

THE AMERICAN
Horticultural
MAGAZINE



AMERICAN HORTICULTURAL SOCIETY

1600 BLADENSBURG ROAD, NORTHEAST / WASHINGTON, D. C. 20002



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The American Horticultural Magazine is the official publication of the American Horticultural Society and is issued four times a year during the quarters commencing with January, April, July and October. It is devoted to the dissemination of knowledge in the science and art of growing ornamental plants, fruits, vegetables, and related subjects.

Original papers increasing the historical, varietal, and cultural knowledges of plant materials of economic and aesthetic importance are welcomed and will be published as early as possible. The Chairman of the Editorial Committee should be consulted for manuscript specifications.

Reprints will be furnished in accordance with the following schedule of prices, plus postage, and should be ordered at the time the galley proof is returned by the author: One hundred copies—2 pp \$7.20; 4 pp \$13.20; 8 pp \$27.60; 12 pp \$39.60; Covers \$13.20.

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OCTOBER COVER ILLUSTRATION

The flowers of *Datura sanguinea* hang straight down. The inflated calyx is half the length of the calyx, then light yellow, followed by red on the upper part including the limb and the corolla. The corolla is about 10 inches long, green from the base to beyond the end of the teeth.—Photo Copyright By J. E. Downward.



PHOTO LONGWOOD GARDENS

Datura suaveolens with a toothed calyx and white flowers.
The conglomerate anthers are not visible in the photograph.

Datura Species in Florida Gardens

BY EDWIN A. MENNINGER¹

Florida homeowners cultivate half a dozen kinds of *Datura*, loosely called angel trumpets, mostly for their exceptionally large white, red, orange, yellow, or purple flowers, yet two anomalies crop up:

(1) Nobody ever picks *Datura* flowers for a bouquet. They may be the largest and most spectacular blossoms in the garden, but they stay on the plant and never get into the house.

(2) The *Datura* plants themselves are so varied, and the reference book descriptions of them are so mixed up and full of errors, that it is a rare gardener indeed who knows which *Datura* grows in his yard.

The flowers are avoided in bouquets not only because they are awkward, usually drooping instead of erect, and very short lived when removed from the plant, but because some kinds have flowers as well as foliage bearing offensive or narcotic odors, and this has made all of them outcasts. Actually a few kinds have flowers with a delightful fragrance, but these cannot live down the bad name of their relatives.

The confusion in nomenclature goes back several hundred years. No taxonomist has attempted a complete, systematic overhaul of the genus, with the result that the contradictory descriptions of the various species are overwhelming to the layman. Fortunately for the non-botanist, partial examinations of the principal species in cultivation have been made recently by three scientists, Safford (1), Blakeslee (2), and DeWolf (3). By piecing these analyses together it is possible, with the aid of a few other reference works and some photographs, to explain in nontechnical language the essential distinctions between cultivated species and at last give correct names to some of the plants in Florida gardens.

Safford made the most comprehensive survey of the genus, defining 24 species,

but complaining of the "great confusion in botanical literature in connection with the specific identity . . . of some of the most common species." Blakeslee held that "more studies are needed to clarify the taxonomy of the genus," and DeWolf struggled with the "discrepancies and inaccuracies in the nomenclature."

The confusion these scholars speak of goes back to Linnaeus. His original description of *D. metel* (1753) was based on an Indian plant with glabrous leaves, the Asiatic "metel-nut" which had been used as a narcotic by the Arabs, Persians, and Hindus long before the discovery of America. It was described by Avicenna in the Eleventh Century. In the second edition of *Species Plantarum* (1762) Linnaeus seems to have overlooked the fact that he had originally described the glabrous Indian plant; now he inserted the word "pubescent," which is not true of the species he was describing, and the trouble began. Dunal in DeCandolle's *Prodromus* (1852) made matters worse by transferring the name *D. metel* from Asia to an American plant described by Miller (1768) under the name of *D. inoxia*. Several later botanists followed this lead, including C. B. Clarke in J. D. Hooker's *Flora of British India* who applied the name *D. metel* to the introduced American species of "downy thorn apple".

In the two principal modern reference works on general horticulture, Bailey (4) and Chittenden (5), these original confusions multiply. Bailey attributes *D. metel* to Linnaeus, then goes on to say that it has a 10-lobed corolla. This is true of the Mexican plant (*D. inoxia*) but not of the Indian (5 lobes). W. J. Bean in Chittenden says *D. metel* has flowers 10 inches long; this is not true for either the Indian plant or the Mexican. The flowers actually are 6-inches, rarely 7 inches long. Bailey picks up the Linnaean error of the second edition and calls *D. metel* pubescent; Bean says

¹ Edwin A. Menninger, D.Sc., Drawer 45, Stuart, Florida 33494.



PHOTO BY IVES DELANGE, UNIV. OF MONTPELLIER, FRANCE

This is Datura innoxia, the Mexican plant to which Dunal assigned the name D. metel, thereby confusing it with the Indian plant to which Linnaeus had given the name D. metel 99 years earlier. The foliage of the two plants is similar but the white flowers of the Mexican plant, with reflexed corolla of 10 lobes separated by caudate teeth, are entirely different from the trumpet-shaped blossoms of the Indian plant with their 5 lobes.

it is hairy. Neither of these authors describes the plant Linnaeus had in mind in his original text. Several varieties of the Indian *D. metel* are in common cultivation in Florida, hence the descriptions by Bailey and Bean do not apply. Bailey describes *D. fastuosa* L. as glabrous; Bean says it is "downy or glabrous"—(author plays safe!). Actually, *D. fastuosa* is only a purple-flowered form of *D. metel*, so both authors contradict themselves.

This confusion goes on and on. Bean recognizes *D. cornigera* Hook., as a tree form to 10 feet; Bailey consigns it to the shrubs and says it is 3-4 feet. Whether this plant with its very fragrant white flowers grows in Florida, is uncertain.

Bailey and Bean both omit from the genus *Datura* any reference to *D. candida* (Pers.) Saff. the type for all the tree forms and certainly the commonest of them in cultivation. This may be partly because some early authors tried to put the South American tree forms into a new genus, *Brugmansia*, but the distinctions they sought to establish for this genus do not hold true, and *Brugmansia* now is properly regarded merely as the tree section of *Datura*. Even so, both reference books describe "*Datura arborea*" and other tree forms, so avoiding

the principal species makes them inconsistent.

So much for the disordered background of the genus, though the ramifications continue to appear as the species under cultivation in Florida are examined.

Herbaceous Forms

The common herbaceous or subshrubby *Datura* in Florida gardens belong to the Indian species *D. metel* as originally described by Linnaeus. They are low plants, rarely more than 3 feet high, usually grown as annuals although often evergreen and persistent over several years. The flowers, 6 to 7 inches long, are usually white, or may be purple without and whitish within; yellow and reddish forms are met with occasionally.² The flowers are never erect, usually horizontal or nodding. Linnaeus gave the purple form the specific name *D. fastuosa*, but there was no excuse for this as the specific characters are identical with those of his *D. metel*. Bailey's illustration of *D. fastuosa* is correct for the species, despite errors in the descriptions; *D. fastuosa* is shown in

² The red-flowered horticultural form listed by Bailey from South Africa, is not known to Dr. H. B. Rycroft, director of the National Botanic Gardens, Kirstenbosch.



PHOTO BY A. B. GRAF

The Jimson Weed (*Datura stramonium*).

big type as an accepted ornamental, but *D. metel* is listed in fine print as a weed!

Because the Indian *D. metel* somewhat resembles the American *D. stramonium*, commonly called thorn apple or Jimson weed, many persons have confused them. *D. stramonium* may grow in cow pastures in Florida, but it certainly is not in cultivation in anybody's garden, because it has a vile odor, and the rank foliage imparts an unpleasant smell to the human skin. Strangely enough, no reference books make any mention of this fact. *D. tatula* is the name commonly given to the purple-flowered form of *D. stramonium*. Its stems and top foliage are usually intensely purple also, and it retains the unpleasant odor of the species.



PHOTO BY JULIA F. MORTON

The purplish form of Datura metel with hose-in-hose corollas. Note the round seed pod covered with short blunt prickles, just under the flower.

*This is Datura tatula, the purple form of the Jimson weed (*D. stramonium*). Note the short corolla, the vicious thorny pod that sticks straight up, and the sharply toothed leaves.*

PHOTO DOUGLAS ELLIOTT





PHOTO BOTANIC GARDEN, BOGOR, INDONESIA

This is the purple form (whitish inside) of the Indian *Datura metel*. Note the teeth of the calyx. This particular blossom has three corollas, one inside of the other, and it stands out horizontally from the plant.

Here are the chief differences between these two species:

Datura stramonium

Plant usually 2 feet high.

Leaves angled or cut-toothed with an offensive odor.

Flowers erect, smelly; corolla 4 to 5 inches long. Fruit erect, stays that way in drying, splits open 4 ways when ripe. Fruit oval.

Fruit covered with needle-sharp spines, hazardous to touch when dry. (Smooth-fruited form is called *D. inermis*).

Datura metel

Plant 3 to 5 feet high.

Leaves entire or weakly lobed, with no appreciable odor.

Flowers horizontal or droopy, musty or odorless; corolla 6-7 inches long.

Fruit rounded, hanging down, sometimes splits open irregularly.

Fruit covered with bumps that terminate in short, broad, blunt spines, never dangerous. (Smooth-fruited form called *D. dubia*).

Datura meteloides A. DC. in Dunal³ is a handsome, herbaceous perennial to 3 feet or more, common along roadsides from Texas to California. It is often cultivated in gardens from Maine to Florida and westward, for the heavily,

³*Datura wrightii* Regel is the correct name for the plant now known as *D. meteloides* of southwestern United States and northern Mexico. *D. meteloides* must be sunk as a name. (Ed.)

fragrant, floppy, funnel-shaped white flowers that are sometimes tinged rose or violet. The epithet *meteloides* is misleading; it means "like *metel*" but actually it is most unlike Linnaeus's *D. metel*. The trouble is that Dunal, who proposed the name, had reference to the Mexican plant *D. inoxia* which he had misnamed *D. metel*. Safford says the corolla of *D. inoxia* has 10 teeth, and that the corolla of *D. meteloides* (which is very similar) has 5 teeth. Bailey's Manual (7) confuses the ordinary gardener by the statement that *D. meteloides* has "5 or 10" teeth. Actually the corolla of *D. meteloides* has 5 teeth and measures 6 or sometimes 8 inches long and 5 inches across; it is always recurved backward on the margin, never forward like a trumpet as in *D. metel*.

Bean's statement that the flowers are "much like those of *D. metel*" refers, of course, not to Linnaeus's plant, but to *D. inoxia*, thereby seeking to perpetuate the error in nomenclature.

The 2-inch, nodding, succulent fruits are prickly; Bailey's Manual says these "burst irregularly." Safford says they do not burst.

The leaves of *D. meteloides* show



PHOTO LESTER ROWNTREE

Datura wrightii (*D. metaloides*) is native along the roadsides in Arizona, New Mexico, and southern California, its white flowers up to 5 inches across, handsome and sweetly fragrant. The outer edge of the corolla always falls back. Note the deeply cleft leaves on this particular plant; their shape and sharp points disagree entirely with the description in Bailey (4) and other reference books.

extreme variations from the textbook *dicta*. Bailey, in Bailey's Manual, and Bean, describe them parrot-like in almost identical words, up to $2\frac{1}{4}$ inches long, unequally ovate, slightly sinuate—apparently all quoting the same uninformed authority; at least that description was not written by a person who knew the plants. The author has examined plants in California and found leaves up to 6 inches long, often heavily incised and sharp pointed, like a black oak leaf. (See photograph.) The author has examined plants in Missouri, South Carolina, and Florida and found leaves

The photo of Datura wrightii (*D. metaloides*) grown as an annual in a garden at Rockport, Maine, illustrates the form with entire, slightly sinuate leaves, much larger than the textbook maximum of $2\frac{1}{4}$ inches.

PHOTO BY A. B. GRAF





PHOTO BY CHARLES SHERMAN

*Although photographs are misleading, this appears to be the flower of *Datura arborea* as described by Linnaeus, because (1) the calyx is a spathe, (2) the corolla does not exceed 17 cm. in length, (3) the margin of the limb between the teeth is notched, and (4) the calyx does not end in a horn-like point.*

averaging $2\frac{1}{2}$ inches or more, with terminal leaves $4\frac{1}{2}$ -5 inches long.

These many flat contradictions on matters of fact are not difficult to understand. *D. innoxia* and *D. meteloides* do look much alike in the laboratory, and a taxonomist, working from the dried remains of plants might easily mistake a poor specimen of one plant for the other. The horticulturist knows the plants in the field: *D. innoxia* is a hairy thing; *D. meteloides* is an attractive plant, with a pretty sheen to its foliage, and lots of heavily fragrant flowers.

*The flowers of *Datura suaveolens* have a toothed calyx in place of the spathe-like sheath found on other tree-type plants that are called "arborea." Unlike the flowers on other white-flowered tree *Datura* where the blossoms hang vertically, those on *D. suaveolens* are nodding, usually at a 30-degree angle from the perpendicular.*

PHOTO BY AUTHOR



Similarly with other species of *Datura*, the man who grows the plants knows how the flowers sit on each kind—vertically, horizontally, nodding, or drooping—and he identifies the plants by these characteristics which his colleague in the laboratory never sees. The garden worker sees how seed pods hang down or stand up, he uses smell and taste to register identities, he knows which flowers change color on the plant after they open. All these identifying features, extremely important in *Datura*, are a closed book to the laboratory worker.

Tree-like *Datura* with White Flowers

Seven different white-flowered *Datura* trees were described by Safford; it is likely that four of these are cultivated in Florida gardens. Most of them are loosely called "*Datura arborea*" or "tree *Datura*," but actually the true *Datura arborea* that Linnaeus described is relatively rare. Bailey says most of the plants cultivated under the name *D. arborea* are "presumably *D. suaveolens*." DeWolf said all the specimens bearing the name *D. arborea* which he had seen, actually were *D. candida* or *D. suaveolens*. This makes the going rough for the average gardener who needs a key to tell the species apart.

**KEY TO THE TREE DATURAS
GROWING IN FLORIDA**

- Calyx with 5 short teeth; anthers conglomerate or sticking together —————
D. suaveolens
- Calyx a spathe without a hornlike point.
Lobes of the corolla-limb separated by a gap ————— *D. arborea*
- Lobes of the corolla-limb not separated by a gap ————— *D. candida*
- Calyx spathe-like with a hornlike point nearly as long as the corolla —————
D. cornigera

The descriptions of *D. arborea* in both Bailey and Chittenden are highly confusing because historically three different plants were described under this name.

Bean in Chittenden says his *D. arborea* is synonymous with *Brugmansia arborea* that was originally described from Ecuador by Lagerheim (1895) and is now known as *D. affinis* Safford. DeWolf says the flowers differ from those

*The calyx with a long extended, hornlike point nearly as long as the corolla, distinguishes *Datura cornigera*.*

AFTER CURTIS' BOTANICAL MAGAZINE



of *D. arborea* L. in their glabrous peduncle, their 2- to 5-toothed calyx, and in the margin of the corolla limb which is not heart-shaped between the teeth, but entire or rounded, as in *D. candida*. This eliminates Chittenden because that author's white-flowered form of tree *Datura* does not grow in Florida.

The plant described by Linnaeus, presumably from Peru (1753), is quite different from the foregoing; it is also different from the *D. arborea* described from Peru by Ruiz & Pavon (1799), and now correctly known as *D. candida* (Pers.) Safford, based on *Brugmansia candida* Peisoon (1805). Ruiz & Pavon themselves were so confused that they drew a picture of *D. candida* and labelled it *D. arborea*!

Bailey starts out by identifying his *D.*



PHOTO ROGER PERRY

The hanging bell-like white flowers of Datura candida are frequently seen in Florida and California gardens. This photograph was taken at Tarapoto, Peru.

arborea with Linnaeus but fails to mention the features distinguishing that plant from other species called "ar-

borea." Those features are detailed here along lines worked out by Safford and DeWolf:

Datura arborea

Corolla less than 17 cm. long. Lobes of the corolla limb separated by a distinct sinus or gap. Calyx spathe-like, deciduous with the corolla.

Fruit ovoid (peach-shaped).

Margin of corolla limb between lobes notched.

Peduncle pubescent.

Leaves entire, glabrous.

Anthers distinct. Flowers pendulous, with musk-like odor.

Datura candida

Corolla 20 cm. or more long. Lobes of corolla limb not separated by a distinct sinus or gap. Calyx spathe-like, persistent around the mature fruit.

Fruit cylindrical.

Margin of corolla limb between lobes entire or rounded, but not notched.

Peduncle pubescent.

Anthers distinct. Flowers pendulous.

Datura suaveolens

Corolla up to 30 cm. long.

Calyx a short, much-inflated tube with 5 short teeth, 1 to 2 cm. long.

Fruit a 2-celled, spindle-shaped pericarp which when dry is brown, thin, fragile, glabrous, longitudinally veined with delicate raised nerves, 12 cm. long \times 2.5 cm. in diameter in middle, tapering to both ends, devoid of all vestige of calyx borne on peduncle 7 cm. long

Peduncle 1½ inches long, smooth, glabrous, terete.

Leaves ovate-oblong, 6-12 inches long, entire often unequal at base.

Anthers conglomerate. Flowers nodding or drooping, fragrant.

Datura suaveolens is perhaps the easiest of the white-flowered tree species to identify because of the toothed calyx and conglomerate anthers, but confusion attaches to it also in some reference books. Macmillan (8) speaks of the "round, green, prickly fruits" of *D. suaveolens*, oblivious of the fact that they are never round, when ripe they are not green, and they are never prickly.

Many different kinds of *Datura*, both shrubs and trees, occasionally develop double or triple corollas, one inside of another, but this obvious peculiarity is no help at all in distinguishing one species from another. Doubled corollas, usually called hose-in-hose,⁴ occur also in *Primula*, *Nicotiana*, and *Rhododendron* (subgenus *Anthodendron*).

Tree Daturas with Colored Flowers

Safford used the flower color to separate the tree *Datura* species he described; on one side were the white-flowered, on the other the species with colored flowers. Whether this was adequate procedure is now called into question.

