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Contents of Volume XXXV

Index to Volume XXXV

Illustrations are in **bold face.**

ARNOLDIA

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***L. flavum* 'Compactum'** — A dwarf version of the preceding. Grows to a height of about 9 inches.
Sources: 3,4,24,60,68; I

Lobelia **Lobelia**
Lobelia Family (Lobeliaceae)

It is a shame to have to condemn such a beautiful group of native plants, but under most garden situations they are short-lived perennials and will usually disappear after a few years. When they find conditions exactly to their liking, they will self-sow in quantity and always be around. For this reason it would be wise to experiment with a few plants to see if seeding will occur.

Lobelias are frequently associated with wet conditions because they are encountered in the wild along streams or in generally wet areas. In the garden, a well-drained, yet moisture-retentive loam is best. Light shade for at least part of the day is preferable, but a position in full sun will not be harmful if the soil is moist. Mulching the plants both in summer and winter is often beneficial when a permanent display is desired. When self-sowing does not occur, the new basal growth which appears in early fall after flowering may be divided and replanted. Seedlings sown in pans and set out annually also will provide a continuing display.

L. cardinalis — Cardinal Flower — Bright scarlet-red flowers on 3 to 4-foot stems from the end of July to early September distinguish this as one of the best-loved wild flowers of eastern North America.
Sources: 3,4,5,7,13,14,24,26,27,39,43,46,50,58,66,67,68; A,B,C,I, L

***L. cardinalis* 'Alba'** — A rare white-flowered form of the Cardinal Flower. Does not reproduce true from seed and must be perpetuated by cuttings. Only worth growing by serious collectors of wild flowers.
Source: 29

L. siphilitica — Blue Cardinal Flower, Great Blue Lobelia — Not a very good name for a beautiful native plant. Has deep blue flowers and grows to 2 to 3 feet in height under garden conditions. The Indians believed that a concoction made from it was useful in curing venereal disease.
Sources: 4,7,26,27,39,43,57; B

L.* × *vedariensis (*L. cardinalis* × *L. siphilitica*) — A stunning hybrid with brilliant purple flowers from July well into September on spikes 2½ to 3 feet tall. Best results are obtained in the shade, and this plant definitely benefits from a protective mulch in the winter.
Sources: 4,13,66,69; C

Left: Lobelia cardinalis

Lupinus **Lupine, Lupin**
Pea Family (Leguminosae)

These cannot be recommended for general cultivation because of their sensitivity to hot summers. They do best in cool, humid areas such as northern New England and the Pacific Northwest. To those familiar with Lupines where they grow well, the show produced in our area is disappointing to say the very least. Of the several types which are hardy, the following strain is by far the showiest and most popular.

L. × *regalis* 'Russell Hybrids' — Stately spikes 3 to 4 feet in height with large pea-like flowers in nearly every color or combination imaginable.
Sources: 13,14,25,30,32,39,46,58,66,69; A,B,C,E,J,K,L

Lychnis **Campion, Maltese Cross, German Catchfly**
Carnation Family (Caryophyllaceae)

Some members of this group of bright-flowered plants only can be recommended for a low maintenance situation if the soil is light, and very well drained. Others lack complete hardiness or are distressingly short-lived. All should be given a situation in full sun.

L. chalcedonica — Maltese Cross — Brilliant scarlet flowers in dense heads in June and July. Plants 2½ to 3 feet in height. Will be short-lived unless soil drainage is excellent, especially in winter.
Sources: 4,24,32,68; A,E,I,J,K,L

***L. chalcedonica* 'Alba'** — The white flowers are not very interesting when compared to those of the species.
Sources: 24; I

L. viscaria — German Catchfly — This species and its several cultivars are the hardiest and longest-lived. The reddish-purple clustered blossoms appear on 12 to 18-inch stems in late May and June above tufts of grass-like foliage. If soil and exposure are correct, little care will be required other than division after about the fourth year.
Source: 46

***L. viscaria* 'Alba'** — Short 9-inch spikes of white flowers in June and July.
Sources: 24; I

***L. viscaria* 'Splendens'** — Bright rose-pink flowers.
Source: L

***L. viscaria* 'Splendens Flore-Pleno'** — Double, bright rose-pink flowers.
Sources: 13,24,32,49,66,67,69; C,I,J,K

***L. viscaria* 'Zulu'** — Flowers light red.
Sources: 32,66

L. coronaria — Rose Campion, Mullein-pink — Short-lived, usually behaves as a biennial, but will seldom disappear from the garden as it seeds freely. Very bright, small reddish-purple flowers on 2-foot stems. Leaves silverish. Listed in some catalogs as *Agrostemma coronaria.*
Sources: E,L

L.* × *haageana (*L. fulgens* × *L. coronaria* var. *sieboldii*) — Haage Campion — Brilliantly colored flowers from orange-red to scarlet or salmon, produced from June to August. Plants about a foot in height. Hardiness sometimes questionable.
Sources: 69; L

Lysimachia **Loosestrife**
Primrose Family (Primulaceae)

Most members of this genus would not look well in a manicured, formal border because of the spreading tendency of the more commonly grown species; however, they are acceptable in the low maintenance situation if space permits.

Loosestrifes planted in full sun require soil that is moist and fairly rich. If the exposure is partial shade, much drier soil conditions are tolerated. Almost no care is needed if they are planted about 3 feet from their nearest neighbors; otherwise, an occasional reduction in the size of the clumps will become necessary. Division to rejuvenate the plants will not be required for a number of years.

L. clethroides — Gooseneck Loosestrife — The 3-foot densely-flowered spikes bend over at the tips producing the curious "gooseneck" appearance. Flowers are white; blooming time is July and August. Leaves turn a bronzy-yellow in the autumn. It bears repeating, with this species especially, that the clumps soon become large.
Sources: 13,49,66; C

L. punctata — Yellow Loosestrife — The leaves are produced in whorls around the stem, and the yellow flowers arise from these. Plants range in height from 2½ to 3 feet. Flowering time is June

and early July. Plants are at their best in light shade.
Sources: 14,24,32,66,67,69; I

L. nummularia — Creeping Jenny, Moneywort — A low creeping plant not suited to the border. Best as a ground cover, used with discretion, in semishaded places. Will often escape into the lawn.
Sources: 3,13,14,57; C

***L. nummularia* 'Aurea'** — Yellow-leaved cultivar of the preceding species.
Sources: 24,68; I

Lysimachia clethroides

Lythrum **Purple Loosestrife**
Loosestrife Family (Lythraceae)

The Purple Loosestrife, a native of Europe, is now so widely naturalized that it is difficult to believe that it is only a comparatively recent addition to our flora.

A number of selections have been made. These vary considerably in height and flower color, many without the magenta tint so conspicuous in the wild forms. They are worth cultivating, especially in difficult wet areas of the garden, and also will grow perfectly well in an ordinary soil in full sun. Purple Loosestrifes will tolerate almost any form of neglect and grow vigorously for many years. They range in height, depending upon cultivar, from 1½ to 4 feet and are suitable at the front or middle of the border. They are best grown as single specimens, or in small groupings of two or three plants spaced 1½ to 2 feet apart. Most cultivars blossom over quite a long period between June and the end of September.

L. salicaria — For garden situations, the species is not as interesting as the selections listed below, but it may find a place in the wild flower garden or for naturalizing in wet places. It should be remembered that this may seed freely and take over extensive areas, frequently choking out all other vegetation. The named cultivars do not seem to possess this tendency.
Sources: 4,7,14,39,45,66

***L. salicaria* 'Columbia'** — Soft pink flowers on well-branched, bushy plants about 3½ feet in height.
Sources: 28, 66; L

***L. salicaria* 'Dropmore Purple'** — Rich violet-purple flowers on plants 3 to 4 feet in height.
Sources: 13,24,69; C,I

***L. salicaria* 'Firecandle'** — Intense rosy-red flowers. Plants 3 feet in height.
Sources: 13,24; C,I

***L. salicaria* 'Happy'** — Dark pink flowers on dwarf, well-branched plants, 15 to 18 inches in height.
Sources: 24,32,69; I

***L. salicaria* 'Morden's Gleam'** — Flowers bright carmine, the nearest to red of any of the cultivars. Plants 3 to 4 feet in height.
Sources: 13,28,32,37,39,59,69; C,H,J,K

Lythrum salicaria *'Purple Spires'. Photo: P. Bruns.*

***L. salicaria* 'Morden's Pink'** — Flowers clear pink. Plants 3 to 4 feet in height.
Sources: 13,24,25,32,46,59,60,66,67,68; B,C,H,I,J,K,L

***L. salicaria* 'Morden's Rose'** — Flowers bright rosy-red. Plants 3 feet in height.
Sources: 24,28; H,I

***L. salicaria* 'Pink Spires'** — Bright pink flowers, plants 3½ to 4 feet in height.
Sources: 58; A

***L. salicaria* 'Purple Spires'** — Rose-purple flowers, plants 3½ to 4 feet in height.
Sources: 28,32,37,58; A,H,K,L

***L. salicaria* 'Robert'** — Flowers bright rose-red. Plants 2 feet in height. Very compact.
Sources: 3,14,24,30,37,59,68,69; B,H,I,J,K,L

***L. salicaria* 'The Beacon'** — Flowers near-red. Plants 2½ feet in height.
Sources: 68; B

***L. salicaria* 'Tom's Choice'** — Rosy-red flowers. Plants 3 to 3½ feet in height.
Source: 68

L. virgatum — Wand Loosestrife — Similar to *L. salicaria* with purple flowers on branched stems. Plants about 3 feet in height. The species is seldom offered by nurseries, but may have played a part in the parentage of a few of the cultivars listed above as *L. salicaria*. The following cultivar is of interest, primarily because of its low stature.

***L. virgatum* 'Rose Queen'** — Rich rose-pink flowers on plants 2 feet in height.
Sources: 24; I

Macleaya cordata **Plume-poppy, Tree-celandine**
Poppy Family (Papaveraceae)

This is almost universally listed in catalogs under the old name *Bocconia cordata*.

Plume-poppy is a large plant that produces stems 6 to 8 feet tall with large scalloped leaves that are almost tropical in their effect. Under most conditions it tends to spread rapidly by its

wide ranging underground stems. It should not be considered for a small garden or a low maintenance situation.
Sources: 24,25,32,66,67,68,69; I,K

Mertensia virginica **Virginia Bluebell, Bluebell**
Borage Family (Boraginaceae)

This plant is indispensable to the spring garden, especially where true blue flowers are wanted. It grows to a height of about 2 feet with clusters of drooping, bell-like flowers in early May. The buds are soft pink and contrast nicely with the blue, opened flowers. A white-flowered form exists, but is very slow growing and not widely offered by nurseries.

This is not a plant for massing in the perennial border. After it blooms the foliage starts to die down and usually has disappeared by July. Therefore, *Mertensia* should be placed among plants with spreading summer foliage, such as Hostas or Ferns.

Plants will not require division for many years. For increase, this is best done in the early autumn, after the plants have died down. Cultivation in summer should be done with care around the dormant plants, and it would be prudent to mark their location in some way. They grow best in shady areas where the soil is cool and moist and contains ample organic matter.
Sources: 3,5,13,14,23,24,25,27,28,29,39,43,46,50,57,60,66,67, 68,69; B,C,I,L

Monarda didyma **Beebalm, Bergamot, Oswego Tea**
Mint Family (Labiatae)

In a strictly low maintenance situation, Beebalm may be recommended only for naturalizing in places where the plants can romp. In most herbaceous border situations, clumps spread rapidly, and division is necessary by the end of the second or third year to keep them in bounds and to prevent degeneration.

Plants grow to a height of 2½ to 3 feet and bloom from late June to August. The 2 to 3-inch tubular flowers are borne in single or double whorls forming dense heads, and are excellent for cutting purposes. The pungent, mint-like fragrance of the leaves and stems is another good feature.

Although Beebalms will tolerate light shade, such a condition encourages the spreading tendencies. A site offering full sun and soil with good moisture retention is best.

M. didyma — Flowers bright scarlet.
Sources: 14,27,39,46,68

Above and Below: Monarda didyma *'Violacea Superba'*

***M. didyma* 'Adam'** — Ruby-red flowers. Probably the best of the red-flowered cultivars.
Sources: 13,24,29,30,66,67; C,I

***M. didyma* 'Blue Stocking'** — Flowers bright violet-purple, not blue as the name would imply.
Source: 69

***M. didyma* 'Cambridge Scarlet'** — Brilliant scarlet flowers.
Sources: 24,25,60,66,69; A,B,I,K,L

***M. didyma* 'Croftway Pink'** — Rich rose-pink flowers.
Sources: 3,13,24,67,69; A,B,C,I,K,L

***M. didyma* 'Granite Pink'** — Rose-pink flowers. More compact habit of growth than most of the other cultivars.
Sources: 29,66,68

***M. didyma* 'Mahogany'** — Dark wine-red flowers.
Sources: 13,57,66,67,69; C

***M. didyma* 'Melissa'** — Soft pink flowers.
Source: 69

***M. didyma* 'Prairie Brand'** — Salmon-red flowers. Plants grow to a height of 4 feet, taller than most other cultivars.
Source: 69

***M. didyma* 'Salmonea'** — Salmon-pink flowers.
Sources: 66,68

***M. didyma* 'Snow Queen'** — White flowers.
Source: 69

***M. didyma* 'Snow White'** — White flowers.
Sources: 24; I

***M. didyma* 'Violet Queen'** — Lavender-violet flowers.
Sources: 13,24,66; C,I

Nepeta × *faassenii (N. mussinii* × *N. nepetella)* **Catmint**
Mint Family (Labiatae)

This is listed invariably in nursery catalogs as *N. mussinii*, which is one of the parents.

N. × *faassenii* grows into a mound 15 to 18 inches wide and 10 to 12 inches in height, and is a valuable plant for the front of the border. Blue-violet flowers are produced abundantly on 12-inch stems from late May through July and intermittently thereafter until September. A heavy autumn flowering is produced if the stems are cut back to about half their length immediately after the first blooming finishes. This encourages vigorous new

growth from the base of the plant and helps to perpetuate a bushy habit. The small leaves are silvery-gray in color, a handsome contrast to the blue flowers. They give an unpleasant pungent aroma when bruised.
Sources: 3,13,24,45,66,67,68,69; C,E,I,L

***N.* × *faassenii* 'Blue Wonder'** — Lavender-blue flowers on compact, 12 to 15-inch mounds.
Sources: J,K

N. cataria — Catnip — Easy to grow and beloved by cats and bees, but too nondescript to find a home in a real perennial garden. Besides the few sources listed here, the plant is readily found in the catalogs of the various herb specialists.
Sources: 45,68

***N.* 'Six Hills Giant'** — A beautiful light blue-flowered hybrid with gray leaves that grows to a height of about 2 feet. It is rampant and spreading and would soon become an untidy nuisance in a low maintenance situation.
Source: 66

Oenothera **Evening Primrose, Sundrops**
Evening Primrose Family (Onagraceae)

Plants of this group that open their flowers during the day are called Sundrops; those that are night bloomers are Evening Primroses.

O. missouriensis — Ozark Sundrop — Here is an American plant that may be grown in any garden offering a well-drained light soil, and space in the sun. If these conditions can be provided, plants will thrive for many years and make few other demands.

Ozark Sundrop is a low plant with a somewhat sprawling habit, not over 8 inches in height, and useful at the front of the border. The 5-inch, golden-yellow, cup-like flowers are quite spectacular. They appear over a long period of time from June through August and have a mild fragrance. The plant is late to appear in the spring so its location should be marked.
Sources: 14,24,25,27,49,59,66,67,68,69; A,I,J,K,L

O. tetragona — Common Sundrop — This is listed in catalogs under the following names: *O. fruticosa* var. *youngii*, *O. youngii*. The species is quite hardy. It is very showy in flower and may be grown where minimal maintenance is not the aim. Soil conditions and exposure are the same as required by *O. missouri-*

ensis. Plants grow to a height of about 2 feet. The lemon-yellow, 1½-inch, cup-shaped flowers are borne in profusion throughout June and July.
Sources: 29,46,66,67,69; L,B,K

***O. tetragona* 'Highlight'** — Large yellow flowers on plants 18 inches in height.
Sources: 24; I

***O. tetragona* 'Yellow River'** — The standard variety. Large canary-yellow flowers up to 2 inches across on plants about 1½ feet in height.
Sources: 3,13,24,68; C,I

***O. tetragona* var. *fraseri* 'Illumination'** (may be listed as *O. fyrverkeri,* or *O.* 'Fireworks') — Deep yellow flowers on plants 15 inches in height with leathery bronze foliage; the young stems and flower buds are reddish-brown. A good plant for rock gardens.
Sources: 24,32; I

Below: Partially open blossom of Oenothera missouriensis.
Photo: P. Bruns.

Paeonia **Peony, Paeony**
Peony Family (Paeoniaceae)

Peonies are most fitting perennials for the low maintenance garden. The relative ease of culture combined with an exceedingly long life, great hardiness, and their popularity as cut flowers make them nearly indispensable.

Plants that are to last thirty years and sometimes more in one spot require a deep, rich, well-drained soil. Plenty of humus should be incorporated at planting time, but manure, especially fresh manure, should never come in contact with the thick, fleshy root system. Divisions should contain at least three to five buds or eyes at the top of the roots, and these should be set about 1 inch below the soil line. Deeper planting leads to poor flowering, or no flowers at all. Late August or early September is the preferred time for planting or transplanting. Although a site in full sun is the usual recommendation, the more delicately colored varieties can be placed in light shade to keep the flowers from fading quickly. Deep shade should be avoided. This produces the same result as planting too deeply: few flowers, or none at all. Blossoms also may be lost if buds are nipped by late spring frost.

Larger flowers can be produced if the lateral flower buds are removed early, taking care not to injure the terminal bud. This usually will be done only by the perfectionist, even though it takes but a few moments.

Peony flowers come in a number of types as well as colors. The Doubles last longest, the stamens and sometimes the carpels being petal-like so that a fully double flower results. The Singles (sometimes called Chinese type) have one or several rows of petals that surround a center of numerous yellow stamens. This simpler type may be preferred by those who find the Doubles too flamboyant. The Japanese type and the Anemone type are often lumped together in catalogs. The former have five or more quite large petals that surround a center of stamens bearing abortive anthers (the part that normally contains pollen). The filaments (the "stemlike" part of the stamen) are thick and enlarged. In the Anemone type the filaments have become narrow, incurved petal-like structures.

So many cultivars are available from specialist nurserymen that only a few of the better ones can be included here. Each year sees the advent of new ones, and gardeners interested in the group would do well to join the American Peony Society.

Double types:

***P.* 'Albert Crousse'** — Soft pink. Fairly late flowering.
Sources: 68; H

***P.* 'Festiva Maxima'** — White. Early flowering.
Sources: 3,8,12,13,20,23,24,30,37,59,60,65,66,68,69; C,H,I,M

***P.* 'Karl Rosenfeld'** — Dark red. Midseason flowering.
Sources: 6,8,12,20,24,37,59,66,68,69; H,I,M

***P.* 'LeCygne'** — White. Early midseason flowering.
Sources: 13,66,67,68; C,H,M

***P.* 'Lowell Thomas'** — Brassy red, crinkled petals, dwarf. Midseason flowering.
Sources: 6,31,69

Single types:

***P.* 'Clair de Lune'** — Yellow. Very early flowering.
Sources: 44,65,68

***P.* 'Pico'** — White. Midseason flowering.
Sources: 6,40,66

Above: Paeonia lactiflora *cultivar.*

Left: Foliage of herbaceous peonies remains attractive throughout the growing season.

Japanese and anemone types:

***P.* 'Alstead'** — Deep pink with yellow center.
Sources: 8; M

***P.* 'Ama-no-sode'** — Bright pink with yellow center.
Sources: 8,40,65,68,69

***P.* 'Mikado'** — Bright red, rose stamens tipped with gold. Mid-season flowering.
Sources: 13,24,68; C,H,I,M

***P.* 'Nippon Brilliant'** — Bright red.
Sources: 8,65,66

Papaver orientale **Poppy, Oriental Poppy**
Poppy Family (Papaveraceae)

Oriental Poppies now can be obtained in such a beautiful array of colors that it is unfortunate many people still associate this group only with the orange-scarlet types. Cultivars with showy flowers 6 to 12 inches across that range in color from white to pink, red and near yellow, deserve consideration today. Of these, the white varieties probably should be avoided as they tend to be rather short-lived, and the flowers often become gray from their own pollen. The so-called yellows are basically orange with a yellow tinge.

Oriental poppies are bold plants, 2 to 4 feet in height when in flower, with coarse, hairy lobed leaves. In time clumps become large: up to a yard across in some varieties. In small gardens, one or two plants are all that will be necessary.

About their only fault in a low maintenance situation is the tendency of the stems of some of the more vigorous cultivars to flop under the weight of the flowers. This can be remedied easily (see staking methods, page 203).

A well-drained soil of moderate fertility, and full sun or partial shade are required. Wet soil conditions in winter lead to a rapid demise. The flowering season is relatively short and the plants disappear entirely from July to September; conspicuous gaps in the garden will result if they have been massed. The leaves reappear in the autumn and remain throughout the winter. Plants can be divided or transplanted only in August or September and generally do not bloom until the second year after transplanting. It is prudent to provide a mulch for the first winter.

Papaver orientale *cultivar*

Poppies may be used as cut flowers if the ends of the stems are seared with a flame before being placed in water.

Over sixty named cultivars are presently available from nurseries. The following selection illustrates the marvelous color range.

***P. orientale* 'Barr's White'** — Large pure white flowers with purplish-black markings at the base of the petals.
Sources: 3,13,24,66,67; C,I

***P. orientale* 'Beauty of Livermore'** — Deep red flowers with black spots at the base of the petals.
Sources: 23,68; A,K,L

***P. orientale* 'Bonfire'** — Bright orange-red flowers with crinkly-edged petals.
Sources: 12,54,66,67

***P. orientale* 'Burgundy'** — Maroon-red flowers.
Sources: 13,24,66,68; C,I

***P. orientale* 'Carnival'** — Flowers vivid orange-red, white at the lower half of each petal.
Sources: 12,13,24,28,32,37,60; C,I

***P. orientale* 'Crimson Pompom'** — Fully double deep red flowers.
Sources: 13,24,60; C,I

***P. orientale* 'Curtis Mahogany'** — Very dark maroon-red flowers with crinkled petals like crepe paper.
Sources: 32,59

***P. orientale* 'Dubloon'** — Fully double clear orange flowers.
Sources: 13,24,66; C,I

***P. orientale* 'Field Marshal Von der Glotz'** — Large white flowers with black markings at the base of the petals.
Sources: 13,24,28,32,37,59; C,I

***P. orientale* 'Glowing Embers'** — Crimson-red flowers.
Sources: 13,24,66; C,I,L

***P. orientale* 'Glowing Rose'** — Large luminous watermelon-pink flowers.
Sources: 12,24,32; I

***P. orientale* 'Harvest Moon'** — Clear golden-orange flowers.
Sources: 3,13,24,28,59,60,66,68; C,I

***P. orientale* 'Helen Elizabeth'** — Light pink flowers with dark markings at the base of the petals.
Sources: 3,12,13,24,28,32,59,66,67,68; C,I

***P. orientale* 'Henry Cayeux Imp'** — Flowers smoky-rose with lavender tints.
Sources: 24,37; I

***P. orientale* 'Lavender Glory'** — Deep lavender flowers with large black spots at the base of the petals.
Sources: 13,24,59,60,66; C,I

***P. orientale* 'May Curtis'** — Watermelon-red flowers.
Sources: 13,24,28,68; C,I

***P. orientale* 'Mrs. Perry'** — Flowers salmon-pink with an apricot tinge.
Sources: 13,24,60; C,I,L

***P. orientale* 'Pinnacle'** — Flowers white with flame colored edges.
Sources: 3,13,24,66,67; C,I

***P. orientale* 'Queen Alexandria'** — Bright salmon-pink flowers.
Sources: 3; A,K,L

***P. orientale* 'Raspberry Queen'** — Raspberry colored flowers.
Sources: 28,32,66

***P. orientale* 'Salome'** — Clear rose-pink flowers.
Sources: 3,13,24,32,37,59,67,68; C,I

***P. orientale* 'Surprise'** — Large vermillion-red flowers.
Sources: 12,13,24,67; C,I

***P. orientale* 'Warlord'** — Probably the finest deep crimson-red cultivar.
Sources: 3,13,24,59,66,68; C,I,L

Papaver nudicaule cultivars — Iceland Poppy — These have strong tendencies to behave as biennials in our area and are frequently treated as annuals. Under suitable conditions they often self-sow freely, but the several fine cultivars available may not reproduce themselves true to variety.

***Phlox paniculata* (syn. *P. decussata*) Summer Phlox, Garden Phlox**
Polemonium Family (Polemoniaceae)

Susceptibility to mildew, rust, and red spider attacks, combined with the need for thinning new growth annually and dividing about every third year, should be sufficient reasons to ban

this handsome group from the low maintenance garden. Also, they require frequent watering during the growing season, and self-sow easily, producing plants of inferior color. For those who are prepared to spray every two weeks against the diseases and pests, few other plants are as showy as Summer Phloxes over such a long period of time in the border. For those who cannot take the time, few other plants will produce such a ragged, tattered appearance.

Summer Phloxes require a deep, rich soil, and full sun or light shade. Thorough deep irrigation in dry periods during the growing season is necessary. Cultivars range in height from 2 to 4 feet and bloom from late June into September. Removal of the faded flower heads prolongs the blossoming period. Flowers range in color from pink in all its shades to red, pale blue to purple, and white. Catalogs often list a group called Symons-Jeune Phlox, which are the celebrated cultivars produced in England by the late Captain B. Symons-Jeune, one of the most noted breeders of Summer Phlox.

***P. paniculata* 'Blue Ice'** — Pinkish-blue at the center when they first open, the flowers turn white as they age.
Sources: 7,24,69; I

***P. paniculata* 'Dodo Hanbury Forbes'** — One of the best with clear pink flowers. Huge pyramidal flower heads up to 14 or 16 inches across.
Sources: 1,7,13,20,24,32,60,66,67,69; B,C,G,I,J,K,L

***P. paniculata* 'Dresden China'** — Flowers soft shell-pink with a deeper "eye" at the center.
Sources: 7,13,23,24,59,67,68,69; C,G,I,J,K,L

***P. paniculata* 'Fairy's Petticoat'** — Very large light pink flowers with a darker pink "eye" at the center. Very long period of flowering.
Sources: 7,24,44,60,66,67,68,69; H,I,J,K,L

***P. paniculata* 'Juliet'** — Pale pink flowers. Plants 2 feet in height.
Sources: 24,69; I

***P. paniculata* 'Lilac Time'** — Lilac-blue flowers.
Sources: 7,13,24,32,37,67; C,H,I,J

***P. paniculata* 'Mount Fujiyama'** — Pure white flowers.
Sources: 13,24,28,67,68; B,C,I

***P. paniculata* 'Orange Perfection'** — Near-orange flowers.
Sources: 3,13,66,67; C,L

***P. paniculata* 'Pinafore Pink'** — Probably the lowest growing cultivar. Plants about 6 inches in height. Flowers bright pink with a deeper pink "eye" at the center.
Sources: 24,66,67; L

***P. paniculata* 'Rembrandt'** — Pure white flowers.
Sources: 59,68,69

***P. paniculata* 'Russian Violet'** — Bright violet-purple flowers.
Sources: 15,20,24,60,66,67; I,J,L

***P. paniculata* 'Sir John Falstaff'** — Very large, luminous salmon-pink flowers with a darker "eye" at the center.
Sources: 3,13,23,24,32,44,46,59,66,69; B,C,I,K,L

***P. paniculata* 'Starfire'** — Brilliant deep red flowers.
Sources: 1,3,13,15,20,24,25,28,30,32,37,44,58,59,60,66,67,69; B, C,G,H,I,J,K,L

***P. paniculata* 'White Admiral'** — Very large clusters of white flowers.
Sources: 3,13,15,20,23,24,37,58,60,66,67,68,69; B,C,G,H,I,J,K,L

***P. paniculata* 'World Peace'** — Pure white flowers in September.
Sources: 24,32,59,66,69; I,J,L

Below: Powdery mildew on the leaves of Phlox paniculata.

Although the following species of *Phlox* with their numerous varieties and cultivars are frequently listed in catalogs dealing with perennials, they are best either in the rock garden or the wild flower garden. Under most conditions they would not fit into the flower border because of their low stature and spreading habit: *P. divaricata* (Spring Phlox), *P. nivalis* (Trailing Phlox), *P. stolonifera* (Creeping Phlox), and *P. subulata* (Moss Pink, Ground Pink).

Physostegia **False Dragonhead, Obedient Plant, Stay-in-Place**
Mint Family (Labiatae)

One could almost forgive this group for its invasive tendencies were it not for the fact that the plants also require annual or biennial division to maintain any semblance of neatness. As they grow with relative indifference to wet or dry conditions and will tolerate sun or partial shade, they are of value for naturalizing in a semiwild area or an informal wild flower garden. But they should be used in herbaceous borders only when time can be devoted to keeping them in bounds.

The common names for *Physostegia* are of some interest. False Dragonhead refers to the one-time confusion between this genus and *Dracocephalum* (Dragonhead). Obedient Plant, or Stay-in-Place, refers to the fact that the individual flowers can be twisted on the stem and will remain as they are arranged, a characteristic that fascinates children.

P. virginiana — Grows to a height of 3 to 3½ feet and produces spikes of purplish-red flowers from July to September. The named cultivars are of much greater value than the species.
Sources: 4,14,27,39,43

P. virginiana **var. *alba*** — Flowers pure white on spikes about 1½ to 2 feet in height.
Sources: 30,69; K

P. virginiana **'Bouquet Rose'** — Flowers rose-pink on spikes 3 feet in height.
Sources: 24,66,69; I,K

P. virginiana **'Rosy Spire'** — Later in flowering than the other cultivars. Rose-pink flowers in early September on plants 3 to 3½ feet tall.
Sources: 39,66,68

P. virginiana **'Summer Glow'** — Rosy crimson flowers on 3-foot plants.
Source: 32

P. virginiana **'Summer Snow'** — White flowers on 2½-foot spikes. Less invasive than the other varieties, but requires the same frequent division.
Sources: 13,14,24,32,66,67,68; B,C,I

Physostegia virginiana *var.* alba

***P. virginiana* 'Variegata'** — Deep green and white variegated leaves. Flowers pink.
Sources: 24,32,66; I

***P. virginiana* 'Vivid'** — The lowest growing and most compact cultivar, but just as invasive as the rest. Glowing deep rosy pink flowers in early September on plants 2 feet in height.
Sources: 13,24,66,67; B,C,I,L

Platycodon **Balloon Flower**
Bellflower Family (Campanulaceae)

P. grandiflorum is the only species, but there are a few varieties and several cultivars that are easily grown and live for many years in a single place.

The roots of Balloon Flowers are thick and fleshy and cannot tolerate wet ground. A light, well-drained soil of moderate fertility suits them best. The pink varieties may fade unless planted in partial shade, but full sun is best for the blue-flowered or white-flowered types. New plants are rather slow of growth, but established clumps may be expected to thrive for twenty years and longer if they are not disturbed. They have no spreading tendencies, no major insect or disease problems, and they blossom from late June through July. Most varieties grow to a height of 3 feet and in some situations there may be a tendency for the stems to flop. This is easily remedied by supporting them by the hoop method described on page 203. Growth is late to start in spring, so early cultivation around the plants must be done with care. Balloon Flowers are seen to best advantage in groups of three spaced about 15 inches apart near the middle of the border. The flowers may be used for cutting purposes if the ends of the stems are seared with a flame before being placed in water.

P. grandiflorum — Chinese Balloon Flower — Handsome 2 to 3-inch cup-like blue flowers with prominent veins borne on stems 2 to 3 feet in height.
Sources: 3,13,14,23,46,67,69; B,C,J,L

P. grandiflorum* var. *album — White-flowered form.
Sources: 3,13,24,46,66,67,68,69; B,C,I,J,K,L

***P. grandiflorum* 'Apoyama'** — A choice dwarf cultivar only 6 to 10 inches high from Japan. Highly prized on the rock garden, it has novelty value at the front of the border as well. Violet-

Platycodon grandiflorum *var.* mariesii

blue flowers almost all summer.
Source: 32

P. grandiflorum* var. *mariesii — Marie's Balloon Flower — One of the most compact forms, about 18 inches in height. Stems do not have the tendency to flop. Bright blue flowers.
Sources: 14,24,46,66,67,68; B,I,K,L

P. grandiflorum* var. *mariesii album — White-flowered form.
Source: 68

***P. grandiflorum* 'Shell Pink'** — Soft shell-pink flowers veined deeper pink on plants 18 to 24 inches in height. Might be best planted in semishade.
Sources: 13,24,25,69; C,I,J,K,L

Plumbago larpentae — See *Ceratostigma plumbaginoides*

Polemonium **Jacob's Ladder**
Polemonium Family (Polemoniaceae)

For refined, delicately textured foliage effects, this small group of mound-like plants is of value in the garden, even though the flowers will never set the world afire with their brilliance. Nonetheless, the terminal clusters of small cup-shaped pale to medium blue flowers appear in spring and early summer at a time when blue in the garden is particularly welcome.

Relatively undemanding, these are plants for light or partial shade. They require soil of at least average fertility with good drainage. Hot sunny places where the plants will bake are definitely unsuitable; in such situations the foliage becomes unsightly by midsummer.

P. caeruleum — Jacob's Ladder — Some common names are self-explanatory, others such as this really stretch the imagination. This plant's leaves, composed of numerous opposite leaflets, supposedly resemble the ladder in Jacob's dream.

The clear blue flowers are borne in nodding panicles at the top of erect, 15-inch stems during the month of May.
Source: 14

P. caeruleum* var. *lacteum (syn. *P. caeruleum* 'Album,' by which it is listed in catalogs). White-flowered form.
Source: 69

***P. caeruleum* 'Blue Pearl'** — Cobalt-blue flowers with yellow centers or "eyes."
Sources: 3,13,14,24,59,66,67,68,69; C,I

P. reptans — Creeping Jacob's Ladder — Again, the common name may be misleading. The plants do not creep; they sprawl, and produce mounds up to 2 feet in width. Flowers are light blue with white centers or "eyes." These appear from May through June.
Sources: 27,43,66

Right: Polemonium reptans. *Photo: P. Bruns.*

Polygonatum **Solomon's Seal**
Lily Family (Liliaceae)

A small group of plants, handsome in leaf, long-lived, and of special use in shady parts of the border in rich moist soil. The white flowers appear in late May or June, hanging on short stalks from the axils of the erect opposite leaves. It is for the handsome foliage effect of deep green leaves on arching stems up to 3 to 4 feet in height that the plants are mainly grown. There are no insect or disease problems. Specimens seldom, if ever, require division, but this may be done in early spring for increase.

P. biflorum — Small Solomon's Seal — Grows to heights of 1½ to 3 feet, depending upon soil conditions. The flowers are borne either singly, or more often in groups of two at each leaf axil.
Sources: 7,14,26,39,43,57,66; B

P. commutatum — True Solomon's Seal, Great Solomon's Seal — The tallest and probably the most handsome species in general cultivation. With good soil conditions plants often attain a height of 3½ to 4 feet.
Sources: 1,7,14,26,39,66

P. multiflorum — Solomon's Seal, Lady's Seal, David's Harp — This is a European and Northern Asian counterpart to our native *P. biflorum* and *P. commutatum*. It reaches a maximum height of 3 feet.
Sources: 59,66,69; C

Primula **Primrose**
Primrose Family (Primulaceae)

This genus, containing hundreds of species varying from minute alpines to 4-foot bog lovers, is so diverse that it has been divided into some 30 sections according to botanical detail (flower structure) and cultural requirements. All except two are native to cool moist areas throughout the Northern hemisphere and most do not adapt readily to the cold winters and hot summers of the Northeastern United States. Soil and moisture demands vary with the section, but all need high shade, a summer mulch, and deep watering during dry periods. A winter covering also should be provided in areas of uncertain snow cover.

The following descriptions are limited to a few species and cultivars that are suitable for the perennial garden, and easy to obtain and maintain.

P. auricula — Auricula — One of a group of hardy European alpines with rosettes of leathery evergreen leaves. All these need rock garden conditions, but the hybrid forms of *P. auricula* are larger and less demanding and can be grown in very well-drained fertile soil with a stone chip mulch to protect the crowns and woody stems from excess moisture.

The umbels of fragrant flowers on 6 to 8-inch stems have a white "eye" and a wide range of unusual muted colors. The whole plant is often powdered with white meal or farina.
Sources: 14,50,67; G

***P. auricula* 'Lynn Hall Strain'** — A fine mixture of seedlings containing the full range of colors.
Sources: 32,44,49

***P. auricula* 'Monarch Strain'** — Another mixture containing the full color range. Leaves silvery.
Sources: C,I

P. denticulata — Himalayan Primrose — This species has unique round flower heads up to 2 inches across, containing numerous small lilac flowers that open among the expanding leaves in April. In the autumn it forms a large dormant bud that sits on the soil surface throughout the winter. *P. denticulata* needs some protection and perfect drainage; it could be tried in conditions similar to those mentioned for *P. auricula*.
Sources: 4,32,43,49,66,69; B

P. denticulata* var. *alba — White-flowered form.
Sources: 29,69

Primula japonica — Japanese Primrose — In deep rich soil this species will thrive and spread by self-sown seed without the waterside conditions it prefers; but it must have summer irrigation and constant shade. Since the plants can be left for a number of years without disturbance, a generous mulch of manure or compost applied before leaves appear in the spring will help maintain soil fertility. In late autumn after the plants have become dormant a 4-inch mulch of hay or pine needles is a precaution against winter heaving.

In late May the first tier of flowers opens just above the leaves, and successive tiers appear for several weeks on the stems that may reach a height of 3 feet. Flower color is typically magenta, but includes white, and shades of pink and crimson.
Sources: 4,32,43,49,66,67,68

Primula* × *polyantha — Polyanthus Primrose — The result of crossing *P. vulgaris veris* and *P. elatior*, *P.* × *polyantha* has been the subject of much hybridization and is now available in a bewildering array of colors and forms. Although this is probably the most universally grown of primroses, it requires more frequent division and heavier feeding than some of the species to maintain the size and quantity of the often enormous flowers; it also is more subject to infestation of red spider. Some of the cultivars are not completely hardy.

P.* × *polyantha — Mixed colors — unnamed varieties.
Sources: 3,14,43,46,49,58,66; L

P.* × *polyantha — Separate colors — unnamed varieties.
Sources: 69; C,L

***P.* × *polyantha* 'Colossea Hybrids'** — Large-flowered hybrids in shades of yellow, pink, copper, and red. (Sometimes listed in catalogs as *P. veris* 'Colossea Hybrids'.)
Sources: 24,32,68; B,I,J

***P.* × *polyantha* 'Pacific Giants'** — Very free-flowering strain with large flowers and an extensive color range.
Sources: 24,32,44,53,60,67,68; G,I,K,L

P. sieboldii — Siebold Primrose — This species is distinguished by its crinkly and scalloped deciduous leaves. It appears very late in the spring, and if conditions are dry, may disappear soon after flowering, leaving at the surface a mat of rhizomes. This is very easy to divide for increase and should be marked against careless cultivation. The flowers appear in late May or early June and are borne in umbels on 10 to 12-inch stems. They range in color from white to shades of pink and rose.
Sources: 4,32,66

P. vulgaris — Common Primrose — More often listed in catalogs as *P. acaulis*, this is the fragrant early primrose of English hedgerow fame. It is an early-flowering evergreen species that is easy to grow in rich humus soil in woodland conditions; to maintain vigor, however, the plants should be divided and replanted in fresh soil every three or four years. A light winter

covering of oak leaves or pine boughs will protect the leaves during open winters.

Flowers of the various cultivars come in white and shades of yellow, blue, purple, orange, and red. They are fragrant, appear very early in the spring, and are excellent for cutting.

The following list *P. vulgaris* in a mixture of colors.
Sources: 14,22,24,66; C,I,L

The following list *P. vulgaris* cultivars in the sought-after shade of blue.
Sources: 22,67

Individual named cultivars are listed by the following (Number 22 has a particularly comprehensive list).
Sources: 22,24; I

Pulmonaria **Lungwort**
Borage Family (Boraginaceae)

This is a small group with only a few varieties, but it provides us with plants of low stature, early flowers, and foliage that remains attractive from spring to autumn. Plants are effective as single specimens, but are used more frequently in groups, spaced about 10 inches apart to give a ground cover effect. The drooping clusters of trumpet-shaped ½-inch flowers appear late in April and May on stems about a foot in height. They often open pink, then change to clear blue. Some varieties have clear pink or white flowers that do not undergo a change in color as they age. Any shady position where the soil is moist and cool, but not necessarily rich, seems to suit them.

Although it is frequently stated that the Lungworts should be divided every four years, they often last in good condition for much longer periods, and division is only necessary when plants have become overcrowded. Because they commence growth early in spring, late summer is the most convenient time to divide the plants. When this is done, frequent watering is necessary to encourage the development of a good root system before the onset of cold weather.

P. angustifolia — Blue or Cowslip Lungwort, Mary and Joseph, Soldiers-and-Sailors — Flowers open pink and turn to blue or deep blue. The deeper blue forms receive names in catalogs such as 'Azurea' or 'Coerulea.' The hairy green leaves are not spotted with white as are those of *P. saccharata.*
Sources: 3,32,66,67,68,69

Right: Pulmonaria saccharata. *The distinctive spots on the leaves make Bethlehem Sage particularly valuable as a foliage plant.*

P. saccharata — Bethlehem Sage — Even if this did not flower at all, it still would be valuable in the garden. The handsome 3 to 6-inch deep green leaves have numerous white spots that help to create a distinctive appearance. Flowers are bluish or reddish-violet.
Sources: 14,68

***P. saccharata* 'Mrs. Moon'** — Large pink buds and showy deep blue flowers.
Sources: 3,32,66,67

***P. saccharata* 'Pink Dawn'** — Bright rose-pink flowers.
Source: 69

Rudbeckia **Cone Flower**
Daisy Family (Compositae)

The cultivars listed in catalogs under the name of *R. purpurea* are to be found in this discussion under *Echinacea purpurea.* The garden varieties in the genus *Rudbeckia* have yellow flowers, often with a dark "cone" or center, and resemble our native Black-eyed Susans. Those belonging to the genus *Echinacea*

have Daisy-like flowers in colors ranging from pink to red or white.

Rudbeckia is a genus of mixed blessings for the low maintenance gardener. Selections of *R. hirta* called the Gloriosa Daisies have handsome, large single or double flowers all summer long in shades of yellow to orange or mahogany. They are more apt to captivate the gardener than any other *Rudbeckia*, and are sometimes advertised as "perennials"; on all but the best-drained soils they invariably behave as annuals.

Another of the group, *R. laciniata* var. *hortensis*, is commonly known as "Golden Glow." It is a true perennial, towering to 7 feet in height. It produces 2 to 3-inch double yellow flowers for most of the summer; these are excellent for cutting purposes. A cultivar of this species, *R.* 'Gold Quelle,' discussed below, does not romp and is much better suited to a low maintenance situation.

For the few Cone Flowers that can be recommended, culture is quite simple. They must have full sun and soil of average fertility; good winter drainage is essential. All the cultivars listed here probably will require division for rejuvenation after the fourth or fifth year. Plant them in groups of three or more spaced about 12 inches apart at the middle of the border. All are excellent as cut flowers.

***R. nitida* 'Autumn Sun'** (the correct cultivar name is 'Herbstsonne' but it is listed by its English translation in American catalogs) — Grows to a height of 4 to 5 feet and produces 3 to 4-inch, Black-eyed Susan-type flowers. The stems are rugged and staking is not required. Flowers through July and August.
Sources: 13; C

***R. laciniata* 'Golde Quelle'** — Plants reach a height of only 2½ feet and clumps increase very slowly. The bright, double yellow flowers appear in profusion from July to September.
Sources: 14,24,32,66; I

***R. fulgida* var. *sullivantii* 'Goldsturm'** — This is probably the finest cultivar in the genus, and represents the Black-eyed Susan to perfection. The deep yellow flowers with near-black "cones" or centers are 3 to 4 inches across and are freely produced on well-branched 2½ foot plants. They start to appear in mid-July and continue through September. Although this cultivar does not perform well in dry soil, it is one of the best perennials for continuous summer color in a low maintenance situation.
Sources: 13,14,24,32,59,60,66,67,69; C,B,I

Right: Rudbeckia fulgida *var.* sullivantii *'Goldsturm'*

Salvia .. **Salvia, Sage**
Mint Family (Labiatae)

A number of the Salvias are quite hardy in this area, but certainly not in every location or in every garden. Some people can grow them well, and others have fleeting success. A few species are biennial or otherwise short-lived and must be raised from seed every few years. The well-known red-flowering types are tropical perennials that are treated as annuals.

All perennial Sages require full sun and well-drained soil. Too much moisture at the roots in winter causes certain death, and most species should have the protection of a winter mulch. They often tolerate positions where they bake in summer, and will withstand a surprising amount of drought.

S. azurea — Azure Salvia — Native to the Southeast, it can be grown as far north as Vermont but is not reliably hardy without a good snow cover in the winter. Whorls of icy blue flowers on 4 to 5-foot stems in August and September.
Sources: 57,66

S. azurea var. ***grandiflora*** (syn. *S. pitcheri*, the name by which it is frequently listed in catalogs) — Pitcher's Salvia — Deep blue flowers. Plants 3 to 3½ feet in height.
Sources: 13,24,67,68; C,I

S. glutinosa — Sticky Salvia — The large flowers are pale yellow. Plants 3 feet in height. Somewhat coarse in appearance. Blooms in July.
Sources: 24; I

S. haematodes — One of the most conspicuous species when in blossom. Flowers are lavender-blue in large panicles during June. Plants are about 3 feet in height. Often behaves as a biennial.
Sources: 67,69

S. jurisicii — This species is perfectly hardy in our area, but its 8-inch height and habit of growth better fit the plant to the rock garden. Perhaps of some use at the very front of the border as edging. Forms mat-like clumps and produces violet-blue flowers for most of the summer if seed production is prevented.
Sources: 4,69

S. sclarea **'Vatican Variety'** — Has strong biennial tendencies. Large silvery leaves with a somewhat unpleasant odor. Lavender-pink and white flowers on 3-foot stalks.
Source: 67

S. sclarea × ***superba*** **'May Night'** — Violet-blue flowers from May to August if seed formation is prevented. Plants 1½ to 2 feet in height.
Sources: 28,69

Salvia × ***superba*** (frequently found in catalogs as *S. nemorosa*) — If seed production is prevented, this and its cultivars will flower from mid-June until late August. The flowers are violet or purple with reddish-purple calyces. Plants are about 2½ to 3 feet in height and quite hardy.
Sources: 68; B,J,L

S. × ***superba*** **'East Friesland'** (listed in some catalogs as 'Ostfriesland') — Much branched 18-inch plants with violet-blue flowers in erect spikes.
Sources: 3,66,67,69; I,J

Scabiosa — Pincushion Flower, Mourning Bride

Teasel Family (Dipsacaceae)

Here is another good group for the low maintenance gardener who can provide a sunny spot and a sandy loam enriched with compost.

The "flowers" are really an inflorescence, similar to Sunflowers. Their globular shape with the stamens sticking out of the individual florets has earned them the name "Pincushion."

Varieties recommended here grow to a height of 2 to 2½ feet and have flowers in shades of blue to white. They are excellent for cutting and are long lasting. The flowering season spans the months of June to September.

After the fourth year clumps may become crowded and need dividing for rejuvenation. This is best done in the early spring using only the young divisions growing vigorously from the outer portions of the old clumps. Scabiosas have no serious pests or diseases, and staking will not be required; they are most effective planted in groups of at least three, spaced 12 to 15 inches apart near the front or middle of the border.

S. caucasica — Caucasian Scabiosa — This species and its several cultivars are the only Scabiosas recommended for the flower border; the others are best in a rock garden situation. *S. caucasica* has 3-inch blue flowers with contrasting gray stamens.
Sources: 3,14,59,66,67; L

S. caucasica* var. *alba — White-flowered form.
Sources: 13,67; C,K

***S. caucasica* 'Blue Snowflake'** — Rich amethyst-blue flowers.
Sources: 29,32

***S. caucasica* 'Constancy'** — Amethyst-blue flowers.
Source: 32

***S. caucasica* 'Isaac House Hybrids'** (sometimes also listed in catalogs as "House Mixture" or "House Hybrids") — The somewhat unusual name refers to their place of origin at Isaac House, Bristol, England. They are a mixture of shades that are basically lavender-blue.
Sources: 13,68; A,C,J,K

***S. caucasica* 'Miss Wilmott'** — Pure white flowers.
Source: 32

S. alpina — Alpine Scabiosa — Typical small mauve-blue "pincushion" flowers on tufty little plants about 6 to 9 inches in height. This species has a reputation of not being long-lived, and is best treated as a rock garden plant.
Sources: 3,32

S. lucida — Very similar to the above in size, recommended treatment, and life span. The flowers are more lilac than blue.
Source: 57

S. graminifolia — Grassleaf Scabiosa — Silvery grass-like foliage on 10-inch plants. The flowers are pinkish and appear from June into August. Another species that is best in the rock garden.
Sources: 13,24,32; C,I

Sedum spectabile **Showy Stone Crop, Live-Forever**
Crassula Family (Crassulaceae)

There are many species in the genus *Sedum* for use in the rock garden, but only two are subjects for the low maintenance flower border. Of the two, the one that should have a home in every border is the nearly indestructible *S. spectabile*, the Showy Stone Crop.

This forms a neat, compact mound about 18 inches high, and produces numerous brightly colored flowers in large flat-headed clusters (cymes) 3 to 6 inches across from early August until frost. Another species quite similar in appearance and uses is *S. telephium* (called Live-Forever or Orpine).

These two require a well-drained soil in full sun. Division will not be necessary for many years, and the plants need be disturbed only when an increase is desired. They are best seen as single specimens, or in small groups of no more than three, planted about 15 inches apart at the front of the border.

S. spectabile — Showy Stone Crop — Rosy pink flowers.
Sources: 58,66,68; B

***S. spectabile* 'Brilliant'** — Carmine flowers.
Sources: 13,20,24,37,61,66,68; C,H,I,J,K,L,M

***S. spectabile* 'Carmen'** — Carmine-rose to red flowers.
Sources: 28,32,66,67; L

***S. spectabile* 'Meteor'** — Very large wine-red flower clusters.
Sources: 13,32,66,67; C

***S. spectabile* 'Star Dust'** — Ivory-white flowers. Blue-green leaves.
Sources: 13,24,32,49,69,70; C,I

***S. telephium* 'Indian Chief'** — Copper or Indian-red flowers. Gray-green leaves.
Sources: 24,32,66,67,68; A,F,I,L

Above and below: Sedum spectabile

Above: Sidalcea *'Stark's Hybrids'*

***S. telephium* 'Autumn Joy'** — Rust-brown flowers.
Sources: 28,32,49,66,69; L

Sidalcea **Prairie Mallow, Miniature Hollyhock**
Hibiscus Family (Malvaceae)

Here is an answer, in diminutive form, for those who wish a Hollyhock-like plant without the biennial characteristics of the true Hollyhock. Prairie Mallows are the products of cross breeding several western American species to obtain a group of narrow upright plants about 3 feet in height with flowers in bright shades of rose, pink or purple. They have single flowers, and the same vertical effect as Hollyhocks, but the leaves are deeply

lobed, quite unlike those of Hollyhocks. Another dissimilarity is the freedom from infestations of Hollyhock rust.

Sidalceas require a position in full sun and must have a good well-drained loamy soil that is moisture retentive in summer, but well drained in the winter. They are excellent subjects for the middle of the border when planted in small groups with 12 to 15-inch spacings. Division of the clumps after the fourth year is advisable. Cutting back the plants immediately after flowering in July will encourage second flowering at the end of the summer.

***S.* 'Elsie Heugh'** — Soft pink flowers. Plants 2 to 3 feet in height.
Source: 68

***S.* 'Rose Queen'** — Rose-pink flowers. Plants about 4 feet in height.
Source: 66

***S.* 'Rosy Gem'** — Rose-pink flowers. Plants 1½ to 3 feet in height.
Source: 69

***S.* 'Stark's Hybrids'** — Mixture of pink, white or purplish varieties. Plants 3 feet in height.
Sources: 13,24,68; C,I

Solidago **Goldenrod**
Daisy Family (Compositae)

Goldenrods are such conspicuous "weeds" of the wayside from midsummer to fall that their garden value is overlooked in this country. Perhaps, too, they are spurned because of their undeserved reputation as hay fever plants.

Hybridization involving several of our native species, principally in Europe, has produced cultivars with 10 to 12-inch flower heads on compact plants. They are first class perennial border subjects.

Full sun is necessary, and almost any soil type except the extremes will do. There are no significant insect or disease problems, plants are extremely hardy, and staking is not required. Division after the fourth year of flowering is frequently necessary. Plants appear best in groups of three, spaced about 12 inches apart.

***S.* 'Cloth of Gold'** — Soft Primrose-yellow flowers in large clusters, on compact plants 18 to 20 inches in height. Mid-August and September.
Sources: 32,67

***S.* 'Golden Mosa'** — Dark yellow flowers on plants 3 feet in height. August and September.
Sources: 13,24,67,69; C,I

***S.* 'Leraft'** — Bright golden-yellow flowers on plants 3 feet in height. August.
Sources: 13,24,69; C,I

***S.* 'Peter Pan'** — Canary-yellow flowers on plants 2½ feet in height. August.
Sources: 32,67

Stachys **Betony, Lamb's Ears**
Mint Family (Labiatae)

The two recommended species in this group differ so greatly in appearance that they are discussed separately below. They have similar cultural requirements that include a position in full sun and very well-drained soil of moderate fertility. They require no care other than occasional division sometime after the fourth year depending upon the condition of the plants.

S. macrantha — Big Betony (may sometimes be listed as *Betonica grandiflora*, but is most commonly found in catalogs as *Stachys grandiflora*) — This grows to a height of 1½ to 2 feet and produces tiered whorls of typical Mint-like, 1-inch bright purple flowers. These appear in May and June and are excellent as cut flowers. The heart-shaped leaves are wrinkled and hairy. This species will tolerate partial shade and in such a position the flowers may last longer.
Sources: 67,68

S. lanata — Woolly Betony — This is a wonderful low plant for a silvery foliage effect. Its soft, gray, densely hairy, tongue-shaped leaves are 4 to 6 inches long. The plant forms a mat of growth often 2 feet in width and a few inches in height, but may become invasive in rich soil. The flowering stalks rise to about 12 inches above the leaves and bear small pinkish purple flowers starting in June. These continue to appear until the end

of the growing season. Although the flowers really cannot be called ugly, they are not handsome either, and some gardeners may wish to cut them off. This species has great value as an accent at the front of the border when used sparingly.
Sources: 13,24,46,49,66,67,69; A,C,E,I,L

Below: Stachys lanata. *Photo: P. Bruns.*

Stokesia laevis **Stokes Aster, Cornflower Aster**
Daisy Family (Compositae)

There is only one species, which is listed invariably in catalogs under the old name *S. cyanea.* The plant is of value for its blue, 3 to 4-inch, Aster-like flowers in August and September. It is of easy culture where a well-drained soil in winter can be provided. If this is not possible, it would be better not to attempt to grow this plant in our area.

