6".	Sam Caldwell
12.	**Double Joy** (Wheeler 1967)—evergreen; scapes 28"; flower 6".	Mrs. Ben Wheeler
	Double Kisses (Wheeler 1967)—evergreen; scapes 26"; flower 5".	Mrs. Ben Wheeler
	Balls of Red (Miles 1964)—dormant; scapes 29"; small-flowered 4½".	James F. Miles
13.	**Ava Michelle** (Flory 1961—semi-evergreen; scapes 18"; flower 6"; *J.C. 1960; A.M. 1965.*	R. W. Schlumpf
	Blue Grass Hemerocallis Society Show Arrangement, Lexington, Ky.	Scotty Parry
	Dining Room Arrangement, by Mrs. Leonard Mederer, Valdosta, Ga. by permission of *The Reader's Digest*	Joseph Janey Steinmetz
14.	**Valdosta Hemerocallis Society Show Arrangements,** Valdosta, Ga.	Scotty Parry
	Blue Grass Hemerocallis Society Show Arrangements, Lexington, Ky.	Scotty Parry
15.	**Sail On** (Claar 1965)—dormant; scapes 32-36"; flower 5½";*H.M. 1967.*	Ben Parry
	Red Rhythm (Claar 1968)—dormant; scapes 28"; flower 6½".	Ben Parry
16.	**Prairie Satan** (Marsh 1967)—semi-evergreen; scapes 26-30"; flower 6½-7".	James Marsh
	Liberty (Claar 1965)—dormant; scapes 26-28"; flower 6½".	Ben Parry

R. B. Whitehead Garden

Walter Schroer Garden

White Coral

Bess Ross

Annie Welch

Queen Eleanor

Bonnie Barbara Allen

Plate 12

Double Joy

Double Kisses

Balls of Red

Ava Michelle

Blue Grass Arrangement

Dining Room Arrangement

Valdosta Show Arrangements

Blue Grass Show Arrangements

Sail On

Red Rhythm

Prairie Satan

Liberty

—3—

Developmental Anatomy and Physiology in Daylily

PAUL D. VOTH, ROBERT A. GRIESBACH, and JOHN R. YEAGER

Vegetative Plant Body

Daylily plants are comprised of fans, or *ramets,* consisting of an underground thickened stem, roots, rhizomes, leaves, and flowering-scapes. Variations occur in the shape, function, position, and seasonality of the stem itself and of all its parts. Concepts involved in the development, perpetuation, and reproduction of a ramet as well as the production of a flowering-scape and the eventual development of seeds are discussed. Requirements for growth and reproduction of representative plants of *Hemerocallis* are also discussed.

In garden parlance, each fan or ramet consists of a crown which produces leaves above and roots below. The crown, as gardeners call it, is an underground stem which is being slowly pulled into the ground by contractile roots. Other names for this stem are vegetative stem, rootstock, and pseudobulb. Figure 1 represents, somewhat diagrammatically, portions of a well-established plant in late summer which had leaves nearly three feet high with a loss of at least five leaves between May 1 and August 1 through aging and decay. The same plant had 12 more leaves, one of which had just emerged and at least 12 very immature leaves hidden in the bud. Furthermore, new leaves were in the process of forming within the depressed pit at the apex of the stem or pseudobulb. In the garden new leaves appear throughout the growing season at somewhat longer than weekly intervals until cooler weather and shorter days retard the elongation of young ones and the initiation of new ones. This decreasing activity presages winter; it may not even occur in evergreen daylilies. Closely associated leaves in all stages of development constitute a bud which is insulated by the remanants of outer leaves and which if cold-adapted survives the winter; leaves of these buds emerge in spring through the old leaf bases of the previous season. This spring emergence of leaves often is rapid, because young leaves have been initiated and largely differentiated perhaps eight months earlier. In the spring months enlargement of cell and new growth in basal tissues takes place.

Aging leaves wither and finally die to the base. Plant cells located at the crown (the juncture of stem and leaf) develop thick walls, tinted in colors from tan to a rich brown, depending upon age and clone. These cells function simultaneously as an abscission layer and as a protective covering resembling cork. Such cells mature gradually over a period of time rather than being formed by a true abscission layer or cork cambium as in broad-leaved plants.

Leaf scars where the old leaves died off are readily visible in daylilies; they form the wrinkled outer surface of the underground stem, or rootstock (Fig. 1). With a hand-lens the scars of *vascular bundles* (conducting strands for water and nutrients) are plainly visible within each encircling leaf scar. Bases of former leaves are placed so compactly that virtually no space exists between them; the stem has produced leaves but has not elongated visibly. A cabbage head has these characteristics in a less extreme form.

The interior of the stem is shown by a longitudinal section made in the plane

of the shortest diameter of the stem and therefore 90° from the plane of the midribs of the two-ranked leaves (Fig. 1). In many clones the central area of the stem (stippled in the drawing) is strikingly pink in color and filled with cut ends of contorted vascular bundles surrounded by thin-walled, living cells (*parenchyma*). These conducting bundles are more-or-less continuous from the smallest root to the tip of the leaf but are concentrated as a network of supply lines in the central parts of the stem (the *stele*). Small bundles extend through the outer region, or *cortex*, of the stem, enter the base of the leaf and continue with very little branching or diminution to the leaf-tip.

Roots. Roots originate at the outer rim of the stele which is buried rather deeply in the stem (Fig. 1, A); a mass of conducting bundles from the stele extends into all new roots. New roots are initiated by midsummer; the one at A in Figure 1 is at its maximum diameter and will grow forward at its tip which is covered by the protective root cap. It has not yet digested and forced its way through the cortex but from all indications it will emerge later in the season. Judging from the number of roots produced in the past two seasons by this plant, eight new ones will emerge before next sping, neatly spaced and all on the same circumference. The root, B and C, represents what A soon will be and what units D plus E were a year ago. During vigorous growth, a root is nearly white but its external layers soon shade into cream and eventually into tan. In most species and cultivars, the end, E, enlarges to form the familiar fleshy daylily root with its crisp interior. In some clones roots do not enlarge; such plants are said to have a fibrous ("thread" or "cord-like") root system. All roots described to this point come from the stem.

Another kind of root, noted at F, also begins its development in internal tissues but, in this instance, from the fleshy portion of the large root. It is a *secondary* root. Two to five such roots may be produced near its front end and scattered ones may arise in other positions on the fleshy root; small roots may also form on the non-swollen part. Branching is a conspicuous feature of the small roots which, because of their number and distribution, are essential to normal growth of the plant. Recovery of a ramet after transplanting involves the re-establishment of roots, especially the fine ones. Fortunately they are produced quickly.

Absorption of water and mineral nutrients in solution is, obviously, one of the main functions of roots in all plants. These substances are passed through tubes consisting of cell units specialized for this task. The same pathways are also involved in the movement of growth-regulating substances (chemicals) throughout the plant, whether they are formed by it or applied externally by man. Tissues which conduct water as well as those specialized for the translocation of food, are adequately illustrated and discussed in standard botany texts.

Root hairs are scarce on large roots in mid-summer. They have been observed in an immature condition in a narrow zone about 7 mm back of the root tip of one clone. Roots taken from several cultivars growing under a variety of nutrient conditions, have been examined microscopically but fail to show a single root hair. However, a large colony of 'Europa' growing near the city of Oregon in northwestern Illinois, produced root hairs copiously. Most roots in daylily plants are also encased in a mantle consisting of loose cells and very fine filaments. The latter may be mycorrhiza or fungi, known to be associated with many higher plants as an aid in absorption.

A neat physiological problem remains unsolved in roots possessing few root hairs. The efficiency of *Hemerocallis* with respect to water uptake and outgo must be high but neither rates of transpiration nor absorptive capacity of roots have been determined. It has long been known that water can enter the roots of several kinds of trees even though their root cells are suberized (corky).

The daylily plant is anchored by an

Fig. 1. Diagrammatic and simplified longitudinal section of the base of a daylily ramet in the summer of its second season. The junction of leaf bases and rootstock (stem) constitutes the crown. Origin and development of stem and roots and their internal organization is shown. A, young root growing through cortex of stem. B, base and C, end of a vigorously growing adventitious root. D, base and E, enlarged end of a root which resembled B and C a year ago. Ridges on D indicate its contractile nature. F, secondary roots, here arising from a fleshy root. Additional features are labeled.

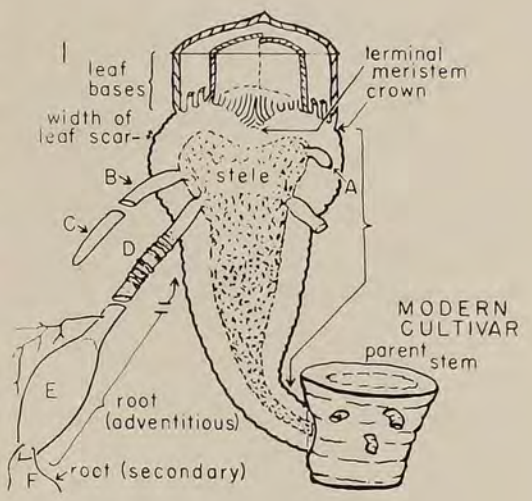


Fig. 2. Rhizome, identified by scales and elongated internodes, arising from parent stem. A root has arisen from internal tissues on opposite side.

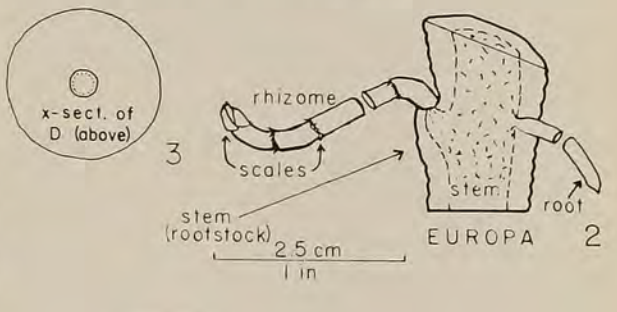


Fig. 3-4. Internal views of roots; inner circles of dots denote groups of water-conducting tissues. Fig. 3, cross-section of D in fig. 1 between ridges. Fig. 4, cross-section of E in fig. 1; A, a water-storing parenchyma cell of cortex; B, secondary root which originated in outer layer of stele.

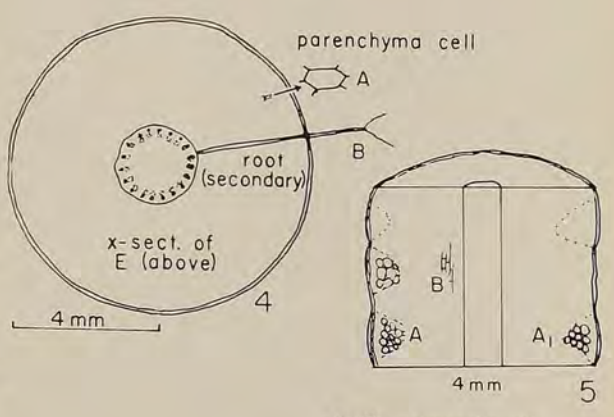
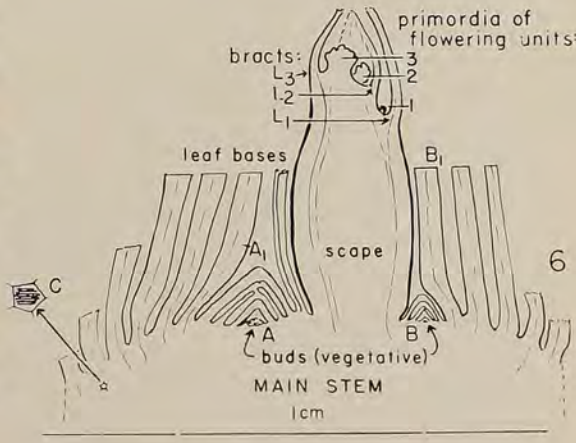


Fig. 5. Portion of contractile root (D in fig. 1) in longitudinal section. A and A_1, parts of one ring of cells whose enlargement accounts for the contraction of the root. B, smaller, compact cells in remainder of cortex.

Fig. 6. Stem and leaf bases in early spring condition seen in longitudinal section. Scape, initiated months earlier, now appears to be the apex of the plant. Inflorescence units, 1 to 3, are associated with bracts L_1 to L_3, respectively (see mature condition in fig. 11). Flowering would have begun within 6 weeks. Growing region A is associated with leaf A_1. Young bud at B belongs to B_1. Lack of leaves of intermediate size in A and B denotes that both buds have been relatively dormant. C, tightly packed crystals which occur in isolated cells of leaves, stems and roots at various times of the year.



expansive root system. The ramet in Figure 1 possessed 16 vigorous roots and at least 10 others in various stages of aging. Secondary roots exceeded 100; roots arising in turn from secondary roots were not counted. Transplanted ramets require time to re-establish at least a small portion of such a root system so as to resist contraction and expansion of the surrounding soil during freezing weather. Perceptive gardeners soon learn that local weather, exposure, site, soil and subsoil characteristics affect the growth of roots and adjust their latest planting dates accordingly. If transplanted at least six weeks before winter sets in, carefully mulched ramets and seedlings can be expected to survive in the North; personal care must compensate for an inadequately developed root system.

Storage of water and food is another important function of roots; the large laterals obviously have the largest storage capacity (Figs. 3, 4). Persons familiar with enlarged roots in plants other than daylilies, naturally expect visible storage products, such as starch, to be present in the fleshy root of *Hemerocallis*. This, however, is not the case. Thin cross sections of roots, viewed microscopically, reveal liquid-filled cells in a beautiful hexagonal arrangement; only thin layers of living substance line their cell walls (Fig. 4A). Water storage in roots must have been a factor during the evolution within the genus *Hemerocallis;* the ability to store water accounts for drought-hardy qualities of present-day cultivars. With adequate water, a root system consisting of many long and relatively thin fibrous roots and many laterals results in a plant that flowers more efficiently (including the re-blooming kinds) than where enlarged root growth occurs at the expense of continued longitudinal growth. Even though water predominates it would be instructive to determine the amounts of mineral nutrients and soluble foods which could be extracted from roots of daylily.

Large roots which have gone through a season of dormancy when they are inactive often develop transverse ridges at fairly regular intervals giving them a wrinkled appearance (D, Fig. 1). Cells in the cortex of first-season and of ridged roots are nearly alike in size except that in the older roots much larger cells are characteristic of the bulging area. (A to A_1, Fig. 5). These larger cells resemble loosely-placed balls and do not fit into a compact tissue as in other parts of the root. Presumably they have not increased in number; three-dimensionally they form a collar, located inside the circumference of the root. It is assumed that these cells have developed high internal pressures because of regulatory changes in membranes and cell walls. They have not, however, crushed their neighbors; instead they have expanded into the soil. This lateral expansion has created a contractile pull above and below which tends to shorten the roots. Successive zones of enlarging cells compound the contraction which is known to occur in more than 400 species of plants; Wilson and Honey (1966) and Chan (1952) show that in hyacinth and narcissus, cells of the inner cortex account for contraction in these plants. In narcissus the contraction is as much as 8 mm in five weeks. That daylily plants do not rise vertically as much as the upward growth of the stem would suggest, can be verified by driving a metal stake deeply into the ground adjacent to a vigorously-growing ramet; yearly measurements of height of stake and crown, compared with known rates of stem elongation of nearby plants of the same clone show that plants are actually being "pulled" into the ground. Root contraction is made possible only by active expansion of living cells in a specified area of the root. In this manner a unique additional function is performed by certain roots.

Root tips of *Hemerocallis* resemble those of onion and lily which are illustrated in biology and botany texts, but both cells and chromosomes are smaller in the daylily. In roots of certain onions, cell divisions occur most frequently near noon and at midnight. Such a periodicity in *Hemerocallis* is unknown to the present authors.

As seen in Figures 1 and 4, both adventitious and secondary roots arise from internal tissues. Cells in this position belong to layer III of Dermen (1960), Arisumi (1964), and other authors. A root-tip count of 44 chromosomes (or a reasonable approximation) may be considered as proof that the massive inner layers of the stem are tetraploid.

The weight of a freshly-dug root system approximates that of living leaves of the plant. In a medium-sized ramet, the weight of the root system and leaves were both found to be 40 grams. If all small roots could be recovered from the soil, the root system would outweigh the foliage. On an average an underground stem weighs two to five grams.

Leaves. Leaves are the most conspicuous component of a Hemerocallis plant in its vegetative phase. Bracts on a flowering stalk or scape, scales of a rhizome (underground running stem as in 'Europa', Fig. 2), and the cotyledon in a seed (Fig. 7) are modified leaves but their main function is not the manufacture of food; they will be discussed later. Despite their prosaic appearance, foliage leaves are unexpectedly intricate in their development and structure.

The green leaves of seedling and adult daylily plants are surprisingly uniform in structure at comparable ages and seasons and also in their two-ranked arrangement. Location of leaves and the alternating position of midribs of successive leaves by 180° is evident in the top of Figure 1; the geometry of leaf origin is difficult to visualize in a mature stem wherein cell divisions which give rise to leaf primordia (beginnings of leaves) occur in a concavity (Fig. 1). Ridges of cells around this depression continue to divide more or less at the same time. These ridges, or leaf primordia, grow and differentiate into leaves. The region where most of this activity takes place is said to have "meristematic," or actively dividing cells. The depression results when more cells differentiate and enlarge into leaf primordia than into new tissues of the stem itself.

It is easiest to study the origin of leaves in an embryo. Figure 7 is a cross-section of a daylily seed in which seed coats and most of the endosperm (the nutritive material within the seed) have been omitted. The cut was made at a level where five leaves are visible; the summit of the stem is central. Obviously the stem tip must be higher than the level at which the leaves are attached; leaves are clearly separate one from another. Here and in young daylily plants, as well as in most species of plants, the stem tip is conical rather than concave as in the mature daylily.

The youngest leaf (Fig. 7) in the embryo is V-shaped in cross section; inner surfaces of successively older leaves come closer together and actually touch each other before they emerge into the sunlight. Furthermore, the edges of leaves soon overlap as they do in the oldest leaf in this illustration. A seedling-leaf as well as any subsequent leaf initially is a mere sliver of green substance rising vertically and unfolding as it elongates.

A very young leaf (Fig. 7) already possesses a midrib and several semi-transparent areas which are immature veins—vascular bundles with their associated fibers. Tissues of a very young leaf are not completely formed which means that many cell divisions occur as the leaf continues to grow. It must also be remembered that such leaf sections represent the tip of the leaf and that a cross section of the leaf taken from the mid-region would not necessarily have the same number of veins. A maximum of 13 vein areas are present in Figure 7, whereas slices taken slightly below the tip of the leaf may have as many as 19. Even in leaves as diverse in size as *H. minor* and 'Bess Ross', vein number ranges between 15 and 28 at mid-point. Generally the midsection has a few more veins than the base. The number of veins in perianth-segments approximates those found in leaves.

The number of cells in a single row from tip to base is much smaller in the immature than in the mature leaf. New cells are added to the base of a leaf over a period of weeks; in leaves that overwinter in an immature state, the time

span is several months. The effect of climate may leave its mark on such leaves in the form of stubby tips. Among semi-evergreen clones grown outside their optimal range, corky fissures often develop on over-wintered leaves.

A half-grown leaf of daylily cannot be divided into distinct blade, petiole, and base regions. On the basis of comparative anatomy, Agnes Arber (1925) has interpreted the entire leaf of *Hemerocallis* to be only a leaf base. Common usage is so deeply engrained, however, that the green, expanded portion of the daylily leaf is referred to as the "blade" while the lower, cylindric part is designated as a "base." Distinctions are unclear and delineations between these two regions depend more on environment than on anatomy.

When a ramet is sectioned vertically, the base of an emerging leaf is seen to be trumpet-shaped, whereas the same region in a nearly mature leaf is a straight cylinder with a slit on one side. When the leaf is completely mature it is slightly smaller in circumference at the region of attachment than at higher levels (Fig. 1). This condition is inevitable because as new tissues form and successive leaves enlarge, lateral expansion of leaf bases results in extreme compaction. Tremendous pressures are exerted in leaf bases which function as a major means of support for the ramet; without these pressures, leaves of daylilies would sprawl. Lower portions of mature leaf bases do not manufacture food nor do they develop many functional stomata.

Unless careful measurements are made, an emerging leaf appears to grow slowly, but as many gardeners have observed, a newly transplanted ramet in which all leaves have been cut back drastically, may project an inner leaf as much as 1 cm (2/5 in.) above adjacent leaves in one night.

Young leaves may be greener than older ones even though they still are partially hidden in the concentric mass of older leaf bases. Rays of the sun can reach the young ones more readily than the basal portions of older leaves which are shaded by over-arching blades.

In northern climates a leaf initiated in August, for example, may not expand before winter nor be fully productive in food manufacture until the following March or April. Depending upon climatic conditions, such a leaf may be functional into the following summer until senescence overtakes it. Thus, some leaves may have a life-span of almost one year. Others naturally originate at other times of the year and have correspondingly different periods of growth.

Veins of dead leaves resist decay for months so that a tangled mass of coarse matted fibers persists at the plant base like burlap. Such matted fibers serve as a mulch in protecting the crown and roots in winter and preventing drying in summer.

First-year seedlings as well as recently transplanted divisions with all old leaf bases removed are less likely to have "spring sickness" than well-established clumps, in the experience of Griesbach. Matted fibers surrounding the lower portion of a ramet after the old leaf bases have decayed presumably function to protect the living leaves when the ground freezes. More important is the condition of the living leaves and the growing point at the time of a heavy fall frost. If transplanting stimulates the expansion of leaf primordia into full-grown leaves along with the production of many new roots and the initiation of new leaf primordia, the ramet may be susceptible to frost damage or even to winter-killing. When food reserves have been depleted by rapid growth, ice crystals may form in many cells, thus killing them. When stored foods are present and the metabolism of the plant has been adjusted to a cool environment, damage from freezing rarely occurs.

As is well known, basal growth of a leaf continues for some time after its tip has emerged. Dissection of a half-expanded leaf shows actively dividing cells at its base. This basal zone of cell activity is responsible for most of the leaf growth; growth may even be hastened when above-ground portions of leaves are accidentally cut off.

Old injured leaves begin to age within

a few days and new ones emerge from the center of the ramet with amazing rapidity. Yet in the normal aging process, new leaves may not emerge for days or weeks. Everyone who trims leaf bases to within a few millimeters of the stem apex in preparation for colchicine treatment will have seen these relationships between leaves of different ages.

Inner organization of a daylily leaf may be predicted, in part, by external features. Surfaces of the leaves are far from smooth when viewed with a hand lens. Longitudinal ridges correspond to major veins which lie beneath them; these alternate with smaller veins (Fig. 8). Therefore, the number of veins in a leaf is approximately twice the number of ridges which can be felt by touch or seen with reflected light; in most daylily cultivars the veins protrude more prominently on the lower side.

Cells of the upper epidermis, a cell layer under the cuticle, are less elongated and larger than those of the lower epidermis. Keel-like ridges (Fig. 10) protrude from cells of the lower epidermis and when the leaf is sectioned transversely, the ridge appears as a small tooth (A in Fig. 9). When stained with certain dyes, the ridge appears to consist mainly of cutin, the waxy substance of the cuticle. The edge of a leaf consists of a single layer of colorless cells arranged to form a miniature saw-tooth contour around the entire blade. The cuticle covers both surfaces of the leaf except where stomata are located. The two bean-shaped guard cells (Fig. 10) bulge under internal pressures to open the stomata.

Stomata are rarely found in the upper epidermis although prepared slides of a few cultivars seem to show them. For comparing stomate sizes of diploid (22 chromosome) and tetraploid (44 chromosome) daylilies, Arisumi (1965) and other workers measure not only the length of the stomate but also both ends of the guard cells to obtain the maximum dimension.

Gases such as carbon dioxide, oxygen, and water vapor enter the plant or are given off through the stomata. Carbon dioxide which enters the stomata (small amounts of carbon dioxide are also available within the plant as the result of respiration of living cells) and water which reaches the leaf in vascular bundles are combined in chloroplast-containing cells in the presence of light. As a result of this photosynthetic process food is manufactured and oxygen given off. If the oxygen concentration is greater inside the plant than outside, this gas will tend to diffuse outward; stomata are the main gateways for such diffusion. Conversely, at night when no photosynthesis occurs, oxygen enters the plant and is involved (as the terminal acceptor of hydrogen in the formation of water) with the oxidation of food. This process of aerobic respiration is the means whereby energy (originally stored within the food) is made available for the continued welfare of every living cell of the plant. Thus, at night gas exchange is the reverse of what it is during the day. It must be remembered that in daylight hours, respiration as well as photosynthesis occurs simultaneously in all cells containing chloroplasts and that all nongreen cells respire as well. It is unlikely that carbon dioxide produced by respiration in a root cell will travel the length of the root and through the stem to reach the leaf and be used in photosynthesis; it probably will diffuse into the soil instead. It is plain that stomata are the main diffusion route for gases but that other avenues are also present.

Water in the form of vapor is lost through transpiration when stomates are open. Transpiration is a continual drain on the water reserves of the plant. It must not be assumed that stomates are always open during the day and always closed during the night. Exact data for *Hemerocallis* appear to be lacking. Diverse patterns of stomatal closing during the day as well as in the night have been recorded for most crop plants. It is also known that in many plants stomates open and remain open during wilting. Stomatal behavior in daylilies must be determined by careful study, since it is difficult to know when leaves of daylily are wilted. Strongly reinforced veins, fluting of leaves and ridge reinforcements on cells of the lower epidermis

all prevent daylily leaves from drooping. Fortunately, *Hemerocallis* is fairly drought-resistant and water-conservant; witness the abiliy of ramets to survive for weeks in a non-moist condition when shipped "dry." Even though daylily leaves do not immediately reflect internal water deficiency in the form of wilting, ultimately the effects of water loss are manifest through yellowing, and even death of foliage. The oldest leaves of a ramet are the first to turn yellow.

If all thin-walled cells in a leaf of *Hemerocallis* could be destroyed (as by retting) the remaining structures would resemble long parallel hallways with few if any "doors" between. The roof and floor would be the upper and lower epidermis, respectively, and the wide walls would be the veins (or *fibro-vascular bundles*). Slits in the floor would be the numerous stomates. If this Lilliputian allegory is abandoned and the two-dimensional drawings (Fig. 8, 9) are consulted, additional structural and functional details become evident.

Most of a vein consists of thick-walled cells which are slightly pointed and are parallel to the long axis of the leaf; each vein consists of an "I-beam" which gives great rigidity to the expanded leaf. In larger veins this beam reaches both the upper and lower epidermis; in smaller veins, thin-walled cells occur between the thick-walled fibers and the epidermis.

Within the compact fibro-vascular bundle, are located two tissues of great functional significance: (1) the *phloem,* which occupies the lower portion of the transport system. Function of the phloem concerns principally the conduction of organic substances, including foods and certain plant hormones. The *sieve tubes,* consisting of series of elongated cells (sieve-tube elements) arranged end to end, constitute the conduit through which organic substances move. (2) the *xylem,* which occupies the upper portion of the fibro-vascular bundle. At the completion of cellular differentiation the xylem tissue consists of a series of non-living cylindrical segments, intimately arranged end to end; it is within these structures, the *vessels,* that much of the mass movement of water and minerals occurs. Additional non-living cells with non-perforated end walls, the *tracheids,* also participate in conduction. Thin-walled cells occur among the conducting elements of both phloem and xylem. Branched veins, and the conducting tissues contained within them are of rare occurrence in leaves of daylily hence the leaves of daylily are parallel-veined.

In old daylily leaves, a cell-free, nearly rectangular region is found midway between nearly every pair of larger veins (Fig. 9); in effect, it is an open channel running the length of the leaf. Inspection of younger leaves reveals that this was not a channel originally; large, thin-walled parenchyma cells occupy these regions. Water-storage appears to be their initial function but in the literature scant attention is given to the existence of this tissue. It is assumed here that these channels contain not only water but many substances derived from the dissolution of the thin-walled cells. Such compounds, in solution, could be important in controlling water loss from leaves.

The remaining cells of the leaf, not yet discussed, are mainly thin-walled and of two classes: (1) those with colored plastids and (2) those without colored plastids. The latter may form a sheet of two to four cells in depth adjoining both the upper and lower epidermis. The plastid-bearing cells may form cell layers three to eight cells deep surrounding the channels of large, thin-walled, water-storing cells just described. These *chlorenchyma* cells are polyhedral in shape, scarcely elongated (in contrast to the cylindrical "palisade" cells of many broad-leaved plants) and compactly placed.

Leaves of true albino seedlings generally lack all plastids and survive only as long as food reserves from the seed endosperm are available. Efforts to "feed" such plants with various sugars and amino acids prolong life for only short periods. Such albino plants often absorb foods with difficulty, are light-sensitive, and under ordinary conditions are at-

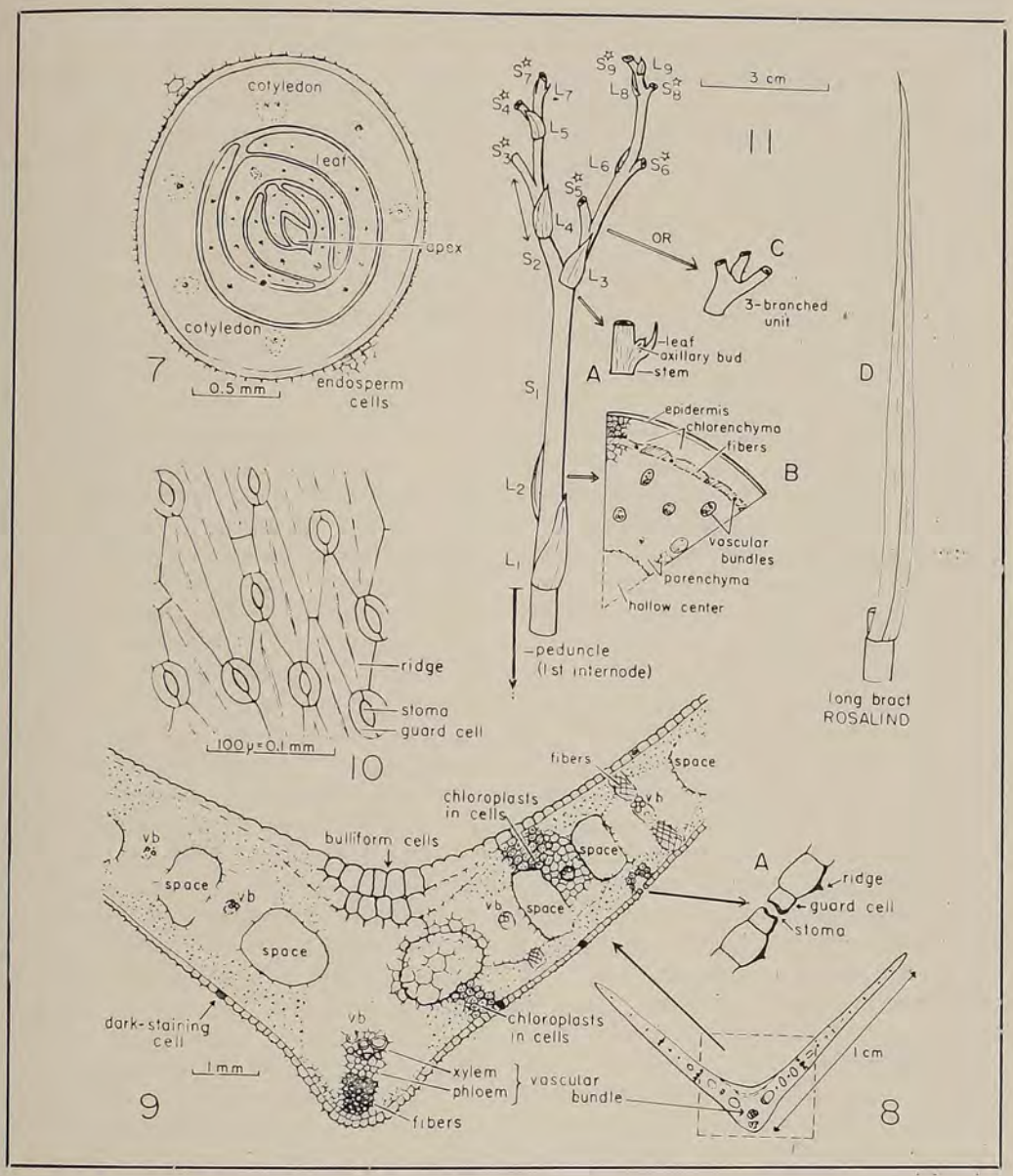


Fig. 7. Cross section of an embryo at level of "apex" in figure 28. Four foliage leaves are present.

Fig. 8. Cross-section of a leaf a part of which is enlarged in figure 9.

Fig. 9. Leaf in cross-section in midrib region. A, stoma in cross-section; vb = vascular bundle.

Fig. 10. Stoma on lower epidermis of leaf, in surface view. Ridge is seen in cross-section in A, figure 9.

Fig. 11. Inflorescence, after flowering. L = bract, S = stem ending in a flower, numerical subscripts denote sequence of development. A, bud produced in axil (angle) of bract-leaf; B, cross-section of scape; C, 3-way fork produced by some flowering branches; D, long bract produced by some cultivars.

tacked by many kinds of bacteria and molds which penetrate the albino daylily seedling and soon kill it.

Albino seedlings are of common occurrence in some daylily crosses. Those with yellowed foliage are lacking in the usual amount of chlorophyll. Voth and Simon (unpubl.) found that seedlings from selfed (pistils pollinated with pollen of the same cultivar) 'V42' plants often bore light green leaves which did not become dark green with added mineral nutrients. (Hereafter the code number, 'V42', will be used to designate an unnamed seedling derived from 'Felice' × 'Dorothy McDade' by P. D. Voth in 1948.) Pigment analyses showed that both chlorophyll a and b were present but no quantitative determinations were made. Seedlings in which photosynthetic pigments are inadequate often do not survive beyond the first flush of leaf expansion.

Of considerable interest are the "bulliform" or large thin-walled cells, located on the upper side of the leaf in the midrib region of *Hemerocallis* (Fig. 9). As the bulliform cells enlarge it is believed the two halves of the leaf change from V-shaped to flat. This change occurs gradually as the young leaf emerges between older ones. Bulliform cells also store water.

Distantly-spaced epidermal cells in different cultivars are filled with a homogeneous substance resembling mucilage and/or tannins. These deposits also occur in other cells of the leaf and in the scape. The perianth of many daylilies also contains mucilage cells. Chemical tests must be undertaken to determine their nature.

Non-foliage leaves such as bracts, scales, and flower parts are discussed separately.

Stems. The mature vegetative underground stem (not to be confused with the flowering scape) is top-shaped and develops a shallow depression on its upper end from which successive leaves arise (Figs. 1, 6). Not only is the underground stem the sole source of leaves and of buds which grow into new vegetatively-produced plants; the stem also gives rise to all major roots and to the flowering-stem as well. *Hemerocallis* possesses a stem which approaches immortality as closely as any vegetative structure among higher plants. In other words, *Hemerocallis* is a perennial plant.

One tissue not found in leaves forms a several-layered cylinder of thin-walled cells, the *pericycle,* which comprises the outer boundary of the stele (Fig. 1). The roots originate from this layer.

A striking feature of a vegetative stem of daylily is the mass of conducting strands crowded into the stele. Only by using dyes or radioactive tracers would it be possible to follow even a single bundle in this region from its origin to its end. Because bundles in the stem are scattered no pith is identifiable, in contrast to the condition found in roots (Fig. 3, 4). Epidermis of the rootstock, or underground stem, may consist of only a ring of cells, located between compactly placed leaf bases or leaf scars.

Of unknown value to daylilies are the groups of needle-shaped, calcium oxalate crystals, called *raphides* (Fig. 6C) which fill isolated cells in all organs, but particularly in the leaf-bearing stem.

Flower-bearing scapes of daylily are green and possess stomata and manufacture food as do the leaves. The scattered vascular bundles (Fig. 11B) in the scapes continue for long distances without much branching; cells between bundles consist of parenchyma, thin-walled, living cells. Underlying the hairless epidermis, supporting fibers are common.

Within the bud of the seedling in Figure 6, a massive central column, the embryonic scape, has started with all the subunits of the inflorescence in the axils of bracts. The drawing was made from a longitudinal section of a plant early in May, and the first flower of a comparable ramet opened in the third week in June. Later on Dec. 10 every large ramet from the same clump had flower buds slightly smaller than the one in Figure 6. Several other cultivars also had initiated flower buds. Thus in the North flower buds may be initiated at least

seven months before flowering in many cultivars.

Stout (1941) illustrates axillary as well as terminal origins of scapes; this is also shown in the current illustration. This does not prove, however, that the apex of the stem actually did become the scape. The growing point to the left (A in Fig. 6) could be the real apex which has been displaced to the left by the vigorous development of the young scape. When the change from a vegetative to a reproductive (flowering) bud has been thoroughly studied this question may be settled. The only known publication on this subject is by J. M. Shull (1942). One of his seedlings, only 18 months of age and of the running type, had initiated a scape by late October as shown by the removal of 21 leaves. Shull also reported that clump-type plants generally do not possess the beginnings of a scape in October and that great variability exists in the time of such initiation.

Irrespective of the ultimate origin of the scape, it becomes a well differentiated structure in some daylilies by early spring, hidden among leaf bases until rising temperatures and longer days induce it to elongate several centimeters per day until it towers above the mass of foliage leaves. The time of initiation of the inflorescence and the flowering units of *Hemerocallis* still need to be determined.

The two growing points, A and B, in figure 6 are located in the axils of leaves A_1 and B_1, respectively The leaf in both places appears dome-shaped because of its trumpet-shaped base, as explained in the previous section. It is notable that a great disparity in size, and presumably in age, exists between leaf A_1 and the next youngest leaf of A; the contrast is even more striking in bud B. It is assumed that the younger leaves were initiated near the time of origin of the scape.

Some cultivars of daylily have the capacity to produce more than one scape in fairly rapid succession; 'Surprise Package' (Fay) often gives rise to two scapes with the earlier one slightly more robust than the second. When compared to daylilies that flower but once a year, reblooming or remontant cultivars apparently are able to initiate flower buds and develop flowering stems over a broader range of environmental stimuli.

The factors which initiate the development of a scape may be assumed to have also set in motion conditions which favored initiation of bud B. Stated differently, "sexual" reproduction here seems to be associated with "asexual," or vegetative reproduction, as in *Iris*.

In some cultivars of *Hemerocallis* the asexual reproductive rate is eight to one; as many as eight new ramets may emerge from a parent ramet which produced only one scape that year. Each new ramet may produce a scape the following year, making it appear that one ramet produced several scapes. Close inspection and dissection will show that a "tuft" of ramets exists and only one scape per terminal growing point is produced.

In the very old clone 'Europa', successive buds give rise to rhizomes and also plants which in turn become independent ramets; this may have occurred 5000 times or more during the past several centuries since its origin. Clumps of 'Europa' are scattered on every major continent and island, all derived originally from a single ramet. Griesbach (unpubl.) demonstrated that ramets of this clone, covered with more than 1 meter (39.37 in.) of soil, produced long rhizomes and emerged from the top of the heap to give rise to healthy plants. Cultivars and seedlings which tend to branch as does 'Europa' are discarded because of their mixing in the nursery by means of long rhizomes.

Infrequency of actively growing axillary buds (Fig. 6) accounts for the characteristic contour of a ramet. If the stem produced such a bud with every leaf, a ramet would no longer remain a fan; it could well become a touseled tuft of foliage. Obviously, if few buds were produced the plant would be slow to propagate.

An advantage of cutting a ramet longitudinally when propagating is to separate buds several months earlier than under natural conditions, so that com-

petition between them would be lessened.

Although the leaves of a ramet are two-ranked (distichous), succeeding ones shift slightly, suggesting a gentle helix (spiral), at least in recently transplanted, rapidly growing fans; this indicates that the stem tends to rotate the plane of newly produced leaves by a few degrees. Additional beauty of form is achieved when the ramet emerges from the soil at a slight angle to break the rigid bifacial plane of the two-ranked pattern.

Inflorescence

All daylilies are able to produce more than one flower on each flowering stalk. The nature of the scape or inflorescence of *Hemerocallis* has been defined and discussed by Goebel (1931), Stout (1941), and Rickett (1944). An illustrative model (Fig. 11A), drawn to scale from *H. fulva* var. *rosea* 'Rosalind', is presented here. With certain modifications and expansions, which every gardener can visualize, it may be applied to all species as well as to modern cultivars.

The long leafless scape, part of which in Figure 11 is hidden in the crown, may reach a height of more than three feet to L_1. The scape contrasts sharply with the underground stem, in which successive leaves rest on each other (Fig. 1). The ratio of distance between these corresponding stem portions may be 1000:1 or even greater.

Branches may arise from the flowerstalk wherever leaf-like bracts or smaller bracteoles occur (L_1, L_2), and at points higher in the inflorescence. Flowers of *Hemerocallis* are always produced in sequence, the terminal flower first, followed by the next lower flower bud. Even if branches had been produced at L_1 and/or L_2 the first flower to open probably would be much higher at S_3.

The production of more than one or two flowers on a scape depends on the ability of the lead-stem to produce one or more lateral branches. Thus 'Rosalind', under ideal growing conditions, produces some vigorous scapes which initiate branches at L_1 and L_2; 'August Prince' consistently develops at least two such branch systems. At a higher level in the inflorescence the axis at the left (from S_2 to S_7) as well as at the right (from L_3 to S_9) is made up of branch units which develop in a zig-zag fashion. Each inflorescence unit ends when the axillary bud fails to produce a small branch as at L_7 and L_9.

In the inflorescence of many genera of plants a flower is produced first at a point comparable to S_2 followed by single flowers on the two branches which emerge later at L_1 and at L_2. Such an inflorescence is called a *dichasium* and is the ancestral type from which the *Hemerocallis* inflorescence was derived.

The daylily inflorescence is called a *bostryx* or modified helicoid cyme so that the right- or left-hand branch is the more vigorous. In tetraploids, especially induced ones, a tendency exists for branches of the inflorescence to be shorter than in the diploid of the same clone.

Now to complete the analysis of Figure 11. The position of the bract L_3 clearly shows that the right member of the "wish-bone" is the lateral branch which was produced by the main stem (left) even though the stem may lean away from the vertical more than its branch. At first glance this may seem to be an equal forking (or dichotomy) but basically it is no different than node and internode relations on most plants (inset A, Fig. 11). During the course of growth of the left or main stem, another bracteole was produced at L_4, but the branch did not separate from its parent; the two are confluent for the distance indicated by the double-headed arrow. This failure to separate occurs in many plant species. Little skill is needed to judge that the main stem continues to S_3 and that the flower faced left.

Ordinarily, at least on vegetative stems, an alternation of leaf and branch positions would dictate that S_4* should deviate in its position so that it and successive units describe a spiral. As is obvious, the spiral is modified so that the flowers tend to be facing outward only. Despite this development, flowers can be interpreted to arise in a spiral

which justifies the helicoid (from helix) characterization of this cyme. The tendency to produce flowers in only one direction continues to the top of this portion of the inflorescence. An aborted bud is hidden by L_7. Because segments of the main stem always terminate in flowers and because the production of additional flowers occurs only when short branches continue to be formed, failure of the bud at L_7 obviously puts an end to flowering in this unit of the inflorescence.

Structures in the right branch of the fork grossly resemble those which have been discussed. Technically, the right branch was produced from an axillary bud at L_3, but branching seems to have occurred a little higher up without benefit of a bract. A tiny one may be hidden by the larger bract but even if none is present the forking can be explained by massive growth in which one side of the axis grows more rapidly than the other. Finally, the instability of this particular region of the axis is illustrated by numerous examples of three instead of two stem units arising here (inset B, Fig. 11). The development of additional branches at this juncture accounts for higher flower numbers in several cultivars and radically alters the general appearance of the entire inflorescence. As illustrated, the right portion of the inflorescence produced one more flower than its mate; this is common. The largest increase in flower number, however, can be expected from sites such as L_1 or L_2; 'Autumn Prince' (Stout) is an example. Also shown in Figure 11 is a bract of 'Rosalind' which may elongate to 290 mm. Comments on its occurrence in various clones have appeared in the literature.

As Stout (1941) has pointed out, a synchronization of flowering often occurs between different units of each flower stalk so that nearly every scape may produce, during the height of flowering, at least one flower every day. Weather conditions, however, may accelerate or retard the development of flower buds to alter the predicted date on which a particular bud opens.

Failure of partially developed flower buds to reach maturity is one of the most exasperating characteristics of many daylily clones. Drought, overcrowding, thrips, genetic background, mineral nutrient supply deficiencies, and many other factors have been blamed. Buds generally fail when their pedicels, or flower stalks are smaller in diameter than neighboring units. Before being shed prematurely a flower bud usually loses color. No simple remedies for bud fall have been evolved.

Flower

As the flower scape emerges from the cluster of leaves, the two bracts L_1 and L_2 (Fig. 11) are visible; if these bracts are short and stubby, at least one flower bud will also be seen. In about a week most of the flower buds in the inflorescence are distinguishable and gradations in size are striking. Elongation accelerates with age. In daylily seedling 'V42' growing in the greenhouse at moderate summer temperatures and with humidity partially controlled, 10-mm-long buds grew only 2 mm, whereas 30-mm buds almost doubled their length in four days. At *anthesis,* or flower-opening, the bud is fully 50 percent longer than it was only 30 hours earlier.

Parts of the flower and their relationships are so well known that definitions are almost superfluous; yet in the interest of uniformity and to establish points of reference, basic relations are reviewed. A flower is essentially a branch in which some leaves are specialized for reproduction rather than photosynthesis. The occurrence of "leaves" implies the presence of a stem portion, the *receptacle,* from which all flower parts originate. In *Hemerocallis,* as illustrated in Figures 12 and 15, the basal portion of the flower consists of the *perianth tube* from which three outer perianth-segments ("sepals") and the three inner perianth segments ("petals") emerge (Fig. 13). The so-called sepals and petals of daylily flowers and of many other members of the lily family, e.g., tulip, hyacinth, lily, are not easily distinguished as separate and distinct organs.

For this reason most authorities agree it is better to drop the terms sepals and petal for many members of the lily and amaryllis families.

Stamens (collectively anthers and filaments) associated with outer lobes are shorter than those opposite the inner lobes. An anther terminates each filament; the two lobes of each anther are united with the filament for about half their distance. Anthers are illustrated in Figure 15. Filaments curve gently upward and the anthers face toward the open throat of the flower (introrse). Filament-bases are not spaced equally as they emerge from the top of the perianth-tube because of the bilateral symmetry of the daylily flower. Invariably the two filaments which are uppermost as the flower opens diverge from each other so that a "gap" in the ring of filament-bases is apparent. This is caused entirely by the sidewise bending of the filament; when the filament is plucked from the flower it is always attached along the midline of the respective "sepal" or "petal" no matter how much the filament bends. The moment when the uppermost filaments perceive the stimulus of gravity is not known. In half-grown buds the arching and downward bending is not readily evident but in a full-blown flower the geotropic response imparts a pleasing bilateral symmetry. A critical observer may easily detect how much the photographer has inclined or rotated his camera in "framing" the flower for photographing.

Developmental aspects of a flower bud and flower. The ratio between the length of the perianth-tube and of "sepal" segments need not be constant from the youngest, easily visible bud, to the fully mature one. In many clones the tube and the "sepals" in very young buds are nearly equal in length but the segments grow at a faster rate than the tube as development continues. For example, long tubes account for more than 40 percent of the total bud-length of *H. citrina* and 'Rosalind'. By contrast, several early-flowering species and other diploids which tend to be trumpet-shaped, as well as many tetraploids, develop tubes constituting less than 30 percent of the bud-length.

In a few clones, anthocyanin develops in the outer (in open flowers the lower) epidermis of the "sepals" as the flower bud matures. This is novel because, as can be verified by field observations, anthocyanins typically concentrate in the upper (morphologically inner) epidermis. Despite the underlying green pigments, the bronzed color of such flower buds in considered desirable by many daylily fanciers.

In mature flower buds, some evidence of the ultimate hue develops along "sepal" folds midway between its tip and its region of attachment; but the gradually exposed areas may not approach the final color in quality until just before the flower opens. The "sepal" surface visible in the bud stage is not the surface seen when looking into an open flower. Colors of inward-facing surfaces do not reach full development as long as the bud is even partially open. When a bud is forced open a day before flowering the lackluster of all coloration disappoints every observer who has a mental image of a full-blown flower.

Several species, notably *H. citrina,* as well as many cultivars, exude much nectar from the upper segment portion of the flower bud. In the greenhouse, nectar collected from clone 'V42' was found to be extremely rich in reducing sugars. Other sugars may be present and further analyses for other natural compounds are needed. Out-of-doors this nectar is washed away by rains or harvested by insects. It is an indirect but important factor in thrip injury as recorded by Stout (1944) and others. Such damage is often more noticeable on flower buds than on scapes because the insects force their way between bracts and young flower buds where they can exert greater leverage. In microslides of injured buds prepared by Dr. Leroy Kavaljian, the outer epidermis of "sepals" and perianth-tube had been torn away by the rasping mouth-parts of these thrips. Additional cell layers are often damaged which also stain deeply indicating profound chemical changes.

Scurfy, gray scar tissues eventually develop. Thrips attack only young tissues in which cell division and cell enlargement has not been completed. Undamaged cells divide, enlarge and divide again whereas damaged cells may not divide and enlarge to the same extent. Mechanical relationships can be compared to a latex balloon on one side of which a strip of latex has been cemented. When inflated, the side with the thicker wall expands less than the untreated side; the analogy to a deformed bud and flower of *Hemerocallis* is obvious. Buds with much damage are shed prematurely; they obviously undergo profound functional changes as well as anatomical ones.

If measurements are made on the outside of a bud two days before opening and again on the day of opening, it becomes plain that the exposed part of the "sepal" expands laterally by approximately 30 percent. Expansion of the infolded margin of the sepal may be estimated by cutting across a bud two days before flowering and comparing its measurements with those of the margin of a freshly expanded flower; increase in width of this part is nearly 100 percent. Expansion of "petals" is more spectacular and more complicated than that of "sepals," especially in modern cultivars which develop very wide floral parts. In most of the latter, "petals" expand twice their width in the final 24 hrs. before opening. This is a greater degree of change than in other flower parts.

Owing to the smaller circumference they occupy in the bud and their naturally greater width, "petal" margins overlap each other as much as 50 percent (Fig. 13). Toward the tip, there is an increasing tendency of the margins to curl inward, and this infolding may also become more pronounced as the day of opening approaches. Viewed in cross-section, the "petals" overlap so that the left half overlaps the right half of the adjacent one (convoluted). Frequently one "petal" will overlap both adjacent "petals."

Microscopic examination is essential in determining the cause of the remarkable expansion of organs of daylilies in the last days before opening. Cell division is absent at this stage of development so that enlargement of individual cells is responsible for the changes. At the subcellular level a tremendous surge of chemical changes must take place to account for the many changes. The familiar mushiness of day-old flowers indicates that many processes need to be investigated before the physiology of this flower is fully understood.

Fragrance and internal nectar. Some daylily cultivars in the yellow-orange color range, produce fragrant flowers; but only a few are fragrant with visible anthocyanins. Fragrance is manifest only in open daylily flowers. Strips of "sepals" and "petals," torn from the flower, demonstrate that scent is widely distributed on the inner surface of these segments. Fragrance varies qualitatively and quantitatively in flowers of daylily clones; *H. citrina* has the most penetrating and persistent fragrance, resembling that of the fruit of limes and/or lemons. Breeders know that fragrance is a quality which is readily lost in certain crosses. Nothing further seems to be known about this subject in *Hemerocallis.*

When the perianth-tube of a daylily is broken off at its base and placed in the mouth of an observer, a varying amount of palatable nectar can be withdrawn. It has the same degree of sweetness as the external nectar of "sepal segments" of daylily buds. The source of this exudate has not been determined nor its composition analyzed.

Evidence of profound changes during growth and expansion of a flower bud: Keen observers of flower-bud development probably have their own record of elongation of buds of their favorite clones. For some experimentalists this knowledge is important because it may indicate an approximate date on which treatments should begin in an effort to retain double sets of chromosomes in pollen. If this can be done successfully with chemicals or by other means, such

pollen could be employed in the pollination of tetraploids.

Direct observation under the microscope of squashed anthers is the only certain way to determine the time of reduction division (meiosis). In daylily, it is very difficult to see reduction divisions, as well as the subsequent cell divisions of the ovule, which eventually yield the egg and the primary endosperm nucleus. By making observations of the contents of temporarily stained anthers from very young buds of various lengths, it is possible to predict the time of reduction division, with some confidence. Such prior exploration will permit intensive experimentation during the few days when this important event occurs.

Symmetry of rotation in the flower. In several *Hemerocallis* species, in 'Rosalind', and in many other cultivars, especially those that are oriented horizontally, a "petal" is located uppermost and its opposing "sepal" lowermost; the other segments alternate to form the pleasing floral pattern. However, in the more highly prized cultivars of today, many of the flowers are rotated so that a "petal" is situated lowermost and projects forward as well. Thus, the flower is rotated about 60° from the "wild" type. *Hemerocallis citrina* represents a type in which roughly 25 percent of the flowers are rotated so that a "petal" is uppermost, 25 percent have a "sepal" in that position and 50 percent are intermediate; the latter rotated only 30° from the assumed original state. It would be of interest to determine how constant such observations are on different days and years and in different gardens. To make comparisons valid, the degree and direction of branching of the scape must also be recorded and included in the interpretation.

When the lowermost segment is a slightly more prominent "petal," the flower is considered to be bilaterally symmetrical e.g., the right and left halves are mirror images of each other. A trend toward this form seems to find favor with many daylily fanciers. Bilateral symmetry is strongly expressed in the orientation of the basal portions of the free filaments in all daylily flowers as was discussed earlier.

Variations from the normal flower form. Occasionally one observes daylily flowers that possess only two instead of three "sepals," with comparable reduction or increase in the number of other flower parts. More frequently, however, there occurs an increase to four in the number of floral parts. Kraus (1953), Stout (1957), and Otis (1960) discuss the problems of flower variation in a summary of their experiments. In a cultivar, such as 'Kwanso' and related clones with "double" flowers as well as in some cultivars with petaloid stamens, there is really no question about the deviation having a genetic basis. However, many cultivars consistently, although not invariably, produce flowers that vary under different circumstances. Compared with vegetative organs of a plant, floral traits are usually thought to be less susceptible to environmental modification. In some cases, though, plants are susceptible to modification by environmental variations during the course of growth and development. Modifications may reflect the intake of minerals, food, and hormones, as well as external factors of temperature, light, moisture, and soil. Some growers welcome daylily clones that are consistent in producing extra floral parts. Insofar as there is a tendency for certain cultivars to produce extra parts occasionally, such plants are used by breeders in hope of eventually obtaining seedlings that always produce extra flower parts.

1. *Extra parts in each whorl.* In some diploid and a few tetraploid clones the first flower to open has four "sepals" and corresponding increases in "petals," stamens, and carpels. In a given season, flowers with parts in 4's are fairly common at various locations on the inflorescence, but with different climatic conditions the same clump may produce none or only a few such flowers the following year. The pattern for the entire flower is laid down while the inflorescence is still hidden in leaf bases. For unknown rea-

sons, a pattern of four instead of three is begun and this type of "unusual" flower results. No cultural treatments are known which assure the production of such flowers. Kraus (1953) reported that older clumps of 'Soledad' tended to produce many flowers with duplicated perianth parts.

2. *Twin flowers.* Occasionally two flower buds fail to separate during initiation and development; a twin flower results. No known treatment will assure the production of twin flowers.

3. *Petaloid stamens.* Many persons describe a "double" flower of daylily as one with extra petaloid units derived from modified filaments that have become flattened and petal-like or petaloid. Stout (1956, 1957) defines such flowers as semi-double. If only the showy parts of the flower are viewed, the description is understandable. An analysis of total units within the flower usually reveals no change in the total number of flower parts. Not only is pollen produced in most cases but insects are attracted. Some cultivars are remarkably constant in the production of petaloid stamens. Petalody varies in flowers on the same clump as well as in flowers opening on different days.

In gross appearance, the petaloid unit is neither a well-formed petal nor a normal anther. The anther is usually located some distance back from the tip and often is entirely missing.

4. *Flowers within a flower.* Whether the foliage is green or variegated, daylily 'Kwanso' is unique in floral structure. It is relatively easy to analyze a freshly picked flower. By leaving the lowermost "sepal" in place for purposes of orientation, successive floral units may be removed and stacked into convenient piles. It soon becomes evident that three is the basic number for "sepals" and "petals" but that stamens vary from three to six, as well as in development. Some defective anthers contain little viable pollen and often are borne on petaloid filaments.

The perianth-tube of 'Kwanso' flowers does not collapse when pressed firmly by hand. If the flower is cut lengthwise the tube is seen to be solid. Obviously, the receptacle of the flower, which normally produces only floral leaves, in this instance gives rise to a tube as in other daylilies but the growing region of the developing flower does not produce a pistil. Instead, growth of tissue keeps pace with the developing tube, eventually growing beyond the tube and initiating and developing many additional structures. Reference to a freshly plucked flower will show that additional flower parts are differentiated from a region which eventually is about half again as long as a normal perianth-tube.

Three or four petal-like units are followed by three fleshier "petals" which often are green at the base. In some flowers as many as six partially functional stamens are located in a circle followed by an inner cycle of four equally well-developed ones. Finally three contorted spoon-like projections terminate the "flower"; each is a modified carpel. Occasionally one carpel will differentiate into a feeble structure possessing an ovary portion as well as stigma and style. Some dissections reveal one or more spheres in the "palm" of one or more of these separate, functionless carpels. Although undifferentiated, the spheres probably represent ovules. Analysis of the "flower" of 'Kwanso' clearly reveals that it really is a series of flowers, developed in tandem, with many defects in form, sequence, and function.

Stout (1957) defines the 'Kwanso' flowers as para-double (modified double) and gives much information on 'Kwanso' and morphologically related cultivars. Clones deficient in fertile anthers as well as pistils are said to be super-double.

Pistil

In *Hemerocallis* the compound pistil consists of three elongated carpels (units of the capsule), which, with the exception of the uppermost portion, are so closely associated that they appear as a single unit. The *stigma* (Fig. 15), at the tip of the *style*, is three-lobed and in some flowers three-parted. The elon-

gated style contains three conducting strands when observed in transverse section with the aid of a powerful hand-lens. In 'Pearl Shell' (Kraus), and in numerous other cultivars, the styles may be partially or completely separated into three parts. Sometimes (most frequently in induced tetraploids) the style is spirally twisted.

The pistil often does not conform to the basic 3-carpellate pattern as indicated above. Pistils in daylilies may occasionally have only two carpels or more than three. In some clones the ovary may comprise four carpels but with three stigmas. The additional carpel unit in the ovary does not necessarily guarantee a larger yield of ovules, since irregularities during development often result in underdeveloped conducting tissues and fewer ovules.

Stigma. In many species of *Hemerocallis* and in most cultivars, the stigma is doubly protected in the bud stage by being tucked under the infolded edges of a "petal" and of the "sepals" which are outermost (Fig. 15).

In 'Dominion', in an extensive progeny of 'Dolly Varden' × 'Dominion' (Voth 1965), in many tetraploids, and in other cultivars, the stigma and portions of the style protrude beyond the tip of the flower bud fully 12 hours before the flower opens. Extension of the bud is possible only if the tightly clasped "sepals" and "petals" become unlocked, at least at the far end of the bud.

What effect the premature exposure of the style to natural elements has on the receptivity of the stigma needs investigation. Whether or not this observation bears upon the difficulty of securing adequate fruit-set on cultivars such as 'Dominion', which habitually thrusts out its stigma, also deserves critical study. With tetraploids which possess protruding styles it has been found that evening pollination is often effective, providing dew does not prove a complicating factor.

Most daylily stigmas are rounded and expanded so that this organ has twice the diameter of the style. In some cultivars no over-arching of the stigma at the top occurs (K30, Kraus unnamed seedling) so that the style gradually tapers into the stigma. Nevertheless, the fundamental cell structure of the stigma is the same in all instances.

Conspicuous stigmatic hairs (Fig. 16) radiate from the stigma, giving the appearance of coarse pins in a pin-cusion; the hairy nature of the stigma can often be seen with the unaided eye. Each hair is colorless and glistening and consists of an elongate cell whose base converges with many others to terminate the style. Microscopically, the tip of the hair is slightly bulbous and thick-walled. When mounted on a micro-slide in diluted, brown table-syrup, shrinkage (plasmolysis) occurs revealing fine spirals in the cell wall. Stained preparations indicate that the thickened cellwalls are mucilaginous. This may be related to the production of stigmatic fluid in which pollen grains germinate well. This fluid is not to be confused with the liquid sometimes found on night-opening flowers. Failure of fruit-set has been attributed to this "dew." It would be of interest to determine the nature of pollen germination under these conditions. Ordinarily daylily pollen grains will not germinate in water even if sugars are added; instead, the wall of the pollen grain ruptures irregularly and a mass of shapeless protoplasm emerges. No cylindrical tube is formed and the protoplasm dies almost immediately. As Brewbaker and Gorrez (1967) have reported, calcium and boron are required for successful germination of daylily pollen grains. Testing the viability of pollen under laboratory conditions requires equipment and skill.

Style. This portion of the pistil is essentially a tube in which the wall is comprised of living cells belonging to the three carpels. The upper end of the channel in the tube is usually obscured by stigmatic hairs; at its base it flares into the three locules, or seed chambers, of the ovary. Styles of most diploid daylilies are only a few millimeters in diameter but as long as 10 cm (4 in.), yet they maintain their graceful stance in the

Fig. 12. Flower bud in side view (V42).

Fig. 13. Cross-section of bud 'Caballero' at level indicated in figure 12. Cut passes through anthers of sepal-associated and filaments of petal-associated stamens. True pollen is never produced and anther sac is not normal in shape in this cultivar. One petal is stippled. Style, in very center has 3 vascular bundles.

Fig. 14. Cross-section of flower bud at ovary level; ovules are paired in each carpel.

Fig. 15. Flower viewed in longitudinal section. A, area of enlarged cells which are involved in movements of sepals and petals. B, domed cells of upper epidermis; in these anthocyanin may be formed.

Fig. 16. Portion of style and stigma, showing a stigmatic hair.

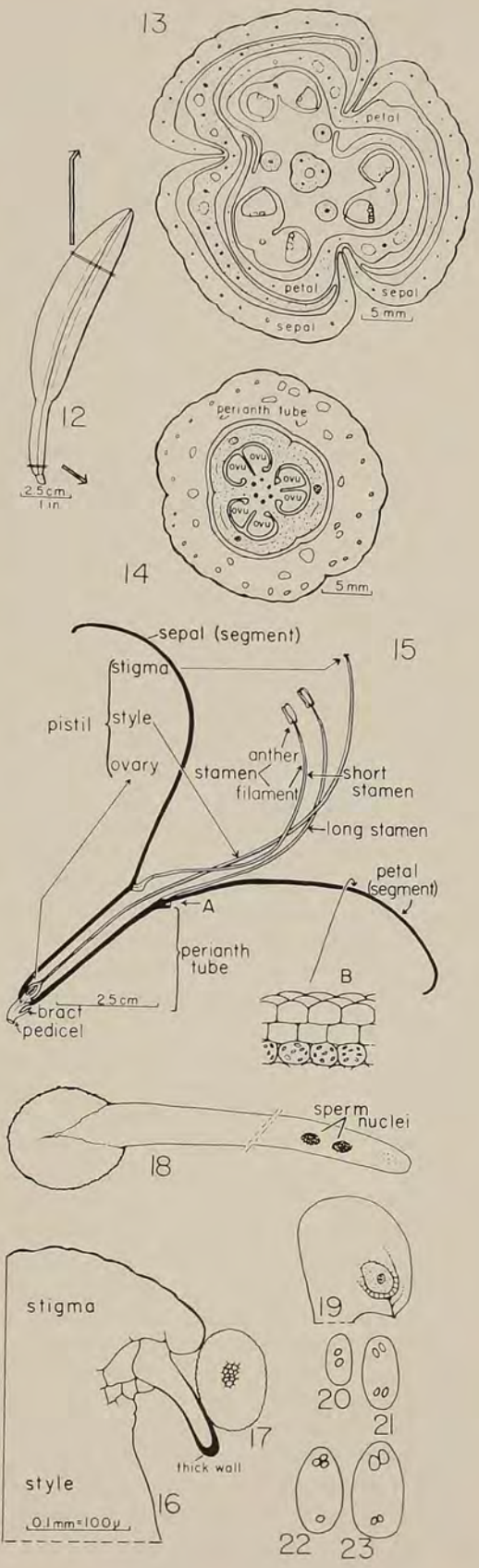
Fig. 17. Pollen grain, showing some of its ornamentation. Scale is the same as figure 16.

Fig. 18. Pollen tube emerging from pollen coat. (Diagrammatic)

Fig. 19. Ovule in longitudinal-section as seen when ovary is cut cross-sectionally. Mother cell of large spore is shown surrounded by a nucellus and 2 integuments. Stage is earlier than in figure 14.

Fig. 20-21. Reduction divisions (meiosis) of cell in figure 19 to give rise to 4 large spores.

Fig. 22-23. In some plants, related to daylily, a fusion of 3 nuclei results in a 2-nucleate stage. Mitotic division gives rise to 4 nuclei.



flower (Fig. 15) for a day or even longer.

Style-length is relatively constant for each cultivar but varies greatly between plants of differing genetic backgrounds. Variations in length of style in flowers of a single clump usually are associated with difficulties in securing fruit-set. Exceptionally long styles are found in 'Betty Slick' (Russell), 'Kindly Light' (a spider), and 'Kraus 597' among others. In half-grown buds of the latter, the style almost touches the tip of the petals but two days before the bud opens, the combined length of the style and the ovary is almost that of the entire bud (7.9 vs 8.2 cm). In the two days before opening, the style of every flower grows so long that it bends back on itself much like one kind of paper clip or it develops zig-zag bends. When the flower opens, the total length of the style exceeds the greatest length of the bud (10.8 cm plus ovary length of 0.7 cm, vs 10.2 cm for one flower). A long style does not seem to be a major factor in unfruitfulness; rather, inhibitory substances secreted by the style into its canal, apparently are far more important in keeping the pollen tube from reaching the ovules.

Within a few days after fertilization an abscission layer forms at the base of the style as well as at the base of the perianth-tube permitting them to be shed.

Ovary. A flower is derived from a bud in which the production of carpels stops the initiation of additional structures except in 'Kwanso' and related clones.

Anatomically, each lobe of the ovary corresponds to the base of a leaf. Chlorophyll imparts the dominant color to the ovary of daylily; usually yellow and orange pigments, in various gradations of intensity, characterize the style. The wall of an ovary resembles a foliage leaf; it has many veins with ample fibers, chorophyll-bearing cells, channels of thin-walled cells which later become long spaces, epidermis, and stomata. In contrast to a foliage leaf of daylily which has parallel veins, the ovary wall has many transverse veins.

Each unit of the ovary has a midrib along its exposed surface and two edges which are closely appressed and "united" with the adjacent two carpels, to form the central column of the ovary (Fig. 14). Carpels correspond to leaves which have never unrolled and, in most plants, the inside chamber is not contaminated with dust, bacteria or mold; only the pollen tube is likely to enter the locule. The centrally-located "edges" of carpels in the ovary portion do not taper to a thin margin as in foliage leaves; instead, they enlarge and initiate not only the ovules but also serve as the tissue through which all water, nutrients, food, and growth substances pass to reach the ovules—and the seeds, which originally were ovules. The two enlarged edges of each carpel are the *placentas.*

On the average, six or seven ovules are borne along each daylily placenta—a maximum of 42 per ovary. However, if the outer wall of a very young fruit is stripped away to expose all the seeds within a locule, only 13 (not 14) may be present. The two placentas of a carpel often do not initiate the same number of ovules; and only 39 ovules are present in such ovaries. These numbers are consistently encountered in diploid cultivars. In many tetraploids only 8 to 11 ovules are initiated in each carpel. As all hybridizers know, seed-yield usually is far below the potential so that in many cultivars no more than 12 viable seeds are produced in a ripened capsule.

Contour of the ovule is shown in Figure 14. Terms pertaining to an ovule and the events which occur within it prior to fertilization and afterwards, are represented diagrammatically in Figures 19 through 26.

Fruit. Botanically speaking, the ovule becomes the seed and the ovary the fruit at the precise moment that the sperm nuclei effect fertilization.

An ovary is triangular in outline when sectioned longitudinally prior to flowering; soon thereafter, the upper

third of the young fruit, in which no ovules are ever produced, grows rapidly in girth to give it the shape of a barrel. In a few cultivars pointed fruits are highly characteristic.

Color In Flowers and Other Plant Parts

Color, other than green, is evident in nearly every organ of the daylily: corky layers of large roots (tan to brown and even pink); the interior of the stem and leaf bases (pink); bracts, flower buds, and fruits (maroon-green); and flowers (lemon yellow through purple-maroon). Practically nothing is known concerning the location of the many pigments and their distribution within cells and organs, nor is their identity firmly established. When more information regarding the basic facts about chemistry, distribution and inheritance of pigments is available an increase in the efficiency of breeding programs in daylily is likely to follow.

Variations in the intensity and quality of green in leaves of daylily are not only conspicuous but also determine the garden value of many cultivars. Even though 'Kwanso' has a unique flower structure, the plant is justifiably devalued because of its light green foliage with the added disadvantage of turning brown during the height of the flowering season. In contrast, many recent introductions are prized not only for their superior flowers but also for blue-green foliage. In some clones the deeper color is associated with greater prominence of alternating veins which gives the blade a pleated appearance, an arrangement which affords greater mechanical support and prevents the abrupt downward bend of the blade at midpoint.

Chloroplasts were discussed in the description of the leaf. These biscuit-shaped bodies are shown to be extremely complicated structurally by electron micrographs. Protein, fatty units, pigments and other substances are all held within a thin mmebrane; two chlorophylls **a** and **b** as well as the yellow and orange carotenoid pigments, (xanthophyll and carotene) are arranged with precision and are present in large amounts. Plastids without green color can be seen in flower parts; they impart colors from yellow to orange in "petals" and "sepals" which correspond to the photosynthetic areas in foliage leaves. In fact, perianth extracts of the yellow-flowered cultivar, 'Shimmer', show detectable amounts of both chlorophylls. Undoubtedly cultivars displaying pronounced green tints on the outside of the perianth or in the throat ('Green Valley' Fischer), possess appreciable amounts of chlorophylls. Robert Simon (unpublished spectrographs) compared the carotenoids and xanthophylls of 'Sunny Morn' and 'Shimmer' and concluded that "sepals" and "petals" of both cultivars were equally rich in these classes of pigments. Pollen of both lacked xanthophylls as did the filaments and anthers of 'Sunny Morn'.

The basis for color differences in leaves is not clear. The nature of the cuticular surface, the relative abundance of the chlorophylls and the balance between the green and yellow pigments are obvious possibilities for color variations. More chlorophyll **a** and smaller amounts of the carotenoids would favor a deeper green color. Chlorophylls break down continually, especially during hot weather, and are re-formed as time goes on; the rate of destruction of the yellow and orange pigments is not as great under similar conditions. Pale foliage probably results from a combination of internal and external factors. Extraction and analysis of pigments and a study of leaf structure should yield the answer to this unresolved problem.

The hues, other than yellow, gold and orange, can be attributed to the anthocyanins which in the flower are located in the vacuoles (cell-sap reservoirs) of epidermal cells. These intensely colored water-soluble pigments occur naturally as glycosides; after removal of the sugar molecules by hydrolysis the resulting colored substance is known as an anthocyanidin. The only research on anthocyanins of the daylily known to the authors are unpublished preliminary results based on extracts of flowers made by William Redding.

Redding found only two anthocyanid-

ins in several clones of *Hemerocallis* which he sampled: cyanidin, the most common, and delphinidin which holds second place for frequency in flowering plants. The former is magenta when viewed on filter paper but in the flower the true color is masked by other pigments. Intensity of flower color generally depends on the concentration of these pigments or on the layering of several colors which gives the color mixtures so common in daylilies. In several clones originated by Kraus, purity of color in the magenta ('Evelyn Claar') and in the red ('Kraus 952') was attributed to the preponderance of one of the anthocyanidins; opaqueness, dullness and the proverbial muddiness of flower colors in others was always associated with the presence of both anthocyanidins as well as other undetermined pigments. Obviously these fragmentary results require verification and expansion. To sample existing cultivars is not enough; a long-range program of breeding based on preliminary pigment studies may succeed in determining the role of each class of pigments and their genetic interrelationships.

The anthocyanins of the daylily are presumed to be cyanidin-3-rhamnoglucoside and delphinidin-3-rhamnoglucoside, pigment molecules which specifically possess the simple sugars, rhamnose and glucose.

Even though many anthocyanins increase in amount as temperatures rise (from 50° to 86°F), it is unsafe to say that only a small amount of pigment is present on a cool day unless extracts at several temperatures show corresponding relationships. In daylilies, the lack of adequate light on some cool days can easily affect the reflective capacity of the domed epidermal cells of sepals and petals and thus influence the observer's judgment. The actual amount of pigment must be determined by chemical analysis and not by direct observation only.

Water-soluble yellow pigments (for example, anthoxanthins) have not been identified in the perianth of daylilies.

Even with the limited information available it can be said that plastid pigments are well represented in nearly all parts of the daylily plant exposed to light. Magenta and red pigments are concentrated in epidermal cells especially those of the flower. Similar colors in internal organs have not been identified nor have colors of cell walls been studied with precision.

Highly instructive observations on color were made by Voth (1967, unpubl.) on a flower produced by an unnamed variegated, daylily seedling. Two thin white lines, 180° apart, extended the length of the scape and continued into a bract and then into a flower. From freehand sections it appeared that the non-green cells extended only six to eight cell-layers into the scape but even gross examination of the flower proved that variegation of flower parts was much more extenisve. From what is known concerning the production of new cells at various locations and from present observations, it is obvious that at least two non-green centers, present in the apex of the stem, gave rise to the two lines of white cells visible on the outside of the scape. However, when a bract and flowers were differentiated, additional cell divisions of "non-green" cells gave rise to a much wider band of white tissue; cells which had color-capacity also divided to make more tissue. In "sepals" and especially in "petals" the affected zone was more than 1 cm (2/5 in.) in width. Viewed from the outside such bands appeared white but the upper surface displayed a clear magenta color when the flower was open. Microscopic inspection revealed that color was localized in epidermal cells whether or not the underlying parts consisted of albino or color-bearing cells. Orange-yellow plastids were present in the unaffected zones and, when viewed from above, color as perceived by the human eye, was not magenta but the ordinary "red" color characteristic of so many daylily perianths. Plastids were not visible at moderate magnifications in the "stripe." Thus in this variegated seedling clone, as is usually the case, plastid and sap pigments are separated anatomically and genetically. The aforementioned clone perpetuates both green and

colorless tissues, a kind of sport known as a chimera, by ramet buds and by scape proliferations.

The variegated flower was observed after pollen had been shed; stamens were not studied. However when the perianth was completely removed a variegated ovary was exposed. One lobe was green and its stylar portion orange; another lobe was white as was its associated style and stigma; the third lobe was again green but its style was tan in color. In the last unit, the placenta was enlarged and ovules were diminutive; ovules and placentas in the other ovary compartments were normal in external appearance.

Styles of all three carpels of the variegated seedling differed in length; the first one was shortest, the albino was intermediate and the tan unit longest. Whereas the orange and albino styles ended in what appeared to be normal stigmas with radiating stigmatic hairs, the tan unit overtopped the other two in a cupped manner and lacked stigmatic hairs. The latter, moreover, was turned almost 180° so that it was not an integral part of the style; its inner channel faced outward instead of becoming a part of the stylar canal which was clearly open at its upper end. In contrast, the stylar canal in a normal flower usually is not visibly open at its upper end because stigma units are at a single level and the masses of stigmatic hairs and their swollen basal cells close the terminal aperture.

Albino and variegated plants are unlikely to contribute directly to plant breeding programs because of the necessity of chlorophyll for photosynthesis. However, their altered anatomy and physiology contribute new insights into the origin and development of tissues, some of which are directly involved in reproduction. For instance, it would be of interest to know if the albino stigma promotes pollen germination and if the associated style still retains the capacity to inhibit the growth of pollen tubes, and lastly, if ovules in the unit were functional.

Pollination, Fertilization and Seed-Set

There are two kinds of *spores*: (1) the small kind which becomes a two-celled pollen grain in the anther, and (2) the large spore in the central part of the ovule which "germinates" to form an 8-nucleate structure; one of the eight nuclei (together with associated protoplasm) is the *egg*, and two nuclei are involved in endosperm formation. The ovoid structure in which the egg and endosperm cells are produced often is referred to as the "embryo sac." (Developmental stages within the ovule are diagrammed in Figures 19 to 24.)

When a daylily flower opens fully on a warm day, the anther sacs usually open almost immediately to display a fluffy mass of pollen grains; insects, hummingbirds, or man carries the pollen intentionally or unintentionally to the stigma of the daylily flower. This is pollination. Compacted pollen from a partially open anther is functional but difficult to handle; masses of pollen grains taken from an anther in this condition do not always adhere well to the stigma and much may be wasted if the pollen is not dried first.

Within minutes, the pollen grain (Fig. 17), in contact with stigmatic hairs (Fig. 16), swells and sends out a glassy-clear tube with contents visible. This is pollen germination.

The *pollen tube* (Fig. 18) penetrates the bases of the stigmatic hairs, enters the hollow style and grows at a rapid rate if no incompatible substances are encountered. During this descent, the smaller of the nuclei in the pollen tube divides to form two *sperm nuclei* which travel along, some distance back of the tip of the pollen tube; the tube reaches the ovary within a day in compatible crosses and with suitable temperatures.

The pollen tube may digest its way into almost any part of the ovule, but usually enters a small pore (*micropyle*) which remains as the covering layers (*integuments*) of the ovule develop. Few cells are digested as the pollen-tube grows toward the egg. Near the

egg the pollen-tube bursts to release the two sperm cells. One sperm unites with the egg to form the fertilized egg (*zygote*). The other sperm nucleus unites with the two centrally located nuclei to initiate the *endosperm* (Fig. 25).

If internal and external conditions are favorable following fertilization, a viable seed will develop. Yet fertilization may not always be successful as hybridizers know who have taken time to dissect ungerminated seeds. Many seeds may contain half-embryos and some no visible one at all, due to functional barriers in the ovule that prevented the development of a normal embryo.

Irregularities in pollination, pollen-tube growth, and seed development are evident when one carpel (seed chamber) of the capsule dries prematurely. Carpels that remain green may develop and mature. Only abortive seeds are generally found in a prematurely ripe carpel and the course of development of the remaining seed chambers is often altered so that few, or no viable seeds are produced. Such irregularly-formed capsules may ripen in 38 to 46 days, instead of the usual 52 days for normal capsules.

Healthy carpels and capsules develop when normal growth and external environmental factors interact favorably. In the normal sequence, the pollen-tube reaches the ovule within one day following pollination (Stout and Chandler, 1933), and fertilization ensues within hours. From fertilization to seed maturity requires 46 to 56 days with a median time of about 52 days in diploid clones. The capsule may begin to split at the tip while still green; in some cultivars the green color fades and the top of the fruit becomes gray before fissures appear. Within a few days, depending upon climatic conditions, the capsule is fully dry allowing seeds to shed; in some tetraploid clones the fruit wall is so massive that force by hand is necessary to remove the seeds.

Longitudinal splitting along the midrib of the daylily carpel (seed chamber) is possible because of thin-walled cells between strands of xylem and the fibers which constitute the median vascular bundle. Differential drying creates torsions and leverages which tear the midribs apart and open the fruit beginning at the top of the capsule. These forces also cause inrolling of the carpel-halves so that seeds may be tightly held for many days; this prolongs the time of shedding.

Again, as in the case of seed and carpel, a nice correlation between functionally related parts of the plant prevails, for once the last capsule is open, the scape gradually dies to its very base and dries; in a few daylilies the scape or part of it may die even before the capsule is fully mature.

Seeds, Seed Germination, and Seedlings

If green capsules are opened about 15 days after pollination, their immature seeds are nearly white; four or five days later the seed-coat turns brown, and a few days later the seeds are black-coated. Under magnification, each cell of the brown seed epidermis contains about 100 vertical stacks of tiny black beads which grow in diameter until adjacent stacks touch each other to perfect the final jet-black, glistening seed coat so characteristic of daylily seeds. Daylily, 'Kraus 5221', produces only unpigmented seeds which are off-white in color; irregular, colorless deposits form on the side walls of the seedcoat epidermis but no stacks of beads are developed. Thus far no immediate offspring of this clone (used either as a seed or pollen parent), have exhibited this trait.

Internal changes inside the growing seed are far greater than the superficial ones. A nutritive layer internal to both seed coats is absorbed as the endosperm grows into a shape that resembles the bearskin (cap) of a guard at Buckingham Palace. The endosperm surrounds the elongating embryo. Cells of the endosperm are blocky and develop thickenings on walls (A, Fig. 27) resembling those in vessels and tracheids, yet they do not take on the dyes which color the xylem. At maturity two sizes of round granules are tightly packed in the endosperm cell (B, Fig. 27).

Peeled seeds of daylily yield 39 per cent protein and 27 per cent oil (Earle

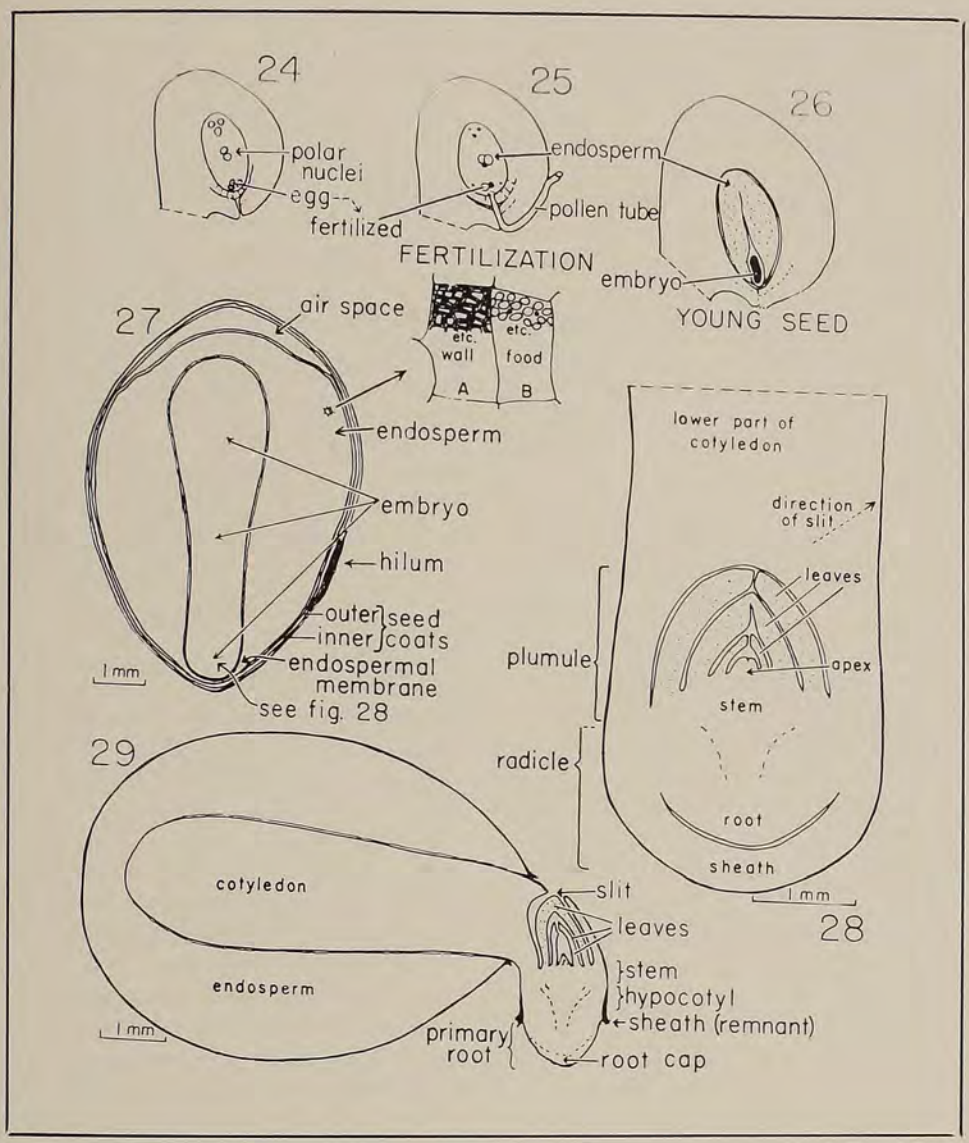


Fig. 24. Ovule at flower opening time; 8 nuclei are present.

Fig. 25. Events at fertilization. One sperm nucleus unites with 2 centrally-located nuclei to give rise to an endosperm cell; the other sperm unites with the egg.

Fig. 26. Fertilized egg has developed into an embryo; endosperm cell into endosperm tissue.

Fig. 27. Mature seed in longitudinal section. One layer, derived from nucellus, is not shown. Endospermal membrane is responsible for dormancy in daylily seeds.

Fig. 28. Enlarged, sectional view of embryo shown in figure 27. Portion below level of cotyledon and leaves is also known as the hypocotyl (general term) and that above, epicotyl.

Fig. 29. Longitudinal section of germinating seed of daylily (seed coats not shown). Elongation of lower portion (fig. 28) pushes the radicle and plumule out of seed, allowing root and leaves to grow.

et al. 1960). Analyses for sugar, starch and cellulose were not made. The iodine test for starch is negative in daylily. The seed and leaf of daylily is rich in many organic substances as demonstrated by Fowden and Steward in 1957 when they reported a previously unknown nitrogenous compound, γ-hydroxy-glutamic acid. They also reported more than 50 unidentified soluble nitrogen compounds in the lily family and related plants, 12 of which occur in *Hemerocallis*. It would be of value to know if any of these substances are related to the notable resistance of daylily to plant diseases.

Embryo. The fertilized egg, or zygote, ultimately develops into the many-celled embryo which is located within an enveloping endosperm. The endosperm furnishes the immediate nutritional source for the developing embryo (Fig. 27).

After the very young embryo has undergone several cellular divisions, growth accelerates, so that cell divisions within the embryo almost keep pace with those of the endosperm. When young, the embryo is spindle-shaped (Fig. 26), and nearly all cells in the structure are capable of dividing. As the embryo continues to grow and differentiate, cell division is gradually restricted to two regions of the embryo: (1) At the base of the embryo, near the tip of the embryonic root (Fig. 28). The cells of the primary root and root-cap (Fig. 29) are derived from this pool of actively dividing cells e.g., the primary root from cells produced toward the inside and the root-cap from cells produced toward the outside. This small pocket of cells which make up the root-tip is the ultimate source for all of the cells of primary root system. In daylily, and in many other plants, a cone of cells is situated beyond the root and its cap. This sheath (*coleorhiza*) is the first to emerge as the seed germinates. (2) at the opposite pole of the embryonic axis—the stem-tip or apex (Fig. 28). Although initially dome-shaped, the stem-apex becomes somewhat invaginated due to a greater rate of cell division on the flanks of the dome as the embryo becomes mature. This is the "perpetually" embryonic tissue from which all leaves, stem and floral tissues will ultimately be derived. Ultimately all major roots of a mature plant grow from stem tissue.

As the two regions, embryonic root and stem apex, grow away from each other, they leave in their wake the differentiated cells of the underground stem and root, most of which do not undergo cell division. A notable exception is the pericycle which retains its ability of cell division and thereby initiates all secondary roots.

The bulkiest, most conspicuous feature of the *Hemerocallis* embryo is the single cotyledon or seed-leaf which is the first leaf formed by the developing embryo. The base of the cotyledon completely surrounds the plumule, or the stem and leaf portion of the embryonic axis (Fig. 28). The envelopment of the plumule is not complete, however, because the cotyledon does not develop as a totally solid structure. The chamber of the cotyledon occupied by the plumule is open to the surface through a narrow slit about 1 mm above the base of the cotyledon (Figs. 28, 29). It is through this slit that the plumule emerges following germination. In the mature seed, the cotyledon is generally about three times the length of the root-stem.

When germination begins, the first tissue to respond is a narrow zone of cells at the base of the cotyledon. These cells divide and elongate to force the root end through the endosperm membrane and seed coats. The degree to which the cotyledonary base grows is reflected in the extent to which it protrudes beyond the ruptured seed coats as seen in Fig. 29. Elongation in this region supplies the force for actual emergence of the root tip. The strong downward bending at the cotyledonary base upon germination insures the vertical orientation of the plant (Fig. 29). The remainder of the cotyledon remains in the seed, still in contact with the endosperm.

Following emergence, the radicle, or embryonic root continues to elongate, pushing through the sheath. The upward emergence of the leaves and stem from the cotyledonary chamber through

the slit follows the downward growth of the root (Fig. 29).

Hemerocallis embryos can be removed from mature seeds and grown on an artificial, semi-solid medium consisting of mineral salts and sucrose in agar. Because the growth medium satisfies all of the requirements for most bacteria as well as molds, the entire procedure of removing the embryos and placing them on the medium should ordinarily be done under aseptic conditions using sterilized instruments and media. Fortunately, *Hemerocallis* stores much food in its cotyledon and the young plant is fairly resistant to the invasion of many microorganisms. Specialists have grown daylily embryos on filter paper in glass dishes with minimum precautions for reducing contamination. Even when grown in light, the cotyledon does not turn green. Griesbach has succeeded in interchanging embryos and endosperm between seeds of different cultivars surgically.

Germination. In a series of thoroughly documented experiments, Griesbach (1955a, 1956b, 1956) and Griesbach and Voth (1957) established the requirements for successful and rapid germination of dormant daylily seeds. Freshly harvested seeds of deciduous-type daylilies sown in the autumn ordinarily remain dormant until the following spring, although occasionally a low percentage of immediate germination will result if the fall weather is unseasonably warm. Seeds of evergreen varieties are generally capable of immediate germination; as a consequence, daylily growers in the South sow daylily seeds in warm summer and fall weather following harvest. Even though immediate germination does not ordinarily shorten the interval before flowering, early germination is of great value in getting a large plant as quickly as possible.

The dormancy of deciduous-type daylily seed disappears after moistened and aerated seeds are subjected to low temperature. Six to eight weeks is usually sufficient to break dormancy provided the temperature is maintained at about 34° F. Seeds stored at temperatures several degrees above 34° require a longer cold treatment before germination is possible. Seeds of tetraploids normally require longer cold-treatments to break dormancy. Germination of diploids or tetraploids may be induced within only a few days even without a cold treatment provided the seed coats are broken and a portion of the embryo is exposed, preferably at the micropyle (pointed) end of the imbibed seed. However, the one-celled living membrane just under the seed-coat must be removed or at least ruptured so as to facilitate gaseous exchange; care must also be taken to avoid damaging the root-tip and other parts of the embryo (Figs. 27, 28) that it intimately envelops.

Most hybridists working with dormant daylilies sow seeds in an outdoor bed within a few months following harvest. It should be stressed that the seeds must have absorbed water in moderately moist soil prior to the onset of cold weather. Laboratory experiments indicate that moistened daylily seeds often do not survive when exposed to subfreezing temperatures; hence, it is important to provide an adequate mulch. Even so, few germinating seeds or very young seedlings survive sudden freezing. And even the survivors may be heaved from the ground during spring thaws and consequently lost.

In some plants seeds remain viable only several days (primrose), but seeds of some other plants remain viable for many years (*Nelumbo*, the Indian Lotus). In seeds of *Hemerocallis*, viability may be expected to be high for six months or so, under temperature and humidity conditions found in modern homes. After six months viability drops off quickly. Viability of seeds is lost most rapidly under conditions of high humidity, especially in conjunction with high temperature. Viability of dry seeds is considerably prolonged beyond normal when the storage temperature is near freezing or even below, especially under conditions of low humidity.

Prior to complete loss of viability,

aged daylily seeds frequently give rise to seedlings with primary roots showing varying degrees of stunting. Based on these observations seeds should be dried rather quickly in a cool dry location. Cloth-mesh sacks or non-waxed paper bags are ideal for drying and storing daylily seeds; dry seeds may then be kept in a refrigerator until planted.

Seed longevity in daylilies is currently being investigated by Voth under conditions applicable to home environment. After several months of preliminary storage in a cool but uncontrolled environment, seeds of the 1960 crop were placed in polystyrene culture flasks (25 ml capacity, horizontal stacking — Falcon 4001) in May, 1961. Thereafter, the bottles, each containing no more than 50 to 60 seeds, were kept for more than six years in a self-defrosting home refrigerator in which cycles of temperature ranged from 34° to 40° F.

Another aspect of this study involved surplus seeds of the 1964 crop, stored in original "kraft" paper bags (½ lb. size). Soon after harvest, seed lots were placed in a closed, corrugated paper box and stored for nearly three years in a controlled-environment room (67 ± 2° F.) at the University of Chicago.

Sample lots of seeds of the 1960 and 1964 crops were removed from storage in June 1967. They were moistened for a day, sandwiched between wet papertoweling, arranged in a cubicled plastic-box, and placed into the same refrigerator in which the dry 1960 seeds had been stored. After three months, the seeds were planted in soil in greenhouse flats (September 1967). Results after 10 days:

1960 crop. Seeds germinated in four of seven lots as folows: 0, 58, 70, 0, 22, 22, and 0 percent. 'Kraus 471' × 'Creek' seed was most viable.

1964 crop. Seeds germinated in six of seven lots as follows: 20, 23, 8, 4, 35, 27, and 0 per cent. The first six lots were duplicate pairs and the unmatched, nonviable one was the white-seeded 'Kraus 5221'; the most successful lot was 'Kraus K35' × 'Kraus K3'.

Seeds of *Hemerocallis* crosses evidently remain viable for at least seven years under certain storage conditions. However, some aspects of the experiment lacked adequate controls; for instance, stratification for three months may or may not be essential for germination. Some seed lots have been retained for future testing.

Seedling. Once the radicle has emerged from the seed coat to a length of 1 mm, seed germination has occurred and thereafter the young living organism is a seedling (Griesbach 1956). The exposed axis responds positively to gravity by which time the primary root has ruptured the sheath (Fig. 29). Many other areas of activity are evident at this time: (1) foliage leaves now emerge from the aperture in the cotyledon, (2) secondary roots arise from the radicle (primary root) and a few adventitious roots arise from the stem region, and (3) the cotyledon may grow a little as it digests reserve foods of the endosperm and translocates these to the most actively growing areas of the seedling. Unless chlorophyll-deficient, the foliage leaves of the seedling become green immediately. For several weeks following the first flush of leaf expansion no more leaves are apparent; root growth, however, remains very active unless changes occur in environmental conditions.

Hybridists who try to induce tetraploidy in seedlings usually treat the germinating seed or very young seedlings with a solution of colchicine. The dosage of colchicine should be more uniform and more likely to succeed on the smaller number of cells in the stem tips of very young vigorous seedlings with simultaneous cell division. Then for a period of three or four months the stem tips seem to grow relatively more by cell enlargement than cell division. When the leaves already formed during seed formation are fairly mature, active cell division at the stem tip seems again to occur.

Which Nutrients are Essential?

Daylily growers have recounted their experiences with fertilizers in various journals over many years, but do not agree on dosages and proportions of fertilizer ingredients. It is asserted that

commercial fertilizers should be used sparingly in some areas; yet success has been reported with fairly large applications of certain combinations of nutrient salts. Daylily seedlings may generally respond favorably to frequent but moderate applications of soil nutrients but in a good garden soil may give no response. Daylilies seem to thrive within sight of the ocean where chlorine and sodium ions are in considerable supply; on the other hand, these plants seem to grow well and to accelerate vegetative reproduction in muck soils which are, presumably, slightly acid.

Observable differences in general appearance, vigor, and vegetative reproduction are often evident when certain cultivars are grown on different soil types even in the same locality. Recorded experiments seem to be lacking which take into account and specify differences in water supply, soil temperature, slope, aeration, pH (acidity vs. alkalinity), and nutrient supply—all of which may vary from garden to garden.

Diversity of observations can best be resolved by experimentation. With this in mind a preliminary investigation was begun at the University of Chicago which is still in progress. Present data are incomplete and results reported here are subject to revision and to repetition with more adequate controls. Regrettably no ramets of daylily were dissected to determine whether scapes had been initiated. However, vigorous ramets from sister clumps dissected the following December invariably had initiated scapes.

One large clump of daylily, 'V42', was brought into the greenhouse on January 24, 1967. All fungus-free ramets were graded for size and treated as follows:

As recently-branched fans could not be divided readily each was planted into pure quartz sand contained in a five inch glazed pot. For three days tap water was applied and thereafter solutions of nutrient salts (Hoagland and Arnon 1950) were supplied twice daily. Only single-ion deficiencies were attempted. Solutions were: complete nutrient; and deficiencies in nitrogen (-NO_3), potassium (-K), phosphorus (-PO_4), calcium (-Ca), and magnesium (-Mg), respectively. One container was given only distilled water.

The unbranched ramets were planted in six-inch pots in greenhouse soil and watered with tap water twice daily. Temperature records were not kept but heat was well-regulated. Humidity was increased as needed by a controlled, motor-driven mist device. Several 200 W overhead light bulbs added light during daylight hours and extended the photoperiod to 20 hrs.

Early in April, scapes emerged in both branches of plants on sand culture, except one pot in which potassium was not supplied; 13 soil-grown plants produced vigorous scapes; one remained vegetative. Because no other clones were being forced, only self-pollination was possible; hence, the degree of productivity may rest on this factor more than on the absence of nutrient ions.

All plants were alive after eight months, even the one on distilled water. Also, all plants with scapes produced flowers, fruits and additional leaves. Early flowers were produced by plants on complete nutrient solution, -NO_3, -PO_4, and soil (April 23-25). Flower number was greatest in some soil-grown plants and on complete nutrient solution. Length of flower-bud varied only slightly from treatment to treatment; only buds on the plant supplied wih distilled water were slightly shorter. Lengths of buds on these greenhouse-grown plants were not significantly different from those produced by garden-grown plants in summer.

In sand culture, the smaller branch produced a shorter scape on which fewer flowers formed in a ratio of about 2 to 1. Scapes were shortest on -K and increasingly longer on -Mg, -PO_4, distilled water, -Ca, complete, soil.

Plants on complete nutrient solution and also those in soil produced the largest number of flowers; those in distilled water and -PO_4 yielded only six fruits on two scapes in each instance. With other treatments fruit number decreased in this order: -Ca, -Mg, -K, and -NO_3. No viable seeds were produced by plants supplied with distilled water. In July, a few of the plants potted in soil produced

new scapes; eventually one-half of the 14 plants flowered, one in October. No plants on sand culture rebloomed.

It is significant that healthy ramets of *Hemerocallis* are able to re-utilize the common nutrient ions or build a sufficient reserve to survive for many months; they are "sparse feeders." Yellowing of foliage was only slight on distilled water, $-NO_3$, and -K solutions; a large number of new leaves, dark green in color, characterized the $-PO_4$-treated plants.

Fruits often dehisced prematurely but on nearly all treatments full-term capsules contained 8 to 24 seeds. However, often one-half of the plump seeds contained no visible embryos, only endosperm. Opened seeds possessing embryos were re-closed (short lengths of soda straws served as closures) and planted in vermiculite. Germination in several preliminary trials exceeded 80 per cent.

More important than the initial experiment would be a follow-up involving the same plants for another season. Ability of the experimental plants to reproduce vegetatively and to initiate scapes, flowers and seeds could then be determined.

Shading

Daylilies are sometimes grown near trees or buildings where less than the full amount of sunshine reaches them. Duration and intensity are not the only factors which change under reduced light. Trees prevent uniform distribution of rainfall and their competing roots deplete not only soil moisture but mineral nutrients as well. Buildings not only produce shade, they also deflect, reflect and re-radiate heat so that a city site may have greater extremes of summer temperatures than a country garden. A preliminary attempt to evaluate the effects of shading was devised in the garden of the Department of Botany at the University of Chicago.

A row of 13 well-established clumps of clone 'V42', almost entirely free of shade from trees and buildings, was selected for uniformity of mass and spacing. A double layer of cheese cloth was attached to a wooden frame to form a cage 36 in. tall and large enough in the other dimensions to accommodate the individual clumps. The cloth was hinged on one side to permit access to the plants. Cages were placed over five clumps on May 9. The first flower opened on July 4. Light measurements were made on several occasions; light in sky often yielded 10,000 ft-c, but plants in the open received only 8,000 ft-c on a bright day and only 1860 to 3800 ft-c reached the caged plants. Such measurements were made at the level of uppermost leaves; readings dropped sharply among leaves and near the clump. Temperature readings revealed no more than a 3° F. difference between boxed-in plants and those in full sunlight, when made under the canopy of leaves. Rains were supplemented with periodic sprinkling.

Not all data have been processed but some information is obvious and certain conclusions are justified:

1. Flower-bud length is not significantly affected by shading (137-145 mm).
2. Flowers opened fully just before sundown under both treatments.

The following differences were noted when shaded plants were compared with a duplicate set of plants grown in the open as controls. Plants in shade showed:

1. More buds blasted.
2. Total flower number per scape was less (average).
3. Total number of fruits was less.
4. Plants began to flower 7 to 12 days later.
5. The period of flowering was less (23:29 days).
6. Leaf edges of base were tinged with red.
7. Leaves were darker green.
8. Leaf bases were longer because blades bent higher up.
9. Fewer young ramets were apparent.

A second season of shading may give more definitive results than those obtained in the first season.

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Cultivars of Daylily

PHILIP G. CORLISS

The clue of successful gardening with daylilies lies in selecting the right cultivars. I know of no hybrid perennial flower for which regional performance is so important. One must consider other things apart from the appeal of the flower itself. Temperature range is vital; humidity, soil structure, and composition are less important. One must also consider the hours of preferred flowering, season of bloom, sunny or shady locations, and whether plants are grown for garden effect and/or use in flower arrangements.

With thousands of fine daylily hybrids registered and available from dealers, how is one to choose? Surely there cannot be so many truly different cultivars. On the contrary, so numerous are the characteristics of the daylily that theoretically an infinite number of different daylilies cultivars is possible. As tetraploid breeding produces new characteristics and variants, the number of possible new daylilies is greatly increased.

While there are many intermediate gradations and some inconsequential overlappings, the following list shows the number of possible clones (i.e., potential cultivars) that could result from a combination of characters listed.

THE FLOWER

Predominant Colors—16
White
Light Yellow
Deep Yellow
Orange
Copper
Peach
Buff
Any of above with red overlay
Pink
Light Red
Medium Red
Rose
Dark Red
Lavender
Purple
Brown

Dusting—3
$3 \times 16 = 48$
None
Diamond-dusted
Gold-dusted

Color Pattern—5
$5 \times 48 = 240$
Self
Bitone
Bicolor
Reverse Bicolor
Blend

Band or Eye Zone—5
$5 \times 240 = 1{,}200$
None
Petals only
Faint, all segments
Heavy, all segments
Wide (over ½"), all segments

Throat Color—3
$3 \times 1{,}200 = 3{,}600$
Yellow
Orange
Green

Throat-color Size—3
$3 \times 3{,}600 = 10{,}800$
Small
Large
Extending fingers into segments

Midribs—4
$4 \times 10{,}800 = 43{,}200$
None
Inner perianth-segments
Outer perianth-segments
Inner and outer

Veins—2
$2 \times 43{,}200 = 86{,}400$
None
Prominent

Contrasting Segment Edges—4
$4 \times 86{,}400 = 345{,}600$
None
Inner perianth-segments only
Outer segments only
Inner and outer

Color of Stamens—2
$2 \times 345{,}600 = 691{,}200$
Yellow or orange
Black

Variations other than Color

Flower Form—8
8 × 691,200 = 5,529,600
Trumpet
Cup (Bell)
Flat
Recurving outer segments
Recurving perianth-segments
All segments recurring
Cockerel
Spider

Segment Ends—3
3 × 5,529,600 = 16,588,800
Round
Pointed
Twisted and/or Pinched

Ruffling—3
3 × 16,588,800 = 49,766,400
Smooth
Ruffled petals
All segments ruffled

Size of Flower—3
3 × 49,766,400 = 149,299,200
Under 3 in.
3-4½ in.
Over 4½ in.

Height of Flower Scape—3
3 × 149,299,200 = 447,897,600
Low (under 2 ft.)
Medium (2 to 4 ft.)
Tall (over 4 ft.)

Number of Perianth-Segments—2
2 × 447,897,600 = 895,795,200
Six (single)
More than six

Growing Characteristics

Hours of Bloom—3
3 × 895,795,200 = 2,687,385,600
Diurnal
Extended
Nocturnal

Season of Bloom—4
4 × 2,687,385,600 = 10,749,542,400
Early
Midseason
Late
Continuous

Character of Foliage—3
3 × 10,749,542,400 = 32,248,627,200
Evergreen
Semi-evergreen
Dormant, deciduous

Color of Foliage—3
3 × 32,248,627,200 = 96,745,881,600
Green
Glaucous (blue-green)
Variegated

Type of Branching—3
3 × 96,745,881,600 = 290,237,644,800
Terminal buds
High branching
Low branching

Type of Growth Increase—2
2 × 290,237,644,800 = 580,475,289,600
Stoloniferous
Non-stoloniferous

Chromosome Number—2
2 × 580,475,289,600 = 1,160,950,579,200
Diploids
Tetraploids

Fragrance—2
2 × 1,160,950,579,200 = 2,321,901,158,400
Fragrant
Not fragrant

FLOWER COLOR

Daylily breeders have enlarged the available color range to its present proportion, yet several colors still do not exist, for example, true blue, brilliant violet, and pure white. It is no longer necessary to speak of daylilies as "so-called reds" or "so-called pinks" for no matter what your idea of red or pink may be, nearly every color hue exists.

Let us review briefly the development of the color range in the daylily, remembering that all known species are yellow, orange, or fulvous. The latter term refers to a flush or overlay of red, brown, or pink on the orange or yellow flower.

Dr. Stout produced 'Theron', the first truly red daylily, described in 1934, through a well-documented breeding program. Other early important reds were 'Royal Ruby' (Nesmith), 'Ruby Supreme' (Wheeler), 'The Doctor' (Claar), 'Garnet Robe' (Milliken), 'Man O' War' (B. Taylor), 'Marse Connell' (Connell), 'Seminole Chief' (Lester), and 'War Eagle' (D. Hall). Now there are several thousand excellent reds, among the finest of the new ones being 'Queen Of Hearts' (Lester) and 'Gath-

ering Storm' (Fleishel).

There is general agreement that yellow and orange flowers have the greatest garden value. These two colors are predominant in all the daylily species and the use of the species has resulted in an extensive list of cultivars with flowers in this color range.

A current vogue exists for green flowers in daylily cultivars. 'Green Goddess' (House) was the first important greenish flowered daylily introduction, followed by 'Lime Painted Lady' (Russell). There have been many more, and among the finest today are those from Mrs. D. J. Harrison (Georgia) who is specializing in green-flowered daylilies.

The quest for pink was difficult. Technically, pink is a diluted rose. Many early daylily introductions were called pink when they were really light red. The pink color also seemed to be tied, genetically, to narrow segments. The pinks all came from *H. fulva,* mostly from *H. fulva* 'Rosea'. The first true pink was 'Marie Wood' (Wood). This satisfied the color purists but the flowers were small and the plant not very vigorous. Mrs. Bright Taylor (Florida) closely approached pinks with many seedlings ('Sweet Alice', etc.) from her linebreeding of *H. fulva* 'Rosea' × *H. aurantiaca* 'Major'. More than any other breeder, she provided cultivars of flourishing evergreen habit which gave great impetus to daylily enthusiasm in mild climates. Other important early pinks were 'Pink Damask' (Stevens), 'Pink Prelude' (Nesmith), 'Cherubim' and 'Seraphim' (both by Richards). The introduction and use in breeding of two "melons" (blends—not really "pink") led to the great development of the current host of fine pinks. These two melons were 'Multnomah' (Kraus) and 'Precious Treasure' (Nesmith).

Many of the first so-called purple and lavender-flowered daylilies were merely dark reds or dusty pinks. In the last decade, great improvement has been made in these color classes. The groundwork was laid by Mrs. Lester, Mrs. Nesmith, Hugh Russell, and others. An outstanding breeder in these colors today is Miss Spalding (Louisiana) and the best-known of her originations is 'Luxury Lace'.

White daylilies have been the goal of many breeders. Most hybridizers have followed the procedure of selecting from crosses of pale yellow. 'Ivory Chalice' and 'Carved Ivory' (both Nesmith), 'North Star' (D. Hall), and 'White Orchid' (Mrs. Wm. Bach) were trail blazers. One of the finest of the near-whites is 'Guardian Angel' (Gore). Culture and climate have a great effect on the paleness of these "white" daylilies. A possible way of getting white daylilies is to breed for increased width of the white midribs. Some startling seedlings have come from this method in Florida.

The depth of color in brown daylilies is also greatly affected by growing conditions. There are many real browns, but under certain conditions they vary from tan to reddish brown. Possibly the greatest merit of brown daylilies lies in their fitness for flower arranging. They are stunning when used alone or with the orange or yellow of other daylilies or other flower species. 'Havana Brown' (Milliken) and 'Black Eyes' (Connell) are examples of good browns.

Dusting

The amount of dusting extends from practically none to a dazzling amount of gold or silver which makes the flower glisten like tinsel. The gold dusting is especially effective in deep orange flowers or in some dark reds such as 'Black Gold' (Corliss). The silver dusting lends enchantment to many pinks and melons, such as the pink 'Cherubim' and 'Seraphim' (both Richards).

Color Pattern (See Fig. 3—Chap. 2)

In the *self,* the tepals (perianth-segments) are of the same color, although the stamens or throat may differ. In the *bitone* the outer and inner segments differ in color intensity, the inner usually having the darker shade. For instance, a bitone might have red (or rose) inner and light red (or pink) outer segments. In the *bicolor* the inner and outer are of different colors, such as

brown and orange or red and yellow, with the inner darker in color. Well-known examples are 'Caballero' (bicolor) and 'Chloe' (reverse bicolor). With *blends* we include both mottled and fulvous flowers. This group includes some of the most beautiful daylilies although they may not make striking garden accents. A famous fulvous cultivar is 'Painted Lady' (Russell). 'Prima Donna' (B. Taylor) is probably the greatest blend of all time. Wm. Munson, Jr., has introduced many fine blends, such as 'Intermezzo'. We have already noted 'Multnomah' and 'Precious Treasure', and we must include today's popular 'Satin Glass' (Fay) and 'Mary Lawrence' (MacMillan) in this color class. In this group we also place the mottled flowers such as 'Macaroon' (Craig).

Band or Eye-Zone

A color feature which distinguishes many daylilies is the band or eye-zone of dark color usually found at the juncture of the throat and outer segment color. It is derived from the band in *H. fulva* and its variants. This band may vary from an almost inperceptible hair-line, as in the light yellow night-blooming 'Tracery' (Nesmith) to a wide band which occupies almost all of the segments beyond the throat. It may appear on the inner only, or on all of the perianth-segments. Several of our leading breeders have paid particular attention to this eye-zone. Craig's 'Wideyed' won rapid favor in this group. Baker Wynne has a distinguished line of daylilies with pink, rose, or purple segments with black (purple or maroon) bands (his Borgia group). The first important banded daylily was Stout's semi-evergreen 'Mikado' which came from a line of breeding that included *H. fulva* 'Europa' and *H.* × *aurantiaca*. Because of the *H.* × *aurantiaca* parentage, this was semi-evergreen, as was his larger 'Jubilee'. Another important step in breeding for eyed daylilies was Hall's 'Mission Bells' which is dormant. Mrs. Taylor's line breeding stemmed from *H. fulva* 'Rosea' × *H.*× *aurantiaca* and her subsequent selections stressed the evergreen tendency. Notable examples of eyed daylilies in her list include 'Nantahala', 'Quincy', and "Selena Bass' (the latter with pink segments with a wide maroon band). 'Black Eyes' (Connell) and 'Copper Rose' (Corliss) have brown flowers with wide purple bands.

Throat Color

Regardless of their principal color, daylilies may have yellow, orange, or green throats. Dark-colored daylilies tend to have either orange or green throats, while yellows, light pinks, melons, etc., tend to have green or yellow throats. In some yellow daylilies, such as 'Spotlight' (Lester), the throat is considerably darker than the principal color. Many gardeners express a preference for green throats; the usual reason given is that green throats look cool and since daylilies bloom best in hot weather, it is refreshing to have the cool look. Personally, I have the same prejudice against green throats that I have against green flowers; there is plenty of green in the foliage. The extent of throat color varies tremendously; it may be only a small accent button or it may reach well down the length of the segments, or even extend fingers almost to the segment tips. This pattern was first seen in Mrs. Taylor's 'Lodestar' and has since appeared in apparently unrelated breeding lines. Such a flower is 'Purple Lodestar' (Corliss).

Midrib Color

As the daylily flower develops, each perianth-segment may be marked by a strong midline of light yellow or (almost) white. The midline color may be faint and barely visible or it may be prominent, as in 'Purple Pagent' (Nesmith) or in the bicolors 'Caballero' (Stout), 'Howdy' (Bremken-Armstrong), and 'Peppermint' (G. Douglas).

Vein Color

The veins of perianth-segments may show variable color patterns, most noticeable in pink-, light red-, and lavender-colored flowers. Variation in the thickness gives prominence to veins in relation to color.

Contrasting Segment Edges

The segment edge may be lighter or darker than the segment color. If lighter, the color should contrast sufficiently so that the lighter edge appears not to be due to fading. A light-colored segment in pink, lavender, or other light color is not as attractive as the dark-colored segments in dark reds, purples, with a contrasting light-colored edge, especially if ruffled. Among the first cultivars with contrasting edges were 'Honey Redhead' (Nesmith), a red with light edge, 'On Parade' (Nesmith), a purple with light edge, and 'Carmen Corliss' (House), a buff with light edge. 'Rosy Day' (Nies) has a rose edge on a buff flower and 'Caprice' (Stout) has a brown edge on a yellow flower. Among some fine new introductions with this feature are 'Step Forward' (D. Hall), with a rose edge on a light pink flower.

Stamen Color

There are some daylilies with black rather than the usual yellow stamens. Black stamens produces an interesting contrast, particularly in the yellow and gold flowers.

FLOWER VARIATION OTHER THAN COLOR

Flower Form

All of the known *Hemerocallis* species have funnel-shaped or bell-shaped flowers. Funnel differs from bell in that flower depth is greater than its diameter; example of funnel: 'Ophir', (Farr). Most of our hybrids have these forms, but breeders have accentuated divergences so that we now recognize five other distinct forms:

(1) Flowers perfectly flat except for the concave throat, as in 'Cartwhells' (Fay-Russell).

(2) Flowers with recurving outer segments. If the inner segments are broad and pointed this makes a triangular flower which is a pleasant change from the round cups. Well-known examples are 'Golden Triangle' (Traub), 'Yellow Triangle' (Bach), and 'Cathedral Towers' (Milliken). In some daylilies the outer segments curl back practically out of sight, giving the novel form of 'Blond Butterfly' (Slaughter) and 'Golden Moth' (Armistead).

(3) Both outer and inner segments may recurve, as in 'Pink Petticoats' (Nesmith) and 'Annie Welch' (Claar). This flower form is quite attractive and especially nice in low-growing plants, as the recurving of the segments tends to produce a small flower.

(4) A novel form is cockeral or cockatoo type in which some of the segments are ascending while the others are recurved. The first important cockerel was 'Golden Cockerel' (Nesmith).

(5) Spider flowers have the segments long and narrow, recurved and often twisted. The best-known spider is 'Kindly Light' (Bechtold), and another outstanding example is 'Daddy Longlegs' (Schroer). Good culture and hot weather are necessary for the most marked spider effect; these cultivars may have up to three complete twists per segment.

Segment Tips

Although there are gradations, we may distinguish rounded and pointed segment ends and segments with twisted and/or pinched tips. Pointed tips in flowers with narrow segments and flat form produce striking stars, such as 'Star of Gold' (Sass).

The first daylily introduction with twisted segment tips was 'Wau-Bun' (Stout, 1929) and this attractive feature is seen in many later introductions, such as 'Athlone' (Russell), 'Yellow Orchid' (Bach), and 'Nashville' (Claar). Oddly, most flowers with twisted and/or pinched petal tips usually have two but not three inner segments so affected.

Ruffling

A refinement not seen in any of the species is ruffling, which may vary from rather wide fluting with only a couple of indentations to the segment to fine crimping. To whatever degree it is present, ruffling adds much refinement to the flower.

Size of Flower

It is quite possible that one day *The*

American Hemerocallis Society will classify daylily flowers by actual size, making a separate class for each inch of diameter, as in gladiolus. However, at present daylilies are divided into only three classes: miniature (under 3 in.), small (3-4½ in.) and others (over 4½ in.). It should be noted that in determining the size of a daylily flower, one measures the greatest diameter *without spreading* any of the segments.

In general, it is safe to say that the size of the flower should be relative to the height of the scape. There are some exceptions to this rule, especially in the *multiflora* type, with extensive branching and numerous flowers opening all at once, when it is preferable to have small flowers. Recently it has become acceptable to have large flowers on low scapes. This happened when the large-flowered but low-growing scarlet 'War Eagle' (D. Hall) found favor. Now there are other large-flowered cultivars suitable for the front of the border, notably Mrs. Bright Taylor's gold 'Chateaugay'.

Small-flowered cultivars, especially some of the newer ones, have great charm, and are especially valuable for the small garden. It is interesting to note that, in general, hybridizes tend to work for giant flowers, and this trend was carried to such a degree in dahlias and gladiolus that the flowers lost much of their popularity with today's gardeners. While there are some fine lady hybridizers who are working with the small-flowered daylilies, notably Miss Spalding (Louisiana), Miss Malinda Warner (Texas), and Mrs. Thomas (Florida), the bulk of the small daylilies have come from the men, such as Stanley Saxton (New York), Hubert Fischer (Illinois), Ralph Wheeler (Florida). Outstanding examples are 'Thumbelina' and 'Golden 'Chimes' (both Fischer) and 'McPick' (Lenington).

Height of Flower Scape

Here, as with flower size, we recognize only three classes: low, medium, and tall. As flower societies are rather notorious for changing their definition of "dwarf," let us arbitrarily class as "low" those cultivars with scapes 24 inches in height or less. The "medium" cultivars are those with scapes 24 to 42 inches in height, leaving all those over 42 inches high as "tall."

A word of caution: Rarely do daylilies achieve the same height every season. They may vary from garden to garden the same season, according to culture. In different climates there may be wide variation. As with bearded iris, those cultivars which require a cold winter dormancy come into bloom at a much lower height in mild climates. And when is height measured, when the first flower opens or when the last one closes?

Probably the cultivar with the shortest scape is Stout's 'Elfin' with flowers that open almost at soil level.

There were some good low cultivars from the leading breeders of the 1940's, among them 'Demi Tasse' and 'Ming Toy' (both Wheeler), 'Starsong' (Nesmith), and 'Jack 'n Jill' (Watkins). However, there are some fine low introductions available from recent workers. such as 'Golden Dewdrop' (B. Taylor) and 'Yellow Rain' (Schlumpf). 'Ivory Glow' (Sass) is usually low, and 'Pink Mirage' (Corliss) is also in this class.

Daylilies in the medium height range are generally preferred, and there are thousands from which to choose. Tall daylilies have never been in much favor with enthusiasts. Their scapes either stand too stiffly above the foliage or they tend to lean or fall over, especially in windy locations. There is a place for tall daylilies in some gardens at the rear of the bed backed by a high fence or house. Hybrids of *H. exaltata* and *H. altissima,* such as those raised by Hamblin (Massachusetts) had much virtue, but were never popular.

Number of Segments

Most daylily flowers have six segments (tepals or perianth-segments). The well-known double-flowered *H. fulva* 'Kwanso' has three or more sets of segments. Occasionally a normal hybrid will produce flowers with extra segments. Some cultivars are especially prone to this

habit, such as 'Ming Toy' (Wheeler). The term cockatoo has been applied to flowers with extra segments or petal-like development of stamens (petaloids). 'Towhead' (D. Hall) almost always has an extra pair of segments, although they may not stand up to produce the cockatoo form. The first double hybrid daylily to be introduced was 'Daily Double' (G. Douglas) with extra segments on about half of its flowers. Stout and Wheeler did much work in breeding double daylilies in their last years. 'Fiddlehead' (Wheeler) is one of these. Now there are many breeders working on the doubles and we may soon expect many new double-flowered cultivars to be available.

GROWING CHARACTERISTICS

Having previously discussed the flower characteristics of daylily cultivars, we shall now consider some other qualities for choosing cultivars. The proper selection of cultivars in the following categories is vital to success with daylilies.

Time of Flowering

Daylilies fall into three principal classes according to the time of day the flowers open (1) nocturnal, (2) extended, and (3) diurnal.

Nocturnal. Since *Hemerocallis* means "beautiful for a day," it may surprise many to learn that some daylilies are not at all beautiful in the day but are strictly "ladies of the night." Insect-pollinated daylily flowers that bloom at night must be light in color and fragrant, in order to attract insects. All daylily species are insect pollinated. The only night-blooming *Hemerocallis* species is *H. citrina* which is both light (yellow) in color and fragrant. Its flowers open just before sundown and close the next afternoon. All night-blooming daylilies are descended from *H. citrina.* However, some with *H. citrina* in their ancestry are strictly diurnal, and the hours of flowering are not predictable in breeding. Nocturnal bloomers, for example, are most desirable for use around patios and swimming pools much used at night. The night-blooming daylily is also of value when used in fresh flower arrangements for dinner or evening affairs providing they open early enough for the occasion. But because of the general lack of interest in night bloomers relatively little breeding has been done in this field. The relatively few good night bloomers that have been introduced actually, were the result, not of planned breeding, but of the recurrence of this *H. citrina* habit. The first good night-bloomer (but with poor substance) was 'Calypso' (Burbank 1917). Among the best-known night bloomers are 'Moonray' and 'Tracery' (both Nesmith), 'Wheeler Halo' (Wheeler) and 'Night Life' (Register). The first two are deciduous and excellent for warm summer nights in the north; the third one is evergreen and suitable for mild climates. 'Night Life' is especially valuable because it opens very early.

Extended bloomers remain open throughout the day and last until at least 10 P.M. Such cultivars are valuable in the patio or pool garden for use both in daylight and evening and for dinner table arrangements. Extended blooming is noted in the cultivar lists pp. 263-267, in registration and in catalogues as "ext."

The *diurnal* daylily normally opens during the daylight hours, although some cultivars may not open until late morning, especially in cool weather. Few gardeners are aware of the time differences in flowering of the diurnal bloomers, not realizing that the flowers seen in early morning may not have opened as the sun rises, but actually may have opened at midnight. The pink 'Show Girl' (Wheeler) opens at 10 P.M. in hot weather, and by 5 P.M. next day it begins to close. Many people complain that it "does not last," not realizing it has a longer blooming span than most daylilies.

The hours of flowering for different cultivars vary every day according to climate and temperature, and from day to day in the same garden. In markedly warmer or colder climates time of flowering fluctuates widely. For example,

'Night Life' opens in my southern Arizona garden at 4 P. M., while in Georgia it opens around 7 P. M. In my garden 'Amur Valley' opens at 9 A. M. in the morning in hot weather, but not until 11 A. M. or noon in cold weather or in the early or the late part of the season.

In cool weather some flowers remain open, or partly so, for three to four days. I do not consider this a virtue for the daylily really requires heat to put on a good show and is not at its best in cool weather.

Some breeders are working for daylilies that will remain open two or more days. This may be acceptable where bloom is sparse, but if a daylily has been through a full day of heat, sun, rain, wind, or suffered the vicissitudes of human or insect damage, I think it should gracefully fold its segments and drop, leaving tomorrow for its fresh flower.

Season of Bloom

Diverse factors influence the beginning, climax, and the end of the blooming season for each daylily cultivar. Although scores or perhaps hundreds of registered daylilies begin their flowering every day of the season, the exact day varies from year to year and from region to region. For a specific region it may be possible to create a number of intermediate classes, but since these classes will not be the same in other regions, it is still best to speak only of *early, midseason,* and *late* bloomers, plus those which repeat dependably (*remontant bloomers*) and those which, once in bloom, continue to bloom until the end of the growing season (*continuous bloomers*).

Choice of season for daylily bloom may depend on how you live. July and August spent on vacation means midseason bloomers at the cottage, and early and late daylilies in the home garden. During periods when the home garden is low in flowering plant material, choose daylily cultivars to bloom at this time. Residents who live far to the north may wish to avoid extra early or very late daylilies which might suffer from frost. In a mild climate the choice may be for continuous flowering by selecting early bloomers which are dependably remontant. Sticklers for genealogy will find that most dependable repeaters have the evergreen *H.* × *aurantiaca* in their ancestry.

Factors responsible for the season of flowering. The four most important species used in daylily breeding for time of flowering and for other desirable characteristics:

a) *H. fulva* and its varieties for color other than yellow or gold. *Midseason.*

b) *H.* × *aurantiaca* for large flowers and evergreen habit. *Midseason.*

c) *H. citrina* for night bloom and fragrance. *Midseason* but later than the two above.

d) *H. multiflora* for large number of flowers and extensive branching. *Late.*

Early Bloomers. The four early flowering species are *H. lilioasphodelus* (*H. flava*), *H. minor, H. middendorffii,* and *H. dumortieri.* All have few flowers on a scape, but have been used for breeding small-flowered and dwarf hybrids. The first two are noted for paucity of flowers and are not known to reflower, so that the two latter have been more extensively used in breeding.

Middendorffii and *dumortieri* will be found in the lineage of many of the good early season hybrids which have vigor, flowers of good form, and attractive foliage and growth habit. In hybrids of *H. middendorffii* or *H. dumortieri* × *H. fulva* or *H.* × *aurantiaca* the period of bloom usually is moved forward. An exception to this is 'Blanche Hooker' Stout) which is the first hybrid with red flowers to bloom in most regions; its color and evergreen habit show the ancestry of *H. fulva* and *H.* × *aurantiaca.*

Among the earliest bloomers are the following:

'Gold Dust' (*H. dumortieri* × *?*)

'Apricot' (*H. lilioasphodelus* × *H. middendorffii*)

'Sovereign' (*H. lilioasphodelus* × *H. dumortieri*)

Midseason bloomers. The great majority of daylily hybrids are midseason bloomers, varying as to date by region and ancestry. Species that bloom in mid-

season with qualities responsible for their wide use in breeding are:

H. fulva and varieties
H. × *aurantiaca* and its cv. 'Major'
H. thunbergii
H. citrina (a bit later than the above three)

We get colors other than yellow and gold from *H. fulva* and its varieties; large flowers and evergreen characteristics from *H.* × *aurantiaca*; robust growth and habit from *H. thunbergii*; fragrance and night blooming from *H. citrina*.

To find examples that show the genetic influence for midseason bloom, the following early introductions serve as examples:

'Mikado' (involves *H. fulva* and *H.* × *aurantiaca*)
'Hyperion' ('Sir Michael Foster' × 'Florham')

'Sir Michael Foster' is a poor seed parent. It comes from *H.* × *aurantiaca* 'Major' (midseason, large-flowered, evergreen) and *H. cirtina* (late season, night-blooming, fragrant). For twenty years I tried to use 'Sir Michael Foster' as a seed parent, because it is fairly early, in mild climates, vigorous, large-flowered, with excellent garden habit, and a most dependable rebloomer. Occasionally poorly developed seed capsules developed with one or two non-viable seeds. Only one season did capsules develop with viable seeds. From these seeds I raised plants whose flowers seemed identical to 'Sir Michael Foster' but because of its low fertility, I questioned its role as a seed parent of 'Hyperion'. The pollen parent of 'Hyperion' is 'Florham', which comes from *H.* × *aurantiaca* × *H. thunbergii*. If we accept the four grandparents given for 'Hyperion', we find that its season of flowering does indeed fit into its expected place in the calendar:

H. aurantiaca 'Major' (midseason)
H. citrina (late midseason)
H. × *aurantiaca* (midseason)
H. thunbergii (midseason)

Late bloomers. The species of greatest importance in breeding for late bloomers is *H. multiflora*. It has the most extensive branching and the largest number of flowers on a scape of all the species. Since it had to be used with species or hybrids which had an earlier season of bloom, its offspring are generally earlier, but selection of late bloomers has been made by those breeders who sought this characteristic. There was also some use of *H. altissima*, but most of its offspring, like their parent, were too tall for general acceptance. Two of Dr. Stout's introductions were important in breeding for late bloomers, namely 'August Pioneer' and 'August Prince' both having *H. altissima* in their parentage.

Remontant and continuous bloomers. In mild climates the vast majority of modern daylily hybrids have more than one round of bloom. The number of repeat periods of bloom depends on length of growing season and genetic makeup of the cultivar. We know that the early flowering species *H. lilioasphodelus* and *H. minor* never rebloom. It is rare for *H. fulva* and its varieties to rebloom and the same holds true for the somewhat later *H. citrina*, and, of course, the late *H. multiflora* never reblooms. The most important ancestor for reblooming is H. × *aurantiaca*.

Many breeders pay great attention to repeat bloom, and careful selection of seedlings has resulted in the introduction of many fine daylilies depended upon for at least two rounds of bloom in the north and three or more in the south.

The average daylily hybrid dependably flowers over at least one three-week period. When considering number and size of flowers produced during this period, few perennial plants can equal the daylily for abundance of flowers. The remontant bloomers are even more valuable in this respect and such cultivars are usually so indicated in catalogues.

A further goal in breeding is for continuous or truly everblooming daylilies. Some of the remontant bloomers send up new scapes soon after the first round finishes, but these are some whose flower scapes are already well-advanced before

the first round has finished. Of today's fine hybrids the lovely melon-pink 'Mary Lawrence' (MacMillan) is outstanding for this characteristic. Another is 'Golden Pinafore' (Corliss), an established plant of which produces a constant succession of flowering-scapes.

One should note that in mild climates, where several flushes of bloom are produced, the number of flowers on a scape is often markedly less than when only one round of bloom is expected. This may not be wholly disadvantageous, as a scape with many stumps, scars, and capsules is not attractive.

FLOWERING IN RELATION TO CULTURAL PRACTICES

Establishment of Plant. Flowering the first season after replanting is usually not typical of the cultivar, due to interruption of its growth cycle; it may bloom earlier or later than is normal for that cultivar. When a cultivar becomes well-established, with many fans and a good root system, it will produce many more flowers over a longer season.

Climate. The same daylily cultivar may bloom in March in mildest climates and in June in cold climates. In my southern Arizona garden a cultivar that flowered first in June was considered to be a "late." If, by "early" you mean "early in the daylily season," there is merit to classifying daylilies as "early," "midseason," and "late." Otherwise, the season of flowering for each climate should be specified. Since most daylily hybrids have some genes of H. × *aurantiaca*, they will rebloom at least once in mild climates. It is possible to cross the second round of bloom (or even the third or fourth round) of an "early" cultivar with the flowers of the first round of the later cultivar. In this way, cultivars originated that were intermediate and filled out the flowering season. Some of our northern breeders used pollen from "lates" sent them by growers in the South to produce capsules on "early" daylilies in the North.

Growing conditions. Everyone knows that the temperature is never identical, day by day, for any two years. Certain regions may have a "growing season" of two hundred days; others of three hundred days. But this is an average, and one cannot expect succeeding years to have exactly the same number of growing days. Dr. Stout listed the dates, certain cultivars flowered in New York. The following dates are for first flowering of 'Blanche Hooker' in my southern Arizona garden:

1958 — February 24	1960 — March 10
1959 — March 12	1961 — March 17

Length of day, and minimum temperatures affect growth and flowering of daylily. Daylilies that require a cold-dormant period fail to bloom and are short-lived if kept in active growth throughout the year. Alternately, evergreen cultivars if they survive winter injury in the North may respond by sending up few to many grassy fans with no, or few, scapes the following season. Some daylilies respond to heavy feeding while others produce rank foliage but sparse bloom, even with light feeding. Whatever the reason, there is a difference in the onset, climax, and duration of the flowering season resulting from varying growing conditions.

CHARACTER OF FOLIAGE

The real *bete-noire* of regional performance for the daylily is the evergreen-dormant factor. An evergreen daylily remains green throughout the year barring killing frost and freezes. The dormant (winter-deciduous) daylily has a period of rest during cold weather (frost is not necessary) when all foliage dies back. The semi-evergreen (semi-dormant) cultivars do not completely die back during cold weather. There are no completely evergreen hybrids. The only evergreen daylily, *H.* × *aurantiaca*, was crossed with dormant cultivars to get the so-called evergreen hybrids. Most dormant hybrids carry genes for evergreenness, since it was necessary to use H. × *aurantiaca* to get large flowers; hence only small-flowered cultivars may be expected to carry dormant characteristics only. This is to say that almost every modern daylily hybrid has some

evergreen and some dormant genes. A correct combination for these two characteristics exists for every climate. For maximum performance, it is necessary to find cultivars with the right combination of characteristics for specific climatic situations.

In a cold climate, do not plant evergreen daylilies. Under no circumstance should dormant cultivars be planted in a frost-free climate. They will bloom the first season, perhaps the second, especially in one of those "unusual" cold winters, but after one normal warm winter dormant daylilies will not flower the next season. Each year they send up some foliage but less and less each year. One year the leaves look like blades of grass; the following year no grass.

COLOR OF FOLIAGE

Daylily leaves are green or glaucous (blue-green) with all grades between. I think the choice is relatively unimportant. There is also the variegated foliage of *H.* 'Kwanso Variegata', a most attractive trait which recommends this plant for any garden. Variegated foliage often appears in seedling beds but the plants usually do not survive. Albino seedlings never survive. The low survival of variegated seedlings is due to the difficulty experienced with all plants lacking sufficient chlorophyll. The foliage of some daylilies tends to yellow easily. This is a characteristic which can be traced in some lines of breeding. It is a real weakness trait and such cultivars should be avoided.

BRANCHING OF SCAPE

Two principal types of branching are recognized: (1) Low branching and (2) high branching.

Low branching, at its best, produces a veritable tree of flowers, but at the end of flowering only buds on the lower part of the scape, often hidden in the foliage, remain in flower, at which time the scape is topped by a bare skeleton and seed pods. High branching gives a fairly uniform height of bloom and if you have a low, a medium, and a tall variety properly placed you will have a pleasing effect at all times. A favorite type of branching for some is found in plants which first seem to produce only one bloom, followed by a succession of buds and flowers from the same terminal point.

In cold climates, where there is but a single round of bloom, it is important to have as many buds as possible on a scape. Cultivars which may have from 50 to 100 flowers on a scape on a single inflorescence in the North may have only 10 to 15 flowers on a scape in the South, but there is a succession of scapes.

TYPE OF GROWTH INCREASE

The hybrid daylily which may be most desirable for the home garden is one that multiplies seemingly by a division of the crown but actually proliferates by extremely short rhizomes. Plants with slightly longer rhizomes are preferred because they are more easily divided. The long rhizomatous growth habit is characteristic of *H. fulva* and its many variations, such as the 'Hankow' daylily, and in most of the early daylily hybrids offered in England and Europe. The long rhizomatous growth habit has been largely bred out of most modern hybrids with *H. fulva* ancestry. This is fortunate since long rhizomes are a nuisance in mixing of cultivars in gardens. The one important use of daylilies with rhizomatous growth is for landscaping or soil erosion control.

CHROMOSOME NUMBER

At present, by far the greatest number of daylilies available are diploids. (See chapters 5 and 6 for a full discussion of diploid and tetraploid daylilies.) Tetraploids are relatively new. In general, diploids are more graceful because they lack the heavier substance of many tetraploids. However, some tetraploids are graceful and with all the desirable variations of diploids.

Triploids are not fertile and usually without seed capsules. No breeder has yet produced a triploid.

Many think that tetraploids are the daylilies of the future. One very definite improvement in tetraploids is the

greater number of flowers and scapes in relation to the amount of foliage, and they are more vigorous in growth than diploids. Of course care must be taken to select tetraploids that are not too leathery in flower texture nor too gross in stalk.

FRAGRANCE

Many people find fragrance one of the most desirable qualities in any garden flower. To most people it is an added virtue. Some rarely smell flowers or care little for fragrance. Heavy smokers and sinus sufferers may have an impaired sense of smell. Some people cannot tolerate fragrance of any kind because of allergies, and anything that stimulates their olfactory nerve may produce unpleasant reactions.

Many fragrant daylilies are available, all descended from *H. citrina,* the fragrant night-blooming species. As noted above, the night-blooming factor is not transmitted in a simple manner to progeny; neither is fragrance. Do not expect to find a daylily that will perfume your garden; the fragrance is never that strong. As with all fragrances, people rarely agree on a description of the fragrance nor on its degree. One friend never leaves my daylily garden without her nose covered with daylily pollen. She tests every flower for fragrance.

UNDESIRABLE CHARACTERISTICS

We will briefly note here some characteristics which may appear in daylily breeding programs but which should result in immediate destruction of such plants lest this bad characteristic be carried into future generations:

1. The unfortunate and transmittable characteristic of yellowing of the foliage not due to cultural faults.

2. Flowers that fail to bloom above the foliage.

3. Scapes with excessive weakness or thickness. The ideal scape is one with a gentle arch and which sways with the breeze, not stiff to be broken in the tempest with its flowers blown off. Nor should scapes sweep the ground with every zephyr's puff or fall to the mud in the rain.

One of Dr. Stout's postulates was that a good daylily should be clean in habit, that is, it should drop its spent flowers at night. The daylily flower is easily pollinated, and the pollinated flower does not shed its segments for several days. If we insist on this requirement it would mean we would have to forego most fertile daylilies. It seems preferable to accept these fertile daylilies and to clean them by hand if one does not want capsule formation.

Does it fade? Or melt? Will it stand dry heat? Humid heat? These are things one should know in choosing daylilies, not only for the garden but for every particular part of the garden. Some fine cultivars that fade in full sun should be moved to a site with afternoon shade. Some pink, rose, and melon-color cultivars that actually improved after fading may be grown in such locations to enhance their charm.

—5—

Breeding of Diploid Daylilies

WILLARD A. KING

Daylilies as they occur in nature are diploid (that is, each cell contains two sets of chromosomes, one from each parent). The number of chromosomes in each daylily cell is 22. There are a few triploid clones, such as *H. fulva* 'Europa' (with three sets of chromosomes) and a few aneuploid (clones with an irregular number of chromosones).

For the amateur it would be hard to find a better plant to use in breeding if he wishes to extend his talents into this area. No formal training is needed as the flower parts are large and easily found. One will find it a most rewarding venture as most of the newer and better daylily cultivars now on the market were produced by amateurs in their own little breeding patch.

The flower parts for seed production are the pistil and the stamens. Pollination is the process of dusting pollen from an open anther onto the stigma at the end of the style. Pollen grains embedded on the moist stigma, germinate and grow tiny pollen tubes down through the style and find their way to the ovules. Each pollen tube discharges two sperm cells, one of which units with an egg cell in the ovule, to form the embryo that develops into a seed; the other units with the polar nucleus to form endosperm which encloses and feeds the embryo as it develops into a seed. This process is called double fertilization. Each new seedling obtains half its hereditary characteristics from each parent. Pollination and fertilization cause the development of a seed capsule containing small seeds which mature in six to eight weeks.

The actual crossing technique is very simple. For best results crosses should be made as soon as the anthers containing the pollen have opened and the pollen is plainly visible. Crosses may be made earlier. By squeezing the anthers end to end, the anthers may be made to open and the pollen used. A dry morning, with the temperature 72° F. is ideal. Early pollination is advised because pollen dries rather quickly on a hot day and by noon it may have blown away, shaken out, or have been knocked off by bees or other insects. Additionally, early pollination offers some measure of assurance that the cross was made before the bees had a chance to pollinate and before the temperatures are 90° F. to above. It is estimated that three hours below 90° F. (optimum about 72° to 80° F.) are required for the pollen tube to begin growing down the style into the ovary. Rain or temperatures of 90° F. may prevent pollen-tube growth during the period of initial pollination. Another method is to pollinate the stigma of an unopened flower the previous evening.

Normally about half the crosses are successful. Occasionally a cross will not succeed because of sterility or incompatability between cultivars. There are many technical reasons for this, most of which are not completely understood. Records should be kept of crosses; by doing so one will know which cultivars give trouble and which ones produce the most seed.

If flowers of selected parents do not open together, the pollen of choice cultivars may be stored for future use. Small gelatin capsules may be obtained from a drug store together with capsule containers. The anthers should be removed from a flower and the pollen scraped from the anthers onto the edge of the capsule. Do not include the filaments or anthers which have a high moisture content that will destroy pollen in a short time. The capsule containing only pollen is then covered and dropped into the capsule container. A glass fruit jar may be used for storage after putting a saturated solution of zinc chloride into the jar; the capsule containers are

suspended above the solution and the lid closed tightly. The zinc chloride reduces the humidity to about 10 percent. The jar should be stored in the refrigerator (not the freezing compartment), and the pollen will be usable for many weeks. With uncontrolled humidity and temperature pollen lasts only a few days but long enough to send to distant friends for use.

After making a cross, the flower should be marked with a tag tied just below the ovary. With a weather-proof pencil, the names of both parents are written on the tag, placing first the name of the seed parent followed by an "×" which means "pollinated by." Then write the name of the pollen parent (Example: 'Shooting Star' × 'High Noon'). A lot of work can be saved by writing only the name of the pollen parent when the cross is made and later writing in the seed parent name when seed is harvested. As the seed pods ripen they gradually turn yellow, then brown. When the pods begin to break open at the top the seeds are ripe. When the pods are harvested, the tags give positive identification of the seeds. The seeds should be removed from the pods and put into a small coin or plastic envelope and stored in a cool dry place until planting time. In areas with mild winters seeds may be planted immediately in one-half inch drills, about one inch apart. In colder climates planting should be delayed until the soil becomes cold for the winter. A good mulch over the rows of seed prevents drying and heaving. Seeds may also be planted in early spring when the daffodils begin to peep through the ground. The seed from each cross should be labeled and in case the labels get lost a record made of the planting. Meanwhile, the seeds should be stored in a refrigerator until planted.

When the seedlings have germinated and are a few inches tall, they should be transplanted in the place prepared for them. The young plants should be spaced no less than six inches apart and the rows no less than two feet apart. If there is enough space, it is better to sow the seed sparsely in drills and allow the seedlings to grow to blooming size without transplanting. Some professional and advanced horticulturists with access to a greenhouse plant the seed in flats and transplant seedlings to pots or directly into the field; but even with this method a cold rest period for the seeds of deciduous cultivars is beneficial, and often necessary. Greenhouse growing is a vast subject in itself, and one should investigate this type of cultivation before starting on such venture.

Unfortunately, there are no simple rules for making crosses. The breeder is lucky if he possesses the talent for selecting the right parents. Unless one is a professional or an advanced amateur breeder, the simplest rule to follow is to cross the best new daylilies, making sure both parents are in the same general color range or class. Much may be learned from daylily specialists and breeders, and much practical data may be obtained from daylily publications.

Another breeding technique is "line breeding." If cultivar "A" is crossed with cultivar "B" and the result is exceptionally good seedlings, then the next step is to cross some of the better sister seedlings with each other. Re-selecting the best seedlings of this cross and further crossing sister seedlings or cousins, as well as crossing a daylily on itself (known as "selfing"), constitutes line breeding. This technique carried on for a number of generations within the same hereditary line should bring out the best from the original cross of A and B. Crossing sister seedlings and selfing are often discouraging because many of the pollinations do not take. This is why outcrossing wins so many converts. However, by selfing many different cultivars, some can be found that produce vigorous seedlings. If seedlings from line breeding begin to lose vigor it is best to cross them with a new cultivar unrelated to cultivars A and B or with the best of another line of breeding. This is known as outcrossing, and one can improve the weaker hybrids by selecting a new cultivar with the good qualities lacking in the hybrid.

Some breeders have thought that with line breeding, vigor and size would be lost. This has proven to be a fallacy as many modern breeders have found that seedlings from line breeding may be larger and more vigorous than their ancestors, and a larger percentage of seedlings are selected for further study than those of earlier generations.

Many of our more advanced daylily breeders use line breeding, and one of its greatest disciples was the renowned Ezra J. Kraus. His experience proved that it is better by far to work with a few cultivars from which definite lines of breeding can be established than to continue to make a multitude of haphazard crossings. His reasons are set forth here:

"In any hybridizing program it is absolutely essential to establish as soon as possible the breeding capacity, the gene complex, of the varieties with which one wishes to work. To explain a bit further: it is assumed on very good evidence that the characteristics a plant displays, whether flower size, color, form, bush habits, season of bloom and the like, are determined by what are called genes, within the chromosomes and by the interaction of those genes. Genes can be worked with as definite entities, which can be put into the make-up of a plant or left out of it, more or less at will by the hybridizer, if he knows with what he is working.

"In a way, genes are to any hybridizer what the alphabet is to language or notes to music. Think of the thousands upon thousands of words which can be made up and used in speaking or writing by the use of 26 basic letters, or the hundreds of thousands of tunes which have been and will be made up and played by the use of some 64 basic notes. It is possible, of course, to take any word or sentence and fairly quickly reduce it to its basic letters and then rearrange them into entirely different words or sentences. The same is true for a piece of music. But when we wish to analyze a plant in a similar manner, the process is longer but can be made just as direct. Its genes and their interaction are determined by selective, controlled breeding, by crossing of one chosen plant with another. Through growing many hundreds of plants and noting their characteristics shown by the offspring, the gene complex of the parents can be determined. When once determined, the knowledge is of incalculable value. Thus eventually, one could come to know the genes for any certain clone, those which determine its flower size, color, shape and so on. (*Ed. note.* A clone consists of all plants derived vegetatively from one seedling or one named cultivar.)

"Some of these characteristics may be the outward manifestation of the interaction of more than one gene. Likewise, certain genes may be present and yet such presence not be obvious in any particular plant. Such is called a recessive gene. Through continued breeding it may eventually meet with its counterpart from another daylily and when they thus occur in duplicate, their presence usually will be revealed in some visible external characteristic."

The outward manifestations of daylily characteristics are the result of *dominant* genes, and breeders, through experience, have found out that narrow, wiry foliage is dominant over broad foliage; eye-zoned cultivars are dominant over those with no eye-zone; red flowers are dominant over yellow; and evergreen habit is dominant over dormant habit. Much time can be saved if this is kept in mind.

It is more fun if one has objectives in breeding, such as producing cultivars hardy in the North as well as the South, or getting a clear lavender or a red which will not scorch in the sun, or a cultivar which blooms continuously instead of only two or three weeks. Better branching and more bud production is still much to be desired in some of the very newest cultivars. Anyway, a new breeder does not know he has lived until he gets up some summer morning and sees his first daylily, one which he has produced by cross-pollinating some two or three years back, one unlike any other which ever bloomed. It may not be a winner, but to him it will be the prettiest flower ever.

—5a—

Breeding of Miniature Daylilies

MELINDA WARNER

Miniature daylilies provide an exciting new frontier for the ambitious hybridizer. My interest in hybridizing was initiated six years ago. Originally, my eleven-year-old soul loved little flowers because they seemed to be custom-made like my toys—for my miniature world. Now, I realize that they are made for everyone and that development of their characteristics adds a new dimension to the overall picture of the daylily.

The rules for judging quality and distinction in large flowered daylilies are applicable to miniatures. My evaluation of a flower includes inspection for beautiful form, unusual color, a green throat, blooms of good texture and substance, average or better than average number of buds, and good proportion in the size and height of the bloom-scape. Another feature to look for is repeat bloom. Seedlings which do not have several of these qualities or some other distinctive feature, are quickly discarded.

Because miniatures are in a class of their own, hybridizing with them involves certain specific goals of its own. My cross-breeding is directed toward (1) new and unusual colors, (2) smaller blooms, and (3) short scapes. The first objective, new and unusual colors, justifies itself; at the present time the smaller ones do not have the variety of color possessed by larger daylilies. The second goal is self-explanatory. The third goal, short scapes, is important because, proportionately, small blooms are set off to the best advantage when the bloom-scapes are under 24 inches in height.

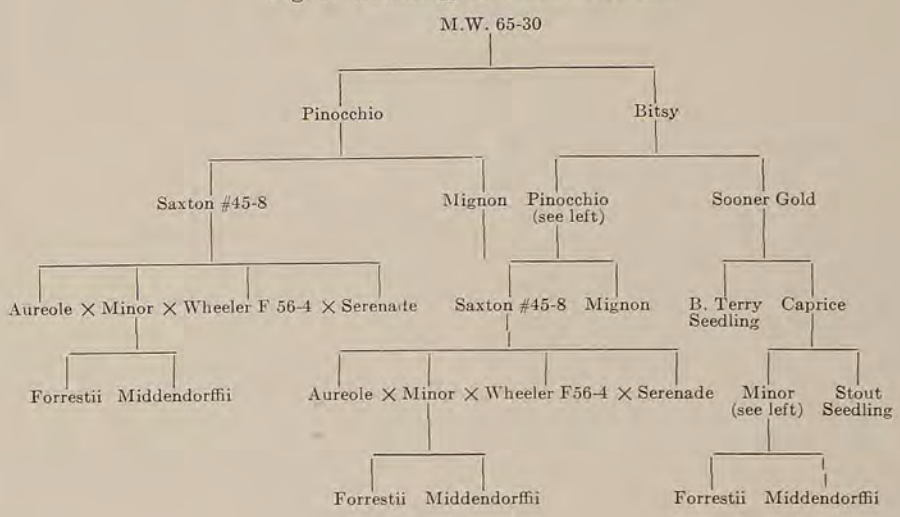
Desirable though these aims may be, the finished product is not achieved without a well-organized hybridizing program. Such a system includes the procedure of cross-pollination as well as the selection of cultivars to be used. The would-be hybridizer can learn from experienced friends, and articles on hybridizing (e.g., those in *The Hemerocallis Journal*). Careful perusal of the checklists to observe what has consistently produced a good miniature for other hybridizers is a worthwhile winter pastime.

The goal of every hybridizer is to develop a flower which is distinctive from other flowers of its kind. Until I had first and second generation miniature hybrids from my efforts, I selected and purchased seedlings from outstanding hybridizers, in addition to named cultivars. T. E. Hughes, Miss Edna Spalding, and Allen Wild helped select seedlings to incorporate into my line. In this way, not only superior cultivars (named), but several select seedlings were available for parents. This course of action is still a constructive aspect of the work.

An idea which produces favorable results is the crossing of daylilies with flowers 2-3 in. in diameter with flowers 3-4 ½ in. in diameter. This procedure proves to be a good beginning because by using both flower sizes, more of the desirable characteristics are in the genetic make-up of the resulting hybrids, and the flower diameter of the progeny is still under 4½ inches. The smaller flowered plants of the progeny are selected for continued inbreeding.

In our garden we grew almost all the miniature cultivars of Stanley Saxton. Therefore, I feel that I started "at the top." He had been interested in miniatures for many years and had devoted much time and effort to improving them. His 'Pinocchio' gave a tremendous boost in successful crossing for mini-

Fig. 1. Genealogy of an Hemerocallis



atures. Its chief attributes are desired size and high fertility.

As part of the hybridizing program, which was entered in the 1966 International Science Fair, a genealogy of 'Pinocchio X 'Bitsy' (Fig. 1) was prepared. The goal of this cross was an improved yellow miniature daylily. The chart was prepared to explore and to understand the observed genetic characteristics, and the potential genetic characteristics which could be expected in future progeny. *Hemerocallis minor* appears in the parentage three times. In only one line does it not appear. The species *H. minor* is a small, low growing, early blooming golden yellow daylily. This genealogy analysis demonstrates some inbreeding. One notes that the recessive traits in *minor* continue to appear and reappear in the successive generations, particularly in the cross 'Pinocchio' × 'Bitsy.' All seedlings with this parentage are small, with early blooming yellow flowers.

The actual crossing, tagging of crosses, and record-keeping of hybridizing miniatures are no different from comparable work with larger flowered daylilies. However, seeds of miniatures are smaller than those of large-flowered kinds. The seeds are dusted with Semesan or Arasan 75 to control soil fungi. Rows are marked with redwood boards. A shallow groove is filled with vermiculite to the bottom edge of the board, and the seeds are planted with tweezers. Rows are filled with vermiculite to the top edge of the board. This procedure keeps the seeds of a cross within its planting area, and insures the accuracy of the records. Each row is marked with a row stake, giving the cross and number of seeds planted. In the spring the boards are removed after the seedlings are a few inches tall.

If only three daylilies were selected as parents in breeding miniatures, the choice would be 'Pinocchio' (Saxton) for size and fertility; 'Luxury Lace' (Spalding) for its dependable contribution to purity of color both in pink and lavender and its ability to contribute a green throat; and 'Bitsy' (Warner) for size, fertility and exquisite form, as well as its genes for rebloom and low bloomscapes.

—6—

Tetraploid Daylilies

VIRGINIA L. PECK AND TORU ARISUMI

Two decades ago tetraploid daylilies not only were of no interest to the average horticulturist but were, indeed, completely unknown to anyone except a very small number of professional botanists. Today tetraploid daylilies have emerged from their obscurity to join the ranks of other tetraploid flowering plant species which are grown for their horticultural and commercial value. Their increasing importance has aroused the interest not only of the hybridizer and commercialist but also of the average daylily enthusiast. This chapter has been prepared to help toward an understanding of the nature of tetraploid daylilies and the basic facts involved in their production and breeding. Some technical language is inherently necessary in a discussion of the subject; but a conscious effort has been made to simplify analyses and descriptions of procedures, as well as to clarify technical terminology which might be a barrier to non-professional but interested horticulturists.

Description and History

Plants and animals all have a basic complement of chromosomes, small bodies within the cell nucleus which carry the genetic factors. This basic complement is known as the haploid number of chromosomes. The gametes (sex cells) of each species have the haploid number of chromosomes (Fig. 7a). When two gametes, male and female, are united, the zygote is formed, which has the diploid number, twice the haploid number. Most plants are diploids; that is, they have two identical sets of chromosomes in each cell. Polyploids are plants with more than two sets of chromosomes. A tetraploid is only one of a whole series of polyploids: triploids have three sets of chromosomes, tetraploids four sets, pentaploids five sets, and so on. The number of sets of chromosomes may be increased either by natural or artificial means. Tetraploidy can arise accidentally in the vegetative cells from sudden cold or heat, or it can be the result of the union of unreduced gametes during sexual reproduction. Also it can be induced artificially through the use of chemicals, such as colchicine, acenaphthene, and para-dichlorobenzene.

Spontaneous chromosome doubling occurs frequently in nature among both cultivated and wild species. By one estimate as many as 50 per cent of flowering plant species are polyploid in some form. However, with the exception of a few triploids, polyploid daylilies occurring through natural evolutionary processes have not been reported. In 1932, A. B. Stout described the results of a general survey of chromosome numbers in daylily. The somatic number of 22 chromosomes is basic for all species of daylily, with the exception of several clones which he found to have 33 chromosomes.

In 1937, the antimitotic effect of colchicine, an alkaloid isolated from the autumn crocus (*Colchicum autumnale*), was proved experimentally. This gave impetus to extensive attempts to induce polyploidy artificially in both ornamental and agricultural plants, using colchicine as an agent for increasing chromosome number. The superiority of the induced polyploid over the diploid forms in many species led to experiments with colchicine to induce tetraploid daylilies during the 1940's. Pioneers in the development of tetraploid daylilies were Robert Schreiner, W. Quinn Buck, and Hamilton P. Traub. Schreiner reported flowering several tetraploid clones in 1947, among them a treated plant of 'Cressida', later named 'Brilliant Glow',

Fig. 1 (below). Eight-months old seedlings. (a) Plant showing exposed crown ready for cutting (b) Crown with ¼ in. hollow at the center ready for colchicine solution.

Fig. 2 (right). Treated crown showing thickened growth at center. Unaffected normal sucker on left should be removed.

and several related seedlings all treated with colchicine, by him as a University of Minnesota student. In 1949 Quinn Buck of the University of California at Los Angeles reported the flowering in 1948 of colchicine-induced tetraploid forms of the diploids, 'Soudan' and 'Kanapaha'. In 1951 Traub gave a detailed description of his experiments at the United States Department of Agriculture in Beltsville, Md. on colchicine-induced tetraploid daylilies *(Plant Life,* Vol. VII). The cultivar 'Tetra Starzynski', which flowered in 1949, was analyzed as his first complete tetraploid.

Significant progress with tetraploid daylilies has been made since these early experiments, both by these pioneer workers and others. During the 1950's Robert Griesbach and Orville Fay treated many small seedlings, and by 1959 they had flowered over 100 tetraploids. From their work emerged the Crestwood series of tetraploids 'Ann', 'Lucy', 'Gold', 'Evening', and 'Bicolor'. These, together with the productions of Traub and Buck, have constituted the nucleus of a tetraploid breeding program for many hybridizers. During the 1960's greater diversity of breeding material has become available through colchicine treatment of plants of different genetic lines, both by professional and amateur workers. In 1964 Toru Arisumi, United States Department of Agriculture, Beltsville, Md., reported that colchicine treatment of a number of named cultivars of various genetic backgrounds resulted in 17 tetraploid forms. Hundreds of dedicated amateur breeders have treated plants with colchicine in an effort to convert old favorites to tetraploids, and to produce new favorites of their own breeding. Improved cultivars as progeny of induced tetraploids have been produced, and a limited number have already been introduced into commerce.

Though present day tetraploid daylilies are far superior to their early predecessors, they are also far from their potentialities. Rapid achievement of this potential has not been possible because of the problems encountered in breeding on the tetraploid level, particularly with the induced tetraploids, and the difficulties involved in inducing desirable new tetraploid breeding material. Various workers are seeking to overcome or lessen these difficulties through scientific investigation. Arisumi, Darrow, and Peck have reported studies of the nature of the changes in tissue development in chimeral polyploids, identification and

A B

Fig. 3 (a) Diploid 'Chetco' flower. (b) Colchicine - induced larger tetraploid *Chetco* flower.

A B

Fig. 4. (a) Diploid 'Chetco' seedpod longer than tetraploid pods. (b) Tetraploid 'Chetco' seedpods thicker than diploid.

isolation of tetraploid tissue in induced tetraploids, uses of chimeral tetraploids in breeding, use of artificial growth substances as an aid to seed set, *in vitro* culture of immature embryos, and also more effective techniques in inducing polyploidy.

Tetraploid daylilies have a number of advantages over diploids. In the tetraploid the flower is larger (Fig. 3); the color of the flower is more intense; the scape is sturdier and stronger; substance of both flower and foliage is increased; and vegetative vigor in leaf, stem, and flower is greater. Another advantage lies in breeding potentialities with an increased number of chromosomes. Theoretically there should follow a parallel increase in the range of heritable traits through tetraploid segregation and recombination of characters, thus enlarging genetic scope. If the beauty of the plant or flower depends upon flexible perianth-segments, thin graceful scapes with miniature flowers, or thin small leaves, induced polyploidy will not improve the flower. Among daylilies the general superiority or inferiority of the tetraploid over the diploid has not been established for certain physiological characters, such as resistance to drought, heat, cold, disease, and insects, tolerance for extreme soil alkalinity, acidity, fertility, or growth habits such as re-bloom or flower-bud count. Some tetraploid seedlings have more flower buds and are more persistently remontant than their diploid forbears. But this is not conclusive evidence of superiority in this respect, as these characters could be the result of genetic combinations rather than doubling of chromosomes.

Artificially Induced Tetraploidy

Colchicine doubles the diploid (2x) number of chromosomes by acting upon cells which are dividing. After chromosome splitting into twice the regular number, colchicine prevents the formation of the nuclear division spindle and

stops cell division at what is called metaphase. Then usual distribution of the daughter chromosomes to both cell halves does not take place, nor does formation of the cell wall. As a result cells with a doubled number of chromosomes (4x) are formed after the nucleus reforms. Since cells in the resting stage are not sensitive to colchicine action, polyploidy can be induced only in tissues with actively dividing cells.

There are numerous techniques for inducing polyploidy through the colchicine method, all of which achieve the same final objective for all flowering plant species. A simple method is to apply colchicine to a stem growing-point (meristem) to stop cell division at the right stage, and also to allow for rapid recovery of the plant after treatment. The growing-point of the daylily is located at the top of an underground stem, which is partially surrounded by leaf bases which make up much of the visible part near the ground line. Some workers have used hypodermic needles to inject colchicine into the growing point. Others split the fan or ramet partially before applying the colchicine. Still another method has been to lift the plant and soak all of it, including roots, in the colchicine solution. Some workers invert the plant and soak only the crown in the colchicine, protecting the roots from exposure both to the colchicine and to drying out. Mature fans, young plants, and newly germinated seedlings have been used in these experiments. Two methods of using colchicine which have worked well for the authors are described in some detail below.

The first of these methods is treatment of the growing-point of a mature plant. When greenhouse or indoor facilities are available, the colchicine treatment may be started at any time the plant is growing vigorously. The plant is potted in a two- to six-inch clay pot in loose, well-drained soil with the crown exposed above the soil level. The fan is cut about one-half inch above the lowest leaf base, and a little of the central portion of the stump is carefully dug out with a scalpel to form a very shallow cup or cavity about one-fourth inch deep (Figs. 1, 2). The growing-point and the surrounding tissues are then soaked with colchicine solution poured into the cup or dropped with a pipette. An aqueous solution of 0.2 to 0.5 per cent colchicine with 1-3 drops of 10 per cent Santomerse per 10 ml of solution is used. The plant is treated every other day until it has had three to five treatments. After two to four weeks new growth appears from the cut surface. New growth of the treated fan four to six inches tall is cut from the crown about one-eighth inch below the leaf base for rooting under mist. If good rooting facilities are not available, the plant should not be disturbed until it flowers.

A second method of inducing polyploidy is to expose recently germinated seedlings to colchicine. Seeds are stratified under moist conditions in the refrigerator at 34° F for eight weeks to break dormancy. They are then allowed to germinate in Petri dishes at 75°-80°F. A few hours prior to the emergence of the shoot from the embryo axis, the seedlings are immersed in a 0.05 per cent aqueous solution of colchicine for 12 hours. Inhibition of spindle formation continues after the seedlings have been removed from the solution, frequently causing chromosomes to double again without the cells dividing. To prevent further action of the colchicine, the seedlings are washed under running water from 3 to 6 hours before they are planted in flats in the greenhouse. To prevent waterlogging and internal rot, the seedlings are planted with the seed and shoot portion above the soil level and watered sparingly during the first few weeks. The seedlings may be field planted when they are 3 to 4 months old.

Interpretation and use of the results of colchicine treatment depend upon an understanding of tissue development in plants. In all flowering plants, the stem tip or apical meristem from which all plant organs are derived consists of three separate and independent cell layers called primary histogenic layers. The first or outermost layer is Layer I, and

this layer gives rise to the epidermal tissue of the plant. The second layer (L-II), a thin layer located immediately under L-I, gives rise to gametes (egg cells and pollen grains) and part of the internal tissues of the leaves, flowers, and stems. In dicots all of the gametes are derived from L-II, but in monocots, such as true lilies and daylilies, gametes are produced from layer L-I as well. However, most of the gametes are derived from L-II in daylily. The third layer (L-III), the innermost layer or group of cells of the growing point, gives rise to the internal tissues of the leaves, flowers, and stems.

The continuity of these layers is dependent upon one, two, or three, rarely four, cells which occupy a central position at the growing-point of each layer. The entire above-ground part of the daylily plant originates from these centrally located cells. If any one of these cells in any given layer should be polyploidized, this change would be continuous in the portion of the plant tissue derived from this cell, while the rest of the plant remains normal. To induce total polyploidy of all cells in a plant through colchicine treatment, all of these centrally located cells of all 3 layers of the growing-point would have to be at the proper cell division stage to be affected; or they would have to advance to the right stage of cell division during the time when the plant was being treated with colchicine. Thus, the total effect of colchicine on polyploidy in the plant as a whole is related to the number of polyploidized cells in the growing point.

Colchicine treatment of daylilies frequently results in partially affected plants, called cytochimeras, rather than in complete polyploids, because not all of the central cells are polyploidized. In some instances *periclinal chimeras* occur, in which one cell layer of the growing-point is completely affected but with no effect on the other two cell layers. Chimeras of this type are thought to be more or less stable in daylily. Usually cell Layers I and II are maintained by anticlinal cell division (the plane of division perpendicular to the surface of the dome) wherein growth spreads in one plane, while cell layer L-III divides both anticlinally and periclinally. When cells divide periclinally (the plane of division parallel to the surface of the dome), growth in depth results as cells accumulate one over the other. If the outer layer should change from anticlinal to periclinal division, which sometimes occurs, an original L-II may be replaced by a daughter layer of L-I; L-II would then replace L-III, and the original L-III might be left out in the subsequent growth of the stem or crown. Sometimes, though infrequently, an inner layer may push into an outer layer and displace it.

Mericlinal or sectorial *chimeras* in which one, two, or all three of the histogenic layers are partially affected occur frequently. Sectorial chimeras are not stable in daylily, and their developmental future is dependent upon the nature and extent of the affected tissues. If sectors within a given histogenic layer result from cells of different ploidy occupying the central position at the apex, the size of the sector is contingent upon the number of centrally located cells that became polyploidized during colchicine treatment. It is likely that a layer thus affected will eventually become diploid or tetraploid, depending upon whether a diploid cell or cells lose their central location, or the reverse. Cells dividing below the apical initial cells at the time of treatment can be affected also, and axial polyploidy (localized and discontinuous sectors of tetraploid tissue) occur as a result. If such tetraploid sectors of tissue in a given layer are large and new growing points form in them and develop into lateral buds, crowns totally tetraploid in that layer may arise. Otherwise these tetraploid tissues are usually lost in the course of vegetative growth.

The direct method of determining chromosome number of stem tissues is by cytological examination of cells in each of the three layers. However, it is not practical to examine for chromosome number in the early stages without destroying the plant. It is better to

wait until new fans are produced by the treated shoot. Before new fans are produced, the chromosomal structure in the shoot apex may be unstable. The newly polyploidized cells may be sectorial and later lost; or an apparently complete tetraploid could become periclinal if the central position at the apex of a given layer is occupied later by diploid cells. Also a sector which is apparently lost may be recovered later by off-shoots arising in the sector. Because of the many possibilities of alteration, each new ramet should be examined for several years after treatment, whatever method of identification of tetraploid tissues is used.

Indirect and simpler methods of identification of polyploidy may be employed for the critical Layers I and II. Tetraploidy in L-I may be determined by microscopic measurement of stomatal size (Fig. 5). As a rule, the tetraploid stomata are about 10 microns longer than those of a comparable diploid. Mature plants which have flowered may also be screened for polyploidy in L-II by measuring pollen grains (Fig. 6). Although size of pollen grains may vary slightly in plants with the same chromosome number, a mean range may be established in the relative size of pollen grains of diploids and tetraploids. In L-II tetraploids, most of the pollen grains have a long diameter of 15 to 25 microns greater than that of normal or comparable diploid pollen grains. If most of the pollen grains are large and only a few are small, this indicates that the plant is chimeral and that L-II is tetraploid and L-I diploid. L-II tetraploids also have thicker seed pods (Fig. 4). If the reverse condition is apparent, then L-II is diploid and L-I tetraploid. The only certain way of determining ploidy of L-III indirectly is by microscopic examination of root-tip cells (Fig. 7b, c) of adventitious roots forced from the treated shoot; all but the primary root tissue grows from L-III.

If microscopic examination of plant parts is not possible, observation of macroscopic characters, or external appearance, may be employed as a means of

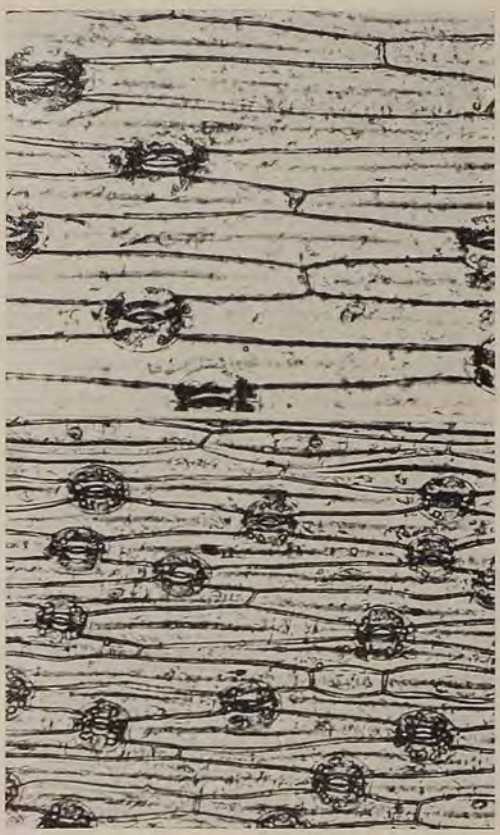


Fig. 5. (A) Stomata of tetraploid 'Summer Interlude' seedling at same magnification. (B) Stomata of diploid 'Summer Interlude' seedling.

screening for colchicine effect. Such evidence should be considered circumstantial rather than absolute, since physiological and genetic differences may account for variations in these characters in plants on the same level of ploidy. The most accurate evidence of ploidy may be obtained if the gross aspect of the treated plant is compared with that of an untreated plant of the same kind, for example, two plants of the same cultivar.

External evidence of polyploidy in cell layer L-I is insignificant and not visually detected. Tetraploidy in daylilies is manifest most noticeably in the floral organs which are almost entirely made up of layer II. Perianth-segments in tetraploid daylilies are larger and thicker than those of diploids, as are ovary, style, and anthers; the overall flower is larger and thicker than the

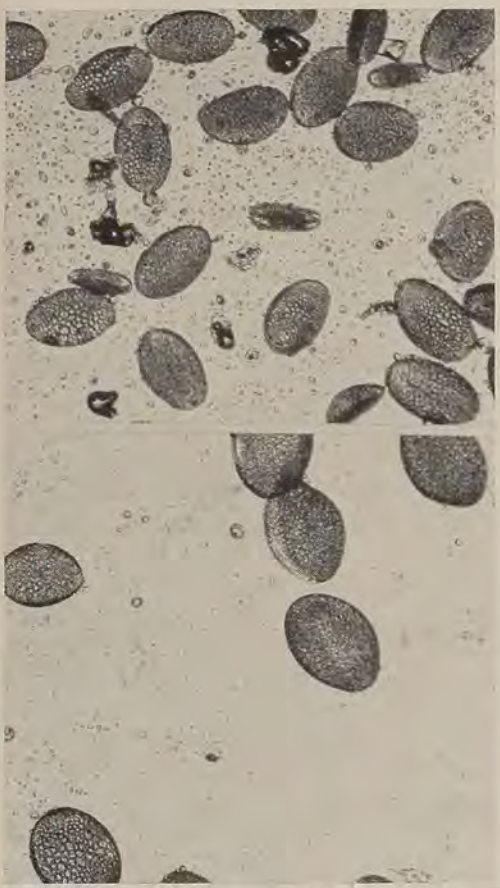


Fig. 6. (a) Pollen grains of diploid 'Sherwood'. (b) Pollen grains of tetraploid 'Sherwood' at same magnification. Note: there are abortive grains in both diploids and tetraploids.

diploid counterpart (Fig. 3). Tetraploidy in L-III is most evident in the scape, which is thicker than that of controls, though L-II also contributes to a thicker scape. Larger, thicker, darker green leaves may be evidence of tetraploidy, mostly in L-II and less in L-III. Usually all of the internal tissue of the leaf near the leaf margin and next to the epidermis in the central region of leaves originates from L-II. The internal tissue of the leaf center derives largely from L-III.

Breeding of Tetraploids

Creating tetraploid daylilies has been frustrating and disappointing to may hybridizers. Perhaps the greatest single barrier to rapid improvement has been low fertility of the induced tetraploids, of which about 10 per cent produce seed, although a larger percentage is pollen fertile. Seed-fertile plants generally produce only a small number of seeds in each capsule. In some instances loss of fertility is due to cytological reasons. The normal pairing of homologous chromosomes is disrupted in the tetraploid because instead of two, there are four chromosomes of a kind, and only two can pair at any point on the chromosome. This often results in the formation of groups of chromosomes (from univalents to quadrivalents) and unequal distribution of chromosomes to the daughter cells. Sometimes seeds fail in other ways, such as the presence of immature or faulty embryos, or abnormal endosperm, the causes for which are not clearly undertsood. Still a further barrier to the breeder is the limitation of available genetic material, both in quality and quantity. Some of the most improved genetic strains in modern daylilies are being used in breeding only on the diploid level. Also, the high cost of the few tetraploids that have been placed upon the market makes them unavailable to the average breeder.

As difficulties are reduced or overcome, breeding at the tetraploid level can be expected to move at a much faster pace. The fertility barrier should become considerably diminished as more tetraploid seedlings and named cultivars become available. Results show that tetraploid seedlings several generations removed from their induced predecessors produce seeds as frequently as many diploids. As compatibility of crosses in tetraploids increases, one may predict that choice of tetraploid parents will be as rigid as that now practiced in diploid breeding. Another advantage of tetraploid seedlings is that not only do the seed capsules generally contain a larger number of seeds than do capsules from induced tetraploids, but a greater percentage of the seeds are viable. Already some breeders are reporting several thousand seedlings per year.

Despite the fertility barrier in induced

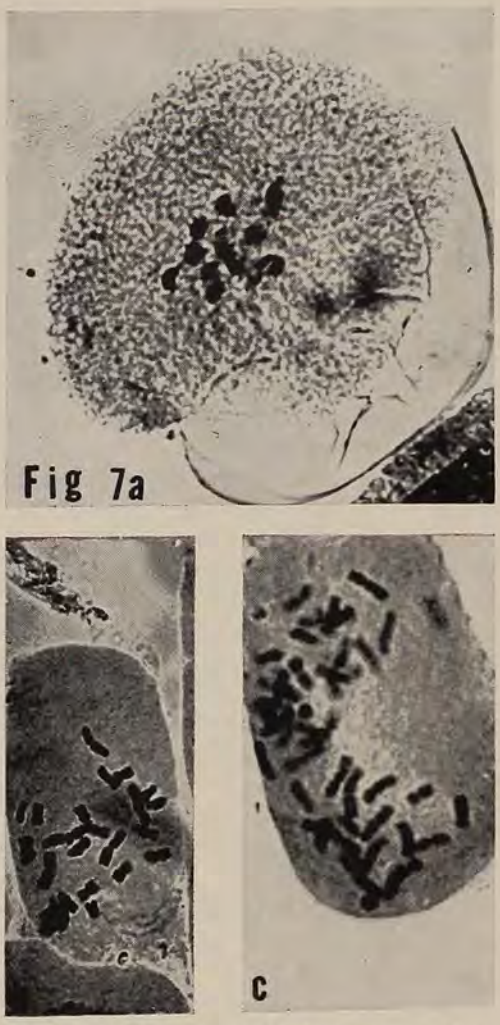


Fig. 7 (a) Metaphase I of pollen mother cell. The 11 groups of paired chromosomes divide to give daughter cells with 11 chromosomes each. (b) A root tip cell from diploid showing 22 chromosomes. (c) A root tip cell from tetraploid showing more than 22 chromosomes.

tetraploids, the importance of creating new artificial tetraploids should continue to be emphasized. Since seed production is more successful in diploids than in most present-day tertaploids, we should try to save time and develop polyploids from the best diploids. Fertility in induced tetraploids can be increased by using only proven fertile diploids; tetraploids induced from highly fertile diploids generally produce more seeds than those derived from diploids with moderate or low fertility. The frequent occurrence of chimeras rather than complete tetraploids need not be a deterrent to breeding; chimeras can be useful, though perhaps not for introduction, when proper breeding procedures are understood.

Periclinal chimeras which have been produced in cell layers L-I or L-II, or both, are no great problem in an understanding of breeding principles. Breeders designate plants that are diploid in L-I and tetraploid in L-II as 2-4, those with the reverse chromosomal pattern as 4-2, and those in which both layers are tetraploid as 4-4. When pollen from 2-4 chimeras is crossed on 4-4 chimeras or tetraploid seedlings, only tetraploid seedlings are obtained. When pollen from 4-4 chimeras or tetraploid seedlings is crossed on 2-4 chimeras, the result is the same, only tetraploid seedlings are obtained. When pollen from 4-2 chimeras is crossed on 4-4 chimeras or tetraploid seedlings, the seedlings will likewise be tetraploid, if any are obtained. Generally when 2-4 chimeras are crossed with each other, only tetraploid seedlings result. Triploid zygotes formed by the union of haploid and diploid gametes usually fail to develop into mature embryos in these crosses.

That L-I sometimes produces egg cells as well as pollen grains has not been established through cytological evidence. However, breeding results seem to indicate that egg cells in indeterminate percentages do develop from this layer. In rare instances seed pods from 2-4 chimeras have been obtained which contained both diploid and tetraploid seeds within the same capsule. Such evidence cannot be considered conclusive, since other factors could have influenced the result. One such possibility could be an alteration in the ploidy of the growing point of L-II. Seedlings from chimeral parents can be checked by any one of the microscopic methods described above. Since all layers are the same, either all diploid or all tetraploid, in seedling of chimeras, only one layer need be checked.

Mericlinal chimeras are more difficult to interpret than periclinal. Mature plants which have been colchicine treated and bloom within a few months may contain in the same flower anthers with tetraploid-sized pollen grains and some with smaller grains of the diploid. If pollen with tetraploid-sized grains is used on 2-4's, 4-4's, or tetraploid seedlings, only tetraploid seeds will be obtained. At a later stage of development a mericlinal chimera in L-II may produce some flowers with diploid-sized pollen and others with tetraploid-sized pollen on the same scape. The tetraploid flowers may be used either as seed or pollen parents according to procedures described above. Usually, by the second season, such a chimera may become totally diploid or tetraploid in L-II, and ramets may arise which are completely tetraploid or diploid in that layer. If tetraploid, they can be isolated and used as other periclinal chimeras or tetraploid seedlings.

In other genera of plants triploid progeny have resulted from crosses between tetraploids and diploids. The authors have been unable to obtain a single triploid daylily from hundreds of reciprocal crosses between diploids and tetraploids. Furthermore, we have no evidence in our experience with daylilies that aneuploid zygotes e.g., gametes with one or two chromosomes more or less than the usual haploid or diploid numbers, are viable. If aneuploidy occurs in daylilies, it is of rare incidence, as many workers have failed to obtain seedlings using the triploid daylily *H. fulva* 'Europa' as a parent.

Some breeders have not visualized the full potentialities of the tetraploid daylily because of the scarcity of superior genetic material. Also certain undesirable characters may be observed in some induced tetraploids, such as faulty flowers which fail to open properly because of the stiffness of their segments, especially the outer segments. Another fault is the heavy, brittle and stiff scapes in some clones which sometimes crack or break in the wind. Scapes usually branch less in some induced tetraploids and have fewer flower buds than do diploids. Foliage may be coarse and leathery in some instances rather than graceful. Geneticists with vision recognize that induced tetraploids are only the initial step upon the threshold of daylily potential and that "raw" polyploids of this kind merely furnish material for future selection in a controlled breeding program.

The merit of the induced tetraploid lies in speeding up evolution of new varieties. The potential superiority of the tetraploid over the diploid offers a challenge to the breeder as well as an economic advantage to the commercial grower. Already hybridizers with an advanced tetraploid breeding program report tetraploid seedlings much superior to their diploid counterparts in size, color range, and form. Rapid methods of propagation are being developed which will enable growers of the newer tetraploids to obtain adequate stocks to place them on the market earlier and at lower prices than formerly. When tetraploid daylilies of quality become available to the average breeder, the connoisseur, and the professional alike, a revolution in the modern daylily may be anticipated.

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Selecting and Evaluating Daylilies

R. WILLIAM MUNSON, JR.

Daylily judging and evaluation is not an easy task and many factors come into play. Perhaps the first necessary step is to establish a numerical reference chart that will assure consistent and fair judging as unbiased as possible. Most important, judging should be objective and free from personal likes and dislikes.

It is essential that specific standards of evaluation be clearly understood before judging is attempted. When evaluating existing cultivars one should not use, as a yardstick of quality, potentially or theoretically perfect plants. We can only judge the existing cultivars and not the mythical, hoped-for cultivar still to be produced.

As progress in breeding continues, ratings of older cultivars once with a high rating, may decrease in value and eventually may no longer be considered garden worthy. This condition exists today. Over the last twenty-five years rapid and exciting progress in the development of new cultivars has brought this about. Progress of this kind requires downgrading of cultivars produced even ten years ago. Current ratings will simply not remain constant in view of the sensational progress now being made in daylily breeding. The newer cultivars now available are so superior that a flower with a rating of 90 points five years ago, may now be entitled to a rating of only 75 points and perhaps in five years will be rated only 55 points or less.

Judging daylilies in a show is completely different from judging daylilies in a garden. Do not confuse them. Show judging is discussed in another chapter in this Handbook. The following section relating to garden evaluation of daylilies is based on my own experience.

Experience teaches one to recognize good and poor qualities in daylily cultivars among those in your own collection and those you see elsewhere. When you have scored many plants you will be able to judge with the experts.

Starting with a potentially perfect daylily with a rating of 100 points, the plant should be awarded 40 points and the flower 60 points. A further breakdown should be made as follows:

THE PLANT		*THE FLOWER*	
Foliage	10	Color	10
Vigor and stamina	5	Form	10
Total scape:		Substance and	
Scape—General	10	sun resistance	15
Buds and		Texture	5
branching	10	Beauty and	
Balance	5	distinction	20
Total points	40	Total points	60

1. The Plant

a. *Foliage* (10 points)

Variation in foliage is important for contrast in color and texture in the total garden picture. It is quite natural to become enamored by an individual flower when in bloom. Foliage and plant habit must be judged when you are not unduly influenced by the beauty of the individual flower. In scoring foliage plants must have an attractive appearance, with deep green arching leaves or other character that presents a good garden picture. The foliage should be free of insect pests and diseases.

b. *Vigor and stamina* (5 points)

The plant should have the ability to grow and multiply under good growing

conditions yet without being invasive of adjacent areas by underground stolons. The plant should establish quickly, thrive and grow stronger each succeeding year. Some cultivars do not establish easily, depending upon locality. Some evergreen daylilies are difficult to establish in very cold areas and some dormants are difficult to establish in very hot and humid areas. A plant should not be difficult to transplant or be susceptible to crown rot or "spring sickness," lack vigor or stamina.

c. *The scape and inflorescence*

Scape—General (10 points)

The scape, buds, branching and plant balance are so closely related they are difficult to separate; yet in point scoring it is necessary to evaluate each aspect separately. The scape must have adequate strength to support the flowers and buds, sufficient to overcome the necessity of staking against winds, rain or excessive leaning toward the light. Size of the flower and height of the scape should be in good proportion to the thickness of the scape. All of these factors taken together affect the total garden picture and must be evaluated accordingly.

Branching and buds (10 points)

The inflorescence should branch so that the buds are not all at the top of the scape. Flowers on the inflorescence should not open all together or be poorly spaced causing crowding and preventing some flowers to open properly. Branches should be wide apart to allow buds to grow and develop normally without touching and hampering the opening of the fully developed flower. Branching and bud count should not be so sparse that flowering ends after a few days. Scapes on some daylilies carry as high as five branches (including the two terminal branches). Other daylily cultivars have only two terminal branches. If a plant with only two terminal branches reblooms several times, it may still be useful provided the plant balance is good. Many gardeners prefer plants with two or three scapes that bloom at different times over a plant with only one scape perfectly branched but limited to one period of flowering. Plants with close branching with buds and flowers that develop unhampered, present a good display and may deserve a good rating.

Balance (5 points)

Balance is a very difficult characteristic to describe but very obvious in a plant without a pleasing relationship between foliage and placement of branches, buds, and flowers. Short foliage and tall scapes with high branching give poor balance. Currently, most hybridizers are working for short scapes. I do not feel this is the whole solution to the matter of balance. We need to concentrate more on how the scape and its branches relate to the plant foliage. A miniature daylily may have a tall scape, magnificently branched and budded, and present a better garden picture than, say, a 10-inch flower on a low 17-inch scape with the flowers among or just above the foliage. A giant flower on the low scape can, and generally does, have poor balance.

2. The Flower

a. *Color* (10 points)

Color should be clear, bright, and attractive. Whether the pastel is medium in tone or dark it should not be muddy or low in saturation of color intensity. From a distance or from close-up, color in daylily flowers should be clear, clean and of good hue and tone. Whether the flowers are polychromes, bi-colored, eyed, pastel (subtle of hues), medium, self-colored or dark and intense, all come closer to perfection if the color is clear.

b. *Form* (10 points)

Flower form is almost or fully equal to color in setting one flower apart from another. Differences in form e.g., round or starlike, flaring or recurved, round, broad, ruffled, plain, flat, twisted, fluted, lily-shaped are of little importance, except as interpreted by the evaluator. These factors usually boil down to evaluator preference. Form is important when flowers consistently are uniform and are sufficiently flat and face outward to display their colors well. Malformed

flowers, dissimilarity of segment shape and lack of uniformity in placement of perianth-segments are undesirable aspects of form.

c. *Substance and sun resistance* (15 points)

Substance is the thickness of tissue structure. In judging substance, firmness and freshness, uniform thickness of perianth-segments (e.g., no thinning toward the petal edge), crispness, and turgidity are all part of substance of the flower in its prime. Flower tissues should not be thin, and not wilt, brown or melt at the edges. If the flower fades during the day, substance should be retained reasonably well. Not totally related to the area of substance, but still a part of the garden picture, is the question of flower opening and extended period of bloom. The flower should open early in the morning and still remain presentable in the evening.

d. *Texture* (5 points)

Texture refers to the surface quality of the flower which varies from flower to flower. Texture varies from the very smooth satiny waxy finish to velvety, creped, pebbled, diamond-dusted, glistening, etc. The major concern is to decide whether flower quality suffers by its texture or is enhanced and beautified by it.

e. *Beauty and distinction* (20 points)

These are two essential factors for any worthwhile daylily, and I am a believer in giving a flower an additional few points on sheer beauty. Too many daylilies, old and new, are being fostered on the buying public without that special quality called beauty. Of course, here again, one is trapped by the old, but nevertheless, true adage that beauty is in the eye of the beholder, and rightly so. Distinction is a little more definitive. Has a daylily that special quality that sets it apart from others of a similar kind? Is the color, pattern or special blending of colors different or rare? Is the form and texture unique, different and beguiling and something special? Is there good proportion and balance and is the total effect pleasing to the eye? In other words, the flower should be eye-catching, outstanding, not easily forgotten. Does it have the qualities to make it a star, or only that of a meteorite soon to disappear even though it will make a lovely light as it burns itself out?

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Introducing and Registering Daylilies

WILLIAM E. MONROE

'Apricot', the first hybrid *Hemerocallis* clone, was introduced in England by George Yeld in 1893. By Jan. 1, 1967, 12,597 clones had been named, described, and published. Where did they all come from and where did most of them go? Before discussing that, it is necessary to review briefly the history of naming, describing and introducing *Hemerocallis* clones.

History of the records of described clones. Description of daylily clones dates to 1893. During the period from 1893 to 1934, Dr. A. B. Stout described 174 clones originated by 23 breeders. Nine of these breeders were from Europe and fourteen from America. These 23 breeders must be considered pioneers in this field. Mrs. Thomas Nesmith, Lowell, Massachusetts, is the only one of this group still active in breeding *Hemerocallis*. Her latest described clones were registered in 1966.

Dr. A. B. Stout kept a record of clones described prior to 1934 and continued to do so until 1942. His first descriptive catalogue appeared in his book, *Daylilies,* published in 1934. He continued to contribute supplementary lists in *Herbertia,* in 1937 and 1939. In 1942 he compiled a list of *Hemerocallis* clones that was published in the 2nd Edition of *Standardized Plant Names.*

The next list of descriptive clones made available to the public was compiled by J. B. S. Norton, M. Frederick Stuntz, and W. R. Ballard. This list published in 1949 by the American Plant Life Society as, *Descriptive Catalog of Hemerocallis Clones* 1893 *to* 1948, was jointly sponsored by the Hemerocallis Society. Only a few copies are extant of this very valuable document.

The preparation of the catalogue of clones led to the development of the registration service now conducted by the American Hemerocallis Society. It was not until 1957 that the Society published the *Hemerocallis Check List.*

Six members of the Society have served as Registrar and these men compiled the 1957 Check List. However, these men had access to the early work that led to the publication of the *Descriptive Catalog* of 1949.

The 1957 Check List was brought up-to-date in 1960 in a Supplement to the *Hemerocallis Journal.* This supplement listed all clones described from July 1, 1957 to December 31, 1959. Since that time an annual supplement to the *Hemerocallis Journal* has been published listing the clones described the previous year. Thus, a copy of the 1957 Check List and the eight supplements, contain descriptions of approximately 12,597 clones.

Table 1 lists the approximate number of breeders or introducers and the number of clones described from 1893 to 1966 by seven important periods in the development and popularity of the daylily.

Table 1 shows the rapid expansion of breeders and clones described. During the past eight years almost as many new breeders have entered the field, naming nearly as many new clones as were named during the 64-year period prior to that time. During this eight-year period an average of 660 clones were described each year. The trend is still upward; 894 clones were described in 1966.

Purpose of registration: Registration is primarily for the purpose of avoiding

Table 1. Approximate Number of Breeders, Introducers, and *Daylily* Clones Described, 1893–1966.

Year	Breeders*			Clones described		
	New breeders during period	Accumulated total	Average per year	During period	Accumulated total	Average per year
1893–March 1934	23	23	less than one	174	174	4
March 1934–May 18, 1937	18	41	6	104	278	35
May 19, 1937–April 1, 1939	19	60	9	140	418	70
April 2, 1939–1942	8	68	3	75	493	25
1942–November 1, 1948	98	166	16	1959	2452	326
November 2, 1948 to June 30, 1957	262	428	28	4535	6987	477
July 1, 1957–December 31, 1966	372	790	44	5610	12597	660

* Breeders and/or Introducers

the duplication of names and the confusion that follows. However, the American Hemerocallis Society has extended its effort to maintain and publish descriptive information, date of introduction into commerce, awards granted by the society and records of synonyms that might result in confusion. Testing or determing the value of a clone is not a function of registration. However, the society does encourage the breeder not to name inferior clones that soon will be discarded. The reputation of a breeder is partially developed by the permanence of his introductions that stand the test of time. Clones not of the highest merit or without being fully tested are in danger of not gaining public acceptance.

Naming clones. The name of a *Hemerocallis* clone is intended for identification purposes only, and not to describe any feature of the clone. A catchy name may have appeal and win for a daylily public acceptance more than a less glamourous one. But the quality of a clone has more to do with public acceptance than the name alone.

If names are used in an attempt to describe the clone, it should be realistic and not misleading. Descriptive terms not exclusive to one particular clone must be avoided. "Broad-Petaled Yellow" would be descriptive of many clones and the name would not be acceptable. Select a name that has not been used before and one that complies with the rules of naming clones.

Registration procedure. The American Hemerocallis Society was selected as the International Registry for the genus *Hemerocallis* by the International Horticultural Congress in 1955. This is an honor and a privilege, but with it the Society has certain responsibilities. In selecting clone names members must abide by the provisions of the International Code of Nomenclature for Cultivated Plants of 1961 as supplemented by the 1955 and 1961 Code of Registration Procedure.

The rules for naming clones (also called cultivars) by the American Hemerocallis Society must comply with the International Code and with the rules of the Society, as long as both are in harmony. The rules now being followed were approved by a representative of the International Horticultural Commission and the Board of Directors of the society in 1964. The rules for naming clones are listed on page 257.

These rules are not intended to work a hardship on anyone; they were developed to avoid confusion on an International scale.

When a name has been selected for a clone that complies with the rules, the next step is to apply for registration of the name for use on a particular clone.

The American Hemerocallis Society requires certain descriptive information on all clones registered. This information must be submitted in duplicate on forms provided by the Society for two cents each. The following information is required:

An acceptable name
Height of scape in inches
Season of bloom
Diameter of flower in inches
Color description
Foliage habit (dormant, semi-evergreen or evergreen)
Originator of clone

Space is provided for additional descriptive information on the Registration Data Sheet, but this information is not required. However, it is kept on file as a permanent record if given.

Registration of a clone is not complicated. Anyone wishing to register a clone should know enough about the clone to give the required information or it should not be registered. Without such knowledge many registered clones already have been abandoned to the compost heap., in which case the registered name is just dead timber, using good names that should have been applied to better clones.

All registered names are published giving the required information on each clone in publications of the Society. This costs money. Thus, there is a registration fee of three dollars per clone. However, to encourage registration of all clones introduced into commerce, fees are not charged to breeders outside the United States and Canada.

Transfer or change of names. If a clone which later proves unworthy of introduction gets a name, what then should be done? The best solution is to officially transfer the name to another clone. Now and then an individual may wish to register a clonal name he no longer likes or feels will not be popular. If this situation arises, the name may be changed to a more desirable name before it gets into commerce, with one exception. If a name has been introduced and is later found to be a duplication of a name already in use, it can be changed to an acceptable name. Fees for the transfer or change of name are the same as the registration fee.

All registered names are published annually in a Supplement to *The Hemerocallis Journal*, giving an adequate description of each clone.

The names of unregistered clones that have been introduced are recognized as valid names by the Society, if they are acceptable and the names are available. However, these clones are not eligible for honors or awards of the Society. This non-registering practice is strongly discouraged as it is felt that anyone truly interested in the development of the daylily will check on the availability of names and register their clones before they are introduced.

Introduction into commerce. Formal introduction into commerce of a new clone is as necessary for certain awards and honors of the American Hemerocallis Society as registration. Introduction consists of offering a clone for sale in a dated, printed catalogue, price list or other publication. All introducers are encouraged to send a copy of their catalogues to the Registrar in order that clones can be properly recorded as introduced.

Registrations around the world. Of more than 12,000 clones (cultivars) that have been described, many originated in England, Italy, France, Holland, Germany, Australia, and Canada. However, by far most of the clones described originated in the United States. Making a summary of described clones by states from 1893 to 1966 would be an almost impossible task. Table 2 gives a summary of breeders, introducers, and clones described for a three-year period. This summary will give a fair indication of where most of the clones originate.

The question is often asked, what happened to the 12,597 clones already

Plate No.		Photo credit
17.	**Lady Fingers** (Peck 1967)—dormant; scapes 32-34"; spider; flower 6".	Ben Parry
	Laurel Anne (Fischer 1962)—dormant; scapes 34"; flower 6"; *J.C. 1961; H.M. 1962.*	Hubert A. Fischer
18.	**Zippety** (M. Warner 1967)—evergreen; scapes 21"; small-flowered 3½"; *J.C. 1966.*	Warner
	Prairie Maid (Marsh 1964)—dormant; scapes 20"; flower 5"; *J.C. 1964; H.M. 1967.*	J. W. Alexander
	Rosy Eterna (Hancock 1966)—dormant; scape 34"; flower 5½".	Hancock
19.	**Color Splash** (Spalding 1967)—evergreen; scapes 18"; small-flowered 4".	R. W. Schlumpf
	Luxury Lace (Spalding 1959)—dormant; scapes 30"; small-flowered; *Giles Award 1965; Stout Award 1965.*	R. W. Schlumpf
	Satin Glass (Fay 1960)—dormant; scapes 34"; flower 5½-6"; *A.M. 1965.*	Frances Lamb
20.	**Crazy Horse** (Pettus 1966)—dormant; scapes 36"; flower 5¼"; *J.C. 1966.*	J. W. Alexander
	Heavenly Haviland (MacMillan 1966)—evergreen; scapes 30"; flower 5½".	R. W. Schlumpf
	Heavenly Haviland Baby (MacMillan 1969)—evergreen; scapes 30"; flower 5-5½".	R. W. Schlumpf
21.	**Crestwood Ann** (Fay-Greisbach 1961)—induced tetraploid; dormant; scapes 25"; flower 5½"; *A.M. 1966.*	Frances Lamb
	Hallelujah Chorus (MacMillan 1968)—evergreen; scapes 26-30"; flower 6".	R. W. Schlumpf
	Fashion Model (Lester 1962)—dormant; scapes 36"; flower 6"; *A.M. 1967.*	Frances Lamb
22.	**McPick** (Lenington 1959)—semi-evergreen; scapes 24"; small-flowered; *Giles Award 1964; A.M. 1962.*	George Lenington
	Mary Todd (Fay 1967)—tetraploid; semi-evergreen; scape 26"; flower 6".	Dr. W. C. Mulliken
	Gypsy Laddie (Peck 1969)—tetraploid; dormant; scapes 26"; flower 6½".	Virginia Peck
23.	**Tinker Bell** (Stevens 1955)—dormant; scapes 24"; miniature 1½"; *Fischer Cup 1963.*	R. W. Schlumpf
	Lee Ann Hughes (Hughes 1968)—dormant; scapes 22-24"; flower 4-5".	Hughes
	Arachne (Schroer 1959)—evergreen; scapes 38"; spider; flower 6-7"; *H.M. 1964.*	Scotty Parry
	Sooner Girl (Sawyers 1961)—dormant; scapes 34"; flower 6¾"; *J.C. 1959; President's Cup 1967.*	D. R. McKeithan
24.	**Dream Mist** (Munson 1961)—evergreen; scapes 42"; flower 5½-6"; *J.C. 1960; A.M. 1966.*	Munson
	Mynelle Gardens, Jackson, Miss.	Mrs. Louis Rockett

Lady Fingers

Laurel Anne

Zippety

Prairie Maid

Rosy Eterna

Color Splash

Luxury Lace

Satin Glass

Crazy Horse

Heavenly Haviland

Heavenly Haviland Baby

Plate 21

Crestwood Ann

Hallelujah Chorus

Fashion Model

McPick

Mary Todd

Gypsy Laddie

Tinker Bell

Lee Ann Hughes

Arachne

Sooner Girl

Dream Mist

Mynelle Gardens

described? Many are still with us providing enjoyment for gardeners all over the world. Some clones have not gone farther than the area where introduced, but are doing well in that region. Fortunately or unfortunately, according to point-of-view, a high percentage of described clones have made their way to the compost heap. Will this happen to your next introduction, or will it be around as long as 'Florham', the first hybrid clone introduced in America by Arthur Herrington in 1899?

Table 2. Three-Year Summary of Breeders and Registrations, Listed Numerically According to Number of Registrations, 1964–1966

State	Breeders			Different breeders	Registrations			
	196	*1965*	*1966*	3-yr per.	*1964*	*1965*	*1966*	*Total*
Texas	18	19	30	47	73	134	124	331
Illinois	6	8	11	14	85	128	72	285
Louisiana	24	25	24	47	81	87	83	251
Missouri	8	5	7	11	79	35	122	236
Georgia	11	13	19	26	54	74	80	208
Ohio	2	1	6	6	3	5	180	188
Florida	14	13	12	22	56	42	39	137
North Carolina	6	6	3	7	27	29	24	80
Alabama	3	3	3	5	20	22	35	77
Massachusetts	5	2	2	5	20	37	14	71
Arkansas	5	4	1	5	26	32	10	68
Oklahoma	4	4	6	7	16	20	24	60
New York	6	4	3	7	27	8	10	45
South Carolina	4	6	6	10	11	11	22	44
California	8	2	4	12	32	4	5	41
Vermont	4	1	1	4	17	6	8	31
Minnesota	7	2	2	7	22	5	2	29
Maryland	3	3	2	4	9	8	7	24
Mississippi	4	7	5	10	5	11	8	24
Tennessee	2	2	5	6	2	9	7	18
Nebraska	5	3	2	6	8	3	2	13
Indiana	3	2	3	6	5	4	3	12
Michigan	1	1	3	3	2	4	6	12
Oregon	2	1	3	3	5	4	3	12
Kansas	5	0	3	5	8	0	3	11
Kentucky	1	1	4	5	1	1	6	8
Iowa	1	0	1	2	4	0	3	7
New Jersey	0	0	1	1	0	0	6	6
Virginia	2	0	2	3	2	0	2	4
Wisconsin	1	0	0	1	2	0	0	2
Foreign								
England (U. K.)	1	1	0	1	6	2	0	8
Totals	166	139	174	298	708	728	894	2330

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Propagation of Daylilies

FREDERICK M. BENZINGER

In recent years there has been increased interest in propagating daylilies by gardeners and commercial growers. Daylilies are propagated by seed and vegetatively. From seed, flowering plants can be produced in one year in the South or two years in the North. Divisions or ramets flower the first year if planted sufficiently early in the spring, or the following year if planted in August or early September.

Seed Propagation

Seeds can be purchased to produce seedlings with red, pink, yellow or orange flowers. Seedlings usually do not closely resemble their parents because of the many species used to obtain the modern daylilies, but lovely flowering plants can be raised from seed. When more plants of a cultivar are wanted, they are grown from divisions or proliferations. The advantage of growing daylilies from seed is that a wide variety of colors and flower shapes may be obtained. Furthermore, by hard work and careful selection over many years, one out of thousands of seedlings may be better than the cultivars now in commerce. Looking at 'Summer Sails' (Munson), one would hardly imagine that 'Show Girl' (Wheeler) or 'Mission Bells' (Hall) were among the ancestors of that beautiful plant. Some desirable characteristics of 'Summer Sails' are its heavy, well-branched scape with beautiful waxy pale cream flowers, whereas 'Show Girl' has lavender flowers on a tall, poorly branched scape, and 'Mission Bells' has a well-branched scape with good yellow flowers.

Seed propagation falls under two main categories. Seeds from evergreen parents can be planted as soon as they mature, for they germinate quickly; seeds from dormant parents need a cold or after-ripening period of 30 days or longer before they germinate. Seeds of the evergreen group might be from parents such as 'Ann Russell' (Russell) × 'George Gilmer' (Traub). Seeds from this cross usually germinate within a few days to a week after planting. Seeds from dormant parents include crosses, such as 'Chetco' (Kraus) × 'Nob Hill' (Hall). The easiest way to handle dormant seeds is to put them in small plastic bags with moist sand or sphagnum moss and a proper label, and place in a refrigerator for 30 to 40 days at about 36° F. Subsequent to this after-ripening, the seeds may be planted in flats. A flat or box 3-4 inches deep is satisfactory. In the bottom of the flat, place about 1 1/2 inches of loose, composted, well-drained soil. Good drainage is important to prevent damping off. For the top 1 1/2 inches, a layer of sand is best for germinating daylily seeds. Seeds are planted 1/4 to 1/2 inches deep and 1 inch apart in rows 1 1/2 inches apart.

Seeds may also be sown outdoors. If the seeds are to be planted in the fall for spring germination, they should be stored dry and cool in air-tight jars or plastic bags in a refrigerator until sown. The seeds are sown about the time of the average date of the first fall frost, late enough to prevent fall germination and winter killing of young seedlings. In the middle latitude of Virginia and westward, and in northern states, cold frame storage of seeded flats should help the young seedlings to an early start in the spring.

The seedlings may be planted directly in the field when two to three months old, or they may be potted when about 4

inches tall into 2 1/2-inch peat pots and soaked before lining out in the field. Seedlings should also be watered after planting so that the pots are in contact with the soil. Mulching the new seedlings with peat moss, sawdust, wood chips, ground corn cobs or loose straw cuts down on weeds and conserves moisture. For the first year the seedlings will need additional watering if the rainfall is scant. Water heavily, to soak the soil to a depth of 4 to 6 inches; less water tends to evaporate too quickly to do much good. An easy way to measure the amount of water is to set a pan or saucer about two feet inside the outer edge of the sprinkled area. When the water is ½ to 1 inch deep in the saucer, move the sprinkler. Some spots may be too wet, but the overall area will have received sufficient water to do a good job.

Vegetative Propagation

Daylily plants may be propagated in three ways: (1) by *natural division* of ramets, (2) by *rooting proliferations,* or (3) by *artificial division* of the ramets by cuttage and the use of chemicals.

1. *Natural division* is by far the most common method of propagation, but it is the slowest method because it sometimes takes years before a clump can be divided. The clump is dug and the ramets are separated with a sharp knife or spade. In heavy clay or in muddy soil, it is best to wash the clump clean before attempting the division. 'Bridal Look' (Fass) or 'Night Hawk' (Fay) might require five or six years before the clump is large enough to be separated. On the other hand, 'Taj Mahal' (Russell), 'Pink Damask' (Stevens), and 'Norma Borland' (Taylor) are naturally rapid growers, and clumps can be dug and divided within three years. With their longer growing season, southern growers can propagate more rapidly than northern growers.

2. *Proliferations* are common on some clones, such as 'Sunset Sails' (Munson), 'Thomas Edison' (Brown-Taylor), 'King's Ransom' (Lester), and 'Matinee' (Childs). Proliferations can be rooted in 50 percent sand or perlite and 50 percent German or Canadian peat or leafmold. They are mature enough to root when the stem of the scape begins to show signs of drying or browning. Mature proliferations while on the plant may even have roots 1/2 to 1 inch long. Immature proliferations rot easily but may make good plants if the base is dipped in rootone before planting and if they are carefully handled. Fully developed proliferations usually root well within 10 to 30 days. Although proliferations when rooted are strong enough to fill a permanent garden spot, the gardener may wish to line them out in a cold frame or in other protected locations during the first winter. By the following spring, the plants are ready to be transplanted to a permanent spot. These plants usually flower within 12 to 15 months. Fig. 1 shows a typical proliferation.

3. *Artificial propagation* is of limited scope unless one has a greenhouse or indoor growing space. The writer first tried this method in the greenhouse, but a good sunny window or a Gro-Lux growing table can serve just as well

Fig. 1. A proliferation from the stem. From Stout, New York Botanical Garden.

during the winter months. The plant should be potted in a loose, organic-free medium which drains rapidly. The fan should be planted with the crown exposed just above the soil line. During the summer months the pots may be set in a semi-shaded cold frame. The plants are watered daily with regular tap water. At three-week intervals, the plants are treated with five drops of gibberellin at the concentration recommended by the manufacturer to keep the plant growing as rapidly as possible. If the aerosol form is used, apply the minimum amount necessary at each three-week interval. High concentrations should not be used nor should applications be made more frequently than the three-week intervals because this may cause retardation of growth. Supplementary light from 6:00 to 10:00 P.M. each night makes the plants grow faster. For this a 40-watt incandescent bulb with an aluminum pie-plate reflector placed about 14 inches above the plants is sufficient. Also, a low priced electric timer is useful to program the light for a 14-hour day.

Two weeks after the first gibberellin treatment, the soil should be pulled away from the crown, and with sharp knife or razor blade a vertical incision should be made into the base of the ramet. The roots should not be disturbed nor should the plant be removed from the soil at this time. The blade should be drawn upward to cut the crown, but not high enough to separate the two halves of the leaf area. A piece of plastic label or other plastic material may be inserted after the knife is withdrawn. In about three weeks the two halves should show the growth of two young ramets. Then the separation of the two halves may be completed by inserting the knife next to the plastic label and completing the cut.

The separated plants should be repotted separately in fresh loose medium, and the procedure can be repeated when the plants resume active growth. Each new division can be separated into two halves every 45 days.

If this method is used during the winter, the minimum night temperature should be above 62° F. Plants are treated at three-week intervals with gibberellin regardless of their stage of development. Generally speaking, evergreen clones respond to this treatment better than dormant clones. However, most of the newer tetraploid dormant clones have responded well to this treatment. By starting in August and completing each division every 45 days, it is possible to have 128 plants from one fan by the June of the following year.

The average gardener should probably use the natural method of propagating daylilies. For those having the technical knowledge and the necessary physical equipment, the artificial propagation process described above should provide an exciting and profitable venture. If pursued successfully by many breeders, the effect on daylily prices in the future and the early distribution of novelties to gardeners of moderate means could be profound.

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Culture of Daylilies

WILLIAM P. VAUGHN

It is well known that the old orange roadside daylily, *H. fulva* 'Europa' seems to thrive on neglect all over the nation. Yet one has only to look for a colony of plants in a rich damp soil and compare their growth and blooms to that of another colony on a starvation diet in a poor dry location to see that even *H. fulva* responds to favorable conditions. We have come a long way in the last 25 years in improving daylilies, and old *fulva* is indeed a poor relation when it is compared to the high pedigreed bloodlines of today's hybrids. The hybrids have no *fulva* 'Europa' genes in them because 'Europa' is self-sterile and crosses have rarely succeeded. Contrary to the old wives tale, daylilies do not spread like wild-fire and take over entire gardens. True, they will soon take over any garden if the "Hem Bug" (collecting fever) bites, but it will be done by the gardener himself and not by means of underground roots.

All too often people generalize when it comes to gardening and think all plants should receive the same attention as to soil, exposure, care, *et cetera*. Plants are as different as people in their likes and dislikes. The sooner one learns their little secrets the better off he and his garden will be. What is the fun of growing or having a garden of any kind, if one does not take the time to know and understand what one has in his collection of plants? Whether the plants are ordered from the four corners of the globe or are trades over the back-fence, they should be given the attention they deserve and the grower will be amply rewarded. If a person knows his plants' likes and dislikes, he will soon be famous for his "green thumb."

Soils and Fertilizer

Almost any well-drained soil, light or heavy, will grow daylilies, but the soil will benefit from the addition of humus. Every scrap of organic compost should be dug into the soil all through the year; and, in planting, a generous amount of peat moss, old rotted cattle manure, and a handful of bonemeal should be ideal. A heavy clay soil will benefit from a generous amount of coarse river sand added to the above combination and persons with clay soils and small gardens may wish to add a load of coarse sand. As a general rule, commercial fertilizers should never be mixed with soil when planting. It is too easy to damage the plants if too much lodges near the roots. After the plants are settled and new growth begins, the chemical fertilizers can easily be added according to directions on the package. If a dry fertilizer is used, it should be scratched lightly into the top soil, then watered well with the hose. Most dry fertilizers need warm temperatures to break them down.

Time to Plant

Daylilies may be planted any time the ground is not frozen, but to be safe it is not advisable to plant them too late in those areas of the country where cold winters are a regular feature. In the colder sections, mid-September is about the deadline. Plants should have time to form new roots and begin to anchor themselves before winter strikes. A mulch is needed on all plants newly set in the fall, and with evergreen clones in the northern states mulching is a must

if possible, plants from the South should be planted in the northern areas of the country in the spring, and certainly not later than early August. These, too, should be protected for their first winter with a coarse mulch that will not pack down on the crown of the plant. A large clay flower pot with the drainage hole in the bottom makes a perfect protection for any special plant and is a fast and safe method. As far north as Illinois plants have been set out in late October with perfect success, yet this is not a dependable rule in the Mid-west. The far North has snow coverage, and when winter comes the snow stays. The problems of freezing and thawing are not as great as in other areas of the middle-states. In the Deep South late August and early fall is the best time to divide and replant. For the Far West planting should take place no later than September 1 in the mountains or in regions that experience rigorous winters. Throughout most of California and in many parts of Arizona it is possible to plant at almost any time the ground is workable —either in spring or fall. In the Southwest it is best to plant in March or early April so that the roots will be established before high summer heat; the best time is after hot weather is over, usually October and November, which gives plants time to become settled before the first freeze. Plants actually suffer much less from cold than from heat, and it is sometimse best not to plant in open sun during the summer months.

Sun or Shade

Full sun gives the best results for most daylilies and will generally keep the scapes lower and give more buds per plant. Many cultivars appreciate partial shade during the hot afternoon, and almost all daylily catalogues frankly state whether or not a cultivar needs shade. In the Deep South, and other areas with very high temperatures, daylilies in the shade have been found to set seed pods more readily than those in full sun, as well as more seeds per pod. One should avoid planting daylilies under or close to broadleaved trees, because of root competition from the tree. However, pines and daylilies seem to associate beautifully together in the South as the high dappled shade and deep root systems of pines make them perfect companions and sun protectors for the daylily plants.

People who collect daylilies soon have an overabundance of plants and end up planting them in the most unlikely places. Some very unusual and most effective results are often seen. A large well grown clump of any daylily, new or old, creates one of the best landscape effects imaginable. Even the foliage in its many shades of lush green throughout the growing season gives an airy grace and texture to daylily plantings. Plants scattered about the landscape do not get the water and attention that the display beds do, yet with a good mulch they can, and usually do, give a good account of themselves each year. The landscaping possibilities with daylilies have been much overlooked except in the South where many other perennial plants are too difficult, if not impossible, to grow.

Watering and Mulching

Water should not be used unless the plants can be given a good slow and thorough soaking. One weekly soaking is far better than a daily sprinkle. Light watering only encourages shallow rooting near the soil surface and possible later suffering by the plant if watering is neglected. Daylilies love water while the bloom-scapes are forming as this does more for bloom than fertilizers. Daylilies may survive weeks in wet conditions, yet a poorly drained site is not recommended as a permanent planting spot for choice cultivars. Straw, pine needles, leaves or other available mulch material do much to conserve moisture and also help reduce the weeding problem. Leaves of broad-leaved trees may be used as a natural mulch in the beds along with or instead of the year-round mulch. For best winter protection, daylily leaves should remain untouched until the new leaves are two to three inches high in the spring. At this time dead leaves are removed and put on the compost pile or may remain in the rows as added mulch. Lady Bugs love mulched beds and are useful in controlling aphids.

Weed Control

Weed killers, or herbicides, should not be used around daylilies unless their exact purposes are known. It is best and safest to check with a friend, or neighbor, who has successfully used a product and get full details. The word of a sales clerk who may know very little about gardening may not be dependable. The most troublesome weed pest in the Midwest and other regions is crabgrass. It is not only a huge problem in the lawn but in all flower beds as well. The seeds are tiny and blow and wash in from wide areas. Crabgrass should be hoed or pulled out as soon as it appears. Any hoeing and cultivating of the daylily beds should be shallow to avoid injuring the roots near the surface. Once daylily clumps are in full leaf, the weed problem is less. If mulches are used, the seed problem is diminished, though the slug and snail problem may be increased. The University of Illinois Department of Agriculture recommends using Crag Herbicide 1 to kill all weed seeds as they germinate, spraying the solution on the ground around the plants in early spring according to directions on the package. It is fully effective for crabgrass. Several sprayings will be needed during the season for complete control. There are many newer products on the market, but one should be sure of them before using. The weed spray should not be allowed to blow or drift to surrounding foliage. Many prefer mulching instead of spraying to control weeds.

Transplanting

Many persons move daylilies in the early spring while the soil is damp and the weather cool. The new spot should be ready to receive the plant. A large clump of soil should be dug to disturb the roots as little or possible. If dug before growth begins, the plant should bloom normally the same season.

Plant division is best done immediately after flowering. The entire plant should be dug, shaking or washing off the soil without damaging the roots. This exposes the entire root system and makes it easy to see just how many plants, or divisions, can be made. After cutting off the leaves within six inches of the crown, the clump may either be divided with a good strong pocket knife or a large sharp kitchen knife unless it is possible to simply pull the clump apart. Extra large older clumps can simply be split into smaller divisions with a sharp spade or hatchet. Another method is to thrust two strong spading forks back to back into the center of the clump and then force them apart. This causes less injury to the roots than cutting. The old portions of the roots should be removed to encourage the formation aof new and vigorous roots. Small ramets that break off in the process of dividing or moving can be saved and soon grow into large single fan plants. Even large fans nearly chopped to death in moving can be rescued by planting in rich soil and keeping well-watered for a few weeks. Planting daylilies on three foot centers allows for ample increase and less frequent need of moving. Some cultivars increase faster than others, but as a general rule plants may not require division for four or five years (See appendix 5a.) Few other perennial plants can go this long without attention. Very late blooming cultivars should be moved or divided in early spring so not to interrupt their bloom season. People are now planting the late flowering cultivars, as they are badly needed to extend the season, especially in areas where there is little rebloom.

Removing Old Scapes

Old scapes should be cut off as close to the base as possible with a flat cut straight across the stem. If scapes are brown, usually they can readily be pulled out without disturbing the plant. Brown or rusted leaves in late summer can either be cut or pulled off individually. Cutting off all the foliage is not recommended as this will rob the plant of its food manufacturing parts and cause it to put out new soft growth too late in the season. In the North plants need to harden off in late summer. In warm cli-

mates with very few killing frosts, foliage pruning should not bother the plants.

Removing Old Flowers

Some people use a knife to cut off the old flowers, but the simplest and safest method is to pinch them off with the thumb nail and forefinger being careful not to brush the old blooms against clothing as they can leave permanent stains. People with large gardens often cut off all the flowers of that day in late after-noon or evening so the garden will be well groomed for early morning visitors the next day. Since the dead flowers make a good addition to the compost heap, a basket or large sack should be used in grooming.

Labeling

Good readable labels are important. Many daylily growers rarely go to much trouble or expense to label their plants because of the change in cultivars from one year to the next. Some people collect only the newest cultivars, not necessarily the best, and do not wait long enough to enjoy and get to know a plant fully before it is discarded. Most gardens have their plants labelled in one way or another. Many labels are on the market and the labels one selects depend on his taste and the money put into them. Labels should be sturdy and durable and should blend into plantings and not distract attention from the flowers. Also, lettering should be weather-proof. Most plastic labels become quite brittle with age and shatter like glass when touched with a hoe or other tool. In the fall labels should be pushed deep to avoid being heaved out of the ground by winter thawing and freezing. This is very important where small plastic labels are used to mark young seedlings. If children are a problem in label snatching, a record of the planting plan should be kept in a garden notebook.

Beginner's Bulletin

In 1966 the American Hemerocallis Society published a small *Beginner's Bulletin* for new members. Each section of the country was well covered with basic planting details and comments for the regional areas. There are, however, certain planting instructions that can easily be applied to any area.

1. Soak newly received daylily plants in a weak solution of liquid fertilizer for several hours before planting, such as Rapid-Gro.

2. Plant in a soil mixture composed of ⅓ good garden soil, ⅓ Michigan peat, and ⅓ well-rotted manure or compost. Mix to a depth of 12 inches after a heavy application of bone meal.

3. Place the crown of the plant on a low cone of soil and arrange roots around sloping sides of cone. Cover with soil so that the crown of the plant is not less than 1 inch or more than 2 inches deep. Mulch with straw, wood chips, or other material to prevent drying out. Water liberally, soaking the mulch, too.

4. Water weekly with deep soakings, especially after bloom scapes appear. This watering, of course, is needed only in case of insufficient rainfall.

5. For winter protection, mulch just enough to keep ground from heaving as a result of alternate freezing and thawing. For tender plants a liberal covering of coarse excelsior, straw, pine needles, or the like should be used.

6. Future care may be provided by occasional foliar spraying with a rose spray to which has been added Rapid-Gro or some similar liquid fertilizer.

Mulching should be done for moisture retention, for weed control, for winter protection, and for general soil health and maintenance. Obviously, the best soil is one high in organic matter. The breakdown of organic matter (mulch) results from bacterial action in the soil. Mulch material consists of vegetable matter that will decay to produce humus. Leaves, straw, corncobs, sawdust, grass clippings, weeds, garden refuse are kinds of mulch material. The decaying process is hastened by shredding or chopping and by the addition of a little nitrogen. Fine daylilies have been grown in a bed of moist peat moss with only foliar feeding. A garden with an abundance of humus will produce a soil acidity near neutral and that is where it should be for daylilies.

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Insects And Related Pests Of Daylilies

FLOYD F. SMITH

That daylilies, or *Hemerocallis* are seldom attacked by insects and diseases is indicated by the few reports on damage in the literature. Many commercial growers and home gardeners have assumed that these dependably hardy perennials are immune to attack by both insects and disease organisms.

In recent years there has been a tremendous increase in popularity of daylilies as garden plants and widespread movement of plants from one region to another through exchange or sale. In such situations pests attacking a crop in one region eventually appear in another, sometimes with damaging results.

In the extensive hybridization of the several species of daylilies to obtain new cultivars with new combinations of color, size, and form of flower and more lush growth, little consideration has been given to the possibility that such new creations may be more susceptible to insect attack than the progenitors. In studies at the New York Botanical Garden some species and cultivars of *Hemerocallis* were more subject to thrip attack than others (Stout 1940, 1943). A group of hybrids selected to flower in sequence over a period of several weeks or months provides a more favorable situation for continued breeding of thrips than a roadside patch of volunteer *Hemerocallis fulva,* which flowers for only a short time in midsummer.

The relative resistance to insects and diseases helps make the daylily one of our most dependable perennials, with a satisfactory display each year with practically no dusting or spraying. However, the growers should be on the alert for the appearance of a certain few pests. Where insect damage does occur the following information will assist in identifying the pest and in selecting the control measures that should be used.

Slugs

Slugs and snails damage the tender young growth of daylilies especially in early spring. They make ragged notches along the edges and sometimes holes in the leaves. Their injury is usually accompanied by shiny slime tracks left as the creatures crawl over the plant.

Several species of slugs and snails occur in gardens in various parts of this country, some of which have come from other countries. Slugs vary in both size and color. The gray garden slug is less than 1 inch long; the brown spotted garden slug may reach 5 inches. Slugs have a soft thickened hump on the back but no shell. Snails also vary in size from one-fourth to 1 inch or more according to the species. They have a coiled shell, into which they withdraw when disturbed.

Slugs and snails feed at night and hide by day in damp places such as trash, soil or wall crevices, under boards or loose stones. Coarse loose mulches around the daylilies or masses of old foliage provide favorable hiding places. A cleanup of hiding places will aid in reducing infestations. Slugs can be collected and destroyed from hiding places under boards placed on the ground in infested areas.

Of the many chemicals tested against slugs and snails, metaldehyde has given the best control. Some commercial metaldehyde baits also contain chlordane or calcium arsenate. These creatures are attracted to metaldehyde, apparently by its odor. They are stupefied or paralyzed by the metaldehyde and become dehy-

Fig. 1. Warty protuberances on hemerocallis buds caused by feeding of hemerocallis aphids. (From Roussel and Stringfellow 1959)

Fig. 2. Hemerocallis aphid (*Myzus hemerocallis* Tak.) colony on foliage. (From Roussel and Stringfellow 1959)

drated and die if the atmosphere is dry; sometimes they recover in cloudy wet weather. For control, metaldehyde granules are placed in piles of about 1 teaspoon at intervals of 3 or 4 feet, and the pellets are scattered among the plants. A dust containing 10 or 15 percent of metaldehyde is applied at the rate of 1 pound per 1000 square feet. A colloidal suspension of metaldehyde is also available for diluting with water and sprinkling or spraying on infested areas. Follow the manufacturer's directions for rates of application under your conditions.

Slugs and snails may remain in their hiding places for several days between feedings, and may escape a single application of metaldehyde. Where heavy infestations exist, two applications should be made about a week apart. Applications on rainy nights should be avoided because the baits lose their effectiveness when they are wet or moldy.

Aphids

Aphid damage on daylilies in the United States was first reported in California (Buck 1954), but the species was not identified. Roussel and Stringfellow (1959) observed large numbers of aphids on the foliage in Louisiana in 1955 and 1956 and smaller numbers on the flower scapes and bloom buds. Infested plants were delayed in starting spring growth, and the new foliage was yellowed, having the appearance of nitrogen deficiency. Feeding on the bloom buds caused warty protuberances (Fig. 1) and malformed blooms. Some flowers showed severe discoloration as the perianth-segments opened. Injury is worst in winter and early spring.

The species found in Louisiana was identified as *Myzus hemerocallis* Tak. known previously only in China, Formosa, and India (Fig. 2). Collections from California in 1959 showed that the same species was established there and probably was the one first observed in 1954. Present information indicates that daylily is the only food plant. It can be expected to appear in other areas.

According to Roussel and Stringfellow

this aphid can be controlled with malathion sprays applied early in the season as new growth starts and repeated every 4 or 5 weeks as needed to protect the later growth and flower buds. Aphids must be wetted by the spray, directing it from all sides to cover the foliage, especially the sheaths and also the young scapes where the aphids congregate.

Wescott (1964) reports injury to daylilies in Florida by feeding of the sand lily aphid (*Myzus leucocrini* Gillette and Palmer. This brownish green aphid with two rust-orange blotches is a pest of *Leucojum* and sand lily.

The same spray can be used on the sand lily aphid and also the foxglove aphid *Acyrthosiphon solani* (Kaltenbach) and the potato aphid (*Macrosiphum euphorbial* (Thomas), and the green peach aphid *Myzus persicae* (Salzer) which occasionally occur on foliage of daylilies but have not caused visible damage.

Thrips

At least five species of thrips have been found infesting daylilies, but which species was responsible for injury on the daylilies was not clear.

The most serious type of injury, shriveling and death of inflorescence while still undeveloped, according to Stout (1940, 1943), is associated with thrips feeding on tender branches and flower buds. The flower stems are bent and twisted (Fig. 3). The feeding areas are rough and brown with several layers of corky dead cells. Few or no flowers develop on heavily infested plants. Less severely injured scapes have vertical corky strips on the stem or branches of the inflorescence without deformity (Fig. 4). No foliage injury was observed on plants with serious flower injury. *Hemerocallis citrina* and *H. multiflora* and hybrids of either species were most seriously affected. Adjacent plants of other species or their hybrids were uninjured. The early flowering cultivars apparently escaped injury and only slight or no injury occurred on those flowering in late August or September.

Stout (1940) recorded four species associated with the injury (Fig. 4) on

Fig. 3. Thrips (*Frankliniella hemerocallis)* injury to stems and bud of daylilies (*H. citrina*). Note the roughened surface of the stems, the bent and twisted flower stems and flower buds dying (from Stout 1940).

Fig. 4. Russeting injury (left) by thrips on stems and (right) stems of dehisced buds following thrip feeding. (Beltsville, Md. 1959).

Fig. 5. Thrips damage to buds and flowers. (Beltsville, Md. 1959).

daylilies—the gladiolus thrips (*Taeniothrips simplex* Mor.), the tobacco thrips (*Frankliniella fusca* (Hinds), the flower thrips (*F. tritici* (Fitch), and a dandelion thrips, *Thrips physapus* L. Because of the greater abundance of the light-colored flower thrips, he assumed that this species was responsible for the injury.

E. J. Kraus in 1943 observed the injury as described by Stout in his daylily collection at Lake Geneva, Wisconsin, but it was apparent to him that a dark-colored species was causing the injury. Later Crawford (1948) described this thrips as *Frankliniella hemerocallis* n. sp. This thrips and its russeting injury on daylilies has been observed at Beltsville, Maryland, in 1949 and again in 1959 (Figs. 5 and 6). Associated with the russeted areas in flower stems and buds at Beltsville were rusty feeding areas in the leaf sheaths near the crown of the plant. It is evident that this species feeds on the foliage early in the season and continues on the flowering parts when they appear. In 1958 E. N. Tissot, of the University of Florida, found it on daylilies in Florida.

Frankliniella hemerocallis can cause serious russeting of stems and distortion and loss of flowers. This thrips is known from New York, Wisconsin, Maryland, and Florida. Although widespread, it is apparently still somewhat localized but can be expected to appear in many gardens. If the characteristic injury is noted, spray thoroughly with malathion, 2 teaspoons of a 57 percent emulsion concentrate per gallon of water, two or three times at weekly intervals. DDT, 2 teaspoons of 25 percent concentrate per gallon, and lindane, 1 teaspoon of 25 percent concentrate per gallon, are alternative treatments.

According to our present knowledge, gladiolus and dandelion thrips were probably incidental visitors from their more preferred hosts. The dark-brown tobacco thrips appear on gladiolus and a number of other plants early in the season, where the adults cause a fine white stippling of the foliage. They then disappear for the season without insecticide application. Large numbers of the flower thrips may be present in daylily flowers, but they cause no distortion or serious discoloration as they do on roses. The flower thrips cannot survive on foliage; it feeds primarily on pollen and nectar. It is the most abundant thrips east of the Rocky Mountains and adults migrate in great numbers for 4 to 6 weeks each spring and then decline in numbers for the remainder of the season.

Imported Long-Horned Weevil

Irregular areas eaten from the margins of daylily leaves in June and July may be caused by the imported long-horned weevil (*Calomycterus setarius* Roelofs). This weevil from Japan, and now common in the northeastern United States, is about 3/8 inch long, wedge-shaped with prominent antennae, black in color but appearing frosty gray due to a covering of gray scales. The adults cannot fly but get around by crawling on people and onto vehicles and wander into houses. They feed on many garden flowers, shrubs, trees, and vegetable plants. They lay their eggs in sod, and their grubs develop in the soil until the following spring, when a new generation of weevils appears.

To control these weevils, apply a 6-percent chlordane dust or 4 teaspoons of 40 percent wettable powder chlordane per gallon of water to infested plants in the ornamental garden. Avoid dusting or spraying vegetables or fruits that will be eaten.

Spider Mites

The two-spotted spider mite (*Tetranychus urticae* (Koch) and related species are present on ornamentals, vegetables or weeds in almost every garden. In the Southern States *T. cinnabarinus* (Boisd.) is the predominant species. Mites feed by piercing the leaves and injury on daylily foliage consists of speckled yellowish spots and sometimes reddish or brown areas. Heavily infested plants are stunted as the foliage declines and may be covered with fine webbing. Two-spotted spider mites are less than 1/50 inch long, yellowish green with two dark spots on the back. The *cinnabarinus* mites are similar in size and in possessing two brown spots but the general color of adult females is brick red or carmine. Spider mites increase rapidly during hot dry weather. One female may lay 100 to 200 eggs, and a generation may be completed in 5 days.

These spider mites live over winter on hollyhocks, violets, chickweed, henbit, dock, and many other plants that retain their green leaves. Clean cultivation to remove overwintering hosts before spring growth starts is important in their control.

Sprays containing malathion (2 teaspoons of 57-percent emulsion concentrate per gallon of water) or dicofol (1 teaspoon of 18.5-percent emulsion concentrate per gallon) should be applied to foliage and mites. Malathion sprays should be repeated weekly and the Kelthane at least every 2 weeks. The treatments should be started early in the season before the infestation has built up and plant damage has become serious.

Rust or Russet Spot

Daylily clones occasionally show yellowish spots on the foliage, and later the entire leaves become rusty brown, dry up and die. According to Fosler and Kamp (1954), no insect, fungus, or bacterium has been associated with this noncontagious difficulty. A virus has been suspected but none has been reported. Rust appears to be associated with varieties derived from *Hemerocallis fulva*.

Cutworms

Young leaves and buds on daylily plants may be damaged by climbing cutworms. Larvae of the most common species, the variegated cutworm *Peridroma saucia* (Hubner), has smooth skin and is light brown, mottled with dark brown, and with a yellow dot on each segment. The moth of this caterpillar is grayish, mottled brown with a brassy lustre and lays its small white eggs on foliage or other surfaces on fences or buildings. The first generation appears in early spring and a second in midsummer. Most conspicuous damage occurs when foliage is small in the early spring. These larvae feed at night, often climbing stems, and hide during the day in loose mulch.

Many caterpillars can be trapped under boards laid on the soil surface near the base of the plants. Spraying with DDT or Sevin will protect the foliage from feeding caterpillars.

Other Pests

Tarnished plant bugs puncture the tips of the flower buds and deformed flowers result. Cucumber beetles eat small holes in the buds and the flowers on opening have a ragged appearance (Davis 1954). Wasps in search of nectar may injure daylily buds by gnawing them. Occasionally Japanese beetles attack the flowers and grasshoppers feed on the foliage (Fosler and Kamp 1954). Chlordane dust and spray as recommended for the imported long-horned weevil will also control these pests.

Root-knot nematodes cause gall-like growths on the roots of daylilies. Consult your county agent or State Experiment Station for control recommendations under your conditions.

In Germany the midge *Dasineura quinquenotata* (Loew) is a common pest of *Hemerocallis fulva*.The adult fly lays 50 or more eggs in a single bud. The white or yellowish larvae feed in the buds causing them to become rotten and to fall off prematurely (Dodge and Rickett 1943). This insect was more recently found infesting daylilies in Sweden (Sylven 1952). It is not known to occur in the United States.

When the periodical cicada of brood X was abundant in Maryland in 1936, the adults, which usually insert their eggs in woody stems, also oviposited in stems of *Hemerocallis fulva,* phlox, and delphinium (Cory and Knight 1937), and the punctured stems usually broke off. However, this damage is usually of minor importance and requires no control measures even in a year of adult abundance, which is only 1 in 17 years.

Precautions

Insecticides mentioned for control of pests on daylilies are available for use in home gardens. They should be used according to directions on the label and all precautions followed for safe handling. Many more toxic materials are obtainable but should be handled only by experienced operators who are familiar with the hazards involved and will heed all precautions.

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Diseases of Daylily

D. L. GILL and CHARLES M. HEALD

Daylily (*Hemerocallis*) plants are considered relatively free from disease. The *Index of Plant Diseases in the United States* (4) lists a few organisms that occur on daylilies. Some of these are at times undoubtedly pathogenic. However, we know of only one report of an attempt to show pathogenicity of an organism (1). Cooley concluded that the organism was nonpathogenic and that the trouble was physiological in nature. Yet, in recent years some growers have encountered serious difficulties, and for this reason we hope the following information will be useful, despite limited information on the subject.

Root and Crown Diseases

Most serious difficulties have involved the roots and crowns of daylily plants. Several fungi (*Phytophthora* sp., *Sclerotium* sp., *Sclerotium rolfsii*) and root-knot nematodes (*Meloidogyne* spp.) are listed as associated with these conditions (4). *Fusarium* sp. has also been isolated from decaying roots of unhealthy plants, but the authors state it may have entered after the roots died (3). R. P. Esser, Florida State Department of Agriculture, in a letter to W. C. Hava of February 1, 1962 (2), stated that he had found the following plant-parasitic nematodes associated with unhealthy *Hemerocallis* plants: sting, spine, ring, spiral, lance, root-knot, lesion, reniform, stubby root, and stunt. Root-knot nematodes were found most frequently.

When we examined soil and roots from poorly growing daylilies, we found several fungi and nematodes. Among the most frequently encountered fungi were: *Fusarium* sp., *Cylindrocladium* sp., and *Rhizoctonia* sp. Plant-parasitic nematodes most often recovered from soil around diseased roots were root-knot (*Meloidogyne* spp.), ring (*Criconemoides* spp.), and spiral (*Scutellonema* spp. and *Helicotylenchus* spp.).

Attempts to prove pathogenicity of several of these fungi and nematodes have thus far failed. Among possible reasons for failure are: (1) use of seedlings for inoculation (our observations indicate that great variation in susceptibility occurs among cultivars in a garden); (2) too vigorous growth of the plants; and (3) too low a level of inoculum in the tests.

Several growers have consulted us in the past few years about serious root and crown difficulties. Beds from which diseased plants were taken have produced good plants after fumigation with methyl bromide-chloropicrin, if replanted with healthy plants. Suggested rates for each 100 square feet of bed space are one pound of methyl bromide-chloropicrin for nematode and weed control, and three pounds for fungus control. The soil should be pulverized to a depth of at least six to eight inches, and the fumigant released under a plastic covering. Because the fumigant will kill shrub and tree roots to which it penetrates and will poison animals, all precautions must be followed as given by the manufacturer and by various State Agricultural Extension Services. Other general purpose fumigants have been used less extensively. Two of these are dichloropropene-dichloropropane plus methyl isothiocyanate (DD + MENCS) and sodium methyl dithiocarbamate (SMDC), which may be used without a plastic covering. Directions should be followed closely.

Seeds planted in such a treated bed or flat, or in flats of a sterile material such

as vermiculite, should provide healthy plants for transplanting into a treated bed. Care should be taken to prevent reinfestation by running water, washing soil, tools or feet carrying soil, or transplanting diseased plants. Reinfestation may result in even greater damage, because enemies of the disease-producing organisms can be destroyed by soil fumigation.

An attempt to disinfect plants of valuable cultivars may be worthwhile, though difficult. Ectoparasitic nematodes and some fungi associated with a dying-back of daylily root tips, or heavy root branching after the growing part has died back, may be treated by the following procedure:

1. Break down the clump to 1 fan.
2. Cut off roots to the base of the crown.
3. Cut off the top.
4. Wash thoroughly and brush the crown area.
5. Soak in a 5% commerical household bleach (5.25% sodium hypochlorite) solution for 20-30 minutes.
6. Root the crown in a sterile material, such as vermiculite, a mixture of peat and vermiculite, or treated sand or soil.

Root-knot nematodes (*Meloidogyne* spp.) are even more difficult to overcome, because they invade the roots and rhizomes. A noticeable root swelling, found in most other plants, is seldom produced in the fleshy roots of *Hemerocallis* by root-knot nematodes, but symptoms of their presence are characterized more through reddish brown to black sunken lesions. Heat will kill these nematodes within the plants. We know of no report concerning heat treatments on *Hemerocallis,* but because of successful use on other plants, *experimental trials* of soaking diseased crowns in water at 118° for 15-20 minutes are suggested.

A chemical treatment of dibromochloropropane, as a drench around growing plants, may provide some control from nematode infestation. When using it, follow directions of the manufacturer of your State Agricultural Extension Service.

Planting too deeply or extremely cold weather may favor *Hemerocallis* damage. Organisms may be associated with these conditions but the plants often overcome them when favorable growth environment is present. Thus, any method of keeping plants in a vigorous growing condition should reduce trouble. Mulches of various materials for winter protection also help.

To understand "Spring sickness," a form of root and crown trouble, it is necessary to recall, as discussed elsewhere in this handbook, that daylilies in cultivation are derived from evergreen, semi-evergreen, and dormant species. Since these species vary greatly in hardiness, seedlings likewise vary. In the colder areas evergreen and semi-evergreen cultivars may not be fully hardy. These are especially liable to injury when high temperatures initiating growth in late winter and early spring are followed by freezing temperatures. Crowns may be frozen and subsequently decay. Bacteria causing soft rot, fungi as *Rhizoctonia* sp., and insects may be associated with the condition. Partially rotted crowns and roots often develop slender, grassy foliage with few or no scapes. Daylily breeders in colder sections discard many such seedlings.

However, following a series of winters with favorable conditions, some less hardy cultivars may be introduced or cultivars adapted to southern regions may be grown in colder areas. Thus 'Playboy', 'Naranja', and 'War Eagle', widely grown in the South, may flower in Maryland but in some winters are severely injured. Cultivars range in hardiness from those adapted to south Florida, Texas, and California to those hardy in Minnesota and northern New England. This hardiness range should be considered in seeking a solution to "spring sickness."

A mulch about the crown helps insulate the plants from rapid temperature changes and early growth which may help prevent "spring sickness." Some growers dig affected plants, clean

off the decayed parts, and replant. Others clean the debris from around affected plants to dry the crown area. Drying may help overcome soft rot. Pentachloronitrobenzene (1 tablespoonful per gallon of water applied at ½ gallon per square foot) will aid in control of *Rhizoctonia* sp.

Foliage Diseases

Several fungi (*Botrytis* sp., *Cercospora hemerocallis, Colletotrichum* (*Vermicularia*) *liliacearum, Heterosporum* sp., *Kabatiella* sp., *Phomopsis achilleae*) are reported on above ground parts of *Hemerocallis* (4). We have found other fungi apparently pathogenic on leaves. Cooley (1) attempted to prove the pathogenicity of *Vermicularia liliacearum* but failed and concluded the condition called russet-spot was a physiological disorder.

Some fungi appear to be pathogenic and cause unsightly leaf-spotting and burning. Damage is often associated with aphid, thrip, or mite injury and their control is suggested because they may aid fungus infection. Since healthy new foliage has followed our use of fungicides, we suggest sprays of zineb or maneb (1 ounce in 3 gallons of water) at 7-to-10-day intervals during periods of rapid growth. A sticker-spreader may be needed to insure adequate coverage of the foliage. Removal of old plant debris should also aid in control.

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Daylilies in Landscaping and for Erosion Control

WILMER B. FLORY

Landscaping

In the small private garden where space is at a premium—and I would judge at least 90 percent of all gardens are of this type—daylilies can be a happy solution to many landscaping problems. In this connection, the following observations should prove helpful to the do-it-yourself gardener.

In general, evergreen cultivars do best in the South and dormant ones do best in the North, although hydridizers are now busy crossing the two in an effort to produce semi-evergreen types that will perform reasonably well in both climatic environments.

The elusive charm of some of our modern delicately blended color variations must be viewed at close range to be fully appreciated. These are especially suited to the small garden and their softly muted color tones do not clash with other flowers.

In view of the fact that in many families both husband and wife work during the day and have only the evening hours in which to enjoy their gardens, cultivars that are listed as extended bloomers should be chosen. Spot lights can often be placed to project garden enjoyment far into the night.

In the small garden, fragrance provides an additional enjoyment dividend, and this is especially true for the blind, who enjoy flowers only through smell and, to a lesser degree, through touch. A loss of sight may to some extent be compensated for by an increased sensitivity to odors and textures, but close contact with flowers is necessary to enjoy them. For this reason, fragrant daylilies must be planted close to garden paths, flanking garden seats and patios, at the side of doorways and garden entrances, and at other points where the blind person will come in close contact with the blooming plants. Although the parentages of our modern daylilies are often omitted, the most fragrant cultivars seem to have been derived from initial crosses of *H. flava, H. citrina,* and *H. thunbergii.* Daylilies with fragrant flowers are usually light yellow. charteuse or greenish yellow and green-throated. Many open in the evening and close in late afternoon or evening of the following day. The height of the flowering scapes of our modern daylily hybrids now ranges from under a foot to more than five feet, heights that will conform to any desired location in the perennial border. The arching, fountain-like foliage of the daylily provides a pleasing contrast to the foliage of most flowering plants. The foliage color ranges through various shades of green, yellow-green, deep green, blue-green and some clones are attractively variegated. In some daylilies the foilage is quite narrow and grass-like; in others, particularly in the evergreen it may exceed an inch in width.

Daylily flowers range over nearly the full color range, except pure white and pure blue. Delicately beautiful near-whites are available, but blues have not yet been obtained, although the originations of Bob Kennedy, Mary Lester, and Edna Spaulding approach this new color threshold. In working out pleasing color

harmonies in the perennial border, the gardener may move daylilies in full bloom with a ball of earth from place to place until the desired effect is obtained. With proper care, plants moved in full bloom will continue to flower with very little effect on quality of bloom or growth. Mistakes in placement according to height may be corrected at the same time.

It is difficult for the novice to visualize daylilies as established clumps. It is best to follow the general rule of placing the newly purchased plants at least three feet apart, since much of the natural grace of daylilies is lost by crowding of the mature clumps. A most satisfying early spring effect may be achieved by an interplanting of daffodils half way between the daylily clumps and well to the front just at the edge of the lawn. After the daffodils have bloomed and their foliage has started to yellow, the new daylily foliage will effectively conceal the unsightly daffodil foliage.

Especially gratifying to the backyard gardener is the daylily's long season of bloom during the hot dry months when most perennials are least attractive. A carefully selected list will provide bloom from June until the scapes are cut down by frost. In the South, there are a few repeat-blooming cultivars that flower during the entire summer. We can expect an increasing number of these "everbloomers" or "continuous bloomers" as hybridizers recognize a demand for them.

In general, daylilies are a rugged lot perfectly capable of standing on their own merit, taking the worst buffeting that Mother Nature and man can give them. Some clones in commerce have been undesirable, although beautiful in bloom, but with little else to recommend them. Some hybridizers have been preoccupied with the beauty of the individual flowers and more or less oblivious to the over-all growth characteristics of the plants. In instances where "line breeding" or inbreeding has been followed too closely, hybrid vigor has been lost. This gives rise to clones that require too much coddling and pampering to be suitable for the average gardener. The compost pile should be their ultimate destination, after years of disappointing performance.

For the small residential plot, many companion plants may be grown together to harmonize with daylilies. Among the best companion plants are Shasta daisy used to separate groups of daylilies with clashing colors. Specific groupings of companion plants that have proved pleasing in different sections of the country are:

Light yellow daylilies with hardy phlox (pink and white) and platycodon (blue and white).

Yellow daylilies with purple buddleia, white columbine; also with deep pink floribunda roses, pink lythrum, blue scabiosa, Madonna lilies; also with white feverfew and dwarf white nicotiana.

Lemon-yellow daylilies with bee balm, deep pink monarda, deep pink rudbeckia.

Pink daylilies with white phlox, blue salvia, blue scabiosa, baby's breath, Shasta daisy, white sweet alyssum, white petunias, and dwarf white nicotiana.

Red daylilies with Shasta daisy and double white baby's breath.

Associated with daylilies for a long season of bloom, try daffodils, iris (dwarf, tall-bearded, Siberian), peonies, floribunda roses, hardy fall asters, veronicas, phlox, cushion mums, hostas, and delphinium. Strawberries, if kept in hills, can prove most effective.

Requirements are slightly different for public plantings than for private gardens. In boulevard and roadside plantings, where the passerby has only time for a quick glance, mass plantings, using many plants of one or a few cultivars of daylily are most effective. Many mixed cultivars in a group would give a distracting, hodge-podge effect when viewed from a passing car. In public parks, along boulevards and roadsides where care of planting materials may fluctuate from time to time, kinds of daylily should be chosen that require a minimum of care and are relatively inexpensive. The best and most expensive of the recent novelties are best entrusted to botanic gardens and arboretums with a

continuity in both planning and maintenance.

Daylilies, because they are permanent and thrive with very little attention, are ideal for naturalizing along streams and ponds, at the edge of woods, on slopes, and in broad open spaces. Such plantings should be in masses of a single bright colored clone in red, pink, yellow and even purple that register well at a distance.

Because daylilies bloom during the peak of the summer vacation season, they are ideal for planting around summer homes, lakeside cottages, and remote retreats where they must shift for themselves. Even when the vacationers are present their preferred activities are not likely to include wielding a hoe, pulling weeds and sweltering in the hot sun.

Landscaping with daylilies has received tremendous impetus by the public in recent years, primarily because of the remarkable improvement brought about by modern plant breeding. This improvement has resulted chiefly from the efforts of American hydridizers. We now have nearly 13,000 cultivars of daylily registered with the American Hemerocallis Society, and nearly 900 new registrations were added in 1966.

In selecting cultivars, it is best to visit test and display gardens, both private and public, and gardens and seedling plots of hydridizers and commercial firms that specialize in daylilies.

Erosion Control

Up until the last few decades, *The Americans* could just as appropriately have been called *the despoilers.* We found here a virgin land, abundantly rich in what seemed to us an inexhaustible supply of natural resources, and proceeded with reckless abandon and lusty pioneer drive to squander this priceless heritage. Now, finally, the pollution of our streams, the stifling smog of our larger cities, and the scarred face of once fertile acres have brought us up sharp—face to face, with the tragic havoc we have wrought. In recent years, we have hopefully reversed the trend and are striving valiantly in a belated attempt to conserve what is left and to heal and restore our partially ravished land. On a rapidly widening front, we are marshalling the forces of science and technology and an aroused citizenry to attack the problems our profligate waste has spawned. This is *one* war the escalation of which we can welcome with enthusiasm.

Perhaps the most urgent phase of this huge effort is our attempt to control erosion. And here, though many may scoff at the idea, the lowly daylily enters the picture as an effective erosion control agent. When I was a small boy, my father, with a team of horses and a home-made drag, "manicured" the gravel roads in our neighborhood in order to work out his road tax. Occasionally, the edge of the drag would gouge into a "colony" of *H. fulva* 'Europa' that had spread from a farmer's garden and encroached upon the roadbed and would scatter the broken roots along the roadside. Now, some 65 years later, these scattered fragments have grown into large masses and, have crowded out grass and weeds, with a tenacious grip so strong the sharp steel edge of the modern road-grader cuts through them with difficulty.

In the midst of a second-growth woodlot, I recently came upon a quarter acre pure stand of 'Europa' that completely concealed the site of a pioneer log cabin that had long since crumbled into the forest mould. The daylilies had evidently spread from a single clump planted by a pioneer woman some 130 years ago, judging from the apparent age of the second-growth trees that covered the spot. The classic and awsome example of erosion is, of course, the Grand Canyon of the Colorado; but many of our states have their "miniature" canyons. In a Government publication years ago, I came across an account of a gully that had started from the drip of a barn roof. Left unchecked, it had engulfed first the barn, then the house, then the farm; and, finally, completely out of control, it had ripped a yawning chasm across the entire county so wide and so deep that it

cut the county in two, compelling residents in one section to detour through an adjoining county in order to reach their own county seat. Often since, I have toyed with the tantalizing speculation that this enormous waste might have been prevented had the farmer planted a few *H. fulva* 'Europa' when he first noticed the drip from his barn.

Until now, daylilies have been little used for erosion control. Effective ways for using them are:

1. To carpet run-offs in cultivated fields.

2. To "heal" heads of gullies where they encroach upon cultivated fields or pastures.

3. To hold steep grades against slipping or gullying.

4. To "heal" blow-holes on sandy farms.

5. To prevent small streams from meandering through fertile bottom lands, by planting along stream banks.

6. To prevent river currents from under-cutting river banks, especially on bends, during time of flood.

7. To beautify railroad right-of-ways and highway cuts where beauty as well as erosion control are desired.

8. To blanket the earthen dams of farm ponds and runways around such dams to prevent break-throughs during time of flood.

The above is just a sampling and by no means a complete list.

The use of daylilies for erosion control might be objected to on grounds of expense, but this objection is hardly valid. It is possible to obtain some of the old clones no longer in great demand for little more than the cost of digging and transporting. The excess of seedlings obtained in hybridizing is another possible source of daylily plants. Persons doing breeding work might be willing to donate their excess of seedlings not otherwise needed for experimental work.

Daylilies that spread rapidly by underground rhizomes, such as *H. fulva* 'Europa', *H. fulva* 'Rosea', *H.* 'Kwanso', 'Queen Esther', and 'Manchu', are excellent for purposes of erosion control. Yet any vigorous, fast growing, deeply rooted cultivar or unnamed seedling might serve as erosion-control plants.

The future should see a much wider use of daylilies in erosion-control problems as we come to realize how effective they are in the control of water run-off from our fields and streams.

–13–

Uses of Daylily as Food and in Medicine

SHIU-YING HU

The daylily is one of the most valuable herbaceous perennials introduced from China to American gardens for their attractive foilage, conspicious and colorful flowers, exquisite and graceful form, superior ability to compete with weeds and to withstand drought, and for their complete cheerfulness in the face of neglect. In the use of daylilies, the American people have only adopted and amplified one of the varied merits of the species discovered by the ancient Chinese, e.g., its ornament merit. The economic and medicinal merits of the species known to the people of eastern Asia, from Korea to Vietnam, is practically unknown to the American public.

Fig. 1. They have been planted in gardens large and small and along highways and byways throughout the United States.

In large cities and small university towns, Chinese cooking classes are offered by university extension courses, city adult education centers, or private cultural organizations. Meanwhile, new Chinese restaurants, like colorful fresh mushrooms over the meadow after a summer night's rain, emerge in American cities, suburbs, and wayside rest areas. The American people have not only patronized these restaurants for ready cooked food, they have also expressed their genuine willingness to learn to prepare the oriental dishes themselves. Publishers and newspaper editors have captured the mass psychology and published numerous Chinese cook books and recipes. But, what about the source material? For this, instructors, homemakers, and herb growers alike turn to botanists who know the plants and their uses. Letters of inquiry come to me repeatedly. Many of these are concerned with the use of flowers in Chinese dishes.

The discoveries of effective principles from old remedies like *Ephedra, Rauwolfia,* for the cure of serious ailments of the respiratory, circulatory, and other organs have turned the attention of modern botanists to the medicinal value of the flowering plants.

Cultivation and Preparation for Market

Cultivation. Although daylily flowers are used extensively as an article of food and the crown and root are used as medicine in China, daylilies are not as abundant in China as in the United States. The wild species in China are found in isolated clumps among grass

and herbs on the slopes of mountainous areas in western, central and northern China where the land is sparsely populated. Daylilies do not occur in large patches as one may see them along the highways in eastern United States (Fig. 1). Actually, in China, daylilies are rarely found around ordinary houses. They are planted as a minor crop for ready cash and are placed along the edges of fields or vegetable gardens where the land is too steep or too dry for major crops. It is only in temple grounds, or the back yards of poets and artists, or around the castles of government officers, that daylilies are planted as ornamentals.

Preparation of flowers for market. Although the mature flower buds are delectable, the thrifty Chinese farmer's wife seldom prepares a daylily dish for her own table. They are a cash crop and must be sold to augment the family income. Because of their highly perishable nature, the daylily flowers are carefully dried on the farm. Fresh flowers are not seen in the market. The dried product appears brownish yellow, wrinkled and twisted and is frequently covered with a whitish mould or bloom. It is amusing to note here that many city folk who use the dried flower buds have no idea that the common daylily is the source of the *Chin-chen-ts'ai* which they esteem so highly at the table. Among my non-botanical Chinese friends in America, I have not found one who does not respond in delightful surprise when told that the daylily flower buds are the source of *Chin-chen-ts'ai.* Perhaps this is the reason for the large importation of dried daylily flowers from Hongkong to meet the demand of Chinese Americans, particularly the restaurateurs.

In preparing daylilies for the market the farmers pick the mature flower-bud early in the morning, just at the time when the flowers begin to open. These buds are brought home and steamed immediately. Then they are spread one by one in a mat and dried in the sun. Experienced field botanists all know the principle of killing plant cells of fleshy specimens, flowers or fruits, by the application of sudden heat or chemicals. Such treatment hastens the drying process and keeps a better color in the dried flowers.

Preparation of the roots for medicine. The ancient Chinese observed the concentration of material and the hibernation of life in the underground portion of the daylilies, and in their battle with hunger and disease they not only learned the use of daylily flowers for food, but they also discovered the value of the crown and root for the conservation of health. To this end, the crown and roots are trimmed off the plant in the autumn or early spring before the leaves appear. These are dried in the sun and used as medicine.

Marketing

The marketing of dried daylily flower buds in China and in world trade is noteworthy. In rural China collectors may carry two willow or bamboo baskets at the end of long poles on their shoulders and travel from village to village to collect small objects of farm products. These collectors transport their collections of daylilies to the nearest town, where wholesale merchants receive and distribute them locally or pack and ship them to larger cities. For shipment, the dried daylilies are packed in large rough bamboo baskets. These bales usually weigh three or four hundred pounds. For world trade, the dried buds are repacked in Hongkong. There the export merchants put the material into smaller packages, attractively packed and labeled to appeal to the overseas Chinese.

Data for the exportation of the dried daylily flowers from various ports of China and the importation of the same commodity into various cities of the world is almost non-existent. However, we have Watter's Consular Report about trade in Chinkiang for the year 1886. Chinkiang is the provincial capital of Kiangsu (Shanghai and Nanking are the better known cities in this province). According to Watter's report "The export of lily flowers has increased from 7,033,000 lbs. to 7,677,622 lbs., and is the largest for many years. The crop was good, price remunerative, about 2/10

consumed in Chinkiang, the rest goes south, ... The cultivation of this plant yearly increases in the north of this province" (*Kew Bull.* 2: 116-118. 1889). It is worthy of note that Chinkiang is about 40 miles southeast of Nanking, the native home of *Hemerocallis altissima* Stout, the Tsu Kin Shan daylily.

For importation to the U. S., we have Stout's investigation on the estimate of the United States Appraiser's Office at New York City. For that city some four thousand pounds of dried daylily flowers were imported annually in the 1930s. In the Chinese groceries in America, these flowers are called *Gum-jum* or *gum-tsoy*, a special Cantonese pronunciation for golden needle or golden vegetable.

Marketing of crown and root for medicinal purposes. Marketing of the daylily for medicinal uses is limited to inhabitants of cities, for in rural China the people live on the good earth. The underground part of the daylily, like any other medicinal plant, is collected as the need arises and is used fresh. In Chinese cities, however, medicinal plants are dispensed by two groups of people, the pharmacists and the herb dealers.

The pharmacists of China are owners of expensive official dispensaries. The walls of their stores are lined with cases full of pigeon holes, shelves, and boxes. The materials they sell are partially cured or prepared. These may be clean dry bulbs, sliced stems and roots, dry flowers, small fruits or seeds, sliced large objects, steamed and dried fleshy roots and fruits, and even pills, extractions, and tinctures. The pharmacists dispense according to the prescriptions made up by old-type Chinese physicians. They do not diagnose or prescribe.

The herb dealers, on the other hand, diagnose, prescribe and sell medicine. They may be herbalists who own small very primitive shops with plants hanging from floor to walls and ceiling, crowded on shelves or even drying on the sidewalk in front of the shop. A larger number of herb dealers are itinerant vendors who peddle a few hundred objects on their shoulders with a long pole and two simple frames. The objects sold by the herb dealers are uncured medicine (*Ts'ao-yeuh*). It is from the herb dealers that fresh or partially dried daylily roots and crowns are always available.

Food and Medicinal Value

Medicinal value. The use of the underground part of daylilies for medicine is not limited to the people of China. The practice has been adopted by all Asians who have assimilated the Chinese culture, from Korea to Vietnam. In my article, *Medicinal Plants of Chengtu Herbshops* published in 1945, I noted: "The spindle-shaped thickened fibrous root of the plant, about 8 cm. long and 1.5 cm. thick, is boiled with port. The preparation is administered to promote the formation of blood cells, to give strength, to relieve a feverish condition and to cure toothache."

Numerous ancient Chinese herbals, for example Li Shih-chen's *Pên-ts'-ao-kang-mu* (Chinese Materia Medica) published in 1590, recorded that daylily underground parts are used for the reduction of temperature (antifebrile), the easing of pain (anodyne), and as a diuretic. It is prescribed for dysuria lithiasis, dropsy, gonorrhea, jaundice, piles and tumor of the breast. Scientific investigation into the active principles of the plant for the empirical Chinese practices is still lacking. G. Klein and G. Pollauf reported the presence of colchicine in *Hemerocallis* (Nachweis des Colchicins *Oesterr. Bot. Zeitsch.* 78:251. 1929). Here it should be pointed out that *Hemerocallis* has an obvious advantage over *Colchicum* as a source of colchicine, because of the greater bulk of *Hemerocallis.*

Food value. The dried daylily has been a delight to the Chinese gourmet. Modern science has proved this gustatory and nutritional choice completely sound. Chemical analysis of the dried flower bud shows that 11.42 percent of the dry weight is protein, 3.3% minerals, 2.27 percent fats, and 8.48 percent crude fibers. The content of Vitamins A and B is also high. Evidently in daylilies one finds a high protein, non-fattening food rich in both minerals and vitamins. It is

very likely that fresh material contains a higher vitamin value, but it seems that the dried form has better flavor.

Daylily-flowers may be used either fresh or dry. In preparing daylilies for cooking, the stamens, pistil and the receptacle of the fresh flower bud are removed. In the case of dried material, the flowers are first soaked over night and then the stamens, pistil and receptacle removed. The flowers may be used whole or in one-inch-long pieces as the recipe requires. In the following recipes the measurements given are for either fresh material or the soaked dried form after cleaning.

Daylily dishes are in the finest tradition of Chinese cooking. But to make the dishes truly Chinese in appearance and flavor, a few specal ingredients have to be purchased from an authentic Chinese store, either directly or by mail. The following items are inexpensive and generally useful in Chinese cookery. (1) Bean thread (Fêng-sze): A product of *Phaseolus mungo*. It appears like thin white vermicelli in the market. When put in boiling water, it becomes soft and transparent immediately. (2) Sesame oil (*Tsu-ma-yiu*): There are two kinds of sesame oil in American markets. The imported kind recommended is produced from roasted seed, and the oil is a rich brown color with an excellent aroma. (3) Fresh ginger (*Shêng-chiang*): This item is the irregular thick rhizome of the ginger plant. In addition to these articles, soy sauce available in most groceries, should always be within reach when one prepares Chinese food. Recipes A to D are daylily dishes with meat, and recipes E and F are meatless dishes for vegetarians.

Recipes

Daylily Sliced Chicken

1 chicken breast
1 medium-sized onion
1 tsp. chopped fresh ginger
1 tsp. salt
3 cups daylily
1 tbsp. soy sauce
1 tbsp. corn starch
3 tbsp. vegetable oil or bacon fat

Slice the chicken breast into paper-thin pieces. Chop one-fourth of the onion. Place both in mixing bowl. Add salt, ginger, corn starch, and soy sauce. Mix thoroughly. Put 2 tbsp. oil in frying pan over strong heat, quick cook the meat mixture for two minutes, stirring to prevent burning. Pour out the meat and clean the pan. Use 1 tbsp. oil to brown the remainder of the onion (in large slices). Add daylily, salt, ¼ cup of water and the cooked chicken. Cook for two more minutes. Serve immediately; serves two or three persons.

Daylily Sliced Pork

3 shoulder chops
1 tsp. salt
¼ tsp. sugar
3 or 4 tbsp. shortening
3 cups daylily
1 tbsp. sherry
1 tbsp. soy sauce
1 tsp. chopped ginger
1 tbsp. corn starch
1 clove garlic
2 onions

Slice the meat into paper thin pieces. Try to cut so that each piece has some fat. Mash the garlic. Chop half an onion into small pieces and cut the rest into large slices. Thoroughly mix the meat, mashed garlic, chopped onion, salt, soy sauce, ginger, sugar, and corn starch. Brown the sliced onion in a large frying pan. Pour in the meat mixture, add sherry, and cook 3 minutes stirring to prevent burning. Add daylily, sliced onion, water and stir. Cook 3-4 minutes more an dserve immediately; serves four.

Daylily Soup

1 lb. pork-chop bones or ribs
¼ tsp. whole black pepper
1½ qts. of cold water
½ cup cubed potato
1 onion
2 cups daylily
1 tbsp. salt
1 tbsp. sherry
2-3 slices ginger

Wash bones or ribs, cut into 1-inch pieces. Slice the onion, and brown over medium heat for 1 minute. Add bones,

salt, and fry for two minutes. Pour in the sherry and cook 1 minute, stirring. Add water and transfer the mixture into a soup kettle. Add potato and pepper. Bring to a boil and simmer for one hour. Five minutes before serving, add daylily, continue to cook over medium heat for 2-4 minutes. Serves four.

Chicken Daylily Soup

1 can condensed chicken bouillon
4 cups cold water
2 ounces dry bean thread
3 cups daylily

Bring bouillon and water to a boil. Ten minutes before serving, add the bean thread. Three minutes before serving add the daylily. Add salt and pepper to taste. Serves four.

Buddha Disciples' Delight
(Loh-han-chai)

10 cups daylily
2 oz. *fa-ts'ai*
6 oz. bean thread
4 oz. dry mushroom
4 oz. *hai-tai*
1 oz. *mu-erh*
6 oz. *fu-chu*
1 can bamboo shoots
1 can wheat gluten
1 can water chestnuts
2 cups fresh Ginkgo seed
2 oz. fresh ginger
1 lb. lotus rhizomes
6 medium-sized onions
1 lb. fried bean curd squares
6 cloves garlic
¼ tsp. black pepper
½ cup soy sauce
¾ cup vegetable oil
1 tbsp. sesame oil
2 tbsp. salt

According to Chinese folklore, Buddha had eighteen close disciples who were exclusively vegetarians. An authentic dish of Buddha Disciples' Delight should contain eighteen ingredients of plant origin. The materials for this dish are available in Chinese stores in America. This is an especially good dish for parties because it can be prepared a day ahead and warmed up over low heat just before serving.

The first seven items are dry. They must be soaked in separate containers for 2-6 hours before cooking. The soaking process can be shortened by using boiling water at the beginning. *Fa-ts'ai* (Hair Vegetables) is a dry mass of *Nostoc* (green alga) collected and dried in Kansus Province of China. Dried mushroom (*Lentinus*) is a black mushroom cultivated on decaying oak logs in Fukien and Anhwei Provinces. It has a very delicate aroma and texture. *Hai-tai* is the dried form of *Laminaria japonica* (brown sea alga). *Mu-erh* is another cultivated mushroom (*Auricularia auricula-judae*) from the Tsing-ling mountains. All these dry stuffs may have sand or dirt particle. After soaking, they should be cleaned. Hai-tai, mushroom, fuchu, bamboo shoot, wheat gluten, water chestnut, fresh ginger, lotus rhizome, onion, and bean curd squares need to be cut or sliced. Ginkgo seeds need to be shelled. (The Ginkgo seed can be picked up under any mature female ginkgo tree in October or even November. After cleaning and drying in the sun, it can be put in cold storage for use throughout the year.)

In cooking, slightly brown the sliced onion in vegetable oil, then transfer to a five-quart kettle. Add all the ingredients except the sesame oil. Mix well. Add 2 cups of boiling water. Bring to a boil over medium heat. Turn the heat low and simmer for one hour. Add the sesame oil just before serving. Serves 10-15.

Daylily Salad

2 cups daylily
½ oz. *liang-ts'ai*
1 tbsp. sesame oil
1/5 can wheat gluten
1 tbsp. soy sauce
¼ tsp. salt
1 cucumber
1/5 tsp. ginger powder
1 clove garlic

Soak the *liang-ts'ai* (agar agar) in cold water one hour before serving. Peel the cucumber and grate it with a medium-size grater. Just before serving, cut the wheat gluten into thin slices, mash the garlic and mix all the ingredients together. Serves four.

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Daylilies in Flower Arrangements

ELIZABETH T. CAPEN

The daylily makes a wonderful cut flower. Its sculptured form lends elegance to every indoor use, while its brief "day of beauty" provides opportunities that longer lasting blooms do not grant the gardener. It seems appropriate that here we discuss the unique features of the daylily as a cut flower and leave to others elsewhere the presentation of the principles and practices, rules and techniques of flower arranging.

Probably, the most novel contribution of the daylily as a cut flower is the wealth of individual blooms that may be picked each day without diminishing future bloom. Gardeners who must guard other plants from raiding "friends" may be profligate with daylilies. When daffodil, iris, and other fanciers pick their flowers, they deplete their gardens for the season. We do not. But to paraphrase a bit, we pick and return to enjoy another day. So, do take advantage of this characteristic to use the single blooms freely for one-day arrangements and to share with visitors. For it's one day, the daylily, like the hibiscus, does not even need water. Use this rare faculty. Perch one behind m'lady's ear, and take a dozen, displayed on a block of styrofoam, to show your garden club.

Simple One-Day Arrangements

Every fancier will want to display in the house his favorite of the day. Float it in a low glass bowl—or a brandy snifter, and put it near the telephone. If you have many to show, provide yourself with a large tray or platter and several very large pinholders (the 6 in. kind). You will enjoy placing the flowers so that each shows effectively, and probably finish with whatever greens the garden supplies. Avoid fussy leaves, but frame your flowers with something substantial. Ivy, hosta, grape, peony, broadleaved evergreens—all make effective backdrops. Such a centerpiece at the family dinner table is more than a conversation piece. It is a nightly source of entertainment—evaluating the new, comparing with the familiar, and testing identification. It may not be an "arrangement," but it's fun. You may expand this idea to provide tables of bloom for parties, for school and church affairs; to add a little color to institution meals. Pile the flowers by color on 12 in. trays—red, pink, melon, yellow. It is an easy way to share your bounty.

Informal Use of Sprays

If you are willing to pick a whole flower spray (inflorescence), there is another type of arrangement suited to daylily habits. You may make a tall splash with several well-flowered sprays, a long thin vase, and some interesting leaves. The exact pattern will change from day to day as new flowers open and you remove the spent ones, but the overall effect will be pleasing on the hall table for about a week.

Flowering

As you know, our "beauty for a day" is fickle as to its hours. Like us, some are "day people" and some are "night people." By testing your own cultivars nightly, you will get to know their individual predilections, which to use for a pre-dawn seance and which for a midnight blast. If you must use one after its "day" is over, pick it the night before, hold it in the ice box with scapes in water until a few hours before you need it. But, don't experiment on the company; try it on the family first.

Figure 1

Figure 2

Figure 3

Daily Replacement in Formal "Line" Arrangements

If a lasting and formal arrangement is wanted, use foliage as the basic structure filling in with a few individual flowers to complete the design. The daylily lends itself to this treatment, because the form of the individual flower is interesting and artistically satisfying. Examples of simple but lasting arrangements given below illustrate formal style with which top shows winners could find a welcome spot in any home:

In Figure 1, "Sweet Simplicity" is the title of Mrs. T. Frank Davis' line arrangement. This kind of "Simplicity" requires high talent, but lends itself to daily renewal.

In Figure 2, Mrs. M .Russell Ludlow's "Red Sails in the Sunset" would need a new name with a change of garb, but its strong triangle invites experimenting with different colors.

In Figure 3, Mrs. Jay E. Warner's "What's My Line" is another artfully simple tricolor winner. The flower and bud of "Kindly Light" might be succeeded another day by something very different.

"Line-Mass" Arrangements

When a more ambitious daylily arrangement is wanted, try the type called "Line-Mass." This is just what its name implies, an arrangement with a strong linear skeleton, but partly "filled in", reinforced with more plant material. This is probably the most American style, borrowing ideas of grace, balance, and proportion from the Japanese, but developing the basic design more lavishly, as our wealth of plant material invites.

What Kind of "Line"

The choice of "line" is limited only by imagination and good taste. "Line" may be severely vertical or horizontal; or it may form a geometric figure; square, triangle, circle, an oval, or part of one, or some variant of the Hogarth "S" curve, often called the "line of beauty." The chosen figure must appear stable and balanced.

What Kind of Plant Material

When you gather material from the garden for an arrangement, look for three ingredients:

1. A tall, interesting "line" perhaps a spray with buds, a branch with an interesting curve, or several tall leaves.

2. A main feature, in this case, daylilies.

3. Leaves about the size of daylily flowers, but of simple form, so as not to detract from the very patterned flowers.

If you can find accompanying material that repeats a shade of your flowers, such as red barberry with red daylilies or yellow and green leaves with yellow daylilies, they will harmonize and give the design unity.

Examples of "Line-Mass":

In Figure 4, Mrs. Goebel Porter's triangular arrangement, the pink of the daylilies is repeated in the variegated ti leaves (*Cordyline*).

"New Moon" is a good name for Mrs. George B. Smith's crescent of pale yellow daylilies (Fig. 5) in a dark blue-green container. Ivy is excellent for "line" and also for leaves at the base. Pine, too, is a satisfying foil for daylilies and may be used to make an infinite variety of frameworks, either for "line-mass" or the more restrained "line" type.

Modern Interpretive Line-Mass

The "line-mass" arrangement lends itself to the severe curves suitable to modern architecture and also to the interpretive arrangements popular at flower shows.

The schedule for a Tampa show called for an arrangement to depict "A High Flying Time—Freedom of Expression in Design of Today, Emphasizing Red Hemerocallis." Figure 6. To Mrs. U. A. Young this suggested swirling red chiffon skirts with a black tuxedo, represented by clipped *Cycas circinalis*, the fern palm, reinforced by stripes of lucite in what was reported as "a parabolic curve." Obviously, the "tuxedo" has become a bit distorted as it supports the "swirling skirts," and you wonder what kind of a party was held. Maybe, symbolism should go only so far, but this arrangement is a splendid example of "line-mass" in modern style.

Accessories and Figurines

"Line-mass" arrangements frequently include something other than flowers and leaves. When you introduce some-

Figure 4

Figure 5

thing else, from a crude stump to a work of art, it must be an integral part of the whole design. If you can remove it and still have a good design, eliminate it.

In Figure 7, Mrs. Wm. K. Russell's lovely grouping about the figurine illustrates how delightful a composition can be.

Daylily Mechanics

Some people keep daylily arrangements for more than a day by taking advantage of the fact that a flower will last a day without wilting. By using a hollow stem of another plant, such as iris, or even pinning the selected flowers on the framework of a lesser cultivar, it is possible to replace the individual flowers without disturbing the whole arrangement.

"Mass" Arrangements

"Mass" arrangements are not for the neophyte. Yet when the occasion calls for a large dramatic display, we turn to the most imposing style of all, called "mass."

The modern "mass" arrangement has evolved from the floral paintings and prints of the 17th and 18th centuries. Unlike some of them, however, the modern "mass" arrangement has a formal three-dimensional shape, and within that, design.

A "mass" arrangement will usually include many kinds of flowers, each kind grouped to make a different pattern within the whole and each framed by others to emphasize its individual beauty. The entire composition will be in balance and give an impression of depth.

Daylilies are particularly suited to this style. They may be combined with many kinds of dooryard flowers, including daisies of all kinds, zinnias and florists' favorites, roses, snapdragons, and gladiolus.

A modern "mass" arrangement by Mrs. Wm. A. Frost is of the formal American

Figure 6

Figure 7

Figure 8

Figure 9

colonial style. Symmetrical pattern, single flower at top, and relatively small container are typical (fronticepiece).

Japanese Arrangements

At the opposite pole of floral design is the work of the Japanese stylized through centuries of Buddhist symbolism, Japanese flower arranging made a virtue of the paucity of plant material. The restraint of linear design, the emphasis on simple color harmonies, and the use of plants as naturally grown, developed in Japan and when exported to this country provided needed discipline to the development of American styles.

However, the pendulum is now swinging the other way. Student becomes teacher, and the Japanese themselves have come a long way from their classic asymmetrical triangle, "Heaven—Man—Earth," until their newest craze, "free style," often abjures the use of plants at all.

Only after years of study at one of the many Japanese schools of flower arranging can one achieve a true Japanese arrangement. We show two arrangements that illustrate Japanese influence:

In Figure 8, the twisted poppy stems and pods suggest Kabuki dancers to the arranger, Mrs. S. Richard Mueller.

In Figure 9, Japanese influence, daylilies, and a bit of whimsy are combined by Mrs. John Butler to portray Indian culture in Ohio.

Personal Decoration

Daylilies may be used effectively in corsages or to trim a ladies hat or handbag. Large flowers are handsome alone, while several small ones may be grouped in a cluster.

Although the flowers will last a long time without special care, it is well to test several cultivars for lasting quality of bloom. After selection, pick in bud and harden by placing buds in water at room temperature for several hours until open. They may then be taped, assembled and left in the icebox until wanted.

Be sure to remove the pollen as it will stain, and so will red and purple flowers; light colors are safer. A wide ribbon or a

mat of leaves under the corsage should protect the clothing.

In The Cuisine

And, finally, have you tasted daylily flowers lately? They have long been a delicacy on the Chinese bill of fare. (see Chap. 13.) Called *gum-tsoy*, golden vegetable, or *gum-jum*, golden needles, daylily flowers are used either fresh or dried in soups and stews. Cooked they are rather like okra. If you really want to astound your guests, color key your luncheon table by using the same kind of daylilies as the center piece and in the salad.

Plate No.		Photo credit
25.	**George T. Pettus Garden,** Saint Louis, Mo.	George Pettus
	Walter Schroer Garden, Valdosta, Ga.	Scotty Parry
	Mynelle Gardens, Jackson, Miss.	Mrs. Louis Rockett
26.	**Multnomah** (Kraus 1956)—dormant; scapes 36"; flower 6"; *Stout Medal 1963.*	R. W. Schlumpf
	National Arboretum, Washington, D. C.	Gene Eisenbeiss
	Pecos (McKeithan 1964)—dormant; scapes 32"; flower 5"; *J.C. 1961; H.M. 1966.*	D. R. McKeithan
27.	**Frances Fay** (Fay 1957)—dormant; scapes 24"; flower 5"; *J.C. 1955; Stout Medal 1964.*	R. W. Schlumpf
	Full Reward (McVicker 1959)—dormant; scapes 32"; flower 5½-6"; *Stout Medal 1967.*	D. R. McKeithan
	Kings Grant (Childs 1965)—dormant; scapes 30"; flower 6½"; *J.C. 1964; H.M. 1967.*	Frank Childs
28.	**Orient** (Wynne 1966)—evergreen; scape 22" flower 5-6".	Baker Wynne
	Cartwheels (Fay 1959)—dormant; scape 24"; flower 6-7"; *J.C. 1957; Stout Medal 1966; F.C.C., R.H.S. 1693.*	Orville Fay
	Gabfeast (Hughes 1967)—dormant; scapes 24-26"; small-flowered 3½".	Hughes
29.	**Nashville** (Claar 1952)—dormant; scapes 36"; flower 6"; *A.M. 1957; Bronze Medal, Hamburg 1963.*	Scotty Parry
	Burning Daylight (Fischer 1962)—dormant; scapes 34"; flower 6"; *A.M. 1967 F.C.C., R.H.S. 1963; 1st prize, Hamburg 1964.*	Ben Parry
	Yazoo Delta (Smith-W.H. 1960)—evergreen; scapes 36"; flower 5½"; *J.C. 1958; H.M. 1962.*	Frances Lamb
30.	**Lula Mae Purnell** (Kraus 1962)—dormant; scapes 20"; miniature 2½"; *A.M. 1967; Fischer Cup 1966.*	Robert Shilling
	Tamlin (Peck 1967)—tetraploid; dormant; scapes 24" flower 6".	Virginia Peck
	Choctaw Dance (Shilling 1969)—dormant; scapes 30"; flower 6".	Robert Shilling
31.	**Golden Showpiece** (Pittard 1958)—evergreen; scapes 36"; flower 6"; *J.C. 1959; A.M. 1964.*	Pittard
	Memorable (Munson 1967)—evergreen; scapes 30"; flower 6"; *J.C. 1966.*	Munson
	Golden Chimes (Fischer 1956)—dormant; scapes 36"; miniature 2"; *A.M. 1961; Fischer Cup 1962; F.C.C., R.H.S. 1963.*	Scotty Parry
32.	**George T. Pettus Garden,** Saint Louis, Mo.	George Pettus
	James F. Cooke Garden, Athens, Tenn.	Frances Lamb
	Louis Rockett Garden, Jackson, Miss.	Mrs. Louis Rockett

George Pettus
Garden

Walter Schroer
Garden

Mynelle Gardens

Multnomah

National Arboretum

Pecos

Full Reward

Kings Grant

Orient

Cartwheels

Gabfeast

Nashville

Burning Daylight

Yazoo Delta

Lula Mae Purnell

Tamlin

Choctaw Dance

Golden Showpiece

Memorable

Golden Chimes

George Pettus Garden

James F. Cooke Garden

Louise Rockett Garden

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Exhibiting and Judging Daylilies

MRS. R. A. FERRIS, JR.

The once humble daylily has come of age in a very short span of time. In twenty years the hybridizing accomplishments have raised the status of daylily to the rank of aristocrats of the summer gardens. As great strides have been made in hybridization, so has the art of exhibiting daylilies gained in popularity. In fact, exhibiting is most rewarding. It acts as a stimulus to breeding and adds to knowledge of the behavior of cultivars and to skill in their cultivation.

The daylily is ideal for the show table. The first competitive all-daylily show was held at the Mead Botanic Garden in Orlando, Fla., April 18-19, 1940 by the American Amaryllis Society, from which the Am. Hem. Soc. descended. Of special interest were displays by the Fla. State Agri. Exp. Station and by H. P. Traub, W. Hayward, and R. W. Wheeler. Local garden and daylily societies are encouraged to stage shows in cooperation with The American Hemerocallis Society. The national society does not dictate rules for shows, be they national, regional, or local in scope. However, where American Hemerocallis Society awards are offered in accredited shows, certain regulations must be observed to maintain high standards and to promote equitable judging.

The purpose of the accredited daylily show is to increase interest in daylilies and their culture. Emphasis on horticulture in shows is most apparent, as the artistic division is not required for an accredited show. (See under Mabel Yaste trophy below.) However, the artistic division is highly recommended for its contribution of beauty, stimulation of public interest, and educational purposes.

Hemerocallis Society Awards

The American Hemerocallis Society gives seven awards, only entries on scapes being eligible. Six of these awards are Rosettes.

The *first rosette* is given for registered and introduced cultivars. Members compare their entries with those of their competitors. Here one sees at a glance those exhibitors who follow superior horticultural practices. All exhibitors soon became eager to make the acquaintance of the breeder with the most refined specimen, as all hope to win blue ribbons. Here, too, participants become stimulated by seeing the latest cultivars as well as others they are not growing in their gardens. Newcomers are most interested in this section of registered, introduced cultivars. Many of the most ardent members join the Society after seeing these exhibits.

The *second rosette* is for the winner of registered but unintroduced cultivars. Much interest is aroused by this section because many daylilies destined to be the favorites of tomorrow are on exhibition.

A third *rosette* is for the winner of seedlings. Here practice in showmanship comes into play as each hybridizer promotes his specimen.

The *fourth rosette* is for the winner of the cultivar at the top of the previous year's national popularity poll or for the cultivar at the top of the previous year's

regional popularity poll. Local societies may make the decision on which of the two polls is to be used.

The *fifth award* is a small rosette given to the winner of registered, introduced, and small-flowered cultivars. A daylily in this section must measure not less than 3 inches nor more than 4½ inches in diameter. Many breeders work only with this size.

The *sixth award* is also a small rosette and is given to the winner in the registered, introduced, miniature section. Flowers in this section may not be more than 3 inches in diameter.

The *seventh award* is the bronze achievement medal awarded to the winner exhibiting three scapes of an unintroduced but named cultivar. To offer this medal, 50 percent of its members of a local society must hold membership in the national society.

Region 12 has made available the *Ophelia Taylor Horticulture Medal* in memory of Mrs. Bright Taylor. This medal may be awarded at each regional and national accredited show to: Class 1—5 different named cultivars, or Class 2—5 different seedlings. Only one award may be made per show and classes must be judged by Awards and Honors Judges.

The *Mabel Yaste Silver Rotating Trophy* is a special award given to create interest in the artistic division. The rules specify that only fresh plant material may be used and that daylilies must be dominant in the arrangement. To qualify for this trophy, rules of national accredited flower shows for tri-color must be followed. The tri-color winner is eligible to compete for the Mabel Yaste trophy. The artistic division must be judged by three national accredited flower show judges.

American Horticultural Society Awards

The American Horticultural Society has made available three awards to member organizations in good standing. The first award is a silver medal that may be given at shows held in conjunction with the National Conventions of the American Hemerocallis Society for a collection of 24 cultivars. The bronze medal may be given at a state or regional show for exhibiting 12 cultivars. The third award is a certificate given at shows held by local societies for a collection of eight cultivars. All cultivars exhibited in competition for these awards must be registered, introduced and score ninety points or above on the rating scale.

Planning a Show

The affiliated societies planning an accredited show should notify the National Exhibition Chairman very early in the year, for purpose of receiving their preliminary report form and other information that will aid in making a tentative schedule. Moreover, all members of show committees should hold membership in the American Hemerocallis Society. Approved shows must be judged by panels of three, two being specially trained as "exhibition" judges and one being an awards and honors judge. The tentative schedule of the show as well as a preliminary report, which must meet all requirements must be approved by the national chairman. Finally after the show, a final report must be received by the exhibition chairman. It, too, must meet all requirements before the show is accredited.

Daylily shows are usually the climax of the local society's activities for the year and it is a joy to invite friends to admire them. American Hemerocallis Society members should exhibit their best blooms whenever possible.

The first requisite of a good show is a precise schedule. Since the schedule becomes the law, its wording should leave no uncertainties as to what the exhibitor may and may not do. Simplicity is advisable in making rules relating to the conduct of the show. Suitable classes should be provided so as to meet the requirements of all potential exhibitors. The schedule should list named cultivars, each cultivar constituting a class. The best scape in each color class receives a purple ribbon and the best purple ribbon winner receives the American Hemerocallis Society special

award rosette. Scapes are not to exceed 36 inches tall. Scapes of seedling specimens should be severed at the ground.

The schedule of the show should carry the official scale of points for named cultivars, seedlings, and the artistic division if it is offered. To receive a ribbon on named cultivars or seedlings, the following points are needed: Purple, highest blue ribbon in each color class; blue, 90 to 100; red, 85 and above; yellow, 75 and above; white, honorable mention.

Qualifications for a hemerocallis exhibition judge or an awards and honors judge are the same in many of their requirements. Both must start with knowledge acquired through being completely addicted to growing daylilies. Personal experience makes one familiar with all its characteristics. Either type of judge should have grown over 300 cultivars from at least 10 well known hybridizers over a period of several years. An exhibition judge must complete a course of study by attending a judges' clinic approved by the American Hemerocallis Society.

Judges supplement their knowledge by visiting other gardens where the cultural practices followed are of the highest standards. A good judge will study books and catalogues on all phases of this plant. A conscientious judge will attend lectures and exhibits at every opportunity. Judges must have fixed in their memory an exact picture of perfection for a particular cultivar, as hemerocallis are judged against perfection of the cultivar and never against another cultivar.

The daylily itself merits excellent judging, so skilled judges must know their responsibilities and good ethical practices. A fair judge will evaluate an entry as he sees it at the time of judging. —judging colors, patterns, forms, and sizes. He judges often to acquire experience in judging techniques that will aid in making wise decisions. Judging assignments are enjoyed with a sense of humor. It is proper for the judges to discuss the entries among themselves. Sometimes one judge will see what others missed. But he must never be guilty of criticism of another judge.

Experience gained by judging is invaluable. A panel of three judges actually gives each the combined experience of all three. A team of judges is a working unit, no one judge dominating the decision. A decision is never influenced by personal preference, but a good judge should have the courage to stand on his own convictions and withhold awards he feels are not merited. It is unethical to judge classes in which a judge has entries. In order to adhere to the show schedule, it is the duty of the judge to be punctual, considerate, and tactful.

Evaluating

The American Hemerocallis Society has an official scale of points to be used by judges in evaluating named cultivars and seedlings on exhibition. For named cultivars the flowers and scape each receive 50 points.

Color of the flower is allowed 10 points. Vibrancy of color plays an important part in judging daylily, particularly patterned ones, such as the bi-colors, bi-tones, and blends. Whatever the color, it should be pure and clear according to cultivar. Color must be fresh and pleasing and true to the cultivar. Among color faults are muddiness, streaking, and fading.

Ten points are given for *form*. Weather and growing conditions influence form. A broken flower not only affects condition but it alters form. If several flowers are open on one scape, form of all should be similar, and there should be a uniformity of placement of perianth-segments. The flower should be artistic. It may be large or small, trumpet-shaped, cupped, flat, recurved, spidery, ruffled or smooth. Among the faults to be considered in the matter of form are the dissimilarity of several flowers and the lack of uniformity of placement of perianth-segments.

Texture and *substance* each receive 10 points. Texture is the surface quality of the tissue structure, its smoothness or roughness. In judging texture the sheen, luster, satiny or velvety qualities of the bloom should be considered. Substance

is thickness of tissue structure. Good garden practices influence substance. Merits to be judged in substance are crispness, freshness, and firmness. Faulty substance is revealed by thinning of tissues, limpness, wilting, browning or melting at edge of inner perianth-segments.

Ten points are given for *size*. Weather and geographic location and good garden practice influence size. The flower should be true to cultivar characteristics. Faults would be that it is not typical of the cultivar and undersized.

Condition and *grooming* of flower and scape receive 15 points. This includes faults or merits incurred in growing, spraying, grooming, transporting to show, and even accidents incurred in placement. If the overall perfection of the flower has been altered more than 15 points, it will be reflected in the area of judging influenced most adversely e.g., form, color, substance. A good scape is fresh and clean, with spent flowers and seed pods removed. The judge will not look with favor on insect damage, presence of insects, faded flowers still present, broken flowers, and scarred scapes.

The *height* and *strength* of the scape receive 15 points. Faults would be that it not be typical, or is inadequate, too tall, or too short. In strength it should be firm, strong and sturdy. Faults such as weakness, limpness, or any kind of deformity would not be acceptable.

Number of buds and *branching* each receive 10 points. One should not expect impossible attainments of a cultivar. He should use discretion in judging, especially when considering the older cultivars as to number of buds. Merits are that number of buds be typical of a cultivar, adequate, and unusually floriferous. Faults are few buds, not typical of cultivar. For branching the same caution applies as in number of buds on older cultivars. Merits of branching are that it be adequate, typical of cultivar, not crowded, unusually well-branched. Faults are scant branching, not typical.

Each cultivar shall constitute a class. A single entry may be given a ribbon if the judges consider it a superior exhibit. In judging a named cultivar on a scape, the over-all perfection of the exhibit is considered. Several flowers open on a scape should be rated higher than a scape with only one flower, and a scape in the prime of its blooming should be rated higher than one with half, or more than half of its buds bloomed out, all other judging points being equal. If a scape with proliferations is exhibited, judges will decide if over-all perfection of appearance is altered, and if size of flower is altered.

In judging seedlings, it is not the primary purpose to encourage new introductions unless they are superior to named cultivars already in commerce. When a seedling receives an American Hemerocallis Society award, the public has a right to expect it to be superior to those already on the market.

In evaluating seedling daylilies, color, pattern, and form each receives 10 points. Texture and substance also receive 10 points each. In all instances, the flower is expected to be superior in purity of color, texture, individuality of pattern and form, and show evidence of excellent substance.

Condition and grooming of flower and scape receive 5 points. Height and strength, buds and branching each receive 15 points. Here the points to look for are superior relationship of scape to flower, bud count, and branching.

Distinction receives 25 points. Distinction is defined in daylilies as that quality of superior excellence and individuality of refinement that is instantly recognized as being worthy of an award. The ability to recognize this elusive virtue has been acquired by the judge through many years of seeing and growing daylilies. Distinction may be found in any one of the elements in the scale of points, but an over-all blending of elements will lend distinction to any specimen.

The points that are briefly outlined above are given in detail in the publication of the American Hemerocallis Society *Handbook for Judges*. This handbook is for the exhibition judges as well as the awards and honors judges.

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Daylily Round Robins

MRS. HAZEL LACEY

The Midwest Hemerocallis Society was organized in 1946, because of a few Hemerocallis Round Robins. Organization of the Society was inspired by the gracious "Flower Lady" Mrs. Helen Field Fischer, of Shenandoah, Iowa and her Flower Program, broadcast over KDKF at that time. Later the Midwest Hemerocallis Society became the American Hemerocallis Society.

The Round Robin is an old institution, often used by families, to keep in touch with its various members without the work of individual correspondence. The *Flower Grower* magazine had a Round Robin Department for many years, under Miss Marion Thomas. Mrs. Viola Richards, of Greencastle, Indiana, was a Robin Director for this same magazine and later became the Round Robin Chairman of the American Hemerocallis Society.

In 1943 Mrs. Olive Hindman of Overland, Missouri, now of Sebring, Florida, became the first Hemerocallis Group Leader. In the 1948 *Yearbook of Midwest Hemerocallis Society,* the following Round Robin Notes, were compiled by Mrs. Jessie Shambaugh, Clarinda, Iowa. These up-to-date minute news notes have been gleaned from letters of Hemerocallis Round Robin members—flying by way of efficient postal service from Canada to Texas, and from New York to California, with very frequent sub-stations through the Middle West. They were inspired and directed by two devoted leaders Marie Anderson of Gowrie, Iowa, and Viola M. Richards of Greencastle, Indiana. It was the Round Robins whom Marie Anderson directed, who first thought about having a "Hemerocallis Get-Together" at Shenandoah in July, 1946. Those of us who were privileged to attend will never forget the joy on every hand as the Robins found each other. It was indeed a symphony of Robin melody. And here our Midwest Hemerocallis Society was formed.

From the Round Robins of the Garden Club of the Air, through Marie Anderson we have the following report: "Several changes have been made in the directorship of our Hemerocallis Robins since the last report—Mrs. Daisy Ferrick, Topeka, Kansas, is now directing the ADVANCED Hemerocallis Round Robin; Mrs. Bess Ross, of Minburn, Iowa, is the director of Flight No. 1; and Mrs Minnie Anderson, of Lawrence, Kansas, is in charge of Flight No. 4; while the late Darrell Crawford of Salina, Kansas, with generous enthusiasm took the directorship of Flights No. 7 and No. 8. These Round Robin members, 22 of them, were turned over to his splendid leadership in September, and now, since the untimely passing of their director, their flight is delayed, waiting for someone to show them the way. If any of you would consider directing some of these Robins, please send in your names. We need you. You would automatically become a member of a Hemerocallis Directors' Round Robin, for the discussion of all phases of this work and for the sharing of experiences with one another."

In the 1966 *Yearbook of American Hemerocallis Society,* which was the Twentieth Anniversary Year, Mrs. Viola Richards writes that the Flower Grower Round Robin Department announced that a Hemerocallis Round Robin was being formed if someone would volunteer to take charge. Mrs. Olive Hindman offered her services and this same Round Robin was later turned over to Mrs. Richards, when Mrs. Hindman returned

to secretarial work, which she had given up for marriage and the rearing of a family. In 1965 Mrs. Hindman received the highest honor, the American Hemerocallis Society can bestow, the Helen Field Fischer Award. For many years Mrs. Hindman served the American Hemerocallis Society as first Robin Leader, then Director of Registration, and for two years on the Board of Directors, and from 1959 as secretary of the American Hemerocallis Society.

Other Recipients of the Helen Field Fischer Award

1951—M. Frederick Stuntz, for compiling the Check List, and for his outstanding work as Registrar and Co-editor of the Descriptive Catalog of Hemerocallis Clones.

1952—Mrs. R. E. Richards, for help in organizing the society, as Vice-President in 1947-48, member on the Registration Committee and Round Robin Committee, and Robin Chairman.

1953—Mrs. Gretchen Harshbarger, for help in organizing the Society, our first Editor, second President, and for many other services.

1954—Mrs. Bess Ross, who served as Director, Vice-President, and Presdent and was chairman of the Publicity Committee.

1955—George E. Lenington. No one worked more for the Society than did George. He is still an active robin member, has developed many beautiful hemerocallis, was President, Secretary and Treasurer, as well as Editor of some of the Society's publications.

1956—F. Edgar Rice, and his friend D. M. McKeithan opened their beautiful gardens of hemerocallis, to the public for many years, and wrote about their favorite flower regularly. Many readers of the *Yearbook* always looked forward to their evaluation of the favorite daylilies of the past year. Mr. Rice, a charter member, has helped to breed sunfast daylilies.

1957—H. M. Russell, not only the Helen Field Fischer Award but the Bertrand Farr Award, the Stout Medal and many other Awards were given Mr. Russell. His large daylily garden was one of the first to be nationally advertised.

1958—Elmer A. Claar. I am not sure if he was ever a robin member or not but I did find some notes which made me think that he was. In the 1959 Yearbook, the following about Mr. Claar was taken from the 1941 issue of *Herbertia* "Mr. Claar, the chairman of the Daylily Committee, again presents very interesting reports on visits to daylily breeders in various parts of the country. Such comparative pictures are urgently needed and he is to be congratulated on his kindly and understanding personality that fits him ideally as the official ambassador of good will in the daylily field." He also served on the Board of Directors, a member of the Committee on awards, and co-chairman of the National Convention at Evanston, Ill., in 1953.

1959—Wilmer B. Flory. Pages could be written about his work for the Society. His outstanding work as President, Editor, his many beautiful hemerocallis originations, his friendly manner and articles about our favorite flower merit this high Award.

1960—Mrs. Carl Marcue. In the 1961 Yearbook, Daisy Ferrick writes—"In the early days of the Hemerocallis Society (known then as Midwest Hemerocallis Society) Mrs. Marcue was Round Robin Chairman for these years. She later served on the Awards and Honors Committee; served two terms on the Board of Directors and three years as President of the American Hemerocallis Society. After the death of Secretary-Treasurer Mrs. Pearl Sherwood, and until a new Secretary could be elected, she moved the records and equipment to her home and took on the varied duties of this office.

1961—D. R. McKeithan. Although no record of his robin membership has been found, he was "quoted" in the robins along with F. E. Rice. The beautiful gardens of McKeithan and Rice at Bartlesville have been open to hemerocallis lovers from everywhere. Both were Charter Members and have done much for the Society.

1962—Mrs. J. C. Lamb. For distin-

guished service to the American Hemerocallis Society as Chairman of the Exhibition Committee. She joined the Midwest Hemerocallis Society in 1948 and did much to upgrade the Hemerocallis Shows. During her chairmanship the Mabel Yaste Tri-Color Trophy Contest and the American Hemerocallis Society Achievement Award were established for accrediated shows, sponsored by affiliated groups.

1963—Mrs. Bright Taylor. Besides being a charter member of the Society, she became a robin member when the Hemerocallis Robins first formed. After serving on the regional level as supervisor for Florida, Region 12, from 1950 to 1953, she was elected to the Board of Directors of the national organization. She served as Treasurer during her two terms as director and claimed with justifiable pride that she was always present at the Board Meetings. Her greatest interest, however, was centered on the Joe House Memorial Research Fund, established in 1955 by the Society. The first donor was Hugh Russell of Spring, Texas. His gift was augmented by Life Memberships from acquaintances. While custodian she guarded the funds zealously in the belief that a strong society, like a family, must have money in the bank. She not only gave the world many beautiful daylilies, both evergreen and dormant, but because of her charm and generosity, won many converts to the daylily cause.

1964—Hubert Fischer may not have been a member but many letters are written by him to promote Daylily throughout the world. He has been especially interested in the small-flowered hemerocallis but has nices ones of different sizes. He has been president and had many other offices in the American Hemerocallis Society. He is really our Goodwill Hemerocallis Ambassador in sending packages of seed to foreign countries.

1966—Mrs. Hugh Purnell. She is doing much to promote friendship among daylily enthusiasts. She gives educational programs on culture and beauty of hemerocallis, and is a Group Leader of two Robins and member of another, She has been a member of the American Hemerocallis Society for 15 years, served as Vice-President of Region 6, organized a Hemerocallis Society in her home town and helped to organize hemerocallis societies in neighboring cities and states. She is also a Master Judge in the National Council for Accredited Flower Shows.

We must not forget the fine accomplishments of our late Helen Field Fischer, first winner and originator of the award under her name. We should pause for a moment to reflect what might have happened had Mrs. Fischer felt too busy to promote our daylily mission over the air or had those first robins decided there was too much work.

The following are excerpts taken from letters of robin members:

Past years I planted Hem seed in seed beds in the spring. They did very well, most of them blooming the second summer, after having been set in rows the previous fall or spring. Fall planting seemed to be the most successful. This fall I followed directions in the Yearbook and planted the seed every few days as it ripened. These came up very quickly and were doing fine when cold weather set in. They are covered with airy mulch to hold snow and protect them from the wind, etc. and should produce good sturdy plants to line out by next fall. We are setting them around the edge of the yard, and at the rate we are going will soon be "hemmed" in.

CLARA BANGS
Nebraska, 1948

Seed sown early this spring, both outside and in, and lined out fairly soon about 8 inches apart in the vegetable garden, have made plants that look so near bloom-size by fall that I kept watching for scapes. Some have only one large crown; some a cluster of ramets; and others have sent out searching side shoots that are coming up at some distance. These were watered twice through the drought with a "soil soaker," a long canvas tube that you attach to the end of your hose. Mine is 30 feet long and works marvelously.

GRETCHEN HARSHBARGER
Iowa City, Iowa, 1948

We have a nucleus beginning in Tetraploids and plan to continue to work with them. It has been my privilege to watch closely the work done by Edgar Brown and his lovely wife Betty. The third generation, blooming this year, had an unbelievable improvement. Nice scape height, marvelous texture and substance, form and clarity of color, beautiful edgings in pinks and rose. I followed his advice on pod parents and have had excellent results this year. We have about 200 seedlings ready for lining out involving about 15 different crosses.

Mrs. Carl G. Theriot
Groves, Texas, 1966

Jo Ann: You and J.P. both have a great advantage over most of us in the robin, because of your longer growing season. You can get almost a year earlier bloom than I can. We have a son, almost 12, another 9 ½ and a daughter 7½. Our yard too is full of kids and dogs and an occasional cat. We are compatabile as long as they leave the flowers alone.

Norman Dye
Ellendale, Tenn. 1966

It is true that my seedlings were far below expectations, yet I still feel "thanksgiving" for my Shooting Star × Capri seedling which fulfills one goal in hybridizing I have been working toward for ten years. It opens so well even on the coolest nights that I believe it will make possible the introduction of the daylily to the gardens in San Francisco and the Bay Area which were hitherto unsuitable for them. I have one lavender seedling which has set seed when crossed with nearly any tetra pollen put on it, yet it has never yielded tetra pollen nor shown enlarged stomata. It was colchicine treated as a sprouting seed.

Jack Romine
Walnut Creek, Calif.
Hopeful Breeders Robin, 1966

Dear Robin Friends: Well, it would seem that I am the old man of the robins—at 77, it seems I'm the only one unable to use a typewriter. Anyhow, growing and hybridizing hems has been my prime activity and hobby for some time and I find it quite rewarding. I also find the robins quite worth while—they build a better knowledge, more friends and better gardens. This last year I have acquired some 66 new varieties.

Newell Daniels
Santa Cruz, Calif.
1966 Robin

I'd appreciate a comment or two about the importance, or lack of it, of refrigerating seeds after the pods have opened and before planting them. Everyone I know does it differently, but all with better success (as measured by % germinating) than I. Many in this area plant the seed immediately and, even though this is usually July, have good luck if they keep them moist, although the loss from rot can be high. Waiting till the fall or the following spring seems to bring problems or at least unpredictable sprouting, so that one never knows whether a seed has been lost or is simply too lazy to get on with it. This may seem like a minor problem for those with established, proven procedures, but I've not gotten that far, I've been sort of casting around for something we could offer or contribute to this robin in small return for the knowledge and friendships that have already begun to spring from it. We received a plant called 'Moon Melody' from Mrs. Pittard in Louisiana, a couple of years ago as a gift. It is very wide petaled yellow-gold with nice ruffling about the edges. The branching is only average but it repeats strongly and the outstanding feature is the wide petals and thick substance of the flower. I'd say it was very outstanding but strangly enough I can't find anyone who has ever heard of it, I'm always meaning to write Mrs. Pittard about it, but never have. At any rate, if it grows and performs for you as it has here, believe you'll not be disappointed. If you would like a plant, mention when you'd like it shipped.

John P. Buettner
Angleton, Texas, 1966

My Tet. germination has been fine, and I just follow general horticultural practices. As soon as a pod is ripe I pick seeds. If they aren't as plump as I like, I put them in a small dish of water until the next morning. I plant each tet. pod in an 8-inch pot. Gravel in the bottom, I use Bacto potting soil mixed with a little sand, then seeds, then one inch of river sand, water from the bottom the first time, add a little more sand if necessary, and set under a tree. I find germination time is very erratic. Some seed will continue to come up for a two-month period. I had only one cross of sister sdlgs. which refused to germinate a seed. That Tetra Edna Spalding cross is a T-1-64 × Tet. E. Spalding cross. I have been most fortunate to have had pollen given to me which I certainly could not have bought. Many people have shared pollen, plants and much needed advice without so much as an ask from me. Hope to one day

produce some plants to earn this show of confidence. Sweet Georgia Brown is one of the best melons I've seen. It has heavy substance, completely round form, low grower, almost self.

Mrs. Carl G. Theriot
Groves, Texas, 1967

Here is how I plant my seeds. I plant in a bed in open ground any time from Sept. to April. Keep the seed in the refrigerator until I'm ready to plant; sometimes they are there several months before I get them planted. They are planted in rows 4 or 5 inches apart and the seeds are spaced about a half inch apart. I cover with burlap until the grassy plants peep through, usually from seven to 14 days, then remove the burlap cover. The bed is kept damp until they all come up. Usually have good germination with one exception when I planted in July and most of them rotted. Some of my crosses of 'Pink Lightning', 'Pink Fluff', 'Annie Welch', 'Winning Ways', 'Lavender Flight', 'Sail On' and my best seedlings sound very exciting. I've been so busy, haven't made many Tetraploid crosses but must get started so I won't be the only dumb one in this robin and way behind the times.

Nedra West
Riviera, Texas, 1967

The foregoing letters give an insight into what this robin-business is all about and how much information and friendship results that is valuable to members of the Society, as well as to those within the robins.

I cannot bring these notes to a close, without mentioning others who have been active in robins in the past.

Mrs. Mary Lester, of Atlanta, Ga. who has given us so many beautiful hemerocallis was a robin member and gave information and daylilies, especially to those just getting interested. Wish she could see her 'Evening Mist', 'Sweet Lavender', 'Carita', and 'Color Magic' in my garden today (July 11, 1967). She worked many years to get these particular colors and they are very outstanding.

Miss Annie Giles of Austin, Texas a former President, is still a robin member and is still working for the promotion of the hemerocallis.

Mrs. R. M. Powell (Hazel) of Hot Springs, Ark. has done much for the Society, especially in the Robins and while on the Board, but had to resign because of a heart condition. Her husband Milton has helped her to carry on as Group Leader and much praise is due this fine and dedicated couple.

Mrs. Agnes Sawyers of Oklahoma City, Okla., group leader, is very interested in hemerocallis and the folks who grow them. Her beautiful garden was removed from the tour during the 1967 convention, because of the sudden death of her husband, Ted. He loved to garden and we shall all miss his friendly smile and feel that Agnes will carry on, as he would want her to. The Sawyers' name attached to the hemerocallis means "sunfastness" to me. 'Sooner Girl' won the Presidents cup.

Mrs. J. E. Zenor, also of Oklahoma City, has been a group leader for many years and kept her robins flying, too. We shall all remember her lovely garden, so well loved and cared for. We also enjoyed visiting with her husband and wish many more years of happy gardening for this couple.

Of our present Directors (1967) I find these names also in robins, adding much information and good-will—Mrs. Warren Y. Gardner, North Carolina; Edward F. Grovatt, New Jersey; Mrs. L. W. Middlebrooks, Shreveport, La.; George Darrow, Glenn Dale, Maryland; Jack Romine, Walnut Creek, California; William P. Vaughn, Chicago, Ill. There may be others too.

Kansas is proud of several members who have been robin members since the beginning—Mrs. Daisy Ferrick, Topeka, was a Robin Leader of Hemerocallis, before there was a Hemerocallis Society; she helped to organize the Midwest Hemerocallis Society, was American Hemerocallis Society Secretary for many years, is still an active robin member and still enjoys her hemerocallis.

Mrs. Henry Glynn, Frankfort, Kans. is also a charter member and still a robin member. Mrs. F. H. Parks, Ottawa, Kans. is also a charter member and belongs to two robins. She has a lovely garden, too.

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A Salute to Our Founders

MRS. HUGH A. PURNELL

The American Hemerocallis Society publishes three issues a year of *The Hemerocallis Journal* and a *Yearbook*. The Society is divided into 15 regions and the National Society holds an annual meeting. The 1967 convention was held in Oklahoma City, Okla. The 1968 convention will be at St. Louis, Mo., July 4, 5, and 6. Future conventions are: 1969 Albert Lea and Austin, Minn.; 1970 Atlanta, Ga.; 1971 Birmingham, Ala.; 1972 Indianapolis, Ind.

Test and Display Gardens sponsored by the Society are being planted in all parts of the country. Tours and Shows are held by local and regional groups as well as by the national group. Slides play an important part in presenting the newer cultivars to the public. F. W. Hall, 109 N. Shady Oak Drive, Lake Jackson, Texas, is Slide Custodian of the Society.

The youth of today are our members of the future, so our youth movement is one of special interest. The Growers' Association, dedicated to high standards in nursery work, is now an important part of our organization. With over 32 active Robins, anyone may find his own special interest by writing for membership to: Norman Dye, Hemcrest—7228 Centralia Rd., Ellendale, Tenn. 38029.

The American Hemerocallis Society is young as compared to some of the other plant societies, yet most will agree that no other has gained such popularity in so few years. Predating the present daylily organization, The American Plant Life Society began a series of significant daylily articles in 1935, in its yearbook *Herbertia*. Much important material was published on the daylily during a 12-year period in its various issues. The 1941 *Herbertia* was devoted entirely to daylilies. With this background, our present American Hemerocallis Society developed out of enthusiasm of the Round Robins, sponsored by *Flower Grower* magazine and radio station KDKF of the Henry Field Seed Company, Shenandoah, Iowa, and aided by the "flower lady," Mrs. Helen Field Fischer.

Founding, 1946

For many years the Henry Field Seed Company sponsored a flower show before World War II. By request the shows were resumed after the war and Marie Anderson, with her Round Robin Reserves, planned operation "Hem Show." "The war is over," she said; "People are hungry for Flower Shows; why not in connection with our Shenandoah meeting put on a flower show of Hems and let people find out what the new ones are like." (1947 Yearbook) She was right. Mrs. Fischer promoted both daylilies and the show over the radio and, on the morning of the first day of the show, Saturday, July 13, 1946, the public came and "The Garden Club of the Air" entertained; it was a big party, much bigger than anyone had anticipated. Hundreds of "Hems" were cut and labeled for the information of the spectators. Dozens of magnificant flower arrangements were in the show. The Field Company with Mrs. Fischer's sisters, Jessie Shambaugh and Susan Conrad, as well as daughter Gretchen and many friends helped to make the red letter days of July 13, 14, 1946, happy and comfortable ones. One big area in the building was made into a dormitory. Many remained overnight and on Sunday afternoon, July 14, the Midwest Hemerocallis Society was organized with Merritt Whitton as the first president. The membership fee was set at $3.00 and Mrs. Mary Clayton became the first charter member, Mrs. Fischer, the second, and Mrs. Richards, the third. Daisy Ferrick was too busy taking in member-

ships to get an early number for herself (A. H. S. Yearbook 1956). The first *Midwest Hemerocallis Society Newsletter* was issued October 27, 1947.

Memberships came in from all over the country; all who sent their memberships before the printing of the first yearbook were charter members. The charter year closed with a membership of 757. Mrs. Richards says "We didn't know how we were going to make things work, but we had faith and our faith has been justified. When Mrs. Fischer asked about the number of yearbooks to be printed when we only had 475 members (to get the right price, we had to have 600 copies printed), I told her to go ahead—that the "surplus copies would some day be museum pieces," which they truly are. The first yearbook was printed March 1947 with Mrs. Gretchen Harshbarger as editor. On the first page it says "Coming together is the beginning. Keeping together is progress. Working together is success." For this first yearbook, Merritt Whitten, the first President, wrote "Perhaps this book should be called a *birth announcement* rather than a yearbook, for the Midwest Hemerocallis Society is barely six months old. When the foundling appeared upon the doorstep of the daylily world, lustily calling for food, it was received with the greatest of kindness and with the promise of much helpful information that should be supplied to our members before spring planting time."

Conventions

The following year, in the August bulletin, the Radio Station KDKF reported the conventions of July 19-20, 1947, of both the Midwest Hemerocallis Society and the Round Robins; at which time Mrs. Gretchen Harshbarger was elected President. Five thousand visiting flower lovers converged on the Henry Field Seed Company at Shenandoah, Iowa, from New York, Texas, Montana, Colorado, Ohio, and Virginia, as well as near-by states. Hotels and private homes were filled, so a dormitory was improvised in the basement of the Congregational Church and dubbed "The Robin Nest." The Field Company seed house became a fairyland of flowers.

As in 1946, outstanding was the goodwill and friendliness of all who attended. The show was non-competitive, the flowers correctly named, and the arrangements were brought solely to show others the beauty of the daylily. A golden wedding anniversary table, using daylilies for the centerpiece attracted much attention. There was even an election for a Queen with 'Hyperion' winning the honor, and 'Midwest Star' and 'Painted Lady' second and third honors.

At the second annual meeting the adoption of a constitution was one of the main items of business. The daylily section of the American Plant Life Society had started a check-list and since Frederick Stuntz and Dr. Norton were members of both groups, with approximately 3,000 cultivar names already compiled, it was decided to cooperate as joint sponsors of the check-list.

On July 11, 1948, the Midwest Hemerocallis Society met for the third convention at the Henry Field Seed Company. With members in 42 states, Alaska, Canada, and England, the Midwest Hemerocallis Society became *The Hemerocallis Society* and George E. Lenington was elected president. Ten regions were established with Regional Directors. Mrs. Merrell Ross, publicity director, appointed nine assistant publicity directors.

The 1949 convention was held on June 25—26 at Bartlesville, Okla., in the Rice and McKeithan Gardens, with 800 delegates and others from 17 states present. A show with about 300 cultivars was held. (Account given on page 14 of the 1949 Yearbook.) Norman P. Goss was elected President for 1949-50. By this time many local societies were being formed with organized tours and shows being held in many sections of the United States. The first popularity symposium by 63 judges was conducted in 1949 with 'Hesperus' winning the top honor. A few other firsts to remember—1947 marks the first registration of new daylily clones under the direction of Frederick Stuntz. A test garden was start-

ed on the grounds of the Henry Field Seed Company with plants being sent from various sections of the country. The *Hemerocallis Society Newsletter* of June, 1950, lists the first daylily checklist with 2,695 listed clones, with the names of 17 listed hybridizers, and with a wealth of material both informative and educational for sale for $1.50.

Cleveland, Ohio, July 7-9, 1950. A new constitution and by-laws was adopted with a 12-member Board of Directors. The beginning of the fiscal year was changed from July to January, to run with the calendar year. Mr. Goss felt he could not serve the rest of the year and Mrs. Bess Ross, first Vice-President, served the remainder of the year. The first board meeting was held November 10, 1950, in St. Louis; Joe House was elected President, and Geo. Lenington, Secretary. W. B. Flory, evaluation chairman, conducted the first popularity poll with 'Painted Lady' winning the top place and the Stout Medal Award to 'Hesperus'. The first Helen Field Fischer Award for distinguished Service to the Society was given to Mrs. Helen Field Fischer. The first Bertrand Farr Award, for outstanding work in hybridizing *Hemerocallis,* was given to Dr. A. B. Stout. Mr. Flory was named Registrar.

Little Rock, Ark., June 8-10, 1951. Joe House, Pres. was host at his ranch "Flower Acres" on Sunday with a barbecue. The 10 regions that had been established in 1948 with regional supervisors (now known as Regional Vice-Presidents), were headed by Edgar Rice, who gave a most encouraging report of their work.

At the November, 1951 board meeting, the first Life membership was presented to Mrs. Helen Field Fischer.

Special Awards—1951

Popularity Poll—'Painted Lady'
Stout Medal—'Painted Lady'
Helen Field Fischer Award—Frederick Stuntz
Bertrand Farr Award—Carl Milliken

Boston, Mass., July 23-25, 1952. Edgar Rice, Pres. Membership of 1,223 was reported.

Special Awards—1952

Popularity Poll—'Painted Lady'
Stout Medal—'Potentate'
Helen Field Fischer Award—Mrs. Viola Richards
Bertrand Farr Award—Mrs. Hugh Lester

Chicago, Ill., July 16-18, 1953. Edgar Rice, Pres.

Special Awards—1953

Popularity Poll—'Orange Beauty'
Stout Medal—'Revolute'
Helen Field Fischer Award—Mrs. Gretchen Harshbarger
Bertrand Farr Award—Mrs. Thomas Nesmith

The *Hemerocallis Society Newsletter* of September, 1953, carries a most interesting account written by Mr. Rice, of this Chicago Convention. The North Shore Hotel, Evansville, Ill., was headquarters. At the Friday night banquet the soup, as well as chicken and wild rice, was flavored with daylilies—but Mr. Rice said that what impressed him most was the exquisitely molded ice cream called "Daylily Colonel Joe." The program was most unusual and entertaining. "Flower Arrangements" by Dame Violet O'Scent, Ireland's Premier Arranger as announced in the bulletin, turned out to be the delightful Dr. Carlton of Chicago; beautifully gowned and sewed up by his wife, he gave a burlesque on Flower Arrangement that was the most hilarious act of its kind ever seen. Sam Caldwell, the Old Dirt Dobber, gave the main address of the evening.

Mr. Rice's report of the many beautiful gardens in the Chicago area reads like a "who's who" of the Daylily World. Many of the lovely seedlings blooming in the David Hall garden were from seed planted in the late winter of 1952. Mr. Rice says "Nobody who has hybridized, grown or seen daylilies could see Hall's and Claar's seedlings, let alone other daylilies, without realizing the possibilities of daylilies of the future. The new daylilies are so spectacular and beautiful that no other flower can touch them for garden effects." A report of

the luncheon in the gardens of the Elmer Claars' at Northfield was given and the name "Daylily Heaven" suggested as a proper name for the place.

The Hubert Fischers' 11-acre estate known as "Meadow Gardens," was described as a horticulturist's dream.

Valdosta, Ga., May 18-20, 1954. This meeting seems to have been a real high-point in the life of the American Hemerocallis Society. The membership had reached 2,000 with Mrs. Carl Marcue as president. The services of Mrs. Peggie Schultz were obtained and the first *Hemerocallis Journal* vol. 9, No. 3, 1955, was issued, taking the place of the newsletter, issued up to that time, and a committee appointed to again revise the Constitution and By-Laws.

Special Awards—1954

Popularity Poll—'Potentate'
Stout Medal—'Dauntless'
Helen Field Fischer Award—Mrs. Bess Ross
Bertrand Farr Award—Dr. E. J. Kraus

Baton Rouge, La., May 16-19, 1955. Mrs. Carl Marcue, Pres.

Hugh Russell initiated the "Joe House Memorial Research Fund" with a gift of $500.00. Life memberships are added to this fund. The word "American" was added to the name of the Society.

Special Awards—1955

Popularity Poll—'Evelyn Claar'
Stout Medal—'Prima Donna'
Helen Field Fischer Award—George E. Lenington
Bertrand Farr Award—Mrs. Bright Taylor

Omaha, Nebr., July 17-21, 1956. Mrs. Carl Marcue, Pres.

A one-day trip was made to Shenandoah in celebration of the Tenth Anniversary of the Society. Elmer Claar presented the Society with a silver loving cup to be designated "The President's Cup" for the daylily giving the best performance in any of the tour gardens to go to the hybridizer.

Special Awards—1956

Popularity Poll—'Evelyn Claar'
Stout Medal—'Naranja'
President's Cup—'Sincerity'
Helen Field Fischer Award—Edgar Rice
Bertrand Farr Award—David F. Hall

Tulsa, Okla., June 22, 1957. Wilmer B. Flory, Pres.

Funds were raised so that the new check list by W. E. Monroe, our present Registrar, could be published. The meeting in Tulsa included a trip to Wilds Nursery of Sarcoxie, Mo.

Special Awards—1957

Popularity Poll—'Evelyn Claar'
Stout Medal—'Ruffled Pinafore'
President's Cup—'Fairy Wings'
Helen Field Fischer Award—Hugh M. Russell
Bertrand Farr Award—Ralph W. Wheeler

Houston, Tex., May 14-15, 1958. Wilmer B. Flory, Pres.

Those Houston folks went "all out" not only to show off many beautiful gardens, including a one-day tour of the large Russell Gardens, but typical Texas social activities were certainly not forgotten: a lovely banquet, a South-of-the-Border party, a visit to San Jacinto Battle Grounds, where the Battleship Texas is anchored, and a lunch at the famous San Jacinto Inn.

Special Awards—1958

Popularity Poll—'Evelyn Clarr'
Stout Medal—'High Noon'
President's Cup—'Marsha Russell'
Helen Field Fischer Award—Elmer Claar
Bertrand Farr Award—Hugh Russell

Washington, D. C., July 9-11, 1959. Hubert A. Fischer, Pres.

For 1959 The American Hemerocallis Society had the opportunity of seeing the nation's Capital; a much needed Exhibition Judges Clinic was held by Mrs. J. C. Lamb; and a well-planned Institute covered all phases of growing daylilies.

Special Awards—1959

Popularity Poll—'Salmon Sheen'

Stout Medal—'Salmon Sheen'
President's Cup—'George Cunningham'
Helen Field Fischer Award—Wilmer B. Flory
Bertrand Farr Award—Elmer Claar

Silver Springs, Ocala, Florida, May 9-12, 1960. Hubert A. Fischer, Pres.

A wonderful time was had by all. Not only did we see daylilies as expected, but many enjoyed the fabulous Silver Springs and many other famous Florida beauty spots. The title of the Convention, "Florida Fanfare," was truly right.

Special Awards—1960

Popularity Poll—'Fairy Wings'
Stout Medal—'Fairy Wings'
President's Cup—'Play Boy'
Helen Field Fischer Award—Mrs. Carl Marcue
Bertrand Farr Award—LeMoine J. Bechtold

Chicago, Ill., July 20-22, 1961. Hubert A. Fischer, Pres.

Special Awards—1961

President's Cup—'Green Valley'
Stout Medal—'Playboy'
Helen Field Fischer Award—D. R. McKeithan
Bertrand Farr Award—Hooper P. Connell
Popularity Poll—'Frances Fay'

Boston, Mass., July 25-28, 1962. Miss Annie T. Giles, Pres.

Special Awards—1962

President's Cup—'Grand Parade'
Stout Medal—'Bess Ross'
Helen Field Fischer Award—Mrs. J. C. Lamb
Bertrand Farr Award—Orville W. Fay
Donn Fischer Memorial Award—'Golden Chimes'

Shreveport, La., June 12-15, 1963. Miss Annie T. Giles, Pres.

Special Awards—1963

President's Cup—'Rare China'
Stout Medal—'Multnomah'
Helen Field Fischer Award—Mrs. Bright Taylor
Bertrand Farr Award—Frank W. Childs
Don Fischer Memorial Award—'Tinker Bell'
Popularity Poll—'Frances Fay'

Valdosta, Ga., May 20-23, 1964. George P. Watts, Pres.

Special Awards—1964

President's Cup—'Angel Robes'
Don Fischer Award—'Curls'
Stout Medal—'Frances Fay'
Helen Field Fischer Award—Hubert A. Fischer
Bertrand Farr Award—Hamilton P. Traub
Annie T. Giles Award—'McPick'
Popularity Poll—'Frances Fay'

Dallas, Tex., June 9-12, 1965. Richard C. Peck, Pres.

Special Awards—1965

President's Cup—'Prairie Sunset'
Stout Medal—'Luxury Lace'
Helen Field Fischer Award—Mrs. Olive Hindman
Bertrand Farr Award—Miss Edna Spalding
Don Fischer Award—'Thumbelina'
Annie T. Giles Award—'Luxury Lace'

Jackson, Miss., June 9-11, 1966. Richard C. Peck, Pres.

Special Awards—1966

President's Cup—'Sea Gold'
Stout Medal—'Cartwheels'
Helen Field Fischer Award—Mrs. Hugh A. Purnell
Bertrand Farr Award—W. B. MacMillan
Don Fischer Award—'Lula Mae Purnell'
Annie T. Giles Award—'Melon Balls'

Oklahoma City, Okla., June 23-24, 1967. George T. Pettus, Pres.

Special Awards—1967

President's Cup—'Sooner Girl'
Helen Field Fischer Award—Mrs. Arthur W. Parry
Stout Medal—'Full Reward'
Don Fischer Award—'Corky'
Annie T. Giles Award—'Little Rainbow'
Bertrand Farr Medal—William R. Munson, Jr.

In conclusion, I quote from the 1947 *Yearbook,* "The Modern Hemerocallis is the Cinderella of the Garden World. As a garden flower, her past is obscure. A roadside waif, her present popularity is assured. She sits a queen; her garments are regal and her wardrobe unending; her prospects are delightful and her admirers many. She has truly gained the title, 'The Perennial Supreme.'" (Orville C. Couglin)

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Exploring for Daylilies in Japan

JOHN L. CREECH

During plant explorations to Japan in 1955, 1956, and 1961, I had numerous occasions to observe daylilies in the wild. Represented by several species, they are distributed from seacliff to mountain meadow throughout the Japanese Empire but with the major distribution in northern Honshu and Hokkaido. Daylilies tolerate a broad range of soil types and moisture conditions in nature, from dry sandy beaches to moist meadow-like stretches along upland roads but always in full sun. In the lowlands, daylilies develop into extensive colonies while they are found as individual clumps in the high mountains. They are easy to collect and survive the ordeals of plant introduction easily since they are readily transplanted and usually free of natural insect pests and diseases.

Daylilies are not common garden plants in Japan. They are not discussed in the more-popular Japanese gardening books. I suspect that the ephemeral character of the flower and the preponderance of shade in Japanese gardens has much to do with this. It is unfortunate that similar attention has not been given to its improvement as is afforded *Iris kaempferi*.

Anyone wishing to see daylilies in Japan must join the thousands of excursioners who travel into the national parklands to enjoy the spectrum of so many magnificent native plants. There are massive daylily colonies along the roadsides and railroads in full bloom during July and August not unlike the stands we see escaped in the United States. Table 1 shows the distribution and flowering time for the Japanese daylily species.

Because the daylily has been cultivated from earliest times and most of the species are well-described, there seems little point to a discussion of general collecting. This is not to imply that collections of known species made in unique localities or wild types with singular qualities are not significant. They are important and will prove their merit by their performance and use by breeders.

Instead, I will describe my encounter with colonies of the latest-flowering species in Japan, *Hemerocallis littorea* Makino. This is a little-known species and one does not expect to encounter

Table 1. Distribution of Japanese species of *Hemerocallis* and their flowering sequence

Name	Distribution	Habitat	Flowering Time
Hemerocallis dumortieri	Central Honshu to Hokkaido	mountains	May-June
H. exaltata	Honshu (rare)	seashore	June-Aug.
*H. exilis**	Central Honshu	seashore	June-Aug.
H. fulva	Kyushu-Hokkaido	seashore to low mountains	July-Aug.
*H. littorea**	Kyushu-southern Honshu	seashore	Sept.-Nov. (Figs. 2, 3, 4)
H. fulva var. *longituba**	Kysuhu-Honshu	seashore	May-June
*H. middendorffii**	Hokkaido	mountains	July-Aug. (Fig. 1)
*H. thunbergii (vespertina)**	Kyushu-Hokkaido	mountains	July-Aug.
*H. yezoensis**	Hokkaido	seashore	July-Aug.

* species collected. *H. exilis* originally was described as an alleged hybrid of *H. fulva* var. *longituba* × *H. thunbergii*.

daylilies at their height of bloom in October and November.

In winter 1956, I was exploring subtropical areas of Japan for broadleaved evergreens of value to the southern areas of the United States. During October, I journeyed to the southern part of Shikoku. This took me to Ashizuri-zaki, a heavily forested Cape, isolated except for a narrow road traversing two mountain passes and another approach from the sea.

Fig. 1. On the eroded sea-cliffs at Esaisi, Hokkaido. *H. middendorffii* displays a broad range of flower types in the colonies that cover the landscape.

Fig. 2. *Hemerocallis littorea* at Ashizuri-zaki, Shikoku.

Along the winding road, *Camellia sasanqua* was in full bloom and the evergreen holly species, *Ilex rotunda* and *I. integra* were covered with red fruit. The evergreen woody plants found commonly included oak, ardisia, spindletree, viburnum, privet, and camphor. The forests were planted mostly to *Cryptomeria*. Thus one can visualize this as an area fully evergreen in winter, without severe cold, and perhaps an occasional frost. It can best be compared to the region adjacent to the Gulf of Mexico in climate and to the coast of Oregon in ruggedness. Nakai, a famous Japanese botanist, counted 148 species of plants at Ashizuri-zaki.

The Cape extends like the small finger from an otherwise closed fist and the tip is approached through gnarled, wind-formed groves of *Camellia japonica*. Abruptly, the land ends in a steep, rocky cliff plunging into the Pacific Ocean. There, standing on a terrace of *Zoysia japonica,* I first saw, with sheer delight, *Hemerocallis littorea,* in full bloom by the thousands. It covered the slopes with its orange-yellow flowers, occasionally interrupted by white clumps of *Peucedanum japonicum,* an evergreen relative of Queen Anne's Lace. I descended the cliff and, perched above the crashing surf, photographed and dug clumps of both species (Figs. 2, 3).

Hemerocallis littorea has orange-yellow flowers up to six inches across, borne on leafy scapes up to 24 inches tall. It flowers between September and December, with the peak of bloom in late October. To my knowledge, the plants sent to the United States in 1956 represent the first introduction of this species into cultivation since 1941, when A. B. Stout repored on two plants received from Nakai.

Since then this daylily has thrived and flowered at the U. S. Plant Introduction Station, Glenn Dale, Maryland. It has

proved to be a late-flowering species in cultivation. It opens its first flowers in September and continues to bloom as long as temperatures are sufficient for flowers to open.

In a subsequent exploration in 1961, I located the first Japanese daylily to bloom in the spring. This is *H. longituba,* an orange-flowered species with 10 or more flowers in loose clusters on short scapes. It occurs along the coastal region of northern Honshu in grassy fields, along railroads, and on sandy beach hummocks. I collected it in bloom on May 29th. Thus we have in cultivation the earliest and the latest of the Japanese daylilies to flower.

Although our expeditions to Japan have resulted in the introduction of most of the Japanese species, there is ample opportunity for intensive collecting, particularly species widely distributed in Hokkaido where great variation in growth and flowering characters exist (Figs. 1 & 4). Like many plants with a long history of cultivation, it appears that much of the variability available in the wild daylily has not been utilized.

[Editor's Note: For 10 years *H. littorea* has grown well, survived the winters and flowered at Glenn Dale, Md. It is late-flowering (not just reflowering), and is probably the latest of all daylilies to flower. In 1959 its first flowers opened about Sept. 1, in 1960 about Oct. 1, in 1961 on Sept. 2, and in 1962 on Sept. 1. The scapes are about 24 in. high, with top-branching, with spider-type flowers about six in. across. It sets seed readily and has been used extensively in breeding, especially with the June-flowering 'Pleasant Hours'. The seedlings mostly bloomed in August and into September in the intermediate season. (Darrow.)]

Fig. 3. Habitat of *H. littorea* at Ashizuri-zaki, Shikoku.

Fig. 4. Habitat of daylilies in Hokkaido, northernmost island of Japan.

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Daylilies in Other Countries

HUBERT A. FISCHER

As foreign secretary of the American Hemerocallis Society, I have corresponded with many people in many countries, and sent numerous packets of seeds, catalogues, bulletins and literature to them. There are always a few informed persons who know of the vast improvement in daylilies and seek additional information. However, many foreign catalogues still list as modern American daylilies those no longer featured here. Catalogues and publications with color plates sent abroad have brought return questions as to whether daylilies in those colors really exist. Requests for seeds are made for certain colors, mostly pink and red but a few wanted white, blue, lavender and heliotrope. Some countries have been unable to import plants since the war due to currency restrictions and grow only a few very old cultivars and have had none of the new American hybrids. Reports from countries where seedlings have bloomed from seed sent, indicate that the flowers were far in advance of any daylily they had seen.

In England, modern daylilies are becoming popular due to the fact that they are on display at places such as the Norton Hall Nurseries, Antony House Nurseries, the private garden of the late Harry Randall and at the daylily trials at Wisley conducted by the Royal Horticultural Society.

In Germany and Austria the trials and display plantings at Hamburg and Vienna have awakened a desire for the new daylilies and nurserymen are featuring many. The German Iris and Lily Society members are active and their bulletins feature articles on daylilies in every issue.

The following information has been gleaned from letters received in answer to direct questions or in correspondence. In many instances direct quotations are used.

England

Though no hemerocallis or daylily society exists in Great Britain, the Royal Horticultural Society for many years has maintained permanent trials at Wisley. During the past nine years the R. H. S. has awarded seven First Class Certificates to two English cultivars 'Wentworth' and 'Shipston' and to five American cultivars 'Marion Vaughn', 'Pink Damask', 'Golden Chimes', 'Burning Daylight', and 'Cartwheels'. Judges of the R. H. S. have also voted many Highly Commended and Award of Merit certificates for outstanding daylilies. New selections are made for trial each year. Plants are selected by a committee of experienced horticulturists and sent to Wisley where they are grown under number. Three plants of each daylily clone are grown and when well established are judged mainly for garden effect, amount of bloom, and attractiveness, rather than for qualities of the individual flower.

Harry J. Randall of Beaconsfield, who for the past twenty years took a leading part in the development of the daylily in England, pioneered in bringing the new and best to his garden. From correspondence received from him, he says "Amos Perry who was undoubtedly the pioneer hemerocallis breeder in the whole world told me at the end of his life that he tried for fifty years to popularize them in Britain but failed. He asked me to carry on where he left off and, as I had a fairly good collection and was hybridizing each year, I promised to do my best. The greatest necessity was to persuade some

of the progressive nurseries to stock the newer things. Several of them are doing so."

R. H. Coe of the Norton Hall Nurseries in Essex has a splendid catalogue with color plates and lists many of the newest and best cultivars from America and England. He grows thousands of seedlings and has introduced 'Celia St. Aubyn', 'Stella Meeson', and 'Kathleen Barker'.

In the south of England in Cornwall, the Antony Estate Nurseries have a planting of the finest American daylilies. Lady Cynthia Carew-Pole states that the increase is rapid and though the demand is still for the less costly, sale of the new ones is increasing as they become known. Sales have doubled yearly.

France

Only a comparatively few commercial growers are found in France. One nursery lists about fifty cultivars; another lists 175 outstanding modern daylilies, most of which are of American origin.

Many gardens contain old cultivars only, such as 'Apricot', 'Orangeman', and the species *H. lilioasphodelus* (*H. flava*) and *H. fulva*. Magazine articles and color-slide lectures by Jean Cayeau help to acquaint the public with daylilies and increase their popularity. Prospective buyers show a preference for strong vivid colors, such as glowing yellow, true orange, red and pink. The pastel and cream colors are less popular. The average sales are for those priced at 75 cents to $3.00. Novelties over $4.00 are difficult to sell. Daylilies are judged first as garden plants and appreciated for their easy culture, hardiness and abundance of flowers. Also the desire is for additional very early to late bloom.

There has been little breeding of daylilies in France to date. Jean Cayeau registered two in 1962, 'Belle Etoile', a green-yellow and 'Geant Jaune', a very large medium yellow with narrow petals. He is growing several hundred seedlings. No awards have been given to daylilies produced in France because they are not known sufficiently well.

The following list includes cultivars that are especially appreciated in France:

Alan	Green Valley
Aten	Lady Inara
Atlas	Late Summer
Bess Ross	Lynn Hall
Buried Treasure	Park Avenue
Cradle Song	President Rice
Crestwood Ann	Rhodora
Doncaster	Smiling Thru
Frances Fay	Summer Splendor
George Cunningham	Toro

It is predicted that as they become better known in nurseries daylilies will become as popular as peonies in France.

Germany

About 75 of the newer American hemerocallis cultivars were shown at Hamburg in 1963 on the occasion of the *Internationale Gartenbau Ausstellung* (International Horticultural Exhibition). Plants were grown on a site called *Planten und Blomen* near the botanical garden and awards were made by the German Iris and Lily Society as follows:

Gold Medal:
Finest Hour

Silver Medals:	Sammy Russell
George Cunningham	Shooting Star
Mary Guenther	Silent Night
Orange Beauty	Songster
Rare China	Toro
Ringlets	Vespers

Silver Medals (miniatures):

Corky	Jenny Wren
Golden Chimes	Thumbelina

Bronze Medals:	Felicity
Atlas	Flair
Atomic Age	Flying Saucer
August Orange	Green-eyed Giant
Blossom Time	Hallcroft
Bold Courtier	Lady Chatterly
Borgia	Lexington
Cherry Ripe	Magic Circle
Dawn Supreme	Nashville
Deep Garnet	Pink Damask
Elegy	Revolute
Evelyn Claar	Warren Treadwell

Introductions by Max Steiger:

Silver Medal:

Feuervogel

Bronze Medals:

Margarite
Stern von Rio

Three French introductions from Cayeau and two British introductions from Brummitt were shown but no awards.

British introductions included two cultivars from Brummitt but no awards.

In 1964 Silver Medals were awarded to 'Burning Daylight' and 'Frans Hals'. and Bronze Medals to seedling '65J' (Brummitt) and to '1961-11' (Muhlstein).

In West Germany the nursery of Grafen von Zeppelin offers about 75 daylily cultivars listed by color class, including 'Atlas', 'High Noon', 'Ringlets', 'Colonial Dame', 'Howdy', 'Crimson Glory', 'War Eagle', and 'Evelyn Claar'. Grafen von Zeppelin has used colored pictures in catalogues at garden shows and in magazine articles and has special display plantings at her nursery entrance. Visitors to the Grafen von Zeppelin nursery are fascinated with the new daylilies. Nurseries mostly offer old cultivars and the species *H. lilioasphodelus* (*H. flava*) and *H. fulva*. Landscape architects are still using *H. citrina*. German gardeners want bright colors, such as golden yellow, bright red and those with sharp contrasting colors. The pale melon colors are not popular.

Austria

At the Wiener Internationale Gartenschau—1964 (Vienna International Exhibition) many American Daylilies were in competition and judged. The following medals were awarded:

Gold Medal:

Flying Saucer

Silver Medals:

Bright Dancer
Bryce Canyon
Feuervogel (German)
Golden Orchid
Green Valley
Pink Damask
Shining Plumage
Trail of Gold
Wideyed

Bronze Medals:

Athlone
Dawning Light
Francis Fay
Lady Godiva
Madrigal
Marsha Russell
Mrs. Tiggert
Painted Lady
Pink Charm
Velvet Robe

Special Awards to Miniatures: Golden Chimes—Corky—Thumbelina.

The competition is being continued under the guidance of the Osterreichische Gartenbau Gesellshaft (Austrian Hort. Soc.).

In 1966 judging continuel and awards were presented to the following:
—First Class Diploma: Inlaid Gold and Torpoint; Second Class Diploma: Frans Hals—Satin Glass—Daafu

Italy

Plans for a daylily planting at the lovely Florence Iris Garden on the banks of the Arno have been delayed. Catalogues list some moderately priced cultivars. Evergreen cultivars grow well in the mild climate of Florence where there is little snow. Bright clear colors attract most people, since daylilies are used mainly for overall garden effect. Mr. Carlo Medici, near Florence, states that the Barni rose nursery is growing daylilies and is interested in new introductions.

George Specht of the "Paradiso" nursery in Florence, reports that a few nurseries are offering the best of the older cultivars at low prices—'Colonial Dame' at 55 cents and 'Pink Damask' at $1.10. Higher priced ones will sell when people know what grow best in Italy. Pioneers buy the lower priced ones first and wait for report from others before buying the more expensive new cultivars. Nurseries are beginning to stock some of the newer cultivars. Though not many people come especially to see daylilies, plantings are made where they may be seen from the highway. Most sales are made from color catalogues.

From Messina on the island of Sicily, a request came for cultivars best suited to the warm Mediterranean climate of that area, with no freezing weather. Mostly evergreen daylilies were recommended together with sources of supply.

Poland

Except in a few isolated private gardens modern American daylilies are unknown. The fulvous (*H. fulva*) and yellow daylily (*H. lilioasphodelus*) are widely grown in village gardens. Species, such as *H. dumortieri, H.* × *aurantiaca, H. middendorffii,* and *H. citrina* are also grown in parks and botanical gardens. Cultivars grown are 'Apricot', 'Queen of May', 'Sir Michael Foster', 'Hyperion', and some of Amos Perry's introductions. Only one relatively modern American daylily is available for purchase in the commercial nurseries, government, city or private, namely 'Tejas' (Russell 1945).

Two gardens that grow some of the modern daylilies received them as gifts from friends. One such garden contained 14 cultivars, including 'Mrs. Bonner', 'Georgia', 'Mary Guenther', 'North Star', 'Pink Damask', 'Pink Orchid', 'Rose Prelude', 'Purple Waters', 'Crestwood Ann', and 'Crestwood Evening'. The other garden with 18 cultivars, included 'August Pioneer', 'Black Cherry', 'Capistrano', 'Fairy Wings', 'Kindly Light', 'Lady Inara', 'Knighthood', 'Melody Lane', 'Rhodora', 'Summer Interlude', 'War Path', and 'Yellowstone'.

Modern daylilies will become available to gardeners in Poland only when government officials import and offer them through commercial nurseries, or when friends send them as gifts to individuals. Until they become better known and gardeners and nurserymen request them there will be few importations. There have been requests for literature and catalogues, also for slides of the new American hybrids which will eventually awaken more interest.

New Zealand

Letters from Sam Rix of Mount Manuganui, North Island, indicate that at present daylilies are rare in gardens.

Daylilies thrive in the mild moist climate from one end of the country to the other. They are spared the extremes of climate experienced in most of the United States. A low of 18° F. is the minimum in some sections of New Zealand; many areas, especially in the North Island, are frost free. In the South Island summer temperatures (December to March) rarely exceed 80°F. and frosts are light and the annual rainfall averages about 60 inches. In the mild northern districts where only light frosts are experienced the evergreen cultivars bloom throughout the year, but the majority flower in spring and taper off in autumn forming massive clumps in a matter of months. Some are summer flowering only, whereas others rebloom.

In nursery catalogues from New Zealand, about 30 cultivars were noted, including 'Duchess of Windsor', 'Painted Lady', 'Brocade', 'Fluffy Ruffles', 'Golden Sceptre', 'Rosilind', 'Summer Star', and 'Red Tartan'. They are in such demand that many have been withdrawn from sale until stocks are increased. Another list offering modern American hybrids included cultivars such as 'Florida', 'Eastern Morn', 'Sir Michael Foster', 'Cherokee Maid', 'Pink Caress', and 'Lady Hosketh'. In another list were 'Persian Princess', 'Rajah', 'Flamboyant', 'Apricot Beauty', 'Gold Dust', 'Patricia', 'Margaret Perry', and 'Black Knight'.

One group of importations not yet released for sale contained 'War Eagle', 'Naranja', 'Ruffled Pinafore', 'Fairy Wings', 'Golden Triangle', 'Gay Lark', 'Cosette', and 'Francis Fay'.

In gardens where daylilies are grown one sees very old cultivars with narrow reflexed pale petals useful chiefly because they are easy to grow. Because of dollar restrictions imposed on nurserymen, the few collections now offered were imported not long after the war and have remained in catalogues ever since with little change. The more recent daylilies to be offered in the next few years will still fall far behind the latest hybrids.

A correspondent writes that "seeds sent several years ago have produced seedlings and those that bloomed have demonstrated the advance made in daylily breeding in recent years. One of rich orange with a crimson eye-zone is the

most beautiful daylily I have seen. From the tetraploid seeds sent I have had my first bloom. I am now growing several thousand seedlings."

New Zealand cultivars registered with the American Hemerocallis Society by Robert H. Taylor in 1956 were 'Bambino', 'Copper Glow', 'Oriental Tapestry', 'Pink Caress', 'Red Sentinel', and several others; it is doubtful whether any have found their way into American gardens.

It is obvious that daylilies will become vasly more popular in New Zealand and there will be increasing interest in the breeding.

South Africa

The nursery of Mrs. F. J. Boshoff Mostert, Balfour, Transvaal, has been growing *Hemerocallis* for twenty years. Old favorites are 'Golden West', 'Hesperus', 'Sachem', 'Autumn Red', and 'Bold Courtier'. Favorites today are 'Angels Robe', 'Sherwood', 'Blythe Spirit', 'Quincy', 'Limonero', and especially 'Colonel Fry'. They have done no hybridizing. Evergreen and deciduous cultivars do equally well. The newer cultivars have better branching, bud count, substance, and stay open longer. Yellow daylilies are more vigorous than those of other colors, especially pink.

Communication from Northdene, Natal, indicates interest started 12 years ago with 'Sachem', 'Autumn Red', 'Hesperus', 'Dr. Stout', and 'Bagette', among the more common. Some hybridizing has been done and some interesting seedlings raised. Favorites today are 'Prima Donna', 'Salmon Sheen', 'Marse Connell', and 'Kanapaha'. In Natal the evergreen cultivars grow as well as the deciduous ones.

In Essexvale, Rhodesia, growing daylilies began in 1950 with *H.* × *aurantiaca* 'Major', *H. citrina, H. lilioasphodelus* (*H. flava*), and later with 'Evangeline', 'Sachem', 'Apricot', 'Golden West', and 'Purple Waters'. Some hybrids have been raised and numerous seedlings named but never registered. Newer favorites are 'Garnet Robe', 'Summer Love', 'Evelyn Claar', 'Salmon Sheen', 'Neyron Rose', and 'Cradle Song'. The newer cultivars are better branched and many rebloom. Gardeners are becoming more daylily conscious in South Africa.

Of interest was the statement that many of the best new American daylilies were sent to the nursery in the Transvaal as proliferations by air letter post.

India

Daylilies are grown in some parts of Mysore State in South India, particularly in Bangalore, and in North India at Delhi. In both private and public gardens of Bangalore yellow and orange daylilies are preferred; named cultivars are not available. Other kinds grown are *H. lilioasphodelus* (*H. flava*), *H.* × *aurantiaca*, and *H. fulva*.

Nurserymen are interested in receiving seeds and plants, especially of pink and orange-flowered kinds. From the National Botanic Garden at Lucknow a request came for seeds and literature. Several attempts to import plants met with failure as the plants arrived dead.

Today very little information about American daylilies is available in India. A letter from Prof. S. Percy Lancaster states that attempts to import daylilies from Africa and America have failed because plants were dead upon arrival. It seems to be difficult to get seeds to set in daylilies grown at the National Botanic Garden at Lucknow where they flower in early summer. Seeds from evergreen crosses have been sent and seedlings are being grown. Dr. L. G. Singh wrote that literature and catalogues have been very much appreciated, especially the Bulletin of the University of Illinois, *Daylilies for every Garden*.

APPENDIX 1

Hybridizers and Commercial Growers

MRS. A. W. PARRY

Daylilies are propagated and sold by the original hybridizer, by daylily commercial growers and by nurseries selling a general line of perennial plants. It would seem helpful to list these for 1967. Several commercial growers have been propagating daylilies for many years. The list of hybridizers who introduce their own originations may be expected to change more rapidly as new breeders obtain superior plants that they feel should be introduced or as hybridizers find that commercial growers can do the job better or as the hybridizer finds the work of introduction too difficult. There are 92 names in the lists; 17 are names of breeders who introduce their cultivars through commercial growers, 68 others are breeders who introduce their own originations but may also introduce those of other breeders and 17 are commercial growers only.

• Indicates that the hybridizer introduces his own originations.

† Indicates that the commercial grower handles a general line of daylily originations.

Where the name of the hybridizer is given with no address, the note just below the name indicates the commercial source of originations.

MRS. FLOYD D. ARMSTRONG*†
Flomax Gardens
8021 Lake Street
Omaha, Neb. 68134

S. H. BAKER*†
Great Meadows, Hope Road
Hope, N. J. 07844

FRANK L. BENNETT
Introductions by
Grovatt Gardens

FREDERICK M. BENZINGER*†
Rt. 1, Box 160
Ruckersville, Va. 22968

CLARENCE BLOCHER*†
336 East Forest Avenue
Wheaton, Ill. 60687

CHARLES E. BRANCH
Introductions by
Wm. J. Dill
Mrs. W. T. Hardy

W. QUINN BUCK*
Box 614
Arcadia, Calif. 91008

JOHN A. BURCH, JR.*†
Fayetteville, Ga. 30214

MR. & MRS. S. A. CALHOUN*†
Introductions by
Ra-Cal Gardens

FRANK W. CHILDS*
Jenkinsburg, Ga. 30234

ELMER A. CLAAR (deceased)
Introductions by
Parry Nurseries

CLYDE W. DAVIDSON*†
1215 Church Street
Decatur, Ga. 30030

BEN ARTHUR DAVIS*†
Hope Haven Garden Service
2910 38th Street
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CLAUDE W. DAVIS*†
University Hills Nursery
470 Delgado Drive
Baton Rouge, La. 70808

MRS. G. E. DENNY†
Libuse, La. 71348

WM. J. DILL*†
370 Monterey Drive
Florissant, Mo. 63031

FAIRMOUNT GARDENS*†
166 Fairmount Street
Lowell, Mass. 01852

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PETER J. FASS*†
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ORVILLE W. FAY
Introductions by
Russell Gardens
Hardy Nursery
Steve Moldovan
Clarence Blocher

HUBERT A. FISCHER
Introductions by
Parry Nurseries

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GROVATT GARDENS*†
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Burlington, N. J. 08016

DAVID F. HALL
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Hardy, Wild and Others

MRS. LAVINEA HAMACHER*
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Mrs. W. T. Hardy*†
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Mount Olive, Ala. 35117

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Mrs. D. O. Holman*
Charlottes Flowers
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Mrs. H. H. Howell*†
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Baton Rouge, La. 70808

Hughes Garden*†
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Mansfield, Tex. 76063

Robert M. Kennedy, III
Introductions by
Gilbert Wild & Sons

M. O. Kent*†
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Longwood, Fla. 32750

Willard A. King
Introductions by
Grovatt Gardens

Ezra J. Kraus (Deceased)
Introductions by
Shilling and others

William Krekler*
Somerville, Ohio 45064

Mrs. O. W. Lacey*
111 East 2nd Street
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Mrs. W. N. Lake
Introductions by
Shipp's Nursery

John R. Lambert, Jr.
Introductions by
White Oak Nursery

Mrs. Erskine W. Landis*
Hurricane Nur. Plantation
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Deland, Fla. 32720

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Mrs. Eli Lewis*
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W. B. MacMillan*†
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Abbeville, La. 70510

James E. Marsh
Introductions by
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T. B. Maxwell*†
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Introductions by
Fairmount Gardens

D. R. McKeithan
Introductions by
Hancock Gardens

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Mrs. W. D. Monkhouse
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Gardens*†
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1327 Hays Avenue
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Mrs. Lee Parker*†
Box 266
Dermott, Ark. 71638

Parry Nurseries†
Signal Mountain, Tenn. 37377

Dr. Virginia Peck
Introductions by
Parry Nurseries

Mr. & Mrs. George Pettus
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Ra-Cal Gardens

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Reigel Plant Farm†
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SHIPP'S NURSERY†
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Baton Rouge, La. 70809

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Pensacola, Fla. 32503

C. G. SIMON NURSERY*†
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ALLEN J. WILD
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Hardy Nursery

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Rules for Naming Hemerocallis Clones (Rev., Nov. 1964)

1. The name of a clone (cultivar) should be a common and well understood word or words, preferably in the English language, although well known words or phrases or recognized transliterations thereof from other languages may be used. Personal names must not be translated. Do not use Latin or Greek words; these are for botanical use only.
2. The name should consist of one or two words and must not consist of more than three words.
3. The accidental or intentional mispelling of any word having a recognized spelling or usage is not acceptable unless it is the actual spelling of a person's name. Example: 'Daylight' not 'Daylite'.
4. A variation in the spelling of another name is not acceptable. Example: 'Gold Nuggett' and 'Golden Nuggett'.
5. Names that are likely to be confused with existing names must be avoided. Example: 'Beatrice' and 'Beatrix'.
6. Avoid names containing abbreviations, initials, numerals, symbols, apostrophes, accents, commas, hyphens or any other marks likely to be misplaced or omitted. Avoid as a prefix to a name the articles 'a' and 'the' and their equivalents unless required by linguistic customs.
7. Avoid the use of descriptive terms that apply to characteristics not exclusive or potentially exclusive to one particular clone. Example: 'Ruffled Petals', 'Green Throat'.
8. Avoid names exaggerating the merits of a clone or which may become inaccurate through the introduction of new clones. Example: 'Earliest of All', 'Latest of All'.
9. Names containing forms of address are not acceptable. Example: 'Miss', 'Mrs.', 'Doctor', or their equivalents in other languages.
10. The use of the surname of the originator or introducer as a part of a name is not permissible, except where such surname is better known as a noun or adjective. Example: Robert Brown could register 'Brown Moth', but not 'Brown's Choice'.
11. (Dropped Nov. 1967 by Bd. of Dir.)
12. The legal or professional name of a living person may be used as a name for a *Hemerocallis* clone only on written permission by the person concerned.
13. A two- or three-word name in use as a *Hemerocallis* clone name cannot be reversed or rearranged and used for another clone. Example 'Pink Diamond' and 'Diamond Pink'.
14. Individuals or groups wishing to name a clone other than their own origination must have the permission of the originator.

APPENDIX 1a

Hemerocallis Growers Association (Affiliate of the American Hemerocallis Society)

The Hemerocallis Growers Association was established as an affiliate of the American Hemerocallis Society, to develop standards of nursery stock and practices among the distributors of daylilies and to promote the industry, and, along with the American Hemerocallis Society, "to promote, encourage and foster the development and improvement of the genus *Hemerocallis*, and public interest therein, by all suitable and appropriate means."

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Mexia, Texas 76667

MRS. LORENE GRIFFIN
Lo-O'Shirl Lily Garden
180 Huey Avenue
Enterprise, Ala. 36330

EDWARD F. GROVATT
Grovatt's Garden
Neck Road, Route 2
Burlington, N. J. 08016

MRS. CHARLES HANCOCK
Hancock Gardens
Box 52
Steele, No. Dak. 58482

MRS. W. F. HANKINS
Hankins Gardens
Route 7, Box 500
Tallahassee, Fla. 32301

MRS. D. O. HOLMAN
Charlotte's Flowers
Timmonsville, S. C. 29161

O. R. HOWE, JR.
Howe Gardens
Holliston, Mass. 01746

T. E. & T. J. HUGHES
Hughes Garden
Route 1, Box 127-C1
Mansfield, Texas 76063

E. R. JOINER
Joiner Gardens
33 Romney Place
Savannah, Ga. 31406

MRS. MATHEW JOYCE
7554 Pickett Street
Jacksonville, Fla. 32208

MISS EDNA LANKART
Lankart Gardens
Rt. 4, Cherokee Trail
Tyler, Tex. 75701

R. L. LENINGTON
Lenington Gardens
7007 Manchester Avenue
Kansas City, Mo. 64133

MRS. ELI LEWIS
Elistonia Gardens
Dawson, Ga. 31742

W. B. MACMILLAN
House O' Macs Gardens
211 N. Washington Street
Abbeville, La. 70510

A. T. NEWSOM
4784 Glenwood Road
Decatur, Ga. 30032

MR. & MRS. ARTHUR W. PARRY
Parry Nurseries
Signal Mountain, Tenn. 37377

MRS. J. R. ROSA
Rosa's Daylily Garden
3219 Thomasville Road
Tallahassee, Fla. 32301

BELDON C. SAUR
Rocknoll Nursery
Morrow, Ohio 45152

J. L. SCHOONOVER
Schoonover Gardens
Box 7, 404 S. 5th Street
Humboldt, Kan. 66748

VAN M. SELLERS
Iron Gate Gardens
Route 3, Box 101
Kings Mountain, N. C. 28086

MR. & MRS. R. H. SHILLING
Shilling Garden
2811 Guilford Lane
Oklahoma City, Okla. 73120

MRS. C. G. SIMON
C. G. Simon Nursery, Inc.
Layafette, La.

J. A. WARD
Ward's Pansy Garden
6028 Houston Road
Macon, Ga. 31206

MRS. BEN F. WHEELER
Wheeler's Daylily Garden
10024 Shady Lane
Houston, Texas 77016

MRS. A. Y. WOODS
Woods Garden
1000 Danielsville Road
Athens, Ga.

J. D. WOOTEN
Route 4, Box 90
Defuniak Springs, Fla. 32433

M. T. YOUNG
800 South Lincoln
Tallulah, La. 71282

APPENDIX 2

Tetraploid Daylilies

JACK S. ROMINE

Schreiner, Buck, and Traub treated daylilies with colchicine to obtain tetraploids in the late 1940's and each reported success in flowering them—Schreiner in 1947, Buck in 1948, and Traub in 1949.

Dr. Hamilton P. Traub began to breed tetraploid hemerocallis in 1949 or in the early 1950's at Beltsville, Maryland, and obtained the Beltsville Series of tetraploids. He introduced the induced 'Tetra Starzynski' (1949), 'Tetra Apricot' (1951), 'Tetra Peach' (1951), and others. These were distributed free to the public through the United States Department of Agriculture. Many observers did not like the first tetraploids, which they reported as being thick, stiff, and lacking in grace and charm. However, realizing their breeding potential, Dr. Traub and others persevered, and today there are thousands of tetraploid seedlings in a full range of colors, with the grace and beauty enhanced.

Registered Induced Tetraploids (17)

Bountiful Harvest (Reckamp)
Brilliant Glow (Schreiner)
Changing Times (Reckamp)
Crestwood (Fay)
Crestwood Ann (Fay-Griesbach)
Crestwood Bicolor (Fay-Griesbach)
Crestwood Evening (Fay-Griesbach)
Crestwood Gold (Fay-Griesbach)
Crestwood Lucy (Fay-Griesbach)
Crestwood Rose (Fay-Griesbach)
Dazzler Gold (Childs)
Envoy (Reckamp)
Seaways Coral (McEwen)
Tetra Elaine (Traub)
Tetra Rosalind (Traub)
Tetra Salmon Sheen (Buck)
Tetra Starzynski (Traub)

Recognzied Tetraploid Clones (16)

Big Brassy (Buck)
Canary Butterfly (Traub)
Doctor Whitaker (Traub)
Elvira (Traub)
Lucia (Traub)
Ophelia (Traub)
Purple Premier (Traub)
Ralph Cornell (Buck)
Saffron Beauty (Traub)
Salmon Orchid (Traub)
Sue Booth (Buck)
Tetra Aurantorosea (Buck)
Tetra Blossom (Buck)
Tetra Kanapaha (Buck)
Tetra Prima Donna (Buck)
Tetra Soudan (Buck)

Registered Tetraploids from Tetraploid Parents (66)

Alcazar (Traub)
Anya (Munson)
Arcadia Buttercup (Buck)
Asia Minor (Munson)
Billy Budd (Traub)
Bonnie Barbara Allen (Peck)
Bright Dawn (Rudolph)
Butterfly Beauty (Traub)
Cabrillo (Traub)
Captain Reid (Traub)
Cathedral Bells (Childs)
Cherokee Princess (Peck)
Deacon's Darling (Maynard)
Elfin Knight (Peck)
Elizabeth Traub (Traub)
Fair Annet (Peck)
Fair Margaret (Peck)
Frosted Full Moon (Hamacher)
Georgica (Munson)
Gertrude Smith (Fay)
Gil Benton (Peck)
Giordano Bruno (Traub)
Golden Surrey (Fay)
Heavenly Harp (Reckamp)
Impertinence (Buck)
Junipero Serra (Traub)
Katherine Jaffray (Peck)
Kathleen Elsie Randall (Fay)
Kemp Owyne (Peck)
Lady Cynthia (Fay)
Lemon Beauty (Traub)
Lord Randal (Peck)
Loyal Subject (Reckamp)
Lucretius (Traub)
Madrid (Traub)
Magdalena Leuthi (Traub)
Mary Hamilton (Peck)
Mary Todd (Fay)
Milanese (Munson)
Monticello (Benzinger)
Moon Temple (Fay)
Oriana (Munson)
Pacific One (Traub)
Pacific Two (Traub)
Padua (Munson)
Peter Cooper (Traub)
Prolific (Fay)
Queen Eleanor (Peck)
Reverend Traub (Traub)
Rosarama (Hamacher)
Sir Patrick Spens (Peck)
Surprise Package (Fay)
Tamlin (Peck)
Tetra Apricot (Traub)
Tetra Arthurstar (Traub)
Tetra Carmine (Traub)
Tetra Elyandre (Traub)
Tetra Peach (Traub)
Tetra Yandre (Traub)
Tetra Yandreland (Traub)
Tetra Yandrestar (Traub)
Thomas Rymer (Peck)
Velvet Butterfly (Traub)
Wyndham Hayward (Traub)
Yellow Beauty (Rudolph)
Yellow Champagne (Rudolph)

APPENDIX 3

Breeders of Tetraploid Daylilies

MRS. JULIA B. HARDY

Because of the possible importance of the tetraploid daylily in the immediate future, a list of 59 of the more serious breeders of tetraploid daylilies becomes important current information. Undoubtedly, this list does not include all, nor does it include possibly 200 other gardeners who are doing some breeding with tetraploid daylilies.

Toru Arisumi
Beltsville, Md.

Clyde F. Anderson
Tucker, Ga.

Riley Barron
Forest Park, Ga.

Mrs. James Bell
London, Ohio

F. Benzinger
Ruckersville, Va.

Clarence Blocher
Wheaton, Ill.

Mrs. Robert L. Bowen
East Point, Ga.

David Brown
Orange, Texas

W. T. Brown
Mobile, Ala.

W. Quinn Buck
Arcadia, Calif.

S. A. Calhoun
Marshall, Texas

Frank Childs
Jenkinsburg, Ga.

George L. Crossman
Hamilton, Va.

George M. Darrow
Glenn Dale, Md.

C. W. Davidson
Decatur, Ga.

Norman Dye
Ellendale, Tenn.

P. J. Fass
Hampton Bays, N. Y.

Orville Fay
Northbrook, Ill.

Rev. John L. Fiala
Medina, Ohio

George Gilmer
Charlottesville, Va.

Robert Griesbach
Park Ridge, Ill.

Mrs. Charles C. Gulley
Lexington, Ky.

Mrs. L. Hamacher
Warren, Mich.

Mrs. Wm. F. Hankins
Tallahassee, Fla.

Mrs. W. T. Hardy
Mount Olive, Ala.

Wilbur M. Harling, Jr.
Gainesville, Fla.

Waino E. Himottu
Gardner, Mass.

Howard J. Hite
Birmingham, Mich.

Frank M. Houser
Macon, Ga.

T. E. Hughes
Mansfield, Texas

W. H. Lachman
Amherst, Mass.

Miss Edna Lankart
Tyler, Texas

Harold Long
Forest Park, Ga.

James E. Marsh
Chicago, Ill.

Mrs. Zelma E. Mayfield
Joelton, Tenn.

Currier McEwen
So. Harpswell, Me.

Mrs. I. J. Mederer
Valdosta, Ga.

Robert P. Miller
Dallas, Texas

Steve Moldovan
Avon, Ohio

R. W. Munson, Jr.
Gainesville, Fla.

D. C. Nearpass
Beltsville, Md.

Virginia & R. Peck
Murfreesboro, Tenn.

Geo. T. Pettus
St. Louis, Mo.

George H. Pride
Jamaica Plain, Mass.

Brother Charles Reckamp
Techny, Ill.

Jack Romine
Walnut Creek, Calif.

N. H. Rudolph
Aurora, Ill.

Fred Schenkl
Janesville, Wis.

J. Schork
Harrisburg, Ill.

R. M. Schroeder
Warrensburg, Ill.

Van M. Sellers
King's Mountain, N. C.

Miss Edna Spalding
Iowa, La.

John J. Temple
Pensacola, Fla.

H. P. Traub
La Jolla, Calif.

Harry I. Tuggle, Jr.
Martinsville, Va.

Anel M. Unger
Houston, Texas

O. B. Whatley
Florissant, Mo.

Robert Baker Wynne
Raleigh, N. C.

Mrs. H. G. Yarborough
Birmingham, Ala.

APPENDIX 4

Preparing and Packing Daylilies for Shipment

WALTER HAVA

The following are the results of a three year study of this subject. The first consideration is the health of the plant to be dug and shipped. Plants should be in good condition for shipping, which means they have been thoroughly soaked with water prior to digging. Roots should be injured as little as possible during digging. In sandy or sandy loam soils plants should be well watered the day before being dug, or, if possible dig the day after a good rain. If the soil is moist at the time of digging, both large and small roots pull out of the soil with little damage except to the very fine rootlets. The shovel or fork used in digging should be placed on only one side of the plant, and forced down and under the roots before prying up. This prevents the cutting of any roots.

Since plants take up most of their water through root hairs and fine rootlets, and since these grow mainly near the end of long young roots, healthy roots should not be pruned. However, old spent roots attached to a dark cone-shaped protrusion in the center of the root system should be removed. The old spent roots are hollow, shriveled or soft and are much darker than healthy roots.

After washing, the roots should be surface dried before packing. A dry cloth used gently, hastens the drying process. It is better to have the roots a bit dry rather than wet. After trimming the foliage, the roots should be placed in a *clean* plastic bag or wrapped in heavy waxed paper leaving the crown of the plant exposed. The foliage should never be wrapped. Before closing the bag or waxed paper, it may be advantageous to place a few strands of *FRESH* sphagnum moss here and there between the roots. Fresh sphagnum moss affords antibiotic protection and usually prevents the formation of mold or fungus infection. In tying the plastic or waxed paper, care should be exercised that the cord or rubber band is not too tight.

It is better to trim the foliage in a V-shape with the center leaf forming the apex, the outer leaves six to eight inches and the three central leaves longer. It is these central leaves that produce later most of the food and growth substances; daylilies treated in the above manner start to grow earlier and better.

The packing box should be adequately punched with air holes, especially close to the foliage to allow a free circulation of air. Square holes are easier to cut than round ones, and should be at least one half inch in diameter. The best packing is a fine excelsior that has been fluffed or loosened. Very compact excelsior can prevent circulation of air in the box. Coarse excelsior is much too rough for daylily foliage. The use of news print for packing next to the plants is to be discouraged, for a residue of nitric or sulphuric acid used in its manufacture may injure the foliage and the newsprint can absorb water from the plant. If the roots are in contact with the news print the plant could be injured. Paper is a wonderful insulator and prevents the free circulation of air in the box which excelsior allows.

Though air mail may be the most desirable method of shipment, it is wise to ship the plant on a Monday or Tuesday to avoid the possibility of a layover in the Post Office during weekends. Many question the advantage of Special Handling. Attention should be paid to the selection of sturdy boxes for shipment. It is suggested that we avoid shipping daylilies in large clumps of six, seven, or eight divisions, as the weight of large plants causes shifting and severe damage to the box. Often the soil between the roots causes excess weight in large plants. In large clumps, the soil cannot be washed thoroughly from between the roots, and we are never sure that this soil does not contain harmful organisms. It is better to divide large clumps into plants of two or three divisions. Most of these large clumps are guest plants being returned.

APPENDIX 5

Recommended Cultivars

Compiled by P. G. CORLISS

The following lists of recommended cultivars are intended to serve as a guide in helping beginners to select cultivars which, at the time of this publication, are considered meritorious. Past experience shows that most of them will be replaced in a few years by newer clones which are superior in one or more respects.

The climatic map which precedes the lists should be of some help. The gardener will do well to select cultivars recommended for the region with a climate most like his own. If you live near the border of one region most of the cultivars recommended for the adjacent region may be grown.

Because of the many factors which affect the performance of a cultivar you may not always succeed even with cultivars recommended for your region. Temperature, soil, shade and available water, may not be just right for some cultivars in your garden. You may even fail in your front yard with a cultivar that does nicely in the back yard. The surest way to select a winner is to pick a cultivar that grows well in a neighbor's garden where conditions approximate yours. These lists have been compiled for your help only when such tangible help is not available.

Before studying the lists of recommended cultivars, it is assumed you will have read the body of this book, especially the chapter on cultivars (Chapter 4) and will know what

Map of Growing "Regions"

Region A. The Northeast and the Great Lakes Fringe. This region has severe winters and a relatively short growing season.

Region B. All of the United States east of the Mississippi River not included in Regions A and D. The growing season is longer than in Region A; normally killing frosts occur, but winter temperatures are less severe. The Mississippi River does not form a true barrier, as both sides of the river basin have similar growing conditions.

Region C. In general, this region has relatively long periods of heat and drought in the summer. It includes all of the United States west of the Mississippi River except the frost-free areas (Region D) and a tier of states along the Canadian border where the growing period is so short that only a limited number of cultivars may be successfully grown.

Region D. Light frosts may occur, but killing frosts are rare. This region includes southern Florida, parts of the Gulf Coast, a very narrow strip along the West Coast, parts of southern Texas and Arizona and other small areas.

types you want. If the information you seek, such as season of bloom, height, size, form is not given in the lists, you should find it in the catalogue from which you make your purchases.

To make the list as useful and comprehensive as possible, not less than four experienced and knowledgeable growers in each region were asked to recommend not less than 20 or more than 40 cultivars for their region. Most of them sent 40 names and complained this was too great a limitation. We concede that many worthwhile cultivars are not in the lists, but to recommend all desirable cultivars would take far too much space. The contributors were asked to include cultivars from the principal color classes and types so there would be some of all wanted kinds. Price was not a factor for inclusion, for price indeed is not a measure of merit but of scarcity.

Some of the contributors did not wish their names to be used and their wishes were granted, but our gratitude goes to all.

In addition to the cultivars recommended by these experts, we have also included those cultivars which received heavy votes in the Regional Popularity Polls of the membership of The American Hemerocallis Society. For this reason, the recommended cultivars are divided into two groups:

(1) The first group consists of those which ranked high in the Regional Popularity Polls. It must be realized that such a list must of necessity contain older (hence better-known) cultivars than those which the experts listed.

(2) The second group included those recommended by the experts which were not in the Regional Popularity Poll lists.

Both lists are arranged alphabetically.

We call your attention to the fact that only evergreen cultivars are recommended for Region D (usually killing-frost-free areas). We have already noted that the effect of evergreen and winter-dormant genes varies greatly and you must temper your choice with knowledge of your climate. Some evergreen and semi-evergreen cultivars appear in the list for Regions B and C. These are hybrids that have kept evergreeness of one parent and some of the hardiness of the other. Choose these with caution if your garden has heavy frosts and severe freezing. For continued success we cannot recommend evergreen cultivars for Region A. Evergreen cultivars only are recommended for Region D, simply because a climate that does not provide enough cold for the needed dormant-rest for the non-evergreen cultivars will eventually result in their poor performance or demise.

Abbreviations used: D = dormant; SE = semi-evergreen; E = evergreen; Day = day blooming; Ext = extended blooming; Noc = night blooming.

REGION A

Popularity Poll

Cartwheels (Fay)	D Day	gold	Luxury Lace (Spalding)	D Day	lavender pink
Crestwood Ann (Fay)	D Day	melon pink			
Frances Fay (Fay)	D Day	melon pink	Satin Glass (Fay)	D Day	pastel melon

Experts' Recommendations

Annie Welch (Claar)	D Day	red	Elizabeth Payne (Lester)	D Day	yellow
April Breeze (Lester)	D Day-Ext	pink			
Ava Michelle (Flory)	D Day	yellow	Emperor's Robe (Fay-Moldovan)	D Day	yellow
Bess Ross (Claar)	D Day	red			
Blythe Spirit (Fischer)	D Noc-Ext	yellow	Fashion Model (Lester)	D Day	melon
Brilliant Red (Claar)	D Ext	red	Fleeta (Claar)	D Day	red
Brittania (Claar)	D Day	red	Full Reward (McVickers-Murphy)	D Day	red
Buddy (Claar)	D Ext	rose-pink			
Buried Treasure (Moldovan)	D Day	yellow	Gary Bee (Helms)	D Ext	orange
Burning Daylight (Fischer)	D Day	orange blend	Golden Chimes (Fischer)	D Day	gold
Castilian (Fischer)	D Day	gold	Grand Champion (Lester)	D Day-Ext	yellow
Cloud Dancer (Hall)	D Day	pink			
Corky (Fischer)	D Day	yellow	Grand Parade (Buttrick)	D Ext	yellow
Crystal Magic (Rudolph)	D Day	pastel blend	Green Valley (Fischer)	D Noc-Ext	yellow
Curls (Kraus)	D Day	melon	Laurel Anne (Fischer)	D Day-Ext	pink
Dawn Supreme (Rudolph)	E Ext	yellow	Lexington (Claar)	D Day	yellow
Day Queen (Branch)	D Ext	yellow	Little Rainbow (Bro. Charles)	D	rainbow of colors

May Hall (Hall)	D Ext	rose blend
Missouri Beauty (Wild)	D Day	chartreuse
Multnomah (Kraus)	D Day	melon
Nashville (Claar)	D Day	banded yellow
Paradise Pink (Hall)	D Day	pink
Paris Gown (Reckamp)	D Day	pastel blend
Pink Lightning (Hall)	D Day	pink
Porcelain Doll (Lester)	D Ext	orange
Prairie Maid (Marsh)	D Day	pastel blend
Prairie Sunset (Wild)	D Day	pastel blend
President Rice (Claar)	D Day	gold
Queen of Hearts (Lester)	D Day	red
Red Siren (Claar)	D Day	red
Red Valor (Howe)	D Day	red
Retha Gay (Shamburger)	D Day	pastel blend
Ringlets (Kraus)	SE Day	yellow
Rondo (Fischer)	D Day-Ext	gold
Sail On (Claar)	D Ext	red
Satan (Claar)	D Ext	red
Serenata (Lester)	D Day	melon
Smiling Through (Fischer)	D Day	apricot
Superfine (Fay)	D Day	melon pink
Teenager (Peck)	D Day	melon
Tom Boy (Branch)	D Day	red

REGION B

Popularity Poll

Alan (Claar)	D Day	red
Cartwheels (Fay)	D Day	gold
Dorcas (Spalding)	E Day	melon pink
Fashion Model (Lester)	D Day	melon
Frances Fay (Fay)	D Day	melon pink
Full Reward (McVickers-Murphy)	D Day	yellow
Lexington (Claar)	D Day	yellow
Lime Painted Lady (Russell)	E Day	yellow
Luxury Lace (Spalding)	D Day	lavender pink
May Hall (Hall)	D Ext	rose blend
President Rice (Claar)	D Day	gold
Rare China (Hall)	D Day	rose
Satin Glass (Fay)	D Day	pastel melon

Experts' Recommendations

Most cultivars recommended for Region A and most dormant cultivars recommended for Region C will do well in northern parts of Region B. Most semi-evergreen cultivars recommended for Region C and some of the evergreen cultivars of Region D will be satisfactory in southern parts of Region B. These recommendations were made by Mrs. Richard Peck (Tenn.), Mrs. W. C. Sheets (N.C.) and several others.

Angie (Sholar)	D Day	pink
Annie Welch (Claar)	D Day-Ext	pink
Apple Blossom Time (Lake)	D Day	pink
April Breeze (Lester)	D Day	yellow
Ardent Pink (B. Taylor)	D Day	pink
Ava Michelle (Flory)	E Day	yellow
Baron (Sheets)	D Day	melon
Bess Ross (Claar)	D Day	red
Blonde Princess (Flory)	SE Day	banded tan
Blythe Spirit (Fischer)	D Noc-Ext	yellow
Burlesque (Lambert)	D Day	eyed yellow
Buttons (Armistead)	D Day	red
Carey Quinn (Hall)	D Day	red
Carita (Lester)	D Day	melon pink
Chantilly Lace (Childs)	D Ext	pink
Chetco (Kraus)	D Day	pastel blend
Clarence Simon (MacMillan)	SE Day	melon
Crestwood Ann (Fay-Griesbach)	D Day	melon pink
Cup of Sunshine (Flory)	SE Ext	orange
Curls (Kraus)	D Day	melon
Daisy McCarthy (Hall)	D Day	melon pink
Delectable (Childs)	D Day	melon pink
Doll Dance (Lake)	D Day	yellow
Erin Farmer (Childs)	D Day	pink
Ethel Lynn (Lake)	SE Day	pink
First Romance (Lester)	D Day	melon pink
Frankly Fabulous (Childs)	D Day	melon pink
Golden Triangle (Traub)	SE Day	gold
Goldensong (Kraus)	SE Day	yellow
Grecian Gift (Spalding)	D Day	pink
Green Rose (Spalding)	SE Noc	rose
Green Valley (Fischer)	D Noc-Ext	yellow
Holiday Tan (Hall)	D Day	pastel
Honey Bunny (Thomas)	SE Day	yellow
Hopewell (Kraus)	D Ext	orange pink
Hortensia (Branch)	D Noc-Ext	yellow
Hush Now (Russell)	D Day	melon pink
Irene Felix (Claar)	D Ext	yellow
Jake Russell (Russell)	D Day-Ext	gold
Janet (Claar)	D Day	yellow
Jubilee Pink (Spalding)	E Day	pink
June Rhapsody (Childs)	D Day	pink

Katherine Elsie Randall (Fay)	D Day	pastel
Late Linda (Hall-Lacey)	D Day	pink
Laurel Anne (Fischer)	D Day-Ext	pink
Lavender Flight (Spalding)	SE Day	lavender
Little Cherub (Claar)	D Day	yellow
Little Wart (Spalding)	D Day	lavender
Love That Pink (Hall)	D Ext	pink
Marianne Russell (Russell)	D Day	pink
Mary Lawrence (MacMillan)	D Day	pastel melon
McPick (Lenington)	E Day	melon
Meadowbrook Green (Gates)	D Day	yellow
Melon Balls (Wild)	D Day	melon
Michael Jon (Lacey)	SE Day	yellow
Mildred Umstead (Lambert)	SE Day	banded yellow
Missouri Miss (Wild)	D Day	pink
Miss Shreveport (Hyde)	D Day	pink
Multnomah (Kraus)	D Day	melon
Nashville (Claar)	D Day	banded yellow
Nob Hill (Hill)	D Ext	pink bitone
Orinda (Fischer)	D Day	banded yellow
Pink Reflection (Childs)	D Day	pink bitone
Prairie Sunset (Wild)	D Day	yellow blend
Prentice LeJay (Hyde)	D Day	pink
Pure Moonlight (Mederer)	SE Day	yellow
Puritan Maid (Spalding)	D Day	melon
Queen of Hearts (Lester)	D Day	red
Red Siren (Claar)	D Day	red
Ringlets (Kraus)	SE Day	yellow
Royal Fashion (Howell)	SE Day	purple bitone
Sail On (Claar)	D Ext	red
Sanders Walker (Wood)	D Day	coral pastel
Serenata (Lester)	D Day	melon
Shirley Wild (Bechtold)	D Day	yellow
Silver King (Lake)	D Day	yellow
Teenager (Peck)	D Day	melon
Tinker Bell (Stevens)	D Day	orange
Trafalgar (Lambert)	D Ext	red
Vagabond King (Hall)	SE Day	red
Veiled Beauty (Hall)	SE Day-Ext	pastel blend
War Eagle (Hall)	E Day-Ext	red tender
Way Out (Gates)	SE Day	yellow
White Empress (Harrison)	D Day	yellow
Yellow Rain (Schlumpf)	D Day	yellow

REGION C

Popularity Poll

Crestwood Ann (Fay-Griesbach)	D Day	melon
Curls (Kraus)	D Day	melon
Frances Fay (Fay)	D Day	melon
Luxury Lace (Spalding)	D Day	lavender
Satin Glass (Fay)	D Day	pastel melon

Experts' Recommendations

Most cultivars recommended for Region A and most dormant cultivars recommended for Region B will do well in the northern parts of Region C. Most semi-evergreen cultivars recommended for Region B and some of the evergreen cultivars of Region D will do well in southern parts of Region C. The experts for this region included Mrs. F. D. Armstrong (Nebraska), Miss Annie Giles (Texas), Mrs. Charles Hancock (Oklahoma), and others.

Astronaut Glen (Hughes)	D Day	yellow
Auria (Hall)	D Day	gold
Brass Cup (Wild)	D Ext	gold
Butterscotch (Sass)	D Day	butter-scotch
Capitol Dome (Sass)	D Day	yellow
Carey Quinn (Hall)	D Day	red
Cibola (Hill)	D Day	yellow
Dee Dee (Terry)	D Noc	yellow
Double Chetco (Kraus-Minks)	D Day	cream pastel
Elf Owl (Lacey)	D Day	yellow
Exalted Ruler (Hall)	D Day	coral-pink blend
Fleeta (Claar)	D Day	red
Full Reward (McVickers-Murphy)	D Day	yellow
Golden Ringlets (Kraus-Armstrong)	D Day	yellow
Green Envy (Lenington)	D Day	buff
Green Eyed Giant (Marx)	D Day	banded yellow
Green Flutter (Williamson)	SE Ext	yellow
Green Gables (Lake)	SE Day	yellow
Green Shadows (Sass)	D Day	yellow
Hush Now (Russell)	D Day	pink
Jake Russell (Russell)	D Day-Ext	gold
Kindly Light (Bechtold)	D Day	yellow spider

King's Grant (Childs)	D Ext	apricot
Lady Inara (Hall)	D Day	peach
Lady Lynn (Calhoun)	D Day	lavender
Lexington (Claar)	D Day	yellow
Lime Painted Lady (Russell)	E Day	yellow
Lona Eaton Miller (Kraus-Shilling)	D Day	yellow
Lucky Strike (Lenington)	D Day	pink
Lula Mae Purnell (Kraus-Shilling)	D Day	orange
Margaret Keran (Kraus-Armstrong)	D Day	pink
McPick (Lenington)	E Day	melon
Multnomah (Kraus)	D Day	melon
Oriel Rice (Kraus)	D Day	melon
Nashville (Claar)	D Day	banded yellow
New Love (Hall)	D Ext	pastel
Osage Delight (McKeithan)	SE D	banded yellow
Pagan Beauty (Moore)	D Day	melon
Paradise Pink (Hall)	D Day	pink
Pecos (McKeithan)	D Day	melon
Peggy Hall (McKeithan)	E Day	yellow
Petite Violette (King)	SE Day	lavender bitone
Pink Lightning (Hall)	D Day	rose
Prentice Lejay (Hyde)	D Day	pink
Prairie Charmer (Marsh)	D Day-Ext	banded pink
President Rice (Claar)	D Day	gold
Renee (Dill)	D Day	yellow
Robert Schlumpf (Hughes)	D Day	yellow
Rocky Ford (McKeithan)	D Ext	melon
Rose Motif (Lester)	D	rose
Royal Fashion (Howell)	SE Day	purple bitone
Sail On (Claar)	D Ext	red
Salmon Seersucker (Hava)	E Ext	pink blend
Satan (Claar)	D Ext	red
Sea Gold (Hall)	D Ext	peach blend
Siloam Springs (Henry)	D Ext	yellow
Skiatook Cardinal (Hancock)	D Day	red
Sonya Marie (Schoonover)	D Day	red
Sooner Girl (Sawyers)	D Ext	yellow
Southern Pride (Alexander)	SE Day	yellow
Step Forward (Hall)	D Day	pink
Superfine (Fay)	D Day	pink
Tiny Miss (Lenington)	SE Day	gold
'Tis Midnight (Russell)	D Day	black purple
Tony Willie (Claar)	D Day	yellow
Vada Parker (Kraus-Armstrong)	D Day	red
Yellow Rain (Schlumpf)	D Day	yellow

REGION D

Popularity Poll

Antebellum (Munson)	E Day	yellow
Angel Robes (B. Taylor)	E Day	yellow
Celebration (Munson)	E Day	cream
Grand Canyon (Farris)	E Day Ext.	peach blend
Lime Painted Lady (Russell)	E Day	yellow
Quincy (B. Taylor)	E Day	banded pastel

Experts' Recommendations

Note that only evergreen cultivars have been included in the lists for Region D. However, most of the semi-evergreen cultivars recommended for Regions B and C will do well in the colder parts of Region D. Recommendations came from E. W. Brown III (Texas), Mrs. Deas' E. Sossaman (Ala.), Mrs. Theodore Weber (Texas), and others.

Aldebaron (B. Taylor)	Day	red
Arachne (Schroer)	Day	gold spider
Arla (Wheeler)	Day	yellow
Astronaut Glen (Hughes)	Day	yellow
Autauga (Farris)	Day	yellow
Autumn Gold (Sutton)	Day	yellow
Babette (Hayward)	Day	yellow
Bessie McArthur (Sutton-McFarland)	Day	red
Betty Hammer (B. Taylor)	Day	red
Big Mamou (Sholar)	Day	brown blend
Brass Buttons (Landis)	Day	yellow
Bridal Wreath (B. Taylor)	Day	banded cream
Bright Dancer (Spalding)	Day	red
Captain Reid (Traub)	Day	red
Cathy Jane Frink (Fay-Simon)	Day	melon blend
Chateaugay (B. Taylor)	Day-Ext	orange
Clarence Simon (MacMillan)	Day	melon
Cosette (Milliken)	Day	yellow blend

Dazzling Eye (Spalding)	Day	banded yellow
Dorfay (Williamson)	Day	melon
Double Decker (Thomas)	Day	double yellow
Dream Mist (Munson)	Day	cream & salmon bicolor
Dreamy (Wheeler)	Day	banded yellow
Easter Anthem (Landis)	Day	cream & purple bicolor
Edgar Brown (MacMillan)	Day	cream
Ethel Smith (MacMillan)	Day	pink
Exotic Gold (Hughes)	Day	gold
Fairy Wand (Connell)	Day	melon
Florence (B. Taylor)	Day	pink
Florentine (Munson)	Day	banded pastel
Gathering Storm (Fleishel)	Day	black-red
Gay Genell (Hughes)	Day	pink
Gene Wild (Lester)	Day	peach
Golden Dewdrop (B. Taylor)	Day Ext	orange
Golden Pinafore (Corliss)	Day	gold
Golden Showpiece (Pittard)	Day	gold
Heavenly Promise (Terry)	Ext	yellow
Heaven Sent (Fretwell-Sewell)	Day	purple
Hilda Babin (Howell)	Day	yellow
Hooper Connell (Farris)	Day	yellow
Jade Crest (Armistead)	Day	yellow
Lady Daphne (Howell)	Day	pink
Laughing Clown (Alexander)	Day	red novelty
Lemon Peel (Sutton)	Day	yellow
Little Mermaid (Sutton)	Day	gold
Llewellyn Love (Sutton-Avis)	Day	melon pink
Louise Simon (MacMillan)	Day	gold
Luann (Williamson)	Day	red
Mac The Knife (McMillan-Wheeler)	Day	cream & pink bicolor
Magic Carpet (Munson)	Day	red
Margaret Cornelius (Wheeler)	Ext	yellow
Marse Connell (Connell)	Day	red
Melon Cup (Simon-Williamson)	Day	melon
Mentone (Connell)	Day	pastel blend
Miss Ozie (Smith)	Day	cream blend
Mobile Melody (Lake)	Day	yellow
Morning Treat (Wheeler)	Day	cream
Myra Hinson (Whitten)	Day-Ext	yellow
Nantahala (B. Taylor)	Day	banded yellow
Night Life (Register)	Noc	yellow
Nobility (Childs)	Day	yellow
Pappy Gates (Gates)	Day	gold
Peacock Alley (Wynne)	Day	banded purple
Penny Peckenpaugh (Ridenour)	Day	yellow
Pickfair (Munson)	Day	orchid-purple
Picolata (Sutton)	Ext	yellow
Pink Fluff (Spalding)	Day	pink
Playboy (Wheeler)	Day	gold
President Giles (MacMillan)	Day	yellow
Prima Donna (B. Taylor)	Day	pastel blend
Purple Splendor (Pittard)	Day	purple
Quilted Gold (Sutton-McFarland)	Day	gold
Quincy (B. Taylor)	Day	banded cream
Raspberry Frills (Williamson)	Day	red
Raspberry Rapture (Williamson)	Day	red
Rinda (B. Taylor)	Day	banded cream
Rose Christian (Silver)	Day	yellow
Rosie Myer (Alexander)	Day	red
Rosy Wren (Trahan-Simon)	Day	rose & cream bicolor
Royal Mantle (Land)	Day	black-red spider
Sally Landis (B. Taylor)	Ext	pastel blend
Salmon Sheen (B. Taylor)	Day	salmon blend
Satin Flame (Corliss)	Day	red
Show Piece (Munson)	Day	pink blend
Sideshow (Russell)	Ext	yellow
Sweetheart Supreme (Wheeler)	Day	yellow
Tetra Soudan (Buck)	Day	yellow
Tiny Tex (Hava)	Ext	gold
Tiddlywinks (Thomas)	Day	banded beige
Twenty Third Psalm (MacMillan)	Day	pink
Velvet Fringe (Fleishel)	Day	magenta
Whitfield Palmer (B. Taylor)	Day	yellow
Wideyed (Craig)	Day	banded yellow
Widget (Landis)	Day	banded buff
Yazoo Delta (Smith)	Day	orange yellow
Yellow Mantle (Wheeler)		

APPENDIX 5a
Long-lived Daylily Bluebloods

W. A. KING

Inexperienced persons undertaking daylily growing for the first time might reasonably like to know which ones have withstood the test of time for outstanding beauty and performance. A number of the "All-time Greats" in this category that excell in beauty and continue to flower increasingly well for 10 to 15 years without dividing are listed below. Many of the newer cultivars produce their best flowers the first or second year and must be divided every third year to maintain prime flowers. This is a chore.

The following list of 16 All-time Greats, while still well worth growing, may be difficult to locate in nurseries. Most hobbyists will have discarded many of them a long time ago.

'Ava Michelle' (W. Flory 1960). A recurved rich gold with a green throat. This beautiful plant flowers over a long period when well-established.

'Beau Brummel' (Nesmith 1955). Flowers vermilion (red-hot pepper color), a most unusual color in a daylily. Late blooming and more beautiful with the years. A collector's item.

'Cartwheels' (Fay 1956). A beautiful gold which opens wide and flat. Another great one from Mr. Fay. Each year it is more beautiful in an established clump.

'Congo Magic' (Hall 1959). A large flat dark red. One of Mr. Hall's greats and extremely beautiful when well grown, particularly if grown in light shade. Prefers to be left alone and not divided.

'Dauntless' (Stout 1935). A pastel buff blend and fragrant. It has won many honors; its claim to fame is that it was the first really good wide-petaled daylily.

'Emily Brown' (Russell 1949). The only real true orange on the market. The color runs deep into the throat and penetrates the undersides of the perianth-segments. Very leathery perianth-segments and flowers withstand the rain.

'Fiftieth Anniversary' (Stout 1946). A striking daylily and, despite its age, continues to be a collector's item, although many people cannot accept the bronze and dark red over orange color. There is a darker marking of oxblood red just above the greenish orange throat. Of good substance with strong and well branched scapes and an abundance of buds. This, like other daylilies of Dr. Stout, is remarkable for the period in which he worked, when little else was available for breeding other than the species found in nature. This cultivar is still tops by today's standards.

'Frances Fay' (Fay 1957). A light melon-pink pastel with a tiny green throat. A daylily of great beauty and distinction. The parent of more modern daylilies than any other cultivar ever produced.

'Golden Galeon' (Milliken 1954). As the name implies this is a beautiful gold. This daylily lost popularity because it failed to perform to maximum capacity after three years. However, some growers "let it be" and found that 15-year-old clumps are more beautiful than ever and will be even better next year.

'Golden Triangle' (USDA-Traub 1949). A large triangular-shaped flower of heavy substance; buttercup-yellow self a little lighter on the edges. Fragrant.

'Jack Frost' (Lester 1953). So cool and pale it looks like lemon ice and when grown in dappled shade it has no equal. The recurved inner perianth-segments give it a beautiful triangular form. Plants should not be disturbed.

'Jake Russell' (Russell 1956). Flowers wide-spreading, round, gold with a greenish overcast and beautiful to behold in an established clump. Mr. Russell produced many fine daylilies in his day, but this one was and still is one of his best.

'Lemon Balm' (Wynne 1954). A beautiful small well-shaped sulphur-yellow flower. It probably has the best branching of any daylily on the market. My clump is 10 years old and I look forward to its beauty each year.

'Lochinvar' (Taylor 1947). Brilliant scarlet flowers with a prominent cream midrib. When established it becomes a show clump and stays that way for years.

'Marse Connell' (Connell 1952). A good looking, stylish, star-shaped red enhanced by the large yellow throat which extends far out into the perianth-segments. To divide under ten years is to miss the enchanting bloom of this garden jewel.

'Shooting Star' (Hall 1951). A gorgeous light yellow in an established clump. This old favorite will be grown for many years by those who know and appreciate good daylilies, because of the profusion of flowering scapes and quantity of flowers produced on well-established plants.

APPENDIX 6

Terminology for Daylilies

MRS. OLIVE M. HINDMAN

ANTHER. (See stamen)

BANDED. (See eyed)

BICOLOR. Flowers with yellow outer segments and inner segments of another color, e.g., red, pink, etc. Examples: 'Caballero', 'Howdy', 'Gay Lark'. REVERSE BICOLOR. Flowers with yellow inner segments and outer segments of another color. Examples: 'Dream Mist', 'Fifth Avenue'.

BITONE. Flower with inner and outer segments in distinctly different hues of the same basic color.

BLEND. Flowers with an intermingling of two colors, as a green or gold throat shading into the body of the flower. Examples: 'Fairy Wings', 'Missouri Miss'.

BOSTRYX. The inflorescence of daylily with a branch system in which the right- or left-hand branch is always the most vigorous.

BRACT. A single leaf on the scape from the axil of which a flower or floral branch arises.

CHIMERA. Tissues of different genetic composition in the same part of the plant. In the daylily, yellow or white streaks in leaf and flower, and red flowers or parts of flowers in a yellow-flowered plant and induced tetraploids are the most common chimeras.

CHROMOSOME. One of a definite number of minute bodies in the cell nucleus of all plants and animals through which characteristics are inherited. Cells of daylily contain 22 chromosomes.

CLONE. (See cultivar) A genetically uniform assemblage of individuals, derived originally from a single individual by vegetative propagation, e.g., in daylilies by natural division of ramets, root proliferations, and artificial division.

COMPLETE SELF. (See self)

CONTINUOUS BLOOM. (See reblooming)

CROSS-POLLINATION. Daylilies may be cross-pollinated by placing the pollen from the anthers of one cultivar on the stigmas of another. During the short life of the flower the pollen-tube must travel down the style into the ovary which contains the ovules or egg cells.

CULTIVAR. (See variety) Denotes an assemblage of cultivated individuals which, when reproduced sexually or asexually retains its distinguishing features. Daylily cultivars are propagated vegetatively and retain their identity as clones. Cultivars of some other plants are seed reproduced.

DECIDUOUS. (See dormant)

DIPLOID. A plant having the basic chromosome number of the species (in daylily 22 chromosomes) in each cell which is twice the number in the sex cells, e.g., the pollen and egg cells.

DISSEMINATED. As applied to *Hemerocallis*, the term simply means that divisions or proliferations of a particular plant (clone) have been distributed, and are being grown in gardens other than the one in which it originated. UNDISSEMINATED refers to a plant whose divisions and proliferations are found in one garden, and have not yet been distributed.

DIURNAL. A daylily flower which opens in early morning or during the day.

DIVISION. (See fan)

DORMANT, DECIDUOUS. A plant that stops all vegetative growth and loses its leaves during the fall and winter months. A dormant or deciduous *Hemerocallis* loses its leaves in Florida or any frost-free climate as well as in the north.

DOUBLE. Flowers with extra segments, e.g., more than the usual six, are called double, as in *H. fulva* 'Kwanso'. Many varieties produce an occasional flower with eight or more segments, but unless most of them are double, plants may not be classed as double-flowered cultivars.

DWARF. Scapes up to 24 in. tall are classed as dwarf and may bear miniature, small or larger flowers.

EVERGREEN. Leaves remain green throughout the year, unless frozen severely. Daylilies are not truly "evergreen" where winters are cold enough to freeze the leaves repeatedly.

EXTENDED FLOWERING. Flowers that remain open 16 hours or more.

EYED, BANDED, HALO. Flowers with distinct color markings slightly above the throat are referred to as *eyed* or *banded*. Markings less distinct may be referred to as *halo*. Examples: (eyed) 'Nashville', 'Green-eyed Giant'; (halo) 'Bridal Wreath'.

FAN, DIVISION, RAMET. Terms refer to individual units of a clump, each portion of which is identical with the parent plant.

FILAMENT. (See stamen)

FULVOUS. Dull yellow, tawny. Color found in many daylilies, typified by *H. fulva*.

HALO. (See eyed)

INTRODUCED. A daylily has been introduced when offered for sale in a dated, printed or otherwise mechanically duplicated list or catalogue with price. Some awards are based on dates of introduction.

MIDRIB. Runs lengthwise as the principal nerve of a leaf or perianth-segment; it may be very prominent or indistinct.

MINIATURE. Daylilies with flowers less than three inches in diameter are classified as miniatures. They may be on dwarf, mediun or tall scapes.

NOCTURNAL. A flower which opens during the night. Depending on the cultivar and how early it opens in the evening, it may remain open most or all of the following day. Some cultivars which disintegrate in the early afternoon are in reality nocturnal blooming types simply closing after a full night and day cycle.

OVARY. (See pistil)

OVERLAY. (Washed, dusted). Used in two ways, to describe *texture* for "a flower with a velvet-like overlay," or in reference to *color* for "a flower with an overlay (or wash) of red over the basic color." Examples: 'Garnet Robe' (velvety) and 'Evenglow' (color wash).

PERIANTH. The daylily flower consists of a funnel-shaped perianth-tube and limb with six colored perianth-segments in two rows—the outer ("sepals") and inner ("petals").

PERIANTH-TUBE. (See perianth)

PERIANTH-SEGMENTS. A normal daylily flower has six perianth-segments arranged in two rows—the three inner ("petals") and three outer ("sepals"). Another term, *tepal* (s), may be used to designate the undifferentiated perianth-segments of daylily which are similarly colored (unlike the differentiated sepals and petals of strawberry, blackberry and some other plants).

PETAL. (See perianth-segments)

PISTIL. The female reproductive organ of the flower, consists of *ovary* (where seeds develop), *style* (channel for pollen tube), and *stigma* (to receive the pollen).

POLLEN. (See stamen)

POLYCHROME. Flowers blending and intermingling many colors. Examples: 'Prima Donna', 'Painted Lady', 'Prairie Sunset'.

POLYPLOID. A plant having three or more sets of chromosomes in each cell. In the daylily, triploids have 33 and tetraploids have 44 chromosomes in each cell.

PROLIFERATION. A leafy shoot from a node found on scapes of many cultivars. Proliferations may be rooted to form a plant (clone) identical to the mother plant. Small roots often form and occasionally a flower is produced while the proliferation is still on the scape.

RAMET. (See fan)

REBLOOMING, REMONTANT. The tendency of cultivars to have more than one cycle of flowering during a season. CONTINUOUS BLOOM. New scapes rising before the previous ones have finished flowering or shortly thereafter, to give continuous flowering through the season. This is more common in mild climates with a long growing season.

REGISTERED. A cultivar (clone) has been registered when a brief description, and the name of originator (and introducer if introduced) have been registered and approved by the Registrar of The American Hemerocallis Society, the internationally recognized authority for this procedure. Only one clone may be registered under a given name.

REMONTANT. (See rebloom)

REVERSE BICOLOR. (See bicolor)

RHIZOMES. Underground stems connecting the fan or ramet to the mother fan, with elongated joints and leaf rudiments as in *H. fulva* 'Europa'; usually very short in most daylilies.

ROOTS. Daylily roots are fibrous or cord-like and often with conspicuous spindle-like thickenings, as in *H. fulva.*

SCAPE. The scape or flowering stalk of daylily is naked in the lower portion, and branched above with flowers, fruit, and seeds. Bracts occur at each node in upper portion.

SEEDLING. In daylily, used in reference to unnamed and unintroduced plants.

SELECTION. An unnamed, unregistered seedling, but numbered and perhaps propagated.

SELF. Flowers with perianth-segments of the same color, although the throat may be yellow, gold, orange or green. Examples: 'Frances Fay', 'Queen of Hearts'.

COMPLETE SELF. Flowers with perianth-segments, throat, pistil, and stamens all the same color. Examples: 'Cartwheels', 'Bride'.

SELFING. Placing the pollen of one flower on the stigma of the same flower or another flower of the same cultivar.

SEPALS. (See perianth-segments)

SMALL. Daylilies classified as small measure three to four and one-half inches across.

STAMENS. The six stamens, each with a filament or stalk, are attached to the perianth-tube, at the base of a perianth-segment. The 2-lobed anthers are full of dust-like grains, the *pollen,* which carries the male sex element of the plant. (each pollen grain has the haploid chromosome number, n = 11, or half the diploid number.)

STIGMA. (See pistil)

STYLE. (See pistil)

TEPAL. Collectively the inner and outer perianth-segments. Used to designate similarly colored and undifferentiated segments (sepals and petals) found in many liliaceous plants, e.g., tulips, hyacinths, daffodils, daylily, and others.

TETRAPLOID. A plant with four sets of chromosomes in each cell (in a daylily 44) which is twice the number in the sex cells (pollen and egg).

UNDISSEMINATED. (See disseminated)

VARIETY. (See cultivar) Reserved for wild plants. The term cultivar, now in general use for horticultural plants, is preferred for clones, such as daylily.

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AMERICAN HEMEROCALLIS SOCIETY

Mrs. Lewis B. Wheeler, Jr., Secretary
P. O. Box 28786, Memphis, Tennessee 38128

Facts About The Society

The American Hemerocallis Society was organized in 1946 at Shenandoah, Iowa as a Mid-West group but developed immediately into a national organization. The present name was adopted in 1955.

During the twenty-two years of its existence, the Society has grown from 472 members to more than 4,000 members at present.

The purpose of the Society is to promote, encourage, and foster the development and improvement of the *genus Hemerocallis*, and public interest therein, by all suitable and appropriate means.

THE HEMEROCALLIS JOURNAL, a quarterly, contains the latest information on plant culture, propagation and hybridizing, scientific articles, the 100 favorite varieties, the annual list of award-winning daylilies, commercial growers' advertisements and color illustrations.

Membership Privileges

- THE HEMEROCALLIS JOURNAL
- REGISTRATION of new cultivars
- BEGINNERS' BULLETIN
- REGIONAL NEWSLETTERS
- Loan Library of materials on the daylily
- Kodachrome Slides of new cultivars
- Round Robins of information
- Garden Visiting with A.H.S. members
- Shows, local and regional, with privilege of exhibiting and competing for American Hemerocallis Society awards
- National Convention of A.H.S. as well as Regional Meetings
- Judges Clinics
- Youth Memberships

Persons interested in purchasing additional copies of the DAYLILY HANDBOOK (paperback $4.00 plus 40¢ for postage and handling) may order them from Wilmer B. Flory, 1533 Meadlawn Avenue, Logansport, Indiana 46947.

Annual Membership Dues

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Persons interested in membership may mail checks to the secretary (see above).

AMERICAN HORTICULTURAL SOCIETY

Mrs. Elizabeth Eastburn, Executive Director
2401 Calvert Street N. W., Washington, D. C. 20008

Facts About The Society

The American Horticultural Society was founded in 1922. In the forty-six years since, several groups devoted to similar interests have merged with it. The latest of these is the American Horticultural Council which united with the Society in 1960.

The Society sponsors the interests of all American horticulture, the only national organization to do so. It is a non-profit association which provides a broad and varied program of services for some 4,500 Ameircan gardeners—novice and professional—and for some 140 local, state and national organizations in the field of horticulture.

Its purpose is to encourage and promote horticulture in all its branches. Scores of horticultural experts and everyday gardeners give their knowledge and experience, their time and talent to the Society's work without compensation.

Membership Privileges

- AMERICAN HORTICULTURAL MAGAZINE, a quarterly
- GARDENER'S FORUM, a quarterly
- SEED SERVICE, members' annual exchange of free seeds of some 250 ornamental trees, shrubs, vines and herbs.
- LIBRARY SERVICE, books by mail
- INFORMATION SERVICE
- BOOK BUYERS' SERVICE
- SPEAKER SERVICE
- ORGANIZATION SERVICE, cooperation with organization members in areas of mutual interest
- RECOGNITION SERVICE, encouragement for high standards of attainment in horticulture through awards, citations, certificates of merit, silver and bronze medals and the Liberty Hyde Bailey Medal
- CONFERENCE SERVICE, the annual American Horticultural Congress

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Green Valley