

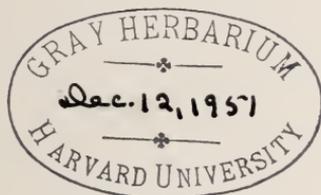
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HARVARD UNIVERSITY

ARNOLDIA



A continuation of the
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ARNOLDIA



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NUMBER 1

FORTY-FIVE OF THE BEST SHRUBS FOR MASSACHUSETTS GARDENS *

THERE are actually thousands of different kinds of shrubs growing in Massachusetts gardens today, but many of these are decidedly inferior to others from an ornamental viewpoint. Just which ones are best will always be a debatable question. Some are meritorious for autumn coloration; some make far better hedges than others; still others are superior for spring bloom. No two people will ever agree on a small list of the best shrubs (the smaller the list the more the disagreement!) Even with these points clearly in mind, the plants discussed on the following pages are offered as among the best shrubs for Massachusetts gardens.

First, however, before scrutinizing the list, it should be understood that there are several "old stand-bys" that will always be most serviceable. New shrubs may be glowingly discussed in the catalogues, but these old-fashioned favorites have served reliably for many years and probably will continue to do so for many more. These are among the plants which every gardener should know and use, for one reason or another. Nothing is meant to be implied in the discussions of the forty-five "selected" types, that would cast a shadow of doubt on the serviceability of these. A few are listed on page 20.

With the above-mentioned "common" shrubs clearly in mind, let us consider some that are more unusual, either not used as frequently in gardens as they might be or are more difficult to find in nurseries. It should be emphasized that some Massachusetts nurseryman has indicated in 1951 that he has plants of each

*This list was prepared at the request of the Horticultural Committee of the Garden Club Federation of Massachusetts, five of the plants to be discussed at each of the nine meetings of horticultural chairmen throughout the year. Because of wide-spread interest in this list, it is here reproduced for the benefit of ARNOLDIA subscribers. It is not perfect and many will take exception to it. However, it does include 45 top-notch shrubs that can be used more in our gardens today. Most important, *all are available in 1951 from local nurseries!*

one of the varieties listed (two exceptions only), available for sale in 1951, and those sources are given. It is useless to become enthusiastic about a plant that is unobtainable. Not so this list of forty-five. Every one is grown and offered for sale in 1951 by some easily available nurseryman (and there are other nursery sources on the record, outside the state, where these plants can be obtained likewise). Consequently, the gardeners of the state are urged to become acquainted with some of the shrubs in the following list in 1951, to purchase and use a few that they do not know already, and in this way increase their knowledge of good plants as well as improve the beauty of the plantings about their homes.

Forty-five of the Best Shrubs Recommended for Massachusetts Gardens

- Berberis julianae* 2, 5, 7, 10, 11
 “ *koreana* 1, 3, 4, 5, 6
Buxus microphylla koreana 2, 4, 5, 6, 8, 11
Chionanthus virginicus 1, 2, 3, 4, 5, 6, 7, 9, 10, 11
Clethra alnifolia rosea 4, 5, 10, 11
Cornus alba sibirica 1, 2, 3, 4, 6, 7, 9, 10
Cotoneaster dammeri 5, 6, 11
 “ *divaricata* 2, 4, 6, 8
Cytisus praecox 2, 4, 5, 7, 8
Enkianthus campanulatus 1, 2, 4, 5, 7, 8, 9, 10, 11
Euonymus alata compacta 1, 2, 4, 5, 6, 7, 8, 9, 11
Fothergilla sp. 2, 4, 5, 6, 7, 8, 11
Hamamelis mollis 5, 6, 7, 8, 11
 “ *vernalis* 1, 2, 4, 5, 6, 7, 8, 9
Hypericum sp. 1, 2, 5, 6, 8
Ilex crenata convexa 1, 2, 5, 6, 7, 8, 9, 10, 11
Juniperus chinensis sargentii 2, 4, 5, 6, 7, 8, 9, 10
Leucothoe catesbaei 1, 2, 3, 4, 5, 6, 7, 8, 9, 11
Lonicera amoena arnoldiana 5, 6
 “ *bella* 1, 6
 “ *korolkowi floribunda* 1, 4, 5, 6, 7
Magnolia stellata 2, 3, 5, 6, 7, 8, 9, 11
Mahonia aquifolium 2, 5, 6, 7, 8, 11
Malus sargentii 1, 2, 3, 5, 6, 7, 8, 9, 10, 11
Philadelphus lemoinei “Avalanche” 6, 7, 9, 10
 “ *splendens* 6
Pieris floribunda 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
 “ *japonica* 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Potentilla fruticosa 6, 7, 8
Rhododendron arborescens 1, 2, 4, 5, 7, 8, 9, 10
 “ *calendulaceum* 1, 3, 4, 5, 6, 7, 8, 9, 10, 11

- Rhododendron gandavense 9
 “ mucronulatum 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
 “ schlippenbachi 1, 2, 4, 5, 7, 8, 9, 11
 “ smirnowi 4, 9
 “ vaseyi 1, 2, 4, 5, 7, 8, 9, 10, 11
 Rosa multiflora 1, 4, 6, 7, 10, 11
 Syringa persica 1, 2, 5, 6, 7, 8, 9, 10
 “ prestoniae 5, 6
 Taxus cuspidata nana 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
 Tsuga canadensis pendula 5, 7, 8
 “ diversifolia 5, 7, 9
 Viburnum dilatatum 2, 3, 4, 5, 6, 7, 8, 10, 11
 “ sieboldi 1, 3, 4, 5, 6, 7, 8, 10, 11
 “ tomentosum 2, 5, 6, 7, 8

Sources for Shrubs Listed

1. Adams Nursery, Inc., Westfield, Mass.
2. Bay State Nurseries, North Abington, Mass.
3. Cherry Hill Nurseries, West Newbury, Mass.
4. Harlan P. Kelsey, Inc., East Boxford, Mass.
5. Kingsville Nurseries, Kingsville, Maryland
6. Henry Kohankie & Son, Painesville, Ohio
7. Littlefield-Wyman Nurseries, 227 Centre Avenue, Abington, Mass.
8. Weston Nurseries, Inc., Weston, Mass.
9. Wyman's Framingham Nurseries, Framingham, Mass.
10. Lexington Nurseries, Inc., 1266 Massachusetts Ave., Lexington 73, Mass.
11. Tingle Nurseries, Pittsville, Maryland

Forty-five of the best shrubs for Massachusetts gardens

Berberis julianae 6' Zone 5 Wintergreen Barberry

A very dense growing, hardy, evergreen barberry. This is one of the few barberries not susceptible to the black stem rust of wheat and hence it is allowed to be grown and sold freely. It should have some winter protection in the coldest parts of the state, and might well be used in evergreen foundation plantings where some protection is usually available. There are other evergreen barberries that are as good or possibly even better, but this one is available. Its spiny evergreen leaves, delicate yellow bell-like flowers and blue fruits combine to make it an interesting plant.

Berberis koreana 6' Zone 5 Korean Barberry

This deciduous Korean Barberry is rapidly proving itself in gardens and nurseries throughout the eastern United States as a perfect substitute for the some-

what taller and certainly more common barberry (*B. vulgaris*). This latter is one of the many species which is an alternate host for the devastating wheat rust, and it is these that the U.S. Department of Agriculture is passing legislation against so that it is becoming increasingly difficult for commercial men to grow them. In this case, the Korean Barberry is a perfect substitute, with its small, pendulous fruit clusters of bright red berries in the fall and its fiery red autumn foliage coloration. It makes an excellent barrier plant as well as a fine specimen.

Buxus microphylla koreana 3-4' Zone 5 Korean Box

This is the hardiest of all the boxwoods. Because of the gardener's inherent desire for boxwood in plantings, even in New England, this variety may have merit. Admittedly there are several clons of the true English Box (*Buxus sempervirens*) that have shown indications of hardiness in New England under varied climatic conditions, but until these are propagated on a wide scale and thoroughly tested under all of New England's tough growing conditions, one might do well, if box must be grown, to confine one's efforts to this species. As time goes on, it may well be that some of the many clons above-mentioned will replace this variety in popularity.

Chionanthus virginicus 30' Zone 4 Fringe-tree

This native Fringe-tree makes a fine ornamental, either as a large shrub or as a small tree. Its fleecy white flowers are produced in the utmost profusion. Usually the sexes are separate with the staminate flowers the larger. One word of caution should be given, for since this plant is closely related to the lilacs, it is also susceptible to the same scale infestations. These should be rigidly controlled. Especially does this make a well-rounded specimen plant in the full sun where it seems to grow best. Some Europeans consider this one of the most striking of the American shrubs introduced into Europe. The fruits are large and grapelike, and the brilliant yellow autumn color is outstanding. Its leaves appear late in the spring, one of the last plants in the Arboretum to produce leaves. Even with this drawback, it makes a splendid specimen where it can be given plenty of room.

Clethra alnifolia rosea 9' Zone 3 Pink Summersweet

Either this variety or the species makes an excellent addition to the garden for summer bloom and fragrance. Not many shrubs bring forth deliciously fragrant flowers in the summer and the narrow spikes of the Summersweet are most beautiful. The flowers of the species are white, and this variety has flowers that are tinged a light pink. Sometimes they gradually fade white. If the pink-flowered form is not essential, don't overlook the species, a native along the New England coast. It tends to grow in clumps and it increases by underground stems. If the



PLATE I

Cytisus praecox, the Warminster Broom. An excellent shrub for dry sandy soils, with pale, lemon yellow flowers in mid-May and green stems all winter.

soil is too dry, there may be some danger from an infestation of red spider, which can be controlled, but in moist soils it is at its best. Native American plants should be exploited in our gardens to the utmost, and this is one that apparently has not been used as much as it should.

Cornus alba sibirica 9' Zone 2 Siberian Dogwood

This variety does not spread as rapidly as does our native *C. stolonifera*, and this fact should be kept in mind so that it is not planted in borders and expected to "take over," as is *C. stolonifera*. However, the Siberian Dogwood has stems the winter color of which is the brightest red of any shrub available. Unfortunately it has become mixed in American nurseries, with some of the lesser brilliant red-stemmed forms, but the real plant is excellent for winter color. It is best to prune it heavily every third year or so, even cutting the planting to the ground in the early spring, so that the young shoots will grow vigorously. It is these that are the brightest colored. Its numerous white flowers in late May, and white to bluish berries in the early fall, are additional reasons why it should be grown.

Cotoneaster dammeri 1' Zone 5 Bearberry Cotoneaster

Lower in habit than *C. horizontalis*, this makes an excellent ground cover or rock garden plant. It is not recommended in place of *C. horizontalis* but only in situations where a lower plant of this type is desired. Its bright red berries are most conspicuous in the fall.

Cotoneaster divaricata 6' Zone 5 Spreading Cotoneaster

The arching, spreading habit of this 6' Cotoneaster is outstanding. The branches are covered with small bright red berries each fall. The leaves are only $\frac{3}{4}$ " long and in the experience of several Massachusetts commercial growers, this species is easily among the most reliable for the state.

Cytisus praecox 6' Zone 5 Warminster Broom

If dry soil or very poor soil is present in the garden, where few other things will grow, the chances are the Brooms will thrive. This one in particular is recommended because of its hardiness (more hardy than the Scotch Broom which has been naturalized on the Cape) and because of its green twigs, that actually give the plant an evergreen appearance in the winter. It grows in a very dense manner, with minute leaves, but its pale yellow pea-like flowers appear in mid-May in the greatest profusion. It should be noted that large plants are hard to move. To avoid disappointments, buy small plants, preferably in pots, and set them out in spring in their permanent situation.

Enkianthus campanulatus 30' Zone 4 Redvein Enkianthus

An ericaceous shrub requiring the same type of cultural conditions as azaleas and rhododendrons, but differing in having small bell-shaped flowers in mid-May and brilliant scarlet autumn color. The flowers appear just before the leaves and so are easily seen. A good acid soil plant, not used nearly enough in our gardens.

Euonymus alata compacta 7' Zone 3 Dwarf Burning Bush

Everyone knows the Cork Bush, but this compact, dwarf form is one that should prove just as well known. It originated in the Adams Nursery in West Springfield in 1926, and only now is becoming widely available. It makes a splendid dense, rounded specimen and has been used in hedges requiring no clipping if sufficient room is available. When space is limited, it can be easily restrained with clipping every other or even every third year. One of the specimens growing in the Arnold Arboretum colors so vividly every autumn that it is easily among the best of all the plants there for fall color.

Fothergilla species 3-9' Zone 5 Fothergilla

There are several species available from different nurserymen, varying chiefly in height at maturity. All have interesting, white, thimble-like flowers in mid-spring, and all have an excellent yellow and red autumn foliage coloration in the fall, especially when grown in the full sun. If in the shade, neither flowers nor autumn coloration are quite so marked. However, in a foundation planting, especially with an evergreen background, these American natives can be kept restrained and still be among the most ornamental plants during the two seasons when they are at their best. They are rather difficult to propagate except by seed, one of the reasons why the nurserymen fail to grow them in large quantities, but from the standpoint of the home gardener, they are certainly worth seeking out!

Hamamelis mollis 30' Zone 5 Chinese Witch-hazel

This Witch-hazel has the largest flowers of the group, and they are fragrant as well — hence it makes a desired garden specimen. Its flowers with unique ribbon-like petals, and its brilliant yellow autumn color, are its chief reasons for two-season interest. It can easily be kept controlled with judicious pruning.

Hamamelis vernalis 10' Zone 5 Vernal Witch-hazel

There are several Witch-hazel species available, but this one should be better known. It is an American native, with deliciously fragrant small flowers in late winter — actually it is the first woody plant to bloom. It is vigorous in growth, needs almost no attention, and like others in this group has bright yellow fall

color. Although the Chinese Witch-hazel has larger flowers, this Vernal Witch-hazel makes a fine bush and is hardier, being amenable to all sorts of pruning and restraint, especially by the over-anxious gardener who likes to force things indoors.

Hypericum species Ground Cover to 6' Zone 4-7 St. Johnsworts

The St. Johnsworts are low woody shrubs, sometimes ground covers, valued for their bright yellow flowers. Some of them, as they grow tall, will have a very interesting shiny brown exfoliating bark of considerable ornamental value in the winter. The ground covers, especially, are frequently avid growers and can quickly crowd out other low plants in the rockery if not restrained. Their fruits are dry capsules and have little autumn coloring. However, a splendid feature of this group, especially the ground covers, is the fact that they grow well in dry, sandy soil. Some of them, like *Hypericum prolificum*, continue to produce flowers over many weeks in the summer and, of course, summer-flowering shrubs, especially those with bright yellow flowers, are none too numerous. These plants should not be overlooked for the small garden especially since several species are available commercially to fit several types of situations. If summer bloom amongst the shrubs is not particularly needed, the shrubby types might be passed over, but the ground covers have merit regardless.

Ilex crenata convexa 15' Zone 5 Convex Leaved Japanese Holly

The best New England substitute for Box. As stated previously, some gardeners may want to try the true Box or one of its many so-called "hardy" clons. For those who do not want to take this chance, this small leaved evergreen is the perfect substitute. One plant in the Arnold Arboretum now is easily 7' tall and at least twice as broad without a dead branch in it. Like other varieties of this species, it is easily pruned and can be used in hedges, but as a specimen plant, untouched by the pruning shears, it makes an excellent well-shaped specimen.

Juniperus chinensis sargentii Ground Cover Zone 4 Sargent Juniper

Certainly not a new plant to American gardens, but one that could well stand more general use. It is a low, prostrate ground cover, found in seashore areas in its native habitat in mats 8-10' in diameter. Its steel blue color differs from that of most junipers used for ground covers.

Leucothoe catesbaei 6' Zone 4 Drooping Leucothoe

An American native, it is black-listed in New England sometimes merely because people do not know how to care for it properly. It may grow as high as 6' in its native habitat, but in New England it should be kept much lower — mostly under three feet. Whenever it is severely injured by a hard winter it might well



PLATE II

Ilex crenata convexa, the Convex Leaved Japanese Holly. The best substitute for box in the north, this plant is 7 feet tall and at least twice as broad. It has been growing in the Arnold Arboretum since 1919 when it was sent here as a small plant from Japan by E. H. Wilson.

be cut to the ground and started all over again. The lustrous dark green leaves in summer are reason enough why it should always be kept growing vigorously, and the bronze autumn color of the foliage lends value to any evergreen foundation planting in the winter. In spots where some winter protection is available, especially some shade during late February and March, the foliage will not be burned as much as when the plant is grown with full exposure to sun and winds. The small racemes of waxy white flowers borne on the under side of arching stems repay anyone for taking a few pains in providing the right growing conditions and winter protection.

Lonicera amoena arnoldiana 9' Zone 5 Arnold Honeysuckle

A very graceful floriferous shrub, it is meritorious for the arching habit of its branches as well as its delicate foliage. Since honeysuckles are not susceptible to serious disease pests, it is well to know a few others than the one or two common species that are planted so much.

Lonicera bella 6' Zone 4 Belle Honeysuckle

Several clons occur in this hybrid species that cause this group to be one of the most floriferous and most fruitful of all. Either for massing or for specimen use these plants have merit. The early summer fruits are, like other *Loniceras*, very bright and attractive to birds.

Lonicera korolkowi floribunda 12' Zone 5 Blue-leaf Honeysuckle

Either the species or the variety (they are very likely mixed in many nurseries) are outstanding for their bluish to grey-green foliage color, adding considerable color variation in the shrub border throughout the entire growing season. It must be noted here that this is one species, as opposed to all the other honeysuckles, that is apparently difficult to establish, but once growing well, it is a worthy addition to the plant population of any garden.