In nature the flowering stems may reach 18 to 24 inches in height but cultivated selections seldom grow more than 12 inches tall. Stokesias are most effective when planted in groups of at least three, about 12 to 15 inches apart. Spring planting or dividing is recommended. After the fourth year of flowering the plants will probably become crowded and require division.
Sources: 4,14,24,49; A,I,L

***S. laevis* 'Blue Danube'** — Deep blue flowers in July and August Plants 12 to 15 inches in height.
Sources: 13,24,28,49,58,60; C,I,J,K

***S. laevis* 'Blue Moon'** — Quite large silvery blue to lilac flowers.
Sources: 13,25,37,66,68; C,H,L

***S. laevis* 'Blue Star'** — Light blue flowers.
Sources: 67; B

***S. laevis* 'Silver Moon'** — Pure white flowers.
Sources: 13,24; C,I.

Above: Stokesia laevis

Thalictrum **Meadowrue**

Buttercup Family (Ranunculaceae)

The delicate compound foliage and lacy flowers of the Meadowrues can be used to impart a light airy feeling in the border. The flowers, which have no true petals, are comprised of petal-like sepals and numerous colored stamens. This somewhat unusual characteristic seldom fails to attract attention.

Most species tolerate shady conditions, but may be grown in full sun if soil is relatively moist. The taller growing species have sturdy stems, so staking is seldom required. Established plants should remain in good condition for a number of years. Flowers are excellent for cutting. To achieve maximum effect in the garden, set the plants in groups of at least three, spaced 15 to 18 inches apart.

T. aquilegifolium — Columbine Meadowrue — The gray-green leaves are similar in appearance to those of the Columbine. The individual lilac-purple flowers are small but produced in great quantity on 3-foot stems; they appear for a relatively brief period in late May and early June.
Sources: 32,66

Left: Stokesia laevis

***T. aquilegifolium* 'Album'** — White-flowered form.
Source: 32

***T. aquilegifolium* 'Dwarf Purple'** — Purple flowers on plants 2½ feet in height.
Sources: 24; I

***T. aquilegifolium* 'Roseum'** — Pink flowers.
Source: 32

T. dipterocarpum — Yunnan Meadowrue — Has lavender or mauve flowers with contrasting yellow stamens. A valuable plant for its August flowering. Reaches a height of about 5 feet and requires a rich moist soil. This species was discovered in Western China by Ernest H. Wilson while travelling for the Veitch Nurseries before he became associated with the Arnold Arboretum.
Sources: 24,66; I

***T. dipterocarpum* 'Album'** — White-flowered form.
Source: 68

***T. dipterocarpum* 'Hewitt's Double'** — A completely double form with rich mauve flowers, it is probably the most desirable cultivar, but does not appear to be available at present from any mail-order source in the country.

T. minus (may be found in catalogs listed by its old name, *T. adiantifolium*) — Low Meadowrue — This is a handsome foliage plant for the front of the border. The much-dissected, fern-like leaves are reminiscent of the Maiden Hair Fern, and are of great value in bouquets. The flowers appearing in June and July are greenish-yellow and not at all conspicuous.
Source: 32

T. rocquebrunianum — Lavender Mist — This is one of the finest of the Meadowrues, and a plant that could well be in every garden. The lavender flowers with soft yellow stamens appear at the top of 6-foot stems from mid-July through August. Gardeners should not be discouraged with this species after the first or even the second year, especially if the plants obtained from the nursery were small; they require a few years to come into their own.
Sources: 13,32,67; C

Thalictrum rocquebrunianum

T. speciosissimum — Dusty Meadowrue — This yellow-flowered species may be found listed in catalogs as *T. glaucum* or *T. rugosum*. The dense clusters of slightly fragrant flowers appear in August on stems 4 to 6 feet in height. The blue-gray leaves are effective in flower arrangements.
Sources: 32,66,67

Thermopsis **False Lupine**
Pea Family (Leguminosae)

This is another in the relatively small group of perennials that have the ability to endure considerable neglect for many years. Although native in the Southeast, it will survive New England winters, has no insect or disease problems, and the compound leaves remain in excellent condition throughout the growing season. The 12-inch spikes of bright yellow, pealike flowers appearing in June and early July resemble a yellow Lupine, hence the common name.

Old plants may reach a height of 4 feet and form clumps up to a yard wide. Under such conditions they may require staking. False Lupines should be grown in full sun in soil that is well drained; only moderate fertility is necessary.
Sources: 3,4,13,14,25,29,66,68,69; B,C,E,K

Tradescantia virginiana **Spiderwort**
Spiderwort Family (Commelinaceae)

Our native spiderwort, *Tradescantia virginiana*, is a plant that will tolerate poor soil, poor drainage and poor light, but may become a serious pest under favorable conditions. Plants reach a height of 18 to 24 inches and have fleshy, somewhat grass-like leaves and stems. The three-petaled flowers appear in small clusters during the summer.

***T. virginiana* 'Blue Stone'** — Clear deep blue flowers.
Sources: 24,69; I

***T. virginiana* 'Innocence'** — Pure white flowers.
Source: 66

***T. virginiana* 'Iris Prichard'** — White flowers with a violet flush.
Sources: 13,32,66,67,69; C

***T. virginiana* 'T. C. Weguelin'** — Porcelain-blue flowers.
Sources: 13,24,32,66,69; C,I

***T. virginiana* 'Kreisler'** — Deep blue flowers.
Source: 66

***T. virginiana* 'Orchid Lady'** — Orchid-pink flowers.
Source: 1

***T. virginiana* 'Pauline'** — Rose-mauve flowers.
Sources: 13,24,32,69; C,I,K

***T. virginiana* 'Pink Delight'** — Rich orchid-pink flowers.
Source: 1

***T. virginiana* 'Purple Dome'** — Rosy-purple flowers.
Sources: 13,24,32,67,68,69; C,I

***T. virginiana* 'Purple Perfection'** — Rich purple flowers.
Source: 1

***T. virginiana* 'Red Cloud'** — Rosy-red flowers.
Sources: 13,24,32,69; C,I,K

***T. virginiana* 'Royal Purple'** — Deep purple flowers.
Source: 1

***T. virginiana* 'Snowcap'** — Pure white flowers.
Sources: 13,24,32,69; C,I

***T. virginiana* 'Valour'** — Deep red-violet flowers.
Source: 66

***T. virginiana* 'Zwanenburg Blue'** — Medium blue flowers.
Source: 66

Trollius **Globe Flower**
Buttercup Family (Ranunculaceae)

Globe Flowers are found in nature growing in sunny, moist or marshy situations. In the garden they must have a position where they will remain moist throughout the summer. Under such conditions they will require little attention for many years. Despite catalog claims to the contrary, they bloom only in spring and early summer.

The flowers range in size from 2 to 3 inches and may be single or double in shades ranging from pale yellow to orange. They make excellent, long-lasting subjects for flower arrangements.

The deeply-lobed leaves resemble those of Buttercups. According to species or cultivar they range in height from 1 to 3 feet and are most effective in groups of at least three spaced 10 to 12 inches apart near the front or middle of the flower border. Division may be accomplished either in spring or fall, but in most situations it will not be necessary for five years or more.

Although a number of fine selections are available in this country, it is unfortunate that more nurseries do not stock them.

***T. asiaticus* 'Byrne's Giant'** — Orange-yellow, semidouble flowers with bright orange-red anthers. Plants 2½ feet in height. Flowers a little later than the *T. europaeus* hybrids.
Source: 69

T. europaeus — Common Globe Flower — The true species probably is not offered by nurseries; but a number of cultivars attributed to this species are available. Many are undoubtedly hybrids between *T. europaeus* and other species.

***T. europaeus* 'Commander-in-Chief'** — Large deep orange flowers. Plants about 2 feet in height. Less vigorous than most other varieties and prefers a deep, rich soil.
Source: 66

***T. europaeus* 'Earliest of All'** — Small clear yellow flowers. Plants about 2 feet in height, true to name.
Source: 66

***T. europaeus* 'Excelsior'** — Bright yellow flowers.
Source: 32

***T. europaeus* 'Fire Globe'** — Deep burnished orange flowers. 2 feet.
Source: 32

***T. europaeus* 'First Lancers'** — Fiery orange flowers. 2½ feet.
Source: 66

***T. europaeus* 'Golden Monarch'** — Large golden-yellow flowers.
Source: 66

***T. europaeus* 'Lemon Queen'** — Very pale lemon-yellow flowers. 2 feet.
Sources: 32,66,68; C

***T. europaeus* 'Mrs. Mary Russell'** — Pale yellow flowers.
Sources: 66,68

***T. europaeus* 'Orange Glow'** — Large deep orange-yellow flowers.
Sources: 32,66

***T. europaeus* 'Orange Princess'** — Orange-gold flowers. 2½ feet.
Source: 68

***T. europaeus* 'Prichard's Giant'** — Large golden-yellow flowers. Plants about 2½ feet in height.
Sources: 66,69; C

***T. europaeus* 'Superbus'** — Bright lemon-yellow flowers.
Source: 68

T. ledebouri — Ledebour Globe Flower — Similar in general appearance to the preceding species, but flowering starts in June. The flowers are orange-gold with erect bright orange stamens. Plants attain a height of about 2 to 2½ feet.
Sources: 14,32,37,67,68,69

***T. ledebouri* 'Golden Queen'** — This is the tallest of all the *Trollius* cultivars, reaching a height of nearly 4 feet under the most favorable circumstances. The very large flowers, often 4 inches across, are orange-yellow.
Sources: C,I

T. pumilus — Dwarf Globe Flower — This is a treasure for a moist spot on the rock garden or similar situation at the very front of the flower border. The 1-inch, clear yellow flowers are produced in May and June on plants 6 to 8 inches in height.
Source: 29

Verbascum **Mullein**
Figwort Family (Scrophulariaceae)

Although they are close relatives of the common Mullein, *V. thapsus*, which is frequently seen along roadsides and in waste places in our area, the species and cultivars for garden use far outshine the wild plant. Unfortunately the types most frequently available to the gardening public exhibit biennial tendencies, and new batches of seedlings must be raised every year to insure against losses. Many of the species and cultivars will self-sow and perpetuate themselves in a low maintenance situation, but this cannot always be guaranteed.

The key to success with *Verbascum* is a location where the soil is very well drained especially during the winter months. Sandy loam that has moderate fertility will suffice, but the planting site must be in full sun. Although plants will withstand surprising amounts of drought, periodic watering during long dry spells will be beneficial.

The types discussed here vary in height from 2 to 4 feet. The five-petaled saucer-shaped flowers are about an inch in width and densely borne on spikes above basal rosettes of green to silvery-gray leaves. Depending upon variety, the spikes may be solitary or branched; some types produce numerous secondary spikes. The taller varieties invariably need staking to prevent the flower spikes from bending or flopping over after heavy rain. Removal of the flowering stalks immediately after flowering may encourage the production of new basal rosettes of foliage, thus discouraging the biennial tendencies of some of the forms. This will not always work, however.

V. nigrum — Dark Mullein — This European native bears bold 2 to 3-foot spikes of small yellow flowers that are purplish at the center. The basal leaves may be oblong or heart-shaped. This species will often be much longer lived than the others discussed here.
Source: 69

V. nigrum var. ***album*** — White-flowered form of the above species.
Sources: 24; I

V. phoeniceum — Purple Mullein — This species exhibits a strong biennial tendency. It is one of the principal parents of the garden hybrids, and unfortunately that tendency has been passed along to them. In a sunny dry location, the plant self-sows with little difficulty in the Boston area, but not prolifically. Plants reach a height of 2½ to 3 feet and bear loosely branched spikes of ¾-inch white to violet or purple flowers.
Sources: 66,69; L

***V.* × *hybridum* 'Bridal Bouquet'** — Pure white flowers on plants 2½ to 3 feet in height.
Source: 66

***V.* × *hybridum* 'Cotswold Gem'** — Soft amber-colored flowers with purple centers. Plants 3 to 4 feet in height.
Sources: 24,67,69; I

***V.* × *hybridum* 'Pink Domino'** — Rose-pink flowers with maroon centers. Plants 4 feet in height.
Sources: 13,24,66,69; C,I

***V.* × *hybridum* 'Yellow Queen'** — Bright yellow flowers on plants 3 feet in height.
Source: 68

Veronica — Speedwell

Figwort Family (Scrophulariaceae)

This is a very large group of garden plants. Many are best

suited to the rock garden or naturalized areas, but a surprisingly large number of forms of great value in the perennial garden are presently offered by American nurseries. Of these selections, most are suitable for a low maintenance situation and are highly prized for their flowers which are excellent for cutting. Blue predominates, but purple, white and pink shades are obtainable as well. With proper selection of varieties, a succession of bloom throughout most of the growing season is possible.

The flowers are small, but are borne densely on numerous erect spikes. Plants vary in height, according to variety, from 12 to 18 inches. They do best in an open, airy, sunny location where the soil is of moderate fertility and well drained, especially during the winter. For tidy growth, clumps probably will require division after the fourth year, either in the spring or fall. Single specimens, or small groups of three plants spaced 12 to 18 inches apart at the front or towards the middle of the border are equally satisfactory.

V. holophylla — Japanese Speedwell — Broad spikes about 12 to 15 inches high with vivid blue flowers. Starts to bloom in August and continues almost to the end of the growing season. Deep green glossy foliage. Very hardy.
Sources: 13,24,29,32; C,I

V. incana — Woolly Speedwell — The woolly white leaves and lilac-blue flowers form a handsome contrast. The flowers appear on 12 to 18-inch stems in June and July. When not in flower the plants seldom exceed 6 inches in height, so may be used at the front of the border or in the rock garden as well. Good drainage is a necessity.
Sources: 14,24,39,46,49,66,68,69; A,I,J,K,L

V. latifolia — Hungarian Speedwell — This species forms a tangled mound of foliage. The deep blue flowers are produced with surprising freedom throughout most of the summer.
Source: 66

***V. latifolia* 'Crater Lake Blue'** — A most desirable cultivar of the above species. It has vivid gentian-blue flowers and the same long blooming season.
Sources: 24,32,59,66,67,69; I,K

V. longifolia — Beach Speedwell, Clump Speedwell — Densely borne, lilac-blue flowers on long spikes that average 2 feet in height. Flowers from midsummer to fall.
Sources: 66; L

V. longifolia* var. *subsessilis — Rich royal blue flowers, quite striking in their effect. Much superior to the species form, and with the same long blooming period.
Sources: 24,46,66,67; B,I

V. spicata — Spike Speedwell — Numerous 14 to 18-inch dense spikes of bright blue flowers from June to early August.
Sources: 30; K,L

V. spicata* var. *alba — Pure white-flowered form of the preceding species.
Source: 66

***V. spicata* 'Nana'** — A very low compact form not over 6 inches in height. Probably of more value in the rock garden, but of some interest for the very front of the flower border. Blue flowers at the same time as the species.
Source: 66

***V. spicata* 'Nana Alba'** — White-flowered form of the above cultivar.
Source: 66

Of the following list of cultivars, some may properly belong under *V. spicata* and others under *V. longifolia.* The two species have been crossed extensively and some cultivars are obviously hybrids between the two. For convenience they are lumped together here as *Veronica* hybrids.

***V.* 'Barcarolle'** — 1-foot spikes of striking deep rose-pink flowers from June to August.
Sources: 24,49,59,69; I,K

***V.* 'Blue Champion'** — Medium blue flowers from July to late summer on bushy, 2½-foot plants.
Source: 67

***V.* 'Blue Peter'** — Deep blue flowers on compact spikes. Much branched 1½-foot plants with fairly long serrated leaves. Blooms from July to August.
Sources: 68,69; B,I

***V.* 'Blue Spire'** — Very erect 1½-foot plants with deep violet-blue flowers from June to August.
Sources: 13,66; C

***V.* 'Icicle'** — Pure white flowers from June to September on 2-

foot spikes. Gray-green leaves.
Sources: 13,14,24,32,39,46,58,66,67,68,69; C,I,J,K,L

***V.* 'Lavender Charm'** — Lavender-blue flowers on 18 to 24-inch spikes from June to September. Dark glossy green leaves.
Sources: 13,24; C,I,J

***V.* 'Minuet'** — Soft pink flowers from June to August on plants about 1 foot in height. Handsome gray-green foliage.
Sources: 13,14,24,32,39,46,49,66,67; C,I,J,K,L

***V.* 'Pavane'** — Bright pink or rose flowers from June to August on 18-inch spikes.
Sources: 32,58,66; K

***V.* 'Pink Spire'** — 18 to 24-inch spikes of soft pink flowers with red anthers. Gray-green foliage.
Sources: 13,66; C

***V.* 'Romily Purple'** — Dark blue-violet flowers from June to August on rigid spikes 1½ to 2 feet in height.
Source: 68

***V.* 'Saraband'** — Violet-blue flowers from June through August on 20-inch spikes.
Sources: 66,67

***V.* 'Sunny Border Blue'** — Navy-blue flowers from June to September on 18 to 24-inch spikes.
Sources: 13; C,J,L

Although all of the following are excellent in their own way, they are quite low growing and not superior to the few low types already mentioned. For this reason it is suggested that they are better suited to the rock garden than to the front of the flower border.

***V. alpina* 'Alba'** — White flowers on stalks seldom exceeding 6 to 8 inches in height.
Sources: 24,67,69; I

***V. pectinata* 'Rosea'** — A mat-forming plant with pink flowers with white centers. Hardiness a bit doubtful in the Boston area.
Source: 66

V. prostrata (sometimes listed in catalogs as *V. rupestris*) — Harebell Speedwell — Forms tufted mats of foliage. Flower spikes 2 to 8 inches in height. Flowers deep blue in May and June.
Sources: 68; B

***V. prostrata* 'Heavenly Blue'** — Sapphire-blue flowers, otherwise the same as the above.
Sources: 24; I,K

V. repens — Creeping Speedwell — Plants 2 inches in height produce slender spikes of pale or lavender blue flowers in June.
Sources: 32,66; A

HARDY ORNAMENTAL GRASSES

Some of the easiest perennials to grow are members of the Grass family (*Gramineae*). They are not seen frequently enough in perennial gardens, and some have a special importance in a low maintenance situation. Ornamental grasses may be of value for their habit of growth, variegated leaves, or decorative inflorescences (flowers). Most possess combinations of these; with some, winter interest is an added asset. The dried flowers or fruiting stalks of many are useful in flower arrangements as well.

All the grasses recommended here are fully hardy in our area and should grow for many years before division for rejuvenation will be necessary. This is best done in early spring, just before new growth commences, and only when clumps start to die out in the center. Those noted for their winter interest should be allowed to retain their dead leaves until early spring, at which time plants should be cut back to an inch or so above ground level.

An excellent, fully illustrated publication *Ornamental Grasses for the Home and Garden*, Information Bulletin 64, is available at a price of $.30 from the Extension Service, New York State College of Agriculture and Life Sciences, Cornell University, Ithaca, New York, 14850.

***Carex morrowi* 'Variegata'** — Japanese Sedge Grass — A low, clump forming plant (actually a sedge, Cyperaceae, not a true grass) that grows from 6 to 12 inches in height. The evergreen leaves have narrow white margins. The flowers are insignificant. It will not spread rapidly under normal conditions and is handsome in both winter and summer. Full sun or partial shade is satisfactory, but a soil that does not dry out for long periods is necessary. Excellent for growing in pots or other containers, both indoors and out.
Sources: 66,67; C

Elymus glaucus — Blue Lime Grass — A very densely-tufted grass with short blue-green leaves. It grows to a height of about 2 feet and is quite effective in small groupings at the front of the border. Unlike *E. arenarius* which is sometimes used in gardens, this species does not spread rapidly. Full sun is necessary, but the soil may be either moist or sandy and fairly dry. Useful in gardens near the sea. The leaves lose their coloration with the first frost.
Sources: 66; L

Erianthus ravennae — Plume Grass, Ravenna Grass, Hardy Pampas Grass — This is a very stately, tall grass that forms imposing 5-foot clumps, and flowering stalks rising 7 to 10 feet in height. It gives the closest effect to Pampas Grass of any plant that can be easily grown in New England. The green leaves present a somewhat coarse effect. The silvery plumes of white or beige flowers are 1 to 2 feet long and appear in September and early October. These are occasionally destroyed by early frosts. Well-established clumps may produce upwards of 40 to 50 flower heads and these are excellent for use in dried arrangements.

Plume Grass is not invasive, but clumps do eventually become several feet in width. A single specimen will be sufficient in most gardens, where the effect will be dramatic to say the least. Where massed, it can be effective as screening for those who may wish something a bit out of the ordinary. Foliage should not be cut down until early spring as the plants have a rather handsome effect in winter. A fairly moist but well-drained and fertile soil should be provided along with full sun.
Sources: 67; B

Miscanthus sinensis (syn. *Eulalia japonica*) — Eulalia Grass, Chinese Silver Grass — This is another very tall grass, usually attaining heights of 5 to 10 feet, and has many of the same uses as *Erianthus ravennae* due to its large size. The flowers are pale pink or red and appear in large, feathery fan-shaped panicles in September. These can be very effective when dried for arrangements. As with *Erianthus* the foliage should be left over winter and not cut until early spring. In a low maintenance situation, a site in full sun with somewhat poor but moist soil conditions should be chosen. In shady locations, or if encouraged by excessive fertility, clumps may require tying to prevent toppling.
Sources: 66; B. (The same sources list a form that they call Gigantea; this grows a foot or so taller than the species.)

Above: Clump of Miscanthus sinensis *provides a contrast to shapes and textures of shrubs and perennials in the Low Maintenance Garden at the Case Estates, Weston. Photo: P. Bruns.*

Above: Erianthus ravenne. *From* Dictionnaire Practique D'Horticulture et du Jardinage. *Paris, 1892–93.*

Left: Miscanthus sinensis. *From* Manual of the Grasses of the U.S. *(ed. 2) by A. S. Hitchcock and A. Chase. USDA Misc. Publ. 200, 1950.*

***Miscanthus sinensis* 'Gracillimus'** — Maiden Grass — This form differs from the above in that the leaves are finer in texture, have a conspicuous white midvein and a more arching habit of growth. It is shorter by about 2 feet.
Sources: 13,24,28,67,68; B,I,L

***Miscanthus sinensis* 'Variegatus'** — Striped Eulalia Grass — Grows to a height of 3 to 6 feet. The leaves are striped yellow, white, and green. Although hardy in the Boston area, it seldom flowers here.
Sources: 66,67; B

***Miscanthus sinensis* 'Zebrinus'** — Zebra Grass — A very striking grass with basically green leaves that have prominent yellow bands. It has an upright habit, and the unique foliage makes it an interesting and unusual specimen plant. It is frequently used near water. Does not form as vigorous clumps as the species, and will require staking if grown in the shade.
Sources: 66,67; B

***Molinea caerulea* 'Variegata'** — Variegated Moor Grass — This forms small dense, upright to arching tufts 1 to 2 feet in height. The leaves have cream-colored margins. The green to purplish flowers are produced over most of the summer and are effective when dried. The plant dies to the ground in winter, so has no value at that time of year. It is effective as a low specimen plant or in small groupings at the front of the border. Adapts well either to full sun or partial shade.
Sources: 24,66,69; I

Panicum virgatum — Switch Grass — Densely upright clumps 3 to 6 feet in height that produce light, airy panicles of dark reddish-purple flowers from July to September. Because of the habit of growth, Switch Grass has distinct ornamental winter value and also has been suggested for use as a wildlife cover at that time of the year. It is suitable as a specimen plant at the middle of the border, and can be used in naturalizing schemes, in waterside plantings, or as a screen when massed.

Prefers a site in full sun and is impartial to soil type. In a shady location plants may require staking. Light sandy soils may encourage spreading, but this happens slowly.
Sources: 66; B

Uniola latifolia — Northern Sea Oats, Spangle Grass — This is one of the best hardy native grasses, and probably the most appropriate for a partially shaded location. It has a narrow, upright to arching habit of growth. Clumps reach 3 to 5 feet in

Above: Panicum virgatum. *From* Yearbook of Agriculture, 1948. *U.S. Govt. Printing Office.*

Above: Uniola latifolia. *From* Manual of the Grasses of the U.S. *(ed. 2) by A. S. Hitchcock and A. Chase. USDA. Misc. Publ. 200, 1950.*

height. The handsome 10 to 12-inch spikes of reddish-brown flowers (which turn to bronze) appear in late July and persist into the winter when they retain their pleasing appearance. The best planting site is where soil is fertile and well drained. A position in full sun will cause the plants to grow shorter and be less effective.
Source: B

The following grasses may be used in a low maintenance situation, but they must be placed second in value to those discussed above:

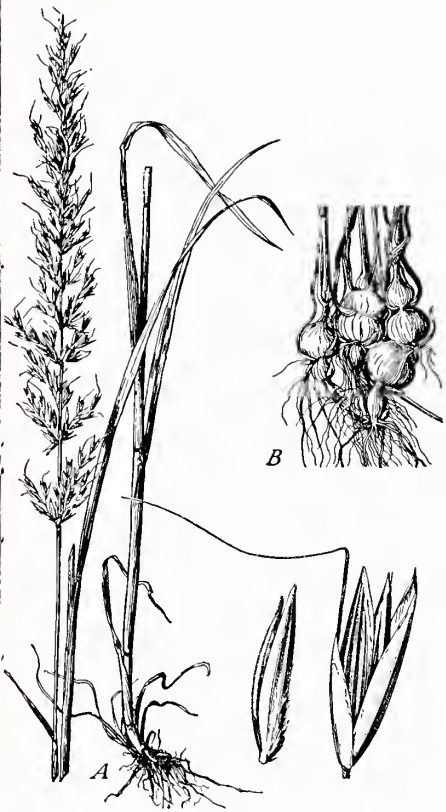
***Arrhenatherum elatius* var. *bulbosum* 'Variegatum'** — Variegated Bulbous Oat Grass, Variegated Tuber Oat Grass — This grows to a height of 18 to 25 inches and has wide green leaf blades with contrasting white stripes. The foliage is most effective in spring and autumn. Because the clumps become untidy looking during hot weather, they should be cut back to the base in midsummer. Plants have a definite tendency to spread, and possess an open, upright habit of growth. Will grow well either in full sun or partial shade, and tolerate dry soil conditions.
Sources: 24,66; I

***Phalaris arundinacea* 'Picta'** — Ribbon Grass, Gardener's Garters — Although this is a very attractive low grass, it has a decided tendency to become rampant in light soils. Also, the foliage becomes less decorative toward the end of the summer. It grows about 2 or sometimes 3 feet in height and has an open, upright habit, not forming tight clumps or mounds. The leaves are green, striped with white, and occasionally pink. This grass was very popular in the past, and still frequently marks the site of old gardens.

***Spartina pectinata* 'Aureo-marginata'** (syn. *S. michauxiana* 'Aureo-marginata') — Cord Grass — An excellent plant for either sandy or wet soils, but may become invasive in the former situation. It grows to a height of 4 to 8 feet (tallest in moist locations) and should have a site in full sun. The 2 to 4-foot leaves are shiny green with yellow stripes along the margins. Yellow flowers on 6 to 15-inch stalks appear from late August through September. This is a very good plant for use along streams and ponds or near the sea; it is of less value in the perennial garden.
Sources: 66; B

The following grasses are not recommended, especially in a low maintenance situation:

Arundo donax — Giant Reed — A very coarse, but striking plant. It may vary in height from 7 to 20 feet, but is seldom over 8 to 12 feet in our area. Although it can be used locally, it is at the margin of its hardiness, and must be heavily mulched in winter.
Sources: 67; B



Above: Arrhenatherum elatius. *From* Manual of the Grasses of the U.S. *(ed. 2) by A. S. Hitchcock and A. Chase. USDA. Misc. Publ. 200, 1950.*

Above: Phalaris arundinacea. *From* Yearbook of Agriculture, 1948. *U.S. Govt. Printing Office.*

***Arundo donax* 'Variegata'** — Leaves with broad white stripes at the margins, and a narrower white stripe down the midrib. Less hardy than the species and not for outdoor culture around Boston.
Sources: 13,66,67; C

Cortaderia argentea (syn. *C. selloana*) — Pampas Grass — A densely tufted perennial grass that grows up to 9 feet and more in height and produces conspicuous silvery-white panicles of flowers in late summer. In the Boston area it can only be grown with considerable protection, and this is hardly worthwhile, as *Erianthus ravennae* makes such a good substitute.
Sources: 25,44,59; A

Above: Arundo donax. *From* The Garden, *Vol. XVI:322, Oct. 1879.*

Above: Festuca ovina. *From* Yearbook of Agriculture, 1948. *U.S. Govt. Printing Office.*

Festuca ovina* var. *glauca — Blue Fescue — Although this is the ornamental grass most frequently offered by nurseries, it is one of the least satisfactory for the true low maintenance situation because of its need for division every second or third year to maintain the vigor of the clumps. It is frequently suggested for use as a ground cover, a purpose to which it is unsuited. Growing in neat clumps about 6 to 12 inches in height, with silvery blue, finely textured leaves, Blue Fescue remains completely evergreen in New England winters. It must have a well-drained soil, but will tolerate either full sun or partial shade. It is a beautiful little plant, well loved by some landscape architects, but not worthwhile for easy maintenance.
Sources: 24,32,44,49,58,59,66,67; A,B,C,I,K,L

Planning and Preparing the Garden

Site Considerations

The ideal site for a perennial garden is one exposed to full sun for the entire day, out of the wind, with a well-drained, fertile, loamy soil abundantly supplied with organic matter, on flat, not sloping land, and occupying a conspicuous location on the property. Few people are blessed with such a site! Fortunately, many perennials adapt to a fairly wide range of conditions, and there are numerous species for special situations.

A thorough survey of one's property should be taken before any decision is made on location. If at all possible, the garden should be sited so that it is visible either from the house or patio, or from the street as an embellishment to the dwelling itself.

Traditionally the perennial garden has been provided with a backdrop, usually a hedge or wall of some sort. Wooden and metal fences of many styles are used for this purpose; in fact, a well-planned perennial border can mask a chain link fence as effectively as it complements the beauty of a wooden fence or screen. Other backdrops may include the shrubbery in the foundation planting of a house, a wall of the house itself, or the boundary of a woodland using the distant scene as a backdrop.

Today landscape thinking and practice have set the perennial border free of the prescribed, often stereotyped, backdrop, making it optional according to the situation. The garden now may be brought out into the middle of the lawn, independent of any single feature, yet integrated into the total scene. In such a position it can take on the various shapes of free-form beds often raised or contoured, and gently defined by curving lines. Shrubs having contrasting shapes, textures, or color can be used as complementary plantings; even interesting large stones or boulders may be sparingly incorporated. The use of these elements adds extra interest during both the growing season and the bleak winter months when most gardens are least attractive.

Liberation from the necessity of providing a riot of color at all times enables the gardener to give consideration to the sub-

tleties of texture and leaf form, to the dramatic effects of bold masses, or interesting small nooks set against the lines or shape of the garden itself. Freed from the rectangular or circular designs that any child could produce, the art rather than the trade of horticulture can come into full play, and almost endless possibilities for the design or location of beds and borders can arise: beside walks, along driveways, in or next to terraces or patios, around existing specimen shrubs or small trees, at the base of a rock outcropping, with or partially surrounding the vegetable garden, by a fence or hedge, or amongst the shrubs of the foundation planting. The number of acceptable sites for perennials, and for low maintenance perennials in particular, is almost equal to the diverse sites to be found on any property.

Sun vs. Shade

Once a visually satisfying location for the perennial garden is selected, attention must be given to the interrelated factors of soil and sun and shade. A relatively large number of plants will survive a poor dry soil in full sun; but relatively few will do well in deep shade even with soil of optimum quality.

Shade conditions may be divided into three categories: 1) partial shade, 2) light shade, and 3) deep shade. Partial shade exists when a location is in direct sun for only a portion of each day. Many sun-loving perennials will adapt to such conditions, but the fewer the hours of direct sun, the greater will be the need for staking, the greater the danger from fungus diseases, and the likelihood that some plants will produce rampant growth. Full sun during the early or later hours of the day is sometimes considered to be preferable to full sun during the middle of the day. Early afternoon sun is the hottest, and is apt to dry the soil and cause flowers to fade rapidly.

Light shade exists when plants receive no direct sunlight, but the light intensity is nonetheless high. This occurs when widely spaced buildings or trees cut off the direct rays of the sun, and is the ideal condition for nearly all shade-loving plants. The extreme condition, deep shade, results when plants receive no direct sunlight, and the light intensity is quite low, similar to indoor room conditions. In such a situation, root competition from trees is often a serious problem. As a practical rule of thumb, the roots of a tree extend from the trunk at least as far as the tips of the branches. A garden that is situated beneath the branches of a tree has to contend with not only the lack of light produced by the branches, but also the competition of the

tree roots for water and nutrients. If at all possible a perennial garden should not be sited adjacent to trees.

Soil and Its Modifications

Existing soil conditions may limit choice of perennials just as exposure to varying degrees of light can affect success. Though it frequently is not possible to alter exposure to sun or shade, soils can be modified; perennials that are not to be divided frequently and will stay in place for several years or longer require thorough attention to their needs *before* they are planted.

The first order of business is to determine what is under the surface of the soil. One or more holes should be dug to a depth of 18 to 24 inches in the area of the prospective site. This will determine the depth of the topsoil, the character of the subsoil, and the conditions of drainage. Many housing developments provide only an inch or two of top soil over a gravel or clay subsoil. This is not adequate to support a garden. Furthermore, the subsoil may be contaminated with mortar, old boards, tin cans, broken bottles, and similar debris that will interfere with drainage and nutrient availability.

The soil for the perennial garden should be 6 to 8 inches deep; the subsoil should be freely drained, and drainage should not be impeded by a layer of clay (hardpan). If the conditions are not ideal, they can be easily remedied. The amount and depth of the soil can be increased by incorporating some sort of organic material into the top 6 to 8 inches. This may be compost, stable or cow manure, sawdust, leaves, chopped hay; in short, any sort of decomposable organic matter that can be obtained cheaply. It can be incorporated into the soil with a rototiller, or it can be dug in with a fork or shovel. Preferably, it should be dug in several months before planting is contemplated to allow time for decomposition. Organic matter also will help moisture retention in a droughty, sandy or gravelly soil, and will tend to lighten a clay soil. However, if drainage is poor, it will pay to add sufficient bulk to the soil to raise the surface several inches above the surroundings. Always the watchword is organic matter and more organic matter.

It is impossible to state how much fertilizer or lime should be added to the soil before planting. That depends entirely upon the existing state of fertility, and it is necessary to have a soil test made to obtain the true picture. Most State Experiment Stations or County Extension Services will make such tests and

distribute information on how to collect a proper sample for analysis. The report they issue on the analysis will state how much of a particular fertilizer will be needed for so many square feet, how much lime will be required to compensate for over-acidity (most perennials prefer soil conditions ranging from slightly on the acid side to near neutral), and how much organic matter will be needed. Fertilizer and lime are easily purchased in any garden store. If the garden is being prepared in the autumn, to be planted the following spring, it is best to withhold fertilizer until spring and rototill again.

Initial preparation of a new site is usually best in the autumn. The soil is easier to work then; grass can be rototilled in to decompose over the winter, and the soil has a chance to settle. If the initial preparation is in the spring, the grass should be removed, including all roots, and placed on the compost pile. After rototilling the soil will be too loose for immediate planting. It should be tamped down by slightly treading with the feet, up and down in rows until the entire area is covered. A distinction should be made here between "treading" and "stomping" as it is easy to compact the soil too much, especially if it is wet. After the treading process is completed, and a firm planting bed has been established, the soil should be raked level, and the planting process may begin.

After the garden has been planted it should be mulched to a depth of 2 to 4 inches with the same material that was dug in to provide organic matter. This mulch should be renewed annually. In the long run a mulch should break down and add organic matter and nutrients to the soil; in the short run, it reduces the temperature of the soil in the summer, delays freezing in the fall and warming in the spring (thus helping to avoid frost damage), and acts as a reservoir for soil moisture. It also slows evaporation of water from the soil surface, and inhibits the germination of weed seeds in the soil. Proprietary mulching materials such as ground bark may be used, but they have little to commend them over less expensive materials. Peatmoss has disadvantages since it dries to form a surface that is difficult to wet; on the other hand, once thoroughly wet it may cause soggy soil conditions.

Some Suggested Staking Methods

The tendency to flop, or the inability of a plant to bear the heavy weight of its own flowers has been listed throughout this handbook as a "fault" possessed by a number of perennials. Some that have this unfortunate tendency possess too many other good characteristics to be excluded from the low maintenance garden.

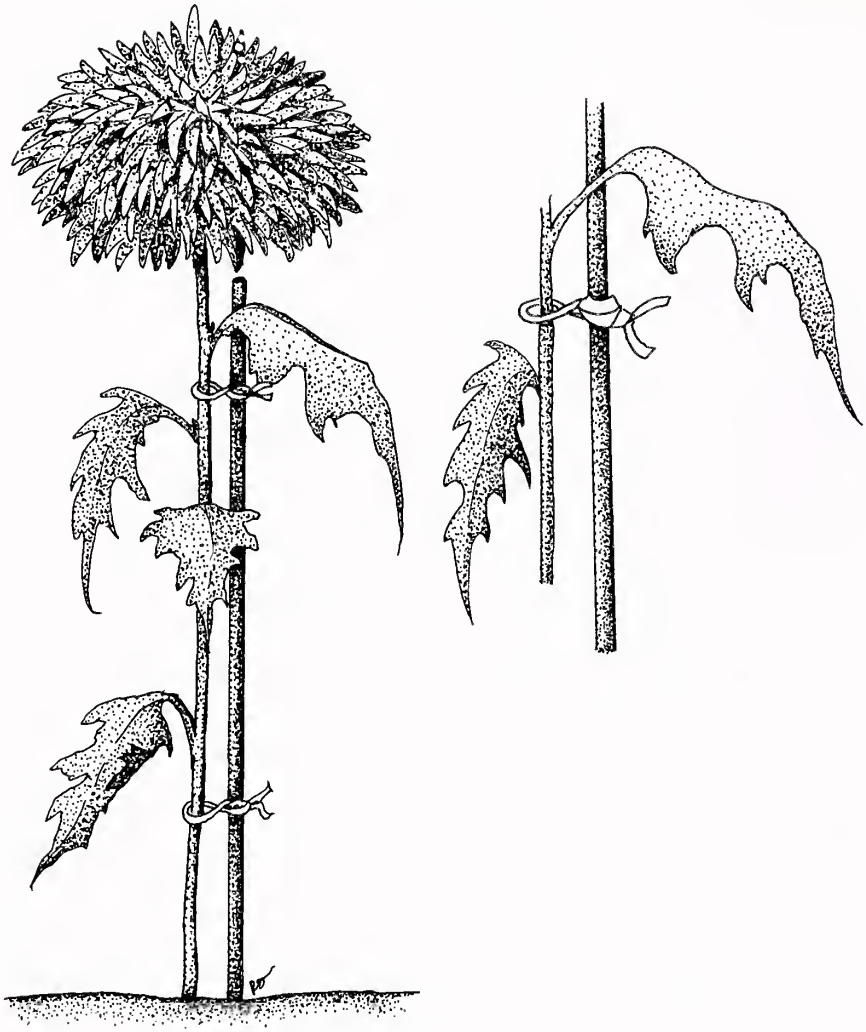
All methods illustrated here are simple, effective, and require very little time of the hurried gardener. It should be emphasized, however, that all staking should be done as early in the growing season as possible, or as soon as the taller growing plants have attained half their height.

Staking a full grown plant requires much more time, and results frequently are unattractive. If it is allowed to flop, or to be toppled by wind and rain, stems often can become twisted or sometimes broken. After a few days the twists tend to become permanent, and staking at such a late date is of very little benefit.

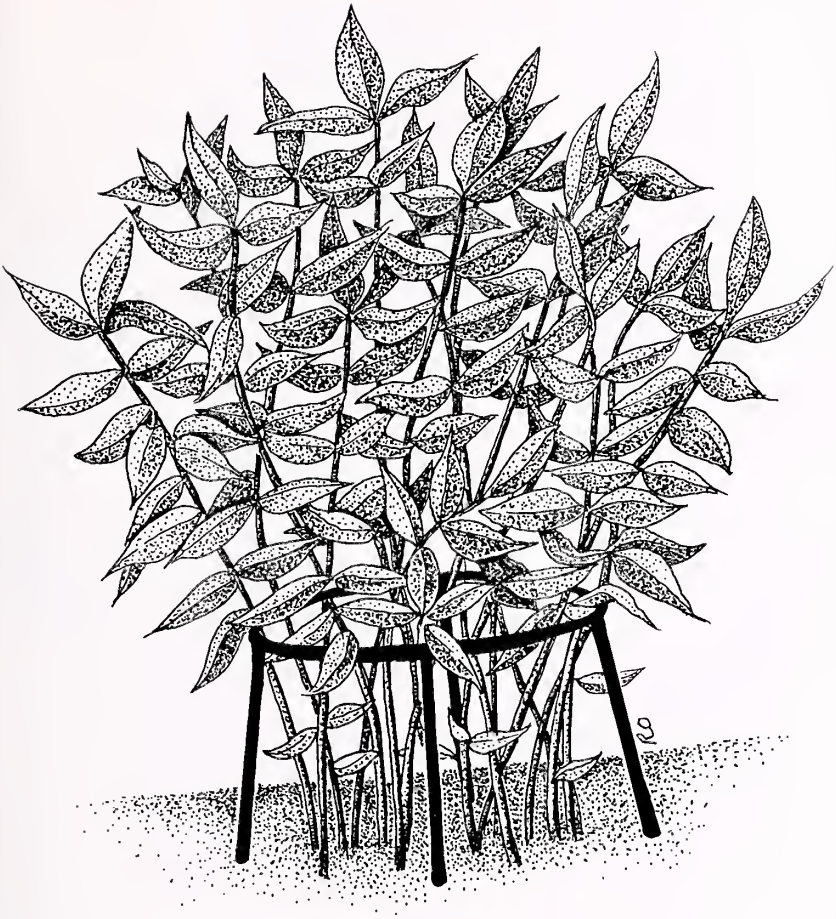
Below: A clump of Thermopsis *has collapsed at the end of the summer. Proper staking earlier in the growing season would have prevented this problem.*

Many plants that produce multiple stems may be staked with small twiggy branches set in the ground just as, or even before, plants commence growth in the spring. This is an old European method, particularly favored with Asters. Seldom used in this country, it is most effective.

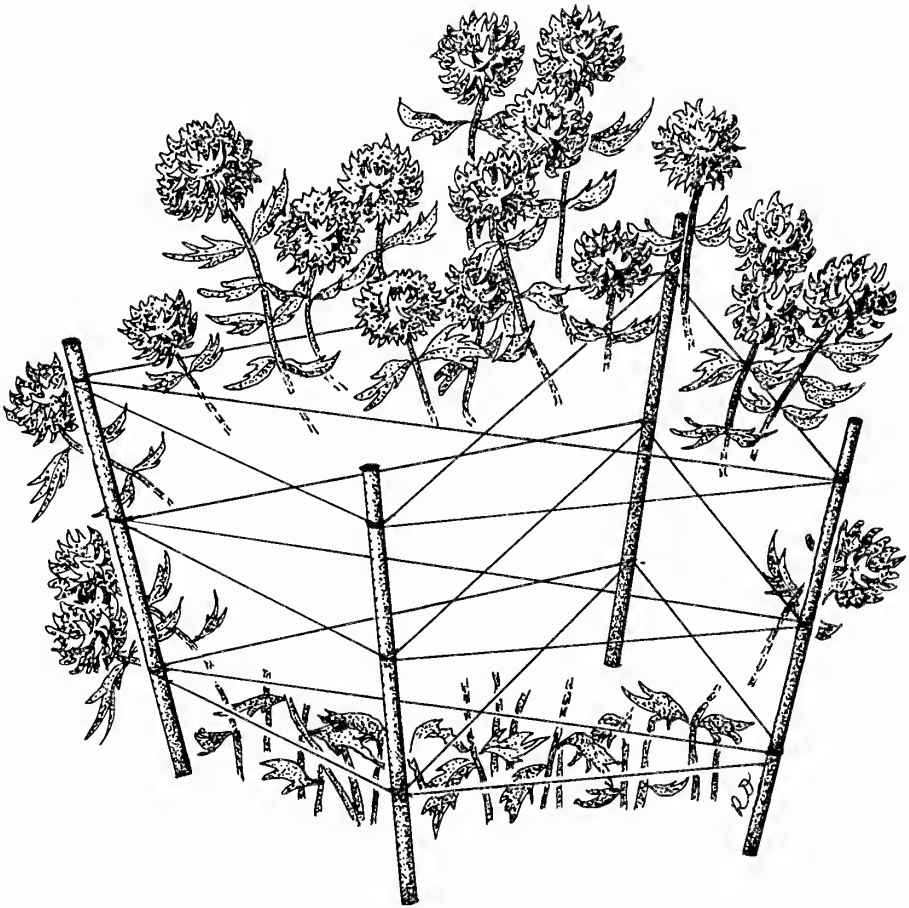
As the plant grows, it is completely supported by the twigs, but the twigs are entirely hidden.



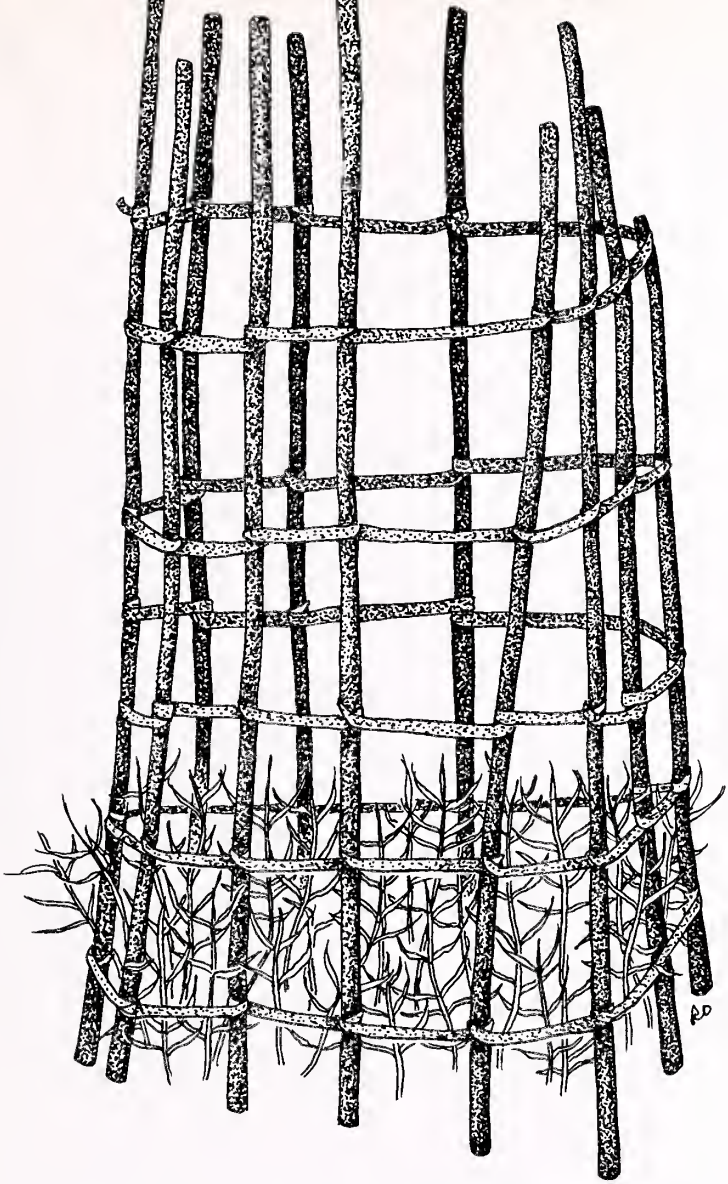
The stems of some taller perennials with large, heavy flowers must be staked individually. Green bamboo canes are best with such plants as *Delphinium* and the larger flowered Chrysanthemums; Raffia, cloth or plastic ties are preferred to metal or wire ties which may constrict or damage stems. A twist in the tie should be made between the stem of the plant and the stake to further avoid damage to the stem.



Shorter plants such as Peonies with large, heavy flowers can be supported with a round hoop attached to three or four legs. Such hoops are easily constructed from heavy gauge wire or even old coat hangers. The legs may be either of wire or bamboo cane.

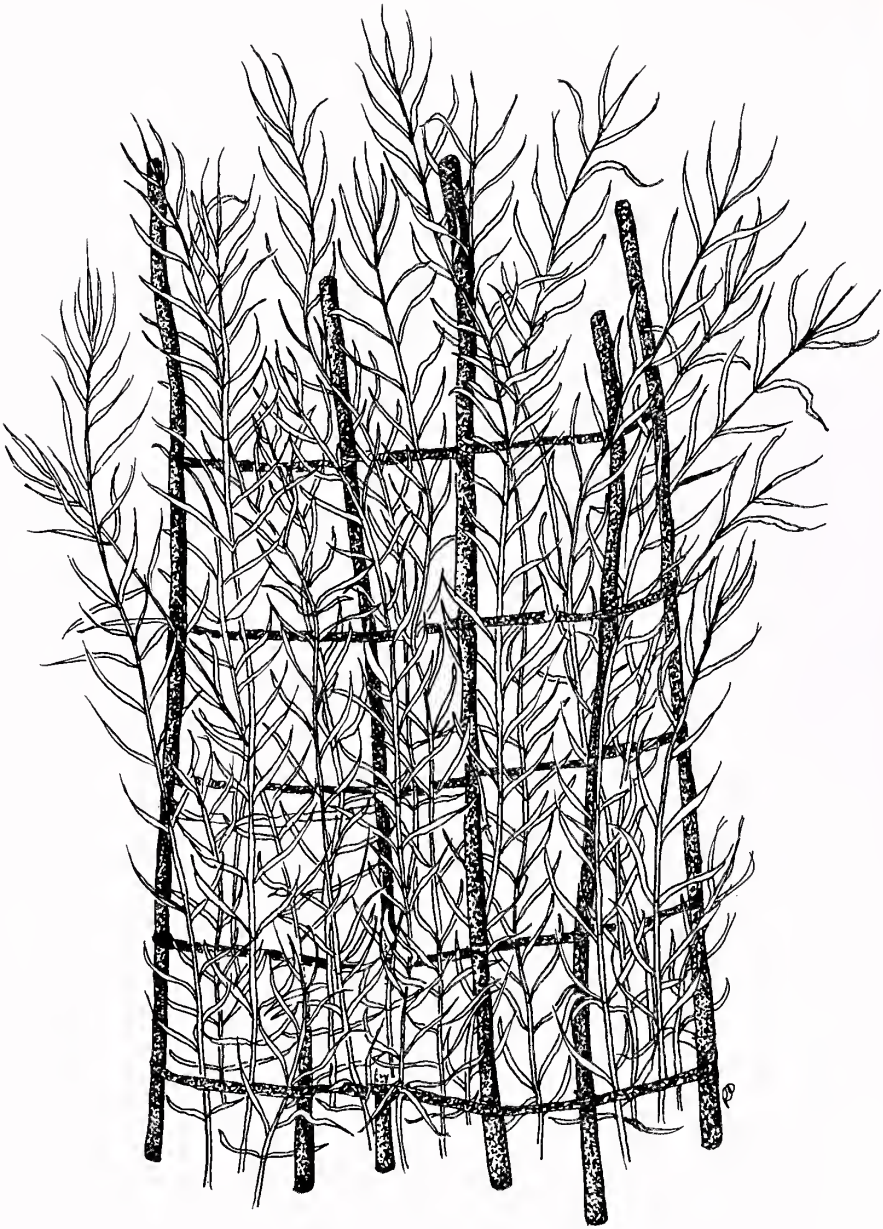


Many taller perennials form dense clumps with many stems. With such plants the most satisfactory method of support is often to construct a "cage" with bamboo canes and string as shown in the diagram. If this is done relatively early in the growing season, the structure will be almost completely hidden by the subsequent growth of the plant.

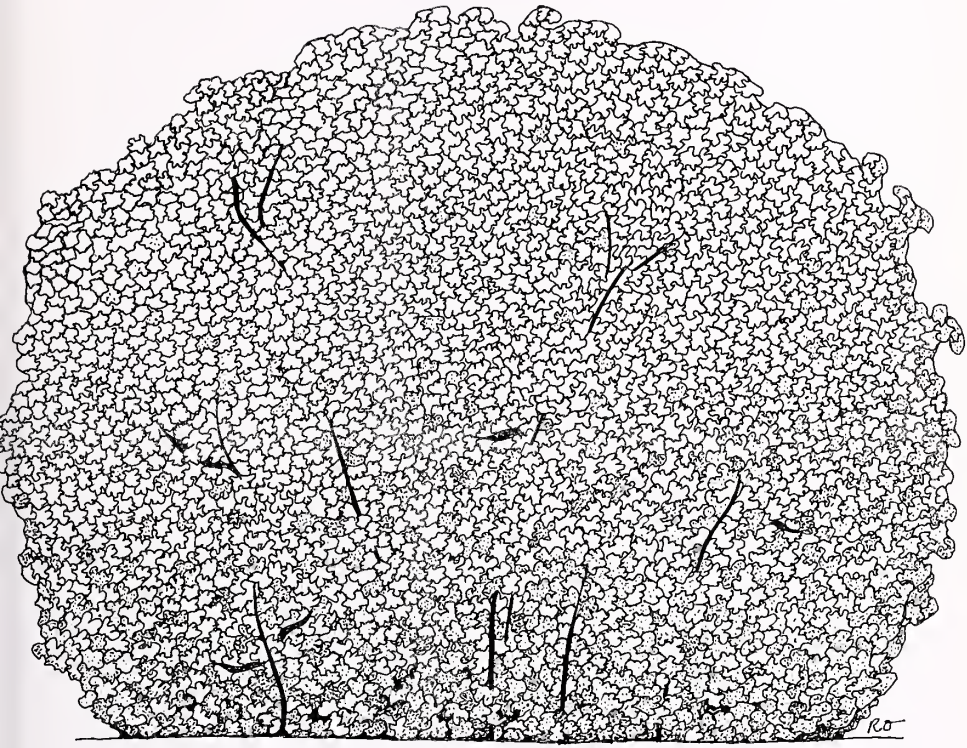


Baby's Breath is one of the most difficult plants to stake effectively. The method we offer is pictured in the White Flower Farm catalog and adapted here.