Trouble has developed over a pink-flowered tree from Ecuador which Safford called *Datura mollis*—"mollis" means soft-hairy. This is not in cultivation in Florida, but two other kinds of *Datura* with colored flowers (not pink!) have been erroneously assigned by reputable authorities to this species and have been masquerading under this name. More detailed consideration by the same authorities has raised grave doubts in their own minds and has suggested the possibility that these "unknowns" may be merely colored forms of white-flowered species, thereby upsetting a basic separation method devised by Safford.

First of these and one of the most spectacular of all *Datura* plants, is a tree-let to 10 feet or more, widely cultivated in Florida, with very large, hanging trumpet-shaped flowers, usually a foot long and flaring 6 inches wide at

⁴M. K. Kay, lexicographer with G. & C. Merriam Co., Springfield, Mass., writes: "The term hose-in-hose undoubtedly stems from an old meaning of *hose*, a sheathe enclosing an inflorescence," that is now disused except in dialect English. It is very easy to see how several centuries ago, before floral morphology was well understood, such a doubly (or triply) corollate flower could be visualized as a doubly (or triply) ensheathed, i.e. sheathe in sheathe or *hose-in-hose*, inflorescence."



PHOTO BY BOTANIC GARDEN, BOGOR, INDONESIA

This is *Datura candida* with a triple corolla, one inside the other, usually called hose-in-hose. Note the spathe-like calyx.

the mouth. These flowers open white or light pink but shortly turn a deep, rich peach color that is very striking. As long ago as 1956 this plant was identified as "*Datura mollis*"—which it may not be at all—and it still travels under that name. The following table presents detailed points on which this "Florida Peach" fails to agree with Safford's description of *D. mollis*:

Datura mollis (after Safford)

- Peduncle "clothed with soft hairs."
- Calyx spathe-like, 19-20 cm. long, obtusely pointed at the apex, somewhat inflated.
- Calyx "densely clothed . . . with soft, spreading hairs."
- Corolla light pink, 25-26 cm long, not much longer than calyx. Safford does not record any change of color.
- Corolla: "Nerves of the corolla and margins of corolla teeth clothed with soft hairs."
- Corolla limb "bearing on its margin 5 caudate teeth 6 or 7 cm. long, at length recurved."
- Leaves pubescent, ovate-lanceolate, entire or remotely toothed, 22 × 10.5 cm.

*Florida Peach*⁵
(from specimens)

Peduncle 6½-8 cm. long, not hairy. Another specimen clothed in fine hair (seen with hand lens).

Calyx 12.5-15 cm. long, abruptly acuminate, somewhat inflated.

Not so. Another specimen bearing a few scattered hairs.

Corolla opens white or light pink, then turns peach-colored. 25-27 cm. long (twice as long as the calyx, or more).

Not so, or only slightly. Another specimen finely pubescent on nerves.

Caudate teeth 3.5 cm long, recurved.

Leaves beneath hairy, dull, entire, with only suggestion of occasional tooth: oblong acuminate 17-20 × 7-8.5 cm.; one leaf blade 1-1.5 cm. longer on midrib at base than the other.

⁵ Suggested as possibly *D. versicolor*, a species of Ecuador. (Ed.)

Enough differences are involved here to challenge identification of the Florida Peach with Safford's *D. mollis*. Ad-

Most spectacular Datura in Florida is a tree to 10 feet tall whose huge pendent flowers come out white, then turn a rich peach color. This plant herein is referred to as the "Florida peach." Although once identified as D. mollis, it differs substantially from Safford's plant of that name. Compare its configuration of flowers above with those of D. candida in Peru photograph.

PHOTO PHILIP S. DORLON



mitedly there has been no critical study of *Datura* in general, and flower color alone could not be definitive. Several botanists have reviewed the problem recently and at least two of them have concluded that Safford's description is not satisfactory and that his *D. mollis* may not be a good species. So much variation has already been observed in the Florida Peach that even when a specimen seems to conform to many points in Safford's description, doubts as to identity still persist and suggest the necessity of examining a considerable number of additional specimens before any conclusions can be reached.

Again, the question has been raised by two scholars whether the Florida Peach might not be a color form of *D. candida* (with which it agrees in many ways) or a hybrid. The Florida Peach does not set seed naturally in Florida; no one has tried raising it from self-fertilized seed to see whether there is any variability in the progeny, or whether it is sterile. Consequently the plant must continue to be known as the Florida Peach until its true identity is determined.

The other "*Datura mollis*" which may not be that species at all, developed at Longwood Gardens, Kennett Square, Pa., and was pictured and described by Huttleston (6). The 12-inch leaves are elliptic to ovate, the pendent 12-inch corolla is RHS *Nasturtium* orange 610/2, fading to buff-white at the throat. Longwood Gardens distributed cuttings to institutions and nurseries, including some in Florida, so that the plant is undoubtedly in cultivation in this State.

Unlike the Florida Peach, the flowers on this plant do not open white, then change color; they open orange or apricot and stay that way. The corolla is 11-12 inches long, an inch shorter than on Safford's *D. mollis* and the calyx is 4.5-5 inches long, or 3 inches shorter than on Safford's plant. Expressed another way, the corolla is more than twice as long as the calyx, whereas on Safford's plant the calyx and corolla are almost the same length.

Dr. Huttleston now (1965) is first to admit that his plant differs from Safford's *D. mollis* not only in the color of the flower, but also in that the calyx is long-acuminate instead of obtuse, and that there are distinct notches between the corolla lobes. He is convinced that his plant is of hybrid origin involving *D.*

mollis and *D. versicolor* (Lagerh.) Safford, another very beautiful and fragrant South American species whose 10-inch pendent flowers come out white then turn brick red. This perhaps just makes the confusion worse.

Tree Daturas with Red Flowers

The high Andes in South America provide two tree-type *Datura* with red or reddish flowers that are easily set apart from other species because the blossoms are tubular rather than trumpet-shaped. Both of these species survive at high elevations where frost falls every night, yet they have apparently proved too tender for cultivation in California where they have been tried repeatedly. Whether either or both species are now growing in Florida gardens is uncertain, although the United States Department of Agriculture has introduced both of them twice and distributed plants to experimenters.

One was *D. sanguinea* Ruiz & Pavon, which was established here in the 1930's as P.I. 108294 and P.I. 126903. Dr. David Fairchild was in Colombia in November 1941 and as he travelled through the Andes at 5000 feet between Bogota and Villavincencio, he was struck by "the magnificent sight" of the *D. sanguinea* trees along the highway with their hang-



PHOTO LONGWOOD GARDENS

This is the Longwood Gardens "Datura mollis" which now may prove to be a hybrid between D. mollis and D. versicolor. Certainly the flowers do not agree with those of Safford's D. mollis.

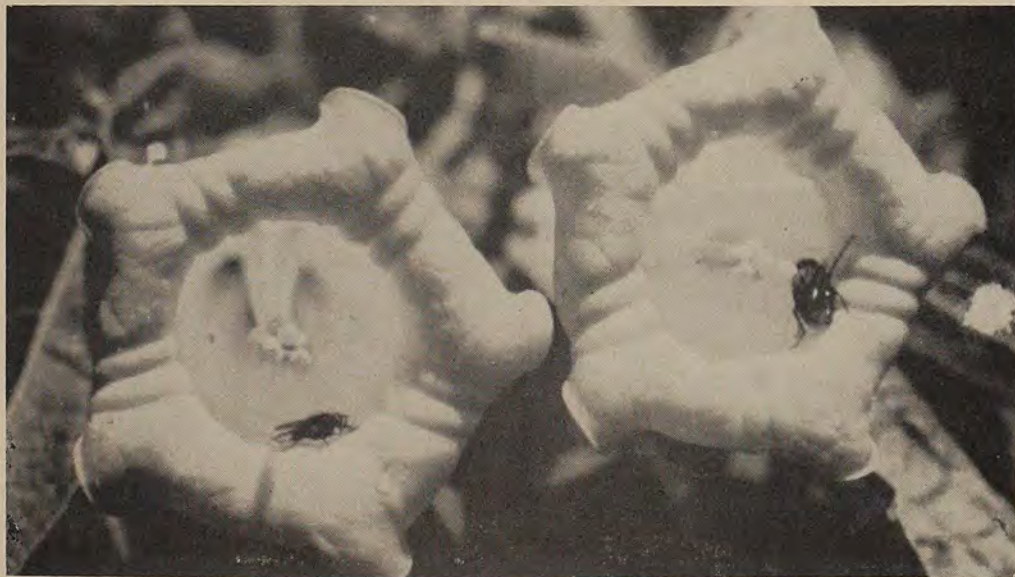


PHOTO WARD'S OF CALIFORNIA, SAN FRANCISCO

The pentagonal mouth of the red-flowered Datura sanguinea from the high Andes, is set off by three yellow longitudinal nerves in the center of each limb, in strong contrast to the bright red coloring of the lobes.

ing 10-inch flowers which he described as "brilliant orange-red with yellow nerves," and "strangely enough, not fragrant." He stopped to pick some of the fruits which are top-shaped, 3.5 inches long, with a smooth skin (no bumps or prickles.) Dr. Fairchild brought the seed back to Florida, and gave some to this author and some to the Fairchild Tropical Garden. Plants from this Fairchild introduction were distributed all over Florida, and some of them may survive today.

The Department of Agriculture also introduced a tree with similar flowers, *Datura rosei* Safford, in 1935 as P.I. 112300 and also ten years earlier as P.I. 58362. (The specific epithet *rosei* refers not to the color of the flowers but commemorates a distinguished botanist J. N. Rose.)

Both of these plants are tree-like shrubs to 12 feet or more with big, pendent flowers that are usually red or

Chittenden says *Datura sanguinea* is a tree-like shrub, 4-8 feet. Baily says 4-12 feet. In the Colombian Andes it is a tree to 20 feet or more. Picture was taken at 12,000 feet elevation.

PHOTO ROGER PERRY



reddish, although *D. rosei* flowers have been reported by various authorities as orange and as saffron yellow. The two trees however are easily distinguished by other features outlined by DeWolf:

Datura sanguinea

Leaves entire or sinuate-margined.
Corolla 10 inches long, glabrous.
Calyx with 2 or more large lobes.
Longitudinal nerves in corolla yellow.

Datura rosei

Leaves angular-toothed.
Corolla 6-8 inches long, pubescent.
Calyx spathe-like with a single lobe.
Longitudinal nerves in corolla green.

Conclusion⁶

The foregoing discussion of *Datura* has involved only half a dozen species that are cultivated in Florida gardens, but it illustrates the jumble of contradictions that plagues the genus. Confusion is not confined to these few examples but runs all through the 20 or more described species. Of course the flowers of some are exceedingly similar to those of other species, and when this happens the plants have to be separated by their calyces, fruits, leaves, or other characters. Many botanists have been fooled by the similarities and have, as a consequence, given the same name to different plants. Again some species are highly variable within themselves, so much so that even the great Linnaeus and a lot of lesser scholars have been tricked into considering them distinct species.

This situation will not improve until all of the various cultivated forms are grown together in one garden for comparison, and someone (perhaps the same grower) undertakes to do some breeding work to see what happens when the whites are crossed with the reds and oranges. Until actual experiments prove what the plants are, anybody's guesses on nomenclature are just that—guesses!

⁶The 1956 Supplement to Chittenden's Dictionary (5) virtually wipes out the 2-column original description of the genus *Datura* and substitutes two columns of new material consisting of a key to the species with additional notes and citations by W. T. Stearn. The key is based on Safford (1) and Danert (9). It corrects many previous errors but raises new questions. The key ignores Safford's *D. affinis* although the original description included this species under the name *D. arborea* (= *Brugmansia arborea*). The *D. arborea* listed in the new outline is a different plant. The key also ignores Safford's *D. hirsuta* which is a point at issue in the present paper. The Supplement's description of the genus admits "about 25 species" (Safford defined 24) but the key accommodates only 14 of these. Thus the material in Chittenden's Supplement only reorganizes the confusion.



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This photograph, taken in England, was labeled "Datura arborea knightii." is properly applied only to a double form of *Datura cornigera*, but this photograph is not the flower of that plant for its calyx-spathe does NOT terminate in a long, spreading horn-like point extending halfway down the corolla. The calyx seems to be a spathe, so it cannot be *D. affinis* or *D. suaveolens*. The corolla lobes are not separated by a gap, so it cannot be *D. arborea* L. The corolla limb appears to be notched, so it cannot be *D. candida*.

Apparently all, or at least many, of the tree *Datura* in the Andes are more or less cultivated by the natives, perhaps for their flowers or, more likely, for their narcotic or supposed medicinal properties. Because the plants are easily propagated vegetatively, probably a rather small number of clones is involved, each one selected for some particular property. If each of these clones were regarded as a "species," the confusion would be confounded, for every chance seedling would be different and would have to be recognized. If however, some idea of the natural limits of variation of a sexually reproducing group of these plants could be obtained by growing them experimentally, then taxonomists would be in a position to determine which names are valid, and which mere synonyms.

If this paper could have the effect of provoking such a study, ornamental horticulture would be enriched.

ACKNOWLEDGEMENTS

The author gratefully acknowledges assistance given in the preparation of this paper by Mrs. Julia F. Morton, Morton Collectanea, University of Miami; Dr. Robert W. Read of Fairchild Tropical Garden; Dr. Harold E. Moore, Jr., John Ingram, Dr. Wm. J. Dress, and Robert B. Clark of Bailey Hortorium, Ithaca, N.Y.; Dr. Gordon P. DeWolf of Georgia Southern College, Statesboro, Ga.; Dr. Donald G. Huttleston of Longwood Gardens, Kennett Square, Pa.; Phil Clark of New York Botanical Garden; and Dr. H. B. Rycroft, Director of National Botanic Gardens of South Africa, Kirstenbosch.

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The very long caudate teeth are characteristic of *Datura dolichocarpa* (Lagerh.) Saff., an elegant species photographed in the Colombian Andes.

PHOTO ROGER PERRY



Observations on Deciduous Magnolias in Florida

ROBERT L. EGOLF, M.D.*

The inability of many plants to grow when moved to markedly warmer climatic regions has not received the attention from gardeners that the subject deserves. By contrast winter survival of ornamental plants, or cold hardiness, appears again and again in garden literature as a theme of special importance. We are all familiar with the hardiness zones that have been delineated in this country on the basis of winter minimum temperatures. Information is available in a variety of places on the zonal hardiness of garden plants, and most garden catalogs will emphasize hardiness. It is much harder for us in the south to come by good information about the plants that will not do well because of the opposite climatic extreme. Practical southern limits of cultivation for the majority of ornamental plants are still largely a matter of dirty fingernails and word of mouth. Here in the Tampa Bay region of central Florida, for example, we must get along without most of the spring bulbs, bearded iris, penies, lilacs, and a long long list of other garden standbys. There is little reliable information available about the performance of the deciduous magnolias in this climatic region. As a result I have been growing a variety of deciduous magnolias here for several years, and have found many of these plants to be subject to some degree of heat damage. One would have to search this area very carefully to find an oriental or native deciduous magnolia that has been in the ground for even ten years. In part this is due to our traditional tropical garden image, and in part also to simple lack of experience, information, or availability of these plants. Visitors to Florida admire the extravagantly lush and exotic appearance of tropical plantings, and for this reason deciduous trees have never been popular here. But many Florida garden-

ers, especially those of us with a northern background, enjoy a plant that will mark the passing of the seasons, and a few deciduous trees or shrubs in the landscape provide welcome relief.

There are about seventy-five described species of magnolias in the world at the present time, and a considerably larger number of horticultural forms and hybrids. Less than half of the species are to be found in cultivation, and of these no more than a half dozen are at all common. The magnolias have been divided botanically into eleven sections (see Table 1), of which six, containing about thirty of the species, are deciduous. Of these, three sections are wholly Asiatic, two contain both Asiatic and American species, and one restricted to a single species, *M. virginiana*, is wholly American. In the whole genus Asiatic species outnumber American ones by about forty-eight to twenty-seven. Eight or nine of the American magnolias are deciduous, all of which are native to the United States with the exception of a close relative of *M. macrophylla* which grows in southern Mexico, *M. dealbata*. The deciduous American species all flower with or after the leaves have appeared, and are, therefore, less spectacular and less popular in gardens than are the precocious flowering Asiatic species. Most of the magnolias to be found in gardens are deciduous, and when well grown are true garden aristocrats. Deciduous magnolias have been grown in southern gardens for many years, and fine specimens are to be seen even in Florida as far south as Tallahassee, where *M. denudata* and forms of *M. soulangeana* may be seen in the gardens at Killearn, now Alfred B. Maclay State Park. Until recent years, however, the deciduous magnolias would appear to have penetrated very little farther south.

The remaining five sections of magnolias, with about forty-four of the species, are evergreen. Only four of the ever-

* Director, Student Health Service, University of South Florida, Tampa, Florida.

green species are in cultivation, and three of them, *M. coco*, *M. delavayi*, and *M. nitida*, are extremely rare. The fourth evergreen species cultivated is our own southern *M. grandiflora*, wherever hardy one of the finest broad-leaved evergreen trees grown. *M. virginiana* may appear to be evergreen in the southern part of its range, but actually changes its leaves every year. The evergreen magnolias are for the most part subtropical and tropical. *M. grandiflora* is itself an outlier, with sixteen other closely related species, comprising the section Theorhodon, growing in the Caribbean Islands and as far south in Central America as Panama.

In spite of the long horticultural emphasis on adapting garden plants to ever

more northern gardens a slow reverse migration has taken place, as with the hybrid tea rose. Cold hardiness, after all, is only one of a large complex of factors affecting the ability of plants to grow under different climatic conditions, or to tolerate displacement from their natural habitats. The interplay of these factors of climate and geography, and the physiological adaptations induced by them in plants are often poorly understood, even by botanists. Plants vary widely in their ability to grow under, or adapt to, markedly different ecological conditions. On the one hand we have such circumscribed plants as *Torreya taxifolia* and *Taxus floridana* in Florida, or *Elliotia racemosa* and, in times past, *Franklinia alatamaha* in Georgia, whose natural ranges may be no more than a few miles in extent, and on the other hand plants like the common swamp cyrilla, *Cyrilla racemiflora*, which grows over a latitudinal range of several thousand miles, from Virginia in the north to the Guianas and northern Brazil on the south. Although this kind of adaptability cannot by itself explain natural plant distributions, it is certainly a factor. At the same time it is not safe to assume that in a species with a large natural range the individual plant will be freely adaptable. It is a different matter to move a plant, or the seed of a plant, over a long distance for cultivation than to simply find the same plant growing in two widely separated localities. Plants of a single species growing at the extreme limits of a large range have adapted to local conditions over many thousands of years, and may well refuse to grow if interchanged. *M. mollicomata* and *M. campbellii* are considered by most botanists to be the extreme eastern and western forms of a single species in spite of many differences that are apparent on cultivation. For example, *M. mollicomata* is considered to be hardier than *M. campbellii* and in Florida *M. mollicomata* is more sensitive to heat damage than is *M. campbellii*. It has been said with accuracy that no two places on the face of the earth even a few miles apart provide identical growing conditions, and it is apparent that successful gardeners must have an eye for special conditions in their gardens that help to minimize climatic and geographic change.