Magnolia stellata 20' Zone 5 Star Magnolia

Actually a tree, but easily grown as a shrub even on the small property. The white, fragrant, star-like flowers appear in late April as first among the Magnolias. It also is the hardiest and the only one with a good bronze autumn color when grown in the full sun. Its dense habit of growth, splendid green foliage and autumn color make it a valued addition to the larger shrubs available for Massachusetts planting.

Mahonia aquifolium 3' rarely 6' Zone 5 Oregon Holly-grape

This is perhaps the most popular of the Pacific Northwest plants now grown in the East, yet it could be used more. Its lustrous dark green, leathery leaves,

pyramidal spikes of bright yellow flowers and light-blue grape-like fruits in early summer, make it effective for use in many situations, especially in evergreen foundation plantings and in shaded spots. It does well in poor soil and can be kept low by proper pruning. Its spiny, holly-like evergreen leaves are interesting and its method of increasing by underground stolons insure its use as a ground cover of fair height.

Malus sargentii 6' Zone 5 Sargent Crab apple

The lowest of all the crab apples, included here for it seldom grows over 8' in height, this is a crab apple that can be used on the small grounds. It usually grows twice as broad as high, and, of course, has two seasons of colorful interest, because of profuse white flowers in May and dark red fruits in the fall.

Philadelphus lemoinei "Avalanche" 4' Zone 5

This excellent little variety is only about 4' tall, with single white flowers 1" in diameter and a fine arching habit from which the plant takes its name.

Philadelphus splendens 8' Zone 5

Of excellent habit, this is another mock-orange that can be used as a specimen if desired for it is well clothed with branches to the ground. The flowers are borne in groups of five with conspicuous yellow stamens, but they have only mediocre fragrance. In some situations sacrifices can be made in the fragrance of the flowers in order to have a plant that is symmetrical and well branched.

Pieris floribunda 6' Zone 4 Mountain Andromeda

One of the most serviceable of all broad-leaved evergreens in the North because it seems to do well in any normal soil and has no serious pests or diseases. The erect to nodding clusters of white flowers are composed of numerous small waxy flowers similar in size and shape to those of the blueberry. The flower buds are prominently evident all winter long — somewhat of a conspicuous promise that spring-blossoming time is just around the corner.

Pieris japonica 9' Zone 5 Japanese Andromeda

An excellent broad-leaved evergreen for the same reasons *P. floribunda* is popular. In addition, the Japanese Andromeda has a lustrous dark green foliage and flower clusters that are pendulous. A well-grown specimen of the Japanese Andromeda, covered with lustrous leaves and pendulous flower clusters, is about as beautiful an evergreen as it is possible to grow. In New England it should be grown in protected places, but farther South this is unnecessary. Young foliage is usually a rich bronze in spring, later turning a normal green. This species can

be grown in a shaded situation, but like many other plants, will not produce as many flowers there as in situations with more sun.

Potentilla fruticosa 4' Zone 2 Bush Cinquefoil

Many varieties of this species have been found over a wide area of the northern hemispheres. The sturdy, very hardy plants, bloom in mid-May and continue throughout summer, sometimes even into September. Because of its comparatively low height, its lack of interesting fruits and autumn color, its garden effectiveness is easily supplanted by annuals or perennials. Incidentally, a large number of potentillas are herbaceous. When comparing *P. fruticosa* varietal differences with those of the massive lilac, they do not appear very important. The extremely long blooming season is their only redeeming factor for the places where they might be used in the garden are limited.

Rhododendron arborescens 9' Zone 4 Sweet Azalea

An unusually fragrant species, blooming near the end of the azalea sequence. Even though the beautiful white flowers do appear after the leaves, they are conspicuous and their delicious fragrance makes them useful in mass plantings.

Rhododendron calendulaceum 9' rarely 15' Zone 5 Flame Azalea

This is the most showy of the American species and is among the best for northern gardens. It has the unique property of retaining its colorful flowers in good condition in full sun for nearly two full weeks in June. The flowers of many Asiatic azaleas quickly fade in direct sun and so must be used with partial shade if they are to be enjoyed for a longer period. When large numbers of seedlings are grown it is noticed that the flower colors vary from yellow (orange buff 507 to cadmium orange 8) to scarlet (19) on the Royal Horticultural Colour Chart. The lighter colored forms have been given the varietal name *croceum*, and the red-colored types the varietal name *aurantiacum*. Since very few azaleas are in flower at the time this species blooms, this variation in color is most helpful in making an interesting display — when planted singly and in groups in an open oak woods, there is nothing at this time of year more colorful.

Rhododendron gandavense 6-10' Zone 4 Ghent Azalea

There are many hybrid varieties of this hardy species of value because they bring brilliant red and yellow flowers into the garden at a time when they are greatly needed. Ghent azaleas have lived many years and been perfectly hardy as far north as Bryant Pond, Maine, where they have been exposed to temperatures as low as 20 degrees below zero. Some nurserymen grow these from seed, some propagate them by asexual means so that the definite colors of the variety will be maintained. A very interesting and lively colored group, these should be



PLATE III

Viburnum sieboldi makes a splendid specimen in flower or in fruit. This particular specimen is 37 years old.

used considerably more than they are, and it is hoped that more and more nursery-men will find means of propagating them asexually. They bloom just before *R. calendulaceum*.

Rhododendron mucronulatum 6' Zone 4 Korean Rhododendron

Although another member of this genus blooms earlier in the Arnold Arboretum, this Korean Rhododendron can really be considered the first of its clan to bring forth flowers in the spring, since the other is not a good ornamental. It is not wise to use this plant in the coldest parts of the state, but if planted where it obtains some winter protection, it will usually bloom in mid-April except in the coldest years. A particularly good plan is to use it on the northern slopes where its early opening flowers may be retarded just long enough to protect them from late freezes. Easily pruned, and perfectly at home under pine trees, it is one of our earliest flowering shrubs.

Rhododendron schlippenbachi 15' Zone 4 Royal Azalea

A handsome azalea because of its good growth habits and general appearance. It has very large flowers appearing in mid-May and is fortunate in being in the group with colorful autumn foliage. These are two important reasons for including it in the garden.

Rhododendron smirnowi 6-18' Zone 4 Smirnow Rhododendron

Perfectly hardy as far north as Boston, this dense rhododendron makes a good ornamental not only for its large flowers but also because the undersurfaces of the leaves are covered with a conspicuous white, woolly tomentum that adds to its attractiveness. Because of this woolly undersurface, the plant is not infested with lace bug — an important maintenance item. Sometimes the flowers have corollas with a wavy margin which is another desirable characteristic. All in all this species, though little used yet in American gardens, can well be added to an ever lengthening list of worthy rhododendrons.

Rhododendron vaseyi 6-9' Zone 4 Pinkshell Azalea

This native azalea is one of a very few with colorful autumn foliage in the fall, hence it has two good seasons of interest in gardens. It does well in moist situations bordering ponds where its delicate pink flowers can be reflected in the water, or it will do well on drier soils. One of the best of the native azaleas, the flowers appear at the same time that the young leaves of the oaks are unfurling.

Rosa multiflora 10' Zone 5 Japanese Rose

Perhaps the most vigorous of all the rose species, this splendid plant is being used more and more as an ornamental. Although its flowers are small and white,



PLATE IV

Tsuga diversifolia, the Japanese Hemlock, is slower growing than its American relatives and so can be used on small properties readily.



PLATE V

Hamamelis mollis, the Chinese Witch-hazel, the largest flowered of this genus, first introduced into America by the Arnold Arboretum in 1902.

tal plants, serviceable the year round as dark evergreen masses of foliage which are practically free of insect or disease pests. All have sexes separate, that is, the staminate flowers are on one plant and the pistillate flowers are on another. Both types must be in the near vicinity in order to insure the fruiting of the pistillate plant. There should be a spot for some yews in every garden!

Tsuga canadensis pendula 15' Zone 4 Sargent Hemlock

The Sargent Hemlock, a dwarf weeping form of the native Canada Hemlock, is an ideal plant for the garden where space is not too limited. In the rockery, or at the rear of a low perennial border or beside a pool, it has considerable merit. Its definite form — flat topped with drooping to pendulous branches — limits its use some, but gardeners certainly should know it and use it if the right place is available. It has all the good traits of the Canada Hemlock which is one of the best of all ornamental woody plants.

Tsuga diversifolia 90' Zone 5 Japanese Hemlock

This tree is listed here merely because it is an excellent slow-growing hemlock and can fulfill the place of an evergreen shrub in many situations. If the Canada Hemlock were used, it would have to be sheared repeatedly, whereas this plant grows sufficiently slow so that it must be sheared but seldom. Worthy of a trial in evergreen plantings where the hemlock type of foliage is desirable.

Viburnum dilatatum 9' Zone 5 Linden Viburnum

One of the best of the viburnums for its very colorful bright red fruits. Dense and compact in habit, it is usually covered with red fruits every fall, the fruit clusters being sometimes as much as 5" in diameter. The yellow-fruiting variety is just as clean a shrub with regularly formed foliage and both are very dense, well adapted for either specimen planting or for massing in general.

Viburnum sieboldi 30' Zone 4 Siebold Viburnum

If I were to choose only one viburnum for my garden, I think it would be this because of the splendid long (6") leaves, its very desirable branching habit which results in rounded masses of foliage interspersed with open areas where lights and shadows add much interest, and also because of its colorful fruits. Although these are black at maturity, they remain unripe and bright red for several weeks in summer, and even after they turn black and fall off or are eaten by birds, their red fruit-stalks remain another three or four weeks to give color to the plant at a time when the fruits of most other shrubs are not sufficiently ripened to be colorful. As a specimen plant it is the best of the viburnums for the northern United States at least.



PLATE VI

Syringa prestoniae "Isabella", one of the most prominent in flower of all this hybrid group (*left*).

Syringa prestoniae "Hecla", showing a smaller and more compact flower cluster typical of some varieties (*right*).

This is really an old-fashion favorite but the more conspicuous flowered variety, the Japanese Snowball, has taken its place too often. The central flowers in the flat clusters of the species are small and fertile, the flowers on the perimeter of the cluster are the large sterile flowers. This plant is outstanding in the fall because of its numerous red fruits, that eventually turn black and are most attractive to birds. It also has merit because of its decidedly horizontal branching, interesting throughout the entire year. Several varieties of this species are also excellent for the same reasons, especially the variety *mariesi*, the fruit of which is even more ornamental than that of the species, but unfortunately this variety is not being offered in 1951 by any of the nurserymen here listed. An excellent species, this may easily grow as broad as it does tall. In the coldest sections of New England it may need some winter protection.

Among The Best Common Shrubs Everyone Uses Are:

- Berberis thunbergi* 1, 2, 3, 4, 6, 7, 8, 9, 10, 11
Cornus mas 2, 4, 5, 6, 7, 8, 10, 11
Cotoneaster horizontalis 2, 4, 5, 6, 7, 8, 9
Ilex crenata microphylla 5, 6, 11
 " *glabra* 2, 4, 5, 6, 7, 8, 10, 11
 " *verticillata* 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Juniperus chinensis pfitzeriana 1, 2, 3, 4, 6, 7, 8, 9, 10, 11
Kalmia latifolia 1, 2, 3, 4, 6, 7, 8, 9, 10, 11
Kolkwitzia amabilis 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Ligustrum species 1, 2, 3, 4, 5, 6, 7, 8, 9
Lonicera tatarica 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Myrica pensylvanica 1, 2, 3, 4, 6, 7
Rhododendron carolinianum 1, 2, 4, 5, 6, 7, 8, 9, 10, 11
 " *catawbiense hybrids* 2, 3, 4, 5, 7, 8, 9, 10, 11
Rosa harisoni 5, 8
Spiraea prunifolia plena 1, 2, 4, 5, 7, 8, 9
 " *van houttei* 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Symphoricarpos albus laevigatus 1, 2, 3, 4, 6, 7, 8, 9, 10
Syringa vulgaris 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Taxus cuspidata 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
 " *media hatfieldi* 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
 " " *hicksi* 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Vaccinium corymbosum 1, 2, 3, 4, 6, 7, 8, 9, 10, 11

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ARNOLDIA



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THE NEW GROUND COVER DISPLAY PLOTS AT THE ARNOLD ARBORETUM

BECAUSE of the tremendous interest in ground covers, an extensive display plot has been started on the Case Estates of the Arnold Arboretum in Weston. Here, in small 6' x 6' plots are growing at present time some 60 different ground covers planted last year. Others are being contemplated for adding during 1951. Although only recently planted some of the plots have already established their claim to the term of "good" ground covers, while others have not. Considerable has been written about certain interesting plants used in this manner, and almost every plantsman has his "pets" for such purposes. Here they are growing side by side in a gravelly loam, not too moist, but with considerable shade on some of the plants for a third to a half of the day.

Typical ground covers are low, dense and rapid in growth. Some do better in shade than others. Some are low enough and sturdy enough to be walked on. In fact, some plantsmen consider this to be one of the essential requirements of a good ground cover. Others are considerably taller or will not stand such rough service. There are certain conditions, especially under such trees as the Norway Maple and the Beech where it is practically impossible to force any ground cover to grow because the feeding roots of these trees are close to the surface of the soil, and quickly take most of the nourishment and moisture from it. When such conditions are encountered, it may save time and expense to refrain from planting ground covers. Let such areas of ground remain bare or cover them with pebbles or paving stones.

These plants are being established at the Case Estates merely because the difficulty of finding sufficient space for them and maintaining them properly after they are established would cause too much of a labor problem at the Arnold Arboretum. As noted above the plots are 6' x 6' with a 2' space between them. Maintenance is being kept down (we hope) by periodically spraying this two foot

strip with weed killers, when the weeds grow too dense or the ground covers themselves grow so vigorously that they overstep their allotted space.

Each plot must be hand weeded several times a growing season at first, but as the plants become better established some plots will need very little hand weeding. Admittedly, this is a very small area to devote to a ground cover, but it is hoped that if the maintenance costs can be kept at a reasonable level, the comparisons in plant performance easily noted among these many plots will be very much worth the effort. Visitors are cordially invited to inspect these plots. They are situated on the north side of Wellesley Street in Weston, on land immediately adjacent to what is known locally as the Case School property, part of the area sold by the University to the Town of Weston a few years ago for public school purposes.

Ground Covers Already Established

<i>Scientific Name</i>	<i>Height</i>	<i>Common Name</i>
<i>Aegopodium podagraria</i>	14''	Goutweed
<i>Aegopodium podagraria variegatum</i>	14''	Variegated Goutweed
<i>Ajuga reptans rubra</i>	3-12''	Purpleleaf Carpet Bugle
<i>Alyssum saxatile</i>	6''	Goldentuft Alyssum
<i>Arctostaphylos uva-ursi</i>	4''	Bearberry, Kinnikinnick
<i>Artemisia stelleriana</i>	2½'	Beach Wormwood, Dusty Miller
<i>Calluna vulgaris</i>	10''	Scotch Heather
<i>Cerastium tomentosum</i>	6'' creeping	Snow-in-Summer
<i>Ceratostigma plumbaginoides</i>	1'	Blue Ceratostigma
<i>Coreopsis aurea nana</i> (?)	4''	
<i>Cotoneaster apiculata</i>	3'	Cranberry Cotoneaster
<i>Cotoneaster horizontalis</i>	3'	Rock Cotoneaster
<i>Dianthus plumarius</i>	1½'	Cottage Pink
<i>Duchesnea indica</i>	3'' trailing	India Mock-strawberry
<i>Epimedium grandiflorum</i>	9''	Longspur Epimedium
<i>Euonymus fortunei coloratus</i>	3'' trailing vine	Purpleleaf Euonymus
<i>Euonymus fortunei minimus</i>	3'' "	Baby Wintercreeper Euonymus
<i>Euonymus fortunei "Silver Queen"</i>	3'' "	
<i>Euonymus obovatus</i>	12'' creeping vine	Running Strawberry Bush
<i>Forsythia "Arnold Dwarf"</i>	3'	
<i>Galax aphylla</i>	6''	Galax
<i>Gaultheria procumbens</i>	4'' creeping	Wintergreen
<i>Gypsophila repens rosea</i>	6''	Rosy Creeping Gypsophila
<i>Hedera helix baltica</i>	vine	Baltic Ivy
<i>Hydrangea petiolaris</i>	vine	Climbing Hydrangea
<i>Hypericum buckleyi</i>	12''	Blue Ridge St. Johnswort
<i>Iberis sempervirens</i>	12''	Edging Candytuft
<i>Indigofera incarnata alba</i>	2'	White Chinese Indigo
<i>Indigofera kirilowi</i>	4'	Kirilow Indigo
<i>Leiophyllum buxifolium</i>	2'	Box Sand-Myrtle
<i>Liriope spicata</i>	8''	Creeping Lily-turf
<i>Lonicera henryi</i>	vine	Henry Honeysuckle
<i>Lonicera japonica halliana</i>	vine	Halls Japanese Honeysuckle



PLATE VII

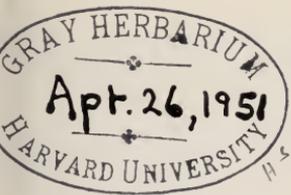
One of the rows of demonstration ground cover plots at the Case Estates of the Arnold Arboretum, Wellesley St., Weston, Mass.