Just as growth starts, 10 to 12 bamboo canes about 2 feet high are placed all around the clump. Twist-Ems are then used to make rings around the canes.



As growth progresses, stems grow through, and are supported by the structure.



By the time the plant flowers, the supporting structure is completely hidden and the plant will withstand high winds or rain without injury.

Division

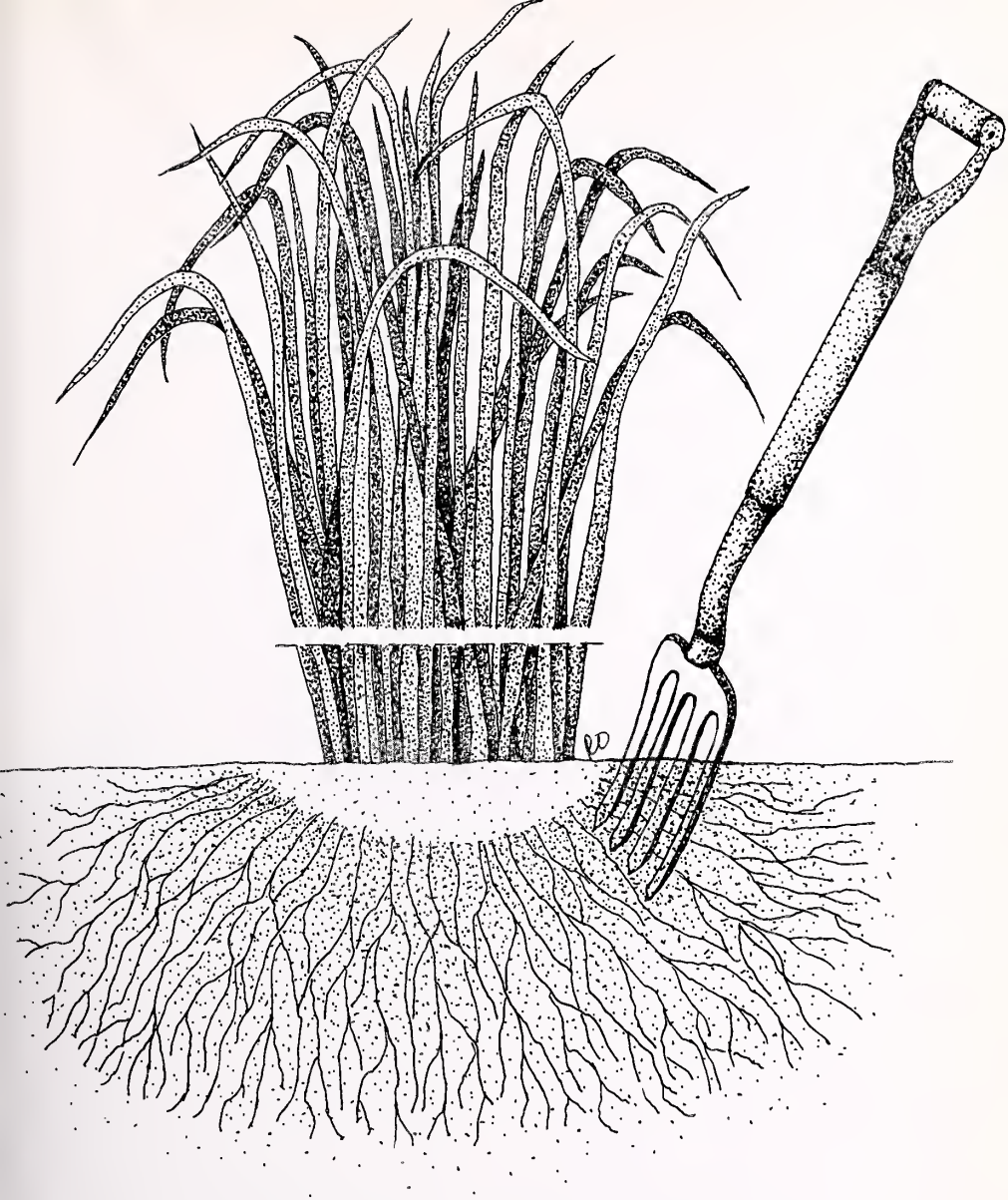
Sooner or later most perennials will need to be divided — either to prevent excessive spreading, or to reinvigorate the plant (or both). Division is also one of the simplest means of propagating many perennials on a modest scale.

Spring or fall division is satisfactory with most types. However, plants divided in the early spring just as new growth is about to start have the advantage of an entire season for new roots to grow and plants to become established before winter.

The best indications that a plant should be divided include: 1) vigor shows a general decline; 2) clumps become very tangled in growth — or become invaded by other plants and weeds; 3) clumps open up and form a dead space in the center.

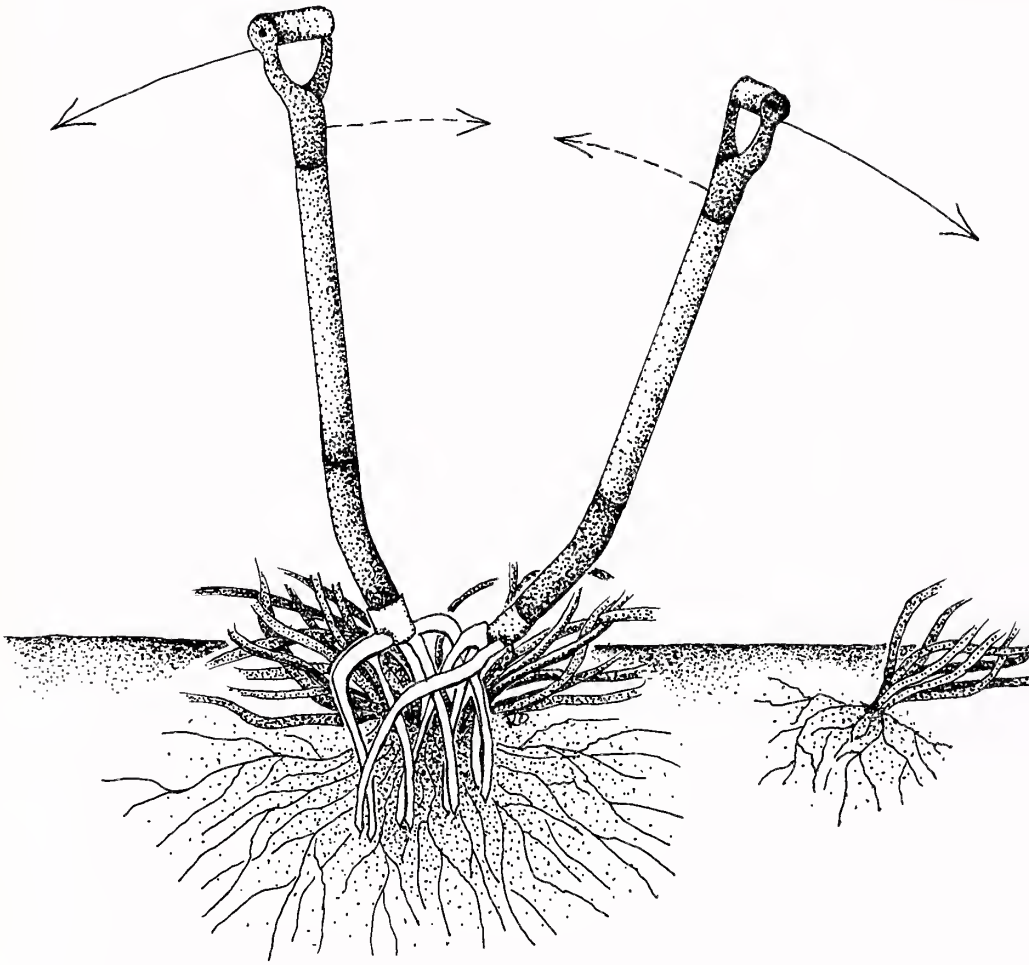
The best divisions are usually obtained from the outermost portions of old clumps — i.e. growth furthest away from the center. This is the most active growing and vigorous part of the plant.

Small plants may be lifted with a fork or small spade; they also may be pulled apart by hand or cut with a knife. Three to five "eyes" constitute the best sized division. Anything smaller may not flower during the current season.

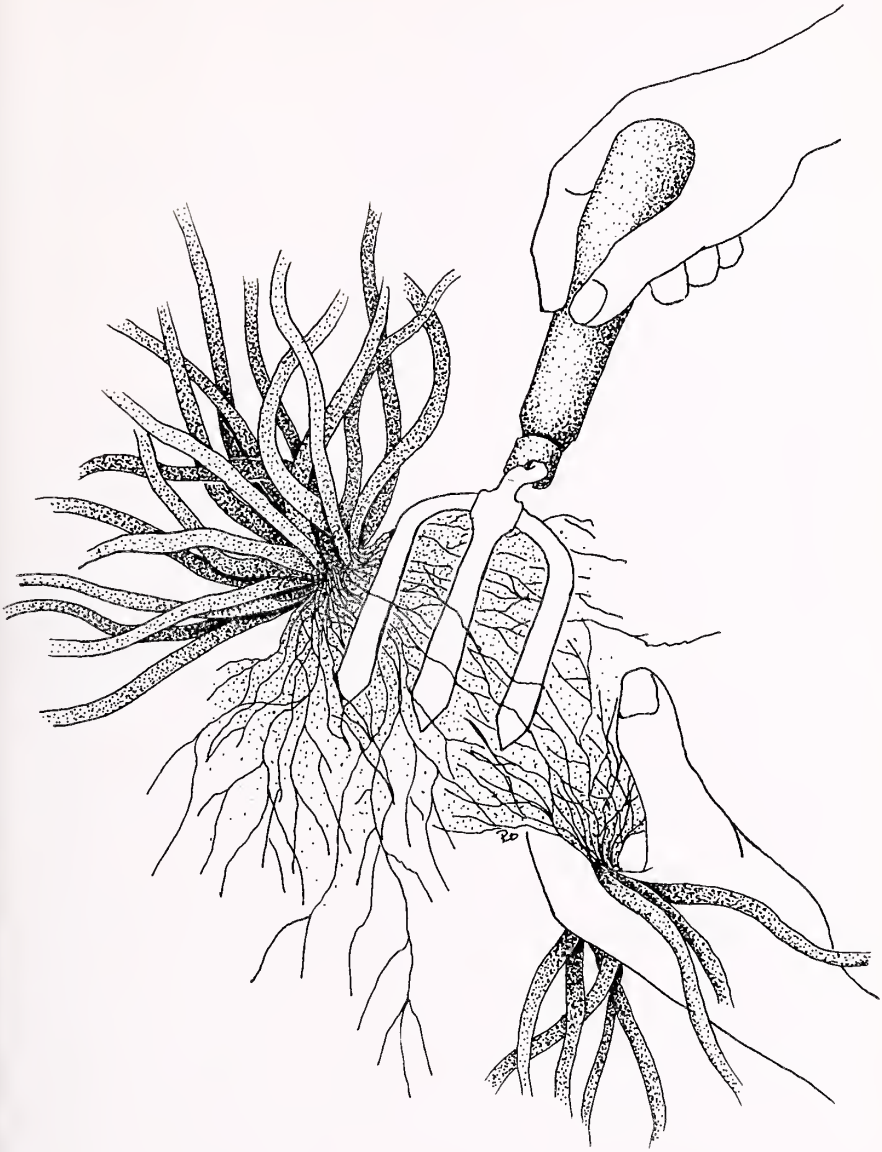


Large vigorous clumps are best lifted with a spading fork. First the top growth is cut down to about 3 inches. The fork is then inserted at several points around the outside of the clump, and gentle upward pressure exerted at each point. If this is done gradually and gently, the clump can be lifted with a minimum of root breakage.

Left: A clump of Anthemis *has died at the center and should be divided.*



To divide large tightly growing clumps after they have been lifted, plunge one fork down through the center of the clump. Then insert a second fork parallel to the first. As indicated, pull the two forks first inward, then outward, and the clump will break in two with minimal crown and root damage. It is important that the initial placement of the forks be as shown.



Once a large clump has been broken up by the spading forks, smaller divisions may be obtained using a hand fork or a knife.

Tabular List of Plants Mentioned

[(x) *indicates the characteristic may be highly variable*]

	Dry Soil Conditions	Moist Soil Conditions	Intolerant of Wet Soil in Winter	Short-lived	Invasive	Hardiness Problems (Summer Heat)	Hardiness Problems (Winter Cold)	Serious Insect or Disease Problems	For Full Sun	Partial Shade	Require Frequent Division
Achillea	x		x		(x)				x		(Every year)
Aconitum		x							x	x	
Adenophora	x	x	x				(x)		x		
Alchemilla	x	x							x	x	
Althaea		x		x	(x)			x	x		
Alyssum	x		x	(x)					x		
Amsonia	x	x							x	x	
Anaphalis	x		x						x		
Anchusa		x		x	x				x		Every other year
Anemone × *hybrida*		x	x				x			x	
Antennaria	x								x		
Anthemis	x			x					x		Every other year
Aquilegia		x	x	x	(x)			x	x		
Arabis	x		x						x		
Arenaria		x		x	(x)	x			x	(x)	
Armeria	x		x	(x)					x		
Artemisia	x		x		x				x		Every year

Aruncus		x						x	x	
Asclepias tuberosa	x		x					x		
Aster		x			x		(x)	x		Every other year
Astilbe		x	x					x	x	
Baptisia	x	x						x	x	
Belamcanda	x	x			(x)	(x)		x	x	
Bergenia	x	x				(x)		x	x	
Boltonia	x	x						x		Every other year
Brunnera		x							x	
Campanula	x	x	x		(x)			x	x	
Cassia marylandica		x	x					x		
Catananche		x		x	(x)	(x)		x		Alternate years
Centaurea	x	x	x		(x)			x		
Cerastium	x				x			x		Every year
Ceratostigma	x	x	x			x		x	x	
Chelone		x						x	x	
Chrysanthemum morifolium		x	(x)	(x)	(x)	(x)	(x)	x		Every year
C. coccineum		x	x			(x)		x		
C. maximum		x	x			(x)	(x)	x		Alternate years
Cimicifuga		x						x	x	
Clematis		x	x					x	x	

[(x) *indicates the characteristic may be highly variable*]

	Dry Soil Conditions	Moist Soil Conditions	Intolerant of Wet Soil in Winter	Short-lived	Invasive	Hardiness Problems (Summer Heat)	Hardiness Problems (Winter Cold)	Serious Insect or Disease Problems	For Full Sun	Partial Shade	Require Frequent Division
Convallaria	x	x			x				x	x	
Coreopsis	x		(x)	(x)			(x)		x		
Delphinium		x	x	x			x	x	x		Every third year
Dianthus	x		x	(x)		(x)			x		
Dicentra		x			(x)				(x)	x	
Dictamnus	(x)	x							x		
Digitalis		x		x					x	x	
Doronicum		x							x	x	
Echinacea	x		x					(x)	x		
Echinops	x	x			x				x		
Epimedium		x								x	
Erigeron	x			x					x		
Eryngium	x		x				(x)		x		
Eupatorium		x			x				x	(x)	Alternate years
Euphorbia	x		x		(x)				x		
Filipendula	(x)	x							x	x	
Gaillardia	x		x	x			x		x		
Geranium		x			(x)				x	(x)	
Geum		x	x	(x)			(x)		x		
Gypsophila		x	x				(x)		x		
Helenium		x							x		

Heliopsis		x						x		
Helleborus		x	x						x	
Hemerocallis	x	x						x	x	
Heuchera		x	x					x	x	
Hibiscus		x					(x)	x		
Hosta		x							x	
Iberis		x	x	(x)		(x)		x		
Iris siberica		x						x	x	
I. Japanese		x						x	(x)	
I. Bearded		x	x				x	x		Every third year
Kniphofia	x		x			x		x		
Liatris	x	x	x					x		
Ligularia		x						(x)	x	
Limonium	x							x		
Linum	x		x			(x)		x		
Lobelia		x		x				x	x	
Lupinus	x	x	x	x				x		
Lychnis	x		x	(x)				x		
Lysimachia	(x)	x			(x)			x	x	
Lythrum		x						x		
Macleaya	x	x			x			x	x	
Mertensia		x						x	x	
Monarda	x	x			x			x		(Every third year)
Nepeta	x	x		(x)	(x)			x		
Oenothera	x	x	x	(x)		(x)		x	x	Alternate years

[(*x*) *indicates the characteristic may be highly variable*]

	Dry Soil Conditions	Moist Soil Conditions	Intolerant of Wet Soil in Winter	Short-lived	Invasive	Hardiness Problems (Summer Heat)	Hardiness Problems (Winter Cold)	Serious Insect or Disease Problems	For Full Sun	Partial Shade	Require Frequent Division
Paeonia		x	x						x	(x)	
Papaver	x	x	x						x		
Phlox		x		(x)			(x)	x	x		Every third year
Physostegia	x	x			x				x		Alternate years
Platycodon	x	x	x						x		
Polemonium		x							x	x	
Polygonatum		x								x	
Primula		x	x	(x)		(x)		(x)		x	(Every third year)
Pulmonaria		x							x	x	
Rudbeckia	x	x	x		(x)				x		(Every third year)
Salvia	x	x	x	(x)			(x)		x		
Scabiosa		x	x						x		
Sedum	x		x				(x)		x		
Sidalcea		x	x						x		
Solidago	x	x							x		
Stachys	x	x	x						x	x	
Stokesia		x	x						x		
Thalictrum		x							x	x	

Thermopsis	x	x				x	x
Tradescantia	x	x		(x)		x	x
Trollius		x				x	x
Verbascum	x	x	x	(x)		x	
Veronica		x	x			x	
Carex		x				x	
Elymus	x	x				x	
Erianthus	x	x				x	
Miscanthus	x	x				x	
Molinea	x	x				x	
Panicum	x	x				x	
Uniola		x		(x)		x	
Arrhenatherum	x	x				x	
Phalaris		x		x		x	x
Spartina		x		(x)		x	
Arundo		x		(x)	x	x	
Cortaderia		x			x	x	
Festuca	x	x				x	x

Acknowledgements

The author is grateful to colleagues and members of the Friends of the Arnold Arboretum for their assistance in the preparation of this guide. Dr. Gordon P. DeWolf, Jr., is responsible for the comprehensive tabular list of low maintenance perennials, and for portions of the chapter on culture. Mrs. Robert S. Blacklow spent many tedious hours carefully codifying the sources; Mrs. Frank Magullion put the primroses in their place, and offered constructive criticism of other portions of the manuscript, as did Drs. DeWolf and Richard E. Weaver, Jr. Mrs. Irving Fraim's lovely garden in Waltham was the setting for many of the photographs; other illustrations reflect the fine workmanship of artist Robert Opdyke.

To others, too numerous to mention, gratitude is due for their interest, encouragement, and knowledge freely shared. Without these contributions, large and small, Low Maintenance Perennials could not have become a reality.

ROBERT S. HEBB
Horticulturist, Cary Arboretum of the New York Botanical Garden
(formerly Assistant Horticulturist, Arnold Arboretum)

Erratum, page 107 — First two sentences under *Heuchera* should read:

These are excellent plants with few troubles, and capable of being left in place at least five years or longer before division will become necessary. They flower best in full sun, but also will perform well in light shade.

Index to Common Names

(*Page numbers refer to those in brackets*)

An attractive grouping of low maintenance perennials.

Page 1

U. S. POSTAL SERVICE

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

(Act of August 12, 1970: Section 3685, Title 39, United States Code)

SEE INSTRUCTIONS ON PAGE 2 (REVERSE)

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Cover: Toxicodendron rectum *from* Hortus Elthamensis . . . , *Vol. 2, by J. J. Dillenius. Lugduni Batavorum. C. Haak. 1774.*

Poison-ivy and Its Kin

Nearly everyone has an acquaintance with poison-ivy, chiefly from the rash that it causes rather than from its nature as a plant. Most of what I shall write here, however, concerns this very interesting plant and its distribution in the world. Hopefully I can dispel myths — old wives' tales — that persist in our folklore despite scientific findings to disprove them.

Benign Relatives

Poison-ivy is a member of the sumac family (Anacardiaceae) to which a number of other familiar plants belong. One of them is the common staghorn sumac (*Rhus typhina*) (See Fig. 1). Actually this plant has several relatives in the United States, all with the upright cone of red fruits in the late summer and fall, which differ very little from one another and which, in fact, occasionally hybridize. These are the smooth sumac (*Rhus glabra*) and the dwarf sumac (*Rhus copallina*), which has a winged petiole or rachis. Some other related species are found in local areas of the Southeastern United States.

Another member of the benign sumacs is the aromatic sumac (*Rhus aromatica*) (See Fig. 2). It is found in diverse places — generally in regions of well-drained sands with pine forest cover in the eastern half of this country. A cognate species, *Rhus trilobata*, exists in the western part of the United States. Perhaps it might be assumed that there is one species complex with distinguishable forms at geographical extremities of east and west. This matter needs to be examined much more carefully.

Additional relatives of the sumacs are found in North America. *Cotinus coggygria*, the smoke-tree, a native of Mediterranean Europe east into Central Asia as far as China, is cultivated in temperate North America. There also is an endemic smoke-tree (*C. obovata*) that is restricted to limestone and dolomite cliffs in the southern Appalachians, extending into eastern Texas. It has larger leaves and inflorescences than its Eurasian counterpart. The pepper-trees, *Schinus* spp. are native in Latin American countries. One, *Schinus molle*, has become weedy

Fig. 1 — Staghorn sumac (Rhus typhina) *in flower.*

throughout Latin America way up into Texas and southern California. It is a tree with finely divided pinnae and long clusters of red drupes on the carpellate, or female, plants. Like most members of the Anacardiaceae, the plants are dioecious (i.e. either male or female). Another common member of this group, *S. terebinthifolius*, has become weedy in the southern part of Florida and is so well established there that it is called Florida holly. The name Brazilian pepper-tree is probably more appropriate, however, since it is no relation to the true holly (*Ilex*).

Poisonous Relatives

The familiar cashew nut (*Anacardium occidentale*), planted and escaped throughout the world Tropics, is originally native to India. The "nut" itself is the ripened ovary, but below this is an expanded pedicel and receptacle that become very much enlarged, fleshy and tasty at fruiting stage (See Fig. 3). It is called the "cashew-apple," and may be eaten raw or made into jam. Because the cashew-nut has poisons in the shell that are closely allied chemically to those in poison-ivy, it is worth mentioning as a poisonous relative of poison-ivy. Cashew nutshell liquid despite its poisonous properties has been important in making heavy-duty brake linings and electrical insulations. During the Second World War, American servicemen overhauling planes in the Canary Islands (where there is no similar dermatitis-producing plant) repeatedly broke out with a rash that looked similar to poison-ivy dermatitis. It was finally traced to the fact that they were working with the brakes and electrical parts of the planes that had been coated with cashew nutshell liquid hardened to a lacquer-like finish.

A decade ago, a number of cocktail stirrers (See Fig. 4) came into the United States from Haiti. They were light in weight, took up little space in one's luggage, and looked "exotic." They were, hence, very popular as souvenirs among air travelers who needed to keep their baggage weight to a minimum. The trouble was that the "head" of this little stirrer (in the shape of a voodoo doll) was an unroasted cashew nut, complete with poisons intact! Moreover, the "eyes" were seeds of *Abrus precatorius*, the rosary-pea, containing one of the most dangerous poisons of the tropics. (Two chewed and swallowed seeds can kill an adult.) They have been banned from further entry into this country.

. 2 — *Aromatic sumac* (Rhus aromatica) *in flower.*

Fig. 3 — Tiny flowers and large fruits of cashew (Anacardium occidentale) *in the West Indies. Note the "cashew-apple," the enlarged and swollen receptacle.*

Fig. 4 — A cocktail stirrer or "voodoo doll" souvenir from Haiti made from unroasted cashew nut head. Eyes are of rosary-pea (Abrus precatorius).

Fig. 5 — Fruiting specimen of dhobi-nut. This one is Semecarpus gigantifolia, *endemic to Taiwan and the Philippines.*

In the Far East the fruits of the tree *Semecarpus* (chiefly *S. anacardium*) are used to make indelible laundry marks in clothing. The fruits have a poison similar to that in poison-ivy that will harden to a black, indelible, and unwashable substance. The fruits have been called dhobi-nuts (See Fig. 5) after the Indian name for the laundrymen, the dhobis. American servicemen stationed in India during the war often broke out with poison-ivy dermatitis on the neck or waistband — i.e. those places where the dhobis had placed a laundry mark in their underwear.

Fig. 6 — Poison-sumac in a typical swamp habitat.

The poison-wood, *Metopium toxiferum*, a tall shrub or small tree, grows in the Bahamas, Greater Antilles, and in Florida as far north as Daytona Beach. It produces a rash no different from that caused by poison-ivy.

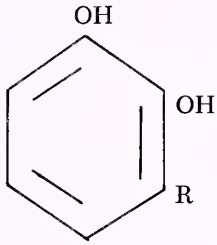
The most common member of the family in the Tropics is the mango (*Mangifera indica*). Even the mango has poisons in it, but they appear to be restricted to the exocarp ("skin" of the fruit) and pedicel. It is therefore advisable always to peel a mango before eating it. One will note that persons who live in regions of the world where the mango is common do so.

Poison-ivy's best known relative in this area is poison-sumac (*Toxicodendron vernix*), which grows only in swamps and other wet places in the eastern third of the United States (See Fig. 6). This is a shrub with a few stout, ascending stems, pale grey bark, compound leaves with smooth shining leaflets, and pendent clusters of greenish flowers followed by whitish fruits (See Fig. 7).

In Asia one of the close relatives of our poison-sumac is the lacquer tree of China and Japan (*Toxicodendron vernicifluum*), from which the beautiful oriental lacquer ware is made. This

lacquer actually is layer after layer of the sap with its natural poisons in oxidized and polymerized form. Those who work with the lacquer endure a painful apprenticeship until they become insensitive to these poisons.

The poisons in poison-ivy have been determined chemically by Dawson (1954, 1956) as being catechols with long side chains:



R may equal: $(CH_2)_{14}CH_3$,

$(CH_2)_7CH=CH(CH_2)_5CH_3$,

$(CH_2)_7CH=CHCH_2\ CH=CH(CH_2)_2CH_3$,

or $(CH_2)_7CH=CHCH_2\ CH=CHCH_2\ CH=CH_2$

The lacquer tree has the first 3 compounds plus the one with the following radical:

$R = (CH_2)_7CH=CHCH_2\ CH=CHCH=CHCH_3$

Morphology

Poison-ivy can grow to a rather large size, although the stems commonly do not exceed an inch or so in diameter. There are some records of poison-ivy vines that have achieved 5 or 6 inches in diameter (See Fig. 8), and there is at least one tree of it on record from Sanibel Island, Florida that stands 15 to 20 feet high (Cooley, 1955). The wood is not poisonous because the poison is carried in special ducts in the phloem, not the xylem.

When the leaves are missing from the shrubs and vines during the fall and winter, poison-ivy may be seen with its stems climbing a number of trees, especially elms. The aerial stems nestle in the corrugations of the bark (See Fig. 9), while the aerial roots hold the vines fast to the tree. In the autumn and

g. 7 — Fruits of poison-sumac (Toxicodendron vernix) *in winter.*

winter the buff or pale yellow fruits that remain on the carpellate plants are harvested by a variety of birds; certain species of flicker make up nearly a third of their diet from poison-ivy fruits. Because these fruits are eaten by birds the plant is common around trees, fence-rows, under telephone wires, and wherever birds are likely to perch. Incidentally, I refer to the disseminules as fruits rather than seeds because the fruits of *Rhus* and *Toxicodendron* species are drupes with the seed wall firmly attached to the endocarp of the fruit wall. What is disseminated is the entire fruit, with the possible removal of the papery exocarp.

Occasionally poison-ivy and poison-sumac are used in decorative indoor arrangements because of their autumn coloration. Poison-sumac, with its bronze-red or cherry-red leaves in autumn, is one of the most attractive of our shrubs at that season. Poison-ivy has fall colors ranging from yellow through orange to dark red. The flowers which are produced in June and July often are overlooked because people do not wish to approach the plant closely enough to see them. They are rather tiny, rarely exceeding 3 mm. in diameter, with the staminate more obvious than the carpellate because of the exserted stamens with yellow anthers. The flowers are greenish-cream in color and blend into the background of leaves (See Fig. 10).

Distribution

The total world distribution of the genus *Toxicodendron* includes Eastern Asia and North America south to Colombia in South America. One will note that it is found in North America and Eastern Asia, a classical distribution pattern first noted for a number of plant species by Asa Gray over a hundred years ago (Gray 1846, 1889). A somewhat reduced range is occupied by the Section *Toxicodendron*, in which poison-ivy and its immediate relatives, the poison-oaks, belong (See Fig. 11).

Poison-ivy is found only in North America and Eastern Asia. It presumably originated in North America about 80 million years ago and migrated across the Bering Straits when there was a land connection between North America and Asia, and when the climate was much milder. In the intervening time, with the formation of the Bering Sea and Straits and the subsequent cooling of the Arctic, plants that were left in North America went their own way evolutionarily from those in Eastern Asia (MacGinitie, 1937). There are similarities in the morphology of both forms of poison-ivy (Asiatic and North American) to suggest their common ancestry. Chief among these are hairs on

Fig. 8 — Section of poison-ivy wood nearly six inches in diameter.

Fig. 9 — Poison-ivy vines nestled in corrugations of elm bark.

Fig. 10 — Close-up of staminate poison-ivy flowers. The flowers are about 3 mm in diameter.

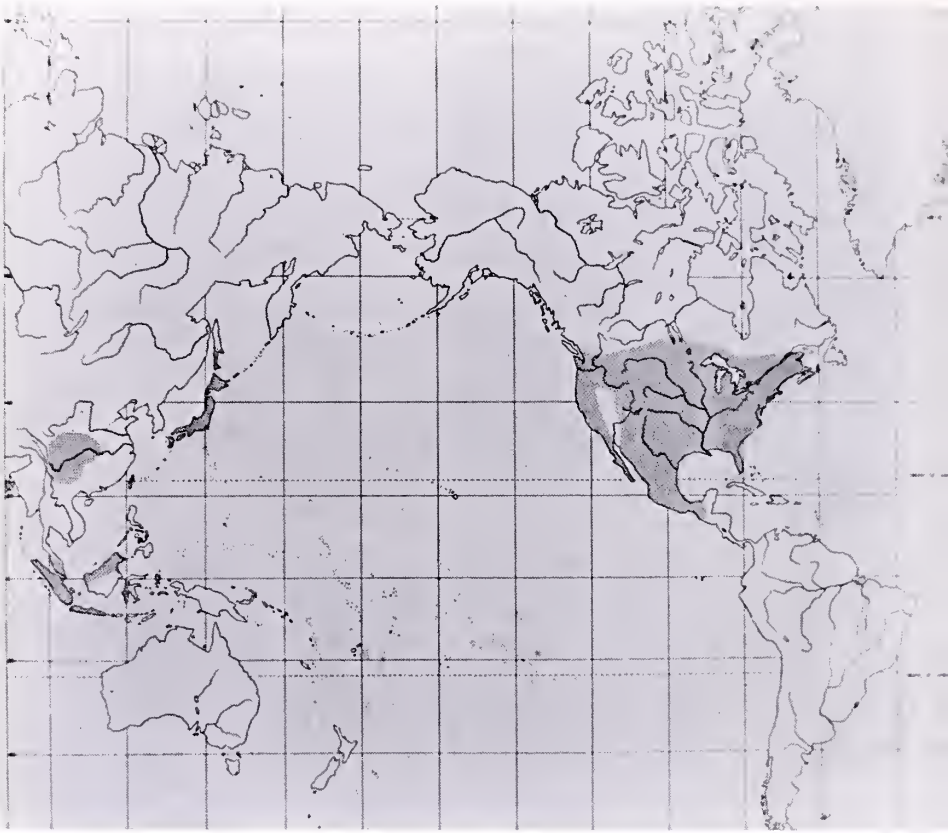


Fig. 11 — Poison-ivy distribution. Shaded areas show native range of all poison-ivies and poison-oaks.

the fruits which are common in plants along the Atlantic Coast (*T. radicans* subsp. *radicans*) and the two taxa in Asia (*T. radicans* subsp. *orientale* of Japan and *T. radicans* subsp. *hispidum* of China and Taiwan).

Although poison-ivy was unknown in Europe prior to the colonization of North America, references to it are known in Eastern Asia in writings of Chinese scholars back as far as the seventh century (Toyama, 1918). Capt. John Smith (1609) first described poison-ivy to Western Europe when he reported that it "causeth itchynge." Although the plant was known much earlier than the writings of Linnaeus, the specimen upon which the name is based is one which Peter Kalm collected about 1751 in the vicinity of Philadelphia.

Most of the diagnostic features of the poison-ivy taxa are found in the carpellate plant, especially in the fruit; therefore it has been difficult in the past to place the original name of poison-ivy among the several subspecies because the type specimen is a staminate plant in flower.

One form of poison-ivy (*T. radicans* subsp. *radicans*) is essentially an Atlantic coastal dweller that occurs from southern Nova Scotia south to the Florida Keys and the western Bahama Islands, and west to eastern Texas. Although there is some variation throughout its range, there is no clear-cut division between populations with specialized characters. I have had to recognize all of these populations as one continuous, although variable, subspecies. A character that unites all of this group along the Eastern Seaboard — and incidentally is shared with populations in Asia — is small tufts of hairs in the vein axils on the lower surface of the leaves. These may be either clear and hyaline or reddish-brown, with a predominance of hyaline ones in the New World and reddish-brown ones in the Old. This subspecies of poison-ivy is the one that can become most dense in its growth. It is perhaps nowhere more abundant than along the sandbars off the coast of New Jersey, Long Island, through the Carolinas, and along the rocky coast of New England. At Island Beach, New Jersey, for example, it forms a dense thicket and carpet that covers the rear dunes and swales — essentially 100 to 200 yards wide — for about ten miles down the undisturbed barrier beach.

In the lower Mississippi River basin there is a form of poison-ivy (*T. radicans* subsp. *pubens*) that is virtually confined to the cotton-growing area of rich soils in places such as the "Delta" region of Arkansas, Louisiana, and Mississippi. On the Edwards Plateau region of Texas and continuing north to the Arbuckle Mountains of Oklahoma another subspecies of poison-ivy is found with sharply pointed lobes on the leaflets (*T. radicans* subsp. *verrucosum*) (See Fig. 12). In recent years, with the activities of man disturbing the habitat, both of these have begun to migrate and come into contact with other subspecies of poison-ivy, with which they interbreed. Because a number of subspecies impinge upon sections of Arkansas and southern Missouri, it is most difficult to name the taxa in these areas due to the great extent of hybridization, introgression, and the blurring of subspecies lines.

Two subspecies of poison-ivy are encountered in Mexico. *T. radicans* subsp. *barkleyi* seems to follow the Sierra Madre Oriental, extending into western Guatemala to the ruins at Zacaleu;

T. radicans subsp. *divaricatum*, which is common in the Sierra Madre Occidental, extends northward into the southeastern corner of Arizona, and to the southern tip of Baja California. There are a few outliers of both of these forms in isolated regions of Mexico, presumably the result of long-distance dispersal, probably by birds. Where the subspecies overlap — chiefly in the trans-Mexico volcanic belt — occasional hybrids between these two subspecies appear.

The most unusual form of poison-ivy is *T. radicans* subsp. *eximium*. I say it is unusual because it has leaf forms quite divergent from all other poison-ivy populations, and because it is rarely collected (not between 1937 and 1964, for example). It is restricted to the tributary valleys of the Rio Grande in Texas and Mexico with one outlier in southern Sonora. The leaflets resemble the "club" on a deck of playing cards. The leaflets of shade leaves are very much smaller than those growing in open sunlight, a general principle with poison-ivy and one that is quite contrary to our usual ecological concept of sizes of sun- and shade-leaves of other plants. Figure 13 shows a single collection in which the shade-leaves are very different from those growing in the sun. These two leaf forms are from the same individual plant from Big Bend National Park, Texas.

In the center of the United States (the midwestern states generally north of the Ohio River), there is a subspecies of poison-ivy that has no distinctive characteristics of pubescence, leaf form, etc. The eastern boundary of this subspecies (*T. radicans* subsp. *negundo*) is the Allegheny ridge, especially clearly delimited in the vicinity of Tuscarora Mountain in Pennsylvania. On the east flank of the Alleghenies is subsp. *radicans* and on the west is subsp. *negundo* (See Fig. 14).

One of the closest relatives of the poison-ivy of our East Coast is found in Japan (*T. radicans* subsp. *orientale*) (See Fig. 15). It extends from the southernmost portions of the Kurile Islands and the lower half of Sakhalin Island (under Russian mandate) to the northernmost of the Ryukyus (Yakushima) and the Bonin Islands. The Japanese poison-ivy is not nearly so abundant in Japan as poison-ivy is in this country. I believe that this phenomenon is due to the fact that all poison-ivies are essentially plants of disturbed habitats, and respond to the activities of man. Most of the land that is under cultivation in Japan has been thus for a long time with little additional disturbance by the removal of forests and construction of cities, the making of new roads, etc.

Fig. 12 — Poison-ivy (Toxicodendron radicans *subsp.* verrucosum) *from the Edwards Plateau, Texas.*

Fig. 13 — Herbarium specimen of poison-ivy from Big Bend National Park, Texas (Toxicodendron radicans *subsp.* eximium). *Both sprigs are from the same individual. The upper one with large leaves is from a climbing cane in the sun; the lower one with small leaves is from a prostrate branch in shade.*

Fig. 14 — A barn leaning under the weight of a poison-ivy vine in Michigan (Toxicodendron radicans *subsp.* negundo).

Fig. 15 — Poison-ivy (Toxicodendron radicans *subsp.* orientale) *from the Boso Peninsula, southeast of Tokyo, Japan.*

Poison-ivy also occurs in China where it has bristly hairs on the fruits (*T. radicans* subsp. *hispidum*). It is found both in northern mountainous regions of Taiwan and also in the interior of Szechuan, Yunnan, and Hupeh provinces of mountainous western China, the area least visited by western explorers.

A peculiarity of the various subspecies of *T. radicans* is that they will climb trees if given the opportunity. If there is no fence or tree to climb, or if the original support is removed, the plant will continue to grow as a sturdy shrub, often up to 5 and 6 feet high. Also peculiar is the fact that the ranges of these subspecies stop as one reaches the 44th parallel of latitude on the north and approximately the 100th meridian of longitude on the west. North and west of these boundaries is a form of poison-ivy that normally does not climb trees. It has a number of other characteristics that set it apart from the viney poison-ivies. It never produces aerial roots; it will grow in different ecological settings from *T. radicans* (e.g., it will grow in vegetation containing abundant bracken fern, whereas *T. radicans* usually does not); its leaflets are on much longer stalks than are the leaflets of *T. radicans*; its leaves tend to be much broader and its fruits far larger. This form is recognized as a separate species, *T. rydbergii*, because it differs in so many characteristics from all the other forms of poison-ivy both in America and in Asia. It is the most widespread and the most uniform of all the poison-ivies. Although it occurs all the way from Central Arizona to the Gaspé peninsula and to the Rockies in southern Canada, it is impossible to distinguish any one geographical race from any other throughout this range (See Fig. 16).

The reference to the 44th parallel of latitude as being a boundary is intriguing for it can be detected along north-south rivers such as the Hudson and the Connecticut as well as it can be seen to be a dividing line between the southern portion of Nova Scotia and the northern part. This parallel of latitude marks an ecotone that has had significance in the past, being the dividing line between the agricultural Indians and the hunter-gatherer Indian in parts of Michigan, for instance (Cleland, 1966). This line also separates the region of presence and region of absence of mastodon skeletons. It presumably is an ecological boundary of some importance, on either side of which two forms of poison-ivy have evolved.

The Poison-oaks

Now to poison-oak. The term "poison-oak" means different

Fig. 16 — Herbarium specimen of Rydberg's poison-ivy (Toxicodendron rydbergii). *Note long petioles and orbicular leaflets that have a tendency to fold along the midrib.*

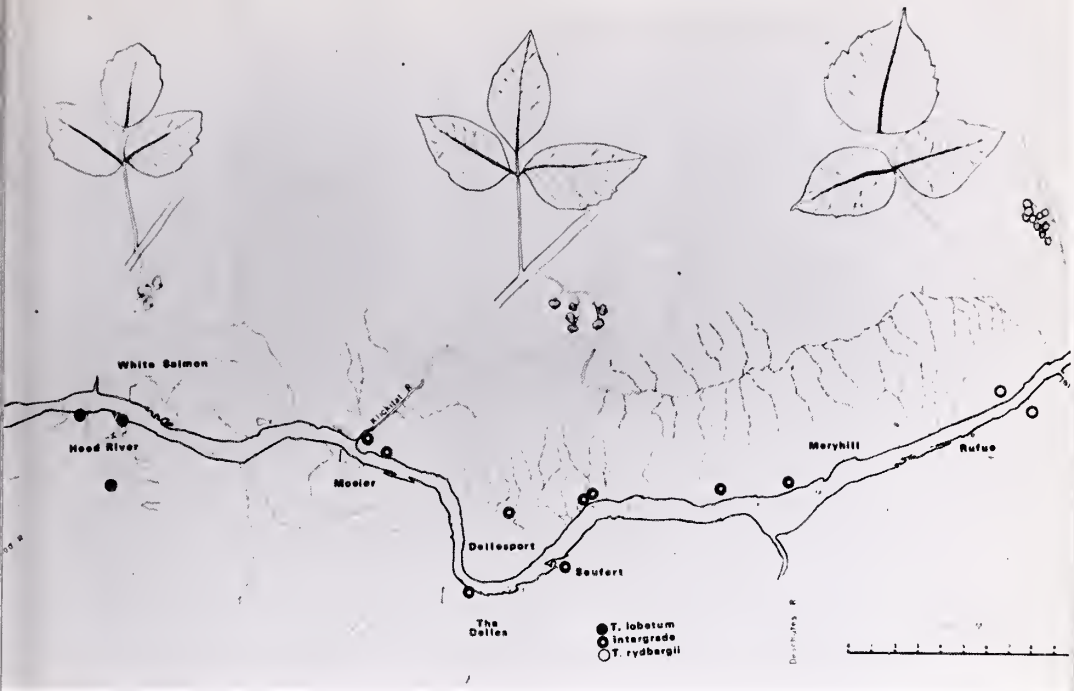


Fig. 17 — Distribution of western poison-oak (Toxicodendron diversilobum) *and poison-ivy* (T. rydbergii) *in the Columbia River gorge of Oregon and Washington, and location of intergrades between them.*

Fig. 18 — Eastern poison-oak (Toxicodendron toxicarium) *in an oak-pine forest, Bastrop County, Texas.*

Fig. 19 — Poison-ivy fruits (left) in dry arrangement.

things to different persons. It generally is applied to plants in the sumac family, and not to any true oak (*Quercus*). The term evolved because of the shape of the leaflets among some of the trifoliolate Toxicodendrons that appear to resemble leaves of true *Quercus* species. The leaflets of the western poison-oak resemble leaves of one or another of the western oaks such as *Quercus agrifolia*, and the leaflets of eastern poison-oak look like small leaves of *Quercus alba*.

There is a western poison-oak (*Toxicodendron diversilobum*) that is indigenous to the region from southern British Columbia to northern Baja California, wedged between the deserts and the Sierras and Cascades on the east and the Coast Ranges on the west. Neither poison-oak on the western flank of the mountains, nor poison-ivy (*T. rydbergii*) on the east crosses the Cascades (except for one population of poison-oak known from a low-elevation pass in northern California). On the other hand, they come into contact in the Columbia River gorge. Where western poison-oak and Rydberg's poison-ivy overlap in range in the Columbia gorge, they form intergrades (See Fig. 17). The western poison-oak is similar to *T. radicans* in that it may grow as a healthy vine or shrub, and that it is found in a multitude of habitats. In fact, it exhibits one of the broadest ecological amplitudes of all the species of plants in the west.

In the eastern United States, the second poison-oak (*Toxicodendron toxicarium*) occurs from southern New Jersey to Marion County, Florida, west to eastern Texas and Oklahoma. Eastern poison-oak, ecologically very different from western poison-oak, is seldom found outside of scrub-oak forests on the coastal plain, commonly where there are ericaceous shrubs, some pine, and bunch- and wire-grasses (*Andropogon* and *Aristida*) (See Fig. 18). In eastern Oklahoma, outside the range of pine, all the typical associates are present with *T. toxicarium*, minus the pine. The sands of poison-oak habitats are usually excessively drained and coarse, low in nutrients, especially calcium. This species never climbs and is always a sub-shrub, like *T. rydbergii*.

There is some variation in the morphology of the poison-oaks. In the western poison-oak, it is chiefly expressed as a response to variation in site, and not geography. Poison-oak from southern California may be indistinguishable from that growing in northern Washington, but two forms growing within a mile of one another may differ considerably.

In eastern poison-oak this variation pattern seems to hold as

well, but there are greater differences in leaf morphology between staminate and carpellate plants than there are in reference to site, geography, etc. As a standard pattern (occasionally reversed), the staminate plant will have considerably more deeply lobed leaflets than the carpellate. In fact, many female plants have leaflets with undulate or entire margins. The late Prof. Fernald described an elobate form of poison-oak from Virginia, never having noticed that all the plants were carpellate!

If the reader feels that he has always been confused by the true definition of poison-oak, he is not alone. On the sheet that was examined by Linnaeus and is the first known herbarium specimen of eastern poison-oak, there are two different species attached: eastern poison-oak and aromatic sumac! The name that Linnaeus applied was *Rhus toxicodendron.* For strict application of this name among those who believe that the toxic sumacs belong with the benign ones in the genus *Rhus*, the only plant to which this binomial can properly be applied is eastern poison-oak. Yet the literature is rife with the name *Rhus toxicodendron* applied to all forms of poison-ivy and to both species of poison-oak. The great French botanist Michaux (1803) ignored the name *Rhus radicans* and made all the toxic American sumacs varieties of *R. toxicodendron*; the Swiss botanist DeCandolle (1825) did just the converse. There must be something particularly euphonious about the binomial *Rhus toxicodendron* that has made so many persons latch onto it for use in such a multitude of contexts! For those like myself (Barkley, 1937), who employ a segregate genus (*Toxicodendron*) for the poison-ivies and poison-oaks, the rules of nomenclature preclude any combination using the word *Toxicodendron* as both a generic and specific epithet (a tautonym). Thus, in *Toxicodendron*, one must employ the next oldest specific epithet legitimately published for this plant. Eastern poison-oak thus has become *T. toxicarium.*

Although typical poison-ivy (both species) and both poison-oaks normally have but three leaflets, occasionally additional leaflets are formed. Added leaflets are especially common in western poison-oak, in which nearly every clone studied can be found to have some leaves with five or more leaflets. I have seen one population that consistently produced additional leaflets, ranging even up to seventeen!

The Generic Name

The use of *Toxicodendron* as a generic name is an old one,

dating back to 1700 in the writings of Tournefort. Few topics can steam up a group of taxonomists so much as arguing the merits of *Rhus* over *Toxicodendron* as the name of poison-ivy and its kin. For the poisonous species that have axillary inflorescences, pendent fruits, smaller pollen grains, and fruits without glandular hairs, I use the generic name *Toxicodendron*, as do Barkley (1937), Heimsch (1940), and others. Dr. Joe Hennen of Purdue University has found rust parasites that attack only *Toxicodendron* species and others that parasitize only *Rhus* species. It appears that these rust fungi are fairly competent taxonomists in noting biological distinctions to add to the morphological ones mentioned above.

Uses

When I give a talk about poison-ivy, generally someone in the audience will ask, "Well, what good is it?" It is surprising to most persons that poison-ivy does have some value. The Dutch of Friesland Province in the north of the Netherlands have used it since early in this century to stabilize dikes (Van Der Ploeg, 1966). It has been cultivated in England (as far back as 1640!), in New Zealand, and Australia for its ornamental attributes, probably chiefly the autumn coloration (Conner, 1951, Anonymous, 1908, and Anonymous, 1949). Many birds feed on its drupes, some flickers and wren-tits making up at least a quarter of their diet from poison-ivy fruits (Martin et al., 1951). Bees can make a nontoxic honey from its nectar (Rostenburg, 1955). A number of small mammals use it for cover. And there are those intrepid flower arrangers who employ poison-ivy fruits in dry arrangements (See Fig. 19).

Poison-ivy and the poison-oaks have been known among the American Indians and have been considered both poisonous and useful in their cultures since pre-Columbian times. In a few American Indian languages the word for poison-ivy is equivalent to "bad woman" or "venereal disease." In a few cases the Indian language word for this plant reflects an attempt on the part of the culture to appease the species; the word may be roughly translated as "you are my friend" in Cherokee language.

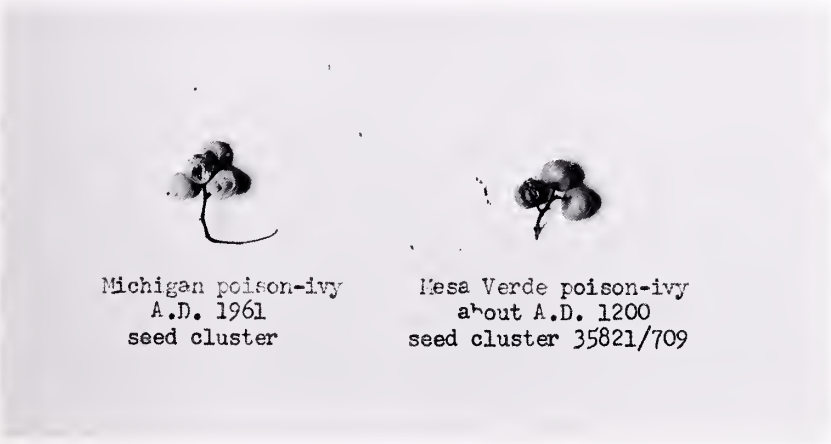
The Pomo Indians of California used the poisonous sap to dye basket fibers (Balls, 1965). The Meskwaki, Ojibwe, and Potawatomi Indians used it as a poultice to remove warts or on a swelling to make the skin open (Smith, 1928, 1932).

In the Wetherill project diggings at Mesa Verde some poison-ivy was found among the medicine man's possessions. The seeds

that were radiocarbon-dated as having grown around the 13th century have been preserved intact simply by the dry desert air. They are clearly identifiable to this day as *Toxicodendron rydbergii* (See Fig. 20). The use to which the medicine man put these plant products is unknown.

As stated in one of my earlier publications (Gillis, 1971): "The Ramah Navahoes made an arrow poison from poison-ivy mixed with deer's blood and charcoal from a lightning-struck tree, the latter no doubt a connection with black Magic (Vestal, 1952). Another version of making this arrow poison added the juices of *Phacelia crenulata* var. *ambigua* Macbr. (Wyman and Harris, 1941). The Navahoes also used poison-ivy (*T. rydbergii*) for good luck in gambling: they chewed a small piece of leaf and gave it to an opponent (Vestal, ibid.). The Karok Indians used sticks of *T. diversilobum* to spit salmon steaks while smoking them over a fire, and its leaves to cover soaproot (*Chlorogalum pomeridianum* Kunth) when baking it in an earthen oven. The Concow Indians of northern California even mixed the leaves of *T. diversilobum* into their acorn meal when they baked bread. Other northern California tribes simply wrapped their meal in its leaves while baking (Balls, ibid.). Some, too, used its supple stems as the warp in weaving baskets (Balls, ibid.).

Fig. 20 — Comparison of poison-ivy fruits (Toxicodendron rydbergii). *Those on left are modern. The ones on the right were retrieved from cliff dwellings at Mesa Verde, and were radiocarbon-dated as having grown in the 13th century.*



"The Yuki tribe of California used sap from *T. diversilobum* to get rid of warts: they would cut off the wart and apply poison-oak sap to the wound. The same treatment was applied to ringworm and rattlesnake bites (Balls, ibid.). They also used the sap, mixed with mountain hemlock and suet, for tribal markings (John N. Taylor, personal communication). The Yukis also (especially the Tatu or Huchnom branch) used a sprig of poison-oak dipped in water to 'keep the women in due subjection.' The men, while attempting to conjure up the devil in their meeting-hall, would paint one of their peers, strip him, place a chaplet of leaves over his face to render him incognito, and send him through the village amid whoops and diabolical yells. As he cavorted through the village, he would sprinkle wet poison-oak branches in the squaws' faces. Screaming with uncontrollable terror, the women would fall prostrate on the ground. Sworn to silence lest they die while discussing a spook, they would never realize who had, in fact, been their attacker (Powers, 1877)."

Fossils

Fossils of poison-ivy (*Toxicodendron magnifolium*) have been known from the western part of the United States from Oligocene time (40 million years ago). Some fossils were quite common constituents of the Weaverville flora of northern California (MacGinitie, 1937), curiously enough a region that has no poison-ivy today, but only western poison-oak. The fossils resemble more closely the poison-ivies of eastern Asia than they do extant poison-ivies from this country today (See Fig. 21). This resemblance further strengthens our belief that the two populations were once continuous between the two continents. Fossils of western poison-oak have been found in Pleistocene deposits in the West. They seem to be little different from *T. diversilobum* of today.

The Disease

Now to the disease, which has been studied extensively by Kligman (1958) and Epstein (1958). The poison in the poison-ivies, poison-oaks, and poison-sumacs is carried in specialized vessels or resin ducts in the phloem. It is not, therefore, normally present on the surface of the leaves or twigs. But it is found within these resin ducts, in leaves, flowers, stems, or roots in all the *Toxicodendron* species. Should the leaves be bruised, chewed by insects, or otherwise damaged, then — and only then — will the poison exude from these resin ducts onto the leaf

Fig. 21 — Type collection of Oligocene fossil of poison-ivy (Toxicodendron magnifolium) *from the Weaverville flora of Trinity County, California.*

surface. Being composed of chemically unstable compounds, the original clear liquid oxidizes and polymerizes in a few hours to a black, gummy substance, not unlike the lacquer exudates of the Asiatic sumac relatives (*T. vernicifluum*, *T. succedaneum*, and *T. trichocarpum*). It is transferable to the human being either directly by breaking the leaves and stems as one brushes against the plant, or it may be transferred by the blackened catechols that have come to the surface of the leaves and remained for some time. The poisons may be effective for an indefinite period of time in causing dermatitis. Several hundred-year-old herbarium specimens have been known to affect a sensitive person who has handled them!