As a group magnolias are fairly

TABLE 1

THE SECTIONS OF THE GENUS MAGNOLIA

1. Section GWILLIMIA—15 evergreen Asiatic species, mostly tropical. Two species in cultivation, *M. coco* and *M. delavayi*.
2. Section LIRIANTHE—A single evergreen species of northern India, not in cultivation.
3. Section RYTIDOSPERMUM—9 deciduous species, 8 in cultivation including the American *M. ashei*, *M. fraseri*, *M. macrophylla*, *M. pyramidata*, and *M. tripetala*, and the Asiatic *M. obovata*, *M. officinalis*, and *M. rostrata*.
4. Section MAGNOLIASTRUM—1 deciduous American species, *M. virginiana*.
5. Section OYAMA—4 deciduous Asiatic species including *M. globosa*, *M. sieboldii*, *M. sinensis*, and *M. wilsonii*, all cultivated.
6. Section THEORHODON—17 evergreen American species, mostly tropical, of which only one, *M. grandiflora*, is cultivated.
7. Section GYNOPODIUM—2 evergreen Asiatic species of which one, *M. nitida*, is found in cultivation.
8. Section MAINGOLA—A tropical evergreen section confined to Asia containing 9 species, none in cultivation.
9. Section YULANIA—8 spectacular, deciduous, precocious flowering Asiatic species of which 6, including *M. campbellii*, *M. dawsoniana*, *M. denudata*, *M. mollicomata*, *M. sargentiana*, and *M. sprengeri* are cultivated.
10. Section BUERGERIA—5 deciduous, precocious flowering, Asiatic species of which 4, including *M. cylindrica*, *M. kobus*, *M. salicifolia*, and *M. stellata* are in cultivation.
11. Section TULIPASTRUM—3 deciduous species of which 2 are American, *M. acuminata* and *M. cordata*, and 1 Asiatic *M. liliflora*, all cultivated.

NOTE: Species enumerations may vary somewhat depending on current botanical opinion. For example, species pairs *M. acuminata* and *M. cordata*, *M. kobus* and *M. stellata*, and *M. campbellii* and *M. mollicomata*, may each be considered as distinct species.

tolerant of displacement from their natural habitats. If they were not the magnolias of the high mountain ranges of southern Asia, *M. campbellii*, *M. mollicomata*, *M. rostrata*, and *M. globosa* among others, would never have grown in the gardens of England, their first home after the great collecting expeditions of George Forrest, Reginald Farrer, and E. H. Wilson. It would be difficult to imagine a greater contrast than between the clear air and extremely high elevations of the Himalayas of Nepal, Tibet, and southwestern China and the fog-bound British Isles. In this country *M. virginiana* has adapted to a wide range of latitude and different climatic conditions from Massachusetts to Florida, and is cultivated well outside its natural range. *M. grandiflora* has been spread over nearly the entire world in cultivation. The distribution of our native magnolias is predominantly in the southeastern states, a result most probably of extinction and retreat before the Pleistocene glaciations. Certainly earlier in the Tertiary magnolias were nearly cosmopolitan over the North American continent. As pure speculation it seems to me that these surviving magnolias, driven south¹ by the ice a million or more years ago, are much more tolerant of northerly than they are of southerly displacement. For example, *M. macrophylla*, *M. fraseri*, and *M. tripetala* are all growing at least as far north as the Arnold Arboretum of Harvard University in Massachusetts, well north of their natural ranges in the southern Appalachians. They grow with much more difficulty, or not at all, in central Florida. *M. ashei* has thus far done poorly in central Florida, and *M. pyramidata* is inclined to be difficult. These two are particularly noteworthy since they are so close here to their normal habitat in northern Florida. Whether the purely tropical magnolias of the Theorhodon series growing down through the Caribbean and Central America ever had, or still retain, any tolerance for cold cannot be answered since not one of them is to be found growing in cultivation. (1)

Leaving aside other problems of ecologic displacement I would like to discuss what I believe to be the effects of excessive heat and sunlight on the decid-

uous magnolias in this region of central Florida. Problems of cold hardiness are not unknown here, due to the popularity of our tropical plantings. As recently as 1962 a disastrous freeze was experienced here, with the official low in Tampa recorded at 18°F. Prior to the great freezes of the late 1890s coconut palms were commonly seen on the west coast of Florida at least as far north as Tampa. No one would now think of planting coconut palms this far north, and the consensus is that our winters are slowly becoming colder. It is a rare winter that does not register at least one night with 6 to 8 degrees of frost in central Florida. But in respect to most of the magnolias, particularly the deciduous species and hybrids, our problem is that of "heat hardiness" or damage by high temperatures. As a descriptive term "heat hardiness" may be somewhat misleading since our summer maximum temperatures, or even our summer mean temperatures, are not too different from those in more northern parts of the country. The climate of the eastern part of the United States has been well described as that of "boreal winters and tropical summers." In six years we have not had a summer temperature in this area as high as 100°F., and such high temperatures are often recorded as far north as Washington, or even Philadelphia. I believe that summer temperatures are not the major factor in producing heat damage in magnolias, and that the high temperatures that do hurt them are our relatively mild winter temperatures. Visitors to Florida cannot help noticing that the most common orchard and dooryard fruits of the north, apples, peaches, plums, pears, or cherries do not exist here. They are not grown because our winters do not provide sufficient sustained cold to allow normal growth, blossoming, or bearing of fruit. This phenomenon has been studied in considerable detail for these fruits of rosaceous stock, to the extent that the number of hours of sustained cold, usually below 45°F., necessary for blossoming and growth can be accurately specified for many different varieties. It does not seem to me that an excessive flight of imagination is required to extend these observations as a working hypothesis to magnolias and other plants that fail to grow where very mild winters are the rule.

¹They may have been there as well as during and after the ice age. (Ed.)

In deciduous magnolias the effects of excessive heat, or insufficient winter chilling, that I have observed are, in order of increasing severity: 1. Failure of stem elongation at terminal growth buds, with the major portion of plant growth coming from ordinarily dormant lateral stem buds. 2. Total failure of stem elongation without lateral bud activity. 3. Degeneration of terminal buds and stems in the spring, usually followed by rapid decline and death of the plant.

In my experience the first type of injury mentioned above is apt to be shown, although in mild form, by *M. pyramidata*, even though the plant is not too far here from its natural range. In its natural habitat in northern Florida *M. pyramidata* grows to a single leader with lateral branches forming at regular intervals disposed in spiral arrangement. In contrast, I have a seedling of this plant, transplanted from the wild, that has changed leaders twice in three years. On two occasions in the spring growth has failed to occur at the terminal growth bud on the leader, and a lateral bud some distance down the stem has sent out a vigorous shoot that has become dominant. The plant appears to remain healthy, however, and I believe it will eventually settle down and make a tree. There is a noticeable tendency among arborescent species of many families to become stunted or shrubby at their southern limits, and it may be that poor terminal growth following excessively mild winters accounts for this, at least in part. *M. fraseri* and *M. acuminata* are subject to the same kind of trouble. Apparently the more sensitive the plant, the farther down the stem the new growth is likely to appear. *M. fraseri* has a tendency to send up vigorous shoots from the roots each spring with little subsequent growth in succeeding years. *M. cordata*, usually considered to be a variety of *M. acuminata* but with a very restricted southern range, has grown better here than *M. acuminata*.

The second more severe form of heat injury consists of complete failure of stem elongation following leafing out in the spring. It is typical of the Rytidospermum series of magnolias that when leafing out occurs in the spring a rosette of leaves with extremely short internodes is formed at each active growth bud. If the shoot is fertile this rosette is

terminated by a flower, and additional growth will come from a lateral bud at the base of the flowers peduncle. If the shoot is sterile the rosette is terminated by a new terminal growth bud. Following a short period of recruitment, or after flowering, the new growth bud becomes active, but now the leaves are produced on stems with elongated internodes, and this second growth period accounts for the bulk of increase in size of the plant. In central Florida this second growth period often fails to materialize for *M. fraseri*, *M. macrophylla*, *M. tripetala*, and even *M. ashei*. As a result the plants remain permanently dwarfed and usually eventually decline and die. It had seemed that this problem would also affect *M. obovata* and *M. officinalis* 'Biloba', but grafted plants in their third season have finally produced appreciable terminal growth, and I am now hopeful that these two species will grow here.

The most severe form of winter heat injury consists of degeneration of terminal stems and buds in the spring, shortly before growth would be expected to begin. This is usually accompanied by considerable, but short-lived, activity in ordinarily dormant buds along the stem, and the usual result is loss of the plant. This process bears a great deal of resemblance to the die-back that is described as a relatively benign disease of mature deciduous magnolias. If so, it is not benign in Florida, or with very young plants. Losses of this nature have occurred with *M. mollicomata*, *M. campbellii*, *M. sargentiana* var. *robusta*, *M. sieboldii*, *M. wilsonii*, and may be the final act with plants of the Rytidospermum series. When grown in a cool, heavily shaded greenhouse these plants have all shown an increased will to survive and grow, so that with them at least hot summer weather in this latitude has an additional deleterious effect not seen farther north. The general rule would seem to be that these magnolias are better able to stand a hot summer after being exposed to a cold winter, and a very mild winter makes cooler summer growing conditions necessary. Interestingly enough, seedlings of *M. campbellii*, 'Alba' have thus far survived and grown under conditions identical with those which result in the loss of *M. campbellii*.

A second and distinct type of injury

associated with climate that occurs in deciduous magnolias in central Florida is destruction of chlorophyll in leaves through excessive insolation, or exposure to direct sunlight, during the summer months. This destruction occasionally proceeds to the point of defoliation and the plants enter a brief secondary dormant period during the late summer. It is difficult to be sure whether this destructive process is photochemical or thermal in nature. There is no doubt that sunlight becomes more intense as one approaches the tropics in the summer due to the more vertical position of the sun. It is equally reasonable to think that a leaf exposed to direct sunlight at any latitude becomes internally hotter than one that is partially or completely shaded. The fact that the leaves of *M. campbellii* undergo this degenerative process in full sun in Florida may indicate that the injury is thermal rather than photochemical, since this plant should be physiologically adapted to intense insolation in the high altitudes of its natural home. It is also interesting to observe in this respect that the leaves of the two magnolias native in this region, *M. grandiflora* and *M. virginiana*, are both structurally modified in a way that protects them against excessive light and heat. The upper surfaces of both are cutinized, waxy, and shining, a surface that reflects much of the light falling on the leaves from any but the most direct angles. At the same time the under surfaces of the leaves are rough and hairy in *M. grandiflora* or softly felted in *M. virginiana* providing a large surface area in relation to the volume of the leaf for the radiation of excess heat. Magnolias growing in full sun in Florida will have generally shorter internodes than similar plants that are partially shaded. This is nearly universally true in the higher plants, and at any latitude, but the greater intensity of the sun in Florida may serve to accentuate the difference.

Magnolias that lose their leaves in late summer due to excessive sunlight generally leaf out again before winter, but with very little or no stem growth. Such plants are generally rather unhealthy in appearance since the effort of producing two sets of leaves in a single season weakens them. Varieties of *M. soulangeana* are particularly prone to this behavior, at least for the first few seasons

until they become well settled. As a general rule plants become more shade tolerant as they are moved into lower latitudes, and it would appear reasonable to treat deciduous magnolias in central and southern Florida like camellias and plant in light shade until experience has shown which species or varieties will tolerate or do better in full sun.

It would be unfortunate if any serious gardener in central or southern Florida decided against planting a deciduous magnolia on the basis of this report. In the first place many of the finest magnolias including *M. stellata*, *M. kobus*, *M. denudata*, *M. watsonii*, *M. loebneri*, *M. veitchii*, and certain of the *M. soulangeana* cultivars, such as 'Alexan'rina' have grown with no special problems, and there are many remaining to be tried. In the second place these observations, of necessity, have been made over only a few years, often with very young grafted or seedling plants, and many, even now, are still growing in containers. Some of these problems may, like measles and chicken pox in children, be diseases of young plants and not be a source of trouble with older larger plants. Magnolias are in general resentful of disturbance, and many of the problems noted here may disappear or become insignificant when sufficient time has elapsed for the plants to become well established. One of the noted English authorities on magnolias, the late Mr. G. H. Johnstone, states flatly that magnolias require two years to become established under favorable conditions after having been moved or otherwise disturbed. Finally, difficulties of cultivation should be considered a challenge rather than otherwise. Often the smallest improvements in technique make all the difference between success and failure, and every gardener should be willing to experiment. Certainly no Florida gardener who endured the great freeze of 1962 can doubt that we would be much better off with hardier basic planting materials, or with better quality hardy materials, than are now commonly used, and of these the deciduous magnolias are among the most beautiful and enduring.

NOTE: Since this was written the U.S. National Arboretum, in cooperation with Professor Joseph C. McDaniel of the University of Illinois, has distributed seedlings of *M. guatemalensis* for horticultural investigation.

Araucarias

Cultivated in Australia

T. R. LOTHIAN

Among the several genera of Conifers which are endemic to the southern hemisphere, *Araucaria* contains some of the tallest, massive and most impressive of trees. Altogether there are about 12 species, one group is native to South America (*A. araucana* (*imbricata*)—Monkey Puzzle Pine, the best known) but the others are found through the Pacific Islands, Norfolk Island, New Guinea, New Caledonia, New Hebrides, and Australia.

All species ultimately grow into trees higher than 60 ft. although in the juvenile state they are frequently used as tub and pot specimens in cold countries. The young trees are symmetrical in habit with branches down to the ground, but as the tree ages the lower ones drop off leaving the trunk clear of branches for at least half its length in old trees. The bark is thick, rough, and resinous.

The branches are horizontal to ascending and usually whorled. Generally the leaves are dark green in color, remain on the tree for many years, spirally arranged, stem clasping and overlapping or imbricate, often differing in size or shape on the same tree and on trees of different ages. These vary from small scale-like bracts in the case of *A. heterophylla* (*A. excelsa*—Norfolk Island Pine) to flat and rigid, triangular and pointed as in *A. bidwillii*, the Bunya Pine.

The trees are usually dioecious but sometimes male and female flowers are borne on different branches of the same tree. The male catkins are usually large, up to 3 or 4 inches long, cylindrical, dense and either single or in clusters. The cones take 2 to 3 years to ripen,

are globular or ovoid, with overlapping woody scales which fall when the seeds are mature. They vary in size, the largest are of the Bunya Pine (*A. bidwillii*) which are often 12 inches in height, proportionately wide and weigh 10 to 15 pounds.

The seeds are usually large, one joined to each scale which is winged on at least one edge. Cotyledons vary from two to four.

Seeds of the Bunya Pine were used as an item of food by aborigines and in the Gympie and Bunya Mountain districts (Queensland), where this tree grows naturally, each tribe was allocated a certain number of trees. Footholds cut into the trunks can be seen in trees still standing in the Bunya Mountains National Park (Queensland).

The wood is yellowish white, straight-grained, resinous and easily worked. It is an important timber for veneers.

All species are usually propagated by seed. Cuttings are used as an alternate means when great care must be taken to use leader or coppice growths only (from decapitated young plants) otherwise sprawling and almost prostrate plants will result. However, sometimes from the base of such plants arise natural erect vigorous growth. This, if left, will produce a tree identical with the parent. Araucarias are unusual amongst the conifers in having the power to regrow a new leading shoot or leader, should the original suffer injury.

The following are descriptions of species commonly cultivated in Australia for ornamental park purposes.

A. bidwillii—Bunya Pine

An important timber tree growing to 100 to 150 ft. in height and 2 to 3 ft. in diameter and when in forest formation

the trunk is free from branches for about half its height. Under open park conditions branches may remain for a considerable period of time, but when 40 to 50 years of age the typical umbrella-topped appearance is produced. In older trees the crown flattens and the branches become crowded near the top.

This species readily regenerates branches at lower levels and frequently where a lateral bud has developed into a robust vertical shoot, a secondary development of the main trunk takes place (see plate).

The foliage is spirally arranged, $1\frac{1}{2}$ to 2 in long, rigid and sharp-pointed, densely covering the branches with spiny armor.

The male and female catkins are usually on different trees, rarely on the same tree. The male catkins are 6 to 7 in. long and borne at the ends of branches, often purple in color and present an attractive appearance. The cones are extremely large and heavy and constitute a danger when they are mature. Seeds are up to 2 inches long, buried in the scales, which are large, with a recurved point. The cones take up to 3 years to mature and up to 50 cones may be produced on a fully grown tree.



PHOTO BY AUTHOR

Araucaria bidwillii. **Bunya Pine**, Adelaide Botanic Garden, planted approximately 90 years ago, estimated height 80 ft. Showing vigorous secondary trunk development under the characteristic umbrella top.



PHOTO BY AUTHOR

Cones from *A. bidwillii* showing variation in size, also cone scale with seed attached.

This is widely planted as a park tree, not so much of recent years, but there are many specimens in Australian parks between 80 to 120 years old. In 1843 Sir William Hooker described the plant from specimens brought to Kew by Mr. J. S. Bidwill.

The Bunya Pine has an altitudinal range from about 500 ft. to about 3,500 ft. Frosts occur above 2,000 ft. The climate is sub-tropical with mild winters and annual rainfall of between 35-50 inches, more than half of this falling during the summer months. It grows well in a variety of soils but prefers valley bottoms.



PHOTO BY AUTHOR

***Araucaria columnaris*. New Caledonian Pine with Norfolk Island Pine on left. Note the somewhat curved trunk. The tree on the left lost the growing center about 12 years ago and has subsequently regenerated a new growing point. Trees are approximately 100 ft. high, planted about 90 years ago.**

A. columnaris (*A. cookii*)—New Caledonian Pine or Cook's Araucaria.

In addition to New Caledonia, it is found also in the New Hebrides. This is a slender columnar tree often reaching 150 to 200 ft. in height and almost invariably with a somewhat bent and leaning trunk particularly at its lower levels. The branches are comparatively short, rarely exceeding 8 ft. in length, somewhat dependent and whip like. The branchlets are somewhat crowded giving a dense outline to the tree.