<i>Lysimachia nummularia</i>	creeping	Moneywort
<i>Mentha piperita</i>	3'	Peppermint
<i>Pachistima canbyi</i>	12''	Canby Pachistima
<i>Pachysandra procumbens</i>	12''	Alleghany Pachysandra
<i>Pachysandra terminalis</i>	12''	Japanese Pachysandra
<i>Parthenocissus quinquefolia</i> St. Pauli	vine	St. Paul Virginia Creeper
<i>Parthenocissus tricuspidata</i> lowi	vine	Lows Japanese Creeper
<i>Phlox stolonifera</i>	12''	Creeping Phlox
<i>Phlox subulata</i>	6''	Ground or Moss Pink
<i>Rhus aromatica</i>	3'	Fragrant Sumac
<i>Rosa wichuraiana</i>	6'' trailing	Memorial Rose
<i>Rubus laciniatus</i>	2'	Cutleaf or Evergreen Blackberry
<i>Salix tristis</i>	1½'	Dwarf Pussy Willow
<i>Saponaria ocymoides</i>	trailing	Rock Soapwort
<i>Sasa variegata</i>	3'	Variegated Bamboo
<i>Satureja alpina</i>	6''	Alpine Savory
<i>Sedum acre</i>	5'' creeping	Stonecrop
<i>Sedum album</i>	8'' creeping	White Stonecrop
<i>Sedum album roseum</i>	8'' creeping	Rose Stonecrop
<i>Stellaria media</i>	4'' creeping	Chick Weed
<i>Teucrium species</i>	6'' (?)	Germander species
<i>Teucrium chamaedrys</i>	1'	Chamaedrys Germander
<i>Teucrium chamaedrys prostratum</i>	8''	Dwarf Germander
<i>Thymus serpyllum</i>	trailing	Mother-of-Thyme
<i>Vaccinium angustifolium laevifolium</i>	8''	Lowbush Blueberry
<i>Vinca minor</i>	trailing	Common Periwinkle or Running Myrtle
<i>Vinca minor rubra</i> (?)	creeping vine	Red Common Periwinkle
<i>Xanthoriza simplicissima</i>	2'	Shrub Yellow-root

DONALD WYMAN

Field Class

The Arnold Arboretum Field Class will again be conducted this year on Saturday mornings (10:00 to 12:00) from April 28 to May 26. A certain phase of the Arboretum's activities will be featured each week under the guidance of various staff members. Registration is in advance by mail (Registration fee — \$1.00). Members of the "Friends of the Arnold Arboretum" are entitled to attend all classes without charge.



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METASEQUOIA BROUGHT UP-TO-DATE

THE history of the discovery of *Metasequoia glyptostroboides* has been retold several times. In short, it is this. In 1941 the genus *Metasequoia* was described by Miki, a Japanese botanist, on the basis of fossil material found in Korea and Japan. Mr. Tsang Wang of the Central Bureau of Forest Research in China, first collected specimens in 1944, not knowing what they were. In 1945, Mr. C. L. Wu, another Chinese botanist, in examining these collected specimens, realized that they represented a genus that was very unusual and probably new. These specimens eventually came into the hands of Dr. W. C. Cheng of the National Central University, Nanking, and Dr. H. H. Hu of Fan Memorial Institute of Biology, Peiping. They were recognized as belonging to the previously described fossil genus *Metasequoia*. To make certain, an expedition was organized in 1946 to collect fresh material which Cheng and Hu later described in 1948 as *Metasequoia glyptostroboides*. To all these Chinese botanists goes the full credit for the discovery of this heretofore "extinct" species. When botanical specimens were examined by Dr. E. D. Merrill, former Director of the Arnold Arboretum, in the latter part of 1946, he became interested in attempting to obtain seeds. Accordingly, a modest grant was sent to Dr. H. H. Hu, who sent out an expedition for this purpose on September 3, 1947. This expedition returned with seeds, the first ones of which arrived at the Arnold Arboretum on January 5, 1947. *Dr. Merrill and the Arnold Arboretum should be given credit for the introduction of this species into modern gardens*, for this first lot of seeds was distributed far and wide throughout the world. Later, additional seed lots were also sent to the Arboretum, as well as to institutions on the Pacific Coast.

Because of great popular interest in the story surrounding the discovery of this species, many articles have appeared concerning it. The best bibliography of these to date appears in "An Ecological Reconnaissance in the Native Home of *Metasequoia glyptostroboides*" by Kwei-ling Chu and William S. Cooper in *Ecology*, Vol. 31, No. 2, April 1950, pp. 260-278.

Metasequoia has exhibited very fast growth. The photograph on page 27 shows how a 28-month-old specimen has grown eight feet from seed in England. Specimens in this country may not have grown quite so fast, although one plant in the Santa Barbara Botanic Garden grew five feet in one year.

As mentioned above, considerable has already been written about this tree and its origin, but requests keep coming in continually for more information concerning it. For detailed facts, the above-mentioned bibliography, and especially the article to which it is attached, will give the complete story. A few points of practical interest here, may help to bring many "up-to-date."

At first it was thought that this species might not be hardy north of Georgia. The climate of the coastal plain in Georgia is very similar to that of the native habitat of this tree. Recent investigations have shown that it is growing in a small section of Szechuan and Hupeh Provinces in China (near Chungking) where the annual rainfall amounts to about 48", rather evenly distributed throughout the year. Here also very little snow falls, and though there may be some, native reports are to the effect that it does not amount to much. Temperatures on the average apparently do not go much below freezing. Just why this species should be confined to this small area of not over 300 square miles will make a most interesting story when all the facts are known.

Suffice it to say that the atmosphere in this area is reasonably moist and that several soil tests show the soils to be about neutral to only slightly acid. Apparently no accurate records are available on the lower temperatures in the winter, and summer temperatures are not supposed to average over 100° F. The tree has been found to be reseeding itself in moist ravines, in what might be considered the same kind of places where we would expect hemlocks to reseed themselves in this country.

Since its introduction, it has been living out-of-doors unprotected in several places on the Pacific Coast. Here in the East it has survived in Washington, D.C., Philadelphia, New York and Boston, living out-of-doors uninjured the last three winters without protection. All reports are not yet available and many seeds and plants have been distributed, so that some may have been injured within this area. It should be pointed out that these three winters have been comparatively mild ones, and no prolonged sub-zero weather has occurred. It would be advisable not to become too enthusiastic concerning the hardiness of this species, certainly not until we see what happens to older trees when unusually cold winters occur.

Practical plantmen can have a field day in discussing the possibilities of hardiness. Many variable factors like soil, rainfall, high temperatures, low temperatures, exposure and length of growing season affect the hardiness of a plant. In the case of a new plant, where climatic records of its habitat are meagre (as in this case), one should proceed slowly in drawing conclusions concerning its hardiness on the basis of three mild winters only. However, for those practical plantmen willing to do some guessing, it will be of much interest to know that Chu and Cooper found the following plants native to the same location as the *Metasequoia*. Incidentally, all of these are hardy in the Arnold Arboretum.



PLATE VIII

Metasequoia glyptostroboides. A 28-month-old specimen grown in a coldhouse at Bramley, Surrey, England, and now 8' 3'' high.

Akebia trifoliata
Cercidiphyllum japonicum sinense
Cornus controversa
Corylopsis sinensis
Cotoneaster horizontalis
Decaisnea fargesii
Euonymus alata
Helwingia japonica
Hibiscus syriacus
Idesia polycarpa

Kalopanax pictum
Lonicera japonica
Morus alba
Parthenocissus tricuspidata
Quercus acutissima
 " *variabilis*
Rhamnus utilis
Spiraea japonica
Styrax japonica
Viburnum setigerum

However, before said practical plantmen wax overly enthusiastic concerning hardiness of this new species, the following plants are also growing in the same location. These are not hardy in the Arnold Arboretum.

Actinidia chinensis
Camellia oleifera
Cunninghamia lanceolata
Ficus heteromorpha

Liquidambar formosana
Lonicera pileata
Nothopanax davidi
Nyssa sinensis

The tallest specimens of this tree in China are about 100 feet high. Estimates have been made from borings in the trunk that some of these trees may be 300 years old. It is obviously a rapid-growing tree, certainly while young, but it should also be emphasized that apparently everyone growing it in America has given it optimum growing conditions. The wood is rather brittle, and is not apparently used for any special purpose except for fuel, by the natives in the vicinity of the native stands in China. It apparently grows best in a moist atmosphere, with soils that contain a good deal of moisture. It is obviously loose and open in habit, and may be best suited for growing in groves rather than as individual specimens, although many in this country, at least, will grow it for a long time as single specimens merely because of its interesting history.

It should be remembered that this species is not an evergreen and in this respect certainly not like the giant redwoods of our Pacific Coast. It is deciduous, and in its native habitat does not grow to the great size and age of our native redwoods. The name "Dawn Redwood" is most misleading, intimating a close association (at least to the general public) with the giant redwoods of the Pacific Coast that actually does not exist.

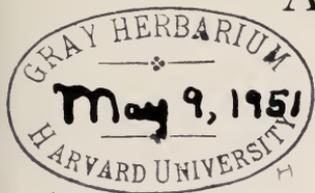
It is easily propagated by cuttings. There are a sufficient number of plants growing in America now, so that even though the seed source may be cut off, commercial propagation of this plant can easily be worked up to supply the demand in a short time. Either soft wood or hard wood cuttings root readily. Although many nurserymen have it in America, there are three, at least, who already list it as available in their catalogues. These are:

Rare plant Club, 208 McAllister Avenue, Kentfield, California
 Tingle Nursery, Pittsville, Maryland
 Verhalen Nursery Company, Scottsville, Texas

These notes should be of value to all those amateurs interested in the latest information concerning this tree.

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THE LARZ ANDERSON COLLECTION OF JAPANESE DWARF TREES

“THE Larz Anderson collection of Japanese dwarf trees presented to the Arnold Arboretum as a memorial to his friend, Charles Sprague Sargent,” is an explanatory statement quoted from the carved inscription displayed with these intriguing plants. This group of dwarf trees is unique in this country and was received at the Arboretum in the fall of 1937. The plants have been on public display in a specially erected shade house ever since. Brought to this country at a time when strict plant quarantines were not in force, these plants were imported with soil around the roots in their original Japanese containers. The Arboretum welcomes the opportunity of being able to display these striking examples of Japanese horticulture to its visitors.

The honorable Larz Anderson became interested in Japanese horticulture as early as 1907 and built a particularly attractive Japanese garden on his estate in Brookline, Massachusetts. Somewhat later he became interested in dwarf trees and in 1913 he brought back from Japan a splendid collection of them, which he acquired while serving as Ambassador Extraordinary from the United States to Japan (1912-1913). These he placed on display in his own garden where they were carefully tended for twenty-five years by different Japanese gardeners. The collection has been displayed at several exhibitions in Boston where it invariably won high honors.

This unique collection is displayed in its lath house between the old Bussey Institution building and the greenhouses, fairly close to the hedge collection. Around the shade house have been planted a few shrubs and trees native to Japan, and during the next few years it is planned to augment this planting. The collection now installed in the shade house consists of 29 specimens all imported in 1913. They are well labelled, but for those unable to visit the collection (the house is open from 9:00 a.m. until 5:00 p.m. each day except Saturday,

Sunday and holidays) the names of the individual plants and their respective ages are given below.

Name of plant	Age
<i>Chamaecyparis obtusa</i>	213 years
“ “	163 “
“ “	148 “
“ “	118 “
“ “	88 “
“ “	63 “
<i>Acer Buergerianum</i>	98 “
“ <i>palmatum</i>	63 “
“ “	63 “
“ “	58 “
“ “	58 “
“ “	53 “
“ “	53 “
“ “	53 “
“ “	48 “
“ “ <i>multifidum</i>	53 “
<i>Cryptomeria japonica</i>	48 “
<i>Larix leptolepis</i>	138 “
<i>Photinia villosa laevis</i>	68 “
<i>Prunus mume</i>	98 “
“ “	88 “
“ <i>subhirtella</i>	98 “
“ “	88 “
“ “	78 “
<i>Thujopsis dolobrata variegata</i>	43 “
“ “ “	43 “
<i>Zelkova serrata</i>	88 “
“ “	63 “
<i>Chamaecyparis pisifera squarrosa</i>	} 43 “
<i>Cryptomeria japonica</i>	
<i>Euonymus fortunei radicans</i>	

“Bon-sai,” the art of training dwarf trees

Century old customs have been handed down by the Japanese regarding the training of the interesting dwarf trees so characteristic of the gardens and homes of that country. There are several reasons for their existence. In the first place, Japanese and Chinese gardens are usually small, for space is at a premium. This is particularly true in the urban areas where the art of making gardens on a very small scale is centuries old. Then, too, the oriental’s well known appreciation of the aesthetic value of living plants has been a prime factor in their cultivation. It often takes fifty to one hundred years to grow a worthy specimen dwarf tree, yet it is possible by twisting the trunk and restraining the growth of tops and roots to give a comparatively young plant the appearance of great age. This



PLATE IX

Chamaecyparis obtusa, 163 years old. (Larz Anderson Collection.)

treatment requires a thorough knowledge of horticulture as well as painstaking patience, but many Japanese are fascinated with "Bon-sai" and practice it as a pastime.

Training

Most woody plants can be dwarfed if given the proper training. If the branches and roots of growing plants are vigorously restrained from developing rapidly, the individuals soon become dwarfed and this is the principle underlying all training. Then, too, great care is given to the training of the trunk, the spread of the branches and their shape, and the spread of the roots, since each can be so trained as to give the impression of great age. Many methods have been devised through the centuries for attaining these ends. Maples, bamboos, cherries, pines, hollies, oaks, azaleas, junipers, and many other plants have been used. They are grown in comparatively small containers, kept pot bound throughout their existence, and carefully and judiciously pruned to maintain the desired type of growth.

Whenever possible, the Japanese start with plants that have already been dwarfed by nature. These are searched for in the high mountains, in regions often unfamiliar to the ordinary traveller. Such plants are frequently found growing in high rocky crevices, just barely existing for lack of sufficient nourishment. If these are dug immediately and removed, they might succumb at once for the delicate balance between the amount of root system and bare existence is easily upset. The plant hunter may locate such plants several years before he will venture to remove them from their rocky dwelling. At first he will prune a small portion of the plant and leave it in place for a year; then he will return and root prune another small portion, repeating this process until it is safe to move the plant. In this way splendid specimens are obtained that have already been trained with the assistance of mother nature herself.

If dwarf plants are to be trained from the seedling stage, the smallest and weakest seedlings are selected. Conifers are considerably easier to train, for they do not form adventitious buds as readily as do the broad leaved plants. The seedling is placed in a very small pot. If there is a tap root, it is pruned considerably, and if a central leader is present, it too is cut back. In order to obtain the desired effect, only certain branches are allowed to develop. As an example, *Chamaecyparis obtusa* is ordinarily a very bushy plant, yet the illustration shows only a few picturesque branches. These few branches have been carefully selected and trained, while the others have been entirely removed. If one of these branches should die, eventually a new bud would be allowed to develop a branch to sufficient size to take the place of the deceased one.

To give the correct appearance of wind-contorted shape, the main stem is often twisted around an upright, and after a formative period the upright is removed. This twisting in itself is a dwarfing process, since frequently it breaks a large number of the conducting vessels in the stem. Branches are twisted in like man-



PLATE X

Pinus jeffreyi in Yosemite National Park has been continually dwarfed by nature for an estimated 600 years.

ner. They may all be trained on one side of the plant, or arranged to droop on one side of the pot, or trained in any one of a dozen different ways. The Japanese gardener usually has a model in mind when he trains his plant, some wind-twisted tree which he is trying to reproduce in miniature form, and it is surprising to the uninitiated to observe how accurate these reproductions can be.

Often in nature one observes old gnarled trees the larger roots of which are exposed, especially when growing in rocky places where there is still soil. This effect is reproduced by the "Bon-sai" artist by growing his seedling in charcoal and moss for a period sufficiently long to induce long roots. When the plant is removed to its permanent container, a part of these roots are left to develop above the soil level, eventually aiding materially in giving the plant the appearance of great age.

Pruning, Repotting and Watering

Not all branches are entirely removed. Some of these century old plants have numerous picturesque stubs, certain gardeners believing that these add to the beauty of the plant. Any diseased tissue on such stubs is carefully scraped, disinfected, and painted. Sometimes in order to gain the appearance of stubby old age rapidly, taller plants that have been growing normally are used. The basal branches are cut back to give the stubby appearance. The top is entirely cut off. The plant is dug and after many of the roots have been removed it is placed in a small pot. Then certain of the adventitious buds are allowed to develop, or else scions are grafted at the desired places.

Grafting is also resorted to when certain shoots die. If a very important branch has died, it may take many years for a new one to grow to a sufficient size from an adventitious bud, so that grafting is often resorted to. The Japanese are particularly adept at this and take great pains in training an individual branch by pinching the buds back here, or twisting the branch there, and so forcing the latter to grow in the desired fashion. The pruning and pinching operations are done during the active growing period, since the development of branches from adventitious buds is then more frequent.

Dwarf trees are repotted every four or five years for two reasons. In the first place it is necessary to remove some of the newly developed fibrous roots so that the tree will remain dwarfed. Secondly, it is necessary to mix a small amount of fertilizer with the soil, since as these trees are forced to grow in very small containers, there is not sufficient room for enough soil to allow new root development unless the plant be artificially stimulated with nutrients.