The so-called "cures" employed by laymen to treat the dermatitis range from the desperate to the fantastic. A compilation of such treatments (see Kligman, 1958) reveals the range of human imagination in dealing with disease. Some of the cures include drinking photographer's hypo (sodium hypochlorite), applying either morphine, gunpowder, cream and marshmallows, or aqua regia to the skin. There are those who swear by the application of sap of *Impatiens capensis* or *I. pallida* (jewel-weed),

and one pharmaceutical company once sold a decoction of jewelweed for this purpose. Some New Englanders claim that the "sure cure" is application of the boiled concentrate of stems, leaves, and fruits of sweet-fern (*Comptonia peregrina*).

The dermatitis may be induced in man via the smoke of burning poison-ivy, but not for reasons commonly supposed. The poison is not volatile, even at the temperatures of bonfires. Any transmission of poison in the smoke is therefore by droplets on particles of dust and ash in the smoke, rather than as a gas. While raking up and burning leaves that may include poison-ivy, the wise householder should avoid standing in the smoke, especially if he is sensitive to *Toxicodendron* poison. The poisons may be transferred to human beings by the hair of animals such as dogs that may run through the poison-ivy or poison-oak; or they may be carried on gloves, boots, and other articles of clothing worn by a person who has been out for a tramp in the woods.

Originally — over 200 years ago — poison-ivy was placed in the genus *Rhus*. For this reason the dermatitis which is caused by poison-ivy and its relatives is known as "Rhus dermatitis" by the medical profession. Although I have attempted (Gillis, 1971) to make a good case for separating the poisonous species from the benign ones into a separate genus, *Toxicodendron*, (which, as a segregate genus, has a history dating back to 1700 in the writings of Tournefort and is therefore not a new idea), it is probably best for the medical profession to retain its general terminology for the disease as Rhus dermatitis — a kind of *nomen conservandum* for the medical folk.

Herbicides

There is no quick-and-easy way to rid oneself of the poison-ivy plant should one wish to do so; it is hardy enough to be little discouraged by weed killers. The surest method is to pull it up. Use cotton work gloves rather than rubber ones to protect the hands. The poisons are soluble in rubber and will eventually dissolve their way through the glove to the inside. After eradicating, discard both plants and gloves.

Herbicides that attack woody species will also do the job (commercial preparations of 2,4-D or 2,4,5-T, or a mixture of them), but application probably will have to be repeated inasmuch as the apparently "dead" plants will usually sprout from the not-so-dead roots.* As I said earlier, they're hardy. The dead vines and branches still must be dealt with and removed, and may cause poisoning even in the dead state.

* Amitrol-T is a weed killer that has been used with considerable success at the Arnold Arboretum. In our experience it is slow to act, but effective.

Plants With Which Poison-ivy Is Confused

Poison-ivy may frequently be confused with a number of other woody or vine plants with trifoliolate leaves. Each one will be described below with the differences that one can use in distinguishing it from poison-ivy.

1. Box elder (*Acer negundo*). This plant is in the maple family and, therefore, has opposite leaves. It frequently has leaves with five leaflets in addition to some with three. The young stems are bright, glossy green with an occasional glaucous patch. Poison-ivy always has brown or dull green young stems and alternate leaves. It also frequently climbs box elder trees, thus adding to the confusion.
2. Hop-tree (*Ptelea trifoliata*). This plant grows as a shrub like poison-ivy. It does not have any well-defined buds, whereas poison-ivy does. The tips of the branches will be quite stubby. The twigs tend to be gray or black, rather than the brown of poison-ivy. The leaflets are borne in threes like those of poison-ivy, but the central leaflet tapers to the base, while that in poison-ivy does not taper. The edge of the leaflets on the hop tree is smooth, or ocsionally has fine teeth, but that in poison-ivy (except along the Atlantic Coast and in the Orient) will tend to be notched The fruits are samaras, that is, there is a dry, circular, papery wing surrounding the seed like a wafer. Poison-ivy fruits are berry-like drupes.
3. Bladder-nut (*Staphylea trifolia*). This plant, like the maple, has opposite leaves. It has sac-like persistent fruits which may be an inch or more in diameter and an inch and one-half to two inches long. It grows as a small tree.
4. Virginia creeper (*Parthenocissus quinquefolia*). This plant grows in some of the same habitats that poison-ivy does, and it climbs much as poison-ivy does. It has five leaflets, all originating from one point, unlike poison-ivy's three. However, some of the younger leaves at the tip of the growing Virginia creeper vine may have only three leaflets. One can look at the scars left from the places where the leaves used to be to determine the difference. In Virginia creeper, they are circular with a raised edge, looking very much like a crater. In poison-ivy, these leaf scars are triangular in shape, often quite narrow. The fruits of Virginia creeper are juicy, purple (almost

black) berries, not hard and light colored like those of poison-ivy.

5. Virgin's bower (*Clematis virginiana*). This plant grows as a vine, but has opposite leaves. The leaflets tend to be a light green and they are quite thin and never glossy. The leaves have veins that turn out from the middle vein and curve upward, almost parallel to the edge. The veins of the poison-ivy plant come out at 60 degrees from the midvein and then run into the edge. The flowers of Virgin's bower are quite conspicuous, cream-white, about three-quarters of an inch across. The fruits have long feathery tails on them.
6. Aromatic sumac (*Rhus aromatica*). This plant is related to poison-ivy, but has leaves more uniform in size. The notches are rounded, rather than pointed. The leaves are generally quite hairy, with their leaflets tapered to the base, unlike those of poison-ivy. The flowers are yellow and appear immediately as the buds open early in April. The fruits will be almost ripe by the time the poison-ivy flowers are just coming out. The fruits of the aromatic sumac are fuzzy and red.

Facts Frequently Misunderstood About Poison-ivy

I frequently have used the following 20 summary statements about poison-ivy — the plant and the disease — to help dispel much misinformation.

1. Poison-ivy is in the sumac family (Anacardiaceae) along with staghorn sumac and its close relatives: pistachio, cashew, mango, squawbush, poison-sumac, and some poisonous trees of the tropics. It is not closely related to Boston-ivy nor English-ivy.
2. Some poisonous relatives of poison-ivy are poison-sumac (*Toxicodendron vernix*), poison-wood (*Metopium spp.*), and guao or maiden-plum (*Comocladia*) of the Caribbean area, cashew (*Anacardium occidentale*), the dhobi-nut (*Semecarpus*), and the mango (*Mangifera*). In mango, the poison is in the pedicel and possibly in the "skin" of the fruit.
3. Poison-oak is not an oak, but a sumac. It is called poison-oak because its leaflets resemble the leaves of some native oaks.
4. There is no poison-oak in Massachusetts; elsewhere there are two species with this common name: one along the

Pacific Coast (*Toxicodendron diversilobum*), and one in the southeastern United States (*T. toxicarium*).

5. There are two species of poison-ivy in the United States (and Canada, Mexico, and Western Guatemala and the Bahamas). One, which may grow as a shrub or vine, is *Toxicodendron radicans.* There are a number of variants now recognized as subspecies. To the west of the 100th meridian of longitude and north of approximately the 44th parallel of latitude there is a non-climbing species, *T. rydbergii.*
6. The chemical nature of the poison in poison-sumac or in either of the poison-oak species presumably is related chemically to that in poison-ivy, but its actual identity has yet to be determined. It is possible that the human body can detect differences between these poisons, but this has yet to be demonstrated. It is likely that a person who is "allergic" to one of these plants is allergic to them all.
7. The poisons are not volatile and therefore cannot be contracted "out of the air." A direct or secondary contact is necessary.
8. The poison may be spread in the smoke of burning poison-ivy because of tiny droplets of the poison present on the particles of dust and ash in the smoke.
9. Poison-ivy may be spread by animals. Petting a dog after it has run through a patch of the plant is a frequent way of contracting it.
10. Poison-ivy may be spread by articles of clothing. A person may reinfect himself by handling the same shoes he wore when he walked through a patch of the plant.
11. The poison cannot be spread by breaking the blisters on the skin.
12. There is little way of hastening the departure of the disease. Any medicines that are used on the skin serve to help dry the blisters, treat for secondary infection, or relieve itching. ACTH or cortisone derivatives will help cure the disease, but should be administered only with the advice and direction of a physician.
13. The level of sensitivity differs from person to person. Once one has surpassed his threshold of sensitivity, he will most likely alter the threshold. In some instances it appears that a severe case will herald more severe cases; in others it appears that one very virulent case precludes any others.

14. An initial contact is sufficient to give a person a rash if he is abnormally sensitive. Usually, however, one must be sensitized by an initial contact before he will react by producing a rash from subsquent exposures.
15. It is difficult to wash off this insoluble poison completely. Strong soap merely removes excess poison from the skin, but will not remove any which has already reacted, because the poison is believed to form a complex with skin proteins. It is therefore not removable short of removing the skin!
16. Injections are sporadic in effectiveness. They generally should be avoided as prophylactic measures, and definitely should be avoided during an attack of the dermatitis. At best, they *may* confer some degree of immunity; at worst, they may make a mildly sensitive person *very* sensitive.
17. Eating a leaf of poison-ivy may have disastrous results. One may surpass his normal level of immunity by the first bite; in this instance, he is headed for an internal case of poison-ivy, occasionally known to be fatal. The idea that American Indians chewed a leaf of poison-ivy to confer immunity is a myth that has never been documented.
18. The mechanism of sensitivity is not thoroughly understood. It does not behave like protein sensitivities such as hay fever pollenosis. It is a hypersensitivity of the delayed type, whose mechanism is related to that of organ transplant rejection.
19. There are some persons who appear to be immune to poison-ivy. Probably very few persons are potentially totally immune, but rather have (a) a high threshold of sensitivity or (b) have never been sensitized. Any survey of the population generally reveals about 50% of those surveyed are immune at the time of census. Some studies seem to indicate that red-heads are more susceptible than blonds, who seem in turn to be more sensitive than brunettes.
20. There is no known easy method for getting rid of poison-ivy, either the plant or the disease.

One Man's Meat . . .

Although it would be useful to be able to give one sure-fire method of recognizing poison-ivy or poison-oak from all other

members of the plant kingdom, it is not possible to do so without indicting a large number of benign species in the wild. One can say that a person should beware of all plants whose leaves are made up of three leaflets, but by the time he has gotten close enough to see the number of leaflets, he is probably too close for comfort. Besides, the average tramper in the woods is not going to examine every plant before he steps on it or passes through it. Hence, only by experience will one be able to spot easily these plants in question among the many others in our woodlands and fields.

Of all animals in the animal kingdom, only man and a few of the higher primates are sensitive to the poisons. Even rhesus monkeys may be sensitized only with difficulty, and they lose their sensitivity relatively rapidly. A few instances are on record of deliberately sensitizing dogs once the poison was applied directly to the skin with the hair removed. But the fact remains that all medical experimentation on this dermatitis must be conducted on *Homo sapiens* himself. He may use no surrogate in his investigations.

We have seen that poison-ivy and poison-oak have value to animals other than man. Birds, small mammals, insects, etc. have made use of the plants in one way or another. Although occasionally browsed by deer, poison-ivy certainly is not a preferred food. All of this goes to show that "one man's meat is another man's poison."

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'Constant Nymph' Updated

Streptocarpus *'Maassen's White'*

There was considerable response to the article "*Streptocarpus* 'Constant Nymph' and Its Mutants" published in the May/June 1973 issue of *Arnoldia.* Since recent developments have occurred of interest to indoor gardeners, it seems desirable to bring things up-to-date.

Several nurserymen throughout the United States have requested and received propagation material from us. At some of the Open Houses held for Friends of the Arnold Arboretum, 'Constant Nymph' and its mutants have been given away when stock was sufficient. This has led many indoor gardeners to tell us that these *Streptocarpus* are among the most satisfactory and exciting house plants they have grown. The author has

seen several very fine specimens that prove these plants can become quite large with a bounty of remarkable blue flowers if given proper care. They seem to be superior to other *Streptocarpus* used as house plants. An item of additional interest has been discovered by indoor gardeners: These plants set seed readily and the easily grown seedlings flower at an early age in an assortment of types, colors and sizes that best can be described as "motley." Home growers therefore can make selections of their own favorite seedlings and propagate them with ease.

The five new clones introduced by the Arnold Arboretum were 'Blue Nymph,' 'Cobalt Nymph,' 'Mini Nymph,' 'Netta Nymph' and 'Purple Nymph.' They were carefully described in an article called "New Streptocarpus Varieties" by Carl D. Clayburg in *The Gloxinian* for September-October, 1970, where the fact was mentioned that the Arnold Arboretum was propagating them at that time.

When the first *Arnoldia* article was written it was pointed out that there was "more to come." At that time a fine white clone called 'Maassen's White' was causing a sensation in Europe. Soon after it was available in this country the demand was so great that growers found it difficult to keep it in stock. Its snow-white flowers are strikingly beautiful, making it a good companion for the various shades of blue of the earlier clones. 'Maassen's White' propagates readily, matures rapidly, and should be as popular as its blue relatives.

Continuing development in both England and Holland makes it clear that the best is yet to come. A Christmas card from the John Innes Institute in 1971 showed a remarkable mixture of new *Streptocarpus* seedlings obviously of 'Constant Nymph' alliance. Since the card was in color the startling new shades of soft pink, rose, dusty red and blue-violet had considerable impact. In the May, 1973, *Journal of the Royal Horticultural Society*, an article called "Hybrid *Streptocarpus*" by A. G. Brown of the John Innes Institute, Norwich, England reviewed the previous work done on *Streptocarpus* and described the new work in progress at the Institute. The whole article was reprinted in *The Gloxinian* for July-August, 1974. The plates accompanying the original article were in color; those used in the reprint appear to be the same but are in black and white.

Mr. Brown confirmed what we had found. He pointed out that 'Constant Nymph' or any one of its derivatives makes "an ideal flowering house plant not only tolerating but thriving in the

climate and conditions of the average house." He rightfully concluded that a much greater color range than the various shades of blue would be very desirable.

The cross that produced 'Constant Nymph' was remade several times but each time the *Streptocarpus* × *hybridus* parent used was in a shade of pink or red rather than blue. Nearly 3,000 seedlings were grown and evaluated in the second (F2) generation where the variation is great in a cross of this sort. The color range went from white through various shades of pink to red, to purples and new shades of blue. New flower patterns and markings resulted also. The same habit of flowering almost constantly from April to October was inherited. By using supplementary lighting to counteract shorter days in November through March, it would be possible to have bloom throughout the year, according to Mr. Brown.

Nine clones have been named so far. They are 'Diana,' a deep cerise with a white throat; 'Fiona,' a good pink; 'Karen,' a magenta-pink; 'Louise,' a deep blue-violet; 'Marie,' a dusky purple; 'Paula,' a reddish-purple; 'Tina,' bright magenta and pale pink; 'Olga,' described as "a bold cerise"; and 'Helen,' a pale blue.

A recent letter from Mr. Brown in answer to my request for propagating material from the above clones indicates that we may have a wait. He states that "we are a Government financed research station and so we have to take out Breeders' Rights on our new cultivars and the distribution is undertaken for us by a Government sponsored company . . . They relieve us of all the business side of propagation and distribution." Apparently, a two-year lapse is required from the time the "Government sponsored company" receives the plant material until it is released so that adequate testing may be done. The writer is waiting now to hear from this organization with the hopes that the Arnold Arboretum may be the means of bringing this whole new crop of fine plants to the American gardener.

In the meantime, news of an excellent "mini white" clone has come from Holland. Another, a tetraploid form of 'Maassen's White' called 'Albatross,' has been described as "very fine indeed."

GEORGE H. PRIDE

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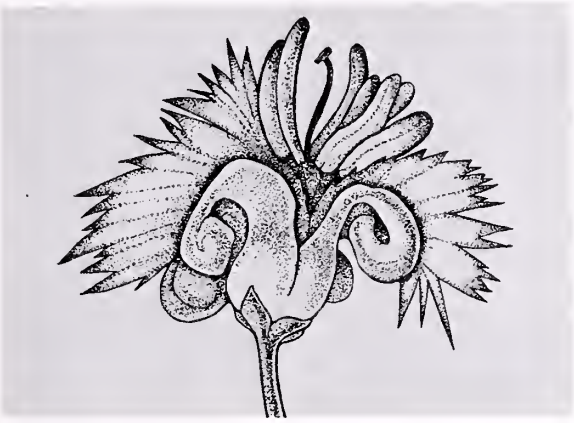
Arnoldia Reviews



Ximenia americana. *From* A Flora of Tropical Florida.

A Flora of Tropical Florida (A Manual of the Seed Plants and Ferns of Southern Peninsular Florida). Robert W. Long and Olga Lakela. Coral Gables: University of Miami Press. 1971. 980 pages, illustrated. $29.50.

John Kunkel Small's work on the vegetation of the southeastern United States culminated in the publication in 1933 of his *Manual of the Southeastern Flora*, an impressive volume of 1576 pages. Small was regarded as a "splitter" since he emphasized minor variations in form, structure or distribution as the basis for describing new genera and species. In the genus *Chamaesyce* Small recognized thirty species, seventeen of which he described.

He divided the wood-sorrel, Oxalis, creating three new genera and describing as new ten of the nineteen species.

The burden of proof that such splitting is not biologically sound unfortunately rests on the succeeding botanists who combined the taxa. Work at the generic level has been conducted at the Arnold Arboretum by Dr. Carroll Wood and collaborators, among whom was Dr. Long, senior author of the present volume.

To the student of the vegetation of southern peninsular Florida a new manual was needed presenting insofar as possible a modern treatment both of the taxonomy and the nomenclature of the plants. Long and Lakela's volume of 980 pages is physically as large as Small's and is not designed to be carried easily in the field. Included are treatments of 1647 species of ferns and their allies, gymnosperms and flowering plants. Many of the commonly cultivated plants or those escaped from cultivation are included.

A special introduction on the history of botanical collecting in southern Florida was contributed by Joseph Evan. The authors review the geology and the plant communities of the area which has its northern limit at the latitude of Lake Okeechobee and includes the Florida Keys. A useable key to families is supplied along with keys to genera and species. The 125 illustrations in general adequately represent the plants. There are some technical errors of fact and of nomenclature which other reviews have noted, but these are very few and can always be corrected in the next edition. The authors are to be commended for completing and publishing a useful volume for an interesting and much visited area of the United States.

RICHARD A. HOWARD

Plants: Wild and Cultivated. P. S. Green, editor. Hampton, England: E. W. Classey, Ltd. 1973. 231 pages. £2.70.

This volume is fundamentally the 24 papers presented during a conference on horticulture and field botany scheduled by the Royal Horticultural Society and the Botanical Society of the British Isles. The papers represent the interests and talents of the several speakers and form an extremely valuable compendium highly recommended for personal and professional libraries. The lead article titled "And never the twain shall

meet: Horticulture and Botany — allies not enemies" appropriately sets the stage for discussions of conservation; the roles of nurseries, private gardens and botanic gardens; the principles of botanical nomenclature and of horticultural nomenclatural problems; the relevance of genetics and the development of garden plants from wild plants; the value of the herbarium; the literature of plants and special treatments of such genera as *Alchemilla*, *Aceana*, *Hypericum*, "Mesembryanthemums," Mints, *Hebe*, Arums, Dandelions and others. The editor apologizes that the colored slides used to illustrate the talks could not be included.

The symposium is an idea that should, and certainly will, be copied by other horticultural societies. The reviewer only regrets that he could not have been present for the Conference, for each article, excellently written, deserves the presence of its author. Copies of this volume are available from the Botanical Society of the British Isles, c/o Department of Botany, British Museum (Natural History), Cromwell Rd., London, S.W. 7.

RICHARD A. HOWARD

Wild Plants for Survival in South Florida. Julia F. Morton. Tampa, Florida: Trend Publications, Inc. 1974. 80 pages, illustrated. $3.95.

This is the third edition and is by a new publisher (the former having allowed the publication to go out of print). Corrections and additions are minor in the current edition, and it is handsome with 16 color and 99 black and white illustrations of more than 125 edible and poisonous wild or, occasionally, cultivated plants of Florida.

If not used for actual survival, the volume would be extremely useful to the casual visitor for the identification and lore of many of the common plants.

RICHARD A. HOWARD

Chimaphila maculata. *From* Winter Keys to Woody Plants of Maine.

Winter Keys to Woody Plants of Maine. C. S. Campbell, F. Hyland, M. L. F. Campbell. Orono: University of Maine Press. 1974. 52 pages, 8½ × 11″, 63 plates, paper cover. $3.00.

The identification of plants in winter condition has always been a challenge to the professional as well as the amateur botanist. Nevertheless there are characteristics in the twigs and buds that enable one to name the plant to genus and occasionally to species.

The present volume, although in title limited to the state of Maine, will have a wider application, and has proven to be a pleasure to use. Dichotomous — two-choice — keys are supplied; the first enabling a determination to genus, and the second to species within the larger genera. Reference is made to the excellent plates that illustrate the critical portions, even to the appearance of the cut end of the stem. The drawings are alive and certainly among the best available for this purpose. A good glossary and an index combining common and scientific

names is supplied with reference both to plates and to the occurrence of the name in the keys.

I particularly appreciate the dedication of this volume to Professor Merritt L. Fernald who, I am sure, would have "humphed" his approval and appreciation.

Copies are available from the Secretary, Department of Botany, Deering Hall, University of Maine, Orono, Maine 04473. The book is highly recommended for enjoyable use on winter days.

RICHARD A. HOWARD

Your First Garden. Planning, Planting and Plants. Jack Kramer. New York: Charles Scribner's Sons. 1973. 120 pages, illustrated. $3.95, paper. $6.95, hard cover.

Although truly a beginner's book, this large (8½ × 11-inch) volume has exceptionally good photographs and drawings, a clarity of text and printing to enhance its basic information, and good suggestions. Chapters are devoted to planning; plant selection, culture and sources; lists of perennials, trees, shrubs and ground covers; suggested reading; and public gardens worth visiting. This would be an excellent guide for the new home owner or a fine housewarming gift.

RICHARD A. HOWARD

Plants for Ground-Cover. Graham Stuart Thomas. London: Dent and Sons. 1970. 273 pages, illustrated. $12.00.

This work by an English author, dealing obviously with British gardening, arouses mixed feelings in the American reader. There is gratitude for a good deal of material that is useful even in a New England setting; yet there is envy that we cannot utilize all the good things here in the United States.

The concept of ground-cover embraces certain plants, mainly perennials and shrubs, that cover the ground. The height of the plants described ranges from a few inches to several feet. There are many pages of descriptive lists on site, micro-climate, native habitat, season, growth habit, as well as characteristics

of blossom, fruit, and leaf. Few of the cultivars cited are available at U.S. nurseries.

There is an interesting section on planting public areas such as highway slopes, but no reference to cushioning plants for softening the impact of ejected motorists. The discussion of cemetery planting makes sense. A very useful appendix, applicable here as well as in England, deals with the extermination of certain ground-covers that the author considers to be vicious weeds. Americans will endorse his opinion. In summary, a most useful book with the English orientation taken into consideration.

ELINORE B. TROWBRIDGE

The After-Dinner Gardening Book. Richard W. Langer. New York: Macmillan. 1969. 198 pages, illustrated. $9.95.

The title of this work, now in its third printing, aroused expectations of coyness in this jaded reviewer. Examination quite erased the prejudice. This pleasant, readable, humorous account of sprouting and growing avocado pits, grapefruit, papaya, mango, kiwi and other seeds in an apartment is presented as the experience of a novice. The author is actually as knowledgeable as most people get to be in a lifetime. He teaches not only techniques of indoor gardening for a beginner, but the underlying generalizations about plant needs which usually are omitted from such books.

Material on containers, soil mixes, drainage, domestic hazards to furniture and marital harmony are included. Langer arouses the reader's interest in botany by his example of watching the potted mango seed and discovering grass blades. Although most of the experiments described involve seeds or cuttings of tropical plants, he also deals with others such as Jerusalem artichokes and sunflowers. No nicer gift than this little book can be imagined for the person just developing some curiosity about plants.

ELINORE B. TROWBRIDGE

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Contents

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Cover: Parmelia rudecta. *Photo: R. Weaver.*

Lichens: Mysterious and Diverse

by Richard E. Weaver, Jr.

The science of lichenology, or the study of lichens, has lagged behind other branches of botany, and many aspects of lichen biology are still shrouded with mystery. In fact, the most mysterious aspect of these plants, and the one basic to understanding them, was not known until the relatively late date of 1867: that although outwardly lichens appear to be discrete organisms, they are in fact made up of two very different kinds of plants bound together in a totally unique union. The components of lichens are these: (1) numerous individuals of an alga, usually of a one-celled green type similar to those which commonly give a green cast to the northern or shady sides of tree trunks, but occasionally a filamentous blue-green type like the ones which form the familiar blackish, rank-smelling scum on shallow water, damp soil, or clay flower pots; and (2) strands of a fungus, similar and somewhat related to the bread molds. The arrangement by which they live together as a lichen is referred to as *symbiosis*, the close association of two dissimilar organisms with, in this case, mutual benefit.

The exact nature of the lichen symbiosis, and the role that each of the components plays, is not completely understood. The fungus obviously provides protection for the alga, accumulates mineral nutrients, and helps in retaining moisture. The alga, because it contains chlorophyll, is able to synthesize carbohydrates. There appear to be mutual exchanges of other organic nutrients, but these have not been identified.

The balance between the components appears to be a precarious one, and slight environmental changes can in some cases upset it, resulting in the death of the lichen. But here an anomaly presents itself: lichens are able to prosper in some of the most extreme of the earth's environments, in places where no other plants are able to survive. They are particularly abundant, for example, in parts of Antarctica. Because of their resistance to damage by extreme desiccation and cold, it has been suggested that lichens or lichen-like organisms would be able

to survive in extra-terrestrial environments. In fact, the pronounced seasonal color changes on the surface of the planet Mars have been suggested to be due to the presence of lichens. Several species have in fact been subjected to simulated Martian conditions, but none survived for more than a few days.

In the remainder of this article I shall discuss various aspects of lichens which, I hope, will prove of interest to the reader. The final portion consists of a simplified, illustrated key to the identification of some common species.

Lichens and Air Pollution

The possibility that lichens are intolerant of air pollution was suggested as early as 1866 from observations made around Paris, France. Since then, studies have been conducted in large urban areas on several continents, and the results are clear: the number of species as well as the number of individual lichen plants decreases as the center of a city is approached. The reason appears to be that the lichens accumulate toxic substances dissolved from the air of cities until they reach lethal proportions. The most important substances in the decline of urban lichens appear to be sulphur dioxide, a common component of the gases given off by the burning of fuels, and various fluorine compounds. The former primarily affects the algal component by destroying its ability to produce food through the process of photosynthesis.

Lichens are decidedly rare in Boston, according to my personal observations. Even in the Arnold Arboretum and Franklin Park, relatively large forested areas near the city limits, they are not common. The most common lichen in these places appears to be a species of *Cladonia* on the bases of trees. But even this plant rarely produces fruiting bodies. Various other Cladonias, several crustose species, and depauperate specimens of a *Parmelia* also are occasionally to be found. The forests in towns as close as Concord to the west and Walpole to the south support a reasonable diversity of lichen species. But the further one goes from any large city, the better the chances of finding a good development of lichen vegetation.

Economic Uses

When one considers the complete range of plant products utilized by man, those obtained from lichens are of minor importance; yet lichens have proved to be of some use. The cell walls of the fungal component consist almost entirely of a unique starch called lichenin. As a result, lichens have some

food value, but the acids present render them somewhat unpleasant to the taste. They have been eaten historically, but mostly in desperation. The manna of the Israelites, for example, was possibly a species of lichen. The Japanese, however, consider *Umbilicaria* species, or Rock Tripes, to be a delicacy.

Cladonias and other fruticose genera of the far northern latitudes provide a forage crop for reindeer and caribou, and the native people of these areas harvest the lichens in large quantities to feed their semi-domesticated stock. But Arctic lichens apparently concentrate radioactive fallout from atmospheric atomic bomb tests, and the animals that eat them, and ultimately the people who eat them are showing signs of radiation poisoning. Various other animals, particularly invertebrates such as slugs and springtails (Fig. 1) also occasionally eat lichens.

Besides the folk remedies concocted from various lichens, such as cures for lung disease from *Lobaria pulmonaria* and for rabies from *Peltigera canina*, lichens do have medicinal uses. Several of the lichen acids are effective as antibiotics, and commercial preparations are available in Europe. In addition, a number of species have had a major importance in the past as dyestuffs, and Harris tweeds still are made with the original lichen dyes.

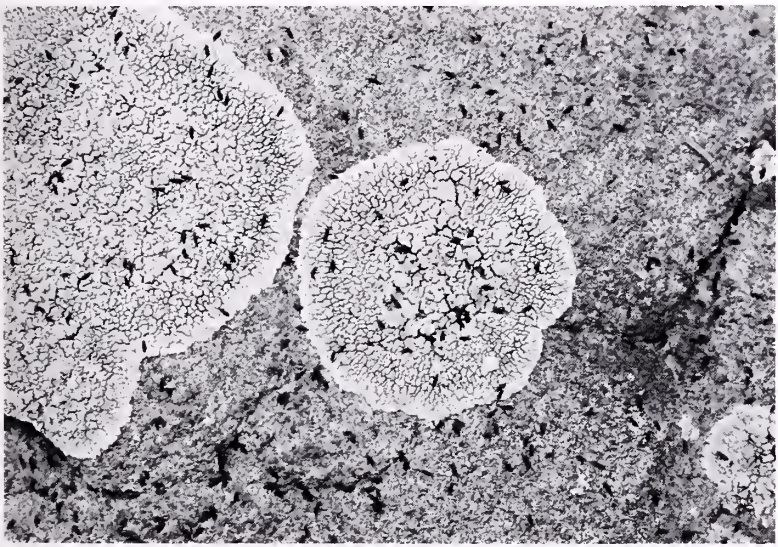


Figure 1. Springtails feeding on a subfoliose lichen.

Structure and Form

The plant body of a lichen is described as a *thallus*, a term referring to those plant bodies that are not differentiated into leaves, stems, and roots. A cross section through the thallus of most lichens would reveal a structure similar to that illustrated in Figure 2. Both upper and lower surfaces of most lichens are covered with a tough protective covering known as the *cortex*. This tissue is composed of tightly packed fungal strands or *hyphae*. Immediately below the upper cortex is the

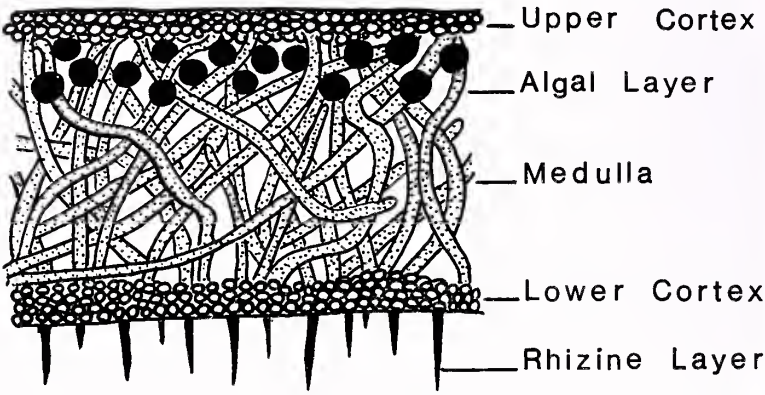


Figure 2. The structure of a lichen in cross section, greatly simplified.

algal layer, made up of loosely packed individual cells of the algal component interwoven with fungal hyphae. The *medulla*, with loosely packed fungal strands, makes up the bulk of the lichen thallus, perhaps as much as 2/3 of the thickness. Extending from the lower cortex are hairlike appendages called *rhizines*, which anchor the lichen to its substrate much as roots do in higher plants. Unlike roots, however, rhizines do not absorb water and mineral nutrients.

There are numerous variations on the general pattern. For example, some lichens do not have a well-defined algal layer; rather, the algae are scattered throughout the medulla. Other lichens lack a lower cortex, and still others, lack rhizines.

Lichens can generally be broken down into three easily recognizable groups on the basis of growth habit (although there are intergrades between each of the groups). *Crustose* lichens (Fig. 3) are those that form an encrustation on their substrate, with such close contact as to be difficult to separate from it. Extreme forms actually have most of their tissues embedded in solid rock.

Figure 3. The trunk of a red maple nearly covered with several genera of crustose lichens. The round black, gray, and pink (in life) structures are fruiting bodies.

Figure 4. Two species of Parmelia, *the largest genus of foliose lichens in our area, growing on a tree trunk.*

Figure 5. Cladonia verticillata, *a fruticose or "shrubby" lichen, showing the upright podetia growing out of flake-like squamules.*

Figure 6. A species of Physcia *with numerous, granular-appearing isidia.*

Foliose lichens (Fig. 4) are perhaps the most familiar type. The thallus of these is organized into lobes or projections radiating from the center but maintaining a position more or less parallel with the substrate. Lichens of this type appear somewhat "leafy," hence the derivation of the term "foliose." Many species may be firmly attached to the substrate, but at least they can be pried off with a knife. A few genera of foliose lichens are more or less rounded in shape without distinct lobes. These are attached to the substrate only in the center of the thallus and are known as *umbilicate* lichens.

Fruticose, or "shrubby" lichens are those in which the thallus is generally freely branched and stands away from the substrate. The most familiar genus of fruticose lichens, *Cladonia*, (Fig. 5) including those species commonly known as "British Soldiers" and "Reindeer Lichens," are unusual in that the plants are composed of two kinds of thalli: one, made up of flake-like, almost foliose segments known as *squamules*, growing close to the substrate; and the other, of upright structures known as *podetia*, which bear the fruiting bodies. In those species commonly known as "Reindeer Lichens," the squamules disappear early in the development of the plant. In other familiar genera such as *Usnea*, the "Old Man's Beard," the entire thallus is fruticose.

Reproduction

Many aspects of the reproduction of lichens remain a mystery. Most species appear to reproduce primarily by vegetative means, and indeed if any part of the thallus is broken off, it has the capability to produce a new plant. But a large number of lichens have specialized structures for vegetative reproduction. *Isidia* are minute, cylindrical or branched outgrowths of the thallus, containing all of its tissues. They are present in large numbers in certain species (Fig. 6) and are very fragile. If detached, each one can grow into a new plant. Other species produce *soredia*, which are minute clumps of algal cells interwoven with fungal hyphae. These erupt in powdery masses (Fig. 7) through the upper cortex. They are easily dispersed by wind and rain, and again each tiny soredium is capable of reproducing the lichen.

Sexual reproduction also occurs in lichens, at least in the fungal component. Sexual reproduction has been reported in lichen algae that have been separated from the thallus and grown in sterile culture, but in the lichen itself they appear to reproduce solely by simple cell division. Fruiting bodies of

various sorts are produced in many species of lichens. The most common are external cuplike or disclike structures known as *apothecia* (Fig. 8). In these structures the fungal component produces spores by sexual means, much as a bread mold would do. The spores are scattered by the wind, and apparently many of them germinate. But to produce another lichen, contact must be made with cells of a suitable species of alga. Since few of the lichenized algae are common as free-living organisms, it is hard to visualize how lichens can be reproduced in this manner. Yet some common crustose species have no obvious means of vegetative reproduction.

One of the classic goals of lichenologists has been to synthesize lichens artificially, that is to create a new thallus by combining the algal and fungal components in the laboratory. Although both lichen algae and fungi can easily be grown in sterile culture, getting them to combine and produce a complete, mature thallus resembling that of a naturally occurring species has never been achieved. Partial successes have been reported in a few cases. The reasons for the repeated failures seem to lie in the simple fact that the algae and fungi, when grown separately, are different from the same species grown together as a lichen, underscoring the uniqueness of the lichen symbiosis.

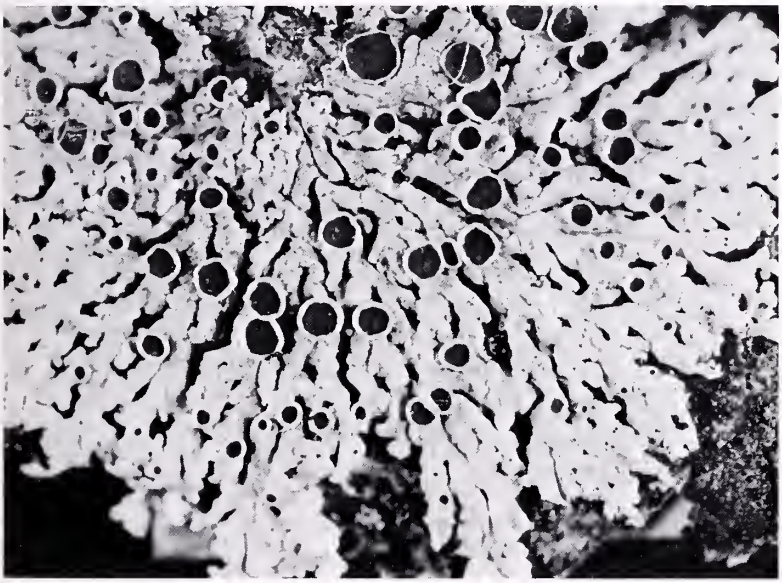
Classification and Identification

Relatively little is known about the algal components of lichens, but it is believed that different genera, with strikingly different morphological characteristics, often contain the same species of alga. Therefore it appears that the fungal component is primarily responsible for the morphological diversity of lichens, and it is assumed that each species of lichen contains its own unique species of fungus. The current taxonomic system reflects this assumption, and lichens are classified essentially as if they were fungi.

Many of the characters used in the classification of lichens, such as those present in the reproductive spores, are quite technical and need not concern us here since they are not necessary for the identification of the common species. But one of these technical characters has recently become extremely useful to professional lichenologists and should at least be mentioned. Lichens produce a large number of complex chemical compounds, called lichen acids, which are unique in the plant kingdom. A particular acid may be produced by each of a large number of species or even genera. Others are of more restricted occurrence. But the type of acids present are usually constant

Figure 7. A species of Physcia *with powdery masses of soredia.*

Figure 8. A species of Physcia *showing the disclike fruiting structures or apothecia.*



within a given species. Within the last 40 years, a series of simple chemical tests has been worked out for determining the presence or absence of certain acids in the thallus of given lichen species. Three chemicals are used: potassium hydroxide, calcium hypochlorite, and paraphenylene-diamine. Applied to the cortex or the medulla these produce various color reactions depending on the acids present. The tests are easy to make and results are immediately and clearly visible. Thus they have become indispensable aids for the serious student of lichenology.

In recent years a number of lichen species have been found to consist of several chemical races. That is, a widely distributed species may appear to be externally quite uniform throughout its range, but plants from different areas may contain different lichen acids. The significance of this is not clear. However, some taxonomists have described each chemical variant as a different species.

In the following key, technical characters are completely excluded. The species are identified only by means of easily visible attributes. The lichens included are common and conspicuous foliose and fruticose species that I have encountered in eastern Massachusetts, but most of them are common and widespread throughout the Northeast. Due to the difficulty in identifying them, crustose species are not included. Most lichens do not have well established common names, so only their Latin names are used. The species are broken down into four main groups based on growth form and habitat or substrate. To identify a given lichen, turn to the appropriate category and work through that section of the key. All species are illustrated as an aid to identification. The key is by no means complete for all of the lichens of Massachusetts, or even of eastern Massachusetts, but it still should be useful to the interested beginner. It will hopefully at least enable him to gain an appreciation for the diversity among this most fascinating group of plants.

Illustrated Key to the Identification of Some Common Lichens in Massachusetts

Fruticose lichens growing on soil, moss, dead stumps, or the base of living trees.

1a. Upright structures grayish or yellowish, the branches round in cross section, without short, hairlike projections on the margins ..... Go to Number **2.**

1b. Upright structures dark brown, the branches flattened, with short, hairlike projections on the margins. .... *Cetraria islandica*

Cetraria islandica (L.) Ach. Iceland Moss. This is a common lichen on sunny, exposed soil and rock outcroppings, often growing among mosses. It is widespread throughout the northern latitudes of the world, and is one of the lichens commonly eaten by caribou and reindeer. The thalli are dark olive or brown and grow from 1 to 3 inches tall.

2a. Podetia of cup-shaped or cone-shaped segments, sometimes one on top of another. ..... Go to Number **3.**

2b. Podetia not cup-shaped or cone-shaped. .... Go to Number **4.**

3a. Podetia of single cup-shaped or cone-shaped segments. ..... *Cladonia chlorophaea.*

3b. Podetia of several cone-shaped segments on top of another. ..... *Cladonia verticillata.*

Cladonia chlorophaea (Flk.) Spreng. There are many species of the so-called "Goblet Lichens," most of them differing in the shape of their cups or the types of lichen acids present. This is the one most common and widespread, occurring throughout much of North America. The cups stand to about an inch tall.

Cladonia verticillata (Hoffm.) Schaer. Several *Cladonia* species are characterized by having several tiers of "cups," but this is the only one in which the tiers arise from the center of the "cups" below rather than from their margins. This species is common in eastern North America, and grows from ½ to 2½ inches tall.

4a. Podetia thin and finely branched, appearing treelike, without conspicuous fruiting bodies. Go to Number **5.**

4b. Podetia thicker and unbranched or sparsely branched, not appearing treelike, often with conspicuously colored fruiting bodies. ..... Go to Number **10.** (Page 146)

5a. Tips of branches pointing downward in one direction. ..... Go to Number **6.**

5b. Tips of branches pointing upward and outward in various directions. ..... Go to Number **7.**

6a. Podetia ashy gray. ..... *Cladonia rangiferina.*

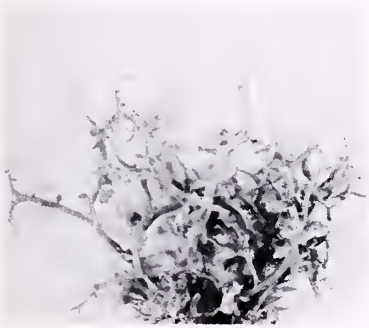
6b. Podetia yellowish or greenish. ..... *Cladonia arbuscula.*

Cladonia rangiferina (L.) Wigg. Several species of *Cladonia* are called "Reindeer Lichens," but this is the one most properly so-called, because the species name *rangiferina* is derived from *Rangifer*, the generic name of Reindeer. It is widely distributed in northern latitudes. The only finely branched *Cladonia* in the Northeast that is ashy gray in color, *C. rangiferina* often stands as tall as 3 or 4 inches.

Cladonia arbuscula (Wallr.) Rabenh. This species is similar to *Cladonia mitis*, another common plant in the Northeast. They may be distinguished with certainty only by means of chemical tests. Both are similar also to *C. rangiferina* but are yellowish rather than ashy gray in color.

7a. Podetia often split open, with scattered flaky squamules. ..... *Cladonia furcata.*

7b. Podetia not split open, without flaky squamules. .... Go to Number **8.**



Cladonia furcata (Huds.) Schrad. This species may be distinguished from the other finely branched Cladonias both by its color, tending to be slightly brownish when dry, and by the presence of flake-like squamules on the podetia. It is common throughout eastern North America, and it grows to about 3 inches tall.

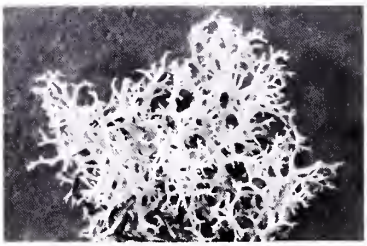
8a. Plants forming discrete conical or mound-like clumps. ..... *Cladonia alpestris.*

8b. Plants forming scattered, entangled masses. .... Go to Number **9.**

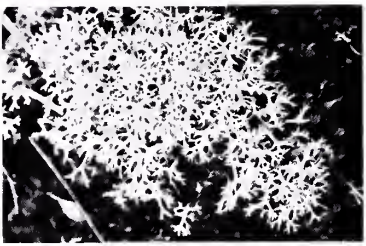
Cladonia alpestris (L.) Rabenh. This species and the closely related but ashy gray *Cladonia evansii* of the southern states form discrete, conical or mound-like clumps. After being dyed green and treated with glycerin to keep them pliable, they are often collected and sold as artificial miniature shrubs for model train setups and architectural models.

9a. Tips of the podetia usually in twos. .... *Cladonia subtenuis.*

9b. Tips of the podetia usually in threes or fours. .... *Cladonia uncialis.*



Cladonia subtenuis (Abb.) Evans. The most common "Reindeer Lichen" in the southern states, this species is also abundant in the Northeast. It may be distinguished from *C. uncialis* by its usually thinner podetia, the tips of which branch in pairs rather than by threes or fours.



Cladonia uncialis (L.) Wigg. This species is similar to *C. subtenuis.* See that species for the differences.

10a. Fruiting bodies bright red. ..... *Cladonia cristatella.*

10b. Fruiting bodies pink or brown, or absent. .... Go to Number **11.**

Cladonia cristatella Tuck. This common and familiar lichen is known by the name "British Soldiers" because of the brilliant red color of its apothecia or fruiting bodies. The allusion to the color of the uniform of the British infantrymen of colonial times should be obvious to anyone who has seen this lichen. It is a common species on roadside banks and other sunny areas, and it is a popular, if ephemeral, component of the terrarium plantings so much in vogue at present.

11a. Fruiting bodies usually absent, but brown if present. ..... Go to Number **12.**

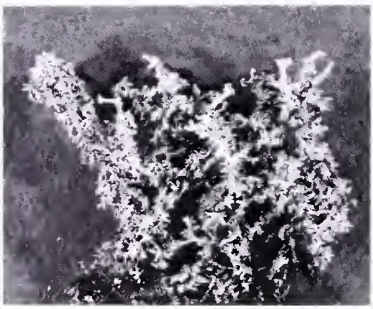
11b. Fruiting bodies present and conspicuous, globular or mushroom-shaped and pink. ..... *Baeomyces roseus.*

Baeomyces roseus Pers. Unlike most of the other lichens treated in this section, this species is not a member of the genus *Cladonia.* Although resembling it superficially, *Baeomyces roseus* differs from *Cladonia* in that its primary thallus is made up of numerous white, closely spaced granules, rather than of flake-like squamules. It is a common species in the Northeast, being almost always found on sunny roadside banks. The fruiting stalks are seldom more than ¼-inch tall.

12a. Podetia unbranched and without squamules. .... *Cladonia bacillaris.*

12b. Podetia branched and densely covered with squamules. .... *Cladonia squamosa.*

Cladonia bacillaris (Ach.) Nyl. This is an inconspicuous and not particularly attractive species of lichen, but it is one of those most tolerant of air pollution. It is perhaps the most common species within the city limits of Boston. It typically grows on dead wood or at the base of living trees. The podetia are seldom more than ½-inch tall and are gray-white in color.



Cladonia squamosa (Scop.) Hoffm. Although related to *C. chlorophaea* and other "Goblet Lichens," the cups of this species are often so modified as to be almost unrecognizable. The species is quite variable in the amount of branching of the podetia and in the development of squamules on them.

Fruticose lichens growing on rocks or trees.

1a. Upright or pendent structures unbranched or sparsely branched, arising out of a base of squamules. .... *Cladonia bacillaris* (See discussion above).

1b. Upright or pendent structures much branched, without squamules at base. ..... Go to Number **2.**

2a. Thallus tufted (all of the branches arising from a single point). ..... Go to Number **3.**

2b. Thallus not tufted, but rather hanging in long, hair-like strands. ..... *Usnea trichodea.*

Usnea trichodea Ach. One of the most common of the lichens popularly known as "Old Man's Beard," this species is often as much as a foot long. It is typical of the high elevation forests of the Appalachians, but it is also common in the Coastal Plain of the southern states. There it is sometimes confused with Spanish Moss, *Tillandsia usneoides*, a flowering plant the species name of which means "*Usnea* — like."

3a. Plants with conspicuously fringed fruiting bodies; main branches of thallus round in cross section and hollow with a tough central cord. ..... *Usnea strigosa.*

3b. Plants with unfringed fruiting bodies; main branches of thallus flattened and solid. ..... *Ramalina fastigiata.*

Usnea strigosa (Ach.) Eaton. This and other members of the genus *Usnea* seem to be particularly susceptible to air pollution and are not often found in the environs of cities. The numerous fringed apothecia, or fruiting bodies, are typical of this species. The branches grow to as much as 3 inches long, much shorter than those of the related "Old Man's Beard."

Ramalina fastigiata (Pers.) Ach. The genus *Ramalina* contains perhaps 20, mostly epiphytic species in the United States, but this is the one most common and widespread. The specimen illustrated is unusual in that it does not display the disc-like apothecia that are commonly produced in this species. The flattened, solid branches are seldom more than 1½ inches long.

Foliose lichens growing on soil or rocks.

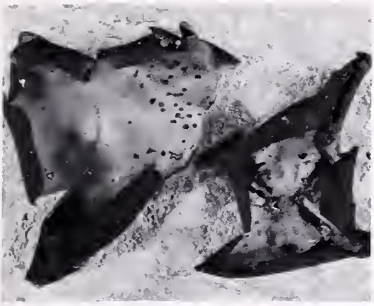
1a. Thallus roundish, without distinct lobes, and attached to the substrate only in the center. .... Go to Number **2.**

1b. Thallus branched, with distinct lobes, attached to the substrate throughout. ..... Go to Number **3.**

2a. Upper surface of the thallus with conspicuous, raised, blister-like areas; lower surface brown or tan. .... *Lasallia papulosa.*

2b. Upper surface of the thallus smooth; lower surface black. ..... *Umbilicaria mammulata.*

Lasallia papulosa (Ach.) Llano. This lichen is often classified in the genus *Umbilicaria.* It differs from *U. mammulata,* the only other common umbilicate lichen in our area, by its smaller size, its tan undersides, and perhaps most conspicuously, the raised, blister-like areas on the upper surface. The thalli are brownish when dry and are usually from 1 to 2 inches in diameter.



Umbilicaria mammulata (Ach.) Tuck. Members of the genus *Umbilicaria* all are lichens that are attached to the substrate only by a tough cord in the center of the thallus. They are commonly called "Rock Tripes" and have been used as human food. This species with its densely felty, jet-black undersides, grows to nearly a foot in diameter, and is one of our largest lichens.

3a. Plants dark brown when wet; plants usually found growing on mosses on damp soil. ..... *Peltigera canina.*

3b. Thallus orange, yellowish, or grayish. Go to Number **4.**

Peltigera canina (L.) Will. This species is common in damp, shady places in North America and Europe. On the latter continent it has long been known as the "Dog Lichen," hence its species name, due to the fact that, mixed with black pepper and milk, it was once believed to provide a cure for rabies. The thallus is dark brown when wet, but it assumes a whitish cast when dry. The lobes are often ½-inch or more broad. This genus is one of the relatively few in our area that contain blue-green algae.

4a. Thallus orange. ..... *Caloplaca elegans.*

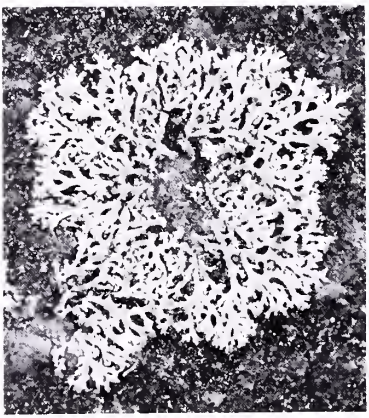
4b. Thallus yellowish or grayish. ..... Go to Number **5.**

Caloplaca elegans (Link) Th. Fr. This beautifully colored lichen is very closely and firmly attached to the rocks on which it grows, and sometimes appears to be almost crustose. In fact, some members of its genus are crustose lichens. It is common on Cape Cod, often growing on tombstones.

5a. Thallus pale yellowish or greenish, usually more than 2 inches in diameter; undersurface black or brown. .... *Parmelia conspersa.*

5b. Thallus ashy gray, usually less than an inch in diameter; undersurface white. ..... *Physcia subtilis.*

Parmelia conspersa (Ach.) Ach. This lichen is a member of the largest and most familiar genus of foliose lichens in the United States. Most of its relatives, however, grow on trees. It is a very common species, often completely covering large areas of rock.

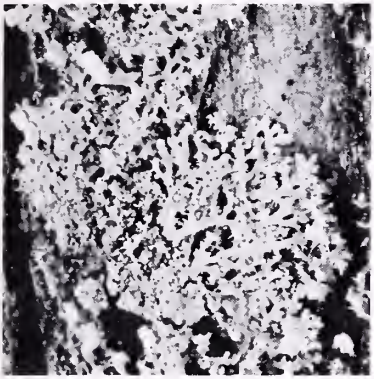


Physcia subtilis Degel. This genus *Physcia* contains a large number of tree-dwelling as well as rock-dwelling species. Most of them are small plants with narrow lobes, but specific identification is often difficult. This is perhaps the commonest rock species in our area. The individual plants are seldom as much as an inch broad, but they often coalesce into large colonies. The lobes are less than 1/16-inch broad.

Foliose lichens growing on trees.

1a. Thallus bright yellow, tiny, usually less than ½-inch broad, often almost hidden among mosses on tree trunks. ..... *Candelaria concolor.*

1b. Thallus not bright yellow, more than an inch broad. .... Go to Number **2.**



Candelaria concolor (Dicks.) Stein. The only foliose lichen common in our area that is bright yellow in color, this tiny plant grows on various hardwoods, particularly ash, elm, and sugar maple, as well as on junipers. It is not a particularly conspicuous plant, in spite of its color, because it often grows intermingled among mosses.

2a. Thallus bright orange, on trees near the seacoast. .... *Xanthoria parietina.*

2b. Thallus brownish, yellowish or grayish, found in various habitats. ..... Go to Number **3.**

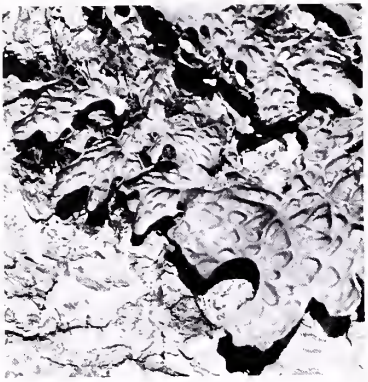
Xanthoria parietina (l.) Th. Fr. Members of the genus *Xanthoria* are usually bright orange in color, and several other species are found in our area. This plant, often with very numerous fruiting bodies, is common on exposed trees near the seacoast, particularly on Cape Cod. A similar but smaller species, *X. polycarpa*, is found in various habitats, most commonly on aspen trees.