The foliage is small, slightly curved, imbricate and obtuse, dark green in color, suggesting a neatly plaited cord. On juvenile shoots the leaves are triangular and up to $\frac{1}{2}$ in. long. The cones are elliptical, comparatively small, 5 to 6 inches long and 3 to 4 in. wide, the male catkins 1 to 2 inches long.

This species was discovered on the Isle of Pines by Captain Cook during his second voyage to the Pacific (1772-1773). Seen from a distance natural stands "are said to resemble columns of basalt."

Today this tree is rarely planted although in the past it was a great favorite. Normally the trunk is completely unbranched but, should the terminal bud be destroyed, this species has the capacity of regenerating leaders from axillary buds. One specimen growing locally has branched twice, giving a total of four trunks arising from points approximately 40 ft. above ground level. It is an interesting tree growing on a variety of soils. However, it is less desirable than *A. heterophylla* which remains attractive throughout its life.

***A. heterophylla* (*A. excelsa*) Norfolk Island Pine**

A beautiful tree and one of the tallest growing species often exceeding 200 ft. in height. This stately tree is, with the Bunya Pine, the best known of the Australian members of the genus. It has been used for conservatory and hot house work for at least 170 years (first grown in England in 1793) and wherever climatic conditions permit it is planted outside.

It is widely planted throughout Australia, including subalpine regions and hot districts receiving as little as 16

***Araucaria heterophylla*. Norfolk Island Pine planted along sea coast south of Adelaide, South Australia. Note the regular growth despite the trees being subject to gale force winds. (About 30 ft. high and 20 years old).**

PHOTO BY AUTHOR



inches of rain a year. South Africa and other subtropical countries grow it, and it is widely planted in the Mediterranean regions and the Azores. A few trees are known in Cornish (England) gardens.

The trunk is erect, often up to 6 ft. in diameter. The main branches are horizontal and in whorls of 4 to 7, rarely more, lateral branchlets are often dependent. The leaves are of two kinds, on lateral or juvenile branchlets awl-shaped, incurved, soft bright green, those on older shoots about $\frac{1}{2}$ in. long, curved and sharp-pointed, overlapping, broadly ovate—much coarser than in *A. columnaris*. The cones are squat, broader than long ($3\text{-}4'' \times 4\text{-}4\frac{1}{2}''$). The seeds are long and narrow ($1\frac{1}{4}'' \times \frac{1}{2}''$) within the scale which is soft and flat with a triangular spine at its apex. Even in Australia on fully mature trees, viable seed is rarely produced, although the trees bear cones. This may be due to the lack of evenly high temperatures during the production of male and female cones.

It is a native to Norfolk Island where it is found on the cliffs and adjoining country on the sea coast. However, because the cliffs are often high above the waves the plant is not as salt tolerant as is generally thought. It requires a good rainfall and mild climatic conditions. It has been freely planted within Australia, most certainly along the coast lines where it is used very frequently by local government bodies for public park planting. It tolerates gale force winds and because it appears immune to diseases and insect pests, very rarely are the trees blown out or collapse during gales.

A. cunninghamii—Hoop Pine (more rarely Richmond River or Moreton Bay Pine)

In the young stages, a massive heavy-branched tree which ultimately attains at least 200 ft. in height and up to 4 ft. in diameter. The bark is hard and rough, forming circular hoops or bands, dark brown or black, red when cut and thick. The branches are somewhat ascending and in whorls up to 7, with branchlets crowded in dense tufts near their ends. As the tree ages the branches



PHOTO BY AUTHOR

Comparison in growth habits between *A. heterophylla*, Norfolk Island Pine (right) and Hoop Pine, *A. cunninghamii* (left), Adelaide Botanic Garden. Approximately 80 ft. high, planted about 75 years ago.

become almost horizontal or even depressed. In mature trees the branches remain on the upper third only and the crown is less symmetrical than is usual in the genus.

The leaves are of two kinds—on seedlings and lateral branchlets they are linear or triangular shaped, spreading, spirally arranged, sharp-pointed, usually green but sometimes glaucous; the adult foliage is crowded, spirally arranged, overlapping, incurved, linear or narrow triangular with a sharp point and deep green in color.

The male and female inflorescences are usually on separate trees. Male catkins are up to 3 in. long; female cones

are ovoid, about 4 in. long with a sharply pointed projection at the tip of each scale. The seed is small ($1/2'' \times 1/8''$) embedded in the scale.

This is the most widely spread of the Australian araucarias. It is found through northern New South Wales and Queensland and with its variety *klinckii* (considered by some to be distinct) extends to New Guinea, usually in coastal ranges, but in New Guinea it is found inland at altitudes between 2,000 and 5,000 ft. This species prefers a subtropical climate but at higher altitudes experiences some frost. The rainfall is from 40 to 60 in. per year, more than half of this amount falling in the summer months. It grows best in rich soil.

It is one of the most important timber trees of Queensland and in more recent years an active re-afforestation program has been undertaken. The bulk of veneer and plywood made in Queensland is from Hoop Pine and is used extensively for all indoor work.

The trees are moderately quick growing but require at least 80 years to produce millable timber. With other members of the southern araucarias, regeneration from axillary buds is possible. Frequently two or three subleaders arise from the base of the plant when the tree is possibly 40 or 50 years old. In the young stages the tree is most impressive and massive in appearance with its upward thrusting dark green clothed branches.

A. rulei

A very rare tree in cultivation but attractive in shape with pendulous tail-like branchlets. The tree grows to about 50 ft. with dark green glossy leaves which are incurved, closely overlap and stem-clasping, hard, stiff and usually sharp pointed.

This species is regarded as allied to *A. columnaris* and bears a likeness to *A. araucana*. It is a native of New Caledonia where it was discovered by a Mr. W. Duncan near the summit of a volcano. The rocky material in which it grows becomes very wet in winter but dries hard in summer. Under cultivation it thrives in good medium soils, adequately drained and in a climate where frosts are not only few in number but slight in effect.

Generally araucarias are plants which should be grown in mild to warm climatic conditions, moderately well-drained soils which should be sub-acid or neutral. Under cultivation they appear indifferent to summer or winter rainfall but require copious moisture during the summer months should this not fall naturally.

Group planting of a single species is probably the most effective way of growing them, although the New Caledonian and Norfolk Island Pines, because of their somewhat similar branching habit, produce quite attractive group plantings.



PHOTO BY AUTHOR

***A. cunninghamii* Hoop Pine. A comparatively young vigorously growing tree about 50 ft. high and 50 years old. Note the stout ascending branches.**

The Botanical Garden of Saint-Pierre 1803-1902

RICHARD A. HOWARD* AND
CLAUDE WEBER**

The eruption of Mount Pelée on the West Indian island of Martinique remains one of the most tragic natural cataclysms of the 20th century. At its foot was the town of Saint-Pierre, the capital city of Martinique and the hub of French influence in the New World. Saint-Pierre was a seaport receiving international trade and a center of culture and education with an opera house, libraries, schools and a college, a zoological garden and a botanical garden. In early May, 1902, volcanic activity was noticed on towering 4,280 foot Mount Pelée, but the weakness of the disturbance prompted the town officials to advise the people to keep calm. On the 8th of May Mount Pelée erupted with violence, and death came to Saint-Pierre in the cloud of smoke and fumes and ashes and cinders that descended the mountain slopes. So unusual was this form of eruption that the name *nuées ardentes* was coined for it and is so used internationally (1). Figures of the loss of human life in total disasters can never be accurate, but estimates of the loss in the complete destruction of the town of Saint-Pierre are between 28,000 and 30,000. Destroyed with the town was much of its history and all of its influence. The records and archives of the public organizations were not duplicated elsewhere in Martinique or in France. The Jardin des Plantes, the botanical garden of Saint-Pierre, was incinerated with the rest of the town, and its director also lost his life in the eruption. Stehlé has reported that only a few of the introduced plants survived the holocaust, these probably because of the favorable location of the garden in a valley, separated by a ridge from both the town and from Mount Pelée (2). The location of the town of Saint-Pierre was reused for its

modern modest successor, however only a new housing development bearing the name Jardin des Plantes gives any indication of the former existence of a famous botanical garden, uniquely the victim of a volcanic eruption.

As the years pass, the records of the old flourishing Saint-Pierre become more difficult to find. A diligent search has yielded only a few bits of information regarding either the history or the nature of the botanical garden of Saint-Pierre. Perhaps by calling attention to the many gaps, additional information may be found to complete its history.

The garden of Saint-Pierre was established in 1803 and was therefore one of the earliest gardens to be formed in the West Indies. The Botanical Garden on St. Vincent, to which Captain Bligh brought the breadfruit at the turn of the century, was founded in 1765, and the small Bath Garden in Jamaica in 1775. The Royal Botanic Garden in Trinidad was established in 1818 (3). The French did have a botanical garden, often referred to as the King's Garden, on Hispaniola, but neither the dates of its existence nor, in fact, its exact location have been determined.

The last two and one half decades of the 18th century, 1775-1800, were turbulent years of war and revolution in the West Indies. Surprisingly, botanical gardens were involved in political events during the period. While the French occupied St. Vincent, the general in charge of the island assisted the British director of that botanical garden in procuring new plants from the French colonies (4). By contrast, a shipment of botanical specimens from Mauritius destined for a French island, probably Hispaniola, was intercepted by Captain Marshall, commander of the warship *Flora* of Admiral Rodney's squadron. The plants on board were taken to Jamaica and among them was the famous mango "Number 11". When

* Director, Arnold Arboretum, Jamaica Plain, Mass. 02130. ** Current address: Conservatoire et Jardin botaniques, 192 route de Lausanne, Geneva, Switzerland.

Hispaniola was lost to the French around 1800 and Martinique became the principle colony in the Antilles, there was a need for a botanical garden and an agricultural research station. It was in 1803, on February 19th, that the botanical garden of Saint-Pierre was established by a M. Castelnau d'Auros. It was located at the foot of a mountain called "Parnasse" in the estate of Corinthe ou Poirier, which before the revolution had belonged to the Convent of Ursuline.

A government document of the period defined the rules of operation of the garden (5):

1. To improve and increase the culture within the colony of all useful plants, native and exotic, spices as well as fruits.
2. To introduce and to naturalize those foreign plants having some relationship to the local vegetation.
3. To enrich by these means the local agriculture with emphasis on products of nourishment to man and to animals.
4. To facilitate the study of botany; to instruct the inhabitants in the usefulness and application of the best fertilizers and the latest methods of cultivation.

5. To produce and maintain an exchange of products with foreign countries.

6. To distribute to the poor the local medicinal plants.

7. To furnish to the Jardin des Plantes in Paris, and to other French colonies, any plants which they lack and wish to have.

Only two descriptions of the Garden have been found that were published during its existence. In 1861 Prince Alfred of England visited Martinique and the botanical garden. His social visit was reported in *Les Colonies* and *Le Moniteur*, the local papers. The Prince wished to see the garden by daylight, although an evening reception there was planned. A general description refers to two waterfalls, several lakes and ponds, grottos and caverns and, in common names, many genera of plants. It was noted that in a section reserved as a botanical garden were more than a hundred species of ferns. Prince Alfred, described as an amateur botanist, was enchanted and took away several species of ferns. During the evening girandoles of Venetian lanterns alternating with



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1. Entrance gate to the Jardin des Plantes, Saint Pierre, Martinique before its destruction by Mount Pelée in 1902.

colored glass chandeliers were placed along the walk surrounding the lake, and garlands of colored lamps enlaced the trees along the shore. The water palace was marked by lamps, reflectors were placed to light the artificial waterfall, and two enormous beacon lights rested to the right and left of the pool. A considerable number of torches made from resinous gum, conveniently distributed, lighted the natural cascades and the more distant paths, delighting the strollers (6).

A second description is found in "Trois ans a la Martinique", by Louis Garaud, published around 1895. The description shows the impact of the garden on a romantic visitor and would lose much in translation (7).

L'allée qui y conduit suit le torrent qui borde par des arequiers, des chênes d'Amérique, des figuiers maudits et des roseaux prodigieux de hauteur. L'allée et le torrent sont serrés entre deux

2. The botanical garden was located in a valley. No maps of the garden have been discovered.

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murs de verdure qui s'unissent en demi-cercle, barrent le chemin et forment un cul-de-sac. Du haut de ce demi-cercle la cascade se précipite, d'une élévation de 50 mètres environ, dans un bassin d'où, assourdissante, elle roule dans le lit du torrent.

"Si on fait, face à la cascade dans l'enveloppement obscur du feuillage et si on lève les yeux, on voit au-dessus de la nappe tombante, à travers l'emmêlement des branches, une échappée du ciel et des scintillements de soleil dans les profondeurs vierges de la forêt. Cette cascade semble sortir de cette trouée de lumière, sous des arbres curieux et penchés qui la regardent tomber et sous des bambous flexible secoués de frissons par le courant.

"Ce coin prodigieux qu'aucune main ne déflore, ces mystères troublants de fécondation effrontée, cette poussée de sève, cet envahissement de lianes, cette fraîcheur, ce silence, ces profondeurs, ces rayons dans les hautes cimes, ces reflets, ces éclaircissements subis ont une saveur inconnue que j'ai goûtée délicieusement."

Following the report of the destruction of the garden in the eruption of Mount Pelée, the horticulturalist Eduard André wrote an obituary to the garden and to its director (8). In the *Revue Horticole*, a most prestigious magazine of its time, André described from his travel notes, an earlier but undated visit to the garden. The garden, he reports, was approximately a fifteen-minute walk from the town, and one entered through an ornate gate into a valley which contained most of the botanical collections. A river which ran through the garden formed waterfalls and lakes and was used in formal pools and fountains as well as for irrigation. The stream created two islands in the valley, one "Île des Ravenales" and the other "Île des Alpinias". There were tall trees such as "Attalea princeps" (*Scheelea princeps*), species of *Casuarina* over 30 meters in height, and magnificent specimens of other trees such as a *Barringtonia speciosa* with a trunk a meter in diameter. The branches and trunks of many trees held epiphytes or orchids, ferns and bromeliads. A grotto was decked with ferns and pitcairnia with long leaves. In one spot André stopped before a picturesque torrent and noted a cavern with steep walls called "the hole

of the serpent." In the garden land crabs scurried under foot and lizards could be seen on the trees and, above all, the garden did not lack the formidable *fer-de-lance*. An avenue of palms, *Archontophoenix*, with trunks a meter in circumference, was an inspiring sight, while in shady places the carpeting of large plants of *Phrynium mexicanum*, *Costus* with golden pompons and *Maranta* with zebra-striped leaves was equally impressive.

Leaving this green valley and passing a hedge of *Thuja occidentalis*, which he thought to be surprising in this tropical location, André found the buildings of a School of Botany, with gardens of beautiful and rare plants arranged in a terrace of three levels, the whole surrounded by a fence. In these terraced beds were plants for study and for special propagation. Nearby was a water tower in which water was collected in an ingenious manner and distributed through small irrigation channels before it formed a cascade into the valley and left as the overflow of a small lake. André reflects how in this garden art, science, and the years have combined to embellish gradually all of its functions.

Little information can be obtained about the directors who made the gardens. André records that the garden was founded by M. Castelnau d'Auros in 1803. A general catalogue of the plants cultivated in the garden in 1829 bears the signature of "M. V. Delorme, directeur du jardin des plantes" (9). The name of Charles Paulus Belanger is cited by Urban as the director from 1853 until his death in 1881 (10). André mentions the directorship of M. Thierry, but without dates, and laments the death of the last director, M. Nollet, and his family in the eruption of Mount Pelée in 1902 (5).

Père Duss gives credit to Belanger for the greatest development of the garden as a scientific botanical institution and a practical horticultural center for Saint-Pierre and for Martinique (11). Perhaps some of this credit should go to Ludwig Hahn, the German horticulturist who was appointed head gardener at Saint-Pierre in 1864 after receiving his training as a gardener at the Jardin des Plantes in Paris. In 1865 Hahn received an additional appointment to the Scientific Commission to Mexico, and between 1867 and 1870 he carried out an

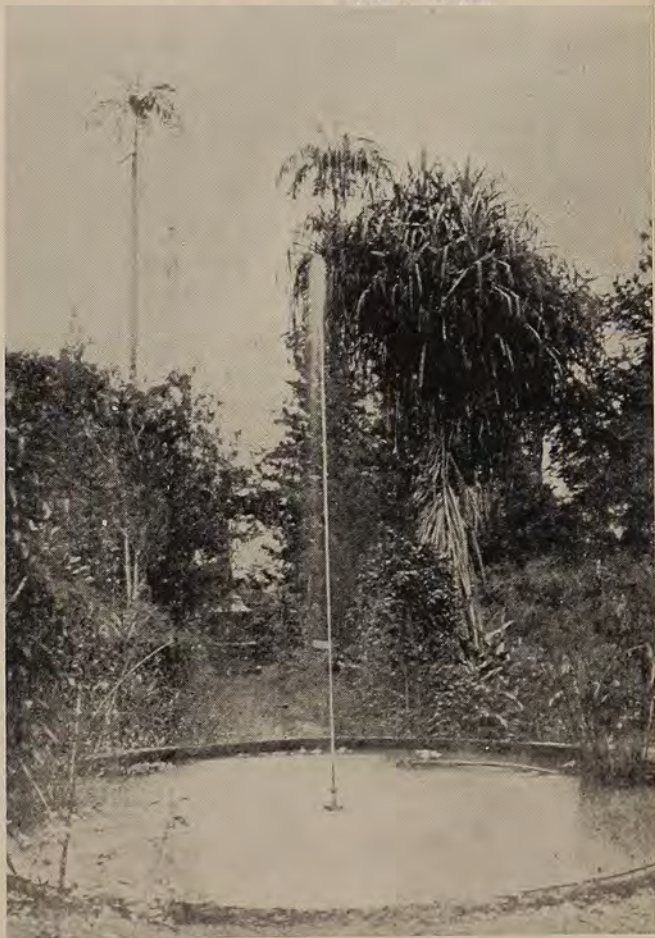
assignment to explore systematically the flora of Martinique. Belanger, the director, and Hahn, the head gardener, both died in 1881.