It is also advisable to keep a fresh layer of green moss on the surface of the soil. This not only adds the impression of age, but keeps the soil from drying out. The containers are usually provided with a hole in the base for proper drainage. In the hot summer days there is some danger of the soil becoming too dry, and at such times the plants need special attention. Spraying the foliage with

water once or twice a day during the hottest spells of summer is advisable in order to keep the plant in good condition.

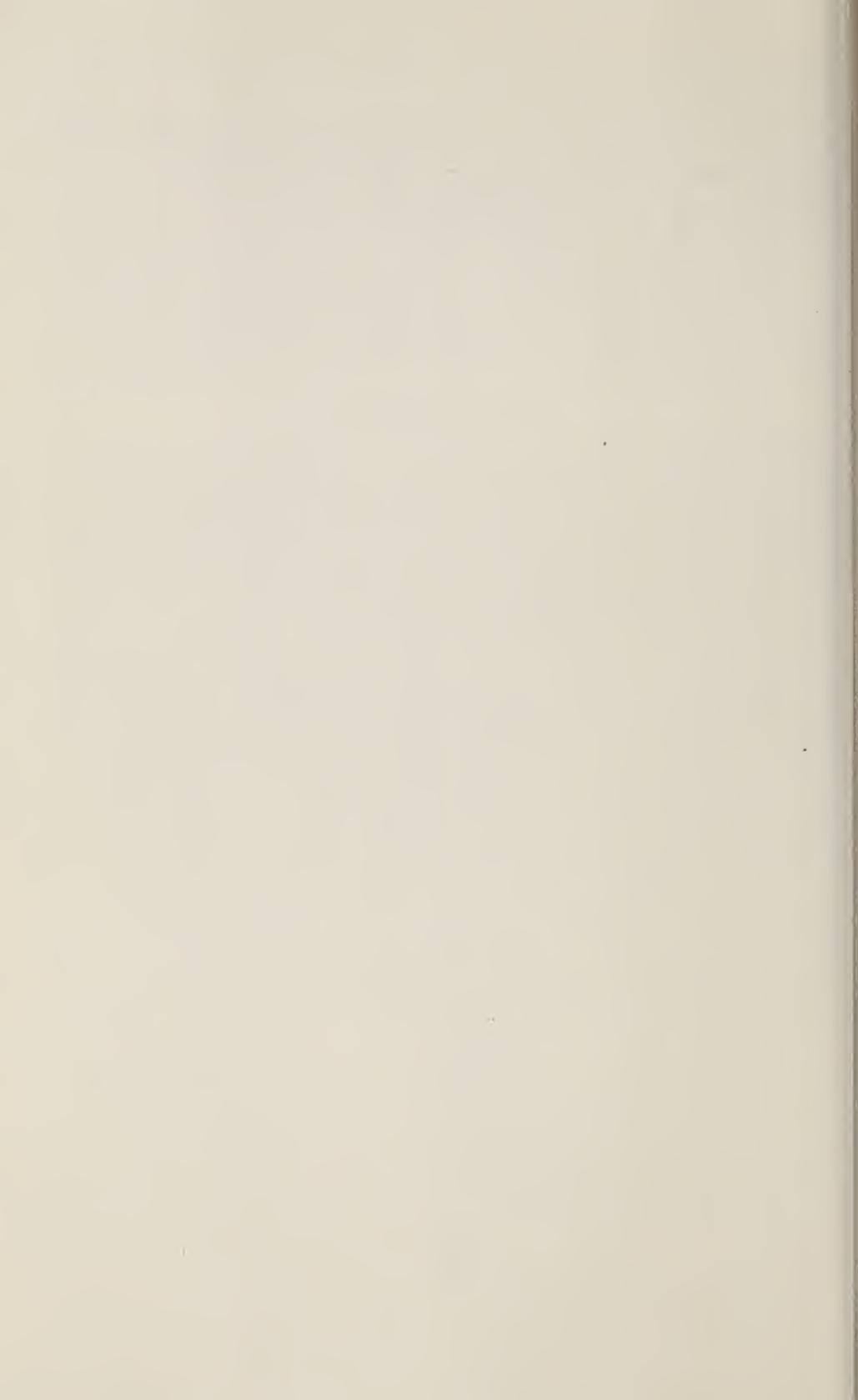
Dwarf trees cannot be considered primarily as indoor plants. They may be used indoors for short periods, but must be grown in the open a greater part of the time. Because of their very small root system, and the small containers in which they are grown, these dwarf trees cannot lose much water through transpiration and still survive. Consequently they must be grown in a shaded location. The shade house in which this location is being maintained at the Arboretum was designed and erected especially for this purpose. Constructed of cypress wood, the top and sides of the house are covered with strips $1\frac{1}{2}$ inches wide with similar spaces left between each strip. This supplies plenty of shade and at the same time keeps the atmosphere considerably cooler and reasonably moist.

Winter Protection

Although many of these trees are hardy, they cannot survive our northern winters because of their shallow root system, unless given some winter protection. A Japanese maple, for instance, growing normally in the ground may survive a winter during which the temperature goes to 20° below zero although the top of the plant may be killed to the ground. However, in these small pots the roots of dwarf trees would be subjected to temperatures almost as low as those of the surrounding atmosphere, and consequently the whole plant would be killed. During the winter in the north, they are best put in cold frames or pits which are well protected with glass and even with boards and mats during the most severe weather. In our pit where these plants were stored last winter the temperature did not go below freezing, although the temperature outside the pit dropped to zero on several occasions. Another danger from freezing temperatures is that with the expansion of freezing soil the containers may break. Although these are seldom ornate, since the Japanese believe that the plant itself should be the point of interest, nevertheless their simplicity alone is beautiful and makes them important adjuncts to any such collection and thus worthy of full protection.

Thus with an exacting knowledge of the numerous rigid requirements of the art of "Bon-sai" the painstaking Japanese gardener is able to reproduce dwarf trees that are exact replicas in everything but size, of century old specimens as they occur in nature. The Japanese have developed other forms of dish gardening, but to the American horticulturist perhaps none is so interesting as "Bon-sai."

DONALD WYMAN



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SOME SHRUBS FOR AT LEAST TWO SEASONS OF BEAUTY

MANY gardeners fail to realize that there are literally several thousand shrubs that are being grown in various parts of the northern part of the United States. Certainly all are not of the best! There must be some basis on which these plants can be judged in which the better ones might be easily pointed up. I would like to suggest that one basis on which such shrubs can be selected is the number of seasons during which they are of real ornamental value.

Take for instance the yews or *Ilex crenata convexa* or many of the evergreen rhododendrons — these plants are of interest every season of the year because of their evergreen foliage. On the other hand, some of the forsythias, deutzias, spireas and lilacs are only of special interest during the two-week period that they are in bloom. They have no interesting autumn color, they have no bright colored fruits, they have nothing particularly meritorious for winter display. Of course such plants will always be needed in many gardens, but the important point to emphasize is that in the small garden, where space is at a premium, plants might well be used that have ornamental interest more than one season during the year.

The viburnums are excellent examples of plants in this group. These plants have conspicuous flowers in the spring, many of them have bright colored fruits in the fall, some of them lasting all winter long, and most have a rich red to purple-red autumn color. Surely such plants merit first consideration on the small property. A suggested list of some of these good plants is given here together with some specific information as to why they are included.

1. Flowers
2. Fruit
3. Summer foliage
4. Autumn coloration
5. General form

6. Winter twig or bark

7. Winter foliage

The numbers below refer to the reasons why these shrubs are valued for ornamental use.

- Abelia grandiflora* 1, 3
Acer palmatum varieties 3, 4, 5
Amelanchier grandiflora 1, 4, 6
Berberis species 1, 2, 4, and some 7
Chionanthus virginicus 1, 2, 4
Cornus alba sibirica 1, 4, 6
C. mas 1, 2, 4, 5
Cotinus coggygia purpureus 2, 4
Cotoneaster dammeri 2, 7
C. horizontalis 1, 2, 5, 7
C. microphylla 1, 2, 7
C. salicifolia floccosa 2, 7
Cytisus praecox 1, 6
C. scoparius 1, 6
Daphne species 1, 2
Enkianthus species 1, 4
Euonymus alata compacta 4, 5
E. fortunei vegeta 2, 3, 5, 7
Fothergilla species 1, 4
Hamamelis species 1, 4
Hydrangea petiolaris 1, 3, 5, 6
Ilex cornuta 2, 3, 7
I. crenata 2, 3, 7
I. yunnanensis 2, 3, 7
Kalmia latifolia 1, 3, 7
Kolkwitzia amabilis 1, 2, 6
Leucothoe catesbaei 1, 3, 4, 7
Ligustrum obtusifolium regelianum 1, 2, 3, 5
Lonicera amoena arnoldiana 1, 2, 5
L. bella 1, 2
L. fragrantissima 1, 2, 3, 7
L. korolkowi floribunda 1, 2, 3
L. maacki 1, 2
L. tatarica 1, 2
Magnolia stellata 1, 2, 3, 4
M. virginiana 1, 2, 3
Mahonia species 1, 2, 3, 4, 7
Malus sargentii 1, 2, 5
Philadelphus floridus 1, 5
P. grandiflorus 1, 5
P. laxus 1, 5
P. virginialis "Bouquet Blanc," 1, 5
P. splendens 1, 5
Pieris species 1, 3, 5, 7
Prinsepia sinensis 1, 2, 5
Prunus tomentosa 1, 2
Rhododendron carolinianum 1, 7
R. catawbiense 1, 7
R. fortunei 1, 7
R. schlippenbachi 1, 4
R. vaseyi 1, 4
Rosa helenae 1, 2, 5
R. multiflora 1, 2, 5
R. roxburghii 1, 5, 7
R. rugosa 1, 2, 4
Spiraea prunifolia plena 1, 4
Taxus baccata 2, 3, 5, 7
T. cuspidata 2, 3, 5, 7
T. media 2, 3, 5, 7
Vaccinium corymbosum 1, 2, 4, 6
Viburnum cassinoides 1, 2, 4
V. dilatatum 1, 2, 4
V. japonicum 1, 2, 3, 7
V. lentago 1, 2, 3, 4
V. opulus 1, 2, 3, 4
V. prunifolium 1, 2, 3, 4, 5
V. rufidulum 1, 2, 3, 4
V. sargentii flavum 1, 2, 3, 4
V. sieboldii 1, 2, 3, 4, 5
V. tomentosum mariesii 1, 2, 3, 4, 5
V. trilobum 1, 2, 3, 4

DONALD WYMAN



PLATE XI

Philadelphus virginialis "Bouquet Blanc." The hybrid species *P. virginalis* is probably best known for its variety "Virginal," but "Bouquet Blanc" makes an excellent specimen, well branched to the ground.

THE EFFECT OF LIGHT ON SEED GERMINATION

For many years we have had difficulty in germinating the seeds of certain species of trees even when stratified in the usual manner. If, however, the seeds are left on the surface of the ground under the trees, they germinate readily. Germinating seeds collected in early spring are planted on moist sphagnum, where they develop rapidly. The young seedlings are then transferred to pots or flats. In this way we have been able to get early germination of *Cedrus libani*, *Pseudolarix* and *Acer griseum*.

The more rapid and complete germination of seeds exposed over winter on the surface of the soil may be related to experiments recently reported by Dr. Risto Sarvas of the Forest Research Institute of Helsinki (Oikos Acta oecologica Scandinavica 1950). Dr. Sarvas finds that the seeds of *Picea excelsa*, *Betula verrucosa*, *Betula pubescens* and *Pinus sylvestris*, germinate much more rapidly if exposed to light. The seeds sown on the surface of the soil, or very lightly covered, germinated more rapidly than those kept in the dark or planted deep enough to exclude the light.

If light is a factor in the early germination of seeds exposed on the ground under natural conditions, the method of germination developed by Dr. Sarvas may give equally rapid germination under artificial conditions and without the hazards of exposing seed to rodents during the winter.

LEWIS LIPP

ARNOLDIA



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SMALLER STREET TREES NEEDED

TIMES were different one hundred and fifty years ago! Take street tree planting for instance. Only a very few kinds of trees were used, and the mighty American Elm was placed at the top of the preferred list. Its great height and lofty arching branches were such that eventually it not only shaded the street completely but also shaded the houses near by as well. During the ensuing century and a half conditions changed. With the tremendous increase in the population of the urban centers came a corresponding increase in property values, especially along the street. The space in which trees were allowed to grow formerly was continually reduced and buildings and paved walks and streets were pushed closer and closer over the wide spreading roots of such giants as the elms.

The horses and buggies of our forbears were gradually changed to horseless carriages — motor machines that emitted gases poisonous to plant growth. At first, this was negligible, but as traffic increased these gases became greater and greater in proportion. This, combined with the fact that the root area allotted to street trees became smaller, did not aid in their perfect growth.

Labor costs became greater, and with larger trees of the magnificent size of mature elms, spray costs and pruning costs reached an all time high.

Then came the Dutch elm disease, a cruel and unscrupulous killer of trees. It was then that the street tree departments of many a town began to realize the tremendous cost of removal of large specimen trees. When it costs between \$100 and \$300 to remove a single tree, some of the towns where killing had been especially great, soon found that normal budgets mean little with a large number of trees to be removed annually. It was then that many an individual responsible for planting street trees, began to look around for "substitutes" for the American Elm.

Of course, there are no real substitutes, for no tree has the wide arching habit of the American elm. However, it is becoming increasingly apparent to many

(and the Arnold Arboretum has been preaching this for fifteen years) that the time has come to carefully scrutinize many other trees that might be suitable for street tree planting — especially trees smaller at mature size than the American Elm. Modern towns do have overhead power lines, much as we dislike them. In some situations, property owners are fortunate in forcing their placement underground, but the great cost precludes this in all but the largest and most congested urban areas. Why not select some small tree, that will reach its mature height under the power lines?

Street Planting

While the planting of our major highways is done chiefly by highly trained state and federal experts and is out of the hands of the average citizen, tree planting along the streets of the towns and cities is much closer to him and he may even serve on a "tree selection" committee. Frequently it has to do with planting on his own property. There are a few generalities about this type of planting that might be kept in mind.

Attempting to grow trees in the heart of our largest cities, is one thing, and growing them in the suburban areas of such cities or in the thousands of towns and villages across the country is another. Very few trees will thrive under the exceedingly tough growing conditions of the city while more might be tried in areas where more soil-space is available, and where traffic hazards, soot and smoke are not as severe.

In some of the major office buildings recently erected in our large northern cities, trees are very much wanted as ornamental features, but they must resist terrific odds in order to survive. The paved walk is all about them and in some places heating pipes are put near their roots to be turned on in the winter to keep the snow melted on the sidewalks above! About all that can be said of such planting is that only the most resistant varieties should be selected and the amount of open ground about their roots should be as much as will be allowed by the architects.

The minimum amount of open ground for a tree to grow in is a square 8' on a side, the larger the better. Often a space 12'x12' is provided. In many European cities and in this country as well, widely woven iron grating is placed over this soil to allow for water to seep through to the roots while at the same time providing for foot traffic over it without pounding the soil down to such an extent that it bakes almost as hard as concrete when it is dried out. Such a condition is not conducive to the free passage of air or rain water to the roots, without which the tree will frequently sicken and die.

Much attention should be given the matter of tree planting before the street is finally laid out by the town engineers. In the horse and buggy days, trees were planted along the street with tree trunks often abutting the curb. Today with automotive transportation what it is, much more room must be given drivers



PLATE XII

The Sentry Ginkgo planted along the Roosevelt Boulevard in Philadelphia, Pennsylvania. The narrow growing trees could be used along a street considerably more narrow than this wide boulevard.

on these streets. If this is not done, accidents (often caused by skidding) are serious, not only to the traffic but to the trees themselves.

The best method of planting along suburban streets is to allow a strip of ground between the sidewalk and the property line in which trees are planted. This strip should be a minimum of 7' to 8' and better still 12' if some of the larger growing types of trees are to be used. This arrangement is ideal, for it does not encroach on private property, yet affords plenty of space for the future development of the trees. It places the tree away from service lines, pipes and sewers that are frequently placed at the edge of the street paving, a decided advantage for when these are opened up and tree roots are in the way, they are usually mercilessly cut. This system is working remarkably well in the newer suburban developments of many large cities, especially in Denver, Colorado, and some areas about Cleveland, Ohio. The property owner can take care of the grass in this strip, and the town will be responsible for the care of the trees. This type of cooperation between the town and the private property owner is obviously an arrangement only feasible when the street and abutting properties have been laid out with this in mind, and certain ordinances have been approved in order for the arrangement to work successfully.

In older suburban areas, where such space is not available, but where the houses are set back considerably from the property line along the street, trees can be planted on the edge of the private property. The sidewalk may or may not abut the street but even if it does not and there is a small grass strip between the sidewalk and street, no trees would be planted in it. They would instead be planted on private property, particularly if the property line abutted the sidewalk. This method of tree planting obviously creates several complications. It would require special town ordinances governing the care and removal of such trees. It would also require the major cooperation and enthusiasm of the original property owners along a certain street. Once the system is agreed on and approved, it is seldom that such purchasers of such property already planted with street trees would seriously object.

This plan has many good points, especially from the standpoint of the health of the trees. They would be away from the street and its destructive traffic, their major roots would be away from the destructive ditch digging operations frequently encountered and property owners as a rule would take pride in their general good health. This plan is working in some areas, but it is obvious that it takes considerable cooperation between property owners and town officials. It can result in more beautiful trees and more permanent trees, which both groups should obviously desire.