3a. Thallus brown or olive green when dry. .... Go to Number **4.**

3b. Thallus gray or greenish yellow when dry. .... Go to Number **6.**

4a. Upper surface of thallus with a network of conspicuous, raised ridges. ..... *Lobaria pulmonaria.*

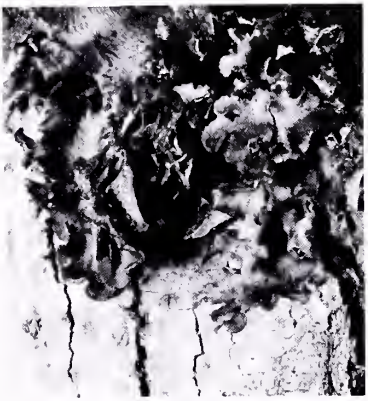
4b. Upper surface of thallus smooth. ..... Go to Number **5.**



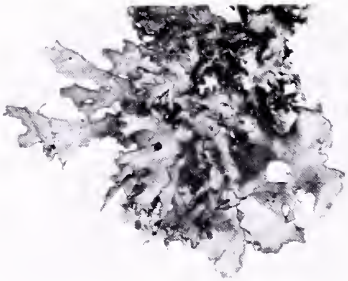
Lobaria pulmonaria (L.) Hoffm. Lung Lichen. The common name of this plant was derived from its supposed resemblance to lung tissue. Because of this resemblance, the plant was once considered to provide a cure for lung diseases. This large and conspicuous species is only common in rich, mature forests and swamps. When it dries, the lobes curve outward and upward, exposing the pale undersides.

5a. Underside of thallus with numerous whitish, dotlike depressions. ..... *Sticta weigelii.*

5b. Underside of thallus without these depressions. .... *Cetraria ciliaris.*



Sticta weigelii (Ach.) Vain. A large, drab, dark brown lichen, this species is occasionally found on rocks as well as trees. The pale, dotlike depressions, called cyphellae, on the undersurface are its most distinctive feature. Although occasionally found in open woods in the Northeast, it is much more common in the southern states.



Cetraria ciliaris Ach. The genus *Cetraria* is similar to the more common *Parmelia.* A number of species are found in the Northeast, but this is among the more common and distinctive ones. The thallus is generally between 1 and 3 inches in diameter, and the lobes are about ¼-inch broad.

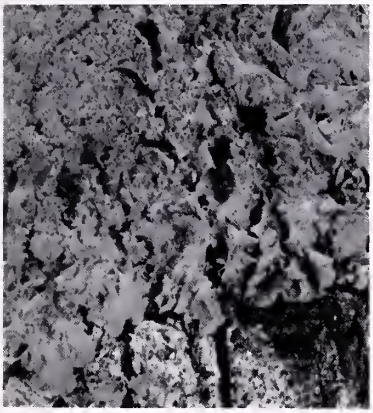
6a. Thallus greenish-yellow when dry. .. *Parmelia caperata.*

6b. Thallus gray when dry. ..... Go to Number **7.**

Parmelia caperata (L.) Ach. This is the only large, greenish-yellow lichen that is common on trees in our area. The plants are often as much as 6 inches in diameter, with lobes almost ½-inch broad. Fruiting bodies are not common, but when they occur their bright chestnut color is conspicuous against the rest of the thallus.

7a. Thallus papery and slate-gray when dry, turning nearly black when wet. ..... *Leptogium cyanescens.*

7b. Thallus ashy gray or gray-green when dry, becoming more greenish when wet. ..... Go to Number **8.**



Leptogium cyanescens (Ach.) Koerb. One of the lichens with blue-green algae in its thallus, *Leptogium* is most commonly collected on the bases of hardwoods where it often grows over or among mosses. It occasionally is to be found also on rocks. This species is the most common one in the Northeast. It very rarely produces fruiting bodies, a characteristic that distinguishes it from *L. corticola,* another native species.

8a. Lobes of the thallus inflated and hollow. .... *Hypogymnia physodes.*

8b. Lobes of the thallus flat and solid. .... Go to Number **9.**

Hypogymnia physodes (L.) Nyl. This species is sometimes classified in the genus *Parmelia*, which it resembles in many respects. Upon close inspection, however, the lobes of *H. physodes* are inflated and hollow at least at the tips. It is a common species on both hardwoods and junipers, often almost covering the younger branches.

9a. Lobes about 1/16-inch broad. ..... *Physcia* spp. (For a discussion of *Physcia* species, see *P. subtilis* above.)

9b. Lobes more than 1/8-inch broad. ..... Go to Number **10.**

10a. Lobes with slender black, hairlike projections on the margins. ..... *Parmelia perforata.*

10b. Lobes without these hairlike projections on the margins. ..... Go to Number **11.**

Parmelia perforata (Jacq.) Ach. Although several other species of *Parmelia* with ciliate lobes (hairlike projections on the margins) may occasionally be found in our area, this one is easy to recognize because of the numerous cup-shaped fruiting bodies with holes in their centers. The thallus is loosely attached to the substrate, and the lobes frequently curve upward.

11a. Lobes more or less angular; upper surface of thallus with a network of fine ridges. ..... *Parmelia saxatilis.*

11b. Lobes broadly rounded; upper surface of thallus smooth. ..... *Parmelia rudecta.*

Parmelia saxatilis (L.) Ach. A species of *Parmelia* with relatively narrow, angular lobes, this lichen is very common on the trunks of hardwoods. A similar species, *P. sulcata*, lacks the coarse isidia found in this plant.

Parmelia rudecta Ach. This is the most common large gray species of *Parmelia* found on hardwoods in our area. A conspicuous feature are the dense masses of granular isidia in the center of the large thalli.

Note: The genus *Parmelia* is the largest group of foliose lichens in the United States. Only a few of the more common and conspicuous species have been included in this key.

Selected References

The following is a short list of books which are strongly recommended for the reader wishing to know more about lichens. I have used them all in the preparation of this article.

Amadjian, V. and M. E. Hale, eds. 1973. The lichens. Academic Press, New York, 697 pp.

This is a technical book, summarizing the recent developments in lichenology. It is a collection of discussions by experts in various aspects of the field. Although meant to be used by the serious student of lichens, amateurs will find many items of interest.

Bland, J. H. 1971. Forests of Lilliput: the realm of mosses and lichens. Prentice-Hall, Englewood Cliffs, N.J., 210 pp.

This is a truly remarkable book, perhaps the only basically popular work on mosses and lichens. Although not a professional in either lichenology or bryology, the author has a thorough knowledge of both fields. Many aspects of the uses and natural history of the fascinating plants are presented in a most readable style.

Hale, M. E. 1961. Lichen handbook. Smithsonian Institution, Washington, D.C., 178 pp.

Although superceded by more recent works by the same author (see below), this is still a very useful book. It includes a succinct discussion of lichen biology and natural history in language readily understood by an amateur. The keys are good, but they are not effectively illustrated. This is the book I used as a text when I took Dr. William Culberson's lichenology course at Duke University.

———. 1967. The biology of lichens. American Elsevier Publ. Co., Inc., New York, 176 pp.

Meant to be a student textbook, this is perhaps the best review of lichen biology available on a semi-technical level. It is recommended as a "must" for anyone seriously interested in lichens, and if used in conjunction with the following book, would provide most of the information a serious amateur would need.

———. 1969. How to know the lichens. Wm. C. Brown Co., Dubuque, Iowa, 225 pp.

This is the best book available for the identification of lichens in the United States. The keys are similar in style to those used in the present article. They are excellent and well illustrated, but they do rely on chemical tests for many identifications. A short discussion of lichen biology is included in the introductory material.

Parmelia conspersa

(*All illustrations in this article are by the author.*)

The Worthy Kerrias

by Jeanne S. Wadleigh

An old fashioned shrub, *Kerria japonica*, infrequently grown these days, has been accorded a position of prominence in the renovated Bussey Hill planting at the Arnold Arboretum.

William Kerr, a plant hunter from Kew who discovered *Kerria japonica* and sent it back from China in 1805 would be pleased: his acquisition, originally known as *Corchorus japonicus*, has more than justified his notice of it and has been widely cultivated both here and in England where it was a popular cottage shrub in years past. Perhaps its recent recognition in Jamaica Plain will cause gardeners in this area to consider it and its four varieties when an easy, durable accent plant is wanted for informal landscapes.

Kerria has other attributes: it bears sunny yellow flowers beginning in May and intermittently throughout most of the summer, it prospers in shady spots (which also help to preserve the brilliant color of its blossoms), it increases freely, and its slender bright green branches are attractive during the winter months.

A member of the Rosaceae and actually native to Japan, *Kerria* was renamed in 1818 by Prof. A. P. De Candolle in tribute to Kerr's memory. The original plant sent baek from China was the double *K. japonica* 'Pleniflora,' which at first was cultivated as a warm greenhouse plant because of uncertainty about its hardiness. It subsequently was discovered to be frost-hardy and by 1810 had made its appearance in most of the principal plant collections about London.

The species itself bears 1- to 2-inch single flowers not unlike buttercups in appearance; *K.* 'Pleniflora' is more vigorous and its ball-shaped blossoms remain in good condition on the arching branches for a longer period of time. Popularly known as Globeflower (not to be confused with *Trollius*), it is the variety most commonly grown, although *K.* 'Aureo-variegata' with yellow-edged leaves appeals to people favoring variegated foliage. A dwarf form, *K.* 'Aureo-vittata' bears branches conspicuously striped with green and yellow. *Kerria* 'Picta' has leaves bordered

Left: Kerria japonica. *From* The Botanical Register. *Vol. 22. London, 1836*

Right: Corchorus japonicus flore pleno. *From* The Botanical Magazine. *Vol. 31–32. London, 1810.*

with white (specimens in the Arnold Arboretum shrub collection have tended to revert, however.)

Generally growing from 4 to 8 feet in height, Kerrias benefit from pruning after the flowering period to promote new growth to bear next year's blooms, and also to remove tips that have winter-killed. Although hardy to Zone 4, they are susceptible to this injury if not provided with a well-drained, partly sheltered location.

The plants increase very rapidly by suckers which the roots produce in ample numbers, but the preferred way to obtain new stock is by softwood cuttings taken in June or July.

Arnoldia Reviews

Wildlife and Plants of the Cascades. Charles Yocum and Vinson Brown. Healdsburg, Calif.: Naturegraph. 1971. 293 pages, 400 line drawings plus several full-color plates. Paperback, $3.95.

This work represents the collaboration of two biologist-naturalists who have taught, lectured, and published. The volume is part of a series designed to acquaint residents and visitors to the Cascade Mountains region of the West Coast with the flora and fauna of the area.

Habitats and their ecology are fully outlined. There are botanical descriptions of the plant families represented in the various plant zones. Animals are treated in a similar fashion. The drawings and colored prints are of excellent quality.

Some prior reader knowledge of botany and zoology is implied throughout the work. The impression of this publication is that it is a required field guide for students. It is not, however, a traditional guide with keys; on the contrary, it consists of a series of descriptive paragraphs concerning various plants and animals of the Cascade region. It is therefore recommended for students in the Cascade area and in general for adults with an interest in nature and/or ecology.

ELINORE B. TROWBRIDGE

John Evelyn and his times. Bernice Saunders. Oxford: Pergamon Press. 1970. 203 pages. $6.95

John Evelyn was born in 1620 and died in 1706. From the time of the Restoration of the Monarchy in 1660 he appears to have been a person of consequence in the government. What this book does do is to give a view of Evelyn and his social milieu — what it does not do is give any real background to explain Evelyn the forester and author of "Sylva, or a Discourse of Forest-Trees, and the Propagation of Timber . . ." a work which went through four editions in Evelyn's lifetime. Neither does it

From John Evelyn and his times.

explain Evelyn the translator of "The French Gardiner: Instructing how to cultivate all sorts of fruit trees, and herbs for the garden . . ." 1658 — (3rd ed. 1676). Nor does it explain Evelyn the author of "Kalendrium Hortense . . ." 1664, 10th edition 1706, which seems to be the original for all subsequent gardeners calendars.

The Evelyn portrayed is a very human person and one for whom it is easy to feel sympathy. The book is well worth reading for its perspective on the life and times of 17th century England.

GORDON P. DEWOLF, JR.

The International Book of Trees. A guide to the trees of our forests and gardens. Hugh Johnson. New York: Simon and Schuster. 1973. 288 pages (9 × 11½″), illustrated. $29.95.

This book must be seen to be believed, for no review can do justice to the encyclopedic coverage, the beauty of the illustrations, the charm of the text. It is, by far, the best single volume on trees ever published.

The author admits he is not a botanist, nor a forester, nor even a gardener, but a writer who has found in trees "a new point of contact with creation, a source of wonder and satisfaction," and he has presented a personal account that, as he states, has made his former awareness of trees seem quite shameful. With the cooperation of many people, he has assembled a tremendous amount of information on trees. The opening chapters, 30 in number and each two pages long, cover topics from how a tree grows, to pruning and other arts. They are delightful essays and reviews at first botanical, then historical; all skim the subject, yet are profusely and appropriately illustrated. It is impossible to stop reading this book because of its content, but one does because of the small type, only to pick it up again and again.

The bulk of the volume comprises illustrated, short articles on groups of trees. Chapters such as The Pines of Asia, The Plum Yews and Podocarps, The Chestnuts, The Hawthornes, Empress Trees and Indian Beans, The Elders, cover the best known genera and range from their wild habitat to their appearance and diversification as cultivated plants.

A reference section and index completes the book, with charts and graphs covering the seasons of flowering, rates of growth (tree outlines superimposed on photographs of buildings depicting ten to one hundred years), insect pests and a guide to choosing the proper plant according to the site, characteristics of the plant or the environmental problem.

A book costing this much is often considered a display item for homes or libraries, but this is a readable, useful, attractive volume, highly recommended. Anyone interested in trees should have a personal copy and no single volume would be more useful to the botany or horticulturel "student" of any age. *The International Book of Trees* is a remarkable accomplishment.

RICHARD A. HOWARD

Viburnum Sieboldii. *Photo: P. Bruns.*

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ARNOLDIA

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Cover: Stewartia pseudocamellia *'Korean Splendor'. Photo: P. Chavny.*

Stewartias - Small Trees and Shrubs for All Seasons

by Stephen A. Spongberg and Alfred J. Fordham

Certainly some of the most interesting and unusual small trees and shrubs available for use in ornamental plantings are the deciduous species of the genus *Stewartia*. And although the horticultural merits of these plants have occasionally been extolled, we feel justified in bringing them to your attention again, particularly since a new species, already in cultivation at the Arnold Arboretum, has recently been discovered and named. Moreover, the methods given below of propagation of Stewartias from seed and cuttings will hopefully encourage growers to increase the numbers of these pest-free plants so that they can receive the widespread use and popularity we feel they deserve.

Stewartia is a member of the tea family, the Theaceae, and plants of the genus are easily recognized in our cultivated flora by their numerous creamy white flowers that are produced individually on short to long pedicels in the axils of the leaves. The small, sometimes bushy trees or shrubs have alternate, simple, dark green leaves that lack stipules; the leaf margins are serrated or toothed, and the under surfaces are often finely pubescent when young. In the Boston area Stewartias bloom during late June and early July, a period when most of the spring-flowering woody ornamentals have past. The flowers are produced on the current season's growth, and the flower buds, enveloped by the calyx and subtended by one or usually two floral bracts, are evident early in spring as the leaves expand.

The calyx is comprised of five sepals that are usually similar in size and shape to the floral bracts, and in some species both are conspicuously foliaceous. The five (or sometimes up to eight) petals of *Stewartia* flowers are essentially scallop-shaped in outline and form and are silky pubescent on their outer surfaces; in one species the petals are flushed with red on the outer surface near the base. The stamens are numerous, and the filaments are united to one another towards the base where they

are usually attached to the base of the petals as well. After flowering, the petals and stamens fall to the ground still attached to one another.

The flowers of Stewartias are similar in size, general structure, and appearance to a single *Camellia* flower. This fact is not surprising since these two genera, along with *Franklinia* and *Gordonia,* belong to the same subfamily of the Theaceae. A key to these genera and other genera of Theaceae in cultivation has been published previously in *Arnoldia* (**17:** 1–12. 1957) in an interesting and informative article by Dr. C. E. Wood, Jr.

Equally intriguing as the flowers, the relatively large fruits are rounded or conical, usually five-ribbed, woody capsules that are tapered at their upper ends into beaklike projections. The capsules develop from the superior, compound ovaries found at the center of the flowers. When in bloom, the ovaries of the flowers are usually hidden from view by the numerous stamens. Green at first and subtended by the persistent sepals and floral bracts, the capsules gradually assume a rich, light or dark brown color at maturity when they open to disclose the seeds in five internal locules or compartments. The capsules of most species remain on the branches during the winter months, providing an attractive accent to the delicate tracery of the branches.

But perhaps the most notable aspect of several species during the winter months is the fact that, once the colorful fall foliage drops, the bark of trunks and limbs is exposed to full view. Four of the deciduous species develop smooth, mottled bark, and on larger trunks and branches soft fawn, silvery or pinkish-brown, or buff colored areas alternate in irregular patterns with one another or with darker cinnamon or reddish-brown areas. The beautiful bark colors and patterns alone are reasons enough to plant these species of *Stewartia.*

As it is now understood, the genus *Stewartia* consists of both evergreen and deciduous species, although the latter are by far the most familiar horticultural subjects. Only one evergreen species, *Stewartia pteropetiolata* Cheng, is known to be cultivated in western gardens, and we have documentation of its cultivation in southern California and in England. While the exact number of evergreen species (sometimes grouped as comprising the separate genus *Hartia*) remains indefinite (probably

Fig. 1. Close-up photograph of the mottled bark pattern developed on the trunks of Stewartia pseudocamellia. *Photo: P. Bruns*

not exceeding eight or nine), seven deciduous species and one hybrid are currently recognized, and all have been introduced into cultivation (see G. P. DeWolf, Jr., The introduction of our hardy Stewartias. *Arnoldia* 29: 41–48. 1969). All of the evergreen species and five of the deciduous species are native to eastern Asia, but the two additional deciduous species occur naturally in the southeastern United States. Thus, *Stewartia* exhibits one of the fascinating distribution patterns that illustrates the floristic relationships between eastern North America and eastern Asia.

The first plants of *Stewartia* on record were found in Virginia by the Reverend Mr. John Clayton in about 1687. The plants Clayton described and distinguished from the dogwood (*Cornus florida* L.) were from a population near Williamsburg on Archer's Hope Creek; that population is still in existence today. Fifty-five years after the Reverend Mr. Clayton had discovered these plants, Mark Catesby, the English traveler and naturalist, received a new shrub for his garden at Fulham, England, from another John Clayton, an English naturalist in Virginia. The plants flowered in May of 1742, and it is suspected that Catesby, recognizing their ornamental value and botanical interest, gave plants of the new shrub to John Stuart, the third Earl of Bute, for the botanical garden he was helping to establish at Kew.

In addition to his gift of living plants to Catesby, the younger Clayton also sent dried herbarium specimens of the shrub to Gronovius, a Dutch botanist who forwarded one to Linnaeus. The name *Stewartia* (sometimes incorrectly spelled *Stuartia*), honoring John Stuart, was given to the new genus and first published by Linnaeus in 1746.

An interesting and ironic historic note to the dual discovery of *Stewartia* by the two John Claytons lies in the fact that both men had discovered different species of the genus. All of the subsequently discovered species of *Stewartia* have been found in eastern Asia, and like several other ornamental genera with eastern Asiatic and eastern American distributions, certain Asiatic Stewartias are the most commonly cultivated ones in western gardens. However the following key, based primarily on floral and fruit characters, will serve to distinguish between all the deciduous species, American and Asiatic. Following the key are notes on the individual species and the one hybrid, an account of the rather unexpected discovery of *S. rostrata* from within the Arboretum's collection, and in conclusion, notes on the propagation of Stewartias.

Key to the Deciduous Species of Stewartia

1. Styles 5, distinct; petioles widely winged, enclosing the lateral and terminal buds; floral bract 1. ..... *S. ovata.*
1. Styles united, terminating in 5 or 6 stigmatic crests or arms; petioles narrowly winged, not enclosing the lateral and terminal buds; floral bracts 2. ..... 2.
   2. Stamens with purplish filaments and bluish anthers; capsules dehiscent by the outward folding of the valve margins, the apices of the valves ± coherent; seeds angular. ..... *S. malacodendron.*
   2. Stamens with whitish filaments and yellow or orange anthers; capsules apically dehiscent, the valves spreading apart from the apex; seeds planoconvex. ..... 3.
      3. Floral bracts about equalling or longer than the calyx; small or large trees or shrubs with smooth or fissured bark; young branches usually terete, not zigzagged. 4.
         4. Ovaries and/or capsules subglobose, completely glabrous or pubescent only at the very base. 5.
            5. Ovaries and/or capsules completely glabrous; 2 ovules or seeds per locule; bark on older branches smooth and mottled. ..... *S. serrata.*
            5. Ovaries and/or capsules pubescent only at the very base; 4 ovules or seeds per locule; bark on older branches finely fissured. ..... *S. rostrata.*
         4. Ovaries and/or capsules conical, pilose or appressed pubescent over the entire surface. 6.
            6. Sepals oblong or ovate with acute apices. ..... 7.
               7. Floral bracts ovate, subequal to the sepals; styles 6–8 mm. long; seeds 7–9 mm. long. ..... *S. sinensis.*
               7. Floral bracts oblong, conspicuously longer than the sepals; styles 3–4 mm. long; seeds 5–6 mm. long. ..... *S. monadelpha.*
            6. Sepals ovoid with rounded, ciliate apices. ..... *S.* × *henryae.*
      3. Floral bracts conspicuously shorter than the calyx; small trees with smooth, mottled bark; young branches usually compressed and zigzagged, rarely terete. ..... *S. pseudocamellia.*

Stewartia ovata (Cavanilles) Weatherby **Mountain Stewartia**
Stewartia pentagyna L'Heritier

Stewartia ovata occurs naturally in the mountains and on the adjacent Piedmont of North and South Carolina, Georgia, Alabama, Kentucky, and Tennessee. It is also known from two isolated stations on the Virginia Coastal Plain in the vicinity of Williamsburg, and it was at one of these localities that the species was first discovered by the Reverend Mr. John Clayton.

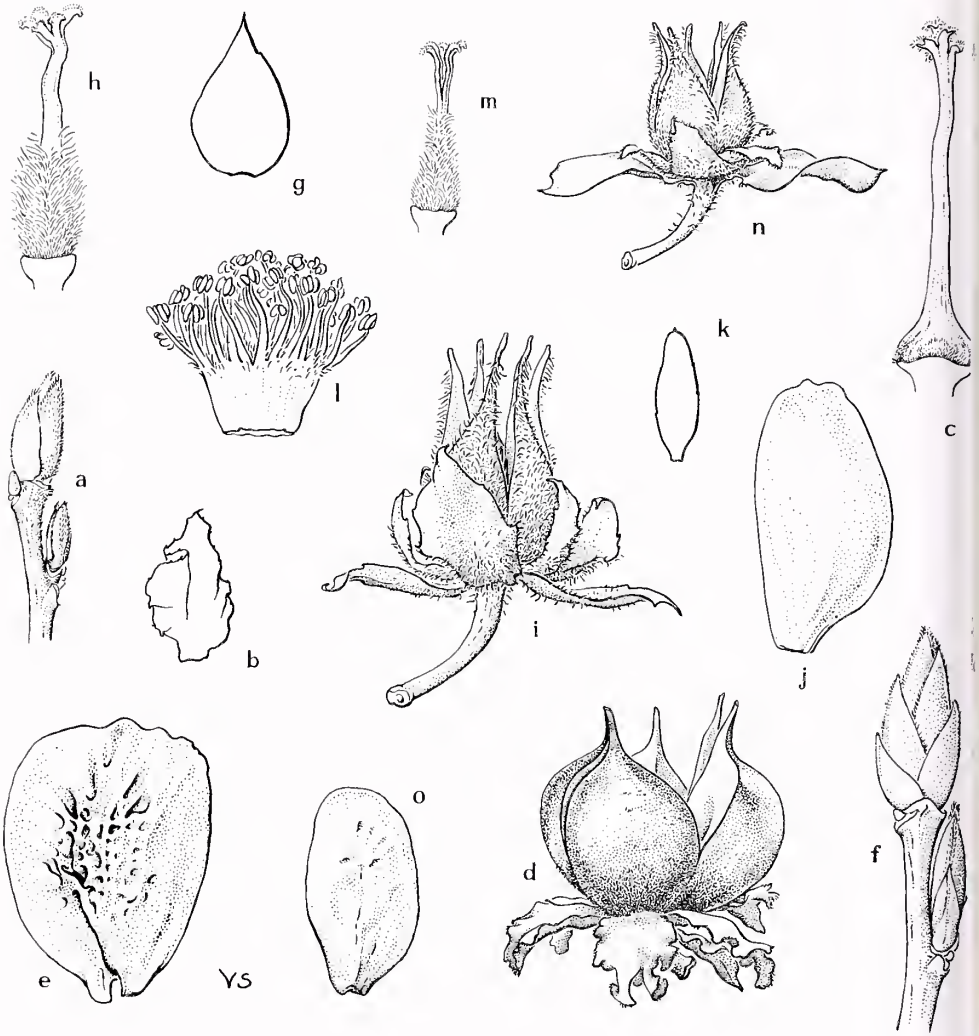


Fig. 2. Stewartia. a–e, S. rostrata: *a, dormant winter buds,* × 2; *b, floral bract,* × 2; *c ovary and style* × 2, *note pubescence only at the base of the ovary; d, dehisced capsule with persistent floral bracts and sepals* × 1 1/2; *e, seed,* × 4. *f–j,* S. sinensis: *f, dormant winter bud,* × 2; *g, floral bract,* × 2; *h, pubescent ovary and style,* × 2; *i, dehisced capsule with persistent floral bracts and sepals,* × 1 1/2; *j, seed,* × 4. *k–o,* S. monadelpha: *k, floral bract,* × 2; *l, stamens,* × 2; *m, pubescent ovary and style,* × 2; *n, dehisced capsule with persistent floral bracts and sepals,* × 1 1/2; *o, seed,* × 4. *Illustrations by Virginia Savage.*

This species is easily distinguished from other Stewartias by the single floral bract that subtends each of its flowers and by its five distinct styles. The flowers, about 2½ inches in diameter, are among the largest produced by any *Stewartia*, and f. *grandiflora* (Bean) Kobuski, a form that occurs sporadically throughout the natural range, is of particular horticultural interest due to its slightly larger flowers (up to 3½ inches across) with five to eight petals. In addition, the stamen filaments in f. *grandiflora* may be purplish rather than the usual white or yellowish color. At the Arnold Arboretum, one plant of f. *grandiflora*, which came originally from Highlands, North Carolina, produces flowers with both purplish and yellowish stamen filaments.

Although the bark of *Stewartia ovata* does not exfoliate to produce a smooth, mottled pattern, the plants develop into small bushy trees or shrubs to about 18 feet in height. And despite its natural southern range, the species and f. *grandiflora* are hardy as far north as the Boston region.

Stewartia malacodendron Linnaeus — **Silky Stewartia**
Stewartia virginica Cavanilles

Native to the Coastal Plain and Piedmont of the Southeastern United States from Virginia south to northern Florida and west to Arkansas and eastern Texas, *Stewartia malacodendron* is the species that John Clayton, the naturalist, discovered growing in Virginia. While the Silky Stewartia is rather infrequently encountered in cultivation, it produces, in our opinion, the most beautiful of all *Stewartia* flowers. The five large white petals form a contrasting, saucer-shaped background, 3 to 3½ inches across, for the erect boss of stamens that are entirely purplish-blue. The color of the stamens alone is sufficient to identify the species when they are in flower. Unlike the other species of the genus, the reddish-brown capsules of *S. malacodendron* open along the sides rather than from the apex. Furthermore, the seeds are a dark, shining, reddish-brown color and are unwinged and angular in outline. Other Stewartias produce more or less flat, narrowly winged, pale brown seeds.

Although we have attempted to grow *Stewartia malacodendron* several times at the Arnold Arboretum, it has not proved hardy. However, the plants, which develop into large, albeit rather spindly shrubs or small trees to about 20 feet, have been successfully grown as far north as Long Island.

Stewartia serrata Maximowicz
Including *Stewartia epitricha* Nakai

With the exception of *Stewartia* × *henryae, S. serrata* is perhaps the least frequently encountered *Stewartia* in American gardens. Native to Japan, where it inhabits mountainous regions of Honshu, Shikoku, and Kyushu Islands, it is represented in our herbarium of cultivated plants by only a few collections. It is, however, known to be hardy as far north as Connecticut.

A small tree with horizontal branches and smooth, reddish-brown, mottled bark, *Stewartia serrata* will be recognized by its petals that are flushed with red near the base on the outer surfaces, as well as by its completely glabrous ovaries. The capsules, like the ovaries, are completely devoid of hairs and are strongly five-ribbed; two seeds are produced in each locule. In England, where it is apparently more commonly cultivated, *S. serrata* is reported to begin flowering before the other species in early June.

Stewartia rostrata Spongberg

In 1939, the Arnold Arboretum received seed of a *Stewartia* from the Lu Shan Arboretum in Kiukiang, China, under the name *S. sinensis*, a species Alfred Rehder and E. H. Wilson had described in 1915. Subsequently, one plant grown from that seed-lot was planted in the *Stewartia* collection on Bussey Hill in the Arboretum. Only recently, however, did the name and identity of our plant come into question. As one of us was checking the identities of our living specimens, this plant did not seem to correspond to the published descriptions of *S. sinensis*.

On consulting Dr. G. P. DeWolf, Jr., and Mr. R. S. Hebb of the Arboretum staff, it was found that they, too, were aware that something was strange about our plant labeled *Stewartia sinensis*. Mr. Hebb's recollection of *S. sinensis* grown at Kew in England was of an upright tree with reddish-brown, exfoliating, smooth, mottled bark. Our Arboretum plant, now 38 years old, is a small bushy tree with several limbs from near the base and with tight, non-exfoliating, finely fissured gray bark.

As a result of these contradictions, further study was undertaken in the herbarium and library. Examination of the holotype specimen of *Stewartia sinensis*, a specimen collected in eastern Hunan Province, China, by Wilson in 1901, showed that Mr. Hebb's memory had served him well. The specimen represents a species with smooth, exfoliating bark; furthermore,

Fig. 3. Flowering branch of S. rostrata, *the species recently described as new, growing in the Arboretum collections. Photo: P. Bruns*

the ovaries in the center of the flowers are finely pubescent. The ovaries from flowers of the Arboretum tree have hairs only at the very base.

Other herbarium specimens that Rehder and Wilson had annotated as *Stewartia sinensis* included some plants that agreed in bark and flower characters with the holotype specimen. Additional specimens, however, appeared to represent the same species as the Arboretum tree on Bussey Hill. Further study revealed other differences between the two species, differences that are most readily observed when the plants are in fruit.

Once it was determined that the Bussey Hill plant was not *Stewartia sinensis*, the question remained whether it belonged to another species already described, or if it were, indeed, a new undescribed species. In an attempt to answer this question, the taxonomy of the entire genus was reviewed (see the *Journal of the Arnold Arboretum* **55**: 182–214. 1974), and all of the published names and as many type specimens as possible were examined. During this process, *S. gemmata*, a name by which several of our living plants were known, also became suspect.

On checking type herbarium specimens of this name it was discovered that Chien and Cheng, the Chinese botanists who had published *S. gemmata,* had redescribed *S. sinensis.* Chien and Cheng had obviously realized that two species were passing under the name *S. sinensis,* but in an attempt to remedy this situation they chose to give the name *S. gemmata* to the species Rehder and Wilson had described and named in 1915. This aspect of the confusion, incidentally, points out the great value of type herbarium specimens in determining the correct application of botanical names. Had Chien and Cheng studied the type of *S. sinensis*, they, too, would have realized that the species that lacked a name was the tree with non-exfoliating bark and flowers with the ovaries pubescent only at the very base. The name *S. rostrata* has been proposed for this new species because of its distinctive rostrate or beaked, five-ribbed capsules that remain on the branches over winter and sometimes into a second or third growing season.

It is of note that *Stewartia rostrata* is the only deciduous Asiatic species that, like the two American species, has tight, non-exfoliating fissured bark. And herbarium data indicate that it is apparently confined in nature to mountainous regions of Chekiang, Kiangsi, and eastern Hunan Provinces in China. In cultivation, it is included in the collections of the Barnes and Morris Arboreta and at Longwood Gardens, as well as at the Arnold Arboretum.

Stewartia sinensis Rehder and Wilson
Stewartia gemmata Chien & Cheng

Once it was realized that the Arboretum's plant labeled as *Stewartia sinensis* was not that species, we were momentarily disappointed that our collection lacked a plant of this Chinese *Stewartia.* It had been discovered by E. H. Wilson, and Alfred Rehder and Wilson had named and described it as new. However, during the taxonomic studies that were initiated because of the unknown identity of *S. rostrata*, it was recognized that plants on Bussey Hill labeled as *S. monadelpha,* a species native to Japan, were actually plants of *S. sinensis.* These plants had been grown from seed obtained in 1934 from the Sun Yat Sen Memorial Park in Nanking, China, and despite the mobility of ornamental plants, it had seemed strange that we had received a Japanese species from a Chinese source.

An erect tree or ascending shrub to about 60 feet, *Stewartia sinensis* is characterized by its attractive, smooth, exfoliating,

mottled bark, its pubescent ovaries, and its foliaceous floral bracts that are about as long as, or slightly longer than, the similar appearing sepals. The capsules are conical and densely pubescent, and two seeds are produced in each locule. The flowers, while smaller than those of some other species (about 2 inches across), are produced in great numbers. In nature this species occurs in mountainous regions of eastern central China, and its closest ally, with which our plants were originally confused, appears to be the Japanese *S. monadelpha.*

Stewartia monadelpha Siebold & Zuccarini
Including *Stewartia sericea* Nakai

Known to attain a height of 50 feet in Japan, *Stewartia monadelpha* is native to mountainous areas of southern Honshu, Kyushu, and Shikoku Islands. In American gardens, however, it is usually a smaller tree that is noted for its beautiful reddish-brown bark on both the trunk and delicate horizontal branches. Its flowers are the smallest produced by any deciduous *Stewartia* (a little over an inch in diameter), and it is easily identified in bud, flower, and fruit by the oblong, persistent floral bracts that are conspicuously longer than the five sepals.

Stewartia pseudocamellia Maximowicz
Including *Stewartia koreana* Rehder

Readily distinguished from other members of the genus by its small, kidney-shaped or rounded floral bracts that are considerably smaller than the densely silky-pubescent sepals, and by its branchlets that are usually compressed or flattened and zigzagged, *Stewartia pseudocamellia* is the most widely cultivated species of the genus. The flower buds, rounded before opening, and the flowers which are up to 3½ inches in diameter, are borne on long pedicels. The boss of stamens with orange anthers suggest those of a single *Camellia* flower. The ground beneath the small trees or shrubs becomes carpeted with the fallen corollas and the attached stamens as the flowering season progresses.

Native to Japan, where it is also cultivated, *Stewartia pseudocamellia* is also known to occur naturally in southern Korea, and the Korean plants grown at the Arnold Arboretum were germinated from seed collected by E. H. Wilson in 1917. Originally regarded as a distinct species (*S. koreana* Rehder), and then as a variety of *S. pseudocamellia* (var. *koreana* (Rehder) Sealy),

the Korean plants do not appear to be morphologically distinct from the plants of Japanese origin. Korean plants at the Arnold Arboretum do, however, differ from Japanese plants in their more saucer-shaped flowers, their extended blooming period, and in the coloration of the leaves in fall. The foliage of the Japanese plants becomes a deep burgundy-red in fall, while leaves of the Korean plants turn a bright yellow- or reddish-orange. As a result of these behavioral differences, differences that are significant to nurserymen and horticulturists, we propose here that the Korean plants henceforth be designated as a cultivar, and we suggest the cultivar name 'Korean Splendor'.

Observations made here at the Arboretum indicate that individual flowers of 'Korean Splendor' persist on the plants for slightly longer than 24 hours once the buds have opened fully. The prolonged blooming season (as compared with the Japanese plants) is not the result of the persistence of individual flowers, but is apparently the result of a greater production of flowers coupled with the less synchronous maturation of the buds. We

Fig. 4. The camellia-like flowers of S. pseudocamellia *'Korean Splendor' are accented by the rich green foliage. Note the rounded, silky buds yet to open. Photo: P. Bruns*

have also noted that small bumblebees are attracted to, and force their way into, the unopened buds of *S. pseudocamellia* and 'Korean Splendor', apparently in search of pollen. The value of *S. pseudocamellia* and 'Korean Splendor' as summer-flowering trees is extended and enhanced by their equal beauty in winter when the mottled bark is viewed against snow-covered ground.

Stewartia × henryae Li

Stewartia pseudocamellia 'Korean Splendor' × *S. monadelpha*

This putative hybrid between the two above listed Stewartias originated spontaneously in the collections of the Henry Foundation for Botanical Research in Gladwyne, Pennsylvania. It differs only slightly from *S. pseudocamellia,* but can be distinguished from that species by its oblong floral bracts that resemble those of *S. monadelpha,* its slightly smaller flower size, and the presence of two seeds per capsule locule. *Stewartia pseudocamellia* produces four seeds per locule, although two are often abortive. From *S. monadelpha* the hybrid can be distinguished by its ovoid sepals with rounded, ciliate apices, and by its larger flower size.

This small tree is known from several specimens at the Henry Foundation where both of the presumed parental species grow in close association with the hybrid, and it is also known in cultivation at Barnard's Inn Farm on Martha's Vineyard. Cuttings obtained from the latter source have been rooted in the Arboretum greenhouses, and young plants of *S.* × *henryae* will soon be added to the Arboretum collection; to our knowledge, it does not occur elsewhere in American gardens.

Propagation of Stewartias by Seed

Stewartia seeds are produced within the five-locular, woody capsules, and each locule, depending upon the species, contains two or four seeds. In some instances fewer seeds are produced in each locule due to the abortion of one or more of the ovules; abortion results because the egg within the ovule either was not fertilized, or the egg failed to develop after fertilization. Natural dispersal of the narrowly-winged, flattened seeds of most species is by wind, and in the latitude of Boston the capsules open and the seeds are available for dispersal (or collection) during late September and early October.

A careful watch must be maintained if one intends to collect the seeds from the dehisced capsules on the plants, since tightly closed capsules can open unexpectedly, and the seeds may be scattered quickly. As a result, it is best to collect capsules before they have dehisced. Maturity of seeds is indicated by a change in the appearance of the capsules; about mid-September they begin turning from green to brown, and at this stage the seeds are fully developed and viable, and the capsules can be gathered. Separation of the seeds from the capsules is easy if the fruits are placed in a paper bag, tray, or other container that is then placed in a dry location. In a few days the closed capsules will have opened, and when the container is shaken the seeds will fall out. Separation of the seeds from the capsules can then be accomplished by emptying the contents into a screen of suitable mesh size to retain the capsules but to permit the passage and final collection of the seeds.

Difficulty in the separation of seeds from capsules may be experienced with the fruits of *Stewartia malacodendron.* As mentioned previously, the capsules and seeds of this species differ from those of other species. The angular seeds are often held tightly within the locules, and their removal may require the forceable opening of the capsule by hand. Since the hard woody capsules of this species dehisce naturally along the sides, a blow on the top of the capsule with a small hammer may be necessary to release the seeds.

When kept in dry storage, *Stewartia* seeds lose their viability quickly. As a result they should be sown or placed in pretreatment without delay after they have been harvested. All of the species grown and tested at the Arnold Arboretum (*S. ovata*, *S. pseudocamellia* and 'Korean Splendor', *S. rostrata*, and *S. sinensis*) produce seeds that are doubly dormant, and in their natural habitats the seeds would require two years to germinate. In other words, seeds dispersed in October of 1974 would be physiologically prepared to germinate by natural seasonal changes in the spring of 1976. However, by placing the seeds in a stratifying medium and providing artificial seasons, the seeds can be induced to germinate in about seven months. This pretreatment must be done in two stages, and the container for the seeds and stratifying medium during the process should be a polyethylene bag. Polyethylene film has the property of being air permeable yet vaporproof. Twisting the top of the bag and binding it with a rubber band makes the stratifying unit vaporproof for the entire treatment, and it should not be opened until the treatment has been completed.

At the Arboretum greenhouses, a stratifying medium composed of equal parts sand and peatmoss has worked well with *Stewartia* seeds. This mixture is dampened (moist but not wet) and, in proportion, the medium should be two or three times the volume of the seeds. This factor is important since at sowing time the seeds are not separated from the medium and the entire contents of the polyethylne bag are sown.

Using seeds of those species in cultivation at the Arnold Arboretum, it has been determined that a period of warm stratification for four months followed by cold stratification for three months satisfies the requirements for germination. Seeds placed in warm stratification in early October are transferred to cold pretreatment in early February, and the seeds are ready for sowing in the greenhouse or out-of-doors in early May. This timetable is excellent, since the seedlings will respond favorably to the warm and lengthening days of spring.

Warm stratification can be accomplished by placing the sealed bags in a location where the temperature is subject to normal day and night fluctuations. We place our bags in bins on a greenhouse bench where the temperature has ranged between 60° and 100°F. Any location where the day and night temperatures vary would be satisfactory; full sun, however, should be avoided since it might lead to high temperatures within the bags that would be detrimental to the seeds. When the period of warm stratification has been completed, the bag is simply transferred to a refrigerator to satisfy the need for cold treatment. At the Arboretum, cold pretreatment is accomplished at about 40°F.; however this temperature is arbitrary, and the temperature maintained in the storage compartment of any refrigerator should suffice for the cold treatment.

Propagation of Stewartias by Cuttings

As an alternative method of propagation, soft-wood cuttings may be taken from Stewartias to be rooted, and depending upon the availability of donor plants, large numbers of new plants can be asexually initiated. At the Arboretum, cuttings of Stewartias have been taken as early as June 23 and as late as August 20. Although rooting has been partially successful in all our attempts over this time period, the greatest number of cuttings was successfully rooted when the cuttings were taken and treated between June 23 and mid-July.

Although a wide variety of root-inducing chemicals have been used with success with *Stewartia* cuttings, we have found that Indolebutyric acid (IBA) has proven to be the best rooting stimulant. Normally, the cut ends of the cuttings are dusted with a 0.8% treatment of IBA in talc with the fungicide 'Thiram' added at the rate of 15 percent. High percentages of rooting have also occurred employing quick-dip treatments using a combination of IBA plus NAA (Napthalene acetic acid) at the rate of 2500 parts per million of each in water. Quick-dip treatment involves immersing the bases of prepared cuttings in the liquid preparation for five seconds.

Rooted cuttings of *Stewartia*, particularly those made late in the growing season, have presented a survival problem during the subsequent winter. When potted or flatted after rooting, the plants have gone into dormancy and never recovered. This loss can be averted, however, if the cuttings are not disturbed after they have rooted. The procedure we use is to fill plastic flats with a rooting medium of half 'Perlite' and half sand by volume. The cuttings are made, treated, and inserted in the flats which are then placed under intermittent mist. When rooting has occurred, the cuttings are left in the flats and hardened off. In November they are transferred to our cold storage unit where the temperature is maintained at approximately 34°F. In February or March the flats are returned to a warm greenhouse, and when new growth begins to appear, the plants are transferred to containers. When handled in this manner, the rooted cuttings can be expected to survive and grow.

When a *Stewartia* is planted in the garden, it is advisable to place the plant in its permanent location where it will be exposed to full sun or high, only partial, shade. The plants appear to grow best in moist, acid soils, and it has been reported that larger plants transplant poorly. However we have had no difficulty transplanting plants upwards of 7 or 8 feet if a sufficient ball of soil is taken. Ideally, the plants should be grown as specimen trees and shrubs so that the full beauty of form, flowers, and bark can be enjoyed from all aspects and at all seasons of the year.

The Arboretum and the Commercial Nursery: *A Symbiosis**

by William Flemer, III

The many services that an arboretum performs for the public at large are too well known to require elaboration. So also is the educational importance of an arboretum attached to a college or university. Less frequently appreciated are the services that an arboretum performs for the commercial nursery industry. And in exchange there are services that the nursery can perform for arboreta, so the relationship can be a two-way street; in short, a symbiotic one.

Perhaps the most important arboretum function of all, from the nurseryman's point of view, is to serve as a show case for the products that he grows and sells. Most nurseries, being relatively small commercial enterprises, must make every acre count from a production standpoint. In the case of plant markets unattached to field production, space is even more limited and the efficient manager tries to make every square yard count. Therefore, few nurseries indeed can find the room to grow to full size and display mature specimens of the many tree and shrub species that they offer for sale. This limitation is especially evident in the case of shade trees, many of which need a quarter of an acre or more of ground space at maturity. While it is true that many of the important nursery plants can be found in mature form and size in the average older residential town, they are almost never labeled for identification and similar species or clones are rarely if ever planted adjacent to each other so that meaningful comparisons can be made. Consequently, fortunate is the retail nurseryman whose establishment is near an arboretum. Not all customers wish to research very thoroughly the trees and shrubs that they propose to plant; but for those who want to see the differences and special qualities for themselves, a nearby arboretum or botanical garden offers the best answer to their many questions.

* An address presented at the Annual Meeting of the American Association of Botanic Gardens and Arboreta in Jamaica Plain, Mass. on October 5, 1974.

Lilac collection at the Arnold Arboretum. Photo: P. Chavny.

The "show case" function of an Arboretum can be a valuable sales tool for a nursery too. Displays of mature plants in full bloom often serve as a strong stimulus to the public to seek out a nursery and buy some younger specimens for their home grounds. This is particularly true of collections of showy flowering shrubs like Azaleas, Lilacs, and Rhododendrons. I know of one retail nurseryman located near an arboretum famous for its lilac collection. He regularly stocks a container-grown selection of the best cultivars because he knows he will have a brisk demand for them each spring following "Lilac Sunday."

Of equal importance to the nursery industry is the arboretum's function as the only source of many authenticated true-to-name species and cultivars. If a grower wishes to add a rare plant to his production schedule, he frequently has nowhere else to turn for foundation stock. In the vicissitudes of human error, mistakes do occur in the propagation department and clones become mixed, to everybody's chagrin. This is particularly true in the case of very similar appearing plants that are slow to come into bloom, like lilacs, cherries or crabapples. In such a plight, a request to an arboretum specializing in the group can provide a new supply of true-to-name scions or cuttings.

For a limited number of nurseries engaged in breeding programs arboreta are invaluable genetic "banks" for parent breeding material. It is impractical for a nursery to maintain in perpetuity, true-to-name plants of all the parent stock that might someday be wanted for a breeding program. Yet, taken as a whole, our North American arboreta do this as a matter of routine operation, and this resource is invaluable for the serious private or institutional plant breeder.

The nursery industry, particularly its mail order segment, thrives on new and improved plants. All arboreta that maintain a policy of adding new plants to their collections for testing and display are an important source of new plants for nurserymen. Those which have an active breeding program are even more important because they are actually producing new and improved clones themselves. The National Arboretum in Washington, with its many breeding programs and its plant exploration trips (in part financed by Longwood Gardens) is doing especially noteworthy work in this area at present. The new and unbelievably hardy Azaleas being produced by the University of Minnesota's Landscape Arboretum is another example, as is the imposing list of woody ornamentals introduced by the Arnold Arboretum in Massachusetts. It is difficult to appreciate the enormous contribution that arboreta and botanical gardens have made to our nursery industry and thence to the gardening public.

Arboreta have a new and growing role in the preservation and dissemination of rare native species and races of plants. Just as zoological gardens may end up as the sole hope for the survival of rare and endangered mammals and birds, so arboreta may become the sole hope for endangered plants. Suburbanization and other changes in land use patterns are taking an increasing toll of rare plants each year. When possible, the creation of sanctuaries for rare plants or biomes is the best solution, but all too often local indifference or even greed may militate against such a hope. In these cases the concern and skill of an arboretum can save the day for posterity. The case of the Franklinia is a well known illustration. One small private botanical garden literally saved this handsome small tree for the gardens of today. A unique natural population of Franklinia was extirpated by collecting and export to England where the climate was unsuited to it. The sole surviving parent tree in Philadelphia was the source of all the Franklinias that we enjoy today.

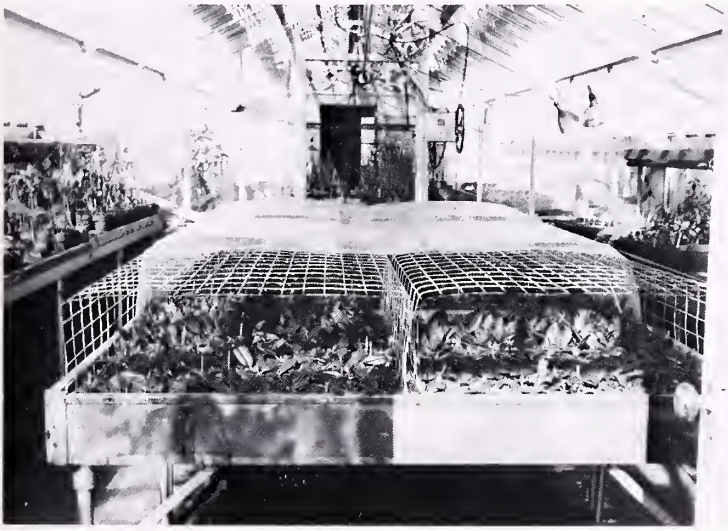
Franklinia alatamaha

A final important Arboretum function is research in propagation techniques and the dissemination of the findings. This is particularly important in the area of rare or little-grown plants. The Arnold Arboretum's Alfred Fordham recently received the Award of Merit of the International Plant Propagators' Society for his lifetime of contributions to this field. Research in how to germinate seeds of rare plants, often with peculiar dormancy requirements, research in the rooting of cuttings and in finding and evaluating understocks for clones that must be reproduced by grafting, have made important contributions to the nursery industry. In the field of propagation, the last word has never been said, and the future will hold many happy surprises for the nursery propagator, as a result of arboretum research.

On the opposite side of the equation, there is much that the nursery community can and does do to further the work of the arboreta and botanical gardens. Especially important is the dissemination to the gardening public of the new plants that they create. An arboretum has neither the space and staff, nor the finances to distribute new plants to the public at large. The best that can be accomplished is to send new introductions to cooperating producing nurseries, the solution presently in effect. Not all new plants have commercial possibilities, and

there are bound to be some disappointments. Arboretum breeders are by no means immune to the temptation of commercial ones, that tendency to think that *each* creation is unique and valuable in itself. A fairly recent example was the flood of Glen Dale Azaleas, a group of hundreds of cultivars whose acceptance by the trade was buried under an avalanche of "look alike" clones. The harsh reality of commerce is necessary to separate the unique yet vigorous clones from the competing "also rans."

Commercial nurseries also can provide, free or at a nominal cost, the understocks needed for routine arboretum propagation and research. Space and facilities are always at a premium, especially in the limitations imposed by an urban location, and nurseries that grow such understocks in enormous quantities can provide exactly the kinds and sizes wanted, thus relieving limited Arboretum propagation facilities of the burden. For establishments with a propagator on the staff, and many are



Propagating unit in the Arboretum's Dana Greenhouses.

now in this situation, nurserymen can propagate the young plants needed for replacement or addition to the collection quickly and efficiently. Each year finds our firm engaged in such activity for arboreta that have no propagator or the specialized structures and techniques needed for certain unusual propagation practices; and many other nurseries regularly take on such special work for favored institutions.

Nurseries, as individuals and through their state and national associations, also can and do assist in financing arboretum work. Our firm and many others regularly make grants of funds and plant material; the latter especially useful for the establishment of the many new arboreta springing up across the country, especially teaching arboreta associated with the new community colleges. The assembly of "one of each" orders for arboretum planting is especially costly and time-consuming, but we think it a very valuable investment for future generations of plant lovers. More and more arboreta and botanical gardens are forming associations of "Friends of The XYZ Arboretum." Such groups, properly led and encouraged, can provide financial assistance, tour guides to relieve pressure on the Arboretum Staff, and volunteer teachers for classes and children's activities. "Friends" associations are an invaluable first line of defense when condemnation proceedings arise, as they sometimes do. And a devoted group of wealthy "Friends" is almost the only source for bequests when death takes its toll. Such a valuable association, like any other, must be carefully cultivated to bear fruit. Nurserymen are more than glad to provide quantities of small rare or new plants to be distributed as gifts to members of such supportive groups. The scope of this kind of industry cooperation and support is bound to grow in the years to come.

Symbiosis is an association of living organisms from which both derive benefits they could not have alone. It is a term that can truly characterize the fruitful relationship between the members of the AABGA and the nursery community.

Mr. Flemer is President of Princeton Nurseries, Princeton, New Jersey.

Arnoldia Reviews

The British Oak. M. G. Morris and F. H. Perring, editors. Faringdon, Berks., England: E. W. Classey Ltd. 1974. 376 pages, illustrated. £6.00.

The Botanical Society of the British Isles is an association of amateur and professional botanists whose common interest lies in the study and conservation of flowering plants and ferns. The Society has sponsored a series of conferences, and since 1948 many of the papers presented at individual conferences have been published as symposium volumes. In 1973 we welcomed "Plants, Wild and Cultivated" edited by P. S. Green. The current volume relates to a three-day conference held in the same year.

"The British Oak" is a comprehensive study of two native species, *Quercus petraea* and *Q. robur*. Peats and sediments provide a pollen record indicating that the oak has been dominant over large areas of the British lowlands for some 8,000 years. Today *Q. robur* and *Q. petraea* remain the dominant trees in all of the British Isles.

As chapters in this volume, twenty-one papers by botanists, foresters and historians cover the taxonomy, cytology, morphology, reproduction, regeneration, productivity, and the ecological role of the oak. The wealth of information makes this an excellent reference work and demonstrates the value of such conferences. The pattern is one that might well be followed to consolidate the knowledge of equally valuable American trees.

RICHARD A. HOWARD

Chain of Friendship. Betsy C. Corner and Christopher C. Booth, editors. Cambridge: Belknap Press of Harvard University Press. 1971. 538 pages. $20.00

Nearly everyone knows of Peter Collinson, the Quaker Merchant of Mill Hill who subsidized and encouraged John Bartram. Less known is his contemporary, the Quaker physician, Dr. John Fothergill, and his garden at Upton. Fothergill's contacts were world-wide. It is recorded that, in the most flourishing

From Chain of Friendship.

period, his garden contained nearly 3,400 kinds of glasshouse exotics and about 3,000 kinds of hardy plants.

Fothergill is of interest to Americans because of his support of, and contact with, horticulturists in the Philadelphia area (including William Bartram), and because he is commemorated in the genus *Fothergilla*.

These selected letters of Dr. John Fothergill give us a glimpse of English society as seen through Quaker eyes in the middle of the 18th century. It includes, incidentally, some background to the political troubles that culminated in the American Revolution. Altogether a delightful and interesting book.

GORDON P. DEWOLF, JR.