A general catalogue of the garden was published in 1829 which lists 8 species of ferns, 3 of cycads, 99 of monocotyledons (including 16 kinds of palms) and 554 species of dicotyledons. This listing and the catalogue of the Garden on St. Vincent published in 1825 appear to be the earliest records of plants cultivated in gardens in the West Indies (12). A list of herbarium specimens collected in the botanic garden of Saint-Pierre by Belanger in 1860 and 1861 and by Hahn has never been published. However, Père Duss may be considered a chronicler of the Saint-Pierre botanic garden.

Duss, a native of Switzerland, came to Martinique in 1865 as a teacher of chemistry in the College of Saint-Pierre. Because he was interested in the chemistry of plant products he became well

3. Water from local streams was directed through a series of falls, pools and fountains.

PHOTO BY AUTHOR



acquainted with the botanic garden and its director, Belanger. Duss returned to France to enter the priesthood and again returned to Saint-Pierre in 1871 as a teacher of chemistry and biology. During both of his periods of residency Duss was encouraged by Belanger, who aided his botanical studies and welcomed his assistance in the preparation of a catalogue of the plants of Martinique. On week-ends and holidays Duss climbed the mountains to collect specimens, and he painstakingly revisited difficult locations to obtain full specimens of plants which were known only in flower or in fruit. This practice explains the great mixtures and the confusion in the citation of Duss collections. Belanger had a small herbarium at the botanic garden which supplemented its truly fine scientific library. It was the combination of the library, the herbarium, the interest of the director, and the cooperation of the staff that permitted Père Duss to develop as a botanist. After the deaths of Belanger and Hahn, it fell to Duss to continue and complete the survey of the flora. Finally, in 1889, Duss returned to France for a rest, for additional religious training, and for the task of identifying those specimens which could not be handled in Martinique.

During this absence from Martinique Duss was recommended for the position of director of the garden of Saint-Pierre. We do not know if the position had been vacant continuously since Belanger's death. Stehlé reports that there is correspondence indicating that Duss would accept the post with joy and pleasure. It was not to be his, however, for his order re-assigned him to Guadeloupe, where he worked to complete his observations on the flora of that island. An enumeration of the plants of Martinique and of Guadeloupe was published in 1897 in the *Annales of the Colonial Institute of Marseille* (11). Throughout this volume are scattered references to species cultivated in the botanical garden of Saint-Pierre. Some references are supported by mention of herbarium specimens collected by Duss, but no collectors' numbers are given. For many of the cultivated taxa Duss published the date of introduction and the source. For others he reported the extent of their cultivation or their establishment as weeds. Few of these specimens are available as duplicates in American herbaria.

Only a systematic search through the herbarium at the National Museum in Paris for specimens collected by Duss, Belanger and Hahn would produce a partial record of the plants in the *Jardin des Plantes of Saint-Pierre*.

In 1887 the administration and maintenance of the garden was transferred to the municipality of Saint-Pierre. The influence and presumably the appearance of the garden declined so conspicuously under this local aegis that in 1890 another official act returned the garden to the national administration in France.

In 1896 an Arrêté described the role of a consultative committee which was to work with the botanic garden on all questions pertaining to agriculture. The committee was to further the introduction and distribution of plants, to supervise all agricultural practices on the island, and to control the prices of "seeds, flowers, fruits, shrubs, ornamental plants and essential materials to industry or forestry" which originated in the colony. The director of the garden was secretary of the committee which was to meet monthly at the garden (13).

The last years of the garden may well have been the most influential ones. The introductions by Hahn between 1864 and 1881 were plants received from many other gardens in the tropics. A botanical mission from the garden in 1898, under the direction of M. G. Landes, visited the gardens of Port-of-Spain and of Demerara to obtain additional plants for the garden of Saint-Pierre. A report of this expedition cites the introductions as ornamental plants in groups of trees, vines, shrubs, palms and orchids, and lists in addition economic plants, including many clones of citrus, coffee, manihot and sugar cane. These plants were grown and propagated at the garden and distributed without charge to local growers.

The implementation of the directive of 1803 to teach botany was evident in the school of botany, the herbarium, and the scientific library. A branch station for research and instruction was established near Fort Royal, later known as Fort de France, at a spot called Tivoli, and the *Laboratoire Agricole of Tivoli* remains active today.

Although the town of Saint-Pierre, like a phoenix, rose from the ashes, the main *Jardin des Plantes* did not. Its role



PHOTO BY AUTHOR

4. Curving staircase led to the entrance of the opera house in the town of Saint Pierre. Breadfruit trees, coconut palms and bananas now grow on the cite. The female figure carved from local stone symbolizes the spirit of Saint Pierre arising from the ashes. From a kodachrome by R. Howard taken in 1950.

and its contributions were influential during its lifetime, but these, like its very existence, seem to have been extinguished by the goddess Pelée.

ACKNOWLEDGMENT

The authors acknowledge with gratitude the assistance of Messrs. Gabriel and Emélie of the Direction des Services Agricoles, of Mme. Anca Bertrand of Fort de France, Martinique, and of Mlle. Madier of the Bibliothèque Centrale, Muséum National d'Histoire Naturelle, Paris. This study is part of a program of botanical and horticultural investigations in the Lesser Antilles and has received support through grants from the National Science Foundation.

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Photographs 1-3 selected by the staff of the Bibliothèque Centrale, Muséum National d'Histoire Naturelle from published illustrations of the Saint-Pierre garden.

Field Mice

BY W. J. HAMILTON, JR.*

Heavy snows had blanketed the Lake Ontario and St. Lawrence River area of northern and western New York for weeks on end. As the great white blanket melted away in the early spring of 1959, residents of the area were appalled at the havoc exposed by the disappearing snow. Ornamental trees, hedges and shrubs were stripped of their bark, valued roses and flowering plants were cut to the ground while fruit trees were so badly girdled that bridge grafting was to prove futile. The damage was not local, but extended widely throughout the northeast.

This great toll was exacted by millions of field mice whose chisel-like teeth spared little vegetation. So abundant were these little rodents that snow plow operators at the Thousand Islands Bridge reported that they plowed hundreds of the little animals out of snow banks during the winter. A cat reportedly brought 38 mice to the kitchen door in a single morning. Such high mouse populations occur somewhere in our country every year. The threat from these destructive little mammals is always with us, and ever poses a hazard to valued plantings.

Perhaps no other small mammal is so adaptable in the selection of a habitat in which to seek its food and rear its young. These short-tailed, beady eyed mice of the genus *Microtus* are found in suitable waste lands throughout the temperate zones of the Northern Hemisphere. Nearly one hundred species and their races occur in North America. Field mice swarm in the salt marshes, crowding to the very edge of the mud flats; they are equally at home in the stunted vegetation of high mountain slopes. These mice find a congenial habitat in the lush meadows, where the damp earth gives rise to a dense vegetation and succulent annuals. Neglected fields that support a canopy of dead grasses shield

them from the prying eyes of soaring hawks. Even a vacant suburban lot, overgrown to tall weeds, will maintain a thriving colony.

Part the dead matted grass of a field and a new world is revealed. Little paths, scarce the width of a garden hose, crisscross one another to form a labyrinth of mouse highways. These are kept clear by the incessant gnawing of any fresh vegetation that may sprout into the tiny pathways. In such a haven, the mice seldom depart from their runways. Little piles of freshly cut vegetation or the middens of little green droppings give testimony to the presence of these ubiquitous creatures. One may find a nest of shredded grass the size of a grapefruit, that provides a resting site or a nursery for the reception of the young.

Field mice are among the most prolific of all mammals. Females carry their young three weeks, and one litter follows another in rapid succession. Able to shift for themselves when twelve days old, the precocious females become sexually mature when they have attained the ripe old age of four weeks. A captive female bore 17 litters in a year, while one of her daughters delivered 13 litters before her first birthday. From three to eight young constitute a litter and the breeding season is an extended one. No other mammal can challenge such fecundity.

Like the snowshoe rabbit of our northern forests and the famed Norwegian lemmings, empire among field mice has its rise and fall. Incredibly abundant one summer, the mice often appear to have all but disappeared by the following spring. What occasions these drastic changes in population levels is little understood. It is apparent that no one single factor is invariably responsible for the regular buildup and inevitable decline. Disease of epidemic proportions appears to be one of the primary causes of the decline, but adverse climatic conditions, parasitism and predatory birds and mammals may well contribute

* W. J. Hamilton, Jr., 615 Highland Rd., Ithaca, N. Y.

toward the decline. These cycles, like those of the tent caterpillar and some locusts, occur with rather regular periodicity. Field mice tend toward a four year cycle, but these are not always of the same intensity. Moreover, cycles in adjacent areas do not necessarily coincide.

When favorable conditions prevail, mice often become incredibly abundant and mass outbreaks occur. These plagues have been recorded since Biblical times and have been recorded by biologists the world over. Often these great irruptions of field mice are brought about by agricultural modification of the land. In dry countries, where mice are usually scarce, irrigation and the consequent increase in the food supply suitable for these little animals has enabled them to increase greatly. Such a change in habitat was probably responsible for the 1907 Nevada outbreak. The Humboldt Valley experienced a tremendous increase in the mouse population, estimates reaching populations of 12,000 mice to the acre. Fields were riddled by their tunnels and holes were scarce a step apart. Entire fields of alfalfa were so seriously injured as to require plowing and replanting. The winter of 1957-58 will long be remembered by the farmers of the Klamath Basin in eastern Oregon. Here the estimate of mouse numbers reached 3000 to 4000 mice per acre and at least 300,000 acres of rich agricultural land was in danger of major damage. One hundred fifty tons of poisoned bait was distributed in the affected area to partially control the mouse hordes.

It is not the mass outbreaks just alluded to that make these mice of such economic importance, but rather the perpetual pilfering of man's plants from year to year. This steady drain, while not particularly apparent, accounts for the loss of many millions of dollars annually to the farmer, horticulturist and plain dirt gardener.

We may ignore the presence of field mice year after year, although suffering noticeable plant loss from these rodents. The time eventually approaches when the mice, favored by a combination of ideal conditions, cause untold loss in a relatively short time. This is particularly true of orchards and conifer plantations growing in sod. Here, under cover of snow, mice girdle through the outer bark to reach the cambium. The pine

mouse, close cousin to *Microtus*, more mole-like in its habits, commonly eats away the roots until the tree, weakened and with little support, topples in a strong wind. Hedges, ornamental shrubs and small conifers are particularly susceptible to the ravaging teeth of field mice but damage is seldom revealed until the disappearance of the snow, when control measures are belatedly attempted.

Just as spraying, pruning and thinning are regular garden practice, so also must the control of field mice be consid-

A 20 year old apple tree completely girdled by field mice. Dirt has been removed about the base of the tree to show the extent of the injury. Extensive bridge grafting may save the tree.

PHOTO W. J. HAMILTON JR.



ered. Usually the greatest damage occurs under the cover of snow, thus preventive measure should be considered prior to winter. Constant vigilance is the only insurance against mouse damage.

Some of the accepted practices for reducing the mouse population are the use of mechanical protectors, poisoning, removing mouse shelter, repellent washes and trapping. All of these methods have their merits but none are infallible. The best practice is a combination of several methods.

Mechanical protectors consist of a roll of half inch hardware cloth, rolled about the basal portion of the trunk of choice trees. The cylinder should be sunk into the ground an inch or two and can be held together with paper clips or string. Newspapers, aluminum foil, burlap and wooden veneer have been used as a temporary guard. These must be removed when the leaf buds commence to swell in the spring. Two laths, wired opposite one another on the trunk, will prevent complete girdling.

Poisoned baits have been widely used for the control of field mice for many years. Zinc phosphide, finely powdered arsenic trioxide and strychnine alkaloid are accepted poisons. Because of its bitter taste, strychnine is probably the least effective. Arsenic has proved quite effective in our own trials. The poison is dusted on fresh baits, such as apple or carrot cubes, or utilized with grain baits. These are placed directly in the fresh runways of the mice, which may be recognized by the grass cuttings and droppings. In young conifer planting and orchards, Toxaphene applied at the rate of five pounds per acre in air blast speed sprayers has been effective in killing a high percentage of mice. Endrin also has been used for mouse control, but its use is more hazardous because of its high toxicity. The United States Fish and Wildlife Service prepares poisoned baits for mouse control. Distribution centers for these poisons can be determined by contacting your county agent.

Since the field mouse requires a good



PHOTO W. J. HAMILTON JR.

This young orchard, with its heavy sod and dense stand of grass, provides an excellent habitat for field mice. The orchardist is distributing arsenic coated apple cubes directly into the runways of the mice. Without such control measures, many of these trees would have been severely girdled by spring.

ground cover to carry on its normal activities, the removal of litter and matted dead grass will help to destroy mouse habitat. These mice often take up residence in heavy stands of low growing junipers, myrtle, pachysandra and other dense vegetation that provides an ideal retreat. From this cover, they may forage into the garden, forsaking their usual runways, to cut down choice stalks of bulbous plants and perennials.

It is in such cover that the home gardener should look for the telltale signs of mice. These ubiquitous pests leave their sign for the observant person to read. In such situations, trapping is an effective control measure. A dozen snap back mouse traps, baited with oat flakes or peanut butter, should be placed so that the pan of the trap will straddle the runway. Since these mice are totally without suspicion, they will trip the trap even if unbaited. Several years ago I lost several choice hybrid lilies that grew at the periphery of a dense stand of Andorra junipers. A dozen traps placed under the clumps of low branches resulted in the capture of 15 mice within a week.

Repellent washes may have some value, but it has been our experience that

they are either injurious to vegetation or simply fail to repel mice. The most effective repellents contain sodium fluoroacetate, a poison that has not been released from government control owing to its extremely poisonous character.

In spite of the foregoing, we can scarcely condemn these mice as useless pests. They serve as food for countless predatory animals that might otherwise feed on more desirable species. Among the birds, hawks, owls, crows, shrikes, gulls, herons, magpies, jays and many others utilize them for food. Weasels, skunks, foxes, badgers, bobcats and even the great bears hunt industriously for these mice. Black snakes, milk snakes and many other serpents take a large toll. Even predacious fish will snap them up when the mice venture into the water.

Since predatory animals are so dependent on the mouse millions, we might well consider them the agents that transform vegetation into flesh. *Microtus* also serves as a fine experimental animal for the biologist. Finally, gentle reader, our subject, properly prepared, provides a unique side dish for those with epicurean tastes.

Two Peruvian Species of *Salvia* of Ornamental and Ethnobotanic Value*

BY PROF. CESAR VARGAS C.**

Of the 67 species of the genus *Salvia* (Labiatae) which J. Francis Macbride describes for Peru, in his "Flora of Peru," undoubtedly, those of major importance and ornamental and ethnobotanic significance are *Salvia dombeyi* Epling (see Back Cover), and *Salvia oppositiflora* R. & P. The first (*S. dombeyi*) (Section Longiflorae), from the ornamental point of view is very attractive and therefore decorative; not only for the size and color of its flowers, but also for its leaves. Its geographic distribution, however, is more limited than the second species, having its localization less frequent, therefore, one encounters it only in determinate places between 3000-3600 m. (10,000-12,000 ft.) Its vernacular name is "sacha ñucchu," which I think is more suitable and exact than "llagas ñucchu," the term quoted by F. L. Herrera. In effect, the Quecha word "Sacha" means shrub and *S. dombeyi* is woody and at times, reaches more than 5 meters (17 feet) in height in its own native habitat. From the descriptive aspect of the mentioned species and in accord with the data taken from the living plants, we have the following: sub-shrubby climber in habit with stems and branches always pendant, bearing various branches from the base, thin, 3 cm. thick, obscurely tetragonal, of red color, pilose, hairs reaching 5 mm. long, transparent when young, lightly yellow later, terminating at the point in a small dark sphere. From the older branches of the past year, arise at the end of spring and during the summer, the floriferous branches which, in the beginning, are totally green. Later, with maturity, they become ligneous, at the apex of which arise the inflorescences which are conspicuously knotty or swollen at the point of

insertion of the flowers. Leaves are of variable size, blade 7-22 cm. long and 12 cm. broad, oval, acuminate, sub-cordate, crenate-serrulate, upper surface sparsely pilose, lower surfaces, sometimes densely pilose, at other times, only on the veins, petiole 2-6 cm. long. Inflorescences in more or less conical racemes up to 34 cm. long, or less, borne at the ends of the floriferous branches from 40-60 cm. long. Flowers on 7-11 opposite head-like nodes, with 1-3 to 8 flowers per node. Calyx cylindrical, purple about 4 cm. long, with acute lobes. Corolla to 12 cm. long, upper lip larger than the lower, densely pilose, scarlet red hairs 5-6 mm long, multi-cellular. Pistil exserted.

In Peru, one encounters this species in the north in Cajamarca, south to Cuzco, Puno, and Bolivia. It flowers at the end of spring and abundantly in summer, occasionally it has been collected flowering in winter (July).

As to the ethnobotanical value of *Salvia dombeyi*, for the moment, I am not able to confirm anything concrete. However, the search of data, both from the colonial chroniclers, as well as from the phytomorphic representations of the ancient Peruvians has been negative. Notwithstanding, there are indications that it was very esteemed as an ornamental inasmuch as one does find it cultivated in the native villages near the native habitat of this plant.

In contrast, *Salvia oppositiflora* called simply "ñucchu," one does find repeatedly represented in color and natural size, on the sacred vases called "keros" (of wood) on the exterior part of which have been painted diverse anthropomorphic, zoomorphic and phytomorphic motifs. In this later case, *S. oppositiflora*, is with evident preference and frequency, with respect to the other motifs of plants.

Traditionally, the "ñucchu" through the representations on vases of wood,

* Translated from the original Spanish by Russell J. Seibert, Longwood Gardens, Kennett Square, Pennsylvania.