In many cities and towns neither one of these methods of tree planting is possible and the trees must be planted between the sidewalk and the curb. No tree should ever be planted closer than $3\frac{1}{2}'$ to the curb, and the further away it is, the better for the tree and the passing traffic. The ideal width for this strip of

grass between curb and sidewalk would be 12' and the tree would not be centered in it but planted closer to the sidewalk than the street.

Street trees should not be planted opposite each other but should alternate, allowing for a greater development of the tops. Spacing should be at least 75' apart. Planting closer than this (except in the use of very small tree species) only creates more costly maintenance, and sometimes may necessitate the removal of some trees which are crowding others. It is far better to plant fewer trees and take care of them properly, allowing them plenty of room for development, than to crowd them close together in order to make a "show" while they are young, at the same time greatly increasing their maintenance cost.

Size of Tree at Planting Time

It is being found by many whose responsibility it is to plant trees along the town and city streets of the country, that smaller trees are much better to use in general street planting — smaller in size at the start and smaller in permanent stature. Trees with a mature height of under 40' can be far less costly to remove. The landscape effects of the tall tree and the smaller tree may not be the same, but there is a nation-wide trend now to consider using smaller trees along the streets of our cities and towns.

Admittedly the need for medium or tall trees will vary with circumstances and specific situations.

Also, it is far easier to plant several trees 1" in diameter, than one 4" in diameter. The smaller trees are more easily acclimated to the new situation, and if properly root pruned and top pruned in the nursery will grow even better the first two years than the larger tree. Water can be added to better advantage, more of the right soil can be given at the start, so the smaller tree usually starts in a more vigorous growing condition than does the larger tree. This bears some thought. Smaller trees are more easily broken and admittedly there are always places where larger trees must be planted.

The arborists of the country have the information and the equipment to move trees at every time of year. There will always be a demand for big tree moving by these experts. However, in the cramped, tough situations in which most street trees are required to start growth, trees of an inch caliper or slightly more usually will get off to a better start than trees of larger caliper. The cost in transplanting is also considerably less. Consequently, the tree superintendent can concentrate on a comparatively deeper hole, on better soil and give more attention to water requirements of the new smaller tree. With mounting labor and transportation costs, these two points are going to prove very important in street tree planting programs during the immediate future.

Some towns like Brookline, Massachusetts, have a policy whereby small streets are planted with one type of tree only. The governing shade tree commissioners see to it that many different types are used throughout the city. It is not with-



PLATE XIII

Crataegus monogyna inermis, a thornless hawthorn with a dense rounded head.

out reason to expect that the majority of property owners on one street might decide on the Sargent Cherry, for instance, whereas on another street another majority would request the Littleleaf European Linden. An intelligent shade tree commission, with certain standard policies, and always ready with helpful suggestions in such cases, could easily mold a most interesting over-all tree planting program that would go a long way to make the town beautiful and interesting.

Small Trees

Height Zone

* <i>Acer argutum</i>	24'	5	
<i>A. campestre</i>	25'	4	Hedge Maple
<i>A. circinatum</i>	25'	5	Vine Maple
<i>A. cissifolium</i>	30'	5	
* <i>A. carpinifolium</i>	30'	5	Hornbeam Maple
<i>A. ginnala</i>	20'	2	Amur Maple
<i>A. griseum</i>	25'	5	Paperbark Maple
<i>A. mandshuricum</i>	30'	4	Manchurian Maple
<i>A. platanoides globosum</i>	50'	3	Globe Norway Maple
<i>A. spicatum</i>	25'	2	Mountain Maple
<i>A. tataricum</i>	30'	4	Tatarian Maple
<i>Carpinus betulus fastigiata</i>	30'	5	Pyramid European Hornbeam
* <i>Carpinus caroliniana pyramidalis</i>	40'	2	Pyramid American Hornbeam
* <i>C. cordata</i>	45'	5	Heartleaf Hornbeam
<i>C. japonica</i>	45'	4	Japanese Hornbeam
* <i>C. turezaniovi</i>	15'	5	
* <i>Celtis bungeana</i>	45'	5	Bunch Hackberry
<i>Chionanthus virginicus</i>	30'	4	Fringetree
<i>Cornus florida</i>	40'	4	Flowering Dogwood
<i>C. kousa</i>	21'	5	Japanese Dogwood
<i>Crataegus species</i>	20-35'	3-5	Hawthorns
* <i>C. monogyna inermis</i>	30'	4	Thornless Single Seed Hawthorn
<i>C. " stricta</i>	30'	4	Upright Single Seed Hawthorn
* <i>C. phaenopyrum fastigiata</i>	30'	4	Pyramidal Washington Hawthorn
<i>Evodia danielli</i>	25'	5	Korean Evodia
<i>Fagus sylvatica fastigiata</i>	40'	4	Dawycck Beech
<i>Gleditsia triacanthos elegantissima</i>	35'	4	Bushy Honeylocust
<i>Koelreuteria paniculata</i>	30'	5	Golden-rain tree
<i>Magnolia stellata</i>	20'	5	Star Magnolia
<i>Oxydendrum arboreum</i>	30-75'	4	Sourwood
<i>Phellodendron amurense</i>	45'	3	Amur Cork Tree
* <i>Prunus nipponica</i>	18'	5	Nipponese Cherry
* <i>P. sargentii columnaris</i>	35'	4	Columnar Sargent Cherry

* <i>Prunus serrula</i>	30'	5	
<i>P. serrulata</i> var.	20-25'	5-6	Oriental Cherry
* <i>Robinia pseudoacacia umbraculifera</i>	35'	3	Umbrella Black Locust
<i>Syringa amurensis japonica</i>	30'	2	Japanese Tree Lilac
* <i>Ulmus carpinifolia umbraculifera</i>	35'	4	Globe Smooth Leaved Elm
<i>Viburnum lentago</i>	30'	2	Nannyberry
<i>V. prunifolium</i>	15'	3	Blackhaw
<i>V. rufidulum</i>	30'	5	Southern Blackhaw
<i>V. sieboldi</i>	30'	4	Siebold Viburnum

Narrow Trees for Narrow Streets

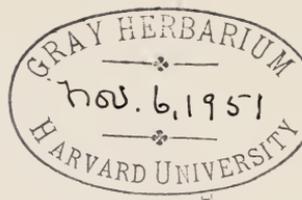
(Not necessarily low in height)

<i>Acer platanoides columnare</i>	75'	3	
<i>A.</i> " <i>erectum</i>	75'	3	Erect Norway Maple
<i>A. rubrum columnare</i>	75'	3	Columnar Red Maple
<i>Ginkgo biloba fastigiata</i>	50'	4	Sentry Ginkgo
<i>Quercus robur fastigiata</i>	50'	5	Pyramidal English Oak
<i>Tilia platyphyllos fastigiata</i>	50'	3	Columnar Big Leaf Linden
<i>Ulmus americana ascendens</i>	100'	2	
<i>U.</i> " <i>columnaris</i>	100'	2	Columnar American Elm
<i>U.</i> " "Augustine"	100'	2	
* <i>U. carpinifolia cornubiensis</i>	50'	4	Cornish Elm
<i>U.</i> " <i>dampieri</i>	50'	4	Dampier Elm
* <i>U.</i> " <i>koopmanni</i>	35'	4	Koopmann Elm
<i>U.</i> " <i>sarniensis</i>	50'	4	Jersey Elm
<i>U. glabra exoniensis</i>	50'	4	Exeter Elm
<i>U. hollandica belgica</i>	75'	4	Belgian Elm
<i>U.</i> " "Klemmeri"	50'	4	
* <i>U.</i> " <i>superba</i>	75'	4	Blanford Elm

* These are apparently not yet offered by American nurserymen but plants are growing in this country and there is no reason why stock could not be worked up. As for the others, they may not all be available in sufficient numbers or the proper sizes to meet the increasing demand but there is no reason why their production should not be increased. And these are not all the possibilities, but certainly enough to initiate the idea that smaller trees are growing in this country and it is high time they are propagated commercially and planted along our streets.

DONALD WYMAN

ARNOLDIA



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AIR LAYERING WITH POLYTHENE FILM

THE making of air layers on woody plants to induce rooting is a practice that is centuries old. Generations of Chinese did it, and undoubtedly it was introduced into America by the earlier settlers. Until comparatively recently, the method has been used chiefly in the greenhouse. It consisted of scarifying the stem of a plant and wrapping moist moss (or soil) around that injured plant part. If the wrapping material was kept moist continually, rooting often occurred. The difficulty came in keeping the wrapping material moist. Rubber or paper wrappings did not prove satisfactory, and watering of the wrapping would frequently have to be done daily and even several times a day in a hot greenhouse. This continual care was frequently more bother than it was worth.

In 1947, Colonel William R. Grove of Laurel, Florida, found that the old-fashioned method of air layering could be decidedly augmented with the use of one of the newer plastic films. He published his findings dealing with the propagation of Lychee in the 1947 "Proceedings of the Florida Horticultural Society." Colonel Grove at first used "Pliofilm" manufactured by the Goodyear Tire and Rubber Company, Inc., but he found that it disintegrated before the roots formed. Then he used "Vitafilm" this yielding much better results. On the strength of this he has used it (and other materials as well) in commercial propagation, and applied for a patent, granted four years later, covering use of plastic material in air layering process.*

In 1950 John L. Creech of the United States Department of Agriculture Station at Glenn Dale, Maryland used plastic films with good success in the propagation of evergreen rhododendron air layers, and published some of his experiences in the National Horticultural Magazine, July 1950. He used a polythene film successfully. The Arnold Arboretum, after suggestions made by Mr. Creech earlier in the year, started using polythene film around air layers in the summer

* Airwrap Products, Box 142, Sarasota, Florida.

of 1949. Results proved so interesting that additional experiments were tried in 1950, some plants showing rooting that might not ordinarily be expected to root as cuttings. During the past summer, Mr. Heman Howard of the Arnold Arboretum placed air layers on 250 species and varieties of woody plants. Some were placed early in the spring, some were placed on the current year's growth in June and July, in an attempt to determine whether this is a reliable method of rooting difficult plants. The results this year have been rather disappointing in that many of the air layers failed to root. Even with the failures, there remain enough possibilities to make this method of interest for everyone, and in order to place some of this information before ARNOLDIA readers the results accomplished in some of these experiments are recorded here.

Polythene Film

There are a confusing number of plastic films now on the market, and all do not have the same properties. The important properties of the film necessary for assisting in the proper rooting of air layers, would obviously include high permeability to gases like oxygen and carbon dioxide, and a very low permeability to water vapor.

A few years ago the Imperial Chemical Industries Ltd. of England developed a plastic known as "Polythene," a high polymer of ethylene. E. I. DuPont de Nemours & Company was licensed to manufacture this resin in the United States in 1943. Originally DuPont used the name "Polythene," but later adopted the trade name "Alathon" for this new plastic. Bakelite Corporation is also licensed to manufacture this resin, they calling their product "Polyethylene." These new plastic films are now widely used for packaging foodstuffs under such trade names as "Howard-Seal," "Pearlon," "Tralon," "Visqueen," etc. Specifically, the material used at the Arnold Arboretum was one of these, purchased from the Harwid Company of Cambridge, Massachusetts under their trade name of "Dura-Clear," manufactured from the resin "Alathon." It is unfortunate that the terms "Polythene" and "Polyethylene" have both been used as the generic name for the high polymers of ethylene since they are confusing to the layman. The point is, that the "Dura-Clear" used in our experiments, has the same properties as the "Alathon" of the DuPont Company. These properties are as follows:

<i>Thickness of Film</i>	<i>Transmission of Water Vapor</i> (in grams per 100 sq. inches of exposed film surface during 24 hours)
0.001"	0.95
0.002"	0.65
0.003"	0.46
0.004"	0.32
0.006"	0.21
0.008"	0.15

Permeability to Gases

<i>Gases</i>	<i>Permeability in cubic centimeters per 100 sq inches in 24 hours</i>
Oxygen	175
Carbon dioxide	700 (higher if water vapor is present)
Nitrogen	72
Hydrogen	225

The thickness of the "Dura-Clear" film we used was four thousandths of an inch, but thinner material would probably have served just as well. It is these qualities relating to water vapor and permeability to certain gases that make this material ideal when wrapped about air layers. (The same properties and its transparency make it ideal in packaging perishable fruits and vegetables.)

It is obvious, from the above, that the polythene film should be conducive to rooting. It should be noted that air layers have been kept perfectly moist by this film, when the wrapping of the film is done tightly, for periods of up to one year in length. Sometimes the sphagnum moss in the wrap actually grows, and grass seeds germinate and grow vigorously when included in the moss mixture. Because the film is fairly transparent, the rooting of the twig inside can sometimes be noted without even opening the wrapping.

This polythene film (the term used here to include all such trade-named products as mentioned on page 50) is ideal for packaging plants also. Mr. Richard Fillmore, the Propagator at the Arnold Arboretum, has merely wrapped dormant scions of roses in polythene with very little sphagnum moss, sent them by ordinary mail to England where they arrived five weeks later in perfect condition. He also wrapped scions of roses (*Rosa hugonis*) without packing material and placed them in the refrigerator for about 12 months with no bad effects, after which they were grafted and some grew successfully. Some azalea plants (3' tall) were dug last spring at the Case Estates, the roots washed free of all soil and then wrapped tightly in polythene film. Some were kept outside, others were kept at room temperatures for a full month, then were planted out, and all grew normally thereafter.

The Air Layer

The making of the air layer itself is very simple and the principle is over a thousand years old. A longitudinal cut of about two inches upward is made on the young twig, the cut going nearly to the center of the twig. (An adaptation of this is to remove a complete circle of bark one half inch wide around the stem.) Then both cut surfaces are dusted with some hormone rooting powder which may (or may not) aid in the rooting. We have used Hormodin #3, but undoubtedly other materials are just as good. Moist sphagnum moss — about a handful — is packed *between* the cut surfaces and then all around the entire cut, fully covering it. Polythene film is wrapped carefully and tightly about it, then tied top and bottom.

Rubber bands used in grafting have not proved satisfactory for tying. Mr. James M. Rooney of Attleboro, Massachusetts, suggested the use of Scotch Electrical Tape #33, and this has proved most satisfactory.

The wrapping and tying of the film should be done in such a way that the moss is well contained and that no opening in the film is left for the evaporation of the moisture from the moss.

Mr. Fillmore has pointed out that the overlap of the film wrapping should be on the underside of the air layer so rain water will not seep in. Also he has pointed out the very important fact that in taping the top end of the wrap the tape should be started on the bare twig and gradually spiral down to completely close the top end of the wrap in order that rain water will not seep down the twig and into the moss inside. In Plate XIII this is not done properly. Many of the air layers we made in 1951 may have failed to root because this was not done, water seeped into the moss packing, pushing out much of the air and creating a soggy condition decidedly unfavorable to rooting. If properly done, the air layer will remain moist for months (we have had some remain moist for a year) and rooting may take place in a few months' time.

This is all there is to the operation. The time it is done, the size of twig used, the amount of hormone powder used and the amount of moisture in the moss are variables with which one has to contend for proper rooting. We have placed air layers in early spring on wood that is dormant, and again in June and July on twigs that grew the current year. As far as our results have been concerned, there seems to be a considerable variation and one would expect that rooting might easily vary with the species. Many plants are propagated from both "hard wood" or dormant cuttings, and "soft wood" cuttings made of wood grown the current year; others may root better from one or the other type of cutting. Consequently one would expect the time these layers are applied might well vary with the species, for best rooting.

Twigs have been rooted that were a half inch in diameter, although usually one might expect normal rooting from the twigs about the size of a lead pencil. We have undoubtedly been over-generous with our applications of the rooting powders, and Mr. Fillmore has suggested that, from the appearances of some of the layers later, too much has been applied, for some have shown what appears to be hormone injury. This also is something what will have to be worked out later. Because so very little moisture passes through the film, one should be extremely careful not to have too much moisture in the sphagnum moss at the time it is applied about the cut. The moss should be squeezed prior to application, so it will be moist — not wet.



PLATE XIII. Materials used in air layer experiments at the Arnold Arboretum. Note comments on making a proper seal at the top of the layer, page 52.

Plants which Rooted by Air Layering

	Number Tried	Number Rooted
*Abeliophyllum distichum	1	1
“	4	2
Acer barbinerve	6	4
“ callipes	3	2
“ circinatum	5	3
“ cissifolium	1	1
“ duretti	3	1
“ ginnala	2	1
* “ griseum	3	1
“ “	3	1
“ grosseri hessi	4	3
“ palmatum dissectum	4	1
“ pensylvanicum	6	6
* “ platanoides	6	4
“ “	4	1
“ “ globosum	4	3
“ “ nanum	2	2
“ “ var.	4	4
“ saccharum monumentale	8	1
Aesculus carnea	4	2
“ hippocastanum	6	2
“ “ umbraculifera	4	1
*Albizia julibrissin rosea	10	5
Betula aurata	3	1
“ fontinalis	4	2
Carya tomentosa	6	1
Castanea mollissima	10	1
Catalpa bignonioides	4	4
“ bungei	4	1
“ speciosa	4	2
Cercis chinensis	4	2
Cladrastis platycarpa	3	2
Clethra barbinervis	3	2
*Cornus alba sibirica	3	3
Cornus florida rubra	9	8
Corylopsis glabrescens	4	3
“ spicata	4	3
Corylus chinensis	4	1

*Layers made in 1950, all others in 1951.

Plants which Rooted by Air Layering (Cont.)