Flowering Cherries. Geoffrey Chadbund. London: Collins Publishers. 1972. 160 pages, illustrated. £2.85.

It is unfortunate that in many areas cherries are threatened by a virus that, added to their other problems, now makes these spring favorites a poor choice for the average small garden. However for those who are prepared to ignore the hazards, this is a reasonably priced and well-written book that should fulfill the late author's hope that he can help the cherry lover to select, plant, and grow the best variety for his purpose.

The 58 cultivars and species described have been selected from the hundreds that have evolved since the cherry first became popular in the Orient centuries ago, and are arranged according to habit of growth. This at first appears to be awkward; but with the aid of the index it proves to be simple and quite effective. The real problem will arise when the gardener has selected the tree that he wants and then tries to locate it commercially.

The chapter on cultivation contains sound information and advice, but I feel that the disease and pest problems are dismissed too lightly. To add variety and complete this very pleasant volume there is also a list, with short descriptions, of trees and shrubs for use as foil and background.

SHEILA MAGULLION

Trees of the United States and Canada. F. H. Montgomery. New York: Frederick Warne and Co., Inc. 1970. 144 pages, illustrated. $4.95.

This work is a pocket-sized tree and, occasionally, shrub guide to specimens in northern areas. The key is described as unique, but substantially represents the usual dichotomous keys to woody plants.

The descriptions of particular species are fuller than usual and there are good, brief descriptions of habitat. Although it has a glossary at the back, this little volume is virtually useless to anyone who does not have a good basic course in botany and/or taxonomy. A book best suited to the expert rather than the novice.

ELINORE B. TROWBRIDGE

Forests of Nepal. J. D. A. Stainton. New York: Hafner Publishing Co. 1972. 181 pages, illustrated.

Devotees of British Colonial literature recognize Nepal as the home of the Gurkha, legendary fighting men of the wars in the Indian sub continent. Nepal is also an Indian state in one of the most horticulturally and botanically interesting regions of the world. It has been only recently however, that westerners have been allowed to travel in the country.

Between 1954 and 1969 J. D. A. Stainton made 18 plant collecting trips to Nepal. The present volume is a synoptic overview of the plant association to be found in that country. It is written for the interested lay person who may have the good fortune to visit Nepal.

Supplementing the text are 156 colored reproductions of photographs and a folding map which shows the physiography and the botanical regions. All in all a useful and interesting book.

GORDON P. DEWOLF, JR.

A Flora of the White Mountains, California and Nevada. Robert M. Lloyd and Richard S. Mitchell. Berkeley: University of California Press. 1973. 208 pages. $8.00.

The White Mountains on the California/Nevada border are celebrated as the home of the oldest known living things: the Great Basin bristle-cone pines. This manual details our knowledge of the plants and plant communities of this area.

The little book is a model of what a local flora should be. A map shows the location of various areas mentioned. Chapters deal with the geology of the area, the phytogeographical relationship of the plants and the plant communities and vegetation.

For pilgrims to the bristle-cone pine forests this little book will be indispensable.

GORDON P. DEWOLF, JR.

White clover. From Your Lawn: How to Make It and Keep It.

Your Lawn: How to Make It and Keep It. R. Milton Carleton. New York: Van Nostrand. 1971. 2nd edition. 127 pages, illustrated. $7.95.

The author is a well-known contributor to various garden magazines. Lawn management is his horticultural specialty. On the basis of decades of study of grasses, fertilizers, disease identification and treatment, he distills his wisdom in this treatise. Everything is here. Emphasis is on starting newly or anew. We read how to site, grade, prepare the soil, fertilize, select appropriate grasses for seeding or sodding. We are instructed in how to nurse the grass, recognize ailments and engage in the necessary chemotherapy.

The treatment is so complete, so scientific, and so dull that most readers will find their salvation in the chapter "Places Where Grass Doesn't Grow." The author's solution to that dilemma: ground-covers. This should arouse the ire of an Arnold Arboretum staff member who is fond of stating, "the best groundcover in the long run is — grass." He obviously hasn't read Milton Carleton's book or his reply might be, "anything but grass — grass is SO MUCH WORK."

ELINORE B. TROWBRIDGE

A Dictionary of Useful and Everyday Plants and their Common Names. F. N. Howes. New York: Cambridge University Press. 1973. 290 pages. $12.50.

One of the most useful indices of plant names available to taxonomists has been *A Dictionary of Flowering Plants and Ferns* compiled by J. C. Willis (6th ed. 1931). The 7th edition of this work (1966), edited by H. K. Airy Shaw, eliminated for brevity much of the general information on economic uses, as has the 8th edition (1973). The present volume compiled by the late Keeper of the Museum at the Royal Botanical Gardens, Kew, consists of that material extended and brought up to date. It is said to include the "common names of plants throughout the world, where English is, or has been spoken or used." Trade names and the names of economic or commercial plant products, including timbers, are included and given in English. No dictionary could ever be complete since common names are so variable in use and in spelling. "British-English" spelling commonly is not the same as an "American-English" spelling. The information supplied varies considerably from long detailed discussions to very brief statements. Most data is supplied under the common name, requiring a cross reference from a generic or scientific name; the cross references are not always adequate. A number of the binomials used do not represent the correct scientific name. Recognizing such limitation, the work of Howes will be useful for occasional reference and probably best used as a starting point for further research on an otherwise obscure English common name.

RICHARD A. HOWARD

The Timber Economy of Puritan New England. Charles F. Carroll. Providence: Brown University Press. 1973. 221 pages. $12.50.

The colonial economy of New England was based upon fishing, farming, and lumbering. While most of us have heard, in a general way, about the King's Trees, I think we are rather ignorant about the colonial timber trade. This volume tells, in a few pages, a great deal about the economic impact of various forest products upon England and Europe and the West Indies. Along with R. G. Albion's "Forests and Sea Power" it should be on the shelf of every New England colonial history buff.

GORDON P. DEWOLF, JR.

Weeds and Wildflowers of Eastern North America. T. Merrill Prentice, artist, and Elizabeth Owen Sargent, text. Salem: Peabody Museum and Barre Publishers. 1973. 114 color plates plus unpaged preface, forward, introduction, and index. $45.00.

The most appropriate, accurate description of this volume is supplied by the artist on the third flap of the dust jacket which, in time, will be lost. It is worth repetition. "This book is not intended to be a reference book and certainly not a field guide. It is by no means complete; however, it may serve to identify some of the less familiar plants and to draw attention to others which may have escaped notice. I have made a real effort to

Lilium tigrinum. *From* Weeds and Wildflowers of Eastern North America.

draw the plants accurately, true to form and color. In general the plates are arranged in the sequence of bloom, beginning with skunk cabbage which appears in March and ending with the seeds and berries of autumn. The book is intended for pleasure rather than instruction and I hope it may in some measure achieve its goal."

The brief commentary rarely exceeding fifty words of free verse which Ms. Sargent provides for each plate is indeed an "enthusiastic response to the life around me." Both the artist and the writer have achieved their goals in this expensive, attractive, well-bound and pleasing volume.

RICHARD A. HOWARD

Viability of Seeds. E. H. Roberts, editor. Syracuse: Syracuse University Press. 1972. 448 pages, illustrated. $20.00.

Viability is defined as: "ability to live, grow and develop." "Viability of Seeds" is an attempt to assess the state of our knowledge of the factors which affect or influence seed viability. It is apparent that much of the work on this subject has been done with a limited number of species of crop plants and weeds; thus the data base is still too limited to allow sure generalizations to be made.

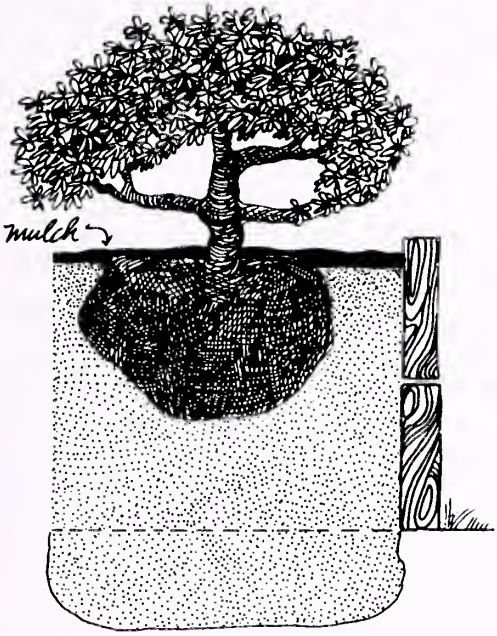
The present volume is welcomed as a summary of present knowledge and an indication of the vast quantity of work to be done.

GORDON P. DEWOLF, JR.

Azaleas. Fred C. Galle. Birmingham, Ala.: Oxmoor House. 1974. 96 pages, illustrated. $6.95 hardcover, $1.95 paperback.

This work is part of a long series of titles published by Southern Living, a regional magazine. The contents are, therefore, suited to readers who reside in Zones 8 or 9, and for visitors to azalea country in spring and early summer.

In a pleasant and comfortable style, the author, director of the Callaway Gardens in Georgia, fully describes and illustrates basic procedures relating to azalea growing. The first half of the test includes digging, planting, weeding, feeding, pruning, mulching and watering. There is attention to selecting suitable sites for "naturalistic" plantings; there are lists and discussions



Detail of raised bed planting. From Azaleas.

of complementary "companion plants." Azaleas in containers, including Bonsai, are treated. Propagation and disease diagnosis and treatment have complete but not excessive space. The final half considers particular species and hybrids thereof with color descriptions, hardiness ratings, sunshine requirements at various altitudes, and the like.

Several pages are devoted to a state-by-state listing of various southern "azalea show gardens." For one in the northeast this little book is still a good buy. The cultural information alone is worth the price of the volume.

ELINORE B. TROWBRIDGE

Seedlings of some tropical trees and shrubs mainly of South East Asia. Dr. D. Burger Hzn. Wageningen, Netherlands: Centre for Agricultural Publishing and Documentation. 1972. 399 pages, illustrated. 60 Dfl.

The variation in form between seedlings of different species is familiar to all gardeners. We are less apt to observe the change in form of the successive leaves produced by the germinating seed until the mature pattern of leaf position, size and shape is established. The young plant in its cotyledons and first few leaves does offer characteristics by which the species can be identified.

Dr. Burger obtained fruits from known native and cultivated plants and germinated the seeds. In this volume 187 species of 49 families are described and illustrated. The book will be useful primarily to foresters in South East Asia. When used along with James Duke's comparable work on plants of Panama and Puerto Rico (Ann. Mo. Bot. Gard. 52: 314–350. 1965; 56: 125–161. 1969) a good coverage of seedling morphology of tropical families is obtained.

The present volume was prepared for publication in Dutch in 1924, but was never published. In 1967–1971 the manuscript was translated into English for the present publication. Regrettably the translation has resulted in many awkward sentences and questionable use of punctuation. The identification keys supplied for a few families seem superfluous considering the few taxa treated. The illustrations are excellent and useful.

RICHARD A. HOWARD

Symplocos paniculata (*Asiatic Sweetleaf*). *Photo: P. Bruns.*

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Contents

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Cover: Pinus thunbergii. *Photo: P. Chvany.*

Common Pines of Massachusetts

by Gordon P. DeWolf, Jr.

We tend to take wood for granted; or, if we are very modern, to assume that steel, aluminum, and plastics have made wood obsolete. Such is not the case, and, although wood may not seem very important in a stainless steel and glass office building, it still provides shelter and comfort for most of us.

To the English colonists who settled New England, wood was a vital commodity that shaped their future in an alien land. The trees that they encountered were usually in vast tracts, and some were totally different from any they had known in England.

The colonists' need to clear land for gardens and pastures, combined with the fact that Spain, Portugal and the British West Indies were experiencing a lumber shortage, encouraged the development of a thriving export trade in timber products. White oak barrel staves to make barrels for wine, molasses, and rum were one of the most valuable New England exports. Old England seemed to be interested in only one commodity, however: white pine logs for masts.

Until the settlement of the American colonies, Britain had obtained most of her ship building timber either locally or from various ports around the Baltic Sea. With the growth of population and empire, the numbers and sizes of ships increased. One of the most serious problems for the ship builder was the availability of suitable masts.

At the end of the Colonial period a First Rate ship carrying 120 guns required a main mast 40 inches in diameter and 40 yards (120 ft.) long. A mast this size could be made from several smaller stems, but was expensive. Such "sticks" had been available in logs of *Pinus sylvestris* from the Baltic, but these soon became rare due to excessive lumbering. White pine (*Pinus strobus*) from New England was the best substitute.

The need for large white pines for masts for the Royal Navy led to a continuing series of laws restricting the use of white pine and to a lumbering industry set up to supply them. It became illegal to cut white pines over 24 inches in diameter for any other purpose.

Big trees were cut (or poached) of course, and the evidence may be seen in many an old house where the boards for floors and wainscotting are between 20 and 23 inches wide. In many cases the sides of the board are not parallel, one side being straight, the other, tapering. The tapering side was the outside of a great log; the straight side, the middle. Two boards 20 inches wide at the widest end could be obtained from a 40-inch log.

We should not assume that in days of old all trees were sound. Sir John Wentworth, Surveyor General of His Majesty's Wood, recorded in 1771 that:

> "This season the Mast Cutters for His Majesty's Contract found in one District a fine Growth of large and uncommonly fair trees, but on cutting them, one hundred and two out of one hundred and six proved rotten at the heart and not worth a shilling."

The whole question of the colonial timber trade is a fascinating one, and has been dealt with by two skillful authors.* Our interest in pines, however, is not in the timber but in the living plant and in particular, those that are commonly available for planting in Massachusetts.

Pines constitute the most important group of lumber trees in the world, and also are highly valued for ornamental planting. There are about 80 species, mostly of temperate regions, but a few occur in the tropical and subtropical climates of the West Indies, Central America, the Philippines, and southeastern Asia.

In nearly all of the species the trunk is typically erect, with whorls of secondary branches inclined more or less at right angles to the trunk. If the terminal bud or shoot of the trunk is destroyed, one or more of the buds or branches in the whorl immediately below the damage becomes erect and assumes the function of the trunk. If a single bud or branch becomes erect, the trunk ultimately has a crook in it at that spot. If two or more buds or branches develop, a forked or multi-trunked tree is the result.

The leaves of pines are narrow and needle-like. The primary leaves (Fig. 1), which may be reduced to mere scales (Fig. 2), are produced on all the growing shoots. In the upper axil of

* Robert Greenhalgh Albion, Forests and Sea Power, The Timber Problem of the Royal Navy 1652–1862. Hamden, Conn.: Archon Books. 1965.

Charles F. Carroll, The Timber Economy of Puritan New England. Providence, R.I.: Brown University Press. 1973.

Fig. 1. Pine seedling with primary leaves, some with fascicles of leaves in their axils.

Fig. 2. Twig from mature tree showing primary leaves reduced to scales.

some of the primary leaves a bud grows forward to produce a cluster or fascicle of 1 to 5 leaves (Fig. 1). This fascicle of leaves consists of a rudimentary mass of stem tissue to which the needles are attached at the tip (Fig. 3). At the base of the needles is a series of closely appressed scale-leaves that form the sheath (Fig. 4). In *Pinus strobus*, the white pine, and species closely related to *P. strobus* (subgen. STROBUS; syn. sect. *Haploxylon*) the sheath generally falls away in the first summer (Fig. 3). By contrast, the sheath persists for the life of the fascicle in the hard or yellow pine group (subgen. PINUS; syn. sect. *Diploxylon*).

The growing shoot produces at its tip a terminal bud surrounded by a whorl of generally 5 lateral branch buds (Fig. 5). One or more of these buds may be modified to form a young female cone, one evidence that the cone is simply a modified branch (Fig. 5). The young female cone continues its development through the summer of the year it is formed; the branch buds remain dormant until the following spring. The male cones are produced in clusters in the base of the terminal bud, in the same relative positions as the fascicles of leaves.

Fig. 3. Fascicles of leaves of the white pine group after the sheath scales have fallen.

Fig. 4. Base of fascicle of leaves showing sheathing scales.

In all of the white pines the female cones are produced at the tip of the first flush of growth in the spring. If there is a second flush of growth later in the season, the cones will seem to be borne laterally. In some of the hard pines the young female cones are borne laterally (not at the tip) on the first flush of growth (Fig. 6).

The young female cones are pollinated in the spring of the year of their formation. They enlarge somewhat during that summer, become dormant in the fall and rapidly enlarge to maturity during the second spring and summer. Generally the cones open at maturity during the fall of the second year and shed their seeds.

Some pines (*P. rigida* and *P. sylvestris*) produce cones every year. In many species, however, cones are only produced at longer intervals, sometimes only every 5 to 10 years. The seeds may be small and winged, or large and nut-like. In some species the cones do not open at all, or do not open immediately and the seeds consequently are retained for several years or indefinitely.

Pines generally produce a tap-root; hence a deep, well-drained (but not necessarily rich) soil suits them best. Their roots are easily injured by drying so, except in seedling stages, they must be moved with a ball of soil. Bushiness in growth may be promoted by removing the terminal buds of the branches, which stimulates the growth of lateral buds. Propagation is generally by seed. Selected clones must be propagated by grafting.

Each year, sometime between spring and fall, the oldest needles on the twigs turn brown and fall away. This is a natural phenomenon and not a cause for alarm. The term evergreen simply means that the green leaves of one year are retained on the plant until new leaves are formed the following year. In general, the leaves of pines are retained for two or more years according to each individual species. Leaves on vigorously growing young plants usually are retained longer than those on plants that are growing slowly. Leaves on leading shoots may be retained longer than those on branch twigs. Finally, pines growing in exposed situations, or at the limit of their hardiness, will generally shed their leaves sooner than trees growing under more favorable circumstances.

Fig. 5. Branch tip showing terminal bud surrounded by a whorl of three lateral branch buds and two female cones.

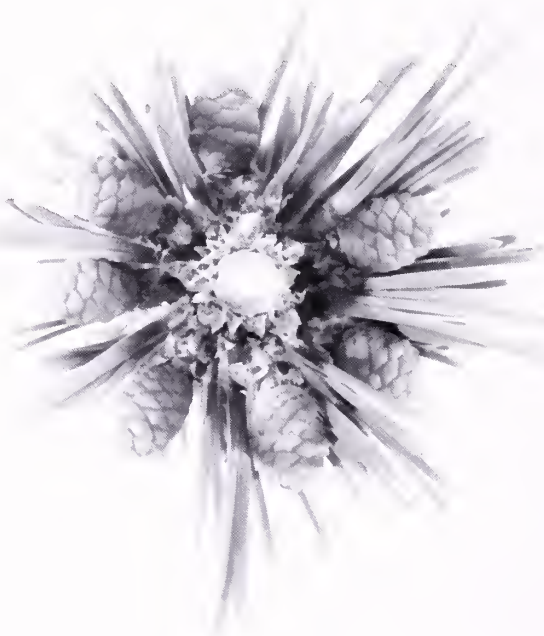
Fig. 6. Female cone in subterminal position on the twig.

Fig. 7. Pine needle scale on leaves of Pinus mugo.

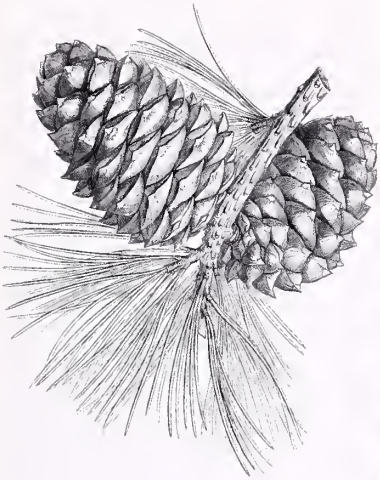
Key to the Identification of Common Pines in Massachusetts

A.	Sheaths of the needle clusters deciduous	Haploxylon (B)
AA.	Sheaths of the needle clusters persistent	Diploxylon (J)
B.	Needles 1 to 4 in a fascicle	edulis
BB.	Needles 5 in a fascicle	C
C.	Needles with conspicuous whitish exudations of rosin, persistent 10 to 12 years	aristata
CC.	Needles without rosin exudate, persistent for less than 10 years	D
D.	Needles drooping on the twigs	E
DD.	Needles straight, twisted or curved, but not drooping	F
E.	Twigs hairy, at least when young, needles 3–5 in. long	strobus
EE.	Twigs smooth, without hairs, needles 5–8 in. long	wallichiana
F.	Needles twisted, 1–3 in. long	parviflora
FF.	Needles straight or curved	G
G.	Needles curved, directed forward	H
GG.	Needles straight, more or less spreading	I
H.	Winter terminal buds acute, stomates in rows only on the back of each needle	albicaulis
HH.	Winter terminal buds with an elongate tip, stomates in rows on all three sides of each needle	flexilis
I.	Winter terminal buds ¼ in. long, the tips of the scales appressed	cembra
II.	Winter terminal buds ½–¾ in. long, tips of the scales spreading	koraiensis
J.	Sheaths of the fascicles persistent but reflexed the 1st year, deciduous the 2nd or 3rd year	aristata
JJ.	Sheaths of the fascicles persistent for the life of the fascicle	K
K.	Twigs 1/12–⅛ in. diameter, needles ¾–1½ in. long	banksiana
KK.	Twigs more than ⅛ in. diameter, needles more than 1½ in. long	L
L.	Twigs more than ½ in. diameter, needles 5–10 in. long	M
LL.	Twigs more than ½ in. diameter, needles less than 6 in. long	N
M.	Winter buds resinous, tips of bud-scales appressed	ponderosa
MM.	Winter buds not resinous, tips of bud-scales free	jeffreyi

N.	Needles 3 in a fascicle	rigida
NN.	Needles 2 in a fascicle	O
O.	Needles 4–6 in. long	P
OO.	Needles less than 4 in. long	Q
P.	Winter buds with the basal scales reflexed, needles slender and flexible, not breaking when bent	resinosa
PP.	Winter buds with the scales spreading, needles stout and stiff, breaking when bent	nigra
Q.	Shrub with ascending branches, needles persistent for 5 years or more	mugo
QQ.	Tree, with an erect trunk, needles persistent 2 to 3 years	R
R.	Winter buds resinous, bark of upper portion of trunk reddish-brown	sylvestris
RR.	Winter buds not resinous	S
S.	Winter buds chestnut-brown, needles slender, flexible, bark of upper part of trunk reddish-brown	densiflora
SS.	Winter buds whitish, needles stout, stiff	thunbergii



Young branch tip of P. thunbergii.



Pinus albicaulis Englemann **White-bark pine**

Tree to 10 m. (30 ft.) or a shrub at timberline. Twigs stout; bark reddish-brown with scattered stiff hairs. Bark on older branches and trunk broken by narrow fissures into thin, narrow, brown or creamy-white plate-like scales. Needles 5 in a fascicle, persistent 5 to 8 years, 5–7.5 cm. (2–3 in.) long, stout, rigid, curved, densely crowded on the twigs, directed forward. Cones subterminal, ovoid-cylindrical, 3.5–7.5 cm. (1½–3 in.) long, never opening. Seeds edible.

Grows in mountains above 1500 m. (5000 ft.) from SW Alberta and British Columbia south to NW Colorado, NE Nevada and the mountains of east central California.

It matures in about 150 to 200 years and is a very slow growing species. Some individuals only 5 feet tall are about 500 years old.

There is some doubt as to whether this pine is actually in cultivation here. Young trees (less than 50 years old) are very similar in appearance to *Pinus flexilis*. The surest identification is by the cones, which do not open in *P. albicaulis* but do in *P. flexilis*. We have had reputed *P. albicaulis* here, but on coning the trees have proved to be *P. flexilis*.

Pinus aristata Engelmann **Hickory pine, Bristlecone pine**

Bushy tree to 15 m. (50 ft.) or a semiprostrate shrub at timberline. Twigs reddish-brown, smooth or hairy. Needles 5 in a fascicle, persistent 10 to 12 years, 2–4 cm. (¾–1½ in.) long, stout, stiff, curved, densely crowded on the twigs, directed forward the first year, spreading later, marked with one or more resin droplets. Cones subterminal, cylindric-ovate, 7.5–8.5 cm. (3–3¼ in.) long, each scale with a slender, curved spine to 6 mm. (¼ in.) long.

Grows in mountains above 2300 m. (7,500 ft.) from Colorado to Arizona and New Mexico.

A very slow growing pine with an irregular habit. In the eastern United States it may be only 4 feet high in 16 years.

A closely related form, growing in Utah, Nevada and extreme eastern California, has recently been separated as *Pinus longaeva*. This includes the pines recently heralded as the "oldest living things." The habit of the two species differs in that the branches of *P. aristata* are spreading or ascending, while the branches of *P. longaeva* are spreading and pendulous.

Pinus banksiana Lambert **Jack pine**

Small to medium-sized scrubby tree 8–18 m. (25–60 ft.). Twigs slender, greenish-yellow, smooth. Needles 2 in a fascicle, persisting for 2 to 3 years, 2–3.8 cm. (¾–1½ in.) long, stiff, curved or twisted. Cones lateral, bent, conical, 2.5–6 cm. (1–2½ in.) long, sometimes opening at maturity, sometimes remaining closed for several years.

Found in well-drained sandy or rocky soil at elevations from 30–400 m. (100–1200 ft.) from Nova Scotia to the Athabasca River southward to Maine and central Michigan.

It bears cones at 10 years of age, and practically stops growing at 80 years. Some of the cones remain closed for many years, opening in response to the heat of forest fires and shedding their seed over the burned land. The seedlings are very intolerant of shade.

Jack pine will grow on sterile, well-drained, soils. It is not an attractive tree.

Pinus cembra Linnaeus **Swiss stone pine**

Tree 20–25 m. (60–75 ft.). Twigs densely yellowish-brown, hairy. Needles 5 in a fascicle, persisting 3 to 5 years, 5–12 cm. (2–5 in.) long, straight. Cones ovoid, 5–8 cm. (2–3½ in.) long, never opening. Seeds edible.

Native to central European Alps from 1200–2400 m. (4,000–8,000 ft.) and in the Carpathian mountains.

A very hardy, but very slow growing pine, preferring a deep, moderately fertile soil for best growth. In Europe the wood is highly prized for wood carving.

It is related to *P. sibirica* and *P. koraiensis*.

Three plants received in the Arboretum in 1918 are only 20 to 25 feet tall today.

Pinus densiflora Siebold & Zuccarini **Japanese red pine**

Tree 20–36 m. (70–120 ft.). Twigs green, smooth. Needles 2 in a fascicle, persisting 2 to 3 years, 5–6 cm. (2–2½ in.) long, slender, soft, twisted. Cones subterminal, about 3.5 cm. (2 in.) long, slender, soft, twisted. Cones subterminal, about 3.5 cm. (2 in.) long, conic-oblong, opening at maturity.

In Japan it ranges from 150–900 m. (500–3,000 ft.). It also occurs in the Chinese provinces of Kiansu and Shantung.

The stems tend to be twisted. Like *P. sylvestris* the branches and upper part of the trunk are covered with thin, exfoliating, orange-brown bark.

P. densiflora is intolerant of shade, but grows well on heavy, moist, but not wet, soils.

Pinus edulis Engelmann **Pinyon pine**

Short stout tree 4–15 m. (12–50 ft.). Twigs stout, orange-brown, smooth or very minutely hairy. Needles 2 to 3 in a fascicle, persistent for 3 to 9 years, 2.5–4 cm. (1–1½ in.) long, rigid, curved. Cones subterminal, ovate, 2.5–3.5 cm. (1–1½ in.) long, opening to release the edible seeds.

Native to mountains and foothills 1500–2400 m. (5,000–9,000 ft.) from S Wyoming and N Colorado south to W Oklahoma, W Texas, and San Bernardino County, California. A dominant component of the juniper-pinyon pine woodland of Utah, Colorado, Arizona and New Mexico.

Pinyon nuts were an important food for the Indians of the Southwest. They are still important commercially and are, after pecans, the most important nut crop in the United States.

Pinyon pine is extremely slow growing; trees 25 years old may be only 3–4 feet tall. They grow at the rate of only 2–4 inches per year.

At the Arnold Arboretum there is a single tree grown from seed received from Utah in 1927. In 48 years it has reached a height of about 10 feet.

Pinus flexilis James **Limber pine**

Short stout tree 12–25 m. (40–80 ft.), or a shrub at timberline. Twigs stout, orange-brown, hairy at first. Needles 5 in a fascicle, persistent 5 to 6 years, 3.8–7 cm. (1½–3 in.) long, stout, rigid, curved. Cones subterminal, subcylindric, 7.5–13 cm. (3–5 in.) long, opening at maturity.

Native to mountains 1500–3600 m. (5,000–12,000 ft.) from S Alberta and British Columbia south to W Texas and S California.

The slow growing trees virtually stop increasing in size at about 200 years of age, but may live to be 400.

Young plants are very similar in appearance to *P. albicaulis* and form a rounded, bushy tree.

At the Arnold Arboretum three young grafted plants received in 1951 are now 15 to 20 feet tall.

Pinus jeffreyi A. Murray **Jeffrey's pine**

Tree 30–60 m. (100–200 ft.). Twigs massive; buds nonresinous, with an odor of pineapple when crushed. Needles 3 in a fascicle, persisting for 5 to 9 years, 12–25 cm. (5–10 in.) long, stout, stiff, elastic. Cones broadly oval, 13–30 cm. (5–12 in.) long, opening at maturity.

Occurs in mountains between 1000–3100 m. (3,500–10,000 ft.), in SW Oregon to Baja California, generally at higher elevations than *P. ponderosa*, which it resembles.

This species begins cone formation at 8 years of age. Individual trees fruit at 4- to 8-year intervals. Individuals mature at 150 years and live to 500 years.

Pinus koraiensis Siebold & Zuccarini **Korean pine**

Slow growing tree 30–45 m. (100–150 ft.). Twigs densely rusty–brown, hairy. Needles 5 in a fascicle, persistent for 2 to 5 years, 6–12.5 cm. (2½–5 in.) long, straight. Cones subterminal, becoming lateral by the growth of the shoot in the summer, cylindric or conic-oblong, 10–15 cm. (4–7 in.) long, opening when mature, but so encrusted with pitch that the seeds are retained.

Grows on well-drained hillside and mountain slopes ranging from near sea level to 2500 m. (8,000 ft.) in E Russia, Manchuria, Korea and the mountains of central and S Japan.

An important timber tree with uses similar to *P. strobus*. The seeds are edible.

Two plants grown from seed received in 1918 are now about 25 feet tall at the Arnold Arboretum.

Pinus mugo Turra **Dwarf mountain pine**

A shrub with ascending branches to 3.5 m. (11 ft.). Twigs dark greenish-brown, smooth. Needles 2 in a fascicle, persisting 5 to 10 years, 2–8 cm. (¾–3 in.) long, stout, crowded on the twigs. Cones subterminal, 2–5 cm. (¾–2 in.) long, conical.

Grows on mountains of central and southern Europe.

Part of a variable complex of forms that range from prostrate shrubs to erect, single-stemmed trees. The forms in cultivation are useful for mass plantings on slopes and rocky areas, as well as for foundation plantings.

Pinus nigra Arnold **Black pine, Austrian pine**

Fast growing tree, 36–45 m. (120–150 ft.). Twigs stout, yellowish-brown, smooth. Needles 2 in a fascicle, persisting about 4 years, 10–15 cm. (4–6 in.) long, stiff, stout, straight or curved. Cones subterminal, 5–8 cm. (2–3 in.) long, ovoid-conic, opening at maturity.

It is native to SE Europe.

Widely planted as a windbreak, it is tolerant of poor and alkaline soils. It survives wind and heavy snow, also salt spray, but is damaged by atmospheric pollutants. Although the stem is usually straight, it is so full of knots that it is useless for timber.

Pinus parviflora Siebold & Zuccarini **Japanese white pine**

Tree 6–15 m. (20–50 ft.). Twigs slender, grayish, with minute scattered hairs. Needles 5 in a fascicle, persistent for 2 to 5 years, 2–7.5 cm. (¾–3 in.) long, slender, curved and twisted. Cones subterminal, ovoid or oblong-ovoid, 5–10 cm. (2–4 in.) long, opening when mature.

Grows on elevations of from 60-2500 m. (200-8,000 ft.) throughout Japan.

In cultivation this is a relatively short, spreading tree, and may be recognized by its sometimes tufted needle clusters and small cones which are borne even on young trees. It is much used in Japan as a subject for Bonsai.

Pinus ponderosa Douglas ex Lawson

Western yellow pine, Ponderosoa pine

Tree 45–70 m. (150–230 ft.). Twigs stout, orange-brown, smooth; buds resinous, with an odor of turpentine when crushed. Needles 2 to 5, usually 3, in a fascicle, persistent about 3 years, 12–26 cm. (5–10 in.) long, stout, rigid, curved. Cones subterminal, 8–15 cm. (3½–6 in.) long, ovoid-oblong, opening at maturity.

Grows at altitudes ranging from sea level to 3350 m. (10,000 ft.), from SW Oregon and NW California to North and South Dakota, Nebraska, and extreme W Oklahoma, and from British Columbia south to central Mexico.

Ponderosa pine was first recorded by Lewis and Clarke, who saw it on the upper Missouri River in 1804. It is very sensitive to air pollutants.

Pinus resinosa Aiton **Red pine**

Tree, 21–36 m. (70–120 ft.). Twigs stout, orange-brown, smooth. Needles 2 in a fascicle, persisting 4 to 5 years, 10–15 cm. (4–6 in.) long, slender, flexible. Cones subterminal, ovoid-conic, 5–6 cm. (2–2½ in.) long, opening at maturity.

Grows from Nova Scotia to the valley of the Winnipeg River, south to Pennsylvania.

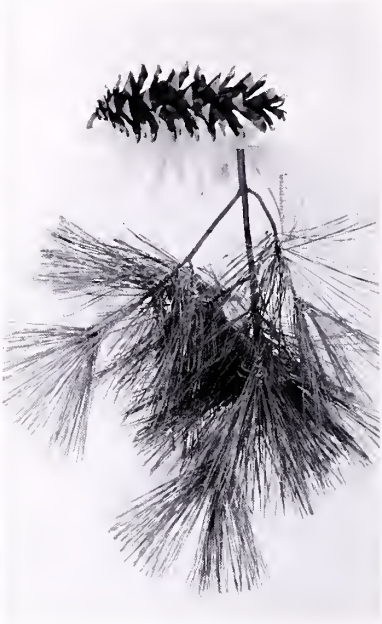
Red pine is a valuable timber tree. It grows more rapidly than white pine, but is less tolerant of shade. It is resistant to salt spray, but suffers breakage from ice, and is sensitive to air pollutants.

Pinus rigida P. Miller **Pitch pine**

Tree, 15–18 m. (50–60 ft.). Twigs stoutish, green, becoming brownish-orange, smooth. Needles 3 in a fascicle, persistent 2 years, 7.5–12 cm. (3–5 in.), stout, rigid, slightly curved and twisted. Cones lateral, ovoid, 2.5–9 cm. (1–3½ in.).

Occurs in poor, sandy or rocky soils, Maine to SE Ontario, south to N Georgia and E Tennessee.

Remarkable for the adventitious buds on stems and branches that produce short, scrubby, branches. Unique in its ability to sprout from cut or burned stumps. It was widely planted on Cape Cod in the 1840s and 1850s on abandoned farm land. These plantations were the basis for the extensive pine woodlands there now.



Pinus strobus Linnaeus **White pine**

A fast growing tree 24.5–45 m. (80–150 ft.). Twigs thin, greenish, hairy at first. Needles 5 in a fascicle, persistent 2 to 2½ years, 7.5–10 cm. (3–4 in.) long, slender, soft, drooping. Cones subterminal, cylindrical, curved, 10–15 cm. (4–6 in.) long, resinous.

Common tree of second growth ranging from Newfoundland to Manitoba, south to Georgia.

It grows best on moist, well-drained, sandy soil; is easily transplanted, and unlike many other pines may be sheared. It is the largest growing native conifer east of the Mississippi. Old growth trees found in early colonial times were up to 6 feet in diameter at the butt. Subject to snow and ice breakage, *P. strobus* survives temperatures to 94° below 0° F. It is very sensitive to salt damage.

The wood is white to light brown. It is used for boxes and crates; for patterns, millwork, building construction and matches. Wood from trees less than 50 years old is usually so full of knots that it can be used for nothing save crates and knotty pine panelling.

Pinus sylvestris Linnaeus **Scots pine**

Tree, 20–30 m. (70–100 ft.). Twigs slender, orange-brown, smooth. Needles 2 in a fascicle, persistent 2 to 3 years, 2.5–10 cm. (1–4 in.) long, stiff and twisted. Cones subterminal, ovoid-conic, 2.5–7.5 (1–3 in.) long, opening at maturity.

Occurs in north and central Europe, extending south in the mountains to Spain, N Italy, and Macedonia, eastward in N Asia to the Pacific coast of Siberia.

Widely grown and valued for timber in Europe, where it has a long history of use. The forms that have been commonly cultivated in this country have not made straight trunks and have been short-lived. Requires a well-drained soil and sometimes self-sows. It is more or less tolerant of salt spray, ice, drought, and wind, but less so than *P. nigra.*

P. sylvestris and *P. densiflora* are unique in having thin, red-brown, scaling bark on the upper parts of the trees.

Pinus thunbergii Parlatore **Japanese black pine**

Tree, 30–36 m. (100–120 ft.). Twigs light brown, smooth. Needles 2 in a fascicle, persisting 2 to 3 years, densely crowded on the twigs, 6–11 cm. (2½–4½ in.) long, rigid, twisted. Cones terminal, ovoid, 4–6 cm. (1¾–2½ in.) long, opening at maturity.

Occurs in coasts and lowlands of the islands of central and S Japan, and the coast of S Korea, sea level to 950 m. (3,100 ft.).

A common plant that has been extensively used for Bonsai.

Pinus wallichiana A. B. Jackson **Bhutan pine**

Tree 15–45 m. (50–150 ft.). Twigs greenish or greenish-brown, smooth. Needles 5 in a fascicle, persisting 3 to 4 years, 12.5–20 cm. (5–8 in.) long, slender, drooping. Cones subterminal, cylindrical, 15–30 cm. (6–12 in.) long, resinous, opening at maturity.

Grows on mountains from 1600–3200 m. (6,000–12,000 ft.) in Afghanistan to Nepal.

An important timber tree and a source of rosin and turpentine. It is fast growing, but in cultivation has a tendency to branch near the base, forming a bushy tree. In Boston it has been damaged by winter cold and severe winds. It is reputed to be resistant to atmospheric pollution, and to white pine blister rust, but is susceptible to white pine weevil which damages the buds and deforms the stems.

Insect Pests *

Symptoms	Pest	Where to treat	When to treat: Apr.	May	June	July	Aug.	Sept.	Materials
A mass of pitch at the tip of the stem just behind the terminal bud in late summer. Death of stem tips and buds. Split tips show signs of borer tunneling.	European pine shoot moth *Rhyacionia buoliana*	Small area between buds on terminals and laterals. Foliage and bark of twigs on Scotch, mugo, Japanese black pine.	—		—				carbaryl
A mass of pitch near the tip of the stem in midsummer. Death of stem tips and buds.	Nantucket pine tip moth *Rhyaciona frustrana*	Foliage, mostly of pitch and black pines.			—				dimethoate or carbaryl or Meta-Systox-R
Young bark of seedlings and twigs is chewed by the adult beetle. Plants become weakened and die.	Pales Weevil *Hylobius pales*	Tender bark of seedling white pine and other conifers up to 18" high; also twigs of some large conifers.						—	Lindane
Large white cottony areas on the trunks and under sides of the limbs, particularly on pine growing in partly shaded areas.	Pine bark aphid *Pineus strobi*	Bark of trunk, branches, twigs on white pine; also Scotch and Austrian pine.	—						60 or 70 sec. oil
Defoliation between June and September.	" "	"		—					malathion or dimethoate or Meta-Systox-R carbaryl
	Pine looper *Lambdina athasaria pelucidaria*	Foliage of pitch pine				—			
Needles turn yellow and dry up. Small exit holes evident on brown needles. Also old mined needles are translucent when held to the light.	Pine needle miner *Exoteleia pinifoliella*	Foliage of pitch pine and jack pine							None suggested

Small elongate dots on the needles (Fig. 7), the needles white colored, spotted and yellowed. Eventual death of the needles, twigs and trees.	Pine needle scale *Phenacaspis pinifoliae*	Needles of white, red, Scotch, Austrian, mugo pine.	—						60 or 70 sec. oil or ethion oil
				—			—		dimethoate or Meta-Systox-R
Defoliation of the twigs beginning with the older needles and working toward the tips. Caterpillars occur in masses, curl upward at both ends when disturbed.	Red-headed pine sawfly *Neodiprion lecontec*	Thorough wetting of needles. Broods may occur throughout the season.				—	—	—	carbaryl
Needles become yellowish and covered with a fine webbing. Chlorosis is most evident at the bases of the needles.	Spruce mite *Oligonychus unuguis*	Thorough wetting of needles and bark.	—						60 or 70 sec. oil or ethion oil
Masses of small 3–4 mm. (1.2–1.6 in.) long, grayish colored insects on twigs and small branches. Sometimes needles become covered with sooty mold.	White pine aphid *Cinara strobi*	Needles of white pine	—						60 or 70 sec. oil.
	" "	Twigs and small branches of white pine		—					dimethoate or diazinon or Meta-Systox-R
Death and/or deformation of leading shoots of stems and leading branches. Tips of shoots bend over and turn brown in June or July. Two years' growth is lost since the past year's growth is infested.	White pine weevil *Pissodes strobi*	Thorough coverage on terminals of white, Norway, Scotch and Japanese black pines	—						Lindane
	" "	Removal or burning of infested leaders before adults emerge			—				
Branch tips die and break off.	Zimmerman pine moth *Dioryctria zimermani*	Bark of twigs and branches of most pines. Adults emerge between June and August to lay eggs.							dimethoate

* Based on information taken from "The 1975 Insect and Disease Control Guide for Trees and Shrubs" by Clifford S. Chater and Francis W. Holmes, published by the Cooperative Extension Service, University of Massachusetts, Amherst, Mass. 01002.

Diseases *

Symptoms	Name	Treatment
Death of leaves and twigs.	Blight Caused by various fungi and bacteria	A. In dry weather clip out and destroy affected parts. Disinfect tools between cuts. B. Spray with appropriate fungicide or bacteriocide early in the growing season (April, May), starting just before the shoots emerge and continuing until the foliage has reached mature size. Check with county agent or professional arborist for identification of blight and appropriate fungicide or bacteriocide.
Cankers on branches and trunk.	Blister Rust *Cronartium ribicola*	Prune off and destroy infected branches. Remove currant and gooseberry bushes (the alternate hosts of the fungus) for a radius of one mile.
Dead spots on surface of tree trunk or branch; many enlarge each year. Ridge of healing growth ("callus") forms at margin each year.	Cankers Caused by various fungi and bacteria	Appropriate feeding, watering, mulching, protection from other diseases and pests, and *avoidance of all wounding.* During dry weather, cankered branches should be pruned out of the tree and burned. Pruning tools should be sterilized between cuts, for example with a 10% solution of household bleach or 70% alcohol. All pruning cuts should be promptly treated by shaping to oval pointed in direction of sap flow and painting 3 to 4 times a year with a tree wound paint.
Wood inside trunk or branch or root is softened and may rot away, leaving a hollow place.	Decay Caused by various fungi	Decay organisms cannot enter except through wounds, so take all precautions to avoid wounding. If the softened wood or cavity is in a branch, cut off the branch flush with the next larger branch or trunk, and promptly treat the resulting wound (see wounds); renew wound paints several times a year to keep decay sealed out. Efforts to gouge out rot or decay in trunks generally do not succeed, but there is recent evidence that decay usually does not later extend into tissues laid down in years subsequent to the original infection. Therefore, efforts to clean out decayed wood from cavities may actually do harm by breaking this internal protection

		layer. Whether tree life is ever prolonged by cavity treatment is not clear. Fillings and braces may sometimes add structural strength so that the rotten tree may be less likely to break at the point of decay.
A state of gradually worsening ill health. Dieback implies a symptom pattern where there are more and more dead twigs and small branches in the top of a tree year after year.	Decline and dieback Precise cause unknown. May be a combination of unfavorable environmental causes.	No particular treatment known. Efforts should be made through feeding, watering, pruning and spraying to restore vigorous growth.
Needles on the older portions of the twigs turn brown.	Fall browning	No disease is involved. The only reason a plant is green the year round is that it bears more than one year's set of leaves. In the spring it adds a new set of leaves and in the fall it drops the oldest set. If only the innermost, i.e. oldest, foliage has turned yellow or brown in September or October and the same thing is happening on other individuals of the same species in that locality at about the same time, that process is normal and routine for a healthy plant.
Browning confined to needles.	Leaf spot caused by various fungi	Treatment is needed only when a large portion of the tree is affected. A fungicide should be applied at bud break (April, May), and two to four times later at 7–14 day intervals. Check with county agent, tree warden or professional arborist for identification of leaf spot and appropriate fungicide
Orange pustules on the needles.	Needle rust *Coleosporium* spp.	Destroy wild asters and golden rods (the alternate hosts) growing near pines. Spray or dust young pines with sulphur early in the season (April, May).

Diseases *

Symptoms	Name	Treatment
Forms cankers on stems.	Pine-pine gall rust *Peridermium harknessii*	See Cankers.
Yellowed or browned fleck-like spots or reduction of growth of the whole plant.	Air pollution	Control can be achieved only by a community-wide effort to reduce levels of pollutants in the air.
Yellowing of leaves or stunting of growth resembling drought injury.	Soil pollution (Oil, grease, salt)	Efforts should be made, through fertilization, watering and pruning to restore vigorous growth.
Symptoms of drought injury due to death and decay of roots and of the stem at ground level.	Root rot *Fomes annosus*	Affects plantation (not wild) trees on poor soils. Plant on good soils or improve the soil and encourage vigorous growth by fertilization and watering. When pines are cut to thin a plantation, immediately apply to the stumps borax powder or a solution of 2 pounds technical-grade urea per gallon of water.
Death of the base of the tree and roots.	Shoestring rot *Armillaria mellea*	Encourage vigorous growth. If the soil is already infected with armillaria it should be replaced to a depth of 18 inches with new soil, or fumigated.
Gradual decline in vigor of the tree.	Smothering	Prevention. Prevent soil compaction. Do not place fill over roots. Do not paint trunks and branches with oil or paint.

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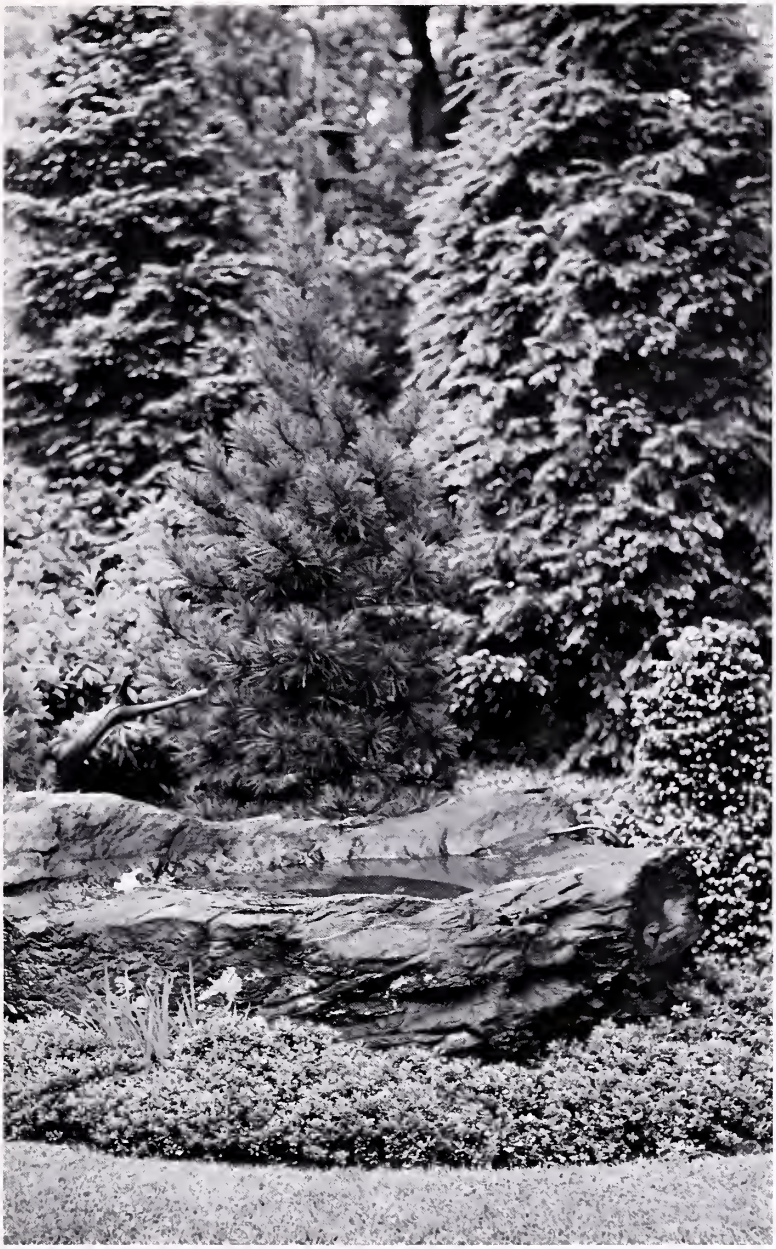


Garden planting of Vaccinium vilisidaea minus.

Dwarf Fruiting Shrubs

by Margo W. Reynolds

To the average gardener the chief attraction of any shrub is usually its flowers: the bigger the better, and if it's bright and showy, too — well, that's just an added plus. Connoisseurs and those familiar with plants know better and recognize the flaws in this kind of thinking. They realize that although flowers are often the most conspicuous feature of a plant, many shrubs offer a great deal more.

Fruits are one of the extra dividends. All too often they are relegated to secondary consideration or overlooked entirely when one is selecting materials for home planting. Yet many shrubs are more highly prized for their fruits than they are for their flowers. Bittersweet is one colorful example, and there are many, many more that will provide year-round interest in a display garden.

A boon to the homeowner with a small piece of property are attractively fruited shrubs that are both small in size and easy to maintain. Dwarf shrubs, evergreen and deciduous alike, that either by habit or occasional pruning can be kept to three feet or below, have an infinite number of uses in today's small gardens. Classified as shrubs by virtue of their woody stems, they fulfill a multitude of purposes in the contemporary landscape. Some form dense, spreading mats and act as soil binders on eroding slopes or banks, as well as ground covers where grass is difficult to establish. Others highlight certain areas of the rock garden or serve as attractive specimen plants in the overall garden scheme. Because of their compact, slow-growing habit, these dwarf shrubs are easy to maintain and remain in scale with the settings for which they were planned.

Most conspicuous among fruiting shrubs are those with red and yellow fruits, and foremost in this category are the viburnums, cotoneasters and barberries. Although there are fewer ornamentally attractive ones, white-fruited shrubs provide their share of color also. Dark blue and black-fruited shrubs are generally the least striking from a color standpoint, but there

are several which do merit more than passing attention. I have included them in the recommended list that follows although they probably should not be given preference over plants with more vivid coloration when space is very limited.

Before listing some of the more spectacular fruiting shrubs, it might be worth just a moment to stop and discuss some of the factors that affect fruit development and insure maximum coloration. Fruiting, in general, is enormously dependent upon both weather and soil conditions. Temperature, rainfall and amount of sunshine all are pertinent. Frost, too, plays an important part. In some instances it serves to hasten development, while in others it merely causes the fruit to brown and drop off prematurely. Long periods of rainy, overcast weather often have a deleterious effect upon fruit ripening. Protracted periods of sunshine and warmth, on the contrary, will cause fruits to ripen and color more quickly.

To the same degree, soil composition is a factor. Poor, dry soil often retards development, whereas the same plant growing in moist, well-drained soil will develop normally and fruit without problem. The addition of nitrogen and phosphorous to the soil of some plants often results in better coloration.

Red-fruited Dwarf Shrubs

Cotoneasters. As a group, cotoneasters are a reliable and ornamental addition to almost any garden. They run the gamut from evergreen to semi-evergreen to deciduous, and vary in height from prostrate ground covers to 18-foot specimens. The flowers of this plant group are fairly inconspicuous and the primary ornamental value lies in their brightly colored berries, seldom more than 1/4-inch in diameter.

Several species can be grouped in the low-growing category with which we are concerned. Among the best are *Cotoneaster horizontalis* and *C. microphylla*. *C. horizontalis*, commonly known as rock spray or rock cotoneaster, is semi-evergreen and attains a height of 18 to 24 inches. Probably the best known and most widely planted cotoneaster, this neat, rugged little plant can be used with equal facility in the rock garden, as a foundation planting, as an edging for the shrub border, or as a ground cover on steep banks. It has an interesting cascading habit, which makes it especially suitable for these kinds of plantings. The fruit is a pea-sized berry produced in abundance that persists well into December.

Cotoneaster horizontalis.

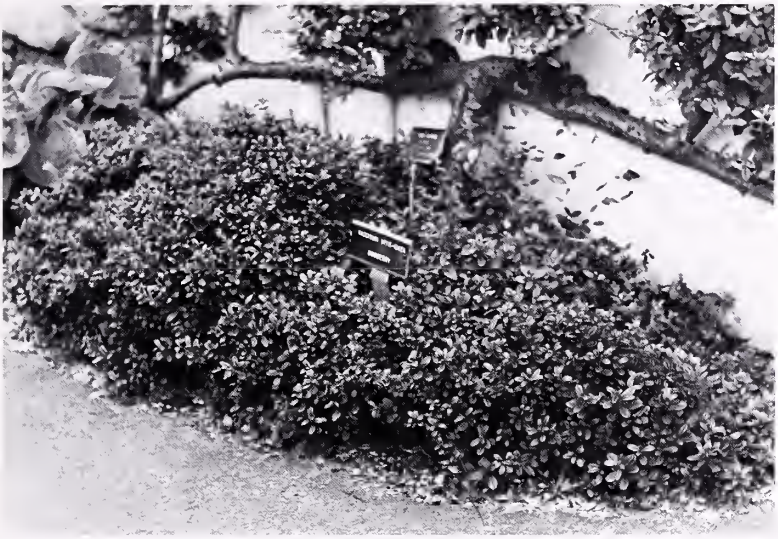
Cotoneaster microphylla, a low, evergreen shrub commonly called small-leaved cotoneaster, attains a height of 2 to 3 feet and is an excellent specimen plant for the rock garden. It, too, has persistent small berries. *C. thymifolia*, a variety of *C. microphylla*, should also be mentioned here. It has the smallest leaves of any cotoneaster (1/8 to 3/8 inches) and it is a good small specimen plant for a special area of the rock garden.