** Cuzco, Peru.

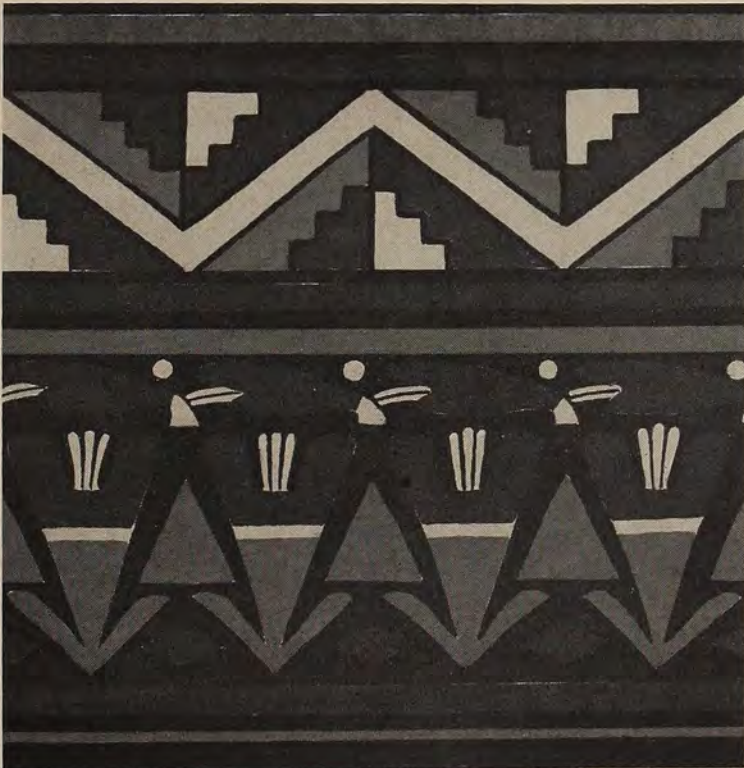
clay and even in fabric, as well as from the cases cited which one encounters in the works of the chroniclers of the conquest, it is known with some precision, that this species (*Salvia oppositiflora*) has had symbolic value and use very often in the *fiestas of the Incanato*. It was a very esteemed and sacred flower, utilized in religious ceremonies with diverse purposes. It was to pacify wrath of the destructive gods, such as the earthquakes, or it was the compliance to the Inca emperors and the personages of the Inca court. In actuality, it is still esteemed and utilized perhaps as a reminiscence, in some religious fiestas, inclusive of the Catholic Church, during the Holy Week in order to cover the sacred effigies with the scarlet corollas.

The geographic distribution of this *Salvia* is greater, covering extensive zones between the mountain ridges from 3000-3600 m. and during the flowering period, gives a vivid reddish tinge to the landscape. The plant is woody, red in color, and the stems are tetragonal, from 30-40 cm. high, woody toward the base,

pilose, with strong typical color. Leaves are small, oval-oblong, with dentate blade, petiole short. Flowers are in 2's at each foliar node; calyx persistent; corolla prematurely caducous, scarlet red, 2.5-3 cm. long; fruit of four free nutlets, visible in the base of the calyx of red color at first, later, black when ripe. Flowers from January (summer) until the month of May (autumn), but in cultivation, it flowers for a more extensive period and also reaches larger size and beauty in mass.

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Salvia oppositiflora.

Woody Plants—for Bonsai and Container Growing

BY LEE ROY BYRD, JR., M.D.

Naturally or artificially dwarfed trees grown in pots and trained into beautiful shapes are called *bonsai* by the Japanese. To produce such trees is most satisfying. For these trees to assume an appearance of maturity and to bloom and, in some instances, produce fruit enhances this satisfaction.

Since very early times in Japan naturally stunted trees have been collected, grown in pots and treasured. Only in relatively recent time (probably during the late sixteenth century) did the idea of artificially improving the shape of potted trees become established. In more recent time Japanese gardeners have realized it is possible to create artificial dwarfs from seedlings, cuttings, and grafts. Since *bonsai* were first seen outside Japan in 1909 at an exhibition in London, interest in them has spread.

BONSAI CULTURE

The culture of dwarf potted plants is based on sound horticultural principles. Roots are confined to a limited space and are pruned at times of periodic repotting to allow for development of new roots. Regular and continued pruning of vegetative growth is done to maintain a balance with the roots, and to train the plant to the desired shape. Health of the plant is maintained by frequent watering and regular fertilization, while good drainage is assured by proper potting. Exposure to the seasonal variations of the plant's natural habitat continues the natural cycle of growth, although it is necessary to give winter protection even in mild climates to prevent freezing of roots.

Training of plants into interesting and beautiful shapes is accomplished by pruning and wiring. This takes into consideration the natural growth habit of the plant. Age alone can create an

appearance of true maturity, but great age is not a prerequisite for a pleasing *bonsai* specimen. A properly selected dwarf yaupon (*Ilex vomitoria*) obtained as a balled and burlapped or gallon can specimen at a nursery may be repotted and pruned to give immediately a beautiful shape with many of the attributes of a mature tree. The direction of growth of a branch may be changed by wrapping it with copper wire to hold it as it is bent into the desired position. Thus, a void in the shape of the plant may be filled or a branch directed in a desired line.

The soil used in potting is determined by the plant and the climate. For broadleaved deciduous trees a mixture of 3 parts sandy loam and sieved clay mixture, 2 parts humus and 1 part sharp sand is generally used. For pines, or similar conifers, a mixture of 3 parts sandy loam and sieved clay mixture and 2 parts sharp sand is used. In the bottom of the pot the larger granules of sieved clay are used in the mixture, in the top part the smaller granules. For Bald cypress (*Taxodium distichum*) a mixture of 3 parts sandy loam, 3 parts humus and 1 part sharp sand is desired.

Repotting is usually done every 4-5 years with evergreens, every year for flowering and fruit bearing trees, and for other deciduous trees every two years. For most of the trees in which the flowers are of prime importance, this is done just after the flowers fall, for fruit bearing trees in early fall. For other trees, with specific exceptions, it is done in early spring just before new growth starts.

As a general consideration at the time of repotting one third to one half of the soil of the old root ball is removed by washing with a stream of water and/or gentle pushing with the finger or a slender stick. Of the roots thus exposed, the older ones are pruned completely and the newer roots are pruned to one

* Lee Roy Byrd, Jr., M.D., 1901 Stanley Blvd., Port Arthur, Texas 77642.

third to one half their length. The plant then is again placed in the same size pot and must frequently be given extra support until it has regrown its root system. For a short time after repotting the plant must be protected from sun and strong wind.

Plants should be watered when the soil in the pot appears dry on the surface, frequency varies with the type of plant, the size of the pot, the cycle of growth at the time and weather conditions. Some plants may be watered three or more times a day, and others perhaps only once in three or four days. Watering is best done with a gentle flow.

Leaching of the soil in the pot is a result of frequent watering. Thus, it is necessary to feed bonsai regularly. A balanced liquid fertilizer applied when the soil is slightly moist several times during the growing season serves very well for flowering and fruiting trees. Conifers are fed less often, frequently only once each spring and fall.

Many pleasures are afforded in growing bonsai, but there are disappointments, too. An energetic Blue Jay looking for a bit of food strips a healthy growth of moss from a pot! A puppy decides to wrestle with a plant, pulls it from its pot, shakes the roots free of soil and leaves it to dry in the sun! The loss in one night of five years of effort in training several specimens because of an unpredicted hard freeze—!

SUITABLE PLANTS

A trip to a local nursery will likely produce a number of useful plants to start the process of creating a bonsai. Plants with small leaves when mature usually make the most likely specimens. Attractive characteristics of bark, interesting lines of trunk growth and limbs, small flowers and fruit, and colorful or interesting shapes of leaves are desirable characteristics to consider in selection of plants.

Also, plants may be obtained from their natural habitat as small seedlings. Occasionally a naturally dwarfed specimen many years old may be found and transplanted for training. Seeds may be planted to obtain seedlings. Cuttings may be rooted or bought as "liners" to produce small plants. In certain species, it is desirable to produce a specimen by grafting.

Of a number of plants given a trial

here on the upper Texas Gulf Coast, these have been found to be suitable for dwarf tree culture:

Anacua—*Ehretia anacua*

A slow growing plant with an interesting, relatively small leaf, and bark that produces a mature appearance early, this plant has an interesting character of growth. It is native to south Texas into Mexico.

Red Cedar—*Juniperus virginiana*

As with other species of juniper, this one makes an interesting bonsai even as a young plant. It grows throughout the eastern half of the United States. Wild seedlings may be transplanted with ease. Juniper is also available in numerous forms in the nursery trade.

Southern Crabapple—*Malus angustifolia*

Other crabapples have long been used for bonsai. On the basis of a short experience this one also promises to be suitable. It is native to the southeastern United States.

Crape Myrtle—*Lagerstroemia indica*

Several varieties are grown in the open in the southern United States and are available in the nursery trade. It may also be grown from seeds or cuttings. It will produce a blooming bonsai in a short time from a gallon can size plant. After the first flush of flowers in midsummer, the old panicles should be pruned, and a new cycle of flowers will develop.

Bald Cypress — *Taxodium distichum* (Fig. 1)

There are trees of this species growing in the southeastern United States that are more than 1000 years old. Its natural range is from southern Delaware to Florida, along the Gulf Coast into Texas and along rivers into Oklahoma, Arkansas, and southern Illinois. From this habitat seedlings 18 to 30 inches tall transplant to pots very well, and from the beginning make beautiful bonsai. It is one of the deciduous conifers.

Principle pruning of vegetative growth is done while the branches are bare in winter and must be extensive to keep the tree within desired bounds. Pruning for shaping new growth may be done during the growing season, and is especially necessary for the topmost branches.

Repotting is done before new growth starts in early spring every two or three years. Root pruning is done principally



PHOTO BY AUTHOR

Fig. 2—Texas Ebony. 14 in. Transplanted from its natural habitat as a seedling about 2 years old. Trained 8 years. Still in a training pot.

PHOTO BY AUTHOR



Fig. 1.—Bald Cypress. (*Taxodium distichum*). Planted from a bayou bank as a seedling about 3 years old. Trained 8 years. Height 4 ft. During the last year roots appeared at the surface of the moss covering the soil in the pot, suggesting that the tree is in the process of forming its typical "knees."

Fig. 3.—Heller's Holly. (*Ilex crenata 'Helleri'*). 8 in. Planted as a small potted plant during its first year from a rooted cutting. Trained 2 years. Height 8 in.

PHOTO BY AUTHOR



on the bottom of the root ball. After new growth has started the pot is kept in a basin of water during the period of active growth.

Texas Ebony—*Pithecellobium flexicaule* (Fig. 2)

Native from south Texas to Yucatan, this thorny evergreen tree is used as a beautiful ornamental in the Rio Grande Valley region of Texas. With a minimum of pruning the ordinarily 12 to 20 foot high trees form a symmetrical, rounded crown of the small, lustrous, dark green leaflets. Grown in a pot, it may be trained into a tree of the same shape. It may be transplanted as a small seedling from its natural habitat or grown from seed, and makes a beautiful specimen from the beginning. The thorns are at most $\frac{1}{2}$ inch in length and do not detract from the appearance of the plant.

When grown in a pot it should be protected from all frost. Repotting is done in early spring every three to five years. Pruning of vegetative growth is done as needed throughout the year.

Heller's Holly—*Ilex crenata* 'Helleri' (Fig. 3)

This dwarf holly has very small leaves of good shape and color. The character of growth is interesting and the bark has a pleasing appearance. A small plant may be pruned and turned into an interesting bonsai immediately. Repotting should be done every two or three years in early spring. It is readily available in the nursery trade.

Convex Dwarf Holly—*Ilex crenata* 'Convexa'

Available generally in the nursery trade, this variety makes an interesting bonsai quickly. It produces very small, white, bell-shaped flowers and small, white, black berries, on the female plant, and has done so on a plant as young as the second year from a rooted cutting.

Red Maple—*Acer rubrum* var. *drummondii* (Fig. 4)

A native maple growing in most of the eastern half of the United States and into Canada, this tree may be collected as small seedlings from its habitat along streams and in swamps. The ruby red flowers open in early spring considerably before the leaves. On a potted plant the leaves are smaller than normal. If all of the first set of leaves are cut off shortly after they have developed, another set even smaller will develop. Every two years repotting should be done in early spring after the flowers have opened and as the leaf buds begin to swell.

Mayhaw—*Crataegus opaca* (Fig. 5)

This is one of about 800 species of Hawthorn widely distributed throughout North America. There are more than 150 species in the United States that grow to small tree size, and most are notable for their sharp, often long, thorns. Leaves are small and after they appear in the spring the showy white flowers appear. The small fruit is apple-like and may be red, yellow, black or blue.

Mayhaw has a leathery, lustrous green leaf three- to five-lobed. When grown in a pot the leaf is 1 to 1½ inches long. Its habit of forming numerous branches lends itself to training by pruning. Spines are few and short, if present. When obtained in a gallon can size or collected from its natural habitat as a small seedling, it makes an interesting specimen in a short time.



PHOTO BY AUTHOR

Fig. 4.—Red Maple. (*Acer rubrum* var. *drummondii*). Collected as a seedling in its first year. Trained 7 years. Height 18 in.

Fig. 5.—Mayhaw. (*Crataegus opaca*). Planted from a gallon can as a 2 year plant. Trained 3 years. Height 20 in.

PHOTO BY AUTHOR





Fig. 6.—Texas Persimmon. (*Diospyros texana*). Planted from a gallon can as a 2 year plant. Trained 3 years. Height 18 in. In early spring of the present season planted in a hole dug out in a piece of lava rock and long roots trailed over rock into soil below. In a galvanized sheetmetal tray for training. Note insulated copper training wire in place.

Fig. 7.—Saffron Plum. (*Bumelia angustifolia*). Planted from a gallon can as a 2 year plant. Trained 3 years. Height 30 in. Note insulated copper training wire in place.



Sago Palm—*Cycas revoluta*

Not a palm at all, but a representative of an ancient and primitive family of plants, this is a very slow growing plant. It has a short, fibrous trunk topped by a rosette of evergreen, heavy textured, pinnately divided leaves. Suckers taken from a dormant plant and trimmed of their leaves may be rooted in sand. With the appearance of the first rosette of leaves, the plant is a thing of beauty. Plants of varying size in cans may be found in the nursery trade.

Growing in a pot it should be protected from all frost. Planted in the ground mature specimens without special protection have withstood temperatures at 17° F each morning and never above 32° F for a five day period here on the upper Texas Gulf Coast.

Oriental Pear—*Pyrus pashia*

The small, leathery, dark green leaves, which turn bright red in the fall, make this plant an interesting subject. From a short experience in growing it, terminated by an unexpected hard freeze, it promises to be a good subject. It is described as having a flower one inch in diameter and fruit three-fourths of an inch long.

Texas Persimmon—*Diospyros texana* (Fig. 6)

In the limestone hill country in central and southwest Texas, this persimmon, with a small, lustrous, dark green leaf, grows as a scrubby tree. The leaf size and its character of growth make possible a beautiful bonsai early in its period of training. The blooms and fruit are insignificant.

Saffron Plum—*Bumelia angustifolia* (Fig. 7)

This evergreen bumelia grows in south Texas and into Mexico. With its small, shiny, dark green leaves crowded on short spurs, and its rough bark, even as a young plant it makes a beautiful bonsai. Planted in the ground it is hardy to 10° F.

Japanese Yew—*Podocarpus macrophylla*

Seedlings of this plant will frequently be found growing around the base of large specimen plants. Many will already have interesting shapes when transplanted, or they can be trained in a short time to be interesting bonsai specimens. Specimens of various sizes are available in the nursery trade.

Yucca, Spanish Bayonet—*Yucca aloifolia* (Fig. 8)

In its natural habitat the plant forms colonies from rhizomes. As a dwarf it is best grown from seed and is interesting as a grove planted in a shallow container. Planting should be from one year seedlings. Pruning is done by pulling off the lowest leaves as they mature. As each rhizome appears on the surface as a new plant, it must be uncovered and removed at its point of origin to keep the colony in its original design. Root growth at the bottom lifts the planting in the pot necessitating repotting each year in early spring. The bottom one half of the root mass is pruned each time. *Yucca aloifolia* in the ground will stand a hard freeze, but in a pot no more than a light freeze.

CONTAINER PLANTS

The principles of bonsai culture may very successfully be applied to many plants for growth in containers to be used as accents in borders or on a terrace or patio. With the aid of a small greenhouse or a structure that may be covered with polyethylene sheeting and heated for winter protection in areas with freezing temperature, such tropicals as hibiscus, croton, and bougainvillea may be carried over from year to year for their wonderful color throughout the hot months.

HIBISCUS

There are many beautiful varieties of hibiscus grown in Florida, and new ones being developed regularly. Many of these are distributed along the Gulf Coast as gallon can size plants. In general they are treated as annuals except in very mild climates, for when pruned and covered for winter, all too often they rot. If left to the vagaries of winter weather most often they are frozen and killed. But a plant of this size, usually one year old from a rooted cutting, may be planted in a 10 inch or 12 inch container and a large plant with many flowers produced through the summer by once or twice daily watering and weekly feeding with a liquid 8-12-4 fertilizer. Figure 9.

After the first light frost, the plants, except for very slow growing varieties, are pruned to a height of 12 to 14 inches and moved to the covered, heated house. With slow growers such as *Hibiscus*



Fig. 8.— Spanish Bayonet *Yucca*. (*Yucca aloifolia*). Grown from seed. Planted as a group at 1 year. Trained 2 years. Height 6 in.

'Luna', the central branch is shortened only a few inches and the laterals are pruned to a six or eight inch length. If the plants are held at a temperature of 55° to 60° thru the winter and early spring, they will put out considerable new growth and therefore begin flowering earlier the following season. But any temperature above freezing will keep them alive until springtime temperatures arrive. During winter storage they are watered sparingly only when the soil appears definitely dry, and are not fed. When the temperature is consistently above 60° the plants are returned to the yard. Best blooming occurs when temperatures remain 70° or above.

Every two years, at the time the plants are pruned in the fall, they are repotted. One half to two thirds of the soil of the old root ball is washed away. The older roots exposed are pruned completely and newer roots shortened. The plant is then returned to the same size container. Some plants have been handled in this manner for as long as eight years and are healthy and producing a good array of blooms each year.

CROTON

Because of their characteristic of producing a comparatively large top growth from a small root mass, Crotons are particularly well adapted to container culture. Their beautifully colored leaves make them admirable as accent plants for summer and fall. They do not stand any frost and a strong cold wind will "burn" them. Therefore they must be moved to winter protection relatively early. At that time they are pruned low to produce low branching, otherwise

they become "leggy" because old leaves are dropped and tip pruning induces branching only near the tip. Each year they are pruned two or three inches above the point of pruning the previous year. The wood pruned may be used as cuttings for propagation. Figure 10.

After pruning the plants are watered very sparingly until new shoots have put on leaves. Then they are watered only when the soil appears dry, and kept at 55° to 60° minimum temperature. It is difficult to keep croton plants through the winter in the home, but it may be accomplished by placing the pots on a large pan of wet gravel in a sunny window. Plants may be returned to the yard when night time low temperatures are consistently above 60°.

Repotting is done at the time of pruning when the plant has become heavily root bound—every 3 or 4 years. One fourth to one third of the soil of the old root ball is washed away. The exposed roots are lightly pruned and the plant is repotted in the next size larger pot until an eight inch size is reached, then repotting is continued in that size pot.

BOUGAINVILLEA

Bougainvillea 'Temple Fire' is a bush variety with a striking red bloom. It has

been very satisfactory as a container plant to grow along with hibiscus and crotons. It begins to bloom on new growth in April or May when night temperatures are consistently above 60°, and continues to bloom until temperatures again fall below 60° in autumn. Watered only when dry and fed every two weeks with a liquid 8-12-4 fertilizer, it produces a profusion of colorful bloom.

After blooming has ceased, pruning is done to maintain shape and a thick growth. Canes are pruned to within 6 to 12 inches of the point of pruning the previous year. The plants are then placed in the winter house with a temperature minimum of 55° to 60°. They are watered sparingly until new growth has started, and are returned to the yard when temperatures are consistently above 60°.

A 13-inch square galvanized wash tub is an admirable container for this bougainvillea. The handles make the thorny bush easier to move. Repotting is done every year at the time of pruning and the plant is handled the same as hibiscus.

The soil used for potting hibiscus, croton and bougainvillea is two parts sandy loam, one part humus, one part sharp sand and one half part horticultural perlite.

The Gardener's Pocketbook

A Maple with Girdling Roots

In the picture accompanying this article, a tree is dying. This is most evident in an area near the base, where the bark of two trunks are becoming separated from the wood. The cause of this condition is girdling roots.

Before this plant, and its plight are further discussed, perhaps a few words about girdling will show the seriousness of its effect. The functional, sap conducting tissues are in close proximity to the outer bark. These tissues because of their location are affected by the pressures of girdling in such a way that sap movement gradually becomes restricted. This restriction decreases the amount of water, mineral salts and carbohydrates necessary for growth. If this condition is not corrected, a gradual decline in plant vigor will follow, resulting in possible die-back of smaller branches, and could lead eventually to the death of the plant.

Since root girdling usually takes place at ground level, or below, it can go unnoticed for such a long period that once discovered little can be done to correct it. This is happening to the David Maple, *Acer davidii*, shown in the accompanying photograph. For twenty years or more this plant was one of the outstanding trees in the National Arboretum's maple collection. Its leaves, large fruit clusters and bark were indeed enjoyable attractions.

About five years ago, something began to happen to this plant. Many of its once beautiful leaves became increasingly smaller. Young branches started to die back. Its fruit production began to decline; and in many places, its once lovely green and white bark became drab and dull. Since no causes for these changes could be found above ground, and additional fertilizer did little to stem the decline, it became necessary to seek the source of trouble below the ground level. There the trouble was found; for after removing the grass and a few inches of soil from the base of the tree, girdling roots were exposed. Several roots as much as eight inches in diame-

ter had been deflected many years ago from their outward course and are deeply embedded in the base of the tree. This condition is so severe that any attempt to remove these roots would hasten the death of the tree.

To add to this complicated condition, after digging the soil further out from the trunk, a very matted root system, with many naturally grafted roots, was discovered. In numerous places, roots while growing away from the base of the tree, came in contact with other roots of this plant as they crossed repeatedly over and under each other. Since no roots were noticed completely surrounded by another, the girdling effects caused by these contacts were confined mainly to small areas, and therefore, less restricting than the girdling of the trunk by larger roots.

Without more knowledge of the root system and the soil conditions under



U.S. NATIONAL ARBORETUM

Tree of Acer Davidii Showing Root Strangulation.

which this phenomenon is occurring, one can only speculate as to the reason for this girdling root system. When the cause is determined it could be one of those mentioned by H. M. Van Wormer in his article in the November 1940 issue of *Arborist's News* entitled *Effects of Girdling Roots on Trees*. Here Van Wormer stated the following: "The question arises, what causes this peculiarity of root development?" The answer would be, several reasons. It is safe to assume that one of the main reasons is the deflection of the root in search of moisture, easier growing conditions or else more abundant nutrient material. Having secured any one of these three items, that portion of the root grows and expands so rapidly that it presses more severely across the trunk of another root, causing a strangulation to occur." There is the possibility that this condition started as the result of the seedling tree being grown too long in a pot or tin container. Some container grown trees develop encircling roots which continue to grow in that manner even after being transplanted to open ground.

As a corrective measure for less severe cases of root girdling than the one mentioned in this article, Van Wormer (l.c.) suggested:

"The general procedure to rectify this strangulation in cases which have not developed too far is to sever the strangulating root and remove at least a two inch section. The cut ends of the root should be covered with wound dressing. Often it may be necessary to dig down one foot, below the surface and remove, as carefully as possible, the root in question.

—ROLAND M. JEFFERSON
Washington, D. C.

Propagation of Hibiscus by Cuttings

My personal experiments over the past five years have proven the following:

I. Time Cuttings may be taken

- 1—Summer—(Outdoors) before blooming—stalks 3' to 4' high.
- 2—Autumn—(Greenhouse) after blooming—before frost.
- 3—Winter—(Greenhouse) from mature clumps dug in January and brought into growing in the Greenhouse.

II. Water—Spray Mist—accurately timed.

III. *Media*—Clean mason's sand—3 in. to 4 in. deep—well drained.

IV. *Rooting*—3 to 4 weeks time.

V. *Method*—If stalks are branched cut 1 in. below node and set 2 in. in sand bed. If only a leaf at the node (on branches) cut 1½ to 2 in. below node and set the node even with the surface. Cut off excess leaves. One (two if small) will suffice under spray mist.

VI. *Rooting Hormone*—Not necessary but beneficial.

VII. Important Procedure

"Ohio Hybrid" Hibiscus are Herbaceous Perennials—winter hardy. Each year's stalks die down in winter to a crown below ground where the new stalk buds are formed for the succeeding year's growth. The stalks of all cuttings taken will die before the end of the year. It is necessary that new growth from cuttings establish their own root systems before the old stalk dies. Therefore, in transplanting from the propagation bed, be certain that the juncture of new growth shoots with the old stock be set below ground level. Within a short time they will establish their own roots and form a new crown.

VIII. *Transplant* to good garden soil. Keep soil moist the first week and gradually ease off to two waterings daily and after 3 weeks to normal garden watering for good growth. With the advent of cold nights (frosty) cease watering.

IX. *Winter Mulch*—Some time in November—necessary the first year only. Established plants (2 years or older) unless transplanted late in the season, need no mulch.

X. *Blooming*—These cuttings of the current year will bloom the succeeding year. Most greenhouse cuttings will bloom the following summer.

Notes

Base cuttings from large woody stalks do not root well if the stalk is dry and has lost its green.

Soft and tender tips of stalks usually fail to root. On the average 2/3 in to ¾ in of a stalk is prime material for cutting and in many instances all except the top 8 in to 12 in.

With 500 to 900 cuttings annually for the past 3 years we have been able to achieve 80 to 90 percent rooting.

In mid-September, at Ohio State Uni-

versity greenhouses and with the capable cooperation of Dr. D. C. Kiplinger (Dept. of Horticulture and Forestry) and the Superintendent of Greenhouses, Mr. Faringer, we made 470 *Hibiscus* cuttings (140 of them heel cuttings) and placed them under spray mist in a perlite media. Initial growth was rapid—both leaves and shoots—in 90 percent of these cuttings.

During the second week a city power failure cut off both heat and water to the greenhouses for two days and two nights. All leaves dropped from our cuttings. After restoration of service, 50 percent of the cuttings began growing again but most were not able to maintain growth. It is remarkable that 29 plants survived and were transplanted to pots.

Of the 140 heel cuts (sliced down from the main stalk) only two survived. We had doubts that any would grow from the woody stalks. However, the experiment was adequate proof of the fact that *Hardy Hibiscus* can be propagated from mature stock in the Autumn.

A Future Possibility

We anticipate that it will be possible to take cuttings in early summer and have them in bloom for the Easter market, possibly (with certain plants) Christmas market and certainly for the early spring roadside and department store markets and for early spring delivery (packaged) to mail order customers. Yet to be proven is the general adaptation to greenhouse culture.

C. S. KENNEDY
Dublin, Ohio

Exotic and Native Ornamentals in the Shenandoah National Park

In March of 1926, a large section of the northern Blue Ridge Mountains of Virginia was destined to become a National Park. Within the next ten years, more than 300 square miles of land was to be purchased for this purpose, much of it from private ownership of more than 300 families that lived within the area. Many of these residents or their ancestors had lived for years on this land, and as a result had frequently planted various exotic species at their homesites.

Generally speaking, these exotic species can be broken down into two major

groups: (1) ornamentals that were used to landscape the homesites and cemeteries, and (2) trees or other plants that either produced fruit or some other product that could either be used as food or sold as a cash-crop in the nearby towns. Many of the native plants in the area were also used for these purposes.

Today, as one either drives along the Skyline Drive and its major access roads or hikes along many of the fine trails in the Shenandoah National Park, he can often locate some of the old homesites and cemeteries by the conspicuous exotic species of plants that have persisted over the years, many of which are now well established and spreading in the area, i.e., *Ailanthus* and *Paulownia*.

Although most of the exotic ornamentals that persist today are trees and shrubs, a few herbaceous plants can also be found in the area. Some of these more conspicuous exotic species persisting at the old homesites include: Norway Spruce, *Picea abies*; Lily-of-the-Valley,



Paniculate Hydrangea (*Hydrangea paniculata*), *Balsam Fir* (*Abies balsamea*), and *Colorado Blue Spruce* (*Picea pungens*) at an old homesite at Skyland.



Savara False-cypress
(*Chamaecyparis pisifera* 'Squarrosa')
at an old homesite at Skyland.

Convallaria majalis; Common Day-lily, *Hemerocallis fulva*; Daffodils, *Narcissus pseudonarcissus*; Iris, *Iris germanica* and *I. pallida*; White Poplar, *Populus alba*; Balm-of-Gilead Poplar, *Populus* × *gileadensis*; White Willow, *Salix alba*; Weeping Willow, *Salix babylonica*; White Mulberry, *Morus alba*; Paper Mulberry, *Broussonetia papyrifera*; Sweet William, *Dianthus barbatus*; Cottage Pink, *Dianthus plumarius*; Sweet-William Catchfly, *Silene armeria*; Peony, *Paeonia lactiflora*; Common Barberry, *Berberis vulgaris*; Japanese Barberry, *Berberis thunbergii*; Mock Orange, *Philadelphus coronarius*; Bridal Wreath, *Spiraea prunifolia*; Spirea, *Spiraea* × *vanhouttei* and *S. cantoniensis*; Japanese Flowering Quince, *Chaenomeles speciosa*; Roses, *Rosa cinnamomea*, *R. canina*, *R. gallica*, *R. chinensis*, *R. micrantha*, *R. multiflora*; Common Pear, *Pyrus communis*; Chinese Pear, *Pyrus pyrifolia*; Common Apple, *Malus pumila*; *Malus prunifolia*; Peach, *Prunus per-*

sica; Sweet Cherry, *Prunus avium*; Perennial Pea, *Lathyrus latifolius*; Tree-of-Heaven, *Ailanthus altissima*; Boxwood, *Buxus sempervirens*; Asiatic Bittersweet, *Celastrus orbiculatus*; Norway Maple, *Acer platanoides*; Horse-chestnut, *Aesculus hippocastanum*; Hollyhock, *Althaea rosea*; Rose-of-Sharon, *Hibiscus syriacus*; Musk-mallow, *Malva moschata*; Golden Bells, *Forsythia suspensa*; Common Lilac, *Syringa vulgaris*; Common Periwinkle, *Vinca minor*; Forget-me-not, *Myosotis scorpioides*; *Anchusa myosotidiflora*; Princess-tree, *Paulownia tomentosa*; Japanese Honeysuckle, *Lonicera japonica*; European Snowball, *Viburnum opulus*; and Japanese Snowball, *Viburnum plicatum*.

Among some of the native (U.S.) plants persisting at the old homesites, one may find: Balsam Fir, *Abies balsamea*; Red Spruce *Picea rubens*; Hemlock, *Tsuga canadensis*; White Pine, *Pinus strobus*; Eastern Cottonwood, *Populus deltoides*; Black Willow, *Salix nigra*; Ward's Willow, *Salix caroliniana*; Osage-orange, *Maclura pomifera*; Red Mulberry, *Morus rubra*; Umbrella Magnolia, *Magnolia tripetala*; Smooth Hydrangea, *Hydrangea arborescens*; Common Ninebark, *Physocarpus opulifolius*; Mountain-ash, *Sorbus americana*; Crab-apple, *Malus angustifolia* and *M. coronaria*; Kentucky Coffee-tree, *Gymnocladus dioica*; Honey-locust, *Gleditsia triacanthos*; American Holly, *Ilex opaca*; Winterberry, *Ilex verticillata*; Mountain Holly, *Ilex montana*; Silver Maple, *Acer saccharinum*; Black Maple, *Acer nigrum*; Box-elder, *Acer negundo*; Black Gum, *Nyssa sylvatica*; Rhododendron, *R. catawbiense* and *R. maximum*; Azalea, *Rhododendron* spp.; Fringe-tree, *Chionanthus virginicus*; Coralberry, *Symphoricarpos orbiculatus*; and Snowberry, *Symphoricarpos albus*.

In addition to the numerous old homesites scattered throughout the area, a few people built summer cottages at Stony Man Camp, now called Skyland, that was founded and developed in 1894 by George Freeman Pollock, the Father of Shenandoah National Park. Many of these cottages were also landscaped with numerous exotic and native ornamentals. Although some of these buildings are still standing at Skyland, one of the finest examples was torn down in 1960, leaving only the exotics to tell the story. Here, on the old Judd property, one will

find such additional native and exotic ornamentals as: Japanese Yew, *Taxus cuspidata*; Colorado Blue Spruce, *Picea pungens*; Hinoki False-cypress, *Chamaecyparis obtusa*; Sawara False-cypress, *Chamaecyparis pisifera* 'Squarrosa'; American Arbor-vitae, *Thuja occidentalis*; Common Juniper, *Juniperus communis*; Gray Poplar, *Populus canescens*; European Beech, *Fagus sylvatica*; Purple Beech, *Fagus sylvatica* 'Atropurpurea'; Pin Oak, *Quercus palustris*; Japanese Knotweed, *Polygonum cuspidatum*; Panicle Hydrangea, *Hydrangea paniculata*; Quince, *Cydonia oblonga*; Flowering Crab, *Malus floribunda*; *Sorbus* × *hybrida*; Clammy Locust, *Robinia viscosa*; Winged Euonymus, *Euonymus alatus*; Sourwood, *Oxydendrum arbo-reum*; Hungarian Lilac, *Syringa josikaea*; Foxglove, *Digitalis purpurea*; and Beauty-bush, *Kolkwitzia amabilis*.

Although many of these exotic species are quite conspicuous, it is the policy of the National Park Service to ignore such material and to recognize only the native plants. Therefore, it is now the policy to plant only native species for landscape purposes within the Park. However, until these exotic species give way to succession, they will continue to play a very conspicuous part in the overall Park flora.

—PETER MAZZEO
Hyattsville, Maryland

Four New Cultivars of Ornamental Trees From Romania

The Romanian Ministry of Agriculture (Editura Agro-Silvica), in Bucarest, published in 1960 a soft cover volume titled *Arbori si Arbusti Forestieri si Ornamentali Cultivati in R. P. R.* (English translation: *Forestry and Ornamental Trees and Shrubs Cultivated in the Romanian Popular Republic*). This manual of 810 pages was authored by Dr. I. Dumitriu-Tataranu, with the collaboration of at least seven Romanian horticulturalists and foresters. Apparently, up to now, this outstanding horticultural reference has not been known to workers in this country, as indicated by a survey of American horticultural literature published within the past six years. It is possible that the inadvertent omission of reference to

this work, or to the new ornamental trees described in it, may be due to an inadequate distribution to horticultural and botanical libraries. One intention here is to call long over-due attention to this book, which could be used beneficially in conjunction with such popular references as Rehder's *Manual of Cultivated Trees and Shrubs*, Bailey's *Manual of Cultivated Plants*, etc.

Within the text of *Arb. Arb. Forest. Orn. Cult. R. P. R.*, as the book should be abbreviated for purpose of convenient citation, four new tree cultivars of ornamentally desirable species are described. These new plants are of considerable significance to us as the species are widely cultivated in the United States. It is to be hoped, that these interesting selections will be soon introduced into this country for trial, and ultimate distribution. In order that these novelties or "elite" cultivars will not continue to be ignored, and thereby, fall into obscurity, their pertinent descriptions and references are given below.

- I. *Abies cephalonica* Loud. 'SIMERIA'
—— Dumitriu-Tataranu, *Arb. Arb. Forest. Orn. Cult. R. P. R.*, pps. 26 and 768 (addenda). 1960.

The Romanian description and observation on page 26 is translated as: All needles at the twig apices are strongly twisted at an angle of 180°-270°. This cultivar is interesting from the ornamental viewpoint because of the twisted needles; the different colors of the needles (dark green above and silvery beneath) being evident simultaneously. The French description on page 768 reads: "Dans toute la cime les aiguilles sont très tordues en angles de 180°-270°."

This unusual cultivar of the Greek fir was discovered in the Simeria Arboretum (Arboretumul ICF Simeria) which is located in the Hunedoara region of Romania. According to St. Radu and A. Hulea, *Arboretumul-Simeria Ghid-Album*, p. 33 (1964), the plant is located in section nine of that Arboretum.

- II. *Morus rubra* L. 'CONSTANTA'
 ——— Dumitriu-Tataranu, Arb.
 Arbus. Forest. Orn. Cult. R. P. R.,
 pps. 487 and 769 (addenda), plate
 XXII. 1960.

The Romanian description on page 487 is translated as: Crown dense, semispherical. The French description on page 769 reads: "Cime dense, sémisphérique." Named after Constanta, a warm-climated city on the Black Sea, this red mulberry cultivar is shown in plate XXII as a single trunked tree of about 18 feet tall having a broader span than tall (approximately 12 feet high and 20 feet across at the center), and a very dense foliated crown. The original plant is to be found in front of the post-office.

- III. *Sophora japonica* L. 'BUCURESTI'
 ——— Dumitriu-Tataranu, Arb.
 Arbus. Forest. Orn. Cult. R. P. R.,
 pps. 690 and 769 (addenda), plate
 XXXII. 1960.

The Romanian description and observation on page 690 is translated as: Shrub with pendulous branches, the tips of which trail along the ground. Leaves white-variegated. This cultivar, which has not been described before in literature, is remarkable because of its bushy habit and peculiar coloration of the foliage. The French description on page 769 reads: "Arbrisseau avec les rameaux pendants, dont le bout est rampant. Les feuilles panachées de blanc."

The photograph (plate XXXII) of the original plant of *Sophora japonica* 'Bucuresti' in the I. V. Stalin Park in Bucurest shows it to be approximately 3 feet tall and 6 feet in diameter, with whitish foliage and pendant branches sweeping to the ground.

- IV. *Ulmus procera* Salisb. 'MIHAIL SADOVEANU' ——— Dumitriu-Tataranu, Arb. Arbus. Forest. Orn. Cult. R. P. R., pps. 743 and 769 (addenda). 1960.

The Romanian description and observation on page 743 is translated

as: Tree, copiously branched, with more or less erect branches. Leaves wide elliptic or wide ovate, smaller than those of the typical form. This cultivar is parallel to *U. foliacea* 'Wheatley' [P.S. Green in *Arnoldia* 24 (6-8):79. 1964, treats cv. Wheatley as a synonym of cv. Sarniensis, which usually is referred to *U. carpinifolia* Gledit.]. The French description on page 769 reads: "Ramification abondante, branches érectes. Les feuilles sont largement elliptiques ou largement ovates, plus petites que celles de la variété typique."

The original plant of this cultivar is cultivated in the Casei Park, which belongs to the estate of M. Sadoveanu in Bucurest.

It is commendable that authentic herbarium vouchers were collected by Dr. I. Dumitriu-Tataranu from the original plants of these cultivars, and deposited for safe-keeping in the herbarium of the Institute of Forestry Research (Institutul de Cercatari Forestiere) in Bucurest. This practice, which guarantees preservation of authentic vouchers (e.g. clonotype specimens) for convenient reference, in the present and future, should be adopted by all plantmen, horticulturalists, and botanists, who describe new ornamentals.

THEODORE R. DUDLEY
 Belair, Maryland

Jindai Botanical Park Tokyo, Japan

Jindai is one of the newer gardens in the Tokyo area and it may surprise some that a city so crowded as is Tokyo could find space for a 62 acre park as recent as 1961. One wonders if such a development could come into being in our own metropolitan areas. Unlike the traditional botanic gardens of the several universities in Tokyo, Jindai is designed with recreation in mind and with an eye towards instilling a sense of closeness to nature in the modern Japanese urbanite. Already the number of visitors exceeds 700,000 annually.



JOHN CREECH

Close-up showing method of construction of bamboo framework for narrow hedges.

For its short span of existence, Jindai has come a remarkably long way. The park contains over 3,000 varieties and species of plants selected for horticultural beauty. These are displayed in distinct gardens, such as azaleas, camellias, flowering cherries, bamboos, maples, variegated plants, etc. In all, there are 26 such features. A school garden has been developed for children of all ages and a natural forest contains a playground area. The day I visited Jindai, a host of young painters was scattered through the park, sketching trees and garden structures.

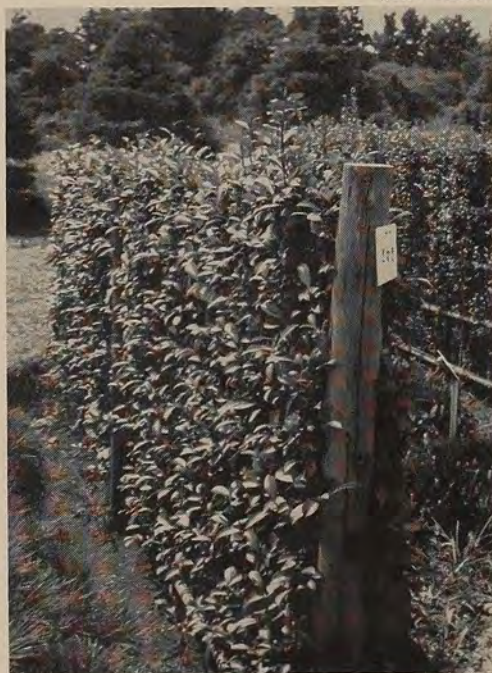
For the horticultural visitor, the garden of variegated plants will be of interest. There is even a variegated form of *Magnolia grandiflora*. But chiefly I wish to report on the hedge garden because it is so different from the conventional row on row of hedges we are accustomed to. This hedge planting consists of 115 species of trees and shrubs grown in alternating rows of dwarf hedges and espaliered hedges. I

had not seen such an arrangement in any of my earlier travels in Japan.

The espaliered hedges are 12 feet long with posts at each end and a pair of smaller posts at mid-distance, spaced about 6 inches apart. Bamboo poles are lashed horizontally to the main posts at one foot intervals. Vertical bamboo poles are tied at the same intervals to form a grid system. This arrangement of bamboo is made in duplicate to form a narrow channel in which the plants are grown. It is as if two fences were set close together. The plants are trimmed to keep them in a narrow form. The resulting hedges are five feet tall and as wide as the bamboo frames are apart, or about 8 inches. Although coniferous evergreens, deciduous species, and broad-leaved evergreens have been planted, the latter type predominate. This is to be expected because of the natural affinity of the Japanese for these plants. *Euonymus japonicus* is the most satisfactory in these formed hedges but *Camellia sasanqua*, *Enkianthus campanulatus*, *Ilex crenata*, *Osmanthus hetero-*

A hedge of *Photinia glabra* developed with a bamboo framework.

JOHN CREECH



phyllus (ilicifolius), *Photinia glabra*, and *Viburnum odoratissimum var. awabuki* are suitable. Even in instances when the plants have not filled in completely, the bamboo work is pleasing. Hedges of this type are perhaps useful

as garden partitions and not practical for long expanses of hedge. But what Japanese garden has such a need?

JOHN CREECH
Hyattsville, Md.

General view of hedge trials at Jindai Botanical Park, Tokyo.

JOHN CREECH



A Book or Two

(Books available for loan to the membership are designated: (Library). Those not so designated are in private collections and are not available for loan. Books available for sale to the Membership are designated with the special reduced price and are subject to the usual change of price without notice. Orders must be sent through the American Horticultural Society accompanied by the proper payment. Please allow two to three weeks for delivery. Those not designated for sale to the Membership at reduced prices can be purchased through the Society, however, at the retail prices given. In these instances the full profit is received by the Society to be used for increased services and benefits of the Membership.)

In Gardens of Hawaii

Marie C. Neal, Bernice P. Bishop Museum Special Publ. 50, Bishop Museum Press, Honolulu (printed by the Lancaster Press, Inc., Lancaster, Pa.). 1965. xix & 924 pages, fig. 317. \$15. (Library)

The author of *In Gardens of Hawaii* has produced an unusual book on the cultivated plants of Hawaii. The present volume is a revision and enlarged edition of the author's earlier book *In Honolulu Gardens*, published in 1948, and was written "for use by amateurs, as well as by professional botanists, as a general floral guide to Hawaii, chiefly to plants found at warm, low altitudes where the great majority of gardens are located." The book is unusual, because it is really a hybrid in its approach to subject matter. Some who call themselves amateurs may object to the technical side, and professionals may wish the author had gone still deeper into detail. The author bridges the gap very skillfully, and for this reason the book will have a wide appeal.

The book covers about 3,000 species—trees, shrubs, herbs—, a phenomenal number in a book of this kind, primarily ornamental and food plants, a few weeds or wayside plants, and about 100 species of outstanding and characteristic native and endemic plants. Each species is provided with a Latin name and well known synonyms, as well as English and Hawaiian common names. Copious notes accompany the text on lore and legend of special interest to many. The book is far more than an annotated list of plant names. Technical keys are provided for easy identification of plants to genus and to species, but not in all families. If the family or common name is unknown, the road to identification will not be so easy, since keys to plant families are wanting, which lessens the utility of the book. Descriptions of plants are provided, but all plants keyed out are not necessarily described in the text. This point and the lack of family keys are the major shortcomings of the book in this reviewer's opinion. But the book has other good points. The line drawings and photographs of nearly 700 species are extremely helpful, and it is a pity that all 3,000 species were not illustrated. There is a one-page illustrated glossary and three ap-

pendices, including flowering time of plants growing in Honolulu, illustrations of fruits and seeds, and color keys to flowers, fruits and seeds. The index includes all valid names, synonyms, and common names, although the synonyms are not distinguished in italics, which would have been helpful. The author acknowledges help from professional plant taxonomists relative to nomenclature, but whether this is a curse more than a blessing depends upon which camp you happen to be in—amateur or professional. But here again, the book aims to reach a wide audience. Readers will note the up-to-date name for the Norfolk Island Pine is *Araucaria heterophylla* (*A. excelsa*), but in some other areas the nomenclature is not so well tended to, as for example, *Coffea robusta* which should be *C. canephora*.

Had the author included keys to families, the book would have been a little more useful. The other point, which is not wholly understandable, concerns the author's arbitrary coverage of only some of the plants in the descriptive part of the text. Along with keys to genera and species, one would hope to find each item described in the text. This the author has done in many instances, but in the Rubiaceae (Coffee Family), the Leguminosae (Bean Family) and in some other families, the author selects a representative number for description and leaves the remainder quite naked in the keys. In the Rubiaceae, for example, 40 genera are covered in the keys, yet only 6 of these genera are covered in the text. It was a pity the author didn't give more even coverage to the plants listed. This for a later edition, perhaps. Also, this reviewer finds little mention of cultivars, yet it is hard to conceive that numerous cultivars are not involved in the cultivated plants of Hawaii. The cultivar *Mussaenda philippica* 'Dona Aurora' is cited, but how it differs from the species itself is not mentioned. Elite selections of plants are so important in any discussion relative to cultivated plants, it is difficult to understand why so little mention has been made of them in this book. It must be assumed that all of the plants cultivated in Hawaii represent merely the simple species, when, in fact, very many have been improved by selection and do not represent the simple species at all in cultivation.

The book is superbly produced and extremely easy to read with seemingly few printing errors. *In Gardens of Hawaii* is a must for anyone interested in ornamental plants, not only of Hawaii, but of the tropics in general.

FREDERICK G. MEYER

Reproductive Biology and Taxonomy of Vascular Plants

Edited by J. G. Hawkes. Published for The Botanical Society of the British Isles by Pergamon Press Inc., 44-01 21st St., Long Island City, New York 11101, 1966. One illustration black and white. 183 pages. \$5.00. (Library)

A series of essays on various aspects relative to: 1. Breeding systems, variation and adaptation; 2. Reproductive biology in relation to plant breeding; 3. Pollination mechanisms; 4. Reproductive capacity and plant distribution; 5. Apomixis (including vegetative reproduction); 6. General discussion and summing-up; plus index. The eminent authors are British, Dutch, and Swedish.

Flowers of the Mediterranean **by Oleg Polunin and Anthony Huxley**

Published by Houghton Mifflin Company, Boston, Massachusetts, The Riverside Press, Cambridge, Massachusetts, 1966. 257 pages. 311 color photographs, 128 line drawings. \$9.75 (Library)

Any plant-minded reader who has traveled in the Mediterranean countries knows very well the frustration associated with recognition and identification (even to common names) of the abundant plant materials, so often present in this more or less uniform floristic area. Never before has such a relatively inexpensive, comprehensive and yet concise, popular guide been available. This volume, of slightly larger than handbook size, is a truly admirable effort. It describes in a mere 243 pages, plus illustrations, the slowest woody and herbaceous plants, most commonly seen in an immense land mass which encompasses parts of seventeen countries and ranges from Gibraltar and North Africa in the west, to the Turkish coast, Syria and Palestine in the east. Although, within this area, possibly 10,000 species of flowering plants occur, the eminent authors (both incidentally, are renowned explorers and biologists) have confined the coverage to about 700 well chosen plants. These reflect the floral spectrum that might be readily observed by the interested, novice traveler or vacationer.

The success or failure of a geographically oriented manual or handbook, designed to meet the identificatory needs of the general public, may be measured by the quality and convenience of illustrative aides. Similarly essential is a readable and useful text, to be used in conjunction with the illustrations. The casual reader inclined to page-thumbing will be amply

rewarded by the 311 excellently reproduced, often superb, color photographs, and the 128 well executed line drawings. Success in identification is guaranteed, if the plant in hand is pictured. It is unfortunate, however, that the photographs and most of the drawings are not cross-referenced to the descriptions in the text. On the other hand, the brief but blithe descriptions of each plant emphasize the most important characters of recognition and distinction. Added to the value and utility of the species descriptions, are the adjunct facts of flowering date, habitat, and one or more common names—if they are known. The fireside reader, the energetic and observant walker, and the bistro lounge will be equally titillated and educated by the medicinal and economic comments following many of the plant descriptions. For example, *Vitex agnus-castus* is described as “. . . associated with chastity . . . the seeds from the day of Dioscorides . . . have been called ‘Monk’s pepper’.” Also, the annual larkspur, *Consolida ambigua*, has been “. . . used to garland mummies in Egypt, and after 3,000 years the blue color of the flowers shows little fading.”

On the debit side, keys to the species, genera or families are totally absent. Without even the simplest keys, the only way to identify a discovery, using this book, is to compare and contrast fresh specimens with the fine illustrations. If identity is to be further verified, this should be done in conjunction with the very adequate descriptions. With perseverance, a successful result could be forthcoming. The onerous process of thumbing back and forth, however, might easily discourage or even bore the more impatient or uninformed reader. Failure to include diagnostic keys is somewhat compensated for by the well organized glossary of technical terms likely to be unknown to some users. If consulted, the carefully worded and unambiguous definitions, most of which are accompanied by a clear line drawing, will dispell any misunderstandings of terminology.

Often, the quality of a field guide or popular manual may be determined by the introductory chapters. These should define the scope and limits of the work. Polunin and Huxley have accomplished this expertly, with a minimum of impediments, in only three pages. This achievement is worthy of notice by many authors. An educational bonus is provided by the concise and very interesting chapter entitled “The Vegetation of the Mediterranean.” This chapter competently defines the Mediterranean climate, the variety of plant life, the types of plant communities, and the altitudinal zonation of vegetation in a manner that is satisfying to the plant ecologists, as well as to the lay traveler. Furthermore, anyone interested in cultivated plants will be gratified to discover that some of the more frequently cultivated and naturalized plants are illustrated and described. There is also a short historical discussion of economic and ornamental plants.

As a stimulating and refreshing work, this book is a distinguished success. For visitors

to the Mediterranean, it is as essential as soap. It should also serve as an inspiration to other authors of popular or semipopular guides. Finally, *Flowers of the Mediterranean* illustrates the great wealth of plants of ornamental merit, many of which could be beneficially incorporated into our gardens. To borrow a title from Ann Bridge, this book might be called a breath of "Illyrian Spring."

T. R. DUDLEY

Libellus de Re Herbaria, 1538 and The Names of Herbes, 1548
by William Turner

Facsimiles with introductory matter by James Britten, B. Dayton Jackson, and W. T. Stearn. Published by the Ray Society, c/o The British Museum (Natural History), Cromwell Road, London, SW 7, England. 1965. Vol. 145 of the Ray Society. 275 pages. \$9.00. (Library)

William Turner has earned the title "Father of British Botany" based upon the two books under the above titles originally published before the middle of the 16th century. The present little volume actually is a second reprinting for both of these excessively rare works, the *Libellus* having been reprinted first from the only known copy in existence in the British Museum (Bloomsbury) by Dayton Jackson in 1877 and *The Names* from one of the few known copies by James Britten in 1882. Wm. T. Stearn has provided a modern dimension to these works in the introduction to the present reprint versions.

Both reprints are actually of more value to modern users than the original books, because both Jackson and Britten provided modern scientific binomials for the names used by Turner. Both volumes are important as the first printed references to many vernacular or common English names of plants which have become traditional, such as Daffodil, Horsetail, Alexanders broom, Butcher's broom, Horehound, Yarrow, Loosestrife, Goatsbeard, Hawkweed,

Larch, Wintergreen, Kidney bean, Soapwort, Strawberry tree, Oxeye, and others.

Turner's most famous work *A New Herball* (part 1, 1551, published in full in 1568) was the first herbal in the English language.

The present reprints, while they may not be in daily use, would make a splendid addition to the library of all plantsmen, simply because they are real landmarks in the history of plants, especially for English speaking peoples.

FREDERICK G. MEYER

Other Books added to the Library
The Rockwells' Complete Book of Roses

F. F. Rockwell and Esther C. Grayson. Doubleday and Company Inc., 277 Park Ave., New York, N.Y. 10017. Revised 1966. Illustrated, color and black and white. 332 pages. \$5.95, AHS members price, \$5.05. (Library)

Wedding Flowers, Decorations, and Etiquette

Virginia Clark, Hearthside Press, Inc., 381 Park Ave., South, New York, N.Y. 10018. Revised 1966. Illustrated. 160 pages. \$6.95. AHS members price \$5.90. (Library)

Basic Floral Designing

Ken Soules, Mercury House, 900, Lafayette, West, Detroit, Mich. 48226. 1965. Illustrated, sketches. 85 pages, paperback. \$1.95. (Library)

American Tomato Yearbook, 1966.

John W. Carncross, Editor, American Tomato Yearbook, P. O. Box 398, Westfield, N.J. 07091. 1966. No illustrations. 44 pages. \$2.00, \$2.50 foreign. (Library)

Agricultural Statistics

U. S. Dept. of Agriculture, Supt. of Documents, U. S. Govt. Printing Office, Washington, D.C. 20402. 1965. No illustrations. 635 pages. \$1.75. (Library)

The Lily Yearbook of North American Lily Society No. 18.

G. L. Slate, Editor, N. A. Lily Society, Fred M. Abbey, Exec. Secy., North Ferrisburg, Vermont. Included as a benefit of membership in N. A. L. S. (Library) Illustrated. 141 pages.

THE AMERICAN
Horticultural
MAGAZINE

VOLUME FORTY-FIVE

1966

WASHINGTON, D. C.



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FIRST EDITION

DAFFODIL HANDBOOK

A Very Special Issue of the American Horticultural Magazine

GEORGE S. LEE, JR., *Editor*

with

WILLIS H. WHEELER, *the American Daffodil Society*

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Ruth C. Carll
Horticultural Editor

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E. ARAUJO

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