	<i>Number Tried</i>	<i>Number Rooted</i>
* <i>Cotinus coggygria purpureus</i>	4	4
“ “ “	11	3
<i>Cotoneaster foveolata</i>	4	4
“ “ <i>horizontalis</i>	4	4
<i>Crataegus monogyna stricta</i>	6	1
“ “ <i>pinnatifida major</i>	6	1
<i>Cytisus praecox</i>	4	1
“ “ <i>supinus</i>	4	4
<i>Davidia involucrata vilmorini</i>	15	5
<i>Diospyros lotus</i>	4	2
<i>Enkianthus campanulatus</i>	5	3
* <i>Forsythia</i> “Arnold Dwarf”	3	3
<i>Franklinia alatamaha</i>	4	4
<i>Ginkgo biloba</i>	1	1
<i>Halesia carolina</i>	6	6
“ “ <i>monticola rosea</i>	4	4
<i>Hedera helix baltica</i>	4	4
* <i>Hibiscus syriacus rosea</i>	1	1
<i>Hippophae rhamnoides</i>	6	3
<i>Ilex crenata convexa</i>	4	4
“ “ <i>glabra</i>	6	6
“ “ <i>montana macropoda</i>	1	1
“ “ <i>verticillata</i>	3	1
<i>Indigofera amblyantha</i>	4	3
<i>Koelreuteria paniculata</i>	8	3
<i>Laburnum anagyroides</i>	4	3
“ “ <i>watereri</i>	8	4
* <i>Ligustrum ibota aureum</i>	3	3
* “ “ <i>ovalifolium</i>	4	4
“ “ <i>vulgare buxifolium</i>	4	4
<i>Lonicera maacki</i>	4	2
<i>Maackia amurensis</i>	4	4
<i>Magnolia denudata</i>	10	1
“ “ <i>soulangeana</i> “Alexandrina”	4	1
<i>Malus astracanic</i>	4	1
“ “ <i>atrosanguinea</i>	5	4
“ “ “Dorothea”	5	5
“ “ <i>floribunda</i>	6	1
“ “ <i>halliana spontanea</i>	5	1

Plants which Rooted by Air Layering (Cont.)

	Number Tried	Number Rooted
Malus "McIntosh"	3	2
" micromalus	7	2
" prunifolia rinki	6	3
" purpurea	4	3
" sargentii rosea	6	3
" spectabilis	6	5
" sublobata	6	6
" "Wabiskaw"	4	2
Morus alba pendula	4	2
Orixa japonica	4	4
Osmaronia cerasiformis	4	2
*Populus alba nivea	2	2
Prunus juddi	1	1
" maacki	2	2
" serrulata "Amanogawa"	4	3
" " "Gyoiko"	2	1
" " "Kwanzan"	6	2
" yedoensis "Taizanfukun"	4	4
Ptelea trifoliata aurea	6	2
*Rhododendron "Dr. Charles Baumann"	7	5
* " "Josephine Klinger"	9	8
Salix caprea	7	7
Styrax japonica	7	2
Symplocos paniculata	6	3
Syringa amurensis japonica	6	1
" prestoniae "Lucetta"	4	3
" " "Paulina"	5	3
" villosa	5	3
" vulgaris vars.	35	9
Tamarix pentandra	2	2
Taxus cuspidata nana	3	1
Tilia cordata	5	3
" platyphyllos fastigiata	8	2
Tsuga canadensis	3	3
Ulmus carpinifolia koopmanni	6	1
" " sarniensis	4	1
" glabra	4	1
Vaccinium corymbosum "Jersey"	3	2
Viburnum carlesii	4	1

Plants which Rooted by Air Layering (Cont.)

	<i>Number Tried</i>	<i>Number Rooted</i>
* <i>Viburnum dilatatum</i>	4	1
“ juddi	4	1
* “ opulus	2	2
“ rhytidophyllum	4	1
“ rufidulum	6	1
* “ sargenti	6	5
“ “	3	3
“ “ flavum	4	4
“ setigerum aurantiacum	8	3
“ sieboldi	4	1
<i>Wisteria floribunda violacea-plena</i>	4	2
“ “ longissima alba	4	2
“ “ “Naga Noda”	4	4
“ formosa	4	2
“ macrostachya	4	4
“ sinensis	15	1
“ “ hybrid	2	2
“ venusta	3	1
<i>Zelkova serrata</i>	6	6
“ sinica	6	3

Plants which Failed to Root

	<i>Number of Layers Tried</i>
<i>Abies homolepis umbellata</i>	6
<i>Acer campstre</i>	6
“ palmatum atropurpureum	1
“ “ lutescens	2
“ platanoides	6
“ shirasawanum	3
“ tataricum	6
<i>Aesculus carnea plantierensis</i>	5
“ discolor mollis	4
“ glabra leucodermis	4
<i>Albizzia julibrissin rosea</i>	16
<i>Amelanchier canadensis</i>	2
<i>Amelasorbus jacki</i>	4
<i>Betula jacquemontiana</i>	3
<i>Carpinus cordata</i>	4
“ orientalis	4

Plants which Failed to Root (Cont.)

	<i>Number of Layers Tried</i>
<i>Carya glabra</i>	6
“ <i>laneyi</i>	2
“ <i>ovata</i>	4
“ <i>schneckii</i>	4
<i>Castanea dentata</i>	4
<i>Catalpa fargesii</i>	6
<i>Cercis canadensis alba</i>	8
<i>Chaenomeles sinensis</i>	4
<i>Chionanthus retusa</i>	4
“ <i>virginicus</i>	2
<i>Cladrastis lutea</i>	4
<i>Cornus florida</i>	4
“ <i>mas elegantissima</i>	8
“ <i>officinalis</i>	4
<i>Corylus avellana fusco-rubra</i>	4
“ “ <i>contorta</i>	3
“ <i>columna</i>	5
<i>Cotinus americanus</i>	5
<i>Crataegus arnoldiana</i>	4
“ <i>coccinioides</i>	6
“ <i>lavalleyi</i>	4
“ <i>monogyna inermis</i>	2
“ “ <i>versicolor</i>	3
“ <i>nitida</i>	5
“ <i>pruinosa</i>	6
“ <i>punctata</i>	6
“ <i>succulenta</i>	3
<i>Diospyros virginiana</i>	4
<i>Eucommia ulmoides</i>	4
<i>Evodia danielli</i>	4
<i>Fagus grandifolia</i>	2
“ <i>sylvatica atropunicea</i>	3
“ “ <i>pendula</i>	4
<i>Fothergilla monticola</i>	2
<i>Fraxinus chinensis</i>	6
“ <i>pennsylvanicum</i>	4
<i>Gleditsia triacanthos</i>	6
“ “ <i>inermis</i>	4
<i>Hamamelis mollis</i>	8

Plants which Failed to Root (Cont.)

	<i>Number of Layers Tried</i>
*Hamamelis mollis	3
Juglans cinerea	6
" nigra	9
* " laciniata	4
" " "	5
Kalmia latifolia	5
" " polypetala	7
Kalopanax pictus	4
Lindera benzoin	3
Magnolia fraseri	6
" loebneri	6
* " stellata rosea	4
" " "	6
" virginiana	4
Malus "Arrow"	3
" baccata	5
" "Bob White"	4
" brevipes	1
" coronaria charlottae	3
" florentina	5
" glabrata	4
" hupehensis	5
" ioensis plena	1
" robusta	4
" sargentii	6
Parrotia persica	4
Phellodendron amurense	9
" chinensis	4
" sachalinensis	6
Photinia villosa	4
Pinus bungeana	5
Prunus maritima "Eastham"	4
" " "Raribank"	4
" serrula	5
Pseudolarix amabilis	4
Quercus bebbiana	4
" bicolor	6
" dentata	4

* Layers made in 1950, all others in 1951.



PLATE XIV

Showing the rooting of *Malus* "Dorothea" in September 1950, three months after the air layer was made.

Plants which Failed to Root (Cont.)

	<i>Number of Layers Tried</i>
<i>Quercus falcata</i>	3
“ <i>marilandica</i>	5
“ <i>mongolica</i>	5
“ <i>robur</i>	6
“ “ <i>argenteo marginata</i>	4
“ <i>runcinata</i>	6
“ <i>stellata</i>	5
“ <i>variabilis</i>	4
<i>Rhododendron</i> “Mrs. C. S. Sargent”	4
“ “Purpureum grandiflorum”	2
“ “Watereri”	3
<i>Robinia longiloba</i>	3
<i>Sophora japonica</i>	4
<i>Sorbus alnifolia</i>	4
“ <i>aria</i>	4
“ <i>aucuparia</i>	8
“ <i>latifolia</i>	6
“ <i>matsumarana</i>	4
“ <i>pratti</i>	3
“ <i>thuringiaca</i>	4
<i>Syringa pubescens</i>	4
<i>Taxus cuspidata expansa</i>	4
<i>Thuja standishi</i>	5
<i>Tilia americana fastigiata</i>	4
“ <i>platyphyllos</i>	4
<i>Tsuga caroliniana</i>	6
<i>Ulmus carpinifolia dampieri</i>	4
“ “ <i>unbraculifera</i>	6
“ “ <i>wredi</i>	4
“ <i>plotti</i>	4
<i>Vaccinium corymbosum</i> “Harding”	2
<i>Wisteria</i> “Jako”	2

Results

It will be noted from the results that only a few plants were tried that are easy to root from cuttings. The process was merely checked at first to ascertain whether easily rooting plants like *Forsythia*, *Ligustrum*, *Syringa prestoniae*, *Populus*, the Siberian Dogwood, *Tamarix* and some of the *Viburnums* would root this way as well. Although the other materials (listed as rooted) may be rooted from

cuttings, most can be considered as "difficult" when handled in this way. The purpose of these reported experiments was to ascertain which of these difficult-to-root plants, would respond to the air layer technique, possibly saving a time-consuming grafting operation.

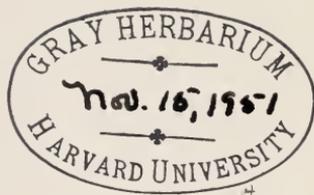
It must be admitted that after the roots are formed, the matter of cutting the potential plant from the parent is not simple. Only a few attempts were made to pot these plants. Mr. Lewis Lipp rooted twigs of the McIntosh apple, but was unsuccessful in getting the plants to grow after they were potted. Some of the other plants are in the same group. It may well be that cutting the rooted twig from the parent plant should best be done at a certain time, or gradually, or that the moss in the air layer might be taken from it and soil substituted before the plant is cut off. These first experiments have to do only with the formation of visible roots during one growing season.

Most of the layers were put on either in late April or July 1951 and were removed in early October. The majority of those that did not root were well callused, some much more so than others. Air layers that were opened by vandals, that broke off in high winds, or that died because of improper cuts, do not enter into the figures given.

This age-old subject of air layering now appears to be given a great impetus due to the properties of these new plastic films. If these results can be repeated, the percentage of rooting increased, and the young plants removed from the parent satisfactorily, this method of propagation will be a highly valued one in any garden where rare and difficult-to-propagate plants are grown.

DONALD WYMAN

ARNOLDIA



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SIMPLE KEY TO THE PINES

(Native or available from nurseries in the United States)

THIS simple key is offered chiefly for the benefit of the amateur gardener who is frequently confronted with keys which he finds unnecessarily complicated. The key is based primarily on foliage characters which, in most cases, can be observed without the use of a hand lens. It should be clearly understood that any key based primarily on the length of the leaves (and this key is just that) is open to serious criticism because the length of the leaves of any plant will vary with the individual as well as with soil, age and climate variations, disease infestations and altitude at which the tree is growing. Other plant characters vary likewise. However, in order to assist the gardener who has an interest in pines, this key is offered in spite of just such criticism. It includes only those pines which one is likely to find in the woods or nurseries of this country. A few native species have been omitted because they occur only in limited areas, and many exotic species are omitted because they have not yet been widely distributed in cultivation. It goes without saying that the more species included in a key, the more complicated that key becomes.

There are about 80 species of pines distributed throughout the northern hemisphere, 27 of which are growing in the Arnold Arboretum. This key includes all but four of the species native to the United States, as well as 15 exotic ones available from nurseries, all in all, 38 species of pines.

All measures of leaf length should be considered as approximate only. On one individual tree needles may vary in length from 2 inches to as much as 8 inches, but in the key the length given would be 4 to 6 inches, meaning that *mature* needles — not the young ones which are elongating, nor the ones on weak or on over-vigorous branches — are mostly within the 4 to 6 inch length. If this is clearly understood by those using this key, the key will undoubtedly prove helpful in the identification of most of our commonly grown pines.

The key is designed to be used chiefly with living material, hence the color of the foliage and the general habit of the tree sometimes plays an important part. Occasionally, as in differentiating between *Pinus strobus* and *P. monticola*, the two species are so much alike that cone characters are used, but these are resorted to only when absolutely necessary, for many a tree which one would like to identify is not graced with cones at the time one wishes to identify it.

This key can be greatly simplified for there are not many pines which are commonly found in any one area in the United States. As an example, let us consider the five-needled pines. There are at least 15 five-needled pine species of which 11 are growing in the Arnold Arboretum. Thirteen species and 3 varieties are listed in the following key. If this key were designed merely to identify the five-needled pines native to this country, the list would be reduced to 7 species. If the key were to be used in identifying the five-needled pines native in the northeastern United States only, this part dealing with five-needled pines would include merely *P. strobus*.

Hardiness is given according to Zones in the Hardiness Map published in former issues of *Arnoldia* (Vol. 3, No. 10, p. 53, 1943). Habitats are also given, because sometimes such information may prove helpful in assisting in plant identification.

There is no excuse for avoiding a simple key such as this one, merely because of a lack of thorough botanical training. Such keys, when carefully made, are understandable, and if they are used with a full knowledge of their limitations, they will prove most helpful to the gardening public. Identifications made by the use of any key, and this one in particular, should not be considered final, but should be further checked against a complete description in some standard text, and available illustrations.

SIMPLE KEY TO THE PINES Native or available in North America

Needles in bundles of 2 to 5, rarely solitary, enclosed at the base by a deciduous or persistent sheath Pinus

1. Needles 5 in a sheath

- | | |
|--|--|
| <p><i>albicaulis</i>—White Bark Pine
 <i>aristata</i>—Bristle-cone Pine
 <i>cembra</i>—Swiss Stone Pine
 <i>flexilis</i>—Limber Pine
 <i>griffithi</i>—Himalayan Pine
 <i>koraiensis</i>—Korean Pine
 <i>lambertiana</i>—Sugar Pine
 <i>monticola</i>—Western White Pine</p> | <p><i>parviflora</i>—Japanese White Pine
 <i>parviflora glauca</i>
 <i>peuce</i>—Balkan Pine
 <i>pumila</i>—Japanese Stone Pine
 <i>strobus</i>—Eastern White Pine
 <i>strobus fastigiata</i>
 <i>strobus nana</i>
 <i>torreyana</i>—Torrey Pine</p> |
|--|--|

2. Needles usually less than $1\frac{1}{2}$ inches long with smooth margin P. aristata
 (California to Colorado) Zone 5

2. Needles usually $1\frac{1}{2}$ to 2 inches long

3. Bark of trunk brown to creamy white, needles rigid and stout, margin smooth **P. albicaulis**
(British Columbia to California) Zone 3
3. Bark of trunk black, needles more flexible
4. Needles bluish green, often twisted, intensely white underneath, leaf margin finely serrulate, i.e., rough to the touch **P. parviflora**
(Japan) Zone 5
4. Needles intensely bluish green **P. parviflora glauca**
4. Needles light green, not twisted
5. Mature twigs glabrous, needles smooth **P. flexilis**
(Alberta to California) Zone 4
5. Mature twigs pubescent; leaf margin finely serrulate, i.e., rough to the touch **P. pumila**
(Japan) Zone 3
2. Needles mostly $2\frac{1}{2}$ to $4\frac{1}{2}$ inches long; leaf margin serrulate, i.e., rough to the touch
3. Mature twigs glabrous
4. Plant shrubby, not tree-like **P. strobus nana**
4. Branches upright, tree dense
5. Needles stiff **P. peuce**
(Balkan Mts.) Zone 4
5. Needles soft and flexible **P. strobus fastigiata**
4. Branches horizontal, tree more open
5. Cones usually 2 to $4\frac{3}{4}$ inches long; twigs glabrous or only slightly pubescent **P. strobus**
(Eastern U.S. and Canada) Zone 3
5. Cones usually $4\frac{3}{4}$ to 10 inches long; twigs pubescent when young
(British Columbia to Idaho and California) Zone 5 **P. monticola**
(These two species are difficult to tell apart with the naked eye, except that the habit of *P. monticola* is more narrow and dense and the needles stiffer than are those of *P. strobus*.)
3. Mature twigs pubescent
4. Tree densely upright, pyramidal in habit **P. cembra**
(Alps of Europe) Zone 4
4. Tree not as above, more open
5. Needles lustrous, dark green **P. koraiensis**
(Japan, Korea) Zone 3
5. Needles dull green
6. Terminal bud blunt almost globular, cones 12 to 20 inches
(Oregon to California) Zone 5 **P. lambertiana**
6. Terminal bud sharply pointed, definitely not globular, cones 4 to 10 inches **P. monticola**
(British Columbia to Idaho and California) Zone 5

2. Needles $4\frac{1}{2}$ to 8 inches long **P. griffithi**
 (Himalayas) Zone 5
2. Needles 8 to 12 inches long **P. torreyana**
 (Southwestern California) Zone 9
1. Needles 3 to 4 only occasionally 5; leaf margin smooth
P. cembroides parryana
 (California) Zone 9 Parry Pinyon Pine
1. Needles 3 in a sheath
- | | |
|---------------------------------|----------------------------------|
| <i>attemata</i> —Knob-cone Pine | <i>ponderosa</i> —Ponderosa Pine |
| <i>bungeana</i> —Lace-bark Pine | <i>radiata</i> —Monterey Pine |
| <i>canariensis</i> —Canary Pine | <i>rigida</i> —Pitch Pine |
| <i>coulteri</i> —Coulter Pine | <i>sabiniana</i> —Digger Pine |
| <i>jeffreyi</i> —Jeffrey Pine | <i>taeda</i> —Loblolly Pine |
| <i>palustris</i> —Longleaf Pine | |
2. Needles mostly 2 to 5 inches long
3. Leaf sheaths deciduous, bark of older twigs smooth, bark of trunk flaky with white or yellow patches **P. bungeana**
 (China) Zone 4
3. Leaf sheaths not deciduous, bark of older twigs very rough, bark of trunk dark brown to black
4. Foliage dark green, cones usually 2 to 4 inches long **P. rigida**
 (Eastern U.S. and Canada) Zone 4
4. Foliage bright or bluish green; cones 3 to 7 inches long
5. Bark on upper part of trunk and branches smooth **P. attenuata**
 (Oregon to California) Zone 8
5. Bark on upper part of trunk and branches rough **P. radiata**
 (Southern California) Zone 8
2. Needles mostly 5 to 10 inches long
3. Winter buds resinous
4. Twigs fragrant when broken; cones 3 to 6 inches; foliage dark green, branchlets orange brown **P. ponderosa**
 (Eastern and Central U.S.) Zone 5
4. Twigs not fragrant when broken; cones 9 to 14 inches; foliage bluish green **P. coulteri**
 (California) Zone 8
3. Winter buds not resinous
4. Foliage bluish green
5. Needles stout, bark cinnamon red, cones 6 to 12 inches **P. jeffreyi**
 (Oregon and California) Zone 5
5. Needles slim, bark red brown, cones 3 to 6 inches **P. taeda**
 (New Jersey to Florida and Texas) Zone 6



PLATE XV

4. Foliage dark green; cones 5 to 12 inches **P. coulteri**
(California) Zone 8
2. Needles 8 to 18 inches long
3. Foliage gray bluish green
4. Needles slender, drooping **P. sabiniana**
(California) Zone 6
4. Needles stiff, erect **P. coulteri**
(California) Zone 8
3. Foliage green
4. Needles mostly 8 to 10 inches long, light green and lustrous
(Canary Islands) Zone 10 ? **P. canariensis**
4. Needles mostly 12 inches or more long, dark green **P. palustris**
(Southeastern U.S.) Zone 7
1. **Needles 3 and 2 in a sheath**
caribaea—Slash Pine
cembroides—Mexican Pinyon Pine
echinata—Shortleaf Pine
ponderosa scopulorum—Rocky Mountain Ponderosa Pine
tubulaeformis—Chinese Pine
2. Needles less than 2 inches long **P. cembroides**
(Southern California and Arizona) Zone 9
2. Needles more than 2 inches long
3. One year twigs greenish to purplish, covered with glaucous bloom
(Eastern U.S.) Zone 5 **P. echinata**
3. One year twigs yellow brown to brownish
4. Terminal bud very resinous **P. ponderosa scopulorum**
(Rocky Mountain Region) Zone 4
4. Terminal bud not resinous or only slightly so
5. Needles 2 to 7 inches long; cones 1½ to 2 inches long
(China) Zone 5 **P. tubulaeformis**
5. Needles 8 to 12 inches long; cones 3 to 6½ inches long **P. caribaea**
(Southeastern U.S., Bahamas, Honduras) Zone 8
1. **Needles 2 in a sheath**
banksiana—Jack Pine *nigra austriaca*—Austrian Pine
densiflora—Japanese Red Pine *pinaster*—Cluster Pine
densiflora oculus-draconis *pungens*—Table Mountain Pine
densiflora unbraculifera *resinosa*—Red Pine
echinata—Shortleaf Pine *sylvestris*—Scotch Pine
mugo—Swiss Mountain Pine *tubulaeformis*—Chinese Pine
mugo compacta *thunbergi*—Japanese Black Pine
mugo pumilio *virginiana*—Virginia Pine
2. Needles ¾ to 3 inches long

3. Foliage with each needle marked with a yellow band
P. densiflora oculus-draconis
3. Foliage bluish green, bark of upper trunk red **P. sylvestris** and vars.
 (Europe) Zone 2
3. Foliage green
4. Plant usually shrubby, with several main branches from the base
5. Needles $\frac{3}{4}$ to 2 inches long, bark black **P. mugo** and vars.
 (Central Europe) Zone 2
6. Dense almost globose shape **P. mugo compacta**
6. Shrubby, upright habit **P. mugo pumilio**
5. Needles 3 to 5 inches, bark red to reddish
P. densiflora umbraculifera
4. Plant a tree with a central leader
5. Needles mostly 1 inch long **P. banksiana**
 (Northeastern U.S. and Eastern Canada) Zone 2
5. Needles $1\frac{1}{4}$ to 3 inches long
6. Branchlets usually with glaucous bloom, often greenish to purplish or yellowish
7. Foliage bluish green, cones usually not persistent, bark of upper trunk red; leaves flexible **P. densiflora**
 (Japan) Zone 4
7. Foliage bright green, cones persistent, bark of upper trunk black; leaves stiff **P. virginiana**
 (Eastern U.S.) Zone 4
6. Branchlets without glaucous bloom, orange to yellow
7. Vigorous shoots often with more than one whorl of branches on the current year's growth **P. pungens**
 (Southeastern U.S.) Zone 5
7. Vigorous shoots with only one whorl of branches on the current year's growth
8. Winter buds white or whitish to light yellow **P. thunbergi**
 (Japan) Zone 4
8. Winter buds dark brown **P. tabulaeformis**
 (China) Zone 5
2. Needles 3 to 8 inches long
3. Winter buds resinous
4. Needles slender and flexible, breaking when bent **P. resinosa**
 (Northeastern U.S. and Eastern Canada) Zone 2
4. Needles stout and stiff, not breaking when bent **P. nigra austriaca**
 (Central Europe) Zone 4
3. Winter buds not resinous (or only slightly so in *P. tabulaeformis*)

4. Buds stout, up to 1 inch long; branchlets bright reddish brown
(Portugal to Greece) Zone 8 **P. pinaster**
4. Buds less than $\frac{1}{2}$ inch long
5. Bark of upper trunk red **P. densiflora**
(Japan) Zone 4
5. Bark of upper trunk black
6. One year twigs with glaucous bloom, green to purplish **P. echinata**
(Eastern U.S.) Zone 5
6. One year twigs without glaucous bloom, yellow to brown
7. Winter buds dark reddish brown **P. tabulaeformis**
(China) Zone 5
7. Winter buds light yellow to white or whitish **P. thunbergi**
(Japan) Zone 4

DONALD WYMAN

EXPLANATION OF THE ILLUSTRATION

The picture (Plate XV, opp. page 66) of the trunk of the lace-bark pine (*Pinus bungeana*), made by Mr. Heman Howard of the Arnold Arboretum, was taken on the property of Mr. and Mrs. Roger Ernst, Brookline. This tree, now about 60 feet tall and nearly 30 feet in branch spread, is standing on what was formerly "Holm Lea" the original home of Professor Charles Sprague Sargent, first Director of the Arnold Arboretum. Since the first plants of this species came to the Arnold Arboretum in 1879 from the old Botanical Garden in Cambridge, Massachusetts, it is highly probable that this tree may have been planted in Brookline about that time.

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FIVE INTERESTING TREES

DURING the past few years, three new trees have proved of considerable interest in the nurseries or the plantings of the Arnold Arboretum. Others, which have been growing here for some time but have not yet been widely distributed in the nursery industry are also worthy of mention. A few of our notes concerning some of these trees may prove of timely interest.

Acer platanoides "Crimson King." This is a seedling of *Acer platanoides schwedleri*, originating at Orleans, France, in the nurseries of Barbier and Company. It was first introduced into America by the Gulf Stream Nurseries, Wachapreague, Virginia, in 1948 and has been patented (No. 735) by this company. It was first planted in the Arboretum on March 10, 1948 under the provisional name *A. platanoides schwedleri nigra*, but later, plants obtained under the patented name in 1949 showed that the earlier plants were identical. This tree is far superior to the Schwedler Maple, in that it keeps its rich purplish red foliage color throughout the entire growing season. Up to the time this clone became available, the Schwedler Maple had proved popular for its colored foliage; but, as many know, this color, while a pronounced red in the early spring, gradually turns greenish in the summer. During the four growing seasons that "Crimson King" has been growing here, it has kept its color uniform throughout the entire period of growth, from spring to fall. Consequently, it is an excellent shade tree in situations where its colored foliage is thought desirable.

Gleditsia triacanthos "Moraine Locust." This variety of the native Honeylocust has recently been given wide publicity, and justly so. To the Siebenthaler Company of Dayton, Ohio, goes the credit for observing, propagating and patenting (No. 836) this tree in 1949. The original tree had apparently been under observation for many years. Two qualities make it outstanding. It is thornless, and, apparently having only staminate flowers does not produce the long pods in the fall, which creates a messy raking problem. There are other forms of *Gledit-*

sia triacanthos inermis. We have grown several from seed here, but whether or not they will bear fruits or have the wide spreading form so desirable in a shade tree, cannot be determined for many years. The "Moraine Locust" has all the other good attributes of the native Honeylocust. It is long lived, has hard wood, grows well under the trying conditions of the city and is fairly drought resistant. It is also easily transplanted, the Siebenthaler Company noting that in one spring and fall they transplanted nearly a thousand trees 5-6' in height without a single loss. It has been growing at the Arnold Arboretum since March 31, 1948, and in the four growing seasons has made remarkably fast growth.

Metasequoia glyptostroboides. This tree has been completely discussed in ARNOLDIA 11: No. 3, April 27, 1951. However, it is interesting to note that at least two of the Arboretum's specimens grew 4'4" during the past summer. In the picture (Plate XVI) the young lady is pointing to the height of this specimen when it was planted in the early spring of 1951. Another plant within a few feet of this one only grew half as much. Both these plants were grown from seed sown July 9, 1948, and the photograph was taken in September 1951. I had hoped this was a record, but recently a note came of a specimen from balmy southern California, growing in the garden of James F. Clarke, San Jose nurseryman, now measuring 11'10" in height.

Davidia involucrata. Much has been written about the beautiful Dove Tree. E. H. Wilson was very fond of it. However, during the past fifteen years it has not performed well in the Arnold Arboretum until this past spring. Only once before during that time, was it known to flower (in the Arboretum), and then only a few deformed flowers were formed. This past spring it was covered with beautiful blossoms and many fully developed fruits were picked this fall. The trees in the Arboretum were killed to the ground in the severe winter of 1933-34 and have had a difficult time recovering. Now about 20' tall, with a season of heavy bloom on the record for 1951, it will be interesting to watch their performance in the future.

Malus toringoides macrocarpa. During the course of the years, the Arnold Arboretum acquires many plants that are improperly named. Some of these prove great disappointments, especially when the name leads one to believe that they may have special merit. Here is one example where the name given probably correctly describes the plant. The Cutleaf Crab (*Malus toringoides*) is now a well known favorite among the crab apples, valued for its densely pyramidal habit, its white flowers in the spring and its small, pear-shaped fruits in the fall that are colored a beautiful red and yellow. However, no varieties of it have been known in America, at least. The story of this "new" plant is simply another in a long list showing how patient one must be in awaiting the normal flowering and fruiting of certain "new" woody plants.

Major F. C. Stern (now Colonel) of Goring-by-the-Sea, Sussex, England, collected seed from our original *Malus toringoides* in the late twenties or early thir-

Fall color of Ginkgo biloba at the Walter Street gate.





PLATE XVI

Metasequoia glyptostroboides in the Arnold Arboretum photographed in September 1951. The seed was sown in July 1948, and when this tree was planted in the spring of 1951 in this spot, it was at the height pointed to by the young lady. During the ensuing growing season it grew 4'4" up to the time it was photographed. Now 8'8" tall, this is not a record growth for these trees in America, but it is not every tree that doubles its own height when slightly over three years old.

ties. One of his seedlings had unusually large fruits, and scions from his plant were received by the Arboretum on February 29, 1939. Large fruited forms of woody plants may sometimes be due to unusually good soil conditions, so we wanted to wait and see how these grafted plants behaved here. It turned out that we had to wait a long time. Four plants were set out in 1942 resulting from the scions we received in 1939. Two were killed by fire in 1945 before they fruited, one was broken off by skiers in 1946 before it fruited.

Grafts were made again from the one remaining plant, in February 1948 when it was apparent that only one specimen of this variety was still alive, and luckily so, for it is recorded as "missing" later in 1948. Three healthy plants were planted in the nurseries in 1949 and were observed in fruit for the first time this fall. The fruits are $\frac{3}{4}$ " in diameter and nearly twice as large as those of the species. They are pear shaped, red and yellow and very beautiful. It is everything the name implies, but the fruits do not remain on the tree as long as do those of the species. The flowers are identical with those of the species, as is the foliage also. In other words, due to a series of circumstances, this plant has been observed in fruit for the first time in the Arboretum after thirteen years. Patience is indeed an asset when growing trees and shrubs!

DONALD WYMAN

Note: Trees for American Gardens, by Donald Wyman, published by Macmillan Company of New York this month, is a companion volume to *Shrubs and Vines for American Gardens*, published in 1949. Approximately 745 native and exotic species and varieties of trees are recommended for planting in American gardens. Nearly one thousand others are listed in a secondary list as either inferior to or no better than those in the recommended list. As with the volume on Shrubs, not every horticulturist will agree with such lists, but in offering them a much needed step is made in the direction of simplification of the tremendous number of good (and mediocre) varieties of plants now being offered in this country by commercial sources. Nearly 250 species and varieties of flowering crab apples are being offered by commercial sources in America — forty-four are suggested as being superior in this book. Written primarily as a companion volume to the book on Shrubs, this one on Trees covers the same hardiness areas and is printed in the same general style.

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WOODY PLANTS USED IN COLONIAL WILLIAMSBURG

THE grace and charm of colonial Williamsburg is being forcibly brought home to an ever-increasing horde of visitors each year. The painstaking care with which this former Virginia capital is being restored is something for which all Americans can be justly proud, for here one is able to visualize the kind of life led by the people who lived here over two hundred years ago. The restoration is not completed, for ambitious building and excavation programs are being executed each year. The restoration appeals to different people in different ways. Volumes have been written about the architecture of the times, about the furnishings in the buildings and the mode of life. To many who are interested in gardening, it is the gardens and plants that are of special interest.

Williamsburg was the capital of the Virginia colony from 1699 to 1780. Here the governor and other representatives of the king lived and entertained. The restless fighting of the earliest adventurers to Virginia's coast had gradually stopped, so that prior to 1750, people were becoming increasingly interested in living leisurely, in becoming comfortable, in making and caring for small but beautiful gardens. Of course, many native plants of the southeastern United States were known to these people and used by them in garden making. Also, many plants had been brought over from Europe during the years of sailing across the ocean, so that by 1750 quite a few woody plants common in European gardens had reached America and were well established.

The stories of the introductions of certain types of European plants brought to America by the earlier settlers would prove most interesting. Many plants undoubtedly were brought over as seeds, for as such they were easily transported. The horse chestnut, lilac, roses, mountain ash, yew and linden could all have been in this group. Many herbs and annual flowers were available and even bulbs such as tulips, narcissus and hyacinths were grown. In a recent list of 265 plants grown in 1700, only 22 were not listed in the current issue of the "Plant Buyers

Guide," showing that the plants used in those times were good selections—sufficiently so to be popular during the ensuing two centuries. The following list is of some of the woody plants used by the early Virginia settlers in making their gardens prior to 1750.

- | | |
|----------------------------------|---------------------------------|
| * <i>Acer platanoides</i> | <i>Colutea arborescens</i> |
| <i>rubrum</i> | <i>Cornus florida</i> |
| <i>saccharinum</i> | * <i>Cornus mas</i> |
| <i>saccharum</i> | * <i>Cotinus coggygria</i> |
| * <i>Aesculus hippocastanum</i> | <i>Crataegus phaenopyrum</i> |
| * <i>Ailanthus altissima</i> | * <i>Daphne cneorum</i> |
| <i>Amelanchier canadensis</i> | * <i>mezereum</i> |
| <i>Amorpha fruticosa</i> | <i>Diospyros virginiana</i> |
| <i>Aronia arbutifolia</i> | * <i>Elaeagnus angustifolia</i> |
| <i>Asimina triloba</i> | <i>Euonymus americanus</i> |
| <i>Baccharis halimifolia</i> | * <i>europaeus</i> |
| * <i>Berberis vulgaris</i> | <i>Fagus grandifolia</i> |
| <i>Betula lenta</i> | * <i>sylvatica</i> |
| <i>lutea</i> | * <i>Ficus carica</i> |
| <i>papyrifera</i> | <i>Fothergilla</i> sp. |
| <i>Bignonia capreolata</i> | <i>Fraxinus americana</i> |
| * <i>Broussonetia papyrifera</i> | * <i>excelsior</i> |
| * <i>Buxus sempervirens</i> | <i>Gleditsia triacanthos</i> |
| * <i>suffruticosa</i> | <i>Gymnocladus dioica</i> |
| <i>Callicarpa americana</i> | <i>Halesia carolina</i> |
| * <i>Calluna vulgaris</i> | <i>Hamamelis virginiana</i> |
| <i>Calycanthus floridus</i> | * <i>Hedera helix</i> |
| <i>Campsis radicans</i> | * <i>Hibiscus syriacus</i> |
| <i>Carpinus caroliniana</i> | <i>Hydrangea arborescens</i> |
| * <i>betulus</i> | * <i>Hypericum calycinum</i> |
| <i>Carya illinoensis</i> | * <i>Ilex aquifolium</i> |
| <i>ovata</i> | <i>cassine</i> |
| <i>Catalpa bignonioides</i> | <i>glabra</i> |
| * <i>Cedrus libani</i> | <i>opaca</i> |
| <i>Celastrus scandens</i> | <i>verticillata</i> |
| <i>Celtis occidentalis</i> | * <i>Jasminum officinale</i> |
| <i>Cercis canadensis</i> | <i>Juglans cinerea</i> |
| <i>Chionanthus virginicus</i> | <i>nigra</i> |
| <i>Cladrastis lutea</i> | <i>Juniperus virginiana</i> |
| <i>Clematis virginiana</i> | <i>Kalmia latifolia</i> |
| <i>Clethra alnifolia</i> | * <i>Laburnum vulgare</i> |

* Exotic plant materials brought over by earlier settlers from Europe.