Viburnums. Most viburnums are rather tall and somewhat coarse for specimen plantings, but their fruits are often spec-

tacular. For this reason it is particularly gratifying to know that there is a small viburnum suitable for rock garden planting. The berries, too, are every bit as showy as they are on some of the larger viburnums. The plant to which I refer is *Viburnum opulus* 'Compactum', a dwarf form of the European cranberrybush.

Although its eventual height is 5 feet, it is a slow grower and periodic pruning will keep it small. This particular variety blooms freely and then produces red berries in great profusion. These fruits have the added plus of persisting throughout the winter. Again, unlike most viburnums, *V. opulus* 'Compactum' is both dainty and compact, assuring it a place of distinction in the small garden.

Vacciniums. The mountain cranberry or mountain cowberry, as it is sometimes called, has the Latin name of *Vaccinium vitis-idaea* var. *minus* and is a close relative of the blueberry.



Vaccinium vitis-idaea. *Photo: P. Chvany.*

Although not quite as ornamental as the above-mentioned plants, it definitely has a place in naturalistic landscaping provided its requirements for cool shade and moisture are met. It cannot tolerate hot, dry summers, but withstands severe northern winters with ease. The mountain cranberry, which reaches a maximum height of only 4 to 8 feet, is often difficult to establish and one should be forewarned. It is best started in spring from potted plants set out in sandy, acid (p^H 5.0) soil.

Arctostaphylos. I often wonder whether I always single out this plant because I like the sound of its name, or whether I have other reasons! In this particular case, there is no denying that this diminutive shrub has great value as a fruiting ground cover plant. *Arctostaphylos uva-ursi* (bearberry) is certainly worth more than just passing note. Evergreen, with scarlet berries and prostrate, creeping habit, bearberry is well-adapted for growing in poor, dry sandy soils. Increasingly it is being used along highways and sandy bank areas where little else will grow. In the home garden it is of enormous value in the rockery or as a ground cover. Happily, it is nearly maintenance-free as well.

Blue-fruited Dwarf Shrubs

Bayberry. Blue-berried shrubs with ornamental appeal are many and varied. Among the first to come to my mind is the versatile bayberry (*Myrica pensylvanica*) with its small greyish-blue fruit. Growing wild throughout its range from Newfoundland to North Carolina, the bayberry is found predominantly in sandy soil along the coast. Because it also prefers full sun, it is a natural choice for seaside gardens and exposed, dry hillsides.

An attractive twig habit, aromatic, semi-evergreen leaves and persistent grey-blue berries all contribute to the ornamental value of this shrub. Although plants are known to grow 8 feet tall, they seldom attain more than 3 to 4 feet and can be kept small and vigorous by occasional heavy pruning of old clumps. It is necessary, however, to plant both male and female plants together in order to insure fruiting, as the sexes are usually separate.

Holly-grape. Two species of *Mahonia*, the Oregon holly-grape, lend themselves to planting for their fruits alone, although their

foliage and flowers are equally noteworthy. The larger of the two is *Mahonia aquifolium* which generally grows to about 3 feet. The bright yellow flowers are followed by grape-like clusters of blue-black berries in the fall. The lustrous semi-evergreen to evergreen foliage turns a most attractive purplish-bronze in the autumn.

Mahonia repens is similar in every way to the above except that it is smaller (10 inches) and its foliage is slightly less lustrous. Planting in the shade seems to protect these plants from the winter burn to which they are susceptible if grown in the sun. Maintenance is at a minimum, for severe winter weather keeps these superior ornamentals low; occasional pruning will keep them dense and vigorous.

White-fruited Dwarf Shrubs

Dogwood. White-fruited shrubs are probably best represented by *Cornus sericea stolonifera* 'Kelseyi'. This dwarf form of C. *sericea* rarely exceeds 24 inches in height and so is an excellent, though slightly coarse, plant to use at the edge of the shrub border. Although better known for its vivid red twigs which show to best advantage against a new-fallen snow, its white fruits have their own merits against the red twigs. This particular native shrub seems to grow well under most conditions, though it prefers to be somewhat moist.

From red, white and blue we come to the purplish fruit group. Here, two dwarf shrubs of particular ornamental value are the coralberry (*Symphoricarpos orbiculatus*) and the Chilean pernettya (*Pernettya mucronata*). The latter is an excellent specimen and probably one of the best-fruiting small shrubs available. An evergreen with lustrous dark foliage, the pernettya produces fruit in great profusion. Varieties run the gamut from white through pink to a lovely deep purple.

Pernettya's mature height is 1½ feet, so it makes an attractive specimen at the edge of the shrub border or in the rock garden as an accent plant, provided it is growing in an acid soil. Full sun will keep it neat and compact; shade tends to cause untidy, open growth. Like many other shrubs this requires two strains or varieties, growing in close proximity, to insure fertilization and subsequent fruiting. It should be noted here that unlike the other shrubs mentioned, pernettya is only hardy as far north as central Connecticut and Cape Cod.

Top left: Symphoricarpos orbiculatus.

Lower left: *Close-up of its fruit.*

Cornus sericea stolonifera *'Kelseyi.'*

Coralberry and Indian currant are two of the names under which the native *Symphoricarpos orbiculatus* masquerades. A widely planted ornamental, coralberry's flowers are of secondary importance to the spectacular purplish-red fruits that decorate the gracefully arching branches in the fall. At 3 feet it most definitely fits into our dwarf shrub classification. Its greatest value, perhaps, is that it adapts readily to nearly any soil and grows equally well in sun or shade. Because it suckers freely, it is best used as a soil binder for slope planting.

Arnoldia Reviews

The Complete Flower Arranger. Amalie Adler Ascher. New York: Simon and Schuster. 1974. 288 pages, illustrated. $9.95.

The dust jacket tells us that Mrs. Ascher began flower arranging as a pastime and has pursued her interest in the subject to become a nationally successful exhibitor, teacher, and judge. She also conducts a TV series and writes articles for various publications.

She shares the wealth of knowledge gained from this profession in a very comprehensive book that covers every possible aspect of arranging. It explains the basics of color and design, simplifies the tiresome mechanics, gives advice on accessories and how to keep the finished design fresh for days. All the traditional styles and materials are discussed, but also accorded full chapters are the subjects of lighting, flower show competition, and the increasingly popular modern styles. These give the book a very complete and up-to-the-minute outlook.

To conclude, there is a chapter of ideas for the flower arranger's garden. Using her own as a guide, Mrs. Ascher suggests plants to provide a year-round selection of interesting flowers and foliage.

Each chapter is well illustrated with appropriate black and white photographs of the author's arrangements. There are two groups of color plates that include, as well as numerous other modern concoctions, the design for which she won a "flower arranger of the year" award.

Whether you are interested in competition or require only that the daylilies stay open for a dinner party, this is definitely a book to consider adding to your collection.

SHEILA MAGULLION

Genetic Resources in Plants. O. H. Frankel and E. Bennett, editors. Philadelphia: F. A. Davis Company. 1970. 554 pages. $17.50.

Conference reports can be deadly documents to read. The present volume, which is based upon a conference held under FAO sponsorship in 1967, is a very mixed bag. Many of the general papers in the first section of the book contain little that is new and much that is of questionable relevance to the sub-

ject. However, there is much in the balance of the book that is intensely interesting.

The themes that run through the book seem to be: 1) in general any given crop, as cultivated under "primitive" conditions, contains a relatively large sample of the available germ plasm of the species. 2) individual crops, as cultivated in the "developed" countries, are based on a dangerously small sample of the available germ plasm of the species. 3) the replacement of indigenous varieties of crops in the "underdeveloped" nations by cultivars produced in or by the "developed" nations is causing a serious loss of germ plasm. 4) some practical way must be found to preserve the germ plasma of "primitive" forms of crops.

The chapters on the various aspects of plant exploration are perhaps the most exciting reading. The chapters on the individual crops give a good view of contemporary problems.

GORDON P. DEWOLF, JR.

128 More Houseplants You Can Grow. Rob Herwig. New York: Collier Books. 1974. 61 pages, paperback. $1.75.
Nothing Grows for You? Frances Tenenbaum. New York: Charles Scribner's Sons. 1974. 118 pages, illustrated. $6.95.

The true value of these two books on houseplants is in inverse proportion to their price.

Rob Herwig has presented his 128 plants in a well-organized and well-photographed booklet. His symbol code for the growing requirements of each plant is most helpful. The plants depicted were chosen by Dr. Donald Wyman, and are, therefore, an interesting group. It should be noted that many of them require greenhouse culture for their survival when not in the house on display.

In spite of a certain archness in presentation, which seems to overcome many people when writing about plants, this is a useful and attractive book at a reasonable price.

Nothing Grows for You?, costing almost four times as much as Mr. Herwig's volume, is rambling, verbose, and written in a painfully coy and folksy style. Except for some very basic suggestions as to how to treat various ordinary houseplants, the advice to the reader consists mainly of exhortations to throw away any plant that seems ailing or difficult to grow.

The illustrations range from barely recognizable and botanically incorrect line drawings of common houseplants to depictions of pots of ivy, each leaf with a smiling or weeping face. They have no horticultural or aesthetic merit.

Mrs. Tenenbaum mentions in her preface that there are "loads" of books on houseplants. The novice would do well to consult other authority than hers.

CORA L. WARREN

Lake Tahoe Wildflowers. Kenneth Legg. Healdsburg, Calif.: Naturegraph Publishers. 1970. 96 pages, illustrated. $2.25.

This is a "mini-volume" pocket guide written by a naturalist who has evolved into an ecologist. The wildflowers are arranged in color categories and each is identified by popular and botanical name and depicted by a full page in color from original watercolors. The editorial style is charming, informal, and chatty without being irritating. The pictures accurately represent the plants.

The work is intended as a companion on a nature walk rather than as a scientific tool. Viewed in this light, it agreeably fulfills its purpose.

ELINORE B. TROWBRIDGE

City Leaves City Trees. Edward Gallob. New York: Charles Scribner's Sons. 1972. 64 pages, illustrated. $6.50.

The format consists entirely of large black and white pictures with text. Author's photographs show trees in real city settings: flanking playgrounds, street parking areas and various architectural backgrounds. There are also some excellent photograms, or black and white prints, made directly from leaves, and a very simple key-like introduction. The trees pictured and described are in the northern segment of the United States, east of the Mississippi.

This work apparently is intended for the novice and is suitable for the teens on. It does not "talk down" to the reader, but the editorial style is pleasantly simple and unaffected; there is even humor. Popular plant names are used. The photographs have human interest and feeling. The plant details are good and flowers and fruits are sometimes included.

This volume could well develop further an uninformed curiosity by supplying the tool of basic recognition, building a feeling of mastery, and arousing and sustaining interest. Highly recommended.

ELINORE B. TROWBRIDGE

Lonicera korolkowii *'aurora'*
Photo: P. Chvany.

Contents

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On the cover: Grounds crew member Maurice C. Sheehan spreads mulch in Jamaica Plain. Photo: P. Chvany.

The Director's Report

The Arnold Arboretum During the Fiscal Year Ended June 30, 1975

The observance of the Bicentennial of the United States began in the spring of 1975 in Lexington and Concord, Massachusetts. The additional publicity given to the Commonwealth has cited the Arnold Arboretum in brochure and maps, resulting in an increase in the number of visitors to both Jamaica Plain and Weston. The Case Estates of the Arnold Arboretum in Weston is shown on many of the route maps of the colonial battles. The Jamaica Plain location of the living collections is one of the stops in the Museum Loop Shuttle Bus service, furnished free to visitors, and operating from Boston Common to the Franklin Park Zoo, with numerous intermediate attractions. Special attention has been given by the Arboretum staff to the appearance of the grounds and the handling of these visitors on weekends.

National problems have affected the Arboretum through the continuing increase in costs of supplies, in shortages, and in the need for fuel conservation. The Arboretum followed the University policy as far as possible in observing fuel-saving days during the Christmas holidays, and by reducing temperatures in all buildings. The only exception made was in the greenhouses where reducing the temperature the previous winter had serious effects on the research projects and the quality of the collections.

The annual meeting of the American Association of Botanical Gardens and Arboreta was held in Boston in October with headquarters at the Arnold Arboretum. Representatives of approximately 100 botanical gardens, arboreta, and horticultural societies gathered for these meetings which were hosted by the Arboretum staff with the valuable assistance of the Arboretum's Volunteers.

The previous fiscal year saw an attempt by the City of Boston to acquire the South Street tract of the Arnold Arboretum for a campus-style high school. No sooner had the City agreed to seek an alternate site, than a bill was filed in the legislature of the Commonwealth to acquire the same site for athletic facilities for Boston State College.

Much time is required of the Arboretum staff, the officers of the University, and even representatives of the National Historic Site Commission in Washington, to combat such bills. The land in question is classified as "wetlands," is inadequately fenced and has relatively few organized collections. It is, however, included within the boundaries of the Arnold Arboretum as recognized in the National Historic Landmark designation. The land is used in teaching and research programs, will be needed in the future for the development of the living collections, and should not be lost to the use of the Arboretum. Convincing legislative committees that open land is useful for current biological studies and is needed for future plantings seems to be difficult.

Finally it should be noted that the changes in governance and fiscal operation of the University in recent years have had an ever-increasing effect on the Arnold Arboretum. Additional charges for University operation have been made against the endowment and gift funds of the Arboretum. Other departments have chosen to de-emphasize the status and role of the curator in their operation. The decision by some organizations and departments to appoint only professors with stipulated and required teaching assignments within the University has been proposed as a University-wide policy. The role of the Arnold Arboretum has been quite different from that of other departments, or even some museums, in its association with the public and with the City of Boston, in the emphasis of curatorial excellence in living and other collections, and in its traditional method of staff appointments for research and service with an option of compensated teaching within the University. These and other problems of academic life in 1975 have been the subjects of continuing discussions within the staff, with the Committee to Visit the Arnold Arboretum, and with Deans and administrative officials of the University. The complex and difficult role of a self-supporting arboretum with a significant autonomous reputation must be considered in its association with a special public, as well as with one of general interests, with a city and with a university.

Staff

There were staff changes in the several sections of the activity of the Arnold Arboretum. Mrs. Patricia Hall resigned as Librarian of the Gray Herbarium and the Arnold Arboretum, and we were fortunate to secure the services of Mrs. Lenore Dickinson on transfer from within the University. In the herbarium, Dr. Norton G. Miller, appointed jointly with the Gray Herbarium as

Associate Professor and Associate Curator, arrived to assume his duties on January 1. With regret we received the resignation of William Grimé, Curatorial Assistant, to accept a position at the Field Museum in Chicago. Dr. Shiu-Ying Hu was given a leave of absence for the second half of the year to teach at Chung Chi College in Hong Kong, and to continue her work on the vegetation of Hong Kong. Miss Kathleen Clagett was promoted to the role of Technical Editor of the Journal of the Arnold Arboretum.

In the horticultural area Mr. Robert Hebb, Assistant Horticulturist, resigned to accept a position at the Cary Arboretum, and Miss Pamela Bruns, Illustrator, resigned to relocate in New Hampshire. Mr. Edward H. Flaherty, III, was appointed Curatorial Assistant to work with the labeling, mapping and record keeping of the living collections. Mr. Arturs Norietis of the greenhouse staff reached the mandatory retirement age and retired at the end of the year.

Dr. Yin-Tse Lee was reappointed a Mercer Research Fellow, and honorary appointments were approved for Mrs. Constance Derderian (Honorary Curator of the Bonsai Collection) and for Dr. Arturo Gómez-Pompa (Honorary Research Associate of the Arnold Arboretum and the Gray Herbarium).

Horticulture

The living collections of the Arnold Arboretum are grown on 265 acres in Jamaica Plain and 110 acres in Weston. By an agreement nearly a century old with the City of Boston, the grounds, and therefore the collections in Jamaica Plain, are open to the public at "reasonable hours." The care and development of the collections are the responsibility of the staff, while the maintenance of roads, paths, benches, and fences are the responsibility of the City of Boston, which also supplies police and fire protection. Not all of the Arboretum is fenced in, and even the fenced areas cannot be closed due to nonfunctioning gates. In fact, the Arboretum collection is open all of the time.

A periodic review by staff and Visiting Committee of the problems of nighttime parties, vandalism to plants, labels and buildings, litter, undisciplined visitors, illegal behavior, fires, etc., commonly results in recommendations of additional guards, better fences, locked gates and admission fees. Contrasting recommendations have also been received from legal advisors, security agencies and the Police Department. Although the problems remain unresolved, they are less than those experienced by arboreta in other major cities — a small consolation.

During April and May, Captain L. Quinlan of Station 13, Boston Police Department, had a 12-hour patrol from 10:00 A.M. to 10:00 P.M. in the Arboretum each day. This resulted in a marked improvement in the crowd behavior and in the litter problem.

The original indenture directed the staff of the Arnold Arboretum to grow all plants hardy in the vicinity of West Roxbury. Sargent and subsequent directors limited this directive, for the most part, to woody plants appropriate in an arboretum.

Many plants are acquired and placed on the grounds only to be lost through a lack of hardiness, improper environmental conditions, theft, injury or other factors. The grounds of the Arnold Arboretum were mapped carefully in the 1940s and the location of each plant recorded in the permanent files. It is today one of the most carefully documented living collections. The collections in 1949 numbered 3,861 taxa. Additions and losses have been variable in subsequent years, but in 1974–1975, 6,186 hardy taxa, as species, varieties and cultivars, are within the living collections in Jamaica Plain and Weston. Other taxa are in greenhouses or nurseries as young plants or research collections and are not counted. Each taxon is repre-

sented by one or more plants, and often by several collections from different geographic areas or different sources.

In recent years the records of the Arnold Arboretum living and dead collections were incorporated in the data bank of the Plant Sciences Data Center, an organization recently renamed from the Plant Records Center. The original printouts of the computer records of the living collections revealed duplication of numbers, misidentifications, misspellings, and the lack of information really needed for some entries. During the past year Mr. Hebb, assisted by several Volunteers, worked over the computer printout and submitted corrected entries to the Plant Sciences Data Center. When these have been incorporated, an up-to-date printout will be available.

The greenhouses and plant propagation efforts are fundamental to the care and maintenance of a quality living collection. Mr. Fordham and his staff handled 617 taxa within the greenhouses for replacement of plants on the grounds (339), for information on methods of propagation (220), for general observation (12), for distribution (20) and for staff research (26). Requests are received from other organizations for seeds or propagation material, and these are filled whenever possible. Thus, 99 shipments representing 468 taxa of plant materials were consigned within the United States, and 11 shipments of 69 taxa were made to 7 foreign countries. We received from United States sources 71 shipments of 161 taxa, and from 8 foreign countries 12 shipments of 37 taxa. Although it is easier to ship and receive materials as seeds, these have genetic variability and may be less than satisfactory for research purposes. Nevertheless we requested and received 114 shipments of seeds of 589 taxa from the United States and 30 other countries, and distributed on request 48 shipments of 186 taxa to 11 countries.

The area around the greenhouses contains many interesting plants of small stature, espaliers and bank plantings. This area is open to the public daily. The greenhouses themselves contain no display material, but only research and maintenance collections. Classes and special groups are admitted as scheduled, and the greenhouses are open to the public one afternoon a week. We are indebted to Volunteers who serve as guides during these open afternoons.

The major landscape development on the summit of Bussey Hill was completed during the first part of the fiscal year and formally opened in October with a special invitation to the Friends of the Arnold Arboretum. The construction was done

Volunteer Mrs. Garrett Birkhoff (left) assists greenhouse staff member Donna A. Lynch in saran house. Photo: P. Chvany.

by Delmonico Construction of Hull, Massachusetts under the supervision of Mr. Vincent Merrill of Shurcliff, Merrill and Footit. The plantings were done by the Arboretum grounds crew. The attractive new area, with benches and walls, has drawn many visitors to its special plantings of summer blooming plants.

Labeling and mapping of the plants has been the responsibility of Mr. Edward Flaherty, III, who received support from Volunteers as well as from summer student trainees in checking maps and plants for labels. Hopefully the labels can be prepared during the winter months and placed next spring.

The Case Estates

The Case Estates in Weston comprises approximately 110 acres, and serves as a general nursery area for recent introductions, an area for accessioned collections either not wanted, or for which there is no room in Jamaica Plain, and for display collections of special educational value.

Staff research projects also can be accommodated in Weston, and to facilitate this use new irrigation lines are being installed by our staff on a program to take several years. The ground cover plant collections are also under renovation on a schedule, and other beds were lined with new edging material and improved in quality during the spring season. The collection of medicinal herbs has been difficult to maintain due to the rapid spreading of some taxa by vigorous rhizome development. Sections of metal barrels have been prepared and used to contain the most rampant spreading species.

Two buildings in Weston are used for teaching, as class rooms or informal laboratories. The central portion of the brick barn has excellent acoustics and is used for meetings of 50 to 150 people. During the winter the wood paneling of this area was cleaned and refinished.

At the request of the Director, the Harvard Corporation voted to permit the town of Weston to take 10,446 square feet of land of the Arnold Arboretum in Weston for a compensation of one dollar ($1.00). This taking is associated with a long-planned and equally long-delayed action to widen Wellesley Street in order to permit sidewalk and bicycle paths for the protection of pedestrians and visitors to the Case Estates. Although construction is delayed again for reasons of fundings, eventually a larger measure of safety will result.

New Bussey Hill plantings are shown to tour group by Joyce Fantasia, Volunteer Guide. Photo: P. Chvany.

Herbarium

In a multifaceted trade for space involving the Botanical Museum and the Museum of Comparative Zoology, the herbaria acquired three units within the MCZ representing approximately 3,000 square feet. With funds supplied largely by the Dean of the Faculty of Arts and Sciences, the rooms were renovated for herbarium, research and office space. Professor Carroll E. Wood, Jr., moved his office into one of the units along with the resources and staff of the project on the Generic Flora of the Southeastern United States. The herbarium cases containing the herbarium of the New England Botanical Club, a responsibility of the Gray Herbarium, occupies slightly more than one unit, and the remainder of the space now holds the collections of ferns and related nonflowering plants. The shift of these collections permitted some expansion of the storage of each. Special attention has been given during the year to curating the ferns, with funds from the NSF curatorial grant. This collection is now in superb condition.

The removal of the New England Botanical Club collection from the fourth floor of the Harvard University Herbaria building has permitted further adjustments within the building. A suite of three rooms, forming an office and laboratory complex, has been designed for Professor Rolla Tryon of the Gray Herbarium, and his associates. This will be completed and occupied during the next fiscal year. A small room has been created for archival material previously scattered in miscellaneous files. Dr. Miller has acquired space adjacent to his office which will be remodeled as a laboratory. Dr. Schubert will obtain a larger office and Dr. Howard will acquire a small laboratory area.

While additional space is welcomed by the recipient staff members, the problems of overcrowding of library and herbarium collections remain critical. The University did approve the hiring of an architect to prepare drawings for an addition to the Herbaria building. A prospectus, including such drawings, will be needed when funding for construction is solicited. Hopefully the addition contemplated will offer proper housing for herbarium specimens and library resources, as well as supply the laboratories and offices for professors of biology.

The herbarium of cultivated plants and general herbarium storage area maintained in the administration building in Jamaica Plain were fumigated by the Waltham Chemical Company during the Christmas holidays.

An Herbarium Committee was formed under the chairmanship of Professor Miller. An initial duty of the committee was

Staff members Dr. Richard E. Weaver, Jr., and Ida H. Burch collect herbarium specimens. Photo: P. Chvany.

to seek a replacement for Mr. Grimé, and Mrs. Jackie Smith was selected to begin her duties in the next fiscal year. Following the changes in the herbarium location of specimens, a new Information for Visitors leaflet was prepared, and the leaflet on loans and the handling of specimens was revised. At the end of the year all microscopes in the herbaria were inventoried, and were cleaned and adjusted on a special contract.

The curatorial grant received from the National Science Foundation was renewed for the third year of a possible five-year period. The grant to Harvard is administered in the office of the Gray Herbarium on behalf of the Arnold Arboretum, Botanical Museum, Farlow Herbarium and Library, and the Gray Herbarium. The grant has permitted the hiring of additional personnel for mounting of specimens and for curatorial work; the result of this additional labor is evident and welcome.

The herbarium is an active one. The collections are funda-

mental to the research of many of the staff, and are regarded as a significant national systematic collection. The requests for loans honored during the year comprised 129 loans of 18,288 sheets to 46 institutions within the United States, and 55 loans of 8,105 sheets to 32 institutions in other countries. Specimens mounted and inserted in the herbarium totaled 15,014, bringing the accessioned herbarium to 1,026,459 specimens of which 154,044 comprise the herbarium of cultivated plants in Jamaica Plain. A total of 16,339 specimens was received: 10,012 by exchange, 2,101 as gifts, 3,632 by subsidy, and 594 in return for identification. In contrast 3,894 specimens were sent in exchange. The herbarium collections housed in the Harvard University Herbaria building in Cambridge require repeated adjustments due to the lack of sufficient space for proper storage and curating. Another 25 Merrill cardboard boxes were added during the year, making a total of 2,396 such containers holding regular herbarium specimens, used in stacks or on top of other cases. In addition it has been necessary to remove unidentified specimens from the generic sequence in the herbarium in order to house properly regular and identified collections. At present the basement area holds 25 cases of such material, identified only to genus or family and removed from the regular sequence. This admittedly is improper care of valuable collections, but is the best that can be done until additional space and facilities become available.

The research of the staff includes floristic studies, monographs, and investigations of single taxa. The bibliography of published papers indicates the type of projects completed and published during the past fiscal year.

Library

Mrs. Lenore Dickinson assumed the duty of head Librarian on August 1, 1974, in a joint appointment with the Gray Herbarium. Mrs. Dickinson is assisted in Cambridge by three full-time Library Assistants, also shared with the Gray Herbarium, and in Jamaica Plain by one Library Assistant. Students are employed for shelving of books and routine cleaning in Cambridge, and Volunteers have assisted materially in Jamaica Plain. A Library Committee consisting of staff members from the Gray Herbarium and the Arboretum was appointed under the chairmanship of Dr. Bernice Schubert to assist the library staff in policy decisions.

The number of botanical periodicals pertinent to areas of staff interest seems to increase yearly. The subscription costs

of both new and existing periodicals have increased, as have expenditures for binding, supplies and equipment. Throughout the University library system, efforts to restrict budget increases have led to an examination of library holdings. In the Biological Laboratories, for example, periodical subscriptions are being canceled if the journal is in another library in Cambridge or Boston. This is certain to increase the demands upon the Arboretum library. To the present, however, no journal has been dropped from the Arboretum holdings.

Since its beginning, the library of the Arnold Arboretum has had an individual system of cataloguing and book arrangement. This was feasible while the library was small or increased slowly, while the primary use was by a cooperative staff, and while management was through the personal interest of a Librarian familiar with the arrangement through long years of service. All these permissive factors have been changed in recent years, and the necessity of adopting a standard system has become evident.

Thus, the Library of Congress system of cataloguing has been adopted for new accessions, and as time permits volumes or sections of the current library will be changed to conform. Catalogue cards under this system can be obtained from the Library of Congress, other research libraries such as the National Agriculture Library, or from the publishers when ordering books. The reference collections in Cambridge and Jamaica Plain will be the first areas where the Library of Congress classification can be put into effect. In time the staff adapts to the methods being taught to library personnel.

There has been an 18 per cent increase in total library circulation over the past year and the use of books by other than staff and students within the Herbaria building is now 20 per cent of total circulation. The requests for books on loan has been handled largely by photocopies, and only three volumes were sent on interlibrary loan during the year, while the 277 photocopy requests filled represented a 20 per cent increase in such service. Following the discovery of vandalism of rare books, an alarm system was installed in the library, greatly restricting the off-hour use of the library by the scientific staff.

With financial assistance provided by the Massachusetts Council on the Arts and Humanities it was possible to repair and restore the bindings on a number of valuable books of the 18th and 19th centuries. The curatorial grant from the National Science Foundation has provision for some retrospective binding and restoration of volumes, as well as the acquisition of

book boxes for the storage of unbindable materials. The regular binding program for periodicals is continued with unrestricted funds of the Arnold Arboretum.

Archival materials associated with the library holdings include catalogued collections of kodachrome slides and historic negatives of Wilson and Rock expeditions. Many hours of labor were contributed in Jamaica Plain by Volunteers during the year in renovating both the kodachrome slide collection and the negative files. The glass negatives exposed by Wilson have been placed in special plastic envelopes for better protection and the legends have been carefully restored on these and the Rock pictures.

The library was increased during the year with the addition of 1,433 catalogued items to total holdings of 84,346 volumes and pamphlets.

Education

The staff of the Arnold Arboretum must function within several distinctive educational levels in the Boston community. By terms of the endowment the Arnold Professor and Director of the Arnold Arboretum is required to teach the knowledge of trees within the University. The role of other staff members in college and university teaching has varied over the years. The opportunity to teach at Harvard has been extended to qualified staff members who have had various joint appointments, usually as lecturers, but occasionally as assistant or associate professors in addition to their regular curatorial appointments. Some departments and museums within the University have now adopted a policy of appointing only professors who will be required to teach a minimum number of courses. Curatorial work in these museums will only be supervised by the professors, and no public service function will be required. Traditionally, and in practice, the Arnold Arboretum has not been solely a teaching organization, but one devoted to research, offering its collections for public visitation or scholarly use to horticulture as well as botanical need. Both teaching and service roles of some or all of the staff have involved contacts with a general public in answering questions, lecturing or conducting tours, supplying material, preparing exhibits or displays, and writing at various levels. However, the role of the curator in maintaining collections is still valid and fundamental to an organization whose traditional work is based on collections of living plants, dried specimens and library books.

Dr. Wood taught all or part of three regularly scheduled

Dr. Carroll E. Wood, Jr., instructs class at the Arboretum. Photo: P. Chvany.

Harvard courses in Biology during the year: Biology 103, The Taxonomy of Vascular Plants; Biology 11a, Diversity in the Plant Kingdom; and Biology S–105, Plants of the Tropics. Dr. Howard shared the summer course with Dr. Wood and also offered in the fall, Biology 209, The Phylogeny of the Flowering Plants. Drs. Howard, Schubert and Wood all supervised the work of graduate or undergraduate students in numbered research courses.

Two Summer School classes were offered at the Arnold Arboretum in Jamaica Plain. Biology S–110, Principles of Practical Horticulture, was taught by Dr. DeWolf, and Dr. Weaver offered Biology S–109, Taxonomy of Cultivated Plants. An evaluation is now being made of the participation by Arboretum personnel in the Summer School program in view of the distance from Cambridge, the lack of air-conditioned lecture rooms as well as proper laboratories and equipment, and the difficulties of involving the staff in summer instruction programs without additional direct compensation.

The staff members of the Arnold Arboretum are invited to present seminars or lectures at other colleges, and they meet college classes that visit the Arnold Arboretum. Mr. Fordham has the greatest contact in this area, for most biology or

horticultural classes visiting the Arboretum request explanation of the propagation work or the procedures used in the greenhouses and nurseries. For tours of the collections, primarily in the spring, the Volunteers are willing and able to lead visiting garden clubs or plant study groups, but the curatorial and professional staff is involved in the explanations and tours of college groups in the library, herbarium, greenhouses and laboratories.

Nationally and internationally, members of the Arboretum staff have had roles in professional organizations. As selected examples, Dr. DeWolf has served on the International Orchid Commission on Classification, Nomenclature and Registration. He attended the Eighth World Conference in Frankfurt, Germany, and was elected chairman of the commission. Dr. Schubert has attended the Mexican Botanical Congresses and served as an active section chairman. In preparation for consideration at the International Botanical Congress, Dr. Schubert has served as chairman of the Standing Committee on Stabilization of Specific Names. For the past two years Dr. Howard has been president of the American Association of Botanic Gardens and Arboreta.

Many requests are received for staff members of the Arnold Arboretum to speak, or to take part in various ways in local organizations and projects. Staff members usually will speak without charge within the communities where the Arboretum is located: i.e., Jamaica Plain, Cambridge, and Weston. Our instructional programs are coordinated with those offered to the public by such local organizations as the Garden in the Woods, the Massachusetts Horticultural Society, Wellesley College, the Massachusetts Audubon Society, Habitat, Inc., and the Cambridge and Boston Adult Education programs. Mr. George Pride serves as coordinator for the Arboretum in these programs. He has also represented the staff at the Earth Week inner city environmental conference on the theme of changing vacant lots to garden plots. As these gardens developed, he served as a judge for the Street Scene exhibits in Cambridge and the 4–H Club vegetable workshop in Dorchester-Roxbury.

The nationwide interest in conservation, particularly the category of endangered plant species, has also involved the staff. Dr. Wood was invited to participate in a discussion at River Front Farm in Virginia, where twelve botanists and a total of fifty people attempted to prepare a list of such taxa for publication. Dr. DeWolf chaired a session on plant materials for the International Conference on Preservation and Restoration of Historic Gardens and Landscapes, held at Dumbarton Oaks in

Washington, D.C. Locally, Dr. Howard has attempted to contribute a "reasonable approach" in advising on some drastic legislation proposed for the Commonwealth of Massachusetts by concerned citizens.

Staff handling of sales and rentals of our two educational films has proved costly in time. We asked for and received competitive bids from film distributors, and contracted with Macmillan Films for the distribution of *The Arnold Arboretum* and *Poisonous Plants*. With extensive advertising by this company the films will receive wider use; the staff has the right to retain several copies for local use. We plan to apply the royalties and additional gifts to the development of another film.

Displays explaining the work of the staff or the plants grown at the Arnold Arboretum are often requested by schools and libraries. The lecture room in the Administration Building in Jamaica Plain offers wall space for other exhibits. One, "Plants in Many Moods," comprising the photography of Peter Chvany, was followed by photographs of botanical gardens and arboreta of the United States by Dr. Howard. An exhibit of books, specimens, and photographs of poisonous plants was prepared by Sheila Geary and displayed in Widener Library during the summer and fall. Specimens of species roses embedded in plastic by Mrs. Sheila Magullion, an Arboretum Volunteer, has made an attractive exhibit that has been displayed in libraries in the suburbs of Boston. Another exhibit, of cones and needle foliage, has been displayed similarly. The transparency display panels used in Jamaica Plain have formed part of an exhibit in the Information Office in Holyoke Center, and artifacts of the Wilson expedition to China were supplied to the Boston 200 Committee for the exhibit "Where's Boston?" staged at the Prudential Center.

During travel for field work or vacation, the staff acquires specimens or photographs useful in teaching and demonstration programs. During the year Dr. Weaver visited the Canary Islands; Mr. Pride, the West Indies; Dr. Stevens, herbaria and gardens in Europe; Dr. Spongberg, gardens and collections in England. Ms. Annette Aiello, a graduate student working on the ornamental genus *Portlandia*, visited Mexico and Jamaica during the year, supported in part by a grant from the Atkins Fund, and in part by the Arnold Arboretum.

The James R. Jewett Fellowship was awarded to Mr. Larry Morse, a graduate student, for support of field work in a study of the species of *Hudsonia* in the coastal areas of eastern North America.

Publications

An Editorial Committee was appointed during the year to aid Dr. Bernice Schubert, who has served as Editor of the *Journal of the Arnold Arboretum* since 1963. In October of the fiscal year, Miss Kathleen Clagett was appointed Technical Editor, Dr. Schubert continuing as chairman of the Editorial Committee which will assume responsibility for the botanical content of the manuscripts submitted. The publication schedule of the four numbers comprising a volume of the Journal was upset during the year by the employee strike in the Printing Office. The four numbers issued included 26 articles by 32 authors, and totaled 626 pages. The new cover for Volume 56, 1975, represented a mass collection of leaves of *Sassafras albidum* drawn by Karen Velmure.

The six numbers of *Arnoldia*, edited by Mrs. Jeanne S. Wadleigh, totaled 550 pages. A treatment of "Low Maintenance Perennials," by Robert Hebb, was issued in two numbers. One number was devoted to "Wild Plants in the City," by Nancy Page and Richard E. Weaver, Jr. "Lichens," by Weaver, and "Poison-ivy," by Gillis, were major articles of other issues.

The first volume of *Flora of the Lesser Antilles* was published by the Arboretum during the year. A grant from the Stanley Smith Horticultural Trust made possible the printing. The first volume contains a treatment of the Orchidaceae by Leslie Garay and Homer Sweet, and introductory historical and phytogeographical data by Dr. Howard.

Hastings House Publishers, Inc., issued Stephanne Sutton's biography of Joseph Rock under the title, *In China's Border Provinces* This work utilizes many of the historical records and photographs among the collections of the Arnold Arboretum. Rock made one trip to China sponsored by the Arnold Arboretum during the administration of Charles Sargent.

Quadrangle/The New York Times Book Company reprinted "Wild Plants in the City"; it also plans to reprint and distribute "Low Maintenance Perennials."

Harper and Row Publishers, Inc., published *A Student's Atlas of Flowering Plants: Some Dicotyledons of Eastern North America.* This work was planned and prepared under the direction of Dr. Carroll E. Wood, Jr., who was assisted by Dr. Elizabeth Shaw, Karen Velmure, and Dr. Kenneth Robertson. The volume features 120 illustrations, representing habit sketches and detailed drawings and dissections. The work is enhanced by an "atlas of descriptive terms," with references to illustrations, and a comparable list of adaptations for pollina-

Top left: Spring dresses the hillside adjacent to the Administration Building in Jamaica Plain. Photo: P. Chvany.

Below: The quiet beauty of the Arboretum in winter. Photo: P. Bruns.

tion and seed dispersal. The original printing was soon depleted, and a second printing, with a new title page, was issued during the year.

The staff also prepared a new brochure and map for the collections in Jamaica Plain, incorporating additional data on publications and on the Friends of the Arnold Arboretum.

Gifts and Grants

Dr. Wood received a grant from the National Science Foundation for a one-year extension of the research associated with a generic flora of the Southeastern United States Dr. Howard received a grant from the Stanley Smith Horticultural Trust to aid in the publication of a volume of the *Flora of the Lesser Antilles* issued during the year. The Friends of the Arnold Arboretum generously contributed monetary gifts as well as gifts in kind. Donations of books for the library were accepted from Mrs. F. S. Deland, Mrs. S. C. Lee, and Mrs. Maud E. Upton. Memorial gifts were received in the names of Mrs. Peter Boshco, Stephen Britton, Loring Conant, William Coulter, Sr., Virginia S. Jewett, Elisha Wilson Morse, and Stanley Woicik.

RICHARD A. HOWARD

Staff of the Arnold Arboretum — 1974–1975

Richard Alden Howard, Ph.D., Arnold Professor of Botany, Professor of Dendrology and Director

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Donald Wyman, Ph.D., Horticulturist, Emeritus

Pamela Anne Bruns, B.A., Artist and Art Director of Arnoldia (Resigned April 18, 1975)
Ida Hay Burch, B.A., Curatorial Assistant
Michael Anthony Canoso, M.S., Manager of the Systematic Collections*
Kathleen Ann Clagett, M.A., Technical Editor of the Journal of the Arnold Arboretum
Constance Tortorici Derderian, A.B., Honorary Curator of the Bonsai Collection
Gordon Parker DeWolf, Jr., Ph.D., Horticulturist
Lenore Mikalauskas Dickinson, M.S., Librarian* (Appointed September 1, 1974)
Alfred James Fordham, Propagator
Edward Herbert Flaherty, III, Curatorial Assistant (Appointed July 15, 1974)
Sheila Connor Geary, B.F.A., Assistant Librarian
Arturo Gómez-Pompa, Dr. Sc., Honorary Research Associate*
William Ed Grimé, B.A., Curatorial Assistant* (Resigned February 28, 1975)
Patricia Dick Hall, M.S., Librarian* (Resigned August 31, 1974)
Robert Stephen Hebb, B.S., Assistant Horticulturist (Resigned October 31, 1974)
Shiu-Ying Hu, Ph.D., Research Fellow in Temperate Asiatic Botany
Thomas Matthew Kinahan, Superintendent, Case Estates
Norton George Miller, Ph.D., Associate Curator and Associate Professor of Biology* (Appointed January 1, 1975)
George Howard Pride, M.A., Associate Horticulturist
Kenneth Ray Robertson, Ph.D., Assistant Curator
Bernice Giduz Schubert, Ph.D., Curator and Editor of the Journal of the Arnold Arboretum
Stephen Alan Spongberg, Ph.D., Assistant Curator
Peter Francis Stevens, Ph.D., Assistant Curator
Karen Stoutsenberger Velmure, B.A., Botanical Illustrator
Jeanne Stockbarger Wadleigh, B.S., Editor of Arnoldia
Richard Edwin Weaver, Jr., Ph.D., Assistant Curator
Robert Gerow Williams, B.S., Superintendent
Carroll Emory Wood, Jr., Ph.D., Curator and Professor of Biology

* Appointed jointly with the Gray Herbarium

AABGA members relax between sessions during Annual Meeting. Photo: P. Chvany.

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Notes from the Arnold Arboretum

Weather Station Data — 1974

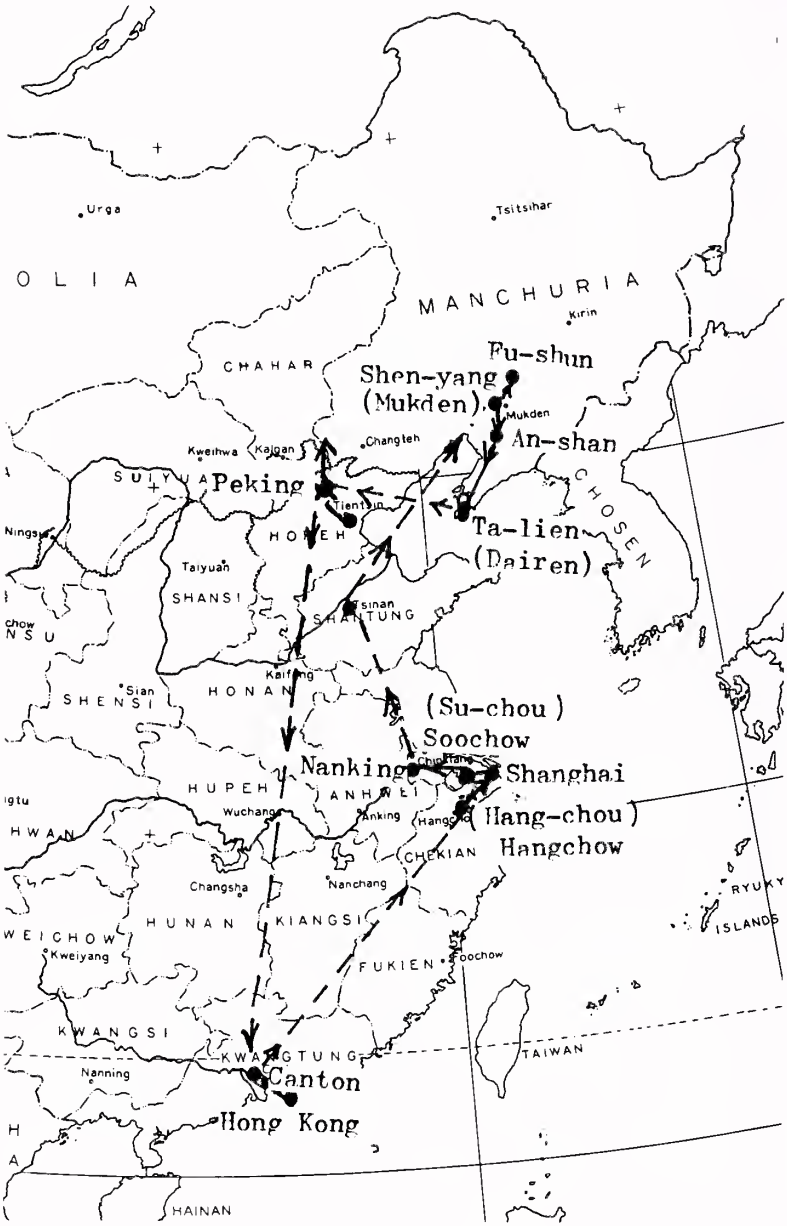
Average temperature for 1974: 50.6°
Precipitation for 1974: 45.85 inches
Snowfall during winter 1973–74: 31.2
Warmest temperature: 98° on July 10
Coldest temperature: –8° on Jan. 18
Date of last frost in spring: April 26
Date of first frost in autumn: Oct. 14
*Growing season for 1974 was 170 days

	Avg. Max. Temp.	Avg. Min. Temp.	Avg. Temp.	Extreme Max.	Extreme Min.	Precipitation	Snowfall
Jan.	38.2	19.1	28.6	65	−8	3.67	12.4
Feb.	38.2	16.4	27.3	57	6	3.33	14.5
Mar.	47.9	27.7	37.8	71	14	4.73	.3
Apr.	60.8	39.4	50.1	88	26	4.44	3.7
May	66.2	44.9	55.5	88	33	3.71	0
June	77.0	55.1	66.5	97	42	2.82	0
July	86.5	61.6	74.5	98	49	2.13	0
Aug.	84.7	60.4	77.5	97	50	3.47	0
Sept.	74.0	53.4	63.7	88	36	7.49	0
Oct.	60.0	36.7	48.3	79	20	3.39	0
Nov.	52.2	34.5	43.3	76	18	2.0	4.3
Dec.	42	26.3	34.1	61	13	4.67	3.5

* Growing season — The growing season is defined as the number of days between the last day with killing frost in spring and the first day with killing frost in autumn. This time is determined by the last spring and the first fall temperature of 32 degrees F. or lower.

Alfred J. Fordham

Trellis for woody vines adjacent to shrub collection in Jamaica Plain. Photo: G. Wadleigh.



Map showing the directions of the tour and the places visited. Broken lines indicate travels made by airplanes; solid lines, those by train or bus.

The Tour of a Botanist in China

by Shiu-Ying Hu

On the morning of August 7, 1975, three members of the Institute of Botany, Academia Sinica, were at the International Airport of Peking to fare me well. Their message was, "Please bear our greetings to botanists elsewhere." To give this message of goodwill to the readers of this article is an objective of the following report.

This summer I had the opportunity to participate in a tour organized by members of the Faculty of Science, Chinese University of Hong Kong. The purposes of the tour were to visit China, and to see the industrial and scientific institutions there. My personal hopes were to see my relatives and friends whom I have not seen for thirty years, to visit botanical institutions, gardens and professional botanists, and to purchase publications for the library of the Arnold Arboretum. To these ends I returned with satisfaction and gratitude.

The programs and activities of the tour were arranged completely by the China Travel Service (CTS). As soon as the group arrived in Canton, two members of CTS were assigned to us for the entire tour. With the exception of personal friends and relatives, all contacts with people and institutions had to be made through the introduction of an official agent such as CTS. As the programs for the tour were designed for a wide spectrum of interests which included only some parks and gardens, most of my visits to herbaria, professional botanists, and botanical and medicinal gardens were made through special requests, at the cost of certain items of general interest and mostly with additional expenses. Under these conditions, the number of botanical institutions visited was limited. I fully realize that such limited observations cannot give a fair picture of botany in China today. However, incomplete as it is, so far as I know, such information is not available to botanists outside China. To give these botanists a glimpse of the botanical activities in China and some information of botanists there, as far as material is available to me, is another objective of this article.

This report contains a general account and first impression of the tour, the botanical gardens and institutions visited, botanists and their current work, and some lessons learned through contact with the people. For convenience, the places visited are plotted in an outline map and the geographical names adopted are those appearing in outstanding newspapers such as the New York Times. Some older familiar names and those used in the Times Atlas of China (1974) are placed in parentheses.

A General Account of the Tour with First Impressions

Our tour within China began at Shen-chen (Sham-chun, Hong Kong spelling), where we went through customs inspection and made some currency exchanges. There the group was taken to a large garden which has a hedge of *Fokienia*. Among the trees there are several cauliflorous *Artocarpus* with large oblong fruits about 20 cm. long and 15 cm. in diameter. In a large dining room with a capacity for 300 people, we were served a sumptuous welcome lunch, then we took a train for Canton.

The train went over the Pearl River delta. There are a few low hills in sight. Rice is the major crop on both sides of the railway. The minor crops include tapioca plant, sweet potato, taro, greater yam (*Dioscorea alata*), jute and hemp. The latter two species are planted for fibers. Large trees of lychee (*Litchi chinensis*) and lungan (*Euphoria longan*), and banana are planted near villages. Papaya is occasionally cultivated along the banks between rice paddies. A very interesting phenomenon that I have not seen before is a green manure plant, *Sesbania cochinchinensis*, grown in loose rows among rice.

For our tour Canton was treated merely as a passing station. Programs were arranged for one half-day to see two historical sites before we took off for eastern China. However, at the conclusion of the tour, permission was granted to me and a former student to stay for two extra days in China to see botanical establishments in Canton. Then I was able to visit Sun Yatsen University which is now in the campus of former Lingnan University where F. A. McClure started a bamboo garden in the early 1930s. We also visited a botanical garden and the Herbarium of the Institute of Botany established by W. Y. Chun at Shih-p'ai, outside Canton.

Hangchow (Hang-chou) was the first city that we visited in eastern China. This place is known as the garden city of China. It is built by the side of West Lake (Hsi-hu) and it has Chien-tang River on the other side. Our hotel was situated on the lake side. For the first day we were driven 40 miles into the country

Dr. Shiu-Ying Hu and Prof. H. T. Chang in front of gate of the present Sun Yatsen University. Photo: C. H. Yeung.

to see a temple preserved for its art objects. Formerly the monks of this temple had the holdings of vast areas of land, and a good sized forest was preserved. So far as I know, this is by far the best preserved mesophytic forest of eastern China. There many large trees of *Acer*, *Aesculus*, *Catalpa*, *Celtis*, *Cinnamomum*, *Cryptomeria*, *Liquidambar*, *Platycarya*, *Pterocarya*, *Quercus*, *Sapindus*, and *Ulmus* have attained the height of 30–40 meters and a diameter of one meter or more.

In Hangchow we also visited a nursery specializing in flowers and flower arrangements. A young lady who is responsible for the bonsai section showed us around. From her we learned that the administration of botanical activities of Hangchow is the responsibility of the Bureau of Garden and Forestry. This office has 17 departments; the Flower Nursery, the Hangchow Botanical Garden, the Park Department, etc. are some of the departments. The nursery was started in 1958. It has 16 technical staff members who take care of the sections of bonsai, orchids, greenhouse, roses, chrysanthemums, woody and herbaceous flowers. It supplies flowers for all occasions and all needs. We were shown over 2,000 bonsai, and 5,000 pots of *Cymbidium*. Some of the cultivars of *Cymbidium* are extremely expensive: $500.00 per plant in U.S. currency.

In Hangchow we visited a water garden over zigzag bridges, a hill garden with pagoda on a hill-top in a setting of natural boulders, and a small garden with streams. We spent half of

a day in Hua-kang Park (Flower Creek Park). It is very well cared for and it reminds me of gardens visited in Kyoto and Tokyo, only this one is much larger. Its site of 300 mu (15 acres) is covered with beautiful lawn, impressive deodar-cedar and lace-bark pine, wisteria, and many other trees, shrubs and creepers, natural boulders, lakes, ponds with various kinds of aquatic plants, bridges, and hundreds of fishes swimming, jumping, and fighting for the bread thrown to them in a special area. By a special arrangement I was able to visit the Hangchow Botanical Garden, which will be described later.

From Hangchow we took a train to Shanghai, the largest city, and a highly industrialized and commercialized center of China. In Shanghai we were put up on the thirteenth floor of the International House where we had an extensive view of the city below. This building is next to the Shanghai People's Park which is converted from the former race course under British management. A bonsai exhibition was going on while we were in Shanghai. It occupied one-tenth of the Park and admission was five cents.

All lights on the streets are put out by 4:45 A.M. People begin to appear individually under the trees of the sidewalks along the park for morning exercises and by 5:40 A.M. a loudspeaker broadcasting instructions begins. Then the park is open and people also practice physical exercise on the walks in the park.

A reliable informant told me that under the leadership of Miss S. K. Cheng the largest botanical garden of China is under construction in Shanghai. Five million dollars have been allocated for this work. In the spring Miss Cheng took a party of eleven persons to Hainan Island. They visited botanical gardens and research institutions in botany along the way to find out what may be introduced into cultivation in Shanghai, in the field or under glass.

From Shanghai we took a train to Soochow (Su-chou). Formerly western visitors to China called Soochow the Venice of China. Then transportation within the town was carried on by boat. Now modern roads and streets for cars and buses are built to and within the city; yet vegetables and other farm products are carried by boat from producers on the farm to consumers of the street.

There is a Chinese saying about Soochow that we heard quoted proudly by our guides. This is, "The paradise above is the Soochow-Hangchow below." Soochow is indeed beautiful in landscape and rich in produce. In comparison with Hangchow, the gardens in Soochow are smaller, more compact and artificial.

With the exception of Hu-ch'iu (= Tiger Hill), all the gardens that we visited were former private residences. The unique characteristics of these gardens are the skillful use of rocks which gives the appearance of a scenery with hills, ledges, cliffs and streams, and the scanty planting of trees, shrubs and creepers.

One of our most impressive days in China was the one spent in a rural commune 40 miles outside Soochow. On the eastern side of Tai Lake there is an island called West Tung-ting Shan, and a peninsula with a hill called East Tung-ting Shan. The area we visited is called East Tung-ting Shan Commune. Members of this commune work in teams, but they all have their own homes. Each family has a small piece of land near the house for vegetables. Together they work in ponds for fish and shrimp, in paddy fields for rice, lotus and *chiao-po* (*Zizania caduciflora*), and in orchards of mei (*Prunus mume*), yang-mei (*Myrica rubra*), loquat, peach, Chinese date (*Zizyphus jujuba*), orange, tangerine, chestnut and ginkgo. They cultivate mulberry trees and keep them short for harvesting the leaves to feed silkworms. This is the first time I saw ginkgo in orchards. The trees are kept short and with broad crowns for the convenience of gathering the seeds. In this area all the trees bear seeds much larger than what one may see elsewhere in China or in America. Good cultivars are propagated by grafting. This commune has factories for making tea and canning fruits and ginkgo seeds. We were taken to a factory where women were embroidering fine garments; one of them was for the Emperor of Japan, we were told. The commune takes order from Shanghai and assigns the work to its members. The real achievement of this commune is that through group action the problem of water in agriculture has been solved. Over eighty small reservoirs have been built and the water of Tai Lake is pumped by steps up the hill where proper irrigation keeps the fruit trees in the orchards flourishing. Likewise a 20-mile-long dam has been built to prevent the fields from flooding in summer. The increased area of arable land and the insured return of labor have not only improved the life of the people, but they have also enriched the capital investment of the commune in tractors and trucks. Consequently, mechanization releases a certain amount of man power for work on fine objects of art.

From Soochow the group took a train to Wu-hsi to visit a modern city of the silk industry. Special arrangements were made for me to skip the activities in Wu-hsi so that I might have two extra days in Nanking to visit relatives, former teachers, and friends. I was most happy to return to Ginling College

campus where I had the first course of botany. It is now used by the Kiangsu Teachers' University, and there are many new buildings on the back hills. The campus has retained its former charm and the trees are taller with bigger trunks. The pond is full of lotus, but I did not see any birds on the trees around it. My classmates and I had a very enjoyable evening in the house of our former president, Dr. Y. F. Wu, who entertained us with a delicious dinner.

Botanical activities in Nanking included a visit to the medicinal plant garden of the College of Chinese Medicinal Sciences, and the Institute of Agricultural Sciences. A very informative and inspiring morning was spent in Nanking Hotel with Dr. R. W. Shan and T. Y. Chou, two taxonomists from the Institute of Botany in Kiangsu, and Prof. P. C. Yeh, a dendrologist and tree breeder of Nanking Technical Institute of Forest Products.

We flew from Nanking to Shen-yang (Mukden), and passed over my home town, Suchow (Hsü-chou). Formerly, in this part of China, Suchow was the dividing point for the type of agriculture, and used to be the northern limit of rice culture. The major crops of this region were wheat, sorghum, soybean, mungo-bean, cotton, peanut and sesame. Now from the air one can see canals and irrigated rice fields all the way from Nanking to Shen-yang. At Tsinan (Chinan), the capital of Shantung Province, we landed for lunch. If it had not been for the attractive flowers of *Calystegia pellita*, an indicator of North China, I would not have known that I was in the Yellow River Region, for the airport is surrounded by rice fields.

Shen-yang is a city of heavy industry; there are about one thousand factories in the area. Visits to plants of steel industry, electronics and mines were arranged for our group. As Shen-yang was the capital of Ching Dynasty before it was moved to Peking, there are imperial palaces and royal tombs in the area. We visited a park that is converted from a royal tomb. The place has been protected and some native trees are preserved. *Sophora japonica* was in full bloom; *Celtis*, *Morus*, *Phellodendron*, *Pinus*, *Pyrus*, and *Ulmus* are common. It is interesting to note that the street trees common in Shen-yang are *Populus canadensis* and *Robinia pseudoacacia*, both introduced from the New World.

A day-long bus trip took us through rice fields and an extensive area with eggplant, Chinese cabbage or radish, to a mining area, Fu-shun, where we descended 535 meters to a coal mine. A similar trip took us to a hydroelectric plant with a dam of 1700 meters. Fields of sorghum and corn are equally common. In plains and hills of this area there is hardly any native vegetation left.

In An-shan we were taken to a park called Two Nineteen, so named to commemorate the date of liberation of the town, February 19th, 1948. In this park there is an artificial lake with bridges, lotus in flower, and boats for pleasure rides. This lake is called Labor's Lake, and we were told that it was built voluntarily by laborers of the area. While members of the group and the guides enjoyed the boat ride and the lake sight, I slipped off to the greenhouse area and made a list of the species in cultivation. It is worthy of note that 70 percent of the species are woody and are planted in large containers 50–100 cm. in diameter. These specimens are moved around for decorating auditoriums or other public places for special meetings. *Cycas revoluta*, *Araucaria excelsa*, *Juniperus chinensis*, *Magnolia grandiflora*, *Ficus elastica*, *Camellia japonica*, *Rhapis excelsa* and *Trachycarpus fortunei* are among the 35 species listed. It is also interesting to note that annually tropical species such as *Michelia alba*, *M. figo*, and *Nerium indicum* are brought to flower and their containers are buried in the ground in certain broad city streets to provide temporary islands. This practice was observed on the streets of Shen-yang.

Arrangements were made for me to spend an evening in the homes of Prof. T. N. Liou, Director of the Institutum Sylviculturae et Pedologiae, and C. Wang of the same institute. Wang was the first person who collected a specimen of the living species of *Metasequoia*. Before World War II he graduated from Peking University where he had his botanical training from Prof. Liou.

Wang gave me a personal account of the discovery of the type tree that evening. It happened in July 1943 when he was making a trip between Szechwan and Hupeh. While waiting for available means of transportation, he met a former Peking classmate, Mr. L. H. Yang, who was teaching in the Agricultural School at Wan Hsien. Yang told him that there was a very unusual conifer at Mou-tao-chi. With the instruction given by Yang, Wang went and found the tree. He collected some leafy branches and picked up some cones dropped between the tiles of the roof of a small temple nearby. In his field book, he named this specimen as *Glyptostrobus*. On returning to Chunkging (Chung-Ching), he showed the specimen to C. L. Wu who was working with Prof. W. C. Cheng in Central University. Wu took a set of the collection to Prof. Cheng, who in turn sent a collector for some better specimens, and published the species with H. H. Hu.

We left Shen-yang for Ta-lien (Dairen) via An-shan. The trip between An-shan and Ta-lien was by train. *Robinia pseudo-*

acacia is planted on both sides of the railroad. On the slope between the trees there are many yellow flowers of *Potentilla* and *Ranunculus*. The major crop of this region is corn. Sweet potato and soybean are occasionally planted also. Distant hills are barren; erosion by rain and wind is obvious. It should be mentioned here that in a report published in January 1975 by the Bureau of Forestry, Ministry of Agriculture and Forestry, one reads about the excellent result of afforestation in Hsing-chin Hsien of the Liao-tung Peninsula. According to this report, small trees were planted over 85 of the 108 barren hills of the county in 1973, and through the Four-sides Movement, six million small trees were planted by the village-side, the house-side, the road-side and the bank-side of the same county. Perhaps similar activities are going on in other counties of the Peninsula, but the trees are too small to be observed from a distance in a moving train.

Ta-lien reminds one of Boston, Massachusetts about thirty years ago. A list of 35 trees, shrubs and herbs observed in the Hsing-hai Kung-yuan (Star Ocean Park) indicates that all the genera and many of the species occur in the Arnold Arboretum or other gardens in the Boston area.

From Ta-lien we flew to Peking. In addition to visiting historical sites and educational institutions, we made two day-long trips: one to Tientsin (Tien-chin) in the south, and another to the Great Wall in the northwest. On the day when the group was scheduled to visit Peking University, which is now situated in the Campus of former Yenching University, arrangement was made for me to visit the Institute of Botany, Academia Sinica. Early that morning, Miss S. Y. Wang of the Institute

came to the hotel room and took me to the Institute where I experienced the warmest welcome and the best reception ever given me by a botanical institution I have visited. There I met some old friends and many eminent botanists whose publications have been familiar for decades. The pictures of some of them are shown at left.

From Peking we returned to Canton by plane. In the plane, Mr. S. T. Chen asked me to read a poem which can be translated as follows:

> "The thousands of poplar and willow trees of Peking,
> Can not tie up the iron-bird from flying.
> If not restricted by the schedule of returning time,
> I would stay forever in this mother-land of mine."

It seems that members of the tour all share Chen's feeling as expressed by this poem.

Before giving my first impressions of the tour, I should like to explain that I left China as a mature botanist with the background of farm life in northern Kiangsu, and what impressed me the most is the effect of scientific agriculture on the life of farmers. This is not to say that the agricultural practices in China today are all modern. Most of the methods used now were familiar to me before I left. Although tractors are introduced into farms, ploughing is done largely by oxen or buffaloes in the south, and horses, donkeys or oxen in the north. Although chemical weed killers are known to some farmers, the weeding in fields and gardens is done primarily by hand. Although most communes have one or more trucks and tractors for transporting farm products, the bulk of fruits and vegetables is moved in carts pulled by animals in the north, and by men or women around Nanking. However, the amount of science and technology applied to agriculture and forestry has already made marked changes in the rural landscape. The rice fields that extend from Canton to Shen-yang and Peking, and the woods on hills in some places such as the White Cloud Mountain near Canton and Purple Mountain east of Nanking, are all new to me. The fundamental factors that brought about these changes lie in a nationwide planning and the mobilization of the people for group action.

The use of electricity to improve irrigation and the construction of canals and dams to regulate the water supply and to prevent flood are primary factors that change the rural landscape. In my youth I experienced repeated annual floods, famine and hunger. The people of the small cluster of villages

Photograph taken outside the Institute of Botany, Academia Sinica, Peking. Front row, left to right: F. T. Wang, T. Tang, S. Y. Hu, Y. Ling, S. Li, and R. Hsü. Back row: C. C. Hu, T. T. Yü, and T. H. Wang. Photo: Institute of Botany, Peking.

related to mine tried to improve the condition by digging the canal running between them. As they had no cooperation from people in distant villages at the lower end of the canal, the portion repaired was soon filled up by the deposits brought down from the hills by rain. Now with nationwide or provincial planning and group effort of all the people concerned, flooding is practically under control. July to August is the rainy season and the flood time in the area visited. In the extensive stretch of land the tour covered this summer, I did not observe any flooding over crops except along the railroad near Tientsin.

The other factor that brought about changes of the physiognomy in the country and attracts the attention of a botanist is the LU-HUA movement. The short and concise term, *lu-hua*, is seen and heard everywhere in China. The Chinese character that stands for *lu* means green and that for *hua* means to transform. In the manner by which the term is used by the people, *lu-hua* connotes ideas that can be expressed by no English equivalent. The word "verdification" may be used for *lu-hua*, but such a word is not in my dictionary. The aims of *lu-hua* are to make the countryside garden-like, to convert the hills into orchards and forests, to produce firewood for the people, and to supply timber for houses and for national construction. The activities of *lu-hua* involve afforestation of the barren hills, the establishment of orchards of fruit trees and of other species of economic importance such as tea-oil trees (*Camellia oleifera*), and four-sides planting in plains and cities.

At present the most obvious effects of *lu-hua* are the trees along the railroads and highways, the small vegetable gardens around houses and even some public buildings, the castor-oil plants along the banks of canals, and the quick and low growing woody species that yield firewood from stump sprouts, and grow on the narrow paths between paddy fields and irrigation ditches. The most striking features are the broad bands of *Taxodium* in the swampy low land along the railway between Shanghai and Nanking, and the wide stretches of trees along both sides of the highway between Peking and its airport. On each side of this highway there is a green wall formed by a harmonious planting of tall poplar, intermediate pagoda tree (*Sophora japonica*), and short *Amorpha fruticosa*. Beyond this wall are several rows of willow, and then apple or walnut orchards and farmhouses.

Another ten years from now visitors to China will have a different view of the distant hills from their train or bus. For several years, especially after the conclusion of a National Con-

vention of Workers for Afforestation that took place in August 1974, the communes of hilly districts have responded to the *lu-hua* movement by mobilizing fifteen to one hundred thousand farmers each. These workers have planted hundreds of millions of trees in each county, according to reports in publications of the Bureau of Forestry, Ministry of Agriculture and Forestry.

It is worth noting the species planted. These vary with the locality. In North China, apple, pear, peach, grape, mulberry, walnut and junipers are planted. In the middle Yellow River Region where strong wind and moving sand is characteristic, paulownia and willow are planted. In Central China, cunninghamia, cryptomeria, black locust and other exotic species are used. In South China localities such as Fukien, tea-oil, persimmon, lungan, lychee and many introduced species such as *Eucalyptus citriodora*, *Grevillea robusta*, *Casuarina equisetifolia*, and *Acacia confusa* are planted. In many places introduced species are preferred to the native ones that fit the same habitats. For example, *Taxodium ascendens* and *T. distichum* are planted in place of *Glyptostrobus pensilis* and *Metasequoia glyptostroboides* in low land and swampy areas; *Pinus elliottii*, *P. taeda*, and *P. palustris* are used instead of *P. massoniana* on slopes. Some of these species are chosen for a better quality of wood; others, for stronger resistance to insect attacks or for faster growth than the native species.

My first impression of changes in cities is the degree of industrialization. From the hotel buildings in all the cities visited, one can see tall chimneys of factories on the horizon. Even the residential cities such as Hangchow and Soochow, which used to be called the land of rice and fishes, are now proud of their industrial productivity. We were told that in Hangchow there are 700 factories. Thirty-eight of these employ one thousand or more workers each; these are steel industries, refineries, truck manufacturers, etc. In Soochow, watches, optical equipment, art pieces, furniture and carvings are produced. Although industries have brought better life to the workers and stronger financial capacity to the municipal governments, in the business centers and residential areas there seems to be a loss of the grandeur and brilliance that were formed in my memory. The change in me might have contributed partially to this impression. Before I left China, I was moving from a village to a town, and from smaller towns to larger cities. The first impressions of things seen appeared bigger and more magnificent than the ones known before. However, there seems to be evidence of less concern by the people regarding the outside appearance of the

houses where they live. With the exception of the hotels visited, the front view of houses and stores generally looks shabby. The four-sided planting of the *lu-hua* movement will eventually improve this condition. At present some areas have good-sized trees along the street. As birds are not encouraged, insect control becomes a serious problem. In Hangchow and Shanghai we met crews spraying the London Plane-tree (*Platanus acerifolia*) every day.

Botanical Institutions Visited

In my general account of the tour, I have mentioned special arrangements provided for me to visit some botanical institutions and botanical gardens in China. Here some additional information about each one is given. Peking is taken arbitrarily as the focal point. As no other institutions were visited north of Peking, the sequence adopted for entering the units is geographically southward from Peking to Canton.

Institute of Botany, Academia Sinica, Peking: The Institute is temporarily located in a building near the Peking Zoo on the northwestern section of the city. Plans have been made for a modern new building as its permanent home near the Botanical Garden outside Peking. The herbarium and library of the Institute have the collections of the former Fan Memorial Institute of Biology and those of the Botanical Institute of the former Peking University. At present the herbarium contains ten times more specimens than it did in the early 1950s. It has a staff of slightly over 300 technical people. In its seven laboratories, active research programs are progressing in many directions of various botanical disciplines, including taxonomic and floristic studies, physiology and morphogenesis, paleobotany, ecology, phytochemistry, economic botany, etc.

A monumental work has been completed in the preparation of Iconographia Cormophytorum Sinicorum in five volumes. The work is in Chinese with scientific names and illustration for every species. Volume V is in press. The following summary may give some general idea of the volumes published.

Volume I. (1972) Bryophyta, Pteridophyta, Gymnospermae, Angiospermae-Dicotyledoneae-Archichlamydeae, fam. Casuarinaceae to Hernandiaceae according to the system of Engler, pp. 1–1157, figs. 1–1730, including: (1) Appendix I. Keys to the families and some genera; keys to the species of Gymnospermae; (2) Appendix II. An illustrated glossary of botanical terms; and (3) Indices to Chinese and scientific names.

Volume II. (1972) Angiospermae-Dicotyledoneae-Archichlamydeae, fam. Papaveraceae to Cornaceae, pp. 1–1312, figs. 1731–3954, including keys to genera of the families included and indices to Chinese and scientific names.

Volume III. (1974) Angiospermae-Dicotyledoneae-Sympetalae, fam. Diapensiaceae-Solanaceae, pp. 1–1083, figs. 3955–5414, including descriptions of the families included and keys to the genera of each family, and indices to Chinese and scientific names.

Volume IV. (1975) Sympetalae, fam. Scrophulariaceae to Compositae, pp. 1–932, figs. 5415–6830, including descriptions of the families included and keys to the genera and some species, and indices to Chinese and scientific names.

The Flora Reipublicae Popularis Sinicae is largely in preparation, with portions of Rosaceae and Cyperaceae already published. The responsibility for the manuscripts of various families and genera is assigned to different persons in universities and botanical institutions throughout the country. In March 1975 the enlarged Sixth National Convention of the participants of the stupendous preparation of the flora took place in Peking under the auspices of the Bureau of Science and Technology. In addition to the people who are responsible for the manuscripts of various families and certain large genera, representatives of the Party, the Army, administrators of the botanical institutions that contribute scientists and technical personnel, leaders of workers in the farms, industry, and the barefoot doctors were invited. I was informed that at the conclusion of the convention an important decision was made that the flora will be completed in ten years. Members of the Institute of Botany in Peking all have confidence that this will be done.

Two excellent journals are published regularly under the auspices of the Botanical Society of China. These are the *Acta Botanica Sinica* and the *Acta Phytotaxonomica Sinica*. Another periodical, *Zhiwuxue ZaZhi* (*Botanical Magazine*), is a popular quarterly journal. It is designed for short articles of two or three pages introducing botanical principles and technology to the general public. It is published regularly in February, May, August and November.

Nanking College of Traditional Chinese Medicine: The scientific world has begun to turn its attention towards traditional Chinese medicine. For example, in the past three years teams of American doctors and of pharmacological scientists have visited China to observe and to learn. In a report, Prof. Norman R. Farnsworth of the School of Pharmacy, University of Illinois,

using the computerized information of his office, has confirmed Chairman Mao's statement that Chinese medicine is a treasure house. It is fitting to say that the College of Traditional Chinese Medicine at Nanking is a pioneer institution in the study of Chinese materia medica. By applying scientific methods in its work on Chinese medicinal plants, it has opened the treasure house and done an excellent job in illuminating the principles and facts on Chinese medicine. From the beginning its triple objective included teaching, research and production. Its various research teams have identified the raw material of Chinese medicine, analyzed various market products and studied their chemical compositions, and extracted pure forms of the effective principles. Its production team has cooperated with drug manufacture houses to produce pills, ointments and injections for the service of the people and to meet government assignments. In 1976 it will celebrate its fortieth anniversary. Its four thousand graduates work in various disciplines of Chinese medicine throughout the country.

At present the college has 800 students and 190 teaching staff members. In my visit I was shown the herbarium, the collection of identified Chinese drugs as bought from the market, and the laboratories where chemical activities take place. Then we went to the medicinal garden twenty miles outside Nanking.

The herbarium was organized by H. T. Sun who was its curator before he died. Sun was a student of S. S. Chien, and worked with him in the Botanical Laboratories in Nanking and in Po-pei, Szechwan, during World War II. For many years he was recognized as the Chinese specialist of Labiatae.

The Chinese drug collection occupies a large room. All the samples are in individual glass containers, each with a label of the Chinese and the scientific names. So far as I know this is the best reference collection of Chinese materia medica prepared and identified by men of scientific training.

The activities in the Chemistry laboratories are out of my line. The exhibits that attracted my attention were the extracts of *Andrographis paniculatus* used as a substitute for penicillin, and those of different species of *Lycoris* employed as anticancerous drugs. The most interesting object was the preparation of injection material from the fruit of *Camptotheca acuminata* for the treatment of patients with cancer. A syrup prepared from *Ilex chinensis* for patients with high blood pressure was naturally a delightful surprise to one who has spent thirty years in the study of the genus *Ilex* in China.

Camptotheca acuminata *growing near Shih-Fang Hsien. Photo: E. H. Wilson, 1908.*

The medicinal garden is the best of its kind. It is on a thirty-five-acre farm assigned to the College for the following purposes: to have a living collection of Chinese medicinal plants, to provide material for chemical analyses and other experiments, and to perform research in the field. The living collection has about 900 species. The specimens are planted in three groups. The shade loving species and those introduced from the high mountains of western China or from the cold temperate regions are cultivated with special care under shade. The mesophytic species are cultivated in plots by families in the nursery. Climbers are planted in a special area with supports. For the mesophytes and the shade loving species each plot is about one and a half meters long and one meter wide. The climbers are in rows.

One of the interesting projects of field research is the cultivation of *Poria cocos*, a parasitic fungus growing in the root of *Pinus massoniana*. The large sclerotia of the parasite, about 15 cm. long and 10–12 cm. in diameter, are collected for medicinal use. So far, only spontaneous products are known. Formerly, large amounts of the sliced central chalk-white portion were exported under the common name, China Root. Small sclerotia of the species are now produced in a laboratory of the medicinal garden. They are too small to be of any practical use yet.

The publications of the College include a *Bulletin*, a statistical *Survey of the Amount and Cost of Production of Chinese Medicine* (1954–55), a preliminary study on the *Identification and Preparation of Chinese Medicine in Nanking Area* (1958), and the *Chinese Pharmacognosy* (1960). The last mentioned work is an illustrated treatise on Chinese materia medica. It is a large book with a dimension of 26 by 18 cm., and consists of 1416 pages with 1396 figures. It is divided into four parts. Part I (pp. 1–115) consists of general aspects of Chinese medicine, including the history, source material, chemical constituents, preparation, identification and principles. Part II (pp. 116–1173) consists of plant drugs, including introduction of plant cells, tissues, and organs with an illustrated glossary, descriptions and illustrations of important plant families, explanation of the cultivation of medicinal plants, and 498 detailed treatments of species grouped by the organs from which the drugs are obtained. Part III (pp. 1174–1273) consists of 82 kinds of animal drugs. Part IV (pp. 1274–1324) contains 54 kinds of mineral drugs. The plant drugs are arranged by the parts employed. These include whole twigs 24, wood 6, bark 20, rhizomes 55, roots 87, leaves 23, flowers 37, fruits 97, seeds 62, entire

herbs 50, and others (including resins, gums, copals, etc.) 42. Illustrated discussions of related products of 160 species are given as notes at the end of some drugs. Consequently the book contains 634 species of plants that yield Chinese drugs. Regarding the quality of the work, Japanese pharmacologists who can read Chinese have commented that it is the best of its kind ever produced in Chinese pharmacognosy. I was told that a bigger book of similar nature is in preparation. In this one both the officinal and the herbal medicines are included.

Kiangsu Institute of Agricultural Sciences: "Everyone has food," was the comment I heard from friends who had returned to China before I did. The higher per acre yield now than 25 years ago is the fact told me proudly by the people who are engaged in agricultural productions, whether in communes or in experimental stations. Now in every province there is an Institute of Agricultural Sciences which is responsible for the development of high yield strains, of better methods in farm management, and of modern measures in crop protection. On the advice of Dr. Y. F. Wu, President of the former Ginling College, arrangement was made for me to visit the Institute of Agricultural Sciences in Nanking.

The Institute is situated outside the Chung Shan Gate on the outskirts east of Nanking, and is on an 165-acre farm. Its eight research laboratories are engaged in crop plant improvement, plant protection, animal husbandry and veterinary science, soil and fertilizer, horticulture, economic crop plants, farm management and farm products. It has a staff of six hundred people. On observing my surprise at such a large number of people, my hosts quickly explained the dual responsibilities of members of the Institute. In addition to operating research projects in Nanking, they also go out to reside in the communes to work with the people, which they call *tun-tien* (to squat on points), or to carry on surveys, or to give supervision in a large area, which they call *p'ao-mien* (to run the surface).

In the field I was shown the various improved strains of high-yielding rice and different demonstrations in the management of cotton farms, including intercropping of cotton with corn or with sweet potato. Then I was taken into a reception hall to see the exhibits of four strains of high-yielding wheat developed by the Institute, and seven kinds of seeds of green manure plants introduced by the Institute to the farmers of the province. Finally I was asked to try the fruit of a cultivar of peach called *pan-t'ao* (discoid peach). The fruit of this cultivar is strongly compressed on the baso-distal axis. It has a diam-

eter of 6–7 cm. and a height of 2–3 cm. The stone is small and round, about 1.5–2 cm. in diameter, and clings to the flesh. This cultivar has a long history. It was developed from the famous *shui-mi-t'ao* (watery honey peach) of the lower Yangtze Region. Its fruit is the most juicy and sweet of the peaches.

Bonsai Exhibition in Shanghai: This exhibition was prepared for the general public in a park of the business center of metropolitan Shanghai, and occupies an area of about one-half of an acre. At the entrance there is a frame with a miniature landscape. The frame is approximately 4 meters long, 3 m. high and 1.5 m. wide. The background is a painting; the floor, white with running water, and the scenery composed of small dwarfed trees and gray rocks. The plants used are *Cryptomeria japonica*, *Pinus wangii*, *P. massoniana*, all about 20 cm. high; four *Pseudolarix amabilis* about 12 cm. high; an *Acer palmatum*; a *Punica granatum* about 20 cm. tall and with a flower bud; a species of *Rhododendron*; a *Serissa serissoides*; and a small bamboo. It is a very attractive arrangement.

Individual specimens are in pots on attractive stands and labeled in Chinese. Ten genera of gymnosperms and 23 genera of angiosperms are used. These are: *Cycas*, *Ginkgo*, *Torreya*, *Podocarpus macrophylla* var. *maki*, *Metasequoia*, *Pinus wangii*, *P. tabulaeformis*, *Juniperus*, *Cryptomeria*, *Pseudolarix*, *Ulmus parvifolia*, *Berberis*, *Nandina*, *Pyracanthus*, *Caragana*, *Millettia*, *Buxus microphylla* var. *sinica*, *Acer palmatum*, *A. paxii*, *Sageretia theezans*, *Malvaviscus*, *Lagerstroemia indica*, *Punica granatum*, *Elaeagnus*, *Rhododendron*, *Jasminum nudiflorum*, *Schefflera*, *Diospyros sinensis*, *Trachelospermum*, *Rhapis excelsa*, and *Serissa*. Also a bamboo and a variegated-leaved grass are on display.

Hangchow Botanical Garden: This is the youngest and also the largest of all the botanical gardens that I have ever visited. It was started in 1956, and it covers 517 acres. Three-fifths of the area is planted and the remainder is for conservation of the spontaneous vegetation. The objectives of the garden are exhibition and research. The activities concern classification, economic botany, a bamboo garden, ornamental plants, and dendrology. All the plants are labeled on stone or cement blocks buried in the ground; the names, both Chinese and scientific, and economic importance are chiseled and colored.

It was raining and time was short. Under umbrellas we went through the medicinal plant collection, and the plantings of Juglandaceae. The design of the medicinal plant section is unique. All the species are planted in an area with a landscape

of an oriental garden with a winding stream, trees, rocks and various herbs. Aquatic species are planted in individual containers a meter in diameter and these are buried in the ground. The lawns between trees are very well kept.

We went to see the *Sequoia sempervirens* and *Sequoiadendron giganteum* that came with the Nixon party. These are kept in a locked-up area.

Lingnan Bamboo Garden in Canton: This bamboo garden was started in the late 1920s and the 1930s by the late Prof. F. A. McClure of Lingnan University with the assistance of H. Fung. The campus is now used by Sun Yatsen University. A large building occupies a portion of the former garden, and the front gate of the present University is nearby. A portion of the Bamboo Garden is left on the old site. According to my memory it is less than one-fifth of the original size. Fung is living, but he is too old to work in the garden.

I was shown three species of *Lingnania*, and was told some of the species died after flowering while some others have been moved to a more suitable site. At present the center of the study of bamboo in this area is shifted to the Kwangtung Institute of Botany at Shih-pai where L. C. Chia is active in research of the bamboo of Kwangtung Province.

Kwangtung Institute of Botany: The name of this institution has been changed several times. When it was first organized by Prof. W. Y. Chun, the name was the Botanical Institute, College of Agriculture, Sun Yatsen University, as it appeared in its journal, *Sunyatsenia*. By the 1950s and in the 1960s its name was Instituti Botanici Austro-Sinensis, Academiae Sinicae, as it appeared on the title page of its publications, *Flora of Canton* (1956) and *Flora Hainanica* II (1965). On the title page of *Flora Hainanica* III (1974) the present name is used.

The herbarium of the Institute is the second largest in China. It is kept in excellent condition, and it has good working space for its staff and for visiting botanists. It was in this herbarium that Y. Tsiang carried on his research of the Apocynaceae and Asclepiadaceae of China. His research area is kept there although he has been on the teaching staff of a neighboring institution of higher education, the College of Agriculture and Forestry of Kwangtung. When Professor Chun started the herbarium in the late 1920s, he decided to file the specimens of the world's newest herbarium by the newest system of classification of the flowering plants. Consequently this becomes the only known herbarium that has adopted Hutchinson's system, both in the filing of the specimens and in the publications.

From left, T. C. Li, P. W. Li (pomologist), S. Y. Hu, Y. Y. Yeh, and H. M. Wu (ecologist) at entrance of the guest house at Kwangtung Botanical Garden. Photo: C. H. Yeung.

Regarding the research activities of the Institute, all its botanists are participants in the preparation of the Flora of China, each taking one or more families. Other publications include *Flora of Canton* and *Flora Hainanica*. *Flora of Canton* (1956, 1–951, figures 1–415) is a very useful book for the identification of species in the Canton-Hongkong area. It was the collaboration of sixteen botanists, F. C. How being the Editor-in-Chief. It is in Chinese, with keys, descriptions, Chinese and scientific names, and the citation of a few voucher specimens.

I have seen only two volumes of *Flora Hainanica*. Volume II (1965, viii, 1–470, figures 1–520) was published under the editorship of W. Y. Chun and C. C. Chang. It is in Chinese, with keys, descriptions, Chinese, scientific and important synonyms and citations of literature, distribution and ecological notes. This volume contains 844 species and 51 infraspecific taxa in 287 genera of 44 families, including Myrtaceae, Malvaceae, Euphorbiaceae, Rosaceae, Leguminoseae, Fagaceae, Aquifoliaceae, Moraceae, etc. It has indices of the Chinese and scientific names and synonyms. Volume III (1974, i, 1–629, figures 527–942) indicates no authorship. It contains 927 species and 77 infraspecific taxa in 409 genera of 56 families. The treatment of the species is similar to that of Volume II. However, there is one very different feature, i.e., the publication

of new genera, species and varieties, and many nomenclatural changes in fourteen families including *Rutaceae*, *Sapindaceae*, *Sapotaceae*, *Myrsinaceae*, *Styracaceae*, *Oleaceae*, *Asclepiadaceae*, *Rubiaceae*, *Compositae*, *Primulaceae*, *Solanaceae*, *Scrophulariaceae*, *Gesneriaceae* and *Acanthaceae*.

Kwangtung Botanical Garden: This is a large garden adjacent to the Institute of Botany. It is concerned with scientific research for the service of the people. Its activities include the introduction, acclimatization and extension of species economically important. It has an exchange program with sixty countries, especially Africa. At present it has over three thousand species under experiment. The research team of the Garden has found many desirable characteristics in *Taxodium ascendens* and *T. distichum* for *lu-hua* in the low-land of Kwangtung. These species can be propagated vegetatively. They have relatively smaller crowns than the native species, and cast less shade on the adjacent crops. They grow rather fast and after six to eight years they can be cut and the wood can be used as a substitute for *Cunninghamia* to meet the need of farmers for construction.

The Garden has 200 acres of developed land. At Ting Wu Mountain of northern Kwangtung, it has an arboretum of 3,000 acres. One-fourth of this area is occupied by natural forest. With our limited time, we were able to walk through the excellent orchid collection and the medicinal plant section of 700 species planted in pots.

News about Some Botanists in China

It is a great pleasure to tell the news about two of the oldest botanists who are active in research projects or teaching. These are Prof. S. S. Sin, who is now 84 and is working on the *nu-shu* (Ancient Agricultural Books) of China, and Prof. J. C. Liu who is 83 and goes to work in Peking University daily. Sin is well known for his exploration of Yao Shan in Kwangsi, and Liu for his *Systematic Botany of the Flowering Families in North China* published in 1931. To many Chinese students of botany, this book is like Gray's *Lessons* in the United States in the 1850s.

The pioneer floristic and taxonomic botanists of China, S. S. Chien, H. H. Hu, and W. Y. Chun are dead. So is Prof. Y. Chen, author of *Classification of Chinese Trees and Shrubs*. This work is illustrated. Its usefulness in China is like Rehder's Manual in the English speaking world. The revised edition is now in press; for this work Chen stayed in Nanking during World War II to be with the material for the revision while his

associates moved with the University of Nanking to Chengtu, Szechwan. He died in Peking as a member of the Institute of Agriculture and Forestry.

The following information about botanists active in various disciplines of botanical research is gathered from available publications and personal communications. This incomplete list is being sent to several institutions in Peking, Nanking, Hangchow, Canton and Shen-yang for corrections and additions. If I hear from any of these while the report is still in manuscript form, due changes will be made. As in the report on the botanical institutions visited, Peking is again taken as a focal point.

Botanists in Peking and Vicinity

Institute of Botany, Academia Sinica

Floristic and taxonomic research:

Chen, C. — Collaborator of T. Tang in Cyperaceae.
Chen, S. C. — Same as the above.
Ching, R. C. — Ferns, now works at home, recently published two new families, Pteridiaceae and Hypodenatiaceae.
Chung, P. C. — Scrophulariaceae, Campanulaceae.
Hong, D. Y. — Commelinaceae.
Huang, C. C. — Geraniaceae.
Ku, T. C. — Collaborator of T. T. Yü.
Kuan, K. C. — Book review, botanical critic.
Kuang, K. Z. — *Physochlaina.*
Liang, S. Y. — Collaborator of Tang in Cyperaceae.
Ling, Y. — Compositae, Convolvulaceae, Director.
Lou, J. S. — Collaborator of P. C. Wu.
Lu, A. M. — Collaborator with K. Z. Kuang in *Physochlaina.*
Lu, L. T. — Collaborator with T. T. Yü in Rosaceae.
Lu, L. Y. — Myrtaceae.
Tai, L. K. — Collaborator with Tang in Cyperaceae.
Tang, T. — Orchidaceae, Cyperaceae.
Tang, Y. C. — Population study, *Tofieldia* mentioned.
Tsui, Y. W. — Caryophyllaceae.
Wang, F. T. — Liliaceae, Leguminosae.
Wang, W. T. — Ranunculaceae, Gesneriaceae.
Wu, P. C. — Bryophytes.
Ying, T. S. — *Epimedium.*
Yü, T. T. — Rosaceae.

Morphogenesis and cytology:

Chang, P. T. — Collaborator of L. C. Chien, see the following.
Chien, L. C. — Ultrastructural changes in cold resistant wheat.
Chien, N. F. — Collaborator with Z. C. Chu and J. S. Kuo
Ching, Y. H. — Collaborator with L. C. Chien.
Chu, Z. C. — Morphogenesis of wheat pollen plants.
Duan, C. H. — Collaborator of C. H. Lou.
Li, Y. — Effects of O_2 and CO_2 on post-maturation of tomato.
Lou, C. H. — Protoplastic withdrawal in the withering leaves of plants.

Kuo, J. S. — Anther culture of *Nicotiana* and *Capsicum*.
Kwei, Y. L. — Collaborator of C. L. Lee of Peking University.
Mao, C. Y. — Collaborator of Y. Li.
Sun, C. S. — Androgenesis of Triticale.
Tang, P. H. — Pollen development and physiology of *Clivia*.
Tsui, C. — Physiology and nutrition of micro-organisms.
Tuan, H. C. — Cytology.
Wang, C. C. — Collaborator of Z. C. Chu.
Wang, S. C. — Studies on factors affecting growth, development and yield of wheat.
Wang, V. H. — Collaborator of Y. Li.
Wang, Y. Y. — Collaborator of J. S. Kuo.
Wu, S. H. — Cytology.

Paleobotany:
Hsü, J. — A leading Chinese paleobotanist, lately worked on collections of the recent Chinese Himalayan expeditions, from plant-bearing sandstone beds at 8,012 m. altitude.
Kong, Z. C. — Collaborator of J. R. Tao.
Sun, X. J. — Collaborator of J. Hsü.
Tao, J. R. — Fossil flora and spore-pollen investigation on the Shang-in coal series in Yunnan.
Morphology and anatomy:
Chang, C. Y. — Morphology of *Archangiopteris* and relationship with *Angiopteris*.
Hu, Y. S. — Collaborator with Y. L. Kwei.
Kwei, Y. L. — Epidermal feature in classification of *Taxus*.
Shi, Y. C. — Pollen morphology of *Thalictrum*.
Ecology and vegetation studies:
Chang, C. S. — Collaborator of Y. L. Li.
Li, Y. L. — Beech forest of Fan-ching Shan in Kweichow.
Ming, T. L. — Collaborator of Y. L. Li.
Tsien, C. P. — In Y. L. Li's team.
Ying, T. S. — Same as the above.
Vertical vegetation belt of Mt. Jolmo-lungma (Mt. Everest):
Chang, K. W. and S. Chiang — Co-authors of the above subject.
Azotobacter and nitrogenase:
The team of Laboratory 7 of the Institute.

Institute of Microbiology, Academia Sinica
Chao, C. D. — *Usnea* of China.
Hsü, L. W. — Collaborator of C. D. Chao.
Sun, Z. M. — Same as the above.
Yü, Y. N. — Fungus infection of *Zizania*, *Yenia* is recognized as a genus, segregated from *Ustilago*.

Institute of Agriculture and Forestry
Cheng, W. C. — Gymnosperms of China, director.
Chu, W. F. — Wood technology, especially the anatomy of wood and bamboo; compilation of a Dictionary of Forestry in Chinese.
Wu, C. L. — Ecology and afforestation.

Institute of Materia Medica, Chinese Academy of Medical Sciences
- Chen, P. C. — Collaborator with P. K. Hsiao.
- Chen, Y. H. — Same as the above.
- Feng, S. C. — Same as the above.
- Feng, Y. S. — Same as the above.
- Ho, L. Y. — Same as the above.
- Hsia, K. C. — Same as the above.
- Hsiao, P. K. — Phytochemistry of medicinal plants, using chromatography and UV spectra.
- Lien, W. Y. — Menispermaceous plants used in medicine, with new taxa described.
- Ling, S. C. — Collaborator with P. K. Hsiao.
- Liu, K. S. — Same as the above.
- Lü, S. C. — Same as the above.
- Sung, W. C. — Same as the above.
- Yueh, C. H. — Collaborator with C. Y. Cheng in *Trichosanthes*.

Peking Medical College, Department of Pharmaceutical Sciences
- Cheng, C. Y. — *Trichosanthes*, with nomenclatural changes and description of new species, in collaboration with C. H. Yueh; synopsis of *Rheum* with descriptions of four new species and two new varieties, in collaboration with T. C. Ko.
- Ko, T. C. — Collaborator of C. Y. Cheng.

North China Agriculture University
- Shao, L. M. — Collaborator of C. H. Lou in cell physiology.
- Wu, H. J. — Physiology, effect of gibberellin on growth of Ramie.

Peking University, Department of Biology
- Lee, C. L. — Morphogenesis, excised stem of mint.

Peking Teachers College, Department of Fundamental Agriculture
- Chao, W. P. — Cell physiology.

Botanists in the Maritime Provinces

Eastern China

Shantung Institute of Tobacco Research, Academy of Agricultural Sciences
- Hsü, H. C. — Anther culture, collaborator of J. S. Kuo.
- Kung, M. L. — Same as the above.

Kiangsu Institute of Botany, Nanking
- Chen, S. L. — Gramineae, collaborator of Y. L. Keng.
- Chou, T. Y. — Cruciferae.
- Shan, R. H. — Umbelliferae.

Kiangsu Institute of Agricultural Sciences, Nanking
- Hsi, Y. L. — Research in the genus *Gossypium*.
- Mei, C. L. — Research in the genus *Triticum*.
- Tsui, C. L. — Research in the genus *Oryza*.

Nanking College of Traditional Chinese Medicine
- Hsü, K. C. — Research and teaching in Chinese medicinal plants.
- Hsü, L. S. — Same as the above.

Nanking University
- Keng, Y. L. — Gramineae, now works largely at home.
- Wei, C. C. — Plant pathology, *Manual of Rice Pathogens*, revised edition in press; manuscript *Manual of Fungus Pathogens*.

Nanking Technical Institute of Forest Products
- Shang, C. B. — Lauraceae
- Yeh, P. C. — Tree breeding, produced F_1 of *Liriodendron chinense* × *L. tulipifera* and intergeneric hybrids of *Cryptomeria* × *Cunninghamia* and *Taxodium* × *Cryptomeria*.

Shanghai, Futan University
- Hsü, P. S. — *Viburnum* of China.
- Hu, C. C. — Screening the plants of Chekiang and Anhwei for antibacterial properties.
- Wang, H. J. — Collaborator of C. C. Hu.
- Yin, C. C. — Same as the above.

Shanghai First Medical College
- Li, Y. — Collaborator of R. H. Shan in *Bupleurum*.

Shanghai Teachers' University, Department of Biology
- Chiu, P. S. — Asiatic *Woodwardia*.

Shanghai Institute of Materia Medica
- Fan, G. J. — Obtained lycoramine from *Lycoris longituba* Hsu & Fan for curing epilepsy.
- Hsü, Y. — Senior author in the *Lycoris* work, see above.

Hangchow Botanical Garden
- Chang, S. Y. — Economic botany, medicinal plants, administrator.
- Chiu, P. L. — Ferns, new species of *Plagiogyria chekiangensis*.
- Yao, C. Y. — Bamboo.

Rui-an District Medical Team, Chekiang
- Ling, C. — Acanthaceae, *Championella sarcorrhiza* C. Ling, and *C. obligantha* (Miq.) Bremek., source of a medicine for curing kidney trouble.

Southern China (including Kwangsi)

Kwangtung Institute of Botany
- Chang, C. T. — *Blumea*.
- Chen, F. H. — Primulaceae, *Carpesium*.
- Chia, L. C. — Economic botany, bamboo.
- Hu, C. M. — Collaborator with F. H. Chen in *Carpesium*.
- Hwang, S. M. — *Aristolochia*.
- Kao, Y. C. — Rubiaceae.
- Liu, Y. H. — Magnoliaceae, Sabiaceae.
- Wu, H. M. — Ecology.
- Yü, C. N. — Collaborator of C. T. Chang in *Blumea*.

Sun Yatsen University, Canton
- Chang, H. T. — Hamamelidaceae, Myrtaceae, Pittosporaceae.
- Fan, K. C. — Marine algae. [Deceased on December 20, 1974.]

Kwangtung College of Agriculture and Forestry, Canton
- Hsü, H. H. — Sterculiaceae.
- Lee, — Plant physiology.
- Li, P. M. — Pomology; Dean of the College.
- Li, P. T. — Collaborator of Y. Tsiang in Asclepiadaceae.

Tsiang, Y. — Annonaceae, Apocynaceae, Asclepiadaceae, Euphorbiaceae.

South China Sea Institute of Oceanology, Academia Sinica, Hainan Island

Pan, K. Y. — Collaborator with Y. C. Wang and K. C. Fan.

Wang, Y. C. — Marine algae of Hsi-sha Islands, new species of Rhodophyta, in collaboration with Y. C. Wang and K. Y. Pan.

Zhan-jiang College of Fisheries, Hainan Island

Li, W. H. — Marine algae, new species of Rhodophyta.

Kwangsi Institute of Botany

Chang, P. N. — Economic botany, medicinal plants, *Check List of Plants of Kwangsi.*

Liang, C. F. — Aristolochiaceae.

Central China

In Central China there is Wu-han University which has been active in botanical explorations in Hupeh and Szechwan. There is also the Lu Sha Botanical Garden in Kiangsi. Unfortunately, in this tour Central China was not included, and the information about botanists there is regrettably scanty.

Hupeh Institute of Botany, Wu-han

Fu, S. S. — Ferns and many families of flowering plant, including Moraceae, Proteaceae, Ficoideae, Polygalaceae, Actinidiaceae, etc.

Hupeh Institute of Hydrobiology

Jao, C. C. — Fresh water algae, the Charophyta of Hupeh.

Lee, Y. Y. — Collaborator of C. C. Jao.

Kiangsi Communism Proletarian University, Department of Forestry

Chuang, F. T. — Anatomy of *Pinus elliottii*, introduced to China in 1946, now used extensively for afforestation in Kiangsi, variations of resin canals and vascular tissue observed.

Szechwan and Yunnan

Szechwan University, Department of Biology

Fang, W. P. — A Chinese pioneer in the exploration and study of the botanical resources of Szechwan, especially those of Mt. Omei, Aceraceae, Cornaceae, Ericaceae, recent work including Nyssaceae, with the description of new species in *Nyssa* and *Camptotheca.*

Soong, T. P. — Collaborator of W. P. Fang in Nyssaceae.

Szechwan Medical College, Department of Pharmacy

Hsieh, C. K. — *Codonopsis* in Szechwan, in team work with the following people.

Shen, L. D. — Same as the above.

Tang, S. Y. — Same as the above.

Yueh, S. G. — Same as the above.

Szechwan Institute of Biological Sciences

Li, C. L. — *Potentilla* and related genera.

Szechwan Institute of Forestry
Chao, N. — *Zanthoxylum.*

Yunnan Institute of Botany
Chen, C. — Labiatae, in collaboration with C. Y. Wu.
Chou, C. — Studies of *Panax* in Yunnan, in collaboration with the team of H. T. Tsai, chemotaxonomic study and experimental work.
Feng, K. M. — Same as the above.
Huang, W. K. — Same as the above.
Yang, C. — Same as the above.
Wu, M. C. — Same as the above.
Tsai, H. T. — Senior author in the report of team work in the study of *Panax.*
Li, H. W. — Labiatae (*Paraphlomis*) and Rafflesiaceae (*Sapria* and *Mitrastemon*).
Huang, S. C. — Labiatae, in collaboration with C. Y. Wu.
Wu, C. Y. — Labiatae, Chenopodiaceae, Amaranthaceae, Saxifragaceae, Malvaceae, etc.; Director of the Institute.

Northwestern China — Including Chinghai and Sinkiang

Northwestern Institute of Botany
Chang, M. S. — Mosses of Tsinling.
Fu, K. T. — Exploration, Crassulaceae, especially *Sedum* and *Sinocrassula*, new taxa of *Corydalis* published recently.
Hsü, Y. P. — Exploration, Pteridophyta of Tsinling, described 15 new taxa as junior author with R. C. Ching.
Flora Tsinlingensis — In Chinese, without authorship, two parts published.
Volume I. part 2. Spermatophyta, 1 + 1–647, figures 1–487. 1974. Including 813 species and 166 infraspecific taxa, families arranged by Engler system, Saururaceae-Rosaceae, with description of new species and varieties in Salicaceae, Betulaceae, Papaveraceae, Ranunculaceae, Crassulaceae and Rosaceae.
Volume II. Pteridophyta, iii + 1–246, plates 1–50. Including 29 families from Psilotaceae to Azollaceae, with 52 new species and varieties described in addenda, of which 34 are by R. C. Ching alone, 15 by Ching and Hsü, 2 by Ching and Hsieh, and 1 by Ching and Wu.

Northwestern University, Department of Biology
Hu, Z. H. — Histochemical and cytological study on the formation of rubber and differentiation of cellular structures in the secretory epidermis of the fruit of *Decaisnea fargesii.*
Tien, L. H. — Collaborator of Z. H. Hu.

Lanchow University, Department of Biology
Cheng, K. C. — Physiology, on the mechanism of the intercellular migrating chromatin substance in pollen mother cell.
Ching, H. — A member of C. S. Lü's team.
Li, Y. C. — Same as the above.
Lü, C. S. — Physiology, on the effect of CCC on the distribution

and accumulation of materials during the grain filling period in wheat.
Nien, H. W. — A member of K. C. Cheng's team.
Wang, I. H. — Same as the above.
Yang, C. L. — Same as the above.
Yang, C. T. — A member of C. S. Lü's team.

Shensi Institute of Forestry
Fu, Y. C. — Salicaceae, described a new variety of *Populus tomentosa*.
Wang, C. H. — Same as the above, junior author.

Shansi University, Department of Biology
Liu, P. — Rusts of China, including the description of *Calostoma variispora* as a new species.
Li, T. Y. — Collaborator of the above.
Tu, F. — Same as the above.

Chinghai Institute of Biology
Chang, H. T. — Revision of *Notopterygium* in Umbelliferae.

Chinghai Institute of Materia Medica
Hu, H. M. — Medicinal plants of Chinghai.

Sinkiang Institute of Biology, Pedology and Psammology
Shen, K. M. — Umbelliferae including new species of *Ferula* and their economic importance in Sinkiang.
Shui, L. R. — Collaborator of K. M. Shen but not co-author of the new species.
Yong, G. — Same as the above.
Ramil — Same as the above.

Sinkiang August I Agricultural College
An, C. H. — Morphology of Cruciferae.
Chang, H. S. — Ecology and geography of the wild fruit tree forest in the Ili Valley of Sinkiang.

Northeastern China

Shen-yang Institute of Sylviculture and Pedology, Liao-ning
Chang, Y. L. — Gramineae, Cruciferae.
Fu, P. Y. — Salicaceae.
Li, S. H. — Ranunculaceae.
Liou, T. N. — Director.
Wang, C. — Salicaceae.
Wang, W. — Compositae.

Academy of Agriculture and Forestry of Hei-lung-chiang
Hsü, C. — Anther culture of wheat, collaborator of Z. C. Chu.
Yin, K. C. — Same as the above.

Northeastern Forestry Academy, Harbin
Chou, Y. L. — *Salix* of Shingan-ling.
Yang, H. C. — Lauraceae of China, Director.

The four-week's tour gave me a good opportunity to listen, to observe and to learn. In conclusion I should like to summarize what I have learned about the condition of the life and work of professional botanists in China.

They work in a state emphasizing trio-union (*san-chieh-ho*), and cherishing its brain-bank and experience pool. They live in a style that lacks physical and social gaps, and they entertain a dedicated devotion to their profession and a strong will to serve the country and the people.

The botanists of China, like all other scientists of the country who work in institutions where science, technology and experience are essential, are familiar with the *san-chieh-ho* of members of the Revolution Committee, the technical staff and the manual workers. In every institution we visited, be it a coal mine, an electronic plant, or a steel factory, we were introduced by the representatives of CTS to members of the Revolution Committee of that organization. One of them acted as the spokesman and gave us the history and the general condition of the organization, with special emphasis on the manifested changes and the increased production after the Cultural Revolution. Then we were shown the operation of the establishment with members of the technical staff explaining, and the laborers demonstrating the performance. All the botanical institutions visited, except Hangchow Botanical Garden, operate in similar manner. In Hangchow Botanical Garden, S. Y. Chang performed all three functions.

The legal age for retirement in China is 55 for a woman and 60 for a man. On retirement a person receives 70 per cent of his regular salary for life. However, this regulation does not seem to apply to the top scientists, professors, doctors and experienced administrators; these people neither have retirement nor sick leave. They work till the end of their lives and they receive full pay even if they are sick or incapacitated for decades. The national medical insurance takes care of their medical bills. I met four persons who are in this condition.

The following fact is cited merely as an example of respect for the older members of an institution. In North China, people salute a man who has passed his 70th birthday by adding the word "*lao*" (= old, sounds like *lord*) to his surname. In the Institute of Botany, Peking, everyone calls Y. Ling "Ling Lord" and in Shenyang, T. N. Liou is called "Liou Lord." In public meetings one hears about the importance of soldiers-laborers-peasants in the national reconstruction. In popular publications one is advised to learn from them. The exaltation of these

people, however, does not mean the neglect of the brain-bank and experience pool in China.

By the governmental regulations for salary scale, the professional people have higher monthly salaries than the technicians and laborers of the same institution; yet the physical environment and social condition of all the people are very similar. The physical and social gaps that used to exist in China before I left thirty years ago are now bridged. Unexpectedly I visited an institute of higher education. The president of the college lives next door to the driver of the car for the institution; their bungalows are of similar size and structure. All the teaching staff as well as the laborers live in such units, each shared by two families. The president's bungalow is shared by a nurse who takes care of a grandchild, and cooks. In another city I visited the director of a botanical institution in his two-room apartment. His right-hand man receives visitors in a bed-living-room combination in similar manner, as do high school teachers or factory workers. After visiting homes of people in different occupations from Shen-yang in the north down to Canton in the south, I realize that a great change in the professional people of China has occurred. Their former aspiration for material gains and personal fame are replaced now by the pride of having an independent and strong country, and the will to serve her and the people to the best of their ability. The time and labor saving devices and modern facilities that are considered daily necessities — such as a private automobile on the road and a refrigerator in the kitchen — are not available to any of the scientists, engineers and physicians whom I have met. Visitors to China are given red-carpet treatment. The luxuries of modern hotels and the beautiful products in friendship stores are for guests of the country. Only those with the proper introduction of CTS or foreign passports stamped correctly may enter. Regarding material possessions, the Chinese professional people have had a mental revolution. They seem to be content with what they can have, and they are looking forward to a time when all the citizens of the country may enjoy more of the products of science and technology. They are working hard towards that goal. In Nanking, my former professor of dendrology and his wife came to see me in the hotel. As lunch time approached, I asked them to stay and eat in the hotel. They refused because he had to return for a program with representatives of the Royal Society of the United Kingdom. Holding my hands in his, this well-tanned, white-haired professor said, "Let's each use the time due to us for the service of the people and the country."

Acknowledgements

I should like to take this opportunity to express my deep appreciation to the members of the Revolution Committee of various botanical institutions and gardens visited, for their hospitality and for the information on the general aspects of their organizations; and to the professional botanists who have explained their work to me. To my former teachers, Dr. Y. F. Wu of Nanking and Dr. H. T. Chen and Prof. P. W. Li of Canton, I am most grateful, for without their advice and assistance I would have missed seeing several botanical establishments included in this report. My thanks and fond memories are due my former students of Chung Chi College, the Chinese University of Hong Kong — Miss C. H. Yeung and Mr. K. B. Lau, who assisted me in many ways in the tour, especially in taking photographs, and to my nephews, Dr. C. L. Hu and Mr. C. C. Hu who helped me in traveling by means of public transportation in Nanking and Peking, respectively, to visit friends and former teachers.

Arnoldia Reviews

How to Control Plant Diseases in Home and Garden. Second edition. Malcolm C. Shurtleff. Ames, Iowa: Iowa State University Press. 1966. 649 pages, illustrated. $10.50.

A condensed, encyclopedic handbook in non-technical language to guide in the identification and control of plant diseases, with emphasis on the control. A brief discussion of the general nature of plant diseases is followed by a chapter on causes, including environmental conditions, and diseases caused by various organisms and their control measures. These sections prepare the reader for the main part of the book where diseases are briefly described after listings of the plants that are susceptible to them.

Common names with technical names italicized in parentheses help the average gardener. Resistant plant varieties have been included in the control recommendations for many diseases.

This volume with its wealth of information is the best on disease control that I have ever seen for use by most gardeners. The person using this reference work will have to remember, however, that some spray materials referred to can no longer be employed because of restrictive regulations.

ROBERT G. WILLIAMS

Popular Flowering Shrubs. H. L. V. Fletcher. New York: Drakes Publishers. 1972. 192 pages, illustrated. $5.95.

A truly excellent book with the usual reservations about those of English authorship; unless they live in California, most U.S. gardeners must forego the joys of ceanothus, cistus, escallonia, and hebes.

I continue to be impressed by the high educational level of English horticultural writers, and Mr. Fletcher is outstanding in this regard. The various shrubs are considered alphabetically with good discussions of the particular varietal attributes. There is a great deal of horticultural information; for example, I had never read that all prunus need lime (our much-used *P. laurocerasus* is in that category). This is an inexpensive, satisfying book for the shrub lover.

ELINORE B. TROWBRIDGE

A pleasant stroll in the Case Estates. Photo: P. Chvany.

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