

THE NATIONAL

Horticultural

MAGAZINE



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COVER ILLUSTRATION: *Fruits of Fall*

Original painting by Erik Hans Krause

The National Horticultural Magazine

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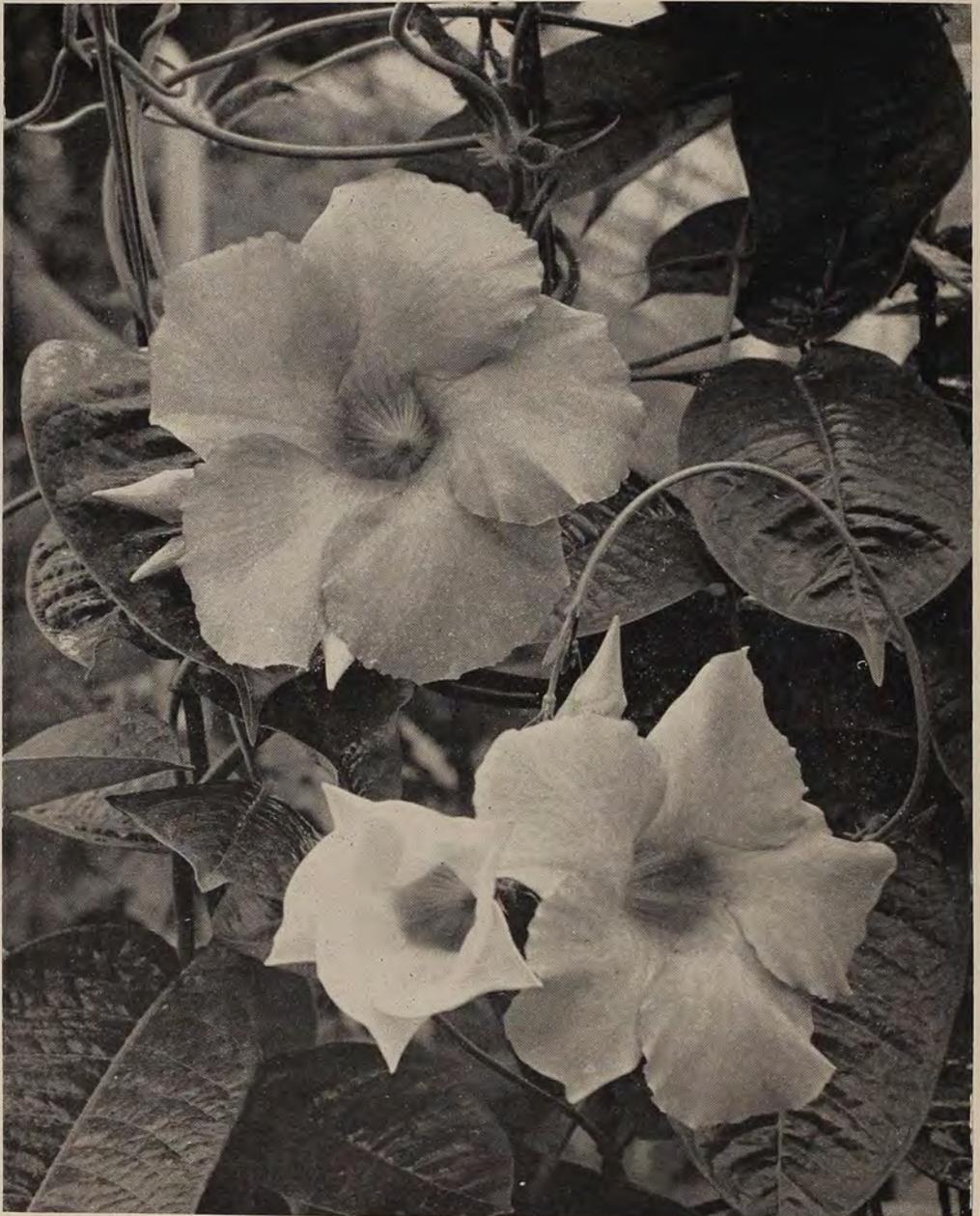
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Gottlieb Hampler

Longwood Gardens

The flowers of *Mandevilla splendens*—an 1841 introduction from the Organ Mountains of Brazil. See Page 359.

Plantainlilies

FREDERIC P. LEE

Plantainlilies or hostas are controversial plants. You like them or you despise them — no tolerant, dispassionate views are heard. They are not gaudy in flower like a dahlia or marigold. Neither are hostas shy and unobtrusive. Their habit and leaves are flaunty. Leaf size and design and cool color variations in shades of green, and green and white, make hostas conspicuous, even a bit ostentatious. You cannot ignore a large-leaf hosta whether in or out of flower.

One gardener on viewing the Siebold Plantainlily (*Hosta glauca*) will have painfully obtuse thoughts of an immense cabbage before it has headed up; another that the plant is interestingly unique, nothing quite like it in either nature or art. Such unimaginative horticulturists would, however, be left dazed by herbaceous perennials like the moisture-loving Gunneras (*Gunnera manicata* and *G. chilensis*), natives of Chile and Brazil, with hugh rhubarb-like leaves four to six feet across on stalks up to six and eight feet. Many hostas have unusually large leaf blades, two of them over a square foot in area, but hostas are far from one of the giant leaf herbaceous perennials of the plant world. Thus that majestic lily, *Cardiocrinum giganteum*, is a temperate zone plant like the hostas, but its leaves are fifteen by eighteen inches, larger than those of the largest hosta. On the other hand, most hostas are far from pygmies. The Siebold Plantainlily and the Giant Plantainlily (*H. fortunei* var. *gigantea*) would provide a garland suitable in past millenniums for adorning the brow of a mastodon.

Characteristics and Uses

Hostas have several characteristics that are both uncommon and valuable for the home gardener.

As has already been vaguely hinted, the foliage of large hostas creates a striking impression. Fancy-leaf caladiums, cannas, elephant ears, and pelargoniums are likewise familiar plants with striking foliage in size, design, or color, but they are all tender tropical or subtropical plants. The hostas are temperate-zone plants that are hardy and permanent even in our most northern states. There is no winter killing.

Hostas are excellent for accents, for large or small edgings and boundary lines, or for facing down shrubs. Their effect is heavy, not airy. Despite the ponderous and unusual appearance of the large hostas, their dense masses of foliage fit into naturalistic gardens even better than into formal gardens. Hostas can be used in woodlands and in shrub borders.

While the exceptional character of their leaves makes hostas primarily foliage rather than flowering plants, nevertheless, their flowers are good. Those of the Fragrant Plantainlily (*H. plantaginea*) are excellent. Hostas are one of the very few hardy herbaceous perennials having conspicuous blooms in summer shade.

Hostas are long-lived perennials. Edgings of the Wavyleaf Plantainlily (*H. undulata*) planted in great-grandmother's day still endure. Undisturbed hosta plants a quarter century old are common. Being an herbaceous perennial, the soft, succulent stems and leaves die down while the crown and roots remain alive and produce new stems and leaves in the spring. In the Washington, D.C., area hostas are effective plants from early May to October; the leaves appear in late spring and die with the first heavy frost.

Hostas do better in the shade than in the sun. They are one of the few shade loving, rather than merely shade tolerat-

ing garden perennials. They will stand not only high shade of deciduous trees but also somewhat denser types of shade, such as those to which many ferns and lilies-of-the-valley are adapted. Hostas light up dark places.

The perennial roots are thick, somewhat tuberous, and durable like heavy cord. They form a dense clump. The Fragrant and the Blue Plantainlilies (*H. plantaginea* and *H. ventricosa*) are exceptions. Their roots are rhizomes, a shallow, knobby, branching rootstock, from which the leaf stalks rise and the roots grow down. See Plate 3. The roots of hostas do not require regular division for maintenance but propagate readily by division in the fall or early spring before the leaves unfurl.

A hosta may take two or three years to become well established but after that it increases rapidly. In five to ten years some of the larger hostas will make a clump of leaves four to six feet wide. If given room hostas will gradually increase the size of their clumps for many years.

The Generic Name

Confusion galore has prevailed among botanists as to the proper generic name for the plantainlilies.

The plantainlilies belong to the lily family (LILIACEAE). Among the 200 or so genera in that family the genus most closely related to the plantainlilies is *Hemerocallis* (the daylilies). Incidentally, the plantainlilies are not kin of the Common Plantain (*Plantago major*) that has distinguished itself as a lawn and garden weed. The Common Plantain belongs to a wholly different group, the plantain family (PLANTAGINACEAE).

Engelbert Kaempfer, a German physician, on a trip to Japan about 1690 saw the plants we now call *H. lancifolia* and *H. glauca*. Karl Peter Thunberg made a trip to Japan in the 1770's following his appointment as surgeon on a ship of the Dutch East India Company. He described the plant we now know as *H. lancifolia*, the Narrow-Leaved Plantainlily, under three different names,—first

in 1780 as *Aletris japonica*, in 1784 as *Hemerocallis japonica*, and in 1794 as *Hemerocallis lancifolia*. *Aletris* is the name now used for stargrass and *hemerocallis* for the daylilies. The plantainlilies thus started out their nomenclatural career as stargrasses and daylilies.

In 1812 the name *Hosta* was proposed by L. Trattinick while in the same year R. A. Salisbury placed two of the species, *H. plantaginea* and *H. ventricosa*, into two new genera, *Niobe* and *Bryocles*, respectively. Then in 1817 Sprengel gave the name *Funkia* (syns. *Funckia* and *Funkea*) to the plants and it prevailed for many years. Until rather recently the plantainlilies have usually been found in the nursery catalogs under the name *Funkia*. Today, *Hosta* (hos-tah or hoh-stah) has become the accepted name for the genus. Nicolaus Thomas Host (1761-1834), from whom the name is derived, was a botanist and physician to an Austrian emperor.

The Species Names

When it comes to breaking down the genus *Hosta* into species the difficulties increase. Hostas as known today in the Western World are composed of plants found in the wild, mainly in Japan; plants introduced into Europe from gardens in China and Japan over a century ago but not known in the wild; and plants, mutants or hybrids, developed in Europe from these introductions but not known in the Orient in either gardens or the wild; also one recent American hybrid. The Fragrant Plantainlily (*H. plantaginea*) was introduced into France from Chinese gardens the latter part of the eighteenth century, and the Blue Plantainlily (*H. ventricosa*) into England a little later in the same century. From 1830 on numerous hostas were brought into Holland from Japanese gardens by Siebold's nursery at Leiden. The plants in this country have come mainly from these European introductions. Doubtless many species or garden forms in Japan still remain to be introduced—a suggestion for the Plant Introduction Section of our Department of Agriculture.

The obscure origin of most of these various plantainlilies makes them a botanist's nightmare. Taxonomic botanists differ widely in their views as to the plants that fall within a particular species of *Hosta*. Few genera are so baffling. Not only are many of the alleged species garden forms but some are probably hybrids. Charles Hervey Grey of England, in his *Hardy Bulbs*, in 1938, lists around thirty species. This is indicative of the large amount of material remaining to be introduced from Japan for Grey based his list on the works of the Japanese botanists Takenoshi Nakai, Gen'ichu Koidzumi, and Fumis Maekawa. In 1940 Maekawa listed thirty-nine species based almost wholly on Japanese native and cultivated plants, and in 1953 Jisaburo Ohwi, another Japanese botanist, considered that the native Japanese plantainlilies consisted of thirty-five species.

Liberty Hyde Bailey, in *Gentes Herbarium*, 1930, listed seven and made brief mention of five more "not known to be in cultivation in North America," and W. T. Stearn, of England, in *The Gardeners' Chronicle*, 1931, starting with Bailey's account, winds up with seven species. Edgar T. Wherry, of the University of Pennsylvania, lists ten in his key in *The National Horticultural Magazine*, 1946. Recently, Nils Hylander, of Sweden, in *Acti Horti Bergiani*, published in 1954, recognized thirteen species mainly on the basis of plants in gardens in Sweden, a country holding hostas in high esteem.

The Flowers

The flowers of hostas are distributed on scapes, that is, leafless flower stalks. The flower scapes arise from the crown formed by the leaf stalks as they emerge from the roots, and extend above the mound of leaves. While the scapes do not have true leaves branching from them, they may have scales or bracts. These are reduced, vestigial, leaf-like structures. Along the top portion of the scape are the flowers, usually well spaced but occasionally, as in the Siebold Plantainlily (*H. glauca*) and the Fragrant Plantainlily (*H. plantaginea*), tending to be bunched into a terminal cluster. The flow-

ers rest on short pedicels. The pedicel is usually surrounded by a prominent leaf-like bract and occasionally, as in the Fragrant Plantainlily, with a small second bract inside. The flowering portion of the scape constitutes a raceme. These bracts around the flower pedicels (not those on the scapes) wither rapidly and also occasionally in their early stages will have the same color as the flower.

The flowers of hostas range from four to six inches long for the Fragrant Plantainlily to the more usual one and a half to two inches in length for most other species. There is no clear distinction between the three sepals (calyx) and the three petals (corolla) and consequently these in combination constitute a perianth of six similar-appearing lobes. The lobes are joined or fused part way up from the base into a tube and then separate and flare into six limbs. The flowers are usually funnel shaped and bell-like, but the Fragrant Plantainlily has long tubular flowers while the Blue Plantainlily and the Blunt Plantainlily have urn-(cup) shape flowers. See Plate 1.

The perianth is dark or pale violet or white, although some, as the Blue Plantainlily (*H. ventricosa*) and the Blunt Plantainlily (*H. decorata*), may be white penciled (streaked or striped) with violet on the inside.

The ovary of the flower with its three cells, surmounted by its single style terminating in the stigma, rests in the center at the base of the perianth. Ovary, style, and stigma constitute the pistil. Each of the six stamens is composed of a filament topped by a pollen-bearing anther. The anthers are attached crosswise on the apex of the filaments and are capable of turning. See Plate 2. The stamens arise under the ovary or are attached to sides of the flower tube. The single pistil is longer than the stamens and both are longer than the lobes of the perianth. Usually both pistil and stamens are reflexed so that the stigma and anthers face down and do not protrude beyond the perianth, at least until stigma and anthers straighten out somewhat as the flower wilts and closes.

The species differ as to the number of flowers in a raceme. The maximum number for some of the species and varieties is approximately as follows:

<i>H. decorata</i>	28
<i>H. fortunei</i> var. <i>gigantea</i> ,	40
<i>H. fortunei</i> var. <i>marginato-alba</i>	36
<i>H. glauca</i>	24
<i>H.</i> 'Honeybells'	60
<i>H. lancifolia</i>	15
<i>H. lancifolia</i> var. <i>tardiflora</i>	24
<i>H. minor</i>	8
<i>H. plantaginea</i>	26
<i>H. undulata</i> var. <i>univittata</i>	20
<i>H. undulata</i> var. <i>erromena</i>	30
<i>H. ventricosa</i>	28

The flowers open successively starting from the bottom of the raceme. One or several of the flowers in a raceme, but not all, may be open at a time. On some days none may be open. Flowers of most species open in the morning and close in the evening. The Fragrant Plantainlily (*H. plantaginea*) opens, however, early in the evening and remains open until early the evening of the next day. 'Honeybells,' a hybrid, *H. plantaginea* × *H. lancifolia*, takes an intermediate position. Its flowers open in the morning and remain open until the following morning. Hot, dry weather may expedite closing.

Hostas may be found in bloom from late June through September and into October. Blooming periods in the Washington, D.C., area are:

Late June or early July:

- H. fortunei* var. *gigantea*
- H. fortunei* var. *marginato-alba*
- H. glauca* (about the earliest)
- H. undulata*
- H. undulata* var. *univittata*
- H. undulata* var. *erromena*
- H. ventricosa*

July:

- H. fortunei* var. *viridis-marginata*
- H. lancifolia* var. *fortis*

August:

- H. decorata*
- H. minor*
- H. plantaginea*
- H.* 'Honeybells'

Late August and early September:

- H. lancifolia*
- H. lancifolia* var. *albo-marginata*

September and early October:

- H. lancifolia* var. *tardiflora*

The flowers of the Fragrant Plantainlily are strongly and pleasantly scented. So is its hybrid, *H.* 'Honeybells.' The scent is even more noticeable at night. Flowers of the other species are without fragrance or only slightly fragrant.

The Leaves

Hosta leaf blades range in size from a maximum of twelve by eight inches for the Fragrant Plantainlily (*H. plantaginea*), fourteen by ten inches for the Giant Plantainlily (*H. fortunei* var. *gigantea*), and fifteen by twelve inches for Siebold Plantainlily (*H. glauca*), to seven by three inches for Narrow-leaved Plantainlily (*H. lancifolia*) and five inches by an inch and a half for the Dwarf Plantainlily (*H. minor*). The leaf blades are more or less heart-shape at the base. Some are broadly heart-shape, others narrow and lanceolate. Most have pointed tips. Leaves have conspicuous curving nerves or side ribs running from either side of the midrib. See Plate 4.

The leaves of hostas vary in color from bright greens and dull greens, to bluish greens. Some have a gray, waxy covering (bloom) on the top or bottom side, or both, of the leaf blade. Such leaves are glaucous like the skin of some plums from which the glaucescence or bloom can be rubbed off. The Siebold Plantainlily is the conspicuous example of a hosta with glaucescent leaf blades.

Some hostas, as the Wavyleaf Plantainlily (*H. undulata*), and its variety *univittata*, have white, irregular stripes down the middle of the leaf blade and

down the greater part of the petiole. Other hostas have white edging to the leaf blade. Thus *H. fortunei* var. *marginato-alba* has an irregular white margin. The Whiterim Plantainlily (*H. lancifolia* var. *albo-marginata*) and the Blunt Plantainlily (*H. decorata*) each have a narrow, white band around the margin of the leaf blade, extending down the edges of the petiole. See Plate 5. The Greenrim Plantainlily (*H. fortunei* var. *viridis-marginata*) has yellowish green leaf blades with deep green edges becoming wholly deep green in summer.

The petioles connecting the leaf blades with the crown are deeply grooved (canaliculate) and usually longer than the blades.

The Siebold Plantainlily (*H. glauca*), the Giant Plantainlily (*H. fortunei* var. *gigantea*), the Blue Plantainlily (*H. ventricosa*), the Fragrant Plantainlily (*H. plantaginea*), the Greenrim Plantainlily (*H. fortunei* var. *viridis-marginata*), *H. fortunei* var. *robusta*, and *H.* 'Honeybells' make clumps twenty-four to thirty inches high. They are large plants and give heavy mass effects. *H. fortunei* var. *marginato-alba*, the Narrow-leaved Plantainlily (*H. lancifolia*), the Bigjap Plantainlily (*H. lancifolia* var. *fortis*), the Whiterim Plantainlily (*H. lancifolia* var. *albo-marginata*), *H. undulata* var. *univittata*, and the Midsummer Plantainlily (*H. undulata* var. *erronena*) are medium size plants. They make clumps fifteen to twenty inches high and two or three feet wide in the same period of time. The Dwarf Plantainlily (*H. minor*), the Autumn Plantainlily (*H. lancifolia* var. *tardiflora*), the Wavyleaf Plantainlily (*H. undulata*), and the Blunt Plantainlily (*H. decorata*) are small with clumps ten or twelve inches high.

Culture

Hostas are not fussy as to soil, whether light or heavy. A soil with humus is desirable. A little fertilizer in early spring is not amiss. The plants look much better if grown in shade and if the soil is somewhat moist. They will endure much dryness but it affects the appearance of the leaves. Edges and tips turn brown.

Watering in dry spells helps a lot. Hostas prefer soils at least slightly acid. They do well under the same growing conditions as azaleas. Their climatic range, however, includes the coldest areas in the country if at least moderate rainfall is available. Whether it includes the Lower South is not known; at least hostas are not grown much there, perhaps because sub-tropical foliage plants are available. Hostas are permanent, durable, and withstand neglect. They may be propagated by division, preferably in the fall or early spring. Their roots are tough and you will need a sharp spade, maybe an axe for some.

If kept out of full sunlight and given adequate moisture, hostas are little subject to diseases or pests unless one calls a heavy hail storm a pest when the hailstones lacerate and shred the leaves. Fortunately in most regions such storms are rare. Occasionally snails or crown rot or one of the leaf spots may trouble hostas, but rarely seriously. Under some city conditions the larger leaf plants need to be washed off occasionally to get rid of soot. In spring and early summer during the growing season for appearance sake cut off damaged leaves; others will replace them or their absence will not be noted.

Exudate from tulip tree scales in overhanging trees may fall on hosta leaves below. This "honeydew" is a clear liquid but a sooty fungus will quickly grow in it discoloring the hosta leaves. The fungus will wash off in rains, but slowly. The leaves may be badly damaged for the season.

Description of Species and Varieties

There are described below various hosta plants available from the trade in this country. The descriptions are of *mature, living plants* in the Washington, D. C., area, not herbarium specimens. Size of leaf, heights, and other figures in some instances run larger than in the corresponding botanical descriptions.

The classification used is not intended for botanists, but gardeners. It is based mainly on using certain species or varietal

botanical names that have substantial acceptance in this country.

The botanists have differences among themselves when it comes to naming hostas. Such difficulties are to be expected when species and varietal names are given to garden forms not known in the wild. Nurserymen's names for hostas re-

flect the confusion among the botanical names. Different nurserymen give different names to the same plant and the same name to different plants. We hope the following classification will be a useful working guide for the hosta gardeners in this country. Any botanist who pays the slightest attention to it, does so at his peril.

There follows a finding list of the species and varieties of the plantainlilies here described and their synonyms:

- Funkia alba*, see *Hosta plantaginea*, Page 319
F. caerulea, see *H. ventricosa*, 319
F. fortunei, see *H. fortunei*, 320
F. glauca, see *H. glauca*, 319
F. grandiflora, see *H. plantaginea*, 319
F. lanceolata, see *H. lancifolia*, 321
F. ovata, see *H. ventricosa*, 319
F. sieboldiana, see *H. glauca*, 319
F. subcordata, see *H. plantaginea*, 319
F. 'Thomas Hogg,' see *H. decorata*, 324
F. undulata, see *H. undulata*, 323
F. variegata, see *H. undulata*, 323
Hosta albiflora, see *Hosta minor*, 322
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H. albo-marginata var. *alba*, see *H. minor*, 322
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N. plantaginea, see *H. plantaginea*, 319
N. sieboldiana, see *H. glauca*, 319
N. undulata, see *H. undulata*, 323

1. *H. plantaginea* (syns. *Funkia subcordata*, *Funkia alba*, *Funkia grandiflora*, *Hosta plantaginea* var. *grandiflora*, *Niobe plantaginea*) (Fragrant Plantainlily):

Usually sold by nurserymen as *Hosta* or *Funkia subcordata grandiflora*.

Distinguished especially by its long, tubular, scented white flowers opening in the evening.

The leaves are a bright yellowish green and both sides are glossy. The leaf blades are twelve inches long and eight inches wide with about nine nerves on either side of the midrib. The wide-spreading foliage forms a mound twenty-four inches high.

The flowers are the finest among hostas reminding one of the white trumpets among some of the "true" lilies. They are a pure, waxy white, four to six inches long, two to three inches wide, and tubular. There is supposed to be a variety, *grandiflora*, which are the plants with five to six inch long flowers.

The slender tube of the flower is longer than the limbs. The stamens have white filaments and yellow anthers; the style is white. The stamens are reflexed and so do not extend as far as the top of the perianth. The pistil is not reflexed and is about the same length as the perianth. The flower scape is thirty inches tall and usually has a single leaf-like bract. The flowers are horizontal and rest on a pedicel surrounded by two leaf-like bracts, a small one inside a much larger one. The flower raceme is well above the leaf mound. The flowers are close together in the raceme making a crowded terminal cluster with about twenty-six flowers to the cluster.

The flowers are very fragrant; some call it an orange-like scent. They open in the early evening and remain open throughout the night and following day until early evening. *H. plantaginea* (except for its hybrid, 'Honeybells') is the only hosta with fragrant, night-blooming flowers. The blooming period is throughout August. See Plate 16.

2. *H. ventricosa* (syns. *Funkia caerulea*, *Niobe caerulea*, *Funkia ovata* (Blue Plantainlily):

Usually sold by nurserymen as *Hosta caerulea* or *Funkia caerulea*.

Distinguished especially by its large, glossy, dark green leaves and urn-shape, dark violet flowers.

The leaves are broad at the base, have a twisted point, and are sometimes wavy. They are a glossy, deep green above and a glossy, grayer green beneath. The leaf blades are ten inches long and eight inches wide, with about ten nerves either side of the midrib. The leaf mound rises to twenty-four inches. It forms large dense clumps.

The flowers are deep violet (campanula violet, HCC 37/2) lavender and white striped and streaked (pencilled) especially inside. They are the darkest flowers of any hosta, two and a quarter inches long and one and a half inches wide. The flowers are urn-shape, abruptly enlarging midway. The species name is derived from its suddenly swollen (ventricose) flower tube. The stamens have white filaments with purple anthers; the pistil a white style with yellow stigma. The flower scape extends to forty inches in height and usually has several leaf-like bracts. The flower raceme is well above the mound of foliage and has up to twenty-eight flowers to the cluster. The flowers bloom in late June and early July. See Plates 4 and 6.

3. *H. glauca* (syns. *Funkia glauca*, *Funkia sieboldiana*, *Hosta sieboldiana*, *Niobe sieboldiana*) (Siebold or Short-cluster Plantainlily):

Frequently sold by nurserymen under the name *Hosta sieboldiana*.

Distinguished especially by the large, deep gray-green, glaucous leaves. Here the "grayness" is "bloom" that will rub off readily. The low flower scapes bring

the raceme of flowers little, if any, above the mound of leaves.

The leaves are most attractive. The leaf blades are broad, roundish, and wrinkled, and the lobes frequently overlap at the base. The leaf blades are fifteen inches long and twelve inches wide. They are a deep gray green on top and a lighter gray green below. Both sides are glaucous. The leaves have about seventeen nerves on either side of the midrib. The plant forms a loose leaf mound twenty-four inches high. Stephen F. Hamblin says the Siebold Plantainlily may be used as an accent "where a very large bang is required."

H. glauca has fine foliage but poor flowers. The flowers are white faintly flushed purple, bell-shape, two inches long and an inch wide. The stamens have greenish white filaments with yellow and brown anthers; the pistil has a greenish white style and stigma. The flower scapes are usually about the same height as the leaf mound and the leaves tend to hide the flowers. The flowers, however, droop and wither quickly, hang on, and are untidy, so it is well that they are partly hidden. The flowers bloom in late June and early July. The scapes have one or two leaf-like bracts. The flowers are close together on the raceme and tend to crowd into a dense terminal cluster. The cluster has up to twenty-four flowers. See Plate 10.

The above is probably the plant designated by Nils Hylander as *Hosta sieboldi* var. *elegans*. Some plants sold under the name *Hosta sieboldiana* have leaves less square or broader at the base, more pointed, and less glaucous than *H. glauca*. Also the flower scapes may rise eight inches or so above the leaf mound. *H. aoki* may belong in this area.

There is a plant sold as *Hosta glauca* var. *aurea variegata* with a wide yellowish green margin to the leaf.

4. *H. fortunei* (syns. *Funkia fortunei*, *Niobe fortunei*) (Fortune or Tallcluster Plantainlily):

H. fortunei is probably not a species but a group of hybrids and there is a tendency to dump any unclassified *hosta* into the group. The result is that plants under the name of *H. fortunei* show a good deal of variation.

The plant that has usually been sold as the typical "species" is that now called *H. undulata* var. *erronema* or sometimes treated as a separate species *H. erronema*. It is described later.

There is, however, a number of "varieties" of *H. fortunei* that are distinctive and are described below. Two of these, *H. fortunei* var. *gigantea*, which is sometimes treated as a separate species, *H. elata*, and the similar *H. fortunei* var. *robusta*, are closely related to *H. glauca* particularly the form of it sold under the name *H. sieboldiana*. Two other varieties are variegated leaf forms, *H. fortunei* var. *marginato-alba* frequently treated as a separate species, *H. crispula*, and *H. fortunei* var. *viridis-marginata* frequently treated as a separate species, *H. albopicta*.

Nils Hylander places under *H. fortunei* four varieties, *stenantha*, *rugosa*, *obscura*, and *hyacinthina*. They are not known in this country, at least by those names. All seem closely related to *H. fortunei* var. *gigantea* (*H. elata*) and *H. glauca* (*H. sieboldiana*).

H. fortunei var. *gigantea* (syn. *Hosta elata*) (Giant Plantainlily): It has large, glossy leaves, deep green above and grayer green underneath, fourteen inches in length and ten inches in width, with about fourteen nerves either side of midrib, sometimes wavy margins.

The flowers are two inches long and one and a quarter inches wide. Their color is white faintly flushed purple. The stamens have white filaments and yellow and green anthers; the pistil has a white style and stigma. Some flower scapes do not top the leaf mound; others extend eight inches or so above it. The flowers are in dense clusters of about forty and bloom in late June and early July. See Plates 4, 7, and 13.

This plant might well be regarded as

a hybrid of *H. glauca* or at least of the form of it sold as *H. sieboldiana*. The flowers are as poor as those of *H. glauca*, but the leaves are fine and the huge plant impressive.

H. fortunei var. *robusta*: This, while large, is smaller than *H. f.* var. *gigantea*. The leaves are gray green, glaucescent underneath, not wavy, eight inches wide and ten inches long, with about eleven nerves either side of the midrib. The leaf mound is twenty-four inches high. This might also be a hybrid of *H. glauca*.

H. fortunei var. *marginato-alba* (syns. *Hosta fortunei* var. *albo-marginata*, *Hosta crispula*); This has dark green, wavy-margined leaves, glossy on the underside, and the leaf mound is twenty inches tall. The leaf blade is up to ten inches long and six inches wide with an irregular white margin, broader than in *H. decorata* and in *H. lancifolia* var. *albo-marginata*. The flower scape is forty-two inches tall.

The flowers are one and three-quarters inches long, and one inch wide. The color is white faintly flushed purple. The stamens have white filaments with yellow and green anthers; the pistil a white style and stigma. There are up to thirty-six flowers to a cluster. They bloom in late June and early July. See Plate 11.

H. fortunei var. *viridis-marginata* (syn. *Hosta albo-picta* f. *viridis*) (Greenrim Plantainlily): This is the only well known hosta with leaves in two shades of green. The leaf blades are a light yellow green with a darker green margin, turning dark green all over in early summer; underneath they are gray green and glaucescent. The leaf blades are twelve inches in length and seven inches in width, with about ten nerves either side the midrib. The leaf mound is dense and twenty-four inches high.

The flowers are two inches long, one and a quarter inches wide, and bell shape; white faintly flushed and penciled violet (bishops violet, HCC 34/3). The filament is white and the anthers violet; the style and stigma are white. There are about thirty-six flowers to the dense cluster. The flower scape is up to thirty

inches tall and has two leaf-like bracts. The flowers bloom in early July.

The flowers of *H. fortunei* var. *viridis-marginata* are much like those of *H. undulata* var. *erromena*. The flowers of both are slenderer and the segments of both flare more widely than those of *H. glauca* and *H. fortunei* var. *gigantea*.

5. *H. lancifolia* (syns. *Hosta japonica*, *Funkia lanceolata*, *Niobe japonica*) (Narrow leaved Plantainlily):

Distinguished especially by its narrow leaves and late blooming period.

Frequently sold by nurserymen as *Funkia lanceolata*.

The leaves are narrow and long, and dark green and glossy on both sides. Their length runs seven inches and their width three inches, with about five nerves on either side of the midrib. The leaf mound is dense and rises to twenty inches in height. The plant spreads readily. There is a form with longer and narrower leaves.

The flowers are violet (violet, HCC 36/2) with some white streaks or lines. They are one and a half inches long and one inch wide, and bell-shape.

The slender tube is about one-third the length of the flowers. The flower scape is thirty inches tall and has two to four leaf-like bracts. The flower raceme extends well above the leaf mound and the flowers are well spaced on the raceme. There are about fifteen flowers to the cluster. The stamens have white filaments with dark purplish anthers. The pistil is a little longer than the stamens and is white. The flowers bloom in late August and September.

There are several varieties:

H. lancifolia var. *fortis* (Bigjap Plantainlily): This variety has broader leaf blades seven inches in length and five inches in width, and pointed. They are dark green, grayer, and glaucous underneath, with about nine nerves on either

side of the midrib. There is a very fine white line around the leaf margin. The variety blooms in late July, earlier than the type species. The leaf mound is dense and twenty inches high.

The flower scape is twenty-six inches tall and has four small leaf-like bracts. There are about thirty-six flowers to the dense cluster. The flowers are one and three-quarters inches long, three-quarters inch wide, and white flushed and penciled violet (bishops violet, HCC 34/3). The stigma is white and the filaments are white with dark purple anthers. The flowers bloom in mid-July.

H. lancifolia var. *tardiflora* (*H. tardiflora*) (Autumn Plantainlily): It blooms in September and October and is much dwarfer than the type species. The leaf blades are deep green and glossy, six inches long and two and a half inches wide. There are about seven nerves on either side of the midrib. The leaves form a low, loose clump twelve inches high.

The flowers are flushed pale violet (cobalt violet, HCC 634/3), and are one and a half inches long and wide. The anthers are yellow. The flower scape is about eighteen inches tall, has two leaf-like bracts, and the flowers are crowded on the terminal of the raceme. There are around twenty-four flowers to the cluster.

Variety *tardiflora* is treated as a separate species by W. T. Stearn. *H. sparsa* may be a clone of *H. lancifolia* var. *tardiflora*.

H. lancifolia var. *albo-marginata* (syn. *H. albo-marginata*) (Whiterim Plantainlily): This has light green leaves with narrow white margins and white edging to petioles. Leaf blades run five by three inches with about five nerves on either side of the midrib. The leaf mound is dense and fifteen inches high. The plant is sometimes treated as a separate species, *H. albo-marginata*. The flowers are similar to those of *H. lancifolia*.

6. *H.* 'Honeybells':

Bristol Nurseries, Bristol, Connecticut,

introduced this hybrid of *H. plantaginea* and *H. lancifolia* in 1952. The leaves are long, not broad at base, and are wavy and glossy. They are a light green and eleven inches long and seven inches wide with about ten nerves on either side of the midrib. The leaf mound rises to twenty-four inches.

The flowers are white penciled violet (bishops violet, HCC 34/3). They are two inches long and an inch and a half wide. The filaments are white, the anthers purple and yellow, and the style and stigma white. The scapes extend far above the leaf mound and may reach fifty inches. They have two leaf-like bracts. There may be up to sixty flowers in a cluster.

The flowers have a fragrance like *H. plantaginea*. They open throughout the morning and close the following morning. *H.* 'Honeybells' blooms the latter half of August. See Plate 9.

7. *H. minor* (syns. *Hosta minor alba*, *Hosta albo-marginata* var. *alba*, *Hosta albiflora*) (Dwarf Plantainlily):

Distinguished especially by its small size, solid green leaves, and white flowers.

Nurseries distribute an excellent dwarf hosta with white flowers. The leaves look like a small *H. lancifolia*. Usually it is sold under the name of *H. minor* or *H. minor alba*. The plant is not described in most botanical listings, at least under this name. It is not the *H. minor* of Takenoshi Nakai. Edgar T. Wherry assigned the plant the horticultural epithet, "albiflora." Nils Hylander recently designated it as a form of the plant here called *H. lancifolia* var. *albo-marginata*.

The leaves of *H. minor* are narrow. They are a dark green and glossy on both sides. In size the leaves run up to five inches long, and an inch and a half wide, with about three nerves on either side of the midrib. The small, dense leaf mound is about ten inches high.

The flowers are white and one inch

wide. The stamens have white filaments and yellow anthers and the pistil is white. The flower scape extends twenty-six inches in height, well above the leaf mound. It has two leaf-like bracts. There are up to twelve flowers to a cluster. *H. minor* has been called "a large flowered Lily-of-the-Valley blooming in August." See Plate 16.

H. venusta is a similar dwarf form but with violet flowers.

8. *H. undulata* (syns. *Funkia undulata*, *Niobe undulata*) (Wavyleaf Plantainlily):

Distinguished especially by its white and green wavy leaves and small size.

Frequently sold by nurserymen as *Funkia variegata*.

The leaves have broad white centers and margins in two shades of green, the darker green on the outside. The white extends down through the petiole which has a narrow green edging. The leaves are five and a half inches long and two and a half inches wide and are wavy, twisted at the tip, and with about seven nerves either side of the midrib. The leaf mound is ten inches high.

The flowers are two inches long and light purple in color, and bell-shape. The flower scape is about twenty-four inches tall, extends well above the leaf mound, and has four large leaf-like bracts. The flowers bloom in July. See Plates 5 and 15.

This is a common plant widely grown for edgings.

H. undulata var. *univittata*: This is a larger plant with a much narrower white center.

The leaves are glossy, pointed, and wavy. They are eight inches long and six inches wide, and are dark green, with some lighter green toward the center, and more narrowly striped or splashed white down the center. The white may extend down through the center of the petiole the greater part of the way. There are about nine nerves on either side of the midrib.

The leaf mound is dense and twenty inches high. Occasional leaves may be all green mutants.

The flower scape is about forty inches tall with three leaf-like bracts also striped white. There are about twenty flowers to the cluster, well spaced in the raceme. The flowers are two inches long, one and a half inches wide, and bell shape; white flushed and penciled violet (bishops violet, HCC 34/3). The filament is white and the anther violet; the style and stigma are white. The flowers bloom in early July. See Plate 14.

H. undulata var. *erromena* (*H. erromena*) (Midsummer Plantainlily): This variety appears to be a solid green leaf form of *H. undulata* var. *univittata*. Some botanists treat it, however, as a separate species, *H. erromena*.

The leaves are eight inches long and five inches wide, with about ten nerves on either side of the midrib, and are dark green and glossy on the underside. The leaf mound is twenty-four inches high. The leaves are somewhat wavy but not so much as *H. undulata* var. *univittata*.

The flowers are white flushed and penciled violet (bishops violet, HCC 34/3), two and a quarter inches long and bell-shape; the stamens have white filaments and deep purple anthers; the pistil has a white style and pale yellow stigma. The flower scape rises to forty-eight inches and has two to five leaf-like bracts. The flowers are horizontal to the flower scape. The flower raceme extends well above the leaf mound and has about thirty flowers to the cluster. The flowers are well scattered in the raceme. They bloom in early July. "Midsummer" is hardly an appropriate common name.

There is in the trade a plant similar to *H. undulata* var. *erromena* save that the flowers are a little smaller (one and three-quarters inch long and one and a quarter inch wide) and are the same violet color all over, not merely white flushed and penciled. The throat, however, has white stripes extending to the point where the segments separate. The flower scape is shorter, thirty-six inches or less, with about thirty-six flowers to the cluster.

9. *H. decorata* (syns. *Funkia* 'Thomas Hogg,' *Hosta decorata* var. *marginata*) (Blunt Plantainlily) :

Distinguished especially by its narrow leaves which together with the petiole are white margined; also blunt leaves.

Frequently sold by nurserymen under the name *Hosta* or *Funkia* 'Thomas Hogg.' The name is taken from that of the nurseryman who brought the plant from Japan to this country, about 1884.

The leaves are broad at the base, blunt, and somewhat wavy at the margins. They are seven inches long and four inches wide, with six nerves on either side of the midrib. The leaves are a dark green, grayer on the underside, with narrow white margins extending down the edges of the petiole. The plant is compact and small with a low, dense mound of leaves twelve inches high.

The flowers are violet (bishops violet,

HCC 34/2), two inches long and one and a half inches wide. They are urn-shape like the flowers of *H. ventricosa* and have a very narrow tube. The stamens have white filaments and cream anthers. The pistil is white. The flowers are held horizontal on the flower scape. The scape is about twenty-four inches tall and has four leaf-like bracts. The flower raceme is well above the leaf mound and has up to twenty-eight flowers to the cluster. The flowers bloom throughout August. See *Plates 5, 12, and 16.*

Note: Nurseries offering by catalog a wide range of hosta species and varieties are few. Those known to have a good range of varieties are listed below. Omission of any such nursery merely indicates lack of information on the part of the writer.

Fairmount Gardens (Mrs. Thomas Nesmith), 166 Fairmount Street, Lowell, Massachusetts.

Mackwoods Gardens, Lotus Woods, Spring Grove, Illinois.

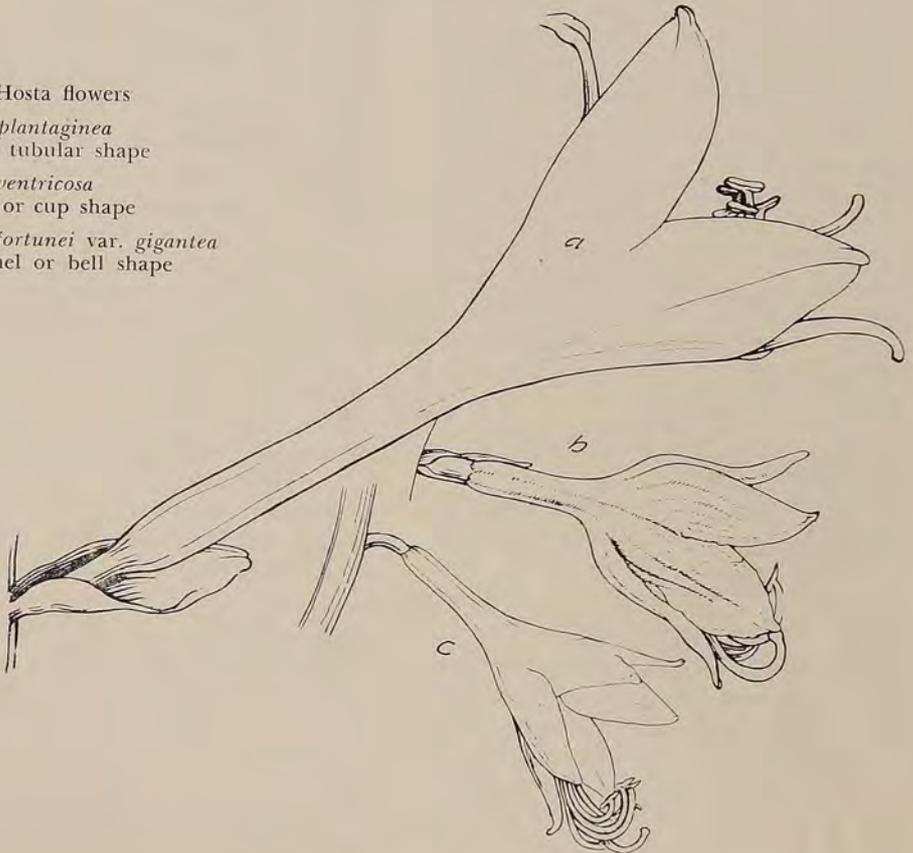
Carl Starker, Jennings Lodge, Oregon.

H. A. Zager, 4215 Urbandale Avenue, Des Moines 10, Iowa.

Plate 1.

Forms of Hosta flowers

- a: *Hosta plantaginea*
long tubular shape
- b: *Hosta ventricosa*
urn or cup shape
- c: *Hosta fortunei* var. *gigantea*
funnel or bell shape



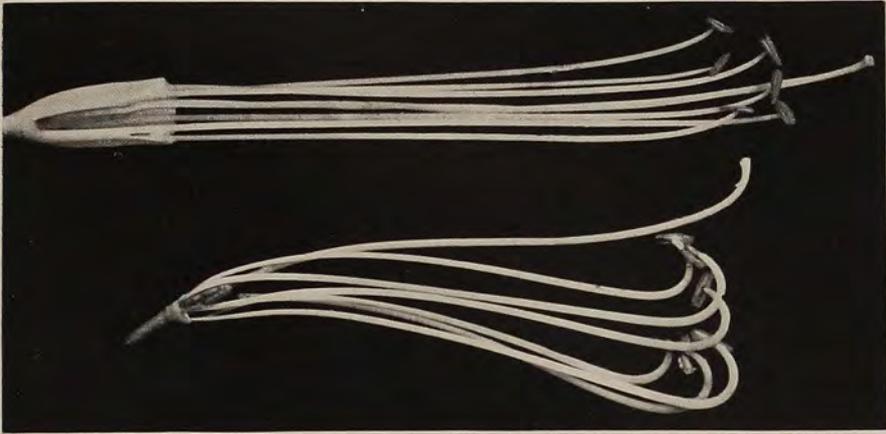


Plate 2. Stamens and pistil in Hostas
Hosta plantaginea (Fragrant Plantainlily), above
Hosta fortunei var. *gigantea* (Giant Plantainlily), below

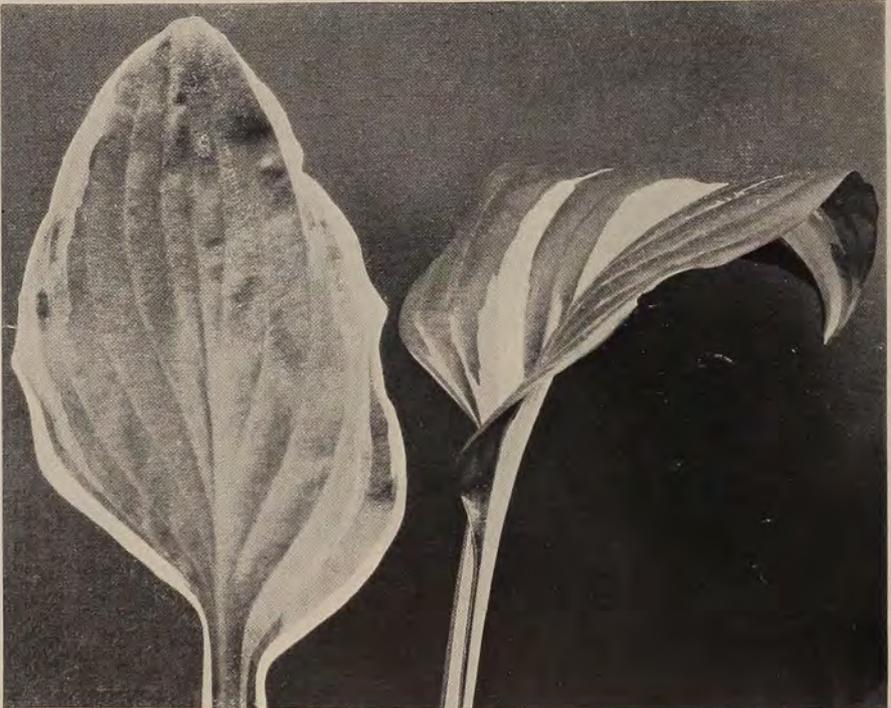


Plate 3. Rootstock of *Hosta ventricosa* (Blue Plantainlily)



Plate 4. Hosta leaves
Hosta fortunei var. *gigantea* (Giant Plantainlily), left
Hosta ventricosa (Blue Plantainlily), right

Plate 5. Variegated Hosta leaves
Hosta decorata (Blunt Plantainlily), left
Hosta undulata (Wavyleaf Plantainlily), right



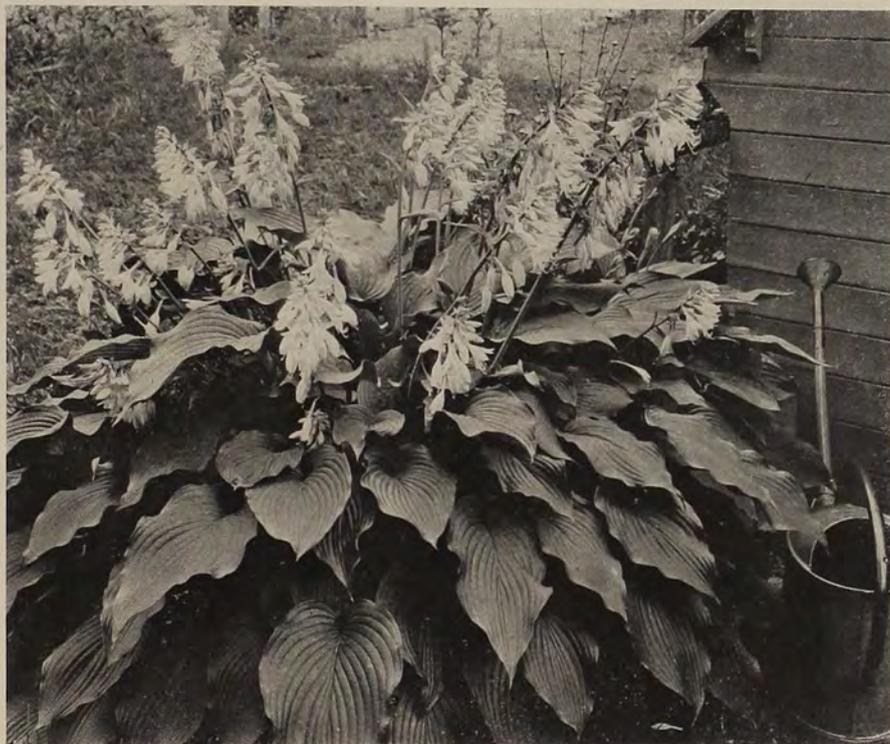


Plate 6. *Hosta ventricosa* (Blue Plantainlily)

Engravings for Plates 1 through 7 are loaned through the courtesy of the Bailey Hortorium, Ithaca, New York. Photographs from which Plates 8 through 15 were made were taken by Marian A. Lee.

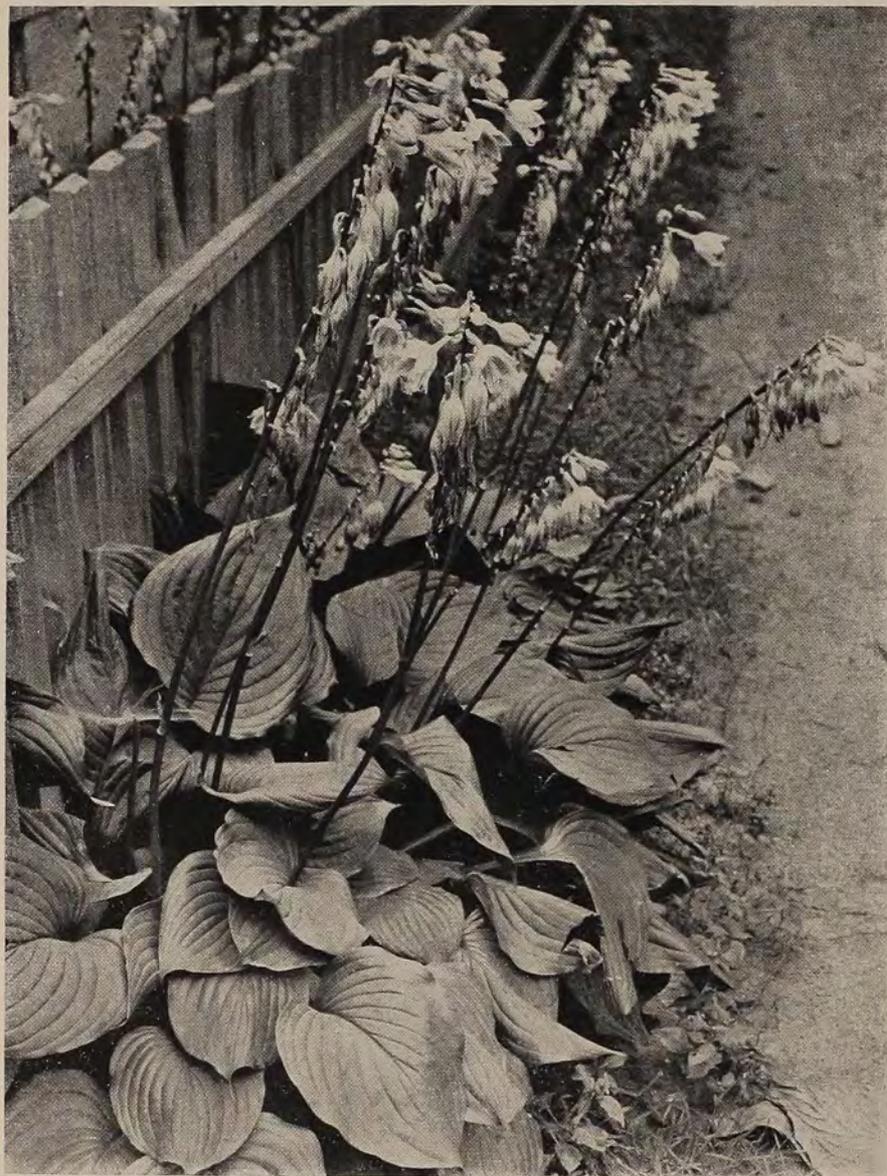


Plate 7. *Hosta fortunei* var. *gigantea* (Giant Plantainlily)



Plate 8. Pale chartreuse shoots of *Hosta fortunei* var. *gigantea*
(Giant Plantainlily) emerging in spring

Plate 9. *Hosta* 'Honeybells' a hybrid of *H. lancifolia* \times *H. plantaginea*





Plate 10. *Hosta glauca* (Siebold Plantainlily)

Plate 11. Leaves of *Hosta fortunei* var. *marginato-alba*





Plate 12. Leaves of *Hosta decorata* (Blunt Plantainlily)

Plate 13. Leaves of *Hosta fortunei* var. *gigantea* (Giant Plantainlily)
growing among Azaleas, Daffodils, and Lilies





Plate 14. *Hosta undulata* var. *univittata*

Plate 15. *Hosta undulata* (Wavyleaf Plantainlily)



Plate 16.
Hosta plantaginea (Fragrant Plantainlily)



Hosta decorata
(Blunt Plantainlily)



Hosta minor
(Dwarf Plantainlily)



A fine grove of *Phyllostachys nuda* (P. I. 103938) at Glenn Dale, Maryland, showing normal development following the winter's ten below temperatures. This grove produces culms up to thirty feet. An American holly plant can be seen at the edge of the planting while other trees are shown growing in the grove.

Photographs—Walter O. Hawley

Hardiness of the Running Bamboos

JOHN L. CREECH

The Oriental bamboos of China and Japan are gradually assuming more frequent roles in American gardens and a number of landscape architects have found that a clump of bamboo provides an exotic focal point in a landscape plan. A filmy plot of the graceful Golden Bamboo, *Phyllostachys aurea*, or a dense planting of the Arrow Bamboo, *Pseudosasa japonica*, can add a distinctly Oriental touch to a prosaic foundation planting and can be maintained with comparatively little difficulty. Although we have not acquired the skill in the use of bamboo as employed by the Japanese where a tall species normally 20 feet may be used to fill in a small triangle formed by merging walks and be held to a height of 3 feet, or the use of a bamboo as a ground cover to fill in a narrow strip between house and walk, we now grow these majestic grasses in some places as hedges, screen plantings, and specimen clumps. Only after considerable acquaintance with the bamboos can the more subtle uses be attempted, for the species vary greatly in their habits.

Bamboos fall into two main groups, the clump forms and the running forms. The former are tropical and sub-tropical bamboos and derive their name from the fact that each new rhizome promptly turns upward, growing into a culm and resulting in a dense clump. In the running bamboos, however, the underground rhizome continues its ramifying horizontal development and culms come up at intervals from lateral buds on the rhizomes. Thus, a loose sort of grove results, if not controlled, gradually filling in to form a dense thicket.

In general we believe that the hardy running bamboos are most thoroughly adapted to the southern and mid-Atlantic States because they will maintain their beauty throughout the winter in such

areas, where the temperature seldom goes below five degrees Fahrenheit. These hardy bamboos fall into several genera; *Phyllostachys* contains the largest running species. The remaining genera, more of a clumpy nature despite their running rhizomes, include *Arundinaria*, *Pseudosasa*, *Sasa*, *Semiarundinaria*, and *Shibataea*. They are all lower-growing sorts, rarely exceeding fifteen feet in height in cultivation.

The hardy bamboos are all evergreen when the temperature does not fall below five degrees but begin to manifest several symptoms of winter injury as the temperature drops below this point. The first symptom may be only scorching of the leaf margins; then almost complete leaf killing; and at -10° F., loss of all leaves, buds and culms of many species. Although the temperature at Glenn Dale, Maryland, reached -23° F. in 1934-35, none of the plants in the large collection was completely killed out.

Bamboo culms, being giant grasses, make their entire height during about six weeks of the spring. This growth may vary from only one foot to sixty feet, according to species. By the time the culm has completed its growth, most of the leaves have unfolded. Two to six leaves are formed on each twig and they are held until autumn in the case of the oldest of a set while the remainder drops after the new leaves unfold in the following spring. The culms live for several years, developing a new set of leaves each year on the twigs which arise from the lateral buds. If a culm is subjected to severe winter injury and all the buds are killed, there will be no further activity from that culm although it may continue to live for a year or more. (Being the kind of plant it is, the bamboo produces no adventitious shoots.) Thus following severe winter injury, it becomes necessary to cut severe-



Phyllostachys aurea (P. I. 70744) showing development of new culms after old ones had been removed



Semiarundinaria fastuosa (P. I. 75146) showing new shoots with leaves just beginning to unfold after old culms had been removed

OPPOSITE: A planting of *pseudosasa japonica* (P.I. 70745)

Branches are borne to the ground by the weight of snow. This clump was completely killed above ground by temperatures ranging between zero and ten below (Fahrenheit).

Old culms are now completely winter killed but new culms are seen springing up around the base of the clump.

All old culms have been removed and the new culms form a ring at the perimeter of the clump.



ly damaged culms back to the base. This pruning should be delayed until late spring after it becomes obvious that the buds have been killed.

During January, 1957, the temperature at Glenn Dale, Maryland, dropped to -10° F. and that was the coldest period since 1935. The bamboo species were so severely hurt by this cold snap that the leaves hung in straw-colored tatters. Not a single species held its foliage following this freeze except a nearby large grove of *Phyllostachys nuda* where some leaves in the innermost part of the planting were not injured. Most of the species in the Glenn Dale collection are grown in huge, steel, open-ended drums and these intentionally restrict the development of the clumps. This cultural practice also intensified the amount of winter injury by reducing the vigor and protective quality which characterizes a large grove. However, a planting of *Pseudosasa japonica* that was not restricted was completely killed to the ground.

The damage to a bamboo culm by winter injury is effected by killing of the buds on the old twigs or by complete killing of the culm itself. The development of the new twigs and leaves coincides with the sprouting of new culms from the lateral buds on the last year's rhizomes. Thus when the new culm sprouts appear in March and April, the new growth on the old culms should also develop.

Of the entire collection, only the species of *Phyllostachys* produced new twigs and leaves on the old culms. The Sasas, Arundinarias, and other similar types were all bud injured and stood stark and dead except for the skirting of new culms that was sprouting around the perimeter of the planting. All of the bamboos put up new sprouts, however, but these will be reduced in stature during this year. All clumps of those types which had killed to the base required rejuvenation by removing the old culms completely.

The bamboos which indicated the greatest hardiness on the basis of the past winter are as follows:

- Phyllostachys aureosulcata*, P.I. 55713
- P. flexuosa*, P.I. 75156
- P. nigra* cv. 'Henon,' P.I. 75158

P. nuda, P.I. 103938

P. sulphurea var. *viridis*, P.I. 77257

P. viridis, P.I. 75160

These species were not killed to the ground and developed normal twigs on the old culms. Not all of the buds were alive and eventually it will be necessary to cut out such culms. This can be done gradually over a period of two or three years.

The bamboos which killed to the ground but produced new shoots are as follows:

Phyllostachys aurea, P.I. 70744

P. bambusoides, and cultivars

P. makinoi, P.I. 195284

P. meyeri, P.I. 116768

P. nigra, P.I. 75159

Sasa spp.

Pseudosasa japonica, P.I. 70745

Arundinaria spp.

Semiarundinaria fastuosa, P.I. 75146

Shibataea kumasasa, P.I. 75157

A winter-killed planting, such as one of *Pseudosasa japonica*, must be cut to the ground. Since fewer new culms are produced in the middle of the clump, a rather ragged hollow, ringed by new sprouts, results. But when the new rhizomes invade this cut-over area, it is covered up within two years. The *Phyllostachys* species, because of their robust size and smaller, more numerous leaves, do not present such a ragged appearance during the season following such a severe pruning, and the clumps scarcely lose any of their attractiveness after the new shoots have grown.

The large planting of *Phyllostachys nuda* owned by Dr. George Darrow, our Glenn Dale neighbor, was planted about 1923. There is not much in the literature concerning this species but in this area it produces culms up to thirty feet at maturity. Being a carefully managed grove and in excellent vigor, this species survived the winter with only leaf damage and no loss of culms. Even here, the number of new culms has probably been reduced this spring and they may not attain their full height this year. But considering the conditions, the damage is moderate and an encouraging note to those interested in planting bamboos in this area.



A clump of *Semiarundinaria fastuosa* (P. I. 75146), left, still defoliated during sprouting period. Culms are all winter killed. A clump of *Phyllostachys flexuosa* (P. I. 75156), right, with new leaves on the old culms and new sprouts arising around the perimeter.

There is no ornamental planting with more elegance and charm than a large clump of such a bamboo. Selective cutting permits walking within the grove and yet makes a complete screen from a distance. It affords protection for birds and serves as a windbreak, not to mention its value as a source of poles. It is possible to plant shade-loving evergreens such as hollies, mahonias, nandina, and azaleas in

the cool, moist perimeter and an occasional pine can be inter-planted in an interesting manner.

Fortunately the running bamboos show a great range of adaptation as well as the degree of winter hardiness and, with their increased availability in the nursery trade, they offer wider experiences in plant culture than any other kind of ornamental species.

Plant Responses to Extreme Climatic Departures from Normals in Southern California

GEORGE R. JOHNSTONE¹

Plants growing at the physiological margins of tolerance in their natural or artificial distributions may develop anomalous growth and reproductive patterns because of extreme climatic departures from normals, thirty-year averages (16)². Delayed foliation and floration among cold-weather deciduous trees and shrubs, and second or autumnal flowering and fruiting among spring-flowering plants are anomalous behavior patterns which occur in Mediterranean climates. Local data will be employed to illustrate these phenomena.

Los Angeles climatological data and local anomalous plant patterns, plant responses, can be correlated as cause and effect. Such correlations need not be assumed as finality without overwhelming evidence. An attempt will be made to provide available evidence. Climatological data representing two extreme climatic departures from normals, one departure occurring in winter and the other in early autumn, will be presented and correlated with local plant responses.

These conditions and initiated plant responses are: 1) mild winters causing prolonged dormancy (delayed response) of cold-weather deciduous plants, and 2) heat waves of several days' duration during early autumn, September, initiating various degrees of necrosis, and second flowering among normally spring-flowering plants.

Some extreme climatic departures from normals will be given more explicitly for Los Angeles, California, but first, general introductory statements for the State as a whole appear significant.

The climatological data for California (14) show that January 1953 was the warmest on record, that February 1953 was the driest on record beginning in 1897, that September 1939 (15) was the warmest, and that September 1955 was the second warmest on record.

Historical Review

Results of extensive experimental work on the "rest" period in plants (9) and the influence of cold in stimulating growth of plants (5) indicate that winter chilling by initiating a protective adaptation has become a physiological necessity in the life-histories of cold-weather trees and shrubs, and the lack of this chilling limits the extent of their geographical distribution towards the tropics. These conclusions are further supported by recent experimental work.

More information is now available on the physiological significance of climatic extremes. Bennett and Skoog (3) have again demonstrated that low temperature, either in the field or in cold storage, is essential for normal breaking of the rest period of fruit-tree buds. As a result of exposure to low temperature, a precursor of auxin accumulates in the buds, followed by the gradual appearance of the auxin. Dormant leaf and flower buds may differ, however, in their stimulus requirements for activation. This was demonstrated by Weinberger (17) at Fort Valley, Georgia, United States Horticultural Laboratory, where he determined the chilling requirements of sixty-four peach varieties. More of his findings will appear under the topic, mild winters and foliation. The influence of climatic extremes has been advanced by Detling (7) to explain the degree of endemism in the flora of a given area as being directly correlated with the total

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² Numbers in parentheses refer to literature cited at end of paper.

number of environmental factors reaching their extremes in the area. He further concluded that the centers of floral areas richest in endemic species coincide with the areas in which occur the end points of a number of climatic gradients.

Economic Aspect

This abnormal flowering and fruiting in deciduous orchards was given particular attention nearly fifty years ago. E. B. Babcock at Whittier, California, began peach hybridization in 1907 which led eventually (11) to combining better fruit characters with adaptation to warm winters possessed by varieties of Honey and Peen-to groups. Collaboration with C. O. Smith occurred in the early stages of the work. In 1924, H. B. Frost and J. W. Lesley of the Citrus Experiment Station, Riverside, California, selected thirty hybrids as worthy of further testing. George P. Weldon, pomologist, Chaffey Junior College, Ontario, California, selected one of these hybrids which was introduced in 1938 as the Babcock peach (11, 19). This problem of intolerance of warm winters by certain cold-weather deciduous trees was early recognized as an obscure disease (8) in southern California, later designated "prolonged dormancy," and solved economically on a scientific basis by selection of hybrids especially adapted to mild winters (11). A twenty-one year (1916-17 to 1936-37) temperature and humidity chart shows eight springs when, because of warm winters, there was injurious delay in opening of buds of deciduous fruit trees in parts of southern California (4).

Just the opposite of chilling requirements, the resting buds of some kinds of plants may be activated by September heat waves.

Historical Data on Heat-Wave Plant Responses

Records of heat waves as a cause of second or autumnal flowering among normally spring-flowering plants appear in the Mediterranean literature, but seem to lack emphasis. Francis Darwin and A. Shrubbs (6) listed seventy-five species of plants in England which were observed to flower a second time and the phenome-

non was attributed to relatively high temperatures. Andrews (1) reported the occurrence of second flowering in *Viburnum opulus* as of September 4, 1922, at Elwood, Indiana, and believed that high temperature might have influenced the plant to renew fruiting activity. Kerner (10) wrote on second flowering of several species in years characterized by particularly mild autumns: apples, gentians, horse-chestnuts, violets, strawberries, primulas, and anemones. Such phenomena have variously evaluated significance.

Data on plant responses to September heat waves will follow the account of chilling requirements of cold-weather deciduous plants in a Mediterranean climate.

This current examination of the available literature on cold-weather deciduous plants and observations in the field justify a further correlation of climatological (15) and symptomological data for the winters and early springs from December 1951 through March 1956. These data are summarized in Table I. Particular use is made of "heating degree days" in this table. A heating degree day, base 65 degrees Fahrenheit, is the number of degrees required to bring the mean temperature of that day up to 65°. If the mean temperature is 65° or above, there are no heating degrees for that day; hence, the larger the number of heating degree days for any period, the colder the period.

1951-1952. Cold, heavy rainfall. No recorded data on young peach trees, no deviation from normal, trees had borne fruit.

1952-1953. Warm, light rainfall. Normal floration, spectacular delayed foliation of terminal shoots. Young fruit formed, none matured.

1953-1954. Warm, light rainfall. Poor floration, delayed foliation of terminal shoots. Excessive sucker growth. No crop.

1954-1955. Cool, light rainfall. Normal floration and foliation. Excessive sucker growth. A good crop of fruit.

1955-1956. Cold, more rainfall. Normal floration and foliation. Excessive sucker growth. A heavy crop of fruit.

TABLE I. CLIMATOLOGICAL DATA (15): FIVE WINTERS AND EARLY SPRING SEASONS (1951-1956). NORMAL (16) THIRTY-YEAR AVERAGES (1921-1950). INTERPRETATION OF DATA AND SUMMARY OF PLANT RESPONSES.

Heating degree days, base 65 degrees Fahrenheit, seasonal totals since July first to end of each month, December through March.

Month	1951- 1952	1952- 1953	1953- 1954	1954- 1955	1955- 1956	1921- 1950
12	452	495	303	324	487	451
1	823	652	595	669	759	779
2	1005	832	693	892	1096	1023
3	1315	1026	935	1034	1246	1235

Inches of rainfall. Seasonal totals to the end of March.

24.64	8.46	11.76	8.43	11.82	13.04
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Interpretation of the above data and summary of plant responses: data on two, local, Cling peach trees.



The effects of prolonged dormancy of terminal-shoot buds of the Silver Maple. The illustrations are of the same tree viewed from different angles and show progressive foliation on June 10, 1953 (left) and June 22, 1953 (right)



Normal floration of Cling peach followed by prolonged dormancy of terminal-shoot leaf buds. Immature fruit, but no leaves on terminal shoots, were visible on May 24, 1953 (left) and leaves were formed on terminal shoots by June 7, 1953 (right)

Mild Winters and Foliation

The unusual amount of prolonged leaf-bud dormancy of cold-weather, deciduous trees during the 1953 spring season attracted considerable attention in southern California. Apparently normal flowering of terminal shoots of seedling Cling peach was followed by delayed opening of the leaf buds on these shoots. Evidence of delayed foliation is shown in the accompanying illustrations of Cling peach and Silver maple.

Irregular flowering and fruiting have been observed among a number of other deciduous trees. A heavy crop of mature fruit on a seedling plum was accompanied with scattered flowers late in June; a White Mulberry, *Morus alba*, flowered and fruited a second time before the end

of June 1953; the two crops were light. This same mulberry tree bore two heavy crops during 1955, and a May 1956 crop. This tree is now in full bloom; the first autumn 1956 inflorescences were observed September 29.

The significance of mild winters has been further established. The chilling requirements of sixty-four peach varieties were determined by Weinberger (17) at the United States Horticultural Field Laboratory, Fort Valley, Georgia. During a twelve-year period, 1937 to 1949, the accumulation of the hours of temperature, 45 degrees Fahrenheit or lower, was determined. Two varieties, Australian Saucer and Jewel, required no chilling. Of the 62 remaining varieties: leaf buds of 24 (38.7 per cent) required the same amount of chilling as their flower buds,

leaf buds of 34 (54.8 per cent) required more chilling than their flower buds, and leaf buds of 4 (6.46 per cent) required less chilling than their flower buds for activation.

In contrast to mild winters, there are early autumn heat waves in southern California which have profound influences on plant behavior patterns.

September Heat Waves

Two early, autumn heat waves in Los Angeles, California, are comparable in time of occurrence, intensity, duration and the resulting responses of plants. Seven days from September 17 to 23, 1939, had an average daily maximum of 103.4 degrees and during August 31 to September 7, 1955, the average maximum was 103.1 degrees Fahrenheit. Further data comparing these heat waves are shown in Table II.

Heat Wave of 1939

Some recorded responses of plants to the 1939, September heat wave emphasize second or autumnal flowering. I made particular note of the autumnal flowering of the Scrub Oak, *Quercus dumosa*. This Scrub Oak has its normal flowering peak during April (2). The Los Angeles Times on December 23, 1939, published a photograph of *Yucca whipplei* in full bloom. The photograph was taken the day before on the William Hume property in Las Flores canyon, Santa Monica Mountains. The normal

flowering period for *Y. whipplei* from my own observations in these mountains is May-June. Somewhat more extensive observations on responses of plants to the 1955, September heat wave have been made.

Heat Wave of 1955

Among the responses of plants to the 1955 heat wave are necroses of leaves of several species, rapid abscission of older leaves a few days after the end of the heat waves, death of trees where lack of water was the limiting factor augmented by the heat wave, and finally second or autumnal flowering and fruiting.

The mesic, Rice Paper Plant, *Tetrapanax papyriferum*, showed considerable leaf damage a few days after the end of the September heat wave. One group on the campus of the University of Southern California in the accompanying illustration suggests that lack of water was not the "limiting" factor, but rather the inadequate shade of the Canary Island Palm, *Phoenix canariensis*.

The xeric-appearing Rubber Plant, *Ficus elastica*, grows successfully in extremes of shade and sunlight. Some Rubber Plants were observed growing on south and east exposures to full sunlight showing a minimum of leaf necrosis, not to exceed a fraction of one per cent.

The heavy, late summer foliage of the Santa Rosa Plum was rapidly depleted within a few days after the end of the

TABLE II. Significant Heat-Wave Data From The United States Weather Bureau For Los Angeles, California (14, 15).

Climatological criteria	September 17 to 23, 1939	August 31 to Sept. 7, 1955
Highest Maximum	107°	110° ¹
Average Maximum	103.4	103.1
Highest Minimum	84.0 ¹	83.0
Average Minimum	74.4	74.5
Highest Mean	94.0	96.0 ¹
Consecutive days, 100 or above	7	8
Relative Humidity, Noon	19	26
Precipitation September 19	.04	0
September 21	Trace	0
September 23	Trace	0

¹Highest on record for Los Angeles, California.



The mesic, Rice Paper Plant, *Tetrapanax papyriferum*, seven days (September 15) after the end of the September 1955 heat wave

heat wave; only the youngest leaves remained on the tips of the branches. This rapid defoliation was augmented by wind.

The Blue Gum, *Eucalyptus globulus*, is believed to be the most rapidly growing tree in southern California, in good soil and adequate water. However, under the conditions of the chaparral vegetation of the Santa Monica Mountains about twenty miles inland from the coast, its success seems to be directly related to the water supply. Early autumn is a critical period for the Blue Gum under these local conditions. This tree's capacity to intercept night fogs is noteworthy. When these autumn fogs occur, so much moisture is condensed by the foliage of the Blue Gum that the ground beneath becomes visibly as wet as if a rainstorm had occurred. Three categories of plant behavior of the Blue Gum were observed in this locality. The best growth is that of a twenty-one-year-old on a north slope of the Santa Monica mountains below the

drainage of a cesspool and a thoroughly watered lawn. This tree has a trunk diameter of two feet and six inches, and an estimated height of seventy feet. Greatly contrasting with this tree is a Blue Gum on a south exposure, subject to no artificial watering, and unfavored for natural precipitation because of being near a black-top pavement. Although approximately thirty years old, this Blue Gum succumbed to the September 1955 heat wave. A third Blue Gum, growing in approximately intermediate moisture conditions, was dependent entirely upon natural precipitation including interception of fog; may be favored by moisture accumulation near its root system because of the peculiar terrain at the foot of a canyon. This tree showed up to fifty per cent necrosis of the surface of many of last year's leaves. This necrosis did not appear to affect abscission. The illustrations show these three Blue Gum and the necrotic adult leaves.



Two Blue Gums, *Eucalyptus globulus*, in extreme edaphic conditions of soil moisture:
Adequately supplied with soil water and no evidence of leaf injury (left)
No artificial watering and dead with persisting dead leaves (right)



A Blue Gum tree at the base of a small canyon and adult leaves showing extent of necrosis
(Photographed July 20, 1956)

The second or autumnal flowering and fruiting of the White Mulberry was particularly impressive; the fruit matured and was sweeter than the earlier crop in May of the same year, 1955. Furthermore this tree has also produced an early 1956 crop, and the first appearance of the 1956 autumnal inflorescences was observed on September 29. This tree appears healthy; it is sixteen years old, has a trunk diameter of eight inches and a crown radius of fifteen and one-half feet.

Further analysis of the data will appear in the discussion.

Discussion

The climatic extremes studied in this southern California area are mild winter and early autumn heat waves. The principle of multiple causation has not been ignored as an important guide in the interpretation of field observations. However, an attempt is made to emphasize the factor which, because of its increased intensity, has a predominating influence, and therefore serves as a clue to the causes of the changes in behavior patterns.

The analysis of the data presented here shows that January 1953 with 157 heating degree days had the smallest number of any January of the five years studied, i.e., the least chilling, was effective in prolonging the dormancy of Cling leaf buds. Whereas January 1955 with more than twice as many heating degree days, more than twice as much chilling, was effective in breaking the dormancy of Cling leaf buds. Yet the total chilling at the end of January 1955 exceeded that at the end of January 1953 by only 17 heating degree days. However, at the end of February 1955 the total chilling had increased over that at the end of February 1953 by 60 heating degree days, resulting in good floration and foliation of Cling peach of 1955.

The conclusions of Weinberger (18) from his Georgia experiments with Sullivan Elberta peach have some bearing on the interpretation of results with Cling. He concluded that continuous moderately higher temperatures delayed breaking of the rest of flower buds more than did brief periods of high tempera-

tures, but the later had greater delaying effect on leaf buds. The data and results at Los Angeles are comparable to those in Georgia. The daily records of temperature in Los Angeles for January 1953 (15) show three scattered, two-day periods having mean temperatures of 66 or above, and finally a four-day period at the end of the month with mean temperatures of 66 or above. Under these conditions, the Cling flower buds were activated, but the leaf buds were delayed. Whereas for January 1955 the conditions were very different with only one day having a mean temperature of 66. Both flower and leaf buds of Cling had normal activity and a 1955 crop of fruit matured.

The spectacular protective effects of a Eucalyptus windbreak by shading mild-winter sensitive peach varieties were again established by Weldon (20) in 1934 at Ontario, California. There were five rows of Salway and Southern Tuscan varieties, within 111 feet of this 80-foot windbreak, which came into bloom by April 7 and bore a full crop of fruit. The early leafage was due to the cooling effect of the shade mostly between December 1 and February 1. Beyond the sixth row the foliage had hardly started by April 7 and no fruit occurred, although there was a scattering of flowers.

I personally observed the results of this augmented chilling by shade of the Eucalyptus windbreak during a Southern California Botanist's field trip conducted by Weldon on March 30, 1940.

This cooling effect of shade suggests that the upper branches of Cling peach and Silver maple may have shaded the lower parts of the trees, thus providing enough additional chilling to activate the leaf buds in the lower parts of these trees while the leaf buds on the terminal shoots had prolonged dormancy as shown in the illustrations.

Dormancy in woody plants reviewed by Samish (13) indicates that chilling requirements have been determined for a large number of varieties.

In contrast to the mild winters and delayed responses of plants, the September heat waves have received much less at-

tention. It appears that conditions unfavorable for vegetative activity have initiated second floration among certain spring-flowering plants. There is more information available on the physiology of flowering than provided for in the scope of this paper.

Summary

1. The correlation of plant responses of Cling peach with climatological data has been extended to include the five-year period of 1951-52 to 1955-56.

2. Evidence is presented to support this correlation.

3. Cold-weather deciduous plants, long known to be adversely affected by mild winters in a Mediterranean climate, are illustrated with orchard and ornamental (shade) plants.

4. Delayed foliation of Silver maple because of mild winters is equally spectacular with that of Cling peach.

5. Climatological data on two September heat waves, 1939 and 1955, are correlated with plant responses.

6. The Rice Paper plant in partial shade showed excessive defoliation of older leaves within seven days after the end of the September 1955 heat wave.

7. Autumnal flowering has been observed in Scrub Oak, which has its normal flowering peak during April.

8. The White Mulberry bore two heavy crops of fruit during 1955, one in May and the other in November. A heavy May 1956 crop is now followed by full floration, first observed September 29.

9. It is now further concluded that extreme climatic departures from normals disturb plant behavior patterns, particularly among plants at the physiological margins of their distribution.

10. Field observations and a review of their literature support this conclusion.

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Vegetative Propagation of Beach Plums

W. L. DORAN & J. S. BAILEY

For many years beach plum jelly has been offered for sale on nearly every roadside stand in the Cape Cod section of Massachusetts. This unique and tangy jelly is made from the fruit of the small plum, *Prunus maritima* Marsh.

There are thousands of acres of these plums growing wild in the sand dunes and on the coastal plains from Virginia to New Brunswick. Since they are all seedlings, they differ markedly in growth habit and size of bush, as well as in color, flavor of fruit, and many other characteristics. Because of this great variability, some bushes bear more and better fruit than others. Unfortunately, crops are uncertain. A large crop is produced only once in three or four years.

Naturally, the jelly manufacturers would like a more reliable and more productive type of bush that produces better quality fruit. Several attempts have been made to bring about the desired improvement. Whenever a better bush is found, it must be multiplied to take advantage of its good qualities. Since beach plums, like cultivated plums, will not "come true from seed," some form of asexual propagation, such as the rooting of cuttings, must be resorted to. Several methods of asexual propagation have been tried with varying degrees of success. None has proved entirely satisfactory. No improvement program will be fully successful until an easy and rapid method of propagation is developed.

The work described in this report is an attempt to find a better solution of this problem of propagation. Propagation by cuttings seemed to offer the most promise because of the number of cuttings which can be obtained from a single bush and the ease and speed with which they can be made. Therefore, three types

of cuttings were tried: hardwood stem cuttings, softwood stem cuttings, and root cuttings. Root cuttings seemed especially promising, judging by previous work. Material to make the cuttings was obtained from bushes growing in Amherst, Brewster, Dennis, and Wareham, Massachusetts. Most of the work was done in a greenhouse with sand as the propagating medium.

Occasional reference is made to the use of indolebutyric acid, usually abbreviated hereafter to IBA. IBA, 8 mg. per gram of talc, corresponds to Hormodin No. 3; IBA, 3 mg. per gm. talc, to Hormodin No. 2; and IBA, 1 mg. per gm. talc, to Hormodin No. 1. These are the powder-dip treatments that were used and compared with each other and with solution-immersion treatments, such as IBA, 50 mg. per liter of water, for the numbers of hours indicated.

Results with Hardwood Stem Cuttings

Hardwood stem cuttings were taken while the plants were dormant from December through March, and variously handled and treated. The results obtained with hardwood cuttings were not encouraging.

Ordinary stem cuttings made from wood of the current year failed to root or rooted in very low percentages whether or not they were treated with IBA, 8 mg. per gm. talc. Storage in moist sphagnum at about 50°F. for 46, 83, or 111 days at 50°F. had no effect on the response to this treatment.

Hardwood cuttings made from two-year-old wood, with a bit of older wood at the base, were taken in late February and immediately planted in the greenhouse. Only 10 per cent of the untreated cuttings rooted. Treatment with IBA, 8 mg. per gm. talc, resulted in the rooting of 18 per cent.

¹Contribution No. 1077 of the University of Massachusetts, College of Agriculture Experiment Station, Amherst, Mass.

Results with Softwood Stem Cuttings

In earlier work of the writers (2), (3),² softwood cuttings of beach plum rooted better if taken in June, when fruits were one-eighth to one-fourth inch in diameter, rather than in May or July. Cuttings that rooted best were made from short lateral shoots with the basal cut made at the base of the current year's growth. Treatments with indolebutyric acid, 50 mg. per liter of water, for four hours or with IBA, 1 mg. per gm. talc, markedly increased the percentages of cuttings that rooted, the powder-dip treatment giving the better results.

In later work, softwood cuttings were successfully taken from June 15 to July 15 in four different years. Cuttings taken earlier or later rooted in low percentages or not at all. Cuttings taken in July sometimes rooted better if made from the tips of shoots rather than from entire shoots. Rooting of softwood cuttings was completed in four to nine weeks. Cuttings taken early in the season usually rooted in less time than those taken later.

There was usually no rooting of untreated cuttings and rarely more than 10 per cent rooted. There was 29 to 70 per cent rooting of treated softwood cuttings.

Rooting of softwood cuttings was improved by powder-dip treatment with IBA, 8 mg. or 3 mg. per gram talc. Rooting was usually less improved by IBA, 1 mg. per gm. talc.

IBA, 3 mg. per gm. talc, gave better results than IBA, 8 mg. per gm. talc, with softwood cuttings taken in late June and early July.

Indolebutyric acid applied to softwood cuttings by the solution-immersion method also improved rooting. Effective treatments were IBA, 50 mg. per liter of water, for 5 or 7 hours. This treatment usually gave better results than treatment for 16 or 24 hours.

The addition of the fungicide Phygon (50 per cent 2,3-dichloro-1,4-naphthoquinone), 600 mg. per liter, resulted in further improvement in rooting.

Rooting of softwood cuttings taken in early July was more improved by equal

²Numbers in parentheses refer to literature cited at end of paper.

parts of that fungicide and Hormodin No. 3 than by Hormodin No. 3 used alone.

Similarly, softwood cuttings taken in early July rooted in lower percentages after treatment with Hormodin No. 3 than after treatment with a mixture of one part of the fungicide Captan (50 per cent N-trichloro methylmercapto-4-cyclohexene-1,2-dicarboximide) and six parts of Hormodin No. 3.

In four instances, solution-immersion treatments gave better results than powder-dip treatments. In two instances, percentages of cuttings that rooted were higher with powder-dip treatments, and in one instance the percentages that rooted were approximately equal with these two types of treatments.

Results with Root Cuttings

Creech (1) lists several species and genera of woody plants that have been propagated by root cuttings. These include, in addition to beach plum, *Albizia julibrissin* Durazz. (silk-tree), *Chaenomeles* (Japan quince), *Clethra* (sweet pepper bush), *Cyrilla racemiflora* L. (leatherwood), *Daphne*, *Ilex* (holly) *Koelreuteria* (China-tree), *Syringa* (lilac), *Wisteria*, and *Xanthoceras*.

Graves (6) has described a method of propagating beach plums by root cuttings. He prefers to make them in autumn, using roots the diameter of a lead pencil. These are cut into short lengths and planted vertically in frames or open ground, their tops covered with an inch of soil. If planted in flats in a cold greenhouse, the tops are set flush with the surface of the soil. Or root cuttings may be planted horizontally out-doors and covered with two to three inches of soil. He adds that cuttings planted in frames or outdoors should be well mulched.

Most of the work of the writers with root cuttings of beach plum was done in the greenhouse. Larger percentages survived and grew than was the case when cuttings were planted in the field and mulched or when placed in a cold frame. This was true of cuttings taken both in spring and fall. Forty to 52 per cent of the cuttings taken in October and November made top and root growth in a

greenhouse, and not more than 12 per cent of the cuttings taken at that time lived in a sash-covered cold frame.

Root cuttings were made by cutting the roots with pruning shears into pieces about 3 inches in length. It may be important later to distinguish between the proximal or upper end of the root cutting, the end nearest to the crown of the plant or the base of the stem, and the distal or lower end, the end farthest from the crown of the plant. The cut at the proximal end was accordingly made squarely across or at right angles to the length of the root, and the cut at the distal end was made diagonally.

Horizontal lower branches of beach plum that have become buried in sand and from which shoots grow may also be used as a source of root cuttings. When such cuttings were taken from three plants in early November and planted horizontally, 50, 41, and 22 per cent of them made top and root growth. These results were as good as those obtained with ordinary root cuttings made from the roots of these plants at that time.

Eggert (5), in his work with an apple, *Malus robusta* (Carr.) Rehd., found that the diameter of the root from which root cuttings are made is important. Seventy-six per cent of the root cuttings of this species developed into trees when made from roots one-fourth inch in diameter, and only 22 per cent developed into trees when cuttings were made from roots one-half to one inch in diameter.

Root cuttings of beach plum made from roots three-fourths to one inch in diameter sometimes made root and shoot growth, but cuttings made from roots of smaller diameter gave better results. Root cuttings taken in early November lived and grew when roots were one-fourth to one-half inch in diameter, but cuttings from larger roots all died. Twenty-seven per cent of the root cuttings made in mid-October lived and grew when made from roots one-fourth to one-half inch in diameter. None of the cuttings made from larger roots survived. Fifty-two per cent of the root cuttings taken in early December lived, and none was more than a half inch in diameter.

Root cuttings taken in early October were divided into three groups on the basis of diameter. Forty-four per cent of those with a diameter of one-half inch and 41 per cent of those with a diameter of one-fourth to one-half inch made root and shoot growth.

Age of plant is also a factor in rooting. Root cuttings were taken in late November from roots of plants three years old and from roots of plants known to be much older. Root cuttings from the older plants all died, but 43 per cent of root cuttings from the younger plants made shoot and root growth within three months. Root cuttings taken from old plants in late April also died without making growth.

Root cuttings made from upper and lower parts of roots may give equally good results. Thus cuttings taken in early March from two-year-old plants rooted and grew to the extent of 94 to 100 per cent whether made from upper or lower parts of roots. When there were differences, root cuttings made from the upper parts of roots gave better results.

It is interesting to note that, as reported by Creech (1), root cuttings of species of ten other genera have given better results when taken from those parts of the root nearest the base or crown of the plant.

Root cuttings were in some cases treated with indolebutyric acid or with naphthaleneacetic acid applied to the distal, lower end of the cutting or to the entire cutting. Such treatments, so important with softwood stem cuttings, were wholly without effect on root cuttings. Results with root cuttings taken in October, November, and March were in no way improved by treatments with indolebutyric acid, 1, 3 or 8 mg. per gm. tale; indolebutyric acid, 50, 100, or 200 mg. per liter, for 5, 12, or 24 hours.

Root cuttings were planted either horizontally or vertically; when vertically, either covered or with the proximal end extending about one-half inch above the surface of the rooting medium. Best results were obtained in four of five cases, when root cuttings were planted vertically with the proximal end exposed.

When root cuttings were planted vertically, with the proximal end down, and wholly covered, polarity was evident. Shoots then grew from the proximal end, and roots from the distal end.

Roots cuttings of an elm, a variety of *Ulmus carpinifolia* Gleditsch, also made better root and shoot growth when they were inserted in the rooting medium with the proximal end exposed rather than wholly covered (4).

If sand is placed around the base of new shoots growing from root cuttings, roots may grow from the lower parts of such shoots; in which case, such shoots may be detached. More plants are thus obtained, but they may be less vigorous or survive in lower percentages than plants that began as an entire root cutting.

Root cuttings were successfully taken, at least from some plants, in October, November, December, March, and April. In all propagation of woody plants by cuttings, there is the possibility of clonal differences in ability of cuttings to root. That is certainly true of the beach plum. Root cuttings made from some plants may give better results than those from other plants. Root cuttings were taken from four young plants in early November, kept separately, and all were planted horizontally. The percentages of the root cuttings that made shoot growth were 33, 0, 53, and 20.

Summary

The beach plum can be propagated by root cuttings and by softwood stem cuttings.

Hardwood stem cuttings taken during dormancy gave poor results.

Softwood stem cuttings, made from the current year's growth, rooted best when taken between June 15 and July 15.

The rooting of softwood cuttings was markedly improved by powder-dip treatment with indolebutyric acid, 3 mg. or 8 mg. per gram talc, or by solution-immersion treatment with IBA, 50 mg. per liter of water, for 5 or 7 hours.

Root cuttings survived and grew in greater percentages when made from roots one-fourth to one-half inch in diameter rather than from larger roots. They gave better results when made from young rather than old plants. Root cuttings made from the upper parts of roots are preferable to those made from the lower parts.

Root cuttings did not respond to treatments with indolebutyric acid or naphthaleneacetic acid.

Larger percentages of root cuttings lived and made subsequent growth when planted vertically with the upper end above the surface of the rooting medium.

Some individual plants are much more readily propagated by root cuttings than are others.

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A Book or Two

(Books designated "(Library)" are available for loan to the Membership)

Roses for Pleasure. How to Select, Grow, Use and Enjoy Them.

Richard Thomson & Helen Van Pelt Wilson. D. Van Nostrand Company, Inc., Princeton, New Jersey. 1957. 207 pages. Illustrated. \$5.95. (Library).

It is possible, of course, that roses can be grown for other reasons than pleasure; but it is difficult to figure out what those reasons might be, because it is a well known fact that even the commercial man who grows roses, presumably for profit, derives more pleasure than pecuniary gain from his rose-growing efforts.

Aside from its redundant title, the book is worthy of a place on any book shelf. It is written in an easy smooth-flowing style by two individually charming people who apparently get pleasure out of writing about roses as well as growing them.

The short history of the origin of our present day roses is sufficient for the average gardener. The selections of species, shrubs, climbers, older roses, hybrid teas, polyanthas and floribundas are well chosen. Great care has been used to make sure that all roses listed are available in the trade.

Chapters on soil preparation, planting, pruning and general care are precise and easily followed; but when it comes to pests and pest control, the authors choose to list the various troubles in alphabetical order thus mixing insects of various types with animals and fungous and bacterial diseases. This procedure may cause a slight confusion. However, in each case a good description of the offending pest is followed by remedial procedure and specific material to use in controlling it.

The last part of the book contains references to the six main climatic divisions in the United States. Included is a list of roses or rose types which can be expected to do well in each zone. This part also has a chapter on how to use roses in the large as well as in the small garden. It is followed by a valuable guide to the important matter of judging and exhibiting roses. The final chapter is about the American Rose Society, its many functions and its value to rose lovers and rose growers all over the United States.

Beautiful plates in color and black and white together with a number of line drawings add to the value of this attractive book.

NIELS J. HANSEN

Gardening Indoors Under Lights.

Frederick H. Kranz & Jacqueline L. Kranz. The Viking Press, New York. 1957. 241 pages. Illustrated. \$4.95 (Library).

Growing of plants entirely under artificial light gives a gardener an opportunity of growing plants without a greenhouse and without the need of an outdoor area. The authors have written this for the person without technical background. They explain the theory of growing plants under artificial light and describe the several ways in which this may be done.

These suggested uses range from simple lamps or lights over plants in the home to larger installations of rooms or areas where many kinds of plants may be grown together. These are followed with information on the soil, temperature, and general culture of such plants. Suggestions are made on the use of such lights for the propagation of plants and starting seedlings for the garden.

There is much information which would be helpful to the home greenhouse gardener who could adapt some of these practices to the greenhouse or who could supplement his growing area by making use of cellar space with artificial light.

CONRAD B. LINK

The Home Gardening Encyclopaedia.

Philosophical Library, Inc., New York, 1955. 368 pages. Illustrated. \$6.00. (Library).

As desirable as it may be to have one handy-sized book as a source for information on any garden problem, the question is bound to arise as to whether such a book is possible. It is true that this book does contain something about almost any subject pertaining to gardening, but the gardener is apt to find this somewhat too sketchy to be of help. An even more serious drawback of this particular book for the American gardener is the fact that it was written for British gardeners and not only are climatic conditions in the British Isles quite different from those in most of this country, but the types of plants suitable for and available in Britain are apt to be quite different from those here. As an example, there are included colored illustrations of twelve apples, not one of which is grown in this country to any extent.

For those who feel that such a limited "encyclopedia" is of use, there are several written for American gardeners that would be far more practical here.

D. G. H.

Greenhouse Gardening Around the Year.

Marion Dulles. The Macmillan Company, New York. 1956. 195 pages. Illustrated. \$3.75. (Library).

Gardening in a Small Greenhouse.

Mary Noble & J. L. Merkel. D. Van Nostrand Company, Inc., Princeton, New Jersey. 1956. 236 pages. Illustrated. \$4.95 (Library).

The Complete Book of Greenhouse Gardening.

Henry T. Northen & Rebecca T. Northen. The Ronald Press, New York. 1956. 353 pages. Illustrated. \$6.50. (Library).

Small home greenhouses are of increasing interest for gardeners who, if they don't have one, probably are at least dreaming or planning for one. A greenhouse provides an opportunity of enjoying plants the year around. It's a hobby that becomes endless since there will probably never be space enough for all the many plants you would like. It can become a greenhouse of special groups of plants or one with as many kinds as possible.

Each of these books is organized in a somewhat different manner but includes the essentials as to kinds and locations to construct a greenhouse, soils, propagation, management and pest control.

The first book is organized on a calendar basis of jobs to be done each month. This arrangement does not lend itself to easy reading about a plant or operation in one place but requires looking at several spots in the book, or it may not always be timely such as the discussion of Chrysanthemums which is mainly in the November chapter. A group of several chapters in the back of the book give brief notes on the culture of many kinds of plants.

Noble and Merkel have included other structures in which to grow plants that are useful under certain conditions such as shade or lath houses and cloth houses. Another chapter is devoted to cold frames, hotbeds, window greenhouses and other small structures. They include many tropical shrubs and vines in their chapter on greenhouse plants. Many of these are not commonly seen in greenhouses.

The Complete Book of Greenhouse Gardening is the best of the three mentioned to be used as a reference by the amateur operator. The many plants that are suggested for greenhouse culture are grouped into chapters of related kinds either botanically, as the Gesneriads, or with similar culture as bulbs for forcing. This arrangement is easy to turn to to find the information on a given plant. There are many illustrations of plants and sketches to help the reader.

CONRAD B. LINK

Snowdrops and Snowflakes.

F. C. Stern. The Royal Horticultural Society, London. 1956. 128 pages. 18 plates, 5 in color. 20 line drawings. \$3.82

This is an outstanding work for horticulturists on the wild species, subspecies, and varieties of *Galanthus* and *Leucojum*, and the cultivated forms and hybrids of the former. Sir Frederick Stern deals with classification and taxonomy, and history and geography, of these plants, based on studies begun in collaboration with the late E. A. Bowles. Garden cultivation is covered briefly, but adequately. The illustrations are superb; the typographical arrangement equally superb.

Today there are available in cultivation, particularly in England, many snowdrops and snowflakes beyond the common snowdrops (*G. nivalis* and *elwesii*) and the spring and summer snowflakes (*L. vernum* and *aestivum*) that are well known to American gardeners. Wishfully, *Snowdrops and Snowflakes* may induce American and Dutch nurserymen to carry a greater range of these small bulbs. Most bloom in very early spring and are adapted to woodland conditions as well as sunny beds.

The late summer and fall blooming *L. roseum* with pink flowers and *L. autumnale* with pink-tinged flowers, and the November-flowering *G. coreyrensis* are rarely seen here. More gardeners should try the garden forms of snowdrops, as, 'S. Arnott,' 'Straffan,' 'Akinsi,' and 'Colesbourne.'

This book takes its place alongside Bowles,' *Crocus and Colchicums* and his *The Narcissus*, Woodcock and Stearn's, *Lilies of the World*, and Hall's *The Genus Tulipa*, as comprehensive treatments of genera of "bulbs" written for the serious gardener. We hope one of these days British horticulturists will also tackle in the same fashion such genera as *Scilla*, *Muscari*, *Allium*, and others.

FREDERIC P. LEE

Intercrossing Among Pink Calla, White Calla, and Yellow Calla Lilies.

Ryoshitsu Shibuya. Kasai Publishing and Printing Company, Tokyo, Japan. 1956. 57 pages. Illustrated.

This is an extensive discourse into the genetics of calla lily breeding. It is the kind of effort that seldom is approached by ornamental research workers mainly because of the intensity applied. The main objective was to produce callas with a wide range of spathe colors. The breeding work from 1937 to 1955 somewhat resembles the intensity of another Japanese worker who studies natural variations in *Lilium speciosum*. It serves to illustrate the keen perception in the Japanese for detailed variation in ornamental plants. It is a good book for the serious breeder at least to look through for an idea of what is involved in proper recording of breeding results. It is not a book that one would want for light reading or for general education in plant breeding.

J. L. C.

*47th Annual Report of the Northern
Nut Growers Association, Inc.*

George L. Slate, Publications Chairman.
Geneva, New York. 1956. 160 pp. (Library).

This yearbook is not only of interest to association members for the proceedings of the annual meetings but to horticulturists in general for up-to-date information on the specialized field of nut culture. The list of nut-bearing trees recommended for planting at the Holden Arboretum, Mentor, Ohio, might well serve as a guide for other institutions and individuals wishing to establish a general collection of edible nuts.

Several of the papers pertain to the problem of blight resistance in the American chestnut. The U. S. Forest Service has undertaken a screening program to test surviving trees in the blight-swept area. Their methods are outlined in a paper by Jesse D. Miller. Several short reports follow on breeding problems with disease-resistant Chinese chestnuts. The discovery of an orange-kernel character is reported by J. W. McKay. This color shows up when certain lines are pollinated by certain other breeding lines but has not yet been fixed in one variety. The orange-colored kernels contained $5\frac{1}{2}$ times as much total carotenoids and $3\frac{1}{2}$ times as much carotene or vitamin A as normal kernels.

Valuable observations on fertility in the various species and hybrids of the JUGLANDACEAE as related to the pollen parent are reported in a paper by J. C. McDaniel of the University of Illinois, Urbana. The dates of flowering at that location and other notes are given for many varieties.

American persimmons receive attention in articles by Louis Gerardi and J. C. McDaniel. Both agree that 'Garretson,' 'Killen' and 'Early Golden' are the choice varieties for planting over the country where Oriental persimmons are not hardy.

HAROLD F. WINTERS

Lawns and Landscaping Handbook.

Thomas H. Everett, ARCO Publishing Company, Inc., New York. 1956. 144 pages. Illustrated. \$2.00 (Library).

This book is a member of "The Do-It-Yourself Series" of the Fawcett Publications, Inc. Other members of the series have gained wide acceptance with the general public in recent years. This is a hard-back publication, very informative and profusely illustrated for the benefit of the amateur gardener who intends to do his own landscaping.

Primary considerations of small property development are discussed with special emphasis on lawn building and maintenance.

Thomas H. Everett, curator of Education and Horticulturist of the New York Botanical Garden, is the author of a number of books on flowers and gardening and has also written several gardening editions of the Fawcett handbooks.
W. O. H.

*A.H.C. Handbook for Plant Originators
and Registrars.*

Commission on Nomenclature and Registration. American Horticulture Council. 1956. 43 pages. Obtainable from the Bailey Hortorium, Cornell University, Ithaca, New York. \$1.00.

This publication of the American Horticultural Council was prepared by one of its Commissions headed by George H. M. Lawrence, director of the Bailey Hortorium. Dr. Lawrence is a leading taxonomist in the field of ornamentals and has represented the plant societies of this country at the sessions of the International Horticultural Congresses in recent years.

The Handbook states for new plant introducers, registrars of the various special plant societies, horticultural writers, and others interested in the naming of plants, the principles embodied in two international codes adopted by the International Horticultural Congress. One is the International Code of Nomenclature for Cultivated Plants, adopted in 1952, relating to the principles governing the naming of cultivated varieties of plants; the other, the Code of Registration Procedure, adopted in 1955, relating to the registration of names of cultivated varieties of plants and compilation of lists of such names. There is an excellent glossary of terms which the gardener needs to know for his own protection in purchasing plants, as "clone," "cultivar," "grex," "species," "variety," "hybrid," and others.

The Handbook is a thoroughly competent piece of work, skillfully presented, that goes a long way in making the abstruse field of plant nomenclature clearer to the layman.

Fundamentals of Horticulture.

J. B. Edmond, A. M. Musser & F. S. Andrews. McGraw-Hill Book Company, Inc., New York. 1957. 456 pages. Illustrated. \$6.75. (Library).

This is a second edition of a textbook intended for a college course in general horticulture. It is written in a manner to first give a working knowledge of the fundamentals of plant growth and then to follow through and help develop the ability to apply these to the solution of practical problems. The final section of the book is devoted to a brief discussion of the principal horticultural crops of this country. The authors have done a good job in preparing a text for a general horticultural course which is a difficult one to teach because of the great diversity of crops and their relative importance in the different sections of the country. This book, especially the first part on plant growth and development and the second part on horticultural practices would be excellent reading for the amateur who wants to become better acquainted with plant growth and basic horticultural practices.

CONRAD B. LINK

A Glossary of Mycology.

Walter H. Snell & Esther A. Dick. Harvard University Press, Cambridge, Massachusetts. 1957. 202 pages. Illustrated. \$5.00

Dictionary of Microbiology.

Morris B. Jacobs, Maurice J. Gerstein & William G. Walter. D. Van Nostrand Company, Inc., Princeton, New Jersey. 1957. 300 pages. Illustrated \$6.75.

Time was when mycophagy, the eating of mushrooms (though the term has a connotation of scientific curiosity and discrimination far beyond this sensual equivalent), was a prevalent and honored interest of some horticulturists and many more lay gardeners and nature lovers. Now, with canned or frozen mushrooms (carrying at least the implied endorsement of the pure food authorities as to wholesomeness) available at nearly every grocery store, amateur mushroom hunting has gone into a decline. At the same time, industrial and medical mycology has, since the discovery of penicillin, been enjoying a protracted boom. Thus the even hand of justice preserves the balance of interest in mycology as a whole. Indeed, the subject is attaining—or regaining—cultural interest quite apart from its material ends.

This is the excuse, then, for mentioning in a horticultural journal books that seemingly are dedicated to professional mycologists and bacteriologists.

The earlier compilation of *Three Thousand Mycological Terms* by the senior author of the *Glossary* has now been expanded to nearly 7,000. Technical terms not only have increased in number but have gained in precision, necessitating greater refinement in their definition. Many of those in the *Glossary*—especially terms of form, color, surface and structure—apply almost equally to the seed plants that are more familiar to horticulturists. Besides these, there is a wide range of other terms—"modern or obsolete, popular or trivial, old wives' or scientific"—everything relating to the growth and properties of fungi is explained in concise dictionary style.

For those to whom the term microbiology is not too formidable, a veritable dictionary in this field will be of major interest. Professional mycologists, but not they alone, will welcome the *Dictionary of Microbiology* by Jacobs, Gerstein, and Walter, for there has been nothing of comparable scope available heretofore. The book really covers microorganisms and their activities—their names, scientific and popular, the materials used in and resulting from their metabolism, the methods used in cultivating them. An amazing amount of information has been condensed into small compass.

Chemists, veterinarians, and physicians, to whom modern microbiology was or is becoming something less than familiar—even writers of science, both technical and popular—will find this small volume among the most used of their reference works.

FREEMAN WEISS

Illustrated Guide to Trees and Shrubs.

Arthur Harmount Graves. Harper & Brothers, Publishers, New York. 1956. 271 pages. Illustrated. \$6.00.

This is a second edition to the 1952 guide which was privately published. The new edition includes the Winter Key to Woody Plants which was published as a supplement to the first edition. It is an illustrated (excellent pen and ink drawings, mostly by Miss Maud H. Purdy) guide to the woody plants—trees, shrubs, vines—of the northeastern United States and adjacent regions, whether cultivated or commonly found woody plants.

The guide is highly recommended for all interested in identifying the woody plants around them.

Japanese Gardens.

Jiro Harada. Charles T. Branford Company, Boston. 1956. 160 pages. 200 illustrations. \$8.50. (Library).

This is the successor to *The Gardens of Japan* and is intended to be an interpretation of the meaning of Japanese gardens and an expression of a national way of life for the Japanese, that being the need for conditions of deep meditation and peaceful surroundings such as is only provided in the casual but serene crypts of a small Japanese garden.

The plates are tastefully selected and are in warm tones that do much for the book which it is based entirely on photographs. These portray the various eras of Japanese gardens and their history. There are no discussions of plant materials and that may have been deliberate since the purpose is not scholastic but rather presumably "to open your eyes to the need for, and the value of rest and spiritual refreshment." It is a good book to have for simple quiet reading.

J. L. C.

Botany. An Introduction to Plant Science.

Wilfred W. Robbins, T. Elliot Weir & C. Ralph Stocking. John Wiley & Sons, Inc., New York. 1957. 578 pages. Illustrated. \$6.95.

Critical attention to every chapter has improved and modernized this text, used in more than 250 colleges in its first edition. There are many new illustrations—including color plates.

The text is designed to emphasize the plant as a whole as a living, functioning organism; the second edition gives increased stress to plant physiology. The discussion of photosynthesis and respiration is accurately yet simply presented and illustrated by diagrams similar to those used for nitrogen and life cycles.

The text is suitable both for science majors and as a terminal course for liberal arts students.

The Gardeners' Pocketbook

An Interim Report on Metasequoia glyptostroboides

Metasequoia glyptostroboides, the Dawn Redwood, was found in Szechuan Province, China, in 1941, by Professor T. Kan, and was later identified by Dr. Ralph W. Chaney, a paleontologist. In 1948 Dr. E. D. Merrill, Harvard University, obtained and distributed seeds of this "Living Fossil."

The U. S. Plant Introduction Garden obtained some of these seeds and distributed seedlings under P. I. 161688 and 165854, during 1949-1950, for evaluation and hardiness studies. They were distributed from central Florida to upstate New York; from Connecticut to Colorado.

After these seedlings had been planted for over six years it was deemed desirable to check on their hardiness. The recipients were requested to evaluate their plants and submit reports that would give an over-all preliminary picture of the ecological requirements of the species.

The distribution range had been deliberately selected to ascertain the plant's possible habitat in North America. A high mortality rate was anticipated at the temperature and humidity extremes. These expectations were realized. Several seedlings succumbed to accidents such as being cut down by a cutter-bar and salt-water flooding.

Only one of ten survived Iowa's -30°F . and dry alkaline soil. The sole survivor is barely holding its own. None survived Colorado's -32° , but four trees in a shipment of four lived through -20° in Colorado, with winter burning. These four are reportedly doing fairly well. Reports of temperatures as low as -14° , -12° and -11° were received. These metasequoias survived and are making thrifty growth, although five reportedly were winter killed in Connecticut, but the minimum temperature was not reported and there was no mention of a sudden freeze.

None survived in Florida, but no rea-

son for loss was given. This points up the question of cold requirements for breaking dormancy as a possible factor. Another possible factor is early start of spring growth followed by frosts. In Ohio some seedlings withstood temperatures up to 105°F . and as low as -14° in full sun and are reportedly making thrifty growth. Other cooperators, from South Carolina to Ohio, reported temperatures from 95° to 104° without noting summer injury to the metasequoia seedlings. All these seedlings survived periods during the winter when the temperature dropped well below 32°F .

Drought reportedly was a factor in the death of trees in New York, Nebraska and one area in Ohio. Two trees were planted near Washington, D.C., one in a dry upland area and the other in a moist, lightly shaded area. The former is fair, about five feet tall. The latter is making thrifty growth and is about twenty feet tall. Metasequoias have done well in the United States National Arboretum, Washington, D.C.

While juvenile cuttings of metasequoia can be rooted, only one horticulturist reported that he had done so. Softwood cuttings of metasequoia taken during the summer will root readily. From the standpoint of subsequent survival, it is deemed desirable to wait until the terminal bud has developed before taking the cuttings.

It appears that the climatic and edaphic requirements of this species limit its range to areas where the temperature remains between -15° and 105°F . and that partial shade and a moist soil are desirable. Geographically this restricts it to the eastern United States north of Florida (Wyman's Hardiness Zones 6, 7, 8 and possibly some areas in 5 and 9) and roughly south of the 42nd parallel (New York City) and areas on the Pacific Coast with a similar climate. — EUGENE GRIFFITH, *U. S. Plant Introduction Garden, Glenn Dale, Maryland.*



Gottlieb Hampfler

Longwood Gardens

Mandevilla splendens trained on fan-shaped wire support

Mandevilla splendens

Many plants have in the past been brought into cultivation, enjoyed a period of popularity and then, for one reason or another, have disappeared. In many cases the reason can be easily guessed. Either they are extremely difficult to grow or they have little horticultural merit. In other cases, however, their loss of popularity is difficult to account for. An outstanding example of this is *Mandevilla splendens*.

In 1841 a woody vine with large, showy, pink flowers called *Dipladenia amoena* was introduced into horticulture from the Organ Mountains of Brazil by the Veitch Nursery in England. During the next 50 or 75 years it became quite popular as a greenhouse plant in America as well as in Europe. Some twenty years ago it was obtained by Longwood Gardens from the Mitchel Estate at Oyster Bay, N.Y. It has been grown here ever since, but has disappeared from most other collections. If readers know of plants that did not come from here recently, I would appreciate hearing about them.

The plant at Longwood Gardens was grown under the name *Dipladenia amoena* until the winter of 1955 when I sent a specimen to Dr. Robert E. Woodson, Jr., at the Missouri Botanical Garden. Dr. Woodson, an authority on the dogbane family to which the plant belongs, identified it as *Mandevilla splendens*. We are treating the plant under this name although there is some evidence that it may not be correct. Chance seedlings of the plant grown at Longwood Gardens have smaller, lighter colored flowers indicating that the parent plant may be a hybrid instead of a true species.

The species is a woody climber with large, tuberous rootstocks which is trained on wire frames so that its ultimate size cannot be judged, but it could undoubtedly produce branches at least 24-30 feet long. Its opposite, dark green, rugose, lustrous leaves are oblong-elliptic, 3-8 inches long by 2-4 inches broad. The

racemose inflorescences are produced from alternate leaf axils. Each bears up to 20 flowers, of which one to four are open at a time. When each funnel-shaped flower first opens it is about 2.5 inches in diameter and is Dawn Pink (RHS Horticultural Colour Chart 523/3) with a flush of Rose Madder (23/3) and a darker (23/1) throat. During the three or four days that a flower lasts, it expands and darkens, reaching a diameter of 4 inches and becoming a dark Rose Madder (23/1).

A plant bearing numerous inflorescences is a striking sight, and its long flowering season, from April through November, makes it a very desirable greenhouse plant. The fruits which are occasionally produced consist of two long, slender follicles about 10 inches long and a half inch in diameter.

The plants do well in any good, well-drained soil. Here a mixture of one part chopped osmunda fiber to 4 or 5 parts loam with enough sand to give a light, well-drained texture is used. Flowers will appear the first or second year from rooted cuttings and a three-year-old plant requires a 12 in. pot or tub. They do well trained on dome or fan-shaped wire forms as shown in the illustration. Warm temperatures are best with 65° to 75° day and 60° night readings being excellent. Watering should be tapered off in late fall when flowering stops and a few leaves drop to be stepped up when growth resumes in early spring.

Cuttings from resting plants root readily in sand or vermiculite in from three to five weeks.

The plants at Longwood Gardens attract a great deal of attention and it is felt that the species would be a valuable addition to any greenhouse. In the past two years rooted cutting have been distributed to several other institutions and a few nurseries. It is expected that stock will become available to the public in the near future — DONALD G. HUTTLESTON, *Longwood Gardens, Kennett Square, Pennsylvania.*



Courtesy, American Begonia Society

Montreal Botanical Garden

Begonia paulensis

Begonia paulensis

Begonia paulensis was discovered by St. Hilaire in Brazil in 1859. Although this plant has not had wide publicity or distribution, it is of interest to the hobbyist as well as being a specimen for display in a botanical garden. This begonia with its shiny, medium green, almost round, peltate leaf, is distinctively striking with its ivory-white sinus or eye from which radiate the main veins. The prominent veins first carry the ivory color on the sinus, then slowly merge into the green of the leaf, becoming recessive. The radial veins are joined by cross veins which tend in a circle giving a fascinating spider-web effect. There are short, white stubble-like hairs running the rim of each "spider-web" section. On the underside of the leaf, we find the hairs are red, showing up distinctly on an apple-green background and pointing the vein pattern. The leaf petiole is light green, covered with one-quarter inch hair. New leaves appear quite red on the back with their concentrated red tomentum. When light shines through a new leaf, the web pattern on the leaf surface appears to be outlined in red and the leaf bordered with the same color.

The large white flowers in long, upright panicles are covered with red hair similar to *Begonia schaffiana*, which gives them a pink cast when viewed at a distance. The male flowers with hairy sepals and hairless petals open first and are practically gone before the hairy female flowers are matured. This possibly accounts for the lack of seed unless someone holds the pollen and hand pollinizes when the female flowers are ready. The red, hairy ovary wings form one corner—one very red. Other wings may also form here while the other ovary corners are only red lined. Seeds do set readily when pollinized with pollen from other begonias. In hybridizing, I have seen some interesting downward-cupped infant plants; some with red backing and vein pattern; but none with the peltate leaf or spider-

web pattern. The infant leaves arise resembling in their hairy juvenile stage the *B. paulensis* parent. It may take a second generation to produce a sturdier offspring with the much desired spider-web vein pattern.

This begonia requires much the same care as *B. howeri*—humidity, well-drained soil and just enough water to keep alive. It is grown successfully as a hanging basket specimen in soil or sphagnum moss culture or as a specimen pot plant usually set on a shelf in the greenhouse. The petioles are long requiring considerable space for this begonia.

It is propagated from cuttings or side shoots. (I still am experimenting with leaf propagation, but so far have not had satisfactory results.) — LOUISE CRAMER, Editor, *The Begonian*, Pasadena, Calif.

Plants Tolerant to Irregular Flooding by Tidal Water

All horticultural perspectives do not originate from hard and fast experiments. If so, this would not have been written. It all began with a discarded fig tree which refused to die, even after it had been cast aside as part of an organic fill in a salt marsh area back of my house. The original objective was to create a low-level terrace, so as to better observe the many species of birds which frequent the salt marshes of Tidewater Virginia.

The fig tree's tenacity to life under adverse conditions prompted the writer to plant it, hoping that in time it would provide shade. The elevation at which it was placed was approximately fifteen inches above normal high water or four feet above mean low water. The tides in this section of Tidewater Virginia vary approximately two and eight-tenths feet. This tree five years ago started my interest with what might be called "salt tolerant plants." I hope eventually to landscape my low-level terrace with such

plants and encourage others to experiment with plants suitable to their salt water locality and conditions.

In order to better understand existing conditions under which this terrace is being built, I will evaluate certain facts which have come under my observation. This is necessary, for dealing with tidal action in one section of the country would not in its entirety be applicable in another. I am, of course, referring to the fluctuation of tides. There is one index, which I believe is quite constant. That index is the type of vegetation which naturally grows along the tidal areas. From my point of observation I note that the so-called "marsh grass" will grow only where tides will flood it up to a few inches. It seldom grows out of water. Then just above normal high tides with its roots in the marsh mud we find what is commonly called in these parts "salt water bush," the Sea-Myrtle (*Baccharis halimifolia*). This plant seems to grow equally well several feet above normal high tides, in fact often miles inland where salt water never reaches. It is in this "Baccharis growing area" that I became interested as a result of the fig tree episode.

In the last six years I have planted quite a number of plant species under the most trying conditions. I have not been meticulous about their planting or care because I am in the process of filling in the area with organic refuse from my upper garden, consisting of weeds and clippings, and under no systematic or planned procedure.

Those species to date that have thrived under this treatment are, of course, worthy of mention. The Yaupon Holly (*Ilex vomitoria*) I was not surprised to find suitable because along Myrtle Beach in North Carolina it lines the beach as a beautiful wind-swept shrub. I was disappointed, however, that the other species of hollies, including the American Holly (*I. opaca*), did not survive the acid test of the Baccharis level which in this instance means at less than two feet elevation above normal high water. *Aucuba japonica* survived for two years but finally succumbed to repeated floodings.

One of the broad-leaved evergreens which really seems to thrive is the Japanese Pittosporum (*Pittosporum tobira*). My first three-foot specimen plant grew to cover eight feet in about three years. It was uprooted by hurricane "Hazel," but was reset and is doing fine. Among the fill material happened to be a couple of the hybrid Daylilies (*Hemerocallis* hy.). For the last two seasons these two daylilies have produced flower spikes that were equal to those which were produced under garden conditions. My greatest thrill, however, was to discover that the French or Bigleaf Hydrangea (*Hydrangea hortensis*, or *H. macrophylla*) grows well under those conditions. [It is believed that these plants have been used extensively as sea-side plants for fifty years or more. Ed.] These plants produce the bluest of blue flowers that I have ever seen. If this adventure in salt marsh gardening brings no further conclusive results, I shall be satisfied to landscape my lower terrace with Pittosporum and Yaupon for a background and Hydrangea and Daylilies for a foreground, with a fig tree for shade and accent. Moreover, *Vinca major* and *Euonymus fortunei* var. *vegetus* are ground covers that love the same surroundings; also *Oxalis* (an undetermined species of).

This year I expect to complete a thousand square feet of terrace. It will average approximately eighteen inches above normal high water.

Now a word about what I can expect from tidal invasions. At least once a month the terrace will be inundated not only by storm tides but by spring tides which, built up by a northeast wind, will raise the water level from eighteen to twenty-four inches above normal. Then perhaps three or four times a year storm tides will cover this area with at least two feet of salt water. Then when another storm like hurricane "Barbara" comes along, I can expect at least four feet of salt water. I do not expect to plant anything on the terrace which will not survive such tests as these.

There are, of course, numerous plants, native and otherwise, that will survive the occasional flooding such as a "Barbara" might bring. Here in Tidewater

Virginia many home owners experience this flooding at low levels. With the usual precaution of watering heavily after such saline invasions, few of our ornamentals suffer, not even azaleas and camellias which are planted in abundance in this region.

I might mention that of all the native trees which border our salt marshes, the Red or Bull Bay (*Persea borbonia*) will venture out to get its feet wet more than any of the others. These others include such trees as the Loblolly Pine (*Pinus taeda*), the Live Oak (*Quercus virginiana*), and the Bald Cypress (*Taxodium distichum*). The Bald Cypress, while more often associated with tidal waters where water is only on the brackish side or diluted with the fresh water, will grow and prosper a couple feet above normal salt tides.

There is, of course, much data to be sought out about plants tolerant to salt, especially those of economic value. I hope that this note will prompt others to experiment and report their findings. I am sure that many already have such data on hand. One thing I have found, however, is that the road is strewn with heartaches, because when you think some plant may survive, as did my Aucubas for two years, later they up and leave for higher elevations.

I am grateful to Mr. Aubrey D. Husted, meteorologist for the United States Weather Bureau in Norfolk, for the information concerning tidal action here.—
FREDERIC HEUTTE, *Superintendent, Bureau of Parks and Forestry, Norfolk, Va.*

Stewartia malachodendron

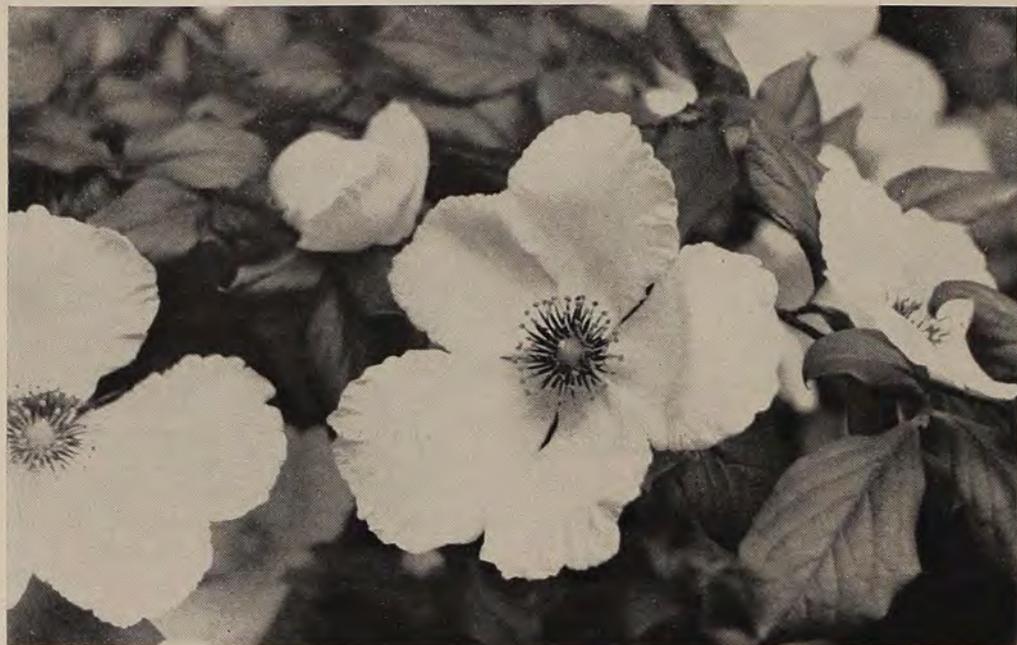
The genus *Stewartia* is a small one comprising two American and perhaps a half dozen Asiatic species of deciduous trees. The native American species occur in the southeastern United States, while the Asiatic species are found in eastern China, Japan and Korea. These members of the Tea or Camellia Family are alike in producing good size, showy white or creamy flowers. Most of the members of the genus are small trees under thirty feet in height, but *S. monodelpha*, a southern Japanese species with the smallest leaves and flowers of the genus, is a good-

sized timber tree reaching 80 feet at maturity and distinctive in appearance because of its smooth, flaking, orange bark.

Mrs. Mary G. Henry's article *The Stewartias*, published originally in April, 1938 and reprinted in the October, 1955 Anniversary Issue of the *National Horticultural Magazine* illustrates several species.

S. malachodendron, the "Silky Camellia," is interesting in that it occurs on the coastal plain from Texas to the eastern shore of Virginia as its northern limit. Throughout this range it is locally rare and in many cases probably unknown to the people living near by. When not in bloom it might be mistaken for a black gum sapling or some equally common scrub tree. Certainly its general appearance is not distinctive enough when out of bloom to prevent it from being cut as worthless scrub. No doubt this is one reason it is always mentioned as being rare even in nature. For a tree that has been known and in cultivation for over two hundred years, few people in this country know it by sight or name and even fewer can tell you when it blooms. On the latter score even the botany texts are wrong, listing its period of bloom as "early June." Certainly throughout its native range few if any of this species bloom this late. Early May is a much more likely date at the northern limit of the range. The mistake is probably easily explained, for in cultivation north of its range it may bloom in June; and all of the other species bloom much later, usually in late June or July.

A trip to the Norfolk, Virginia, area in early June of this year was unsuccessful in locating a native stand of *S. malachodendron*. Three mature specimens out of bloom were seen in the garden of Mrs. Asperngreen in Norfolk and we were shown pictures taken in late April, close on the heels of the flowering dogwood, showing these trees in full bloom. The three- to four-inch bowl-shaped white flower, reminiscent of a single camellia, is set off by a pom-pom of dark purple stamens in the center. As the flowers are produced in considerable number and open near the same time, a tree in full bloom is very showy. These 15-18 foot



Flowers of *Stewartia malacodendron*

trees had been collected from a small grove in a wooded area near the town of Pungo below Norfolk several years before. An attempt to locate the original stand this spring yielded a typical story. The "scrub" trees had been cleared and a flourishing corn field grew in their place.

The day after the visit to see the trees in cultivation we visited the Eastern Shore of Virginia and saw a wooded section near Wachapreague that still is said to harbor a grove of the "Silky Camellia." Mature loblolly pines (*Pinus taeda*) growing in light sandy soil with water just a few feet below the surface sheltered plants such as the high bush blue-

berry (*Vaccinium* sp.) and the Swamp Azalea (*Rhododendron viscosum*). Shelter from strong wind and culture similar to that given rhododendrons and camellias suit the "Silky Camellia" to perfection.

In common with *Franklinia*, *S. malacodendron* is hardy much north of its range. It is grown successfully in Philadelphia and near the coast on Long Island. Certainly if a source of supply can be found, the tree should be tried in regions that are suitable for hybrid rhododendrons.—FREDERICK W. COE, *Bethesda, Maryland*.

The Palm Society

This, perhaps the youngest of our sister Horticultural Societies, was informally organized in November, 1955, largely through the enthusiasm and work of Mr. Dent Smith of Daytona Beach, Florida. Five months later, in April of 1956, a constitution and by-laws were adopted and officers and directors elected. In the short 18-month period of its existence, this voluntary organization has grown into a virile young Society of over 300 members. Starting in January of 1956 with informal processed bulletins, it now finds itself, a year and a half later, completing the first letterpress volume of its new illustrated quarterly journal, *Principes*.

The purpose of the Society is to disseminate information about the palms, both scientific and horticultural, and to promote a wider interest in these noble plants. Officers of the Society at present are: President, W. H. Hodge, of Longwood Gardens; Vice-President, R. Bruce Ledin, of the University of Florida Sub-Tropical Experiment Station; Executive Secretary, Lucita H. Wait; and Treasurer, Nat J. De Leon. Harold E. Moore, Jr., of the Bailey Hortorium of Cornell University, serves as editor of *Principes*.

Anyone keenly interested in the palms is invited to join the Society. Further information may be obtained from the Executive Secretary, Mrs. Lucita H. Wait, 7229 S.W. 54th Avenue, Miami 43, Florida.

Plant Exploration in the Mediterranean for Ornamentals

During the four-month period, March to July, 1957, Dr. Frederick G. Meyer, dendrologist on leave of absence from the Missouri Botanical Garden, St. Louis, conducted an exploration for ornamental plants throughout Spain, Portugal, Italy and southern France.

Visiting botanical gardens, private estates, nurseries, and experiment stations in these countries, Dr. Meyer's primary

objective was to locate not only fresh germplasm of plants already in cultivation in the United States, but also kinds of plants either lost to cultivation or essentially unknown in this country as garden plants. This kind of plant introduction program carries with it many practical applications of a long term nature in view of the tremendous interest in ornamental gardening now prevalent in the United States. Several hundred collections have resulted from Dr. Meyer's travels in these Mediterranean countries. The majority are destined for trial in comparable climatic areas in the United States as well as under conservatory conditions.

This Mediterranean work is the second in a sustained program of exploration for ornamental material for American horticulture. It is sponsored by Longwood Gardens of the Longwood Foundation, Inc., Kennett Square, Pennsylvania, cooperating with the Plant Introduction unit of the U.S. Department of Agriculture, Beltsville, Maryland. The first exploration under this new program was undertaken in the fall of 1956 in southern Japan by Dr. John L. Creech, horticulturist of the U. S. Plant Introduction Garden, Glenn Dale, Maryland.

Solanum quitoense as an Ornamental

One of the most flavorsome and refreshing of tropical fruit juices is obtained from the tomato-like fruits of *Solanum quitoense*, a large herb native to the mild (70°-85°F.), humid (60-100 inches of well-distributed annual rainfall), eastern slopes (4000-5000 feet elevation) of the Andes of Ecuador. Although this species is relatively well-known to horticulture in that republic (under the name *naranjilla*, literally "little orange") as well as in neighboring Colombia, it has received until recently scant attention elsewhere. At present attempts are being made to extend the range of utilization and commercial culture to favorable areas in other parts of the American tropics.



Gottlieb Hampfler

Longwood Gardens

The attractive foliage of *Solanum quitoense*

Quite apart from its prime importance as a source of an important fruit, *S. quitoense* is an attractive ornamental plant. The purpose of this note is to call attention to its possible use, when properly grown, as an interesting foliage ornamental for greenhouse or conservatory.

By nature the species is a rather coarse perennial herb, in habit of growth resembling that of its relative, the more diminutive eggplant, *S. melongena*. However, *S. quitoense* may attain an ultimate height of 6 to 8 feet with large leaves sometimes as much as 2 feet in over-all length. The leaves are what give this species its chief ornamental value, not only because of their size and interesting form, but also because of the attractive pattern made by the bold vein system, which is often, particularly in juvenile leaves, a striking purple color. At maturity the leaves are a rich deep-green above and light-green below, but when young they also are colored purple beneath. As an added feature all aerial portions of the plant are clothed with soft hairs, which are especially plush and attractive on the youngest growth.

Specimen plants best serve as ornaments in their youth prior to flowering, for as the plants mature they incline to become too tall and leggy, the older lower leaves then yellowing and dropping. Plants 3 to 5 feet tall are below average eye-level permitting enjoyment of the interesting living mosaic produced by the large leaves.

The white star-shaped flowers, typically solanaceous in form, are comparatively small and not particularly showy being somewhat hidden at each node where they are borne in corymbose clusters. Although the species flowers freely under conservatory culture, it is said not to set fruit in temperate latitudes. At Longwood Gardens the plants now on display are still (July, 1957) too young to determine their fruit-setting ability, but plants grown at The New York Botanical Garden during the period 1945 to 1947 were reported by Dr. A. B. Stout to have produced abortive pollen. It is

suspected that this species, like many others native to equatorial latitudes, may require the ratio of day and night to which it is accustomed in its home to properly complete its life cycle. It does, however, set fruit at Homestead, Florida, where it has been successfully grown at the Subtropical Experiment Station of the University of Florida.

S. quitoense is readily grown from seed or from rooted stem cuttings. Fresh seed germinates easily, but its length of viability may be expected to be limited as with the tomato with which it shares similar requirements with regard to soil. Unlike the tomato the *naranjilla* does best in partial shade rather than full sun, and to expect the best development it should be grown under humid tropical greenhouse conditions. The species is a heavy feeder, likes rich compost, and if kept potted up should be fed regularly once its roots have become confined. Under such a regime it should prove an interesting and unusual addition to a conservatory collection of ornamental foliage plants—W. H. HODGE, *Longwood Gardens, Kennett Square, Pennsylvania*.

Butterflyweed, a Neglected Native Ornamental Plant

When one visits the gardens of Europe, especially in England and the Scandinavian countries, one is impressed by the number of American "weeds" that are grown and cherished. Wisley Gardens, in Surrey, a plant testing ground of the Royal Horticultural Society, gives much space to our various wild flowers, especially those in the Sunflower Family. Many of the small suburban gardens of Stockholm proudly display massive plantings of such plants as our ordinary goldenrod.

Another such "weed," less frequently grown, is our widely distributed *Asclepias tuberosa*, commonly called "butterflyweed," "pleurisy root," and sometimes, uncomplimentarily, "chiggerweed." This plant, as well as many others of our wild species, deserves a larger place in our ornamental planning. We should certainly have as much interest in them as our European friends.

According to R. E. Woodson, an authority on the Milkweed Family, to which this plant belongs, four subspecies comprise the butterflyweed which, when combined, have an area of distribution from southern Ontario, south to Florida, west to Nebraska and South Dakota, and southwest to Sonora, Mexico. They occur from near sea level up to 6,000 feet altitude, and are nearly ubiquitous as far as their habitat requirements are concerned. Plants may be found on all types of soils from limestone to strongly acid sands in dry sterile fields, thickets, pine barrens, flatwoods, arroyos, canyons, meadowlands or on rocky slopes and in tight clays.

The plant consists of a long simple or slightly branched taproot from whose crown one to many leafy stems arise to an average of 1½ feet tall. At the summit of each stem is borne an umbelliform cyme of showy small flowers that vary in color from bright orange to orange-red or light yellow. The plant frequently forms a massive clump.

Because of its ubiquitous nature, butterflyweed can be depended upon to thrive in nearly any type of soil in most locations except dense forests and areas that are too wet. In fact, it seems to do best in the poorer and dryer soils. The plants are long-lived and will "stay put" when used either as a border plant or in single or mass plantings. The long roots may be successfully transplanted any time of the year, even when in flower, if the stems are cut off just above the root crown. The flowering period often extends over a month, and frequently there is a second less showy blooming season of one or two weeks' duration. Butterflies are attracted to the flowering plants and thus add to their desirability as garden plants.

Although several nurseries include butterflyweed in their catalogues, these are usually the conventional plants with orange-colored flowers. There is a need for horticultural investigation of this species which exhibits so much variability in its habit and flower color. Even simple selection would be of some value. With this in mind, during 1955, with the encouragement of Dr. C. O. Erlanson, I brought together nearly fifty selections

from the wild and placed them under cultivation in Maryland. These were obtained either personally or from some of my colleagues from Maryland, Virginia, West Virginia, North Carolina and South Carolina. The plants not only varied considerably in habit but the flower-color varied from pale lemon-yellow to dark reddish brown, with many intermediate shades of color. The greatest color variation was found to occur in plants growing in sandy soil of Tidewater Virginia. In the meantime, during 1957, I have seen many plants in the Caddo Lake region of northeast Texas that have tight inflorescences of brilliant red flowers on exceptionally strict stems, a form that was not included in the 1955 collection.

There is a wealth of material available in this polymorphic species for some enterprising horticulturist to produce some really worthwhile ornamental stock. It is hoped that this note will encourage some one to carry through to completion an inclusive horticultural study of our beautiful butterflyweed. — DONOVAN S. CORRELL, *Texas Research Foundation, Renner, Texas.*

Lycoris

Lycoris is a genus of late-blooming bulbs whose striking and beautiful flowers are of great value for summer and fall gardens. All the *Lycoris* are hardy, at least as far north on the eastern coast as Washington, D. C., except *L. aurea* which is tender north of the Gulf States. The *Lycoris* may be grown in high shade as well as full sun and are adapted to the same conditions as azaleas and many ferns. Since the flowers bloom on bare stalks long after the leaves have disappeared, planting among ferns affords an effective accompanying foliage at blooming time.

The *Lycoris* are members of the Amaryllis Family and all the species obtainable in this country are natives of China and Japan although some extend their habitats into Formosa and Upper Burma. While the Hardy Amaryllis (*L. squami-*

gera), and Red Spider Lily (*L. radiata*) long confused with the tender *Nerine sarniensis*, and the Hurricane Lily (*L. aurea*) are familiar to many gardeners, particularly in the southeastern United States. Other fine species are rarely seen.

For the gardener the genus *Lycoris* breaks down into two divisions or subgenera. One is headed by the Hardy Amaryllis (*L. squamigera*) which has tubular or funnel-shaped, erect, four inch long flowers on thirty to thirty-six inch stalks. They come in clusters of four to seven. The color is rose-lilac (HCC, magnolia purple, 030/3), and the flower is fragrant. There is also a form tipped purple, variety *purpurea*. *L. squamigera* blooms in late July and August and is hardy into the New England States but does not do well as far south as Florida. The blue-green leaves are a foot long and an inch wide and, like most others in this subgenus, the leaves in the Washington, D. C., area appear above ground in early spring and die down by June.

The other species of this subgenus have a similar form of flower. They include the Sprenger Lycoris (*L. sprengeri*) that blooms in September and October. The flowers on an eighteen inch stalk are pink with purplish and bluish tips. The Fragrant Lycoris (*L. incarnata*) is twenty-six inches tall and blooms in late August and early September. It is also hardy into the New England States. The flowers are three inches long and white with a center stripe of reddish purple on the outside of each purple-tipped segment and occasionally with other stripes. Stamens have reddish purple filaments and yellow anthers. *L. incarnata* is slenderer than *L. squamigera* but its clusters of six flowers are more lovely in their color effect. The Orange Lycoris (*L. sanguinea*) is sixteen inches tall and blooms in August but the leaves appear in October and last until May. Its flowers are about five to a cluster. The color is an orange red (HCC, carrot red, 612/1).

The other subgenus is headed by the Red Spider Lily (*L. radiata*). The form of the flowers bears some resemblance

to the spider form of chrysanthemum. They have no tube or a very short tube and the segments are separated and narrow and about an inch and a half long and have wavy margins. Flowers, including stamens, are a brilliant orange red. There is also a pink form, *L. rosea*, perhaps a hybrid. The flowers come in clusters of six or seven on a twenty-inch stalk. They bloom in September but there is also an August blooming form. The leaves appear in the late fall and die down in the spring. They are six inches long and a third of an inch wide.

Others in this subgenus are similar in the spider form of their flowers. The White Spider Lily (*L. albiflora*) has a pale pink stripe down the center of each white segment. It blooms in late August and September, is about eighteen inches tall, and has as many as twelve flowers to the cluster. It is smaller in flower but larger in leaf than the Red Spider Lily. The leaves appear in the fall.

The Hurricane Lily (*L. aurea*) is cadmium yellow and blooms in September with four or more flowers to the cluster on flower stalks up to twenty-four inches. The leaves appear in the fall. It is widely grown in the Gulf States but generally tender farther north. A recently named species, *L. traubi*, has saffron yellow flowers and wider flower segments. It is twelve inches tall. The Plant Introduction Garden, U.S.D.A., at Glenn Dale, Maryland, has a plant (P. I. 162443) received under the name *L. aurea*, similar to *L. traubi* and *L. aurea* but blooming earlier (late July and August) on twelve-inch stalks with four or more flowers to the cluster. The color is chrome yellow, (HCC, 605/2). The leaves appear in early spring. The plant is much hardier than the Hurricane Lily, being satisfactory at Washington, D. C. Some botanists propose to name it as a new species.

There are three other new species, not readily available in the trade, that have been recently named. They are *L. haywardi*, a bluish pink, similar to *L. sprengeri*; *L. houdysheli*, a fine large chalky



P.I. 162443—Like *Lycoris aurea* but hardier and earlier blooming—perhaps a new unnamed species.

white of the spider form blooming in late August; and *L. caldwelli*, a pale straw yellow of the spider form aging to creamy white, perhaps similar to *L. straminea* which appears to be lost to cultivation in this country. *L. caldwelli* blooms just before *L. albiflora* but the foliage does not come up until early spring. It is two feet tall.

The Plant Introduction Garden at Glenn Dale has a hybrid of the Red Spider Lily and P. I. 162443 mentioned above. There is also a hybrid of *L. traubii* and the Red Spider Lily, known as *L. woodi*.

L. argentea, mauve, and *L. koreana*, orange red, both with the *L. squamigera*

form of flower, are yet to be introduced into this country.

Lycoris bulbs should be planted shallow, just below the surface of the soil, in light shade with leaf mold or humus. Commonly, they may not bloom the first year after planting. In general, they bloom irregularly in that all bulbs in a planting of any one kind are not likely to bloom regularly each year. Most *Lycoris* bulbs increase readily.

Dr. John L. Creech, head of the Plant Introduction Garden, U. S. D. A., at Glenn Dale, Maryland, has cooperated extensively in the preparation of these notes. — FREDERIC P. LEE, *Bethesda, Maryland.*

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