PLATE XVII

Part of the Governor's Palace garden, with sheared evergreen specimens, a favored type of planting in Williamsburg, Virginia, prior to 1750.

- *Lavandula officinalis
 *Laurus nobilis
 *Ligustrum vulgare
 Linderia benzoin
 Liquidambar styraciflua
 Liriodendron tulipifera
 Lonicera sempervirens
 * tatarica
 *Lycium halimifolium
 Magnolia grandiflora
 macrophylla
 virginiana
 *Malus sylvestris
 *Melia azedarach
 *Morus alba
 Myrica cerifera
 Nyssa sylvatica
 Parthenocissus quinquefolia
 *Philadelphus coronarius
 *Picea abies
 Pinus taeda
 virginiana
 Platanus occidentalis
 *Populus alba
 * nigra
 *Prunus avium
 * laurocerasus
 * persica
 *Punica granatum
 *Pyrus communis
 Quercus alba
 coccinea
 marilandica
 nigra
 phellos
 velutina
 virginiana
 Rhamnus cathartica
 Rhododendron arborescens
 calendulaceum
 carolinianum
 nudiflorum
 Rhus aromatica
 typhina
 Robinia hispida
 pseudoacacia
 Rosa alba
 carolina
 * centifolia
 * damascena
 * eglanteria
 * gallica
 * laevigata
 * spinosissima
 * virginiana
 *Salix babylonica
 Sambucus canadensis
 Sassafras albidum
 Sorbus americana
 * aucuparia
 Spiraea tomentosa
 Stewartia malacodendron
 Symphoricarpos albus
 *Syringa vulgaris
 *Taxus baccata
 Thuja occidentalis
 Tilia americana
 * vulgaris
 Tsuga canadensis
 Ulmus americana
 * procera
 Vaccinium corymbosum
 Viburnum prunifolium
 trilobum
 Vinca minor
 Vitis labrusca
 Wisteria frutescens

DONALD WYMAN

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ELMS GROWN IN AMERICA

THIRTY-FIVE years ago, Professor Charles S. Sargent, Director of the Arnold Arboretum wrote the following statement concerning the European Elms—unfortunately just as true today as it was then — “There is probably more confusion in the identification and proper naming of these trees (the European elms) in American parks and gardens than of any other group of trees, and it is only in very recent years that English botanists have been able to reach what appear to be sound conclusions in regard to them. The confusion started with Linnaeus, who believed that all European elms belonged to one species, and it has been increased by the appearance of natural hybrids of at least two of the species and by the tendency of seedlings to show much variation from the original types.”

Today, with six elm species native in the United States, five species native of Europe (including many varieties), and several more species native of Asia, the picture becomes even more confused. The elm is, and always has been, a standard shade tree, for even though it is threatened in certain sections by the Dutch elm disease and phloem necrosis, the gardening public will still plant elms. Approximately fifty elms will be mentioned in this bulletin. About thirty of them have been listed as available in the nurseries of this country during the past two years: all but five of them are growing in the Arnold Arboretum at Boston.

The Native American Elms

Of the six native American species, only three are of ornamental value — the American elm (*U. americana*) and its varieties, the slippery elm (*U. fulva*), and the winged elm (*U. alata*). The winged or wahoo elm is hardy only in the southern United States, being native from Virginia to Florida and westward to the Mississippi River and Texas, while the other two are native throughout the East and Mid-west. These species are easily distinguishable and little reason exists for any confusion. A key based on foliage characters is appended to this paper.

Rich in references in the early history of the United States, the American elm is the most outstanding and the most deserving of all the elms. It is widely distributed throughout southern Canada, as well as the eastern and the mid-western parts of the United States. In early colonial times, it was under numerous stately specimens that important meetings and many important events took place. Some of these historic elms are still standing today and are well over a hundred feet in height. Many a community in the eastern and mid-western United States has its own local history closely tied to some huge elm which is yet living; and it is the concensus of opinion in hundreds of communities that it would be a dire calamity indeed if the use of the American elm were discontinued in landscape work.

There is no ornamental tree just like the American elm. Its wide, vase-shaped form is unique, making it an excellent specimen for lawn and for street planting. Its lofty branches allow much air circulation underneath and, though the tree supplies perfect shade, the widely arching branches do not hinder views from houses. This habit, characteristic of the American elm, is much more evident in mature specimens than in younger trees. Since the habit varies considerably when the trees are grown from seed, it is advisable to propagate vegetatively those individuals of outstanding form. Strangely enough, it is, like the white oak, one of the few of our native trees that does not thrive well in Europe.

Several recognized varieties give clear evidence of the diverging habits of the American elm. There is, for instance, the variety *columnaris* with rather upright branches forming a wide columnar head. The variety *ascendens* is more narrow, distinctly columnar. Other columnar or narrow pyramidal forms would include the "Lake City" elm, the "Moline" elm, the "Augustine" elm and the "Princeton" elm. Sometimes a variety "urni," or "vase-shaped form," is found listed in nursery catalogues; this is, in reality, the true *U. americana*. Then too, there is the variety *pendula*, which has all the good qualities of *U. americana* with the addition of drooping branchlets, making it decidedly graceful. These and other forms should, of course, be asexually propagated in order to perpetuate their characteristic forms.

The slippery elm (*U. fulva*) is usually found over the same range as the American elm but is not such an excellent ornamental and only grows about sixty feet high. Its form is round; its head, broad and somewhat open; and the foliage, not so dense as that of the American elm. From the mucilaginous inner bark of this tree, very popular cough drops were made at one time. The slippery elm is slightly more susceptible to elm leaf beetle injury than the American elm, and need never be used as a substitute for that much better tree.

The winged, or wahoo elm (*U. alata*) of the South is a vigorous growing, small tree with a wide-topped head, reaching a height of about thirty feet. The leaves are smaller than those of either of the elms already described, and there are pronounced broad and opposite corky ridges along the vigorous young branches. Sometimes the winged elm will grow in protected places as far north as Boston,

but it is not dependably hardy north of Philadelphia. Where it can be grown, it makes a vigorous growing, small tree, often with graceful arching branches. It should be given preference to the American elm, however, only where a small sized mature tree is desired.

Three other elms, native in the United States, are seen occasionally in cultivation but these are seldom offered by nurseries because the trees have little to offer as ornamentals when compared with the more beautiful *Ulmus americana*. One is the cedar elm (*U. crassifolia*) of Texas, Mississippi and Arkansas. It is very common in these states but has been found to be of little value elsewhere in the United States. It is a somewhat round-headed tree, growing about 75 feet tall and having, like *U. alata*, opposite corky ridges along the twigs. Closely related is the red elm (*U. serotina*) native to Kentucky, Alabama and Georgia but hardy as far north as Boston. It has spreading, somewhat pendulous branches, forming a broad head; and it, too, often develops corky wings along vigorous growing twigs. These two elms and *U. parvifolia*, the true Chinese elm, are unlike all other hardy members of the genus in that they develop their flowers and fruits in the fall and not in the spring.

The last native elm species is the rock elm, *U. thomasi* (formerly called *U. racemosa*). Though at present it is rarely grown, the tree might be valuable because of its unique growth habit. About 90 feet tall at maturity, it usually has a central trunk and irregularly developed short, lateral branches, giving an outline which is oblong, rounded at the top, but not necessarily dense. Its slow growth and loosely borne branches are probably the reasons why it has not been much utilized as an ornamental, but its growth habit makes it easily distinguishable, even at a distance, from the rest of the elms. It, too, frequently develops irregular corky wings along its younger branches.

So much for the native elms. Some are seen everywhere in the East and the Mid-west; and some of the less desirable ones have been left standing where the surrounding land has been utilized for building purposes. As stated before, the last three species mentioned are probably not grown in nurseries nor used in landscape work, but are seen here and there simply because they have remained untouched in areas where man has "developed" Nature's handiwork. The American elm is the best — far superior to the others in every way.

Asiatic Elms

Of this group, the elm which has caught the public fancy more than any other is the Siberian elm (*U. pumila*). This plant is a native of northeastern Asia. It is unfortunately misnamed the Chinese elm in many nursery catalogues though this name belongs to *U. parvifolia*. It was first sent to this country in 1905 by Professor J. G. Jack of the Arnold Arboretum and later was introduced in large quantities through the efforts of Frank N. Meyer of the U.S. Department of Agriculture. This vigorous growing tree has found much use in the drier areas



PLATE XVIII. Elm Species
Top row. *Ulmus carpinifolia*, *scrobinia*, *glabra*.
Middle row. *U. americanus*, *laciniata*, *hollandica*.

of the Mid-west, where it does better than most other trees. It withstands clipping very well and forms dense hedges and windbreaks when properly clipped.

But when we have noted its drought resistance and its fast growth, everything in its favor has been said. It is a weak-wooded tree, does not grow old gracefully, and if unpruned, becomes very loose and open. Where other trees are available for ornamental purposes, they should be grown. This is especially true in the eastern and northeastern United States. Reports are circulating of certain strains of this tree with good form and habit, which yield similar off-spring when propagated asexually. I have seen several of these trees, which, when young, admittedly make nice specimens; but it is questionable that they will maintain their good habit as they grow older. For dry soil planting, especially in the dry areas of the West, or for a quick screen which later may be replaced with one more permanent, this tree is admirable; but as a permanent specimen in areas where other trees are available, it is not to be desired.

An elm frequently confused with *U. pumila* is the true Chinese elm (*U. parvifolia*) native of northern and central China, Korea and Japan. Like *U. pumila*, it has small leaves, one to two inches long. There are several ways in which it differs from the taller growing Siberian elm, however. The true Chinese elm is a small tree, usually under fifty feet in height. It has thin scaling bark and a round-topped crown, keeps its foliage green until late in fall and is half evergreen in the south. It bears its flowers in the fall while *U. pumila* has them in the spring. Usually, like the other elms, its autumn foliage is bright yellow; but two of the trees in the Arboretum have a bright red autumn coloration. It has been noted in the Japanese beetle area around Philadelphia, that where these two species were growing side by side, the beetles would practically defoliate *U. pumila* and scarcely touch *U. parvifolia* — an interesting observation well worth further investigation.

The Japanese elm (*U. japonica*) has long been a tree of importance to the Ainu, the aboriginal people of Japan. Many of these people believed that this was the first tree created, sent directly from heaven in full growth. This tree plays an important part in their economy. Fire is made by rubbing its dry roots together. When the inner bark of the tree is mashed and mixed with water, it is woven into a cloth from which wearing apparel is made. The outer bark is used in the roofing of houses and as covering for the outside (and the inside) walls. The Japanese elm is a handsome tree with good dark green foliage. It is as important ornamentally as the Scotch elm because of its similarity in general appearance. In the collection at the Arnold Arboretum, it is susceptible only to a very slight infestation of the elm leaf miner and the elm leaf beetle.

The fourth and last Asiatic elm, the Manchurian elm (*U. laciniata*) is of little importance ornamentally simply because it does not have a good habit of growth. All the trees in the collection at the Arboretum have a fan-shaped habit of branching, with a correspondingly rounded head, but the leaves are borne only

at the tips of the long branches, which have very few side shoots. This plant has been offered in a few American nurseries but might well be replaced by some of the better elms.

European Elms

There are three elm species which, strictly speaking, are native of Europe only. They are the English elm, *U. procera* (formerly called *U. campestris*), the Russian elm (*U. laevis*), and the Plot elm (*U. plati*). Characteristic of the European elms as a group is the fact that they all assume their autumn color later in the fall than do the native American elms.

Of the three, the English elm is by far the most important in America. Many of these trees were planted in Massachusetts in the eighteenth century and since that time have been continually used as street trees and specimens throughout the East. E. H. Wilson strongly recommended this tree for city planting for he claimed it withstood the smoke and obnoxious gases of the city better than any of the other elms, the American included. It does not have the queenly arching habit of the American elm, but it does have a grace and beauty all its own, with its numerous ascending and spreading branches. It has also been noted that in good seasons the leaves remain green several weeks longer than do those of the American elm. Unfortunately it is most susceptible to attacks of the elm leaf miner and of the elm leaf beetle.

Several varieties of the English elm are known, but none of them are grown in quantity by American nurseries. The variety *vanhouttei* has leaves tinged with yellow, and *aurea* actually has yellow leaves. The variety *purpurascens* has purplish leaves, and another variety, *marginata*, has leaves with a creamy-white margin. One form, *australis*, has leaves that are much thicker and firmer than those of the species. Perhaps the best ornamental variety is *myrtifolia*, which has the smallest leaves of any of the elms — scarcely one inch long.

The European white elm or Russian elm, *U. laevis* (formerly *U. pedunculata*), is common in some parts of the Scandinavian Peninsula and Russia. It is similar in size to our own native American elm and is as hardy. However, it differs because it has a much thicker coating of tomentum on the undersurface of the leaves, and longer, more sharply pointed buds. In England, it grows better than the American elm. It is apparently rare in American collections, but makes an excellent specimen tree, with a single upright main trunk.

Another European species is the East-Anglian or Plot elm, *U. plati*. The name lock elm was given to it in England because of the difficulty of working its tough wood. This tall growing tree, which reaches a height of 80-90 feet is closely allied to the Scotch elm and is rarely found in American collections.

The next elm species to be mentioned is a hybrid, *U. hollandica*, apparently a hybrid of *U. glabra* and *U. carpinifolia*. There are a number of varieties but the one which well might represent this group is known as variety *major*, commonly called the Dutch elm. It is a tree of over 100 feet with a short trunk, wide-



PLATE XIX

Ulmus parvifolia sempervirens growing in the Huntington Botanic Garden, Pasadena, California. Young plants propagated from this tree have survived three winters in the Arnold Arboretum, but have dropped their leaves only slightly later than the species. However, it is practically evergreen in southern California.

spreading branches and lustrous dark green leaves. Other varieties have been planted to some extent in Europe as street trees and a few have met with favor in America. The Belgian elm, *U. hollandica belgica*, is a tall, rough-barked tree with a straight trunk. Younger trees are dense and pyramidal in habit while older ones may be more or less cylindrical. Trees of this variety in the Arnold Arboretum are apparently somewhat more hardy than typical *U. hollandica major*. The Klemmer elm (var. "Klemmer") has smooth bark, tall ascending branches and a narrow pyramidal habit of growth. It originated in Belgium where it is planted a great deal. The Huntingdon elm (*vegeta*) originating about 1750 has been used in America and is valued for its height, its forked trunk and its rough bark. A narrow pyramidal variety with smooth bark is *superba* and still another variety, *pendula*, originating in England about 1830, has ascending branches but pendulous branchlets.

Species Native of Both Europe and Asia

The last two species are native of Europe and Western Asia and are used a great deal in the United States because of their good ornamental characters and their several horticultural forms.

The first is the smoothleaf elm *U. carpinifolia* (formerly called *U. foliacea* or *U. nitens*). Being used to a great extent in this country, it is constantly confused with the English elm, *U. procera* (*U. campestris*), from which it may be distinguished by its less deeply furrowed bark, mostly glabrous branchlets, longer and often obovate leaves which are lustrous and usually smooth on the upper surface with petioles from $\frac{1}{4}$ to $\frac{1}{2}$ inch long. Unfortunately, the seeds of this tree have been sold for years by European seedsmen as *U. campestris*; consequently, the resulting confusion in this country has been inevitable.

The smoothleaf elm, which may reach a height of 90 feet and is quite variable in growth habit, has many horticultural forms, some of which are available from nurseries in this country. This tree usually is pyramidal in outline, having a single trunk and somewhat ascending branches, although sometimes the branches may be pendulous and the head more or less rounded. In the south of England, it is often referred to as the Herfordshire elm and grows with a broad head and rather pendulous branches, surpassed in beauty only by the American elm as it grows in New England. The pendulous branched form (*pendula*) has been offered by American nurseries. An unusual variety is *webbiana*, of little horticultural value because, even though the tree is narrow and pyramidal with ascending branches, the leaves are folded longitudinally, giving the appearance of wilting. Another form, *variegata*, has its leaves blotched with two shades of green and with white; and though not particularly desirable, it is of interest to those who like trees with variegated leaves.

Eight other varieties of the smoothleaf elm have horticultural significance, six of them being offered in American nurseries. Both the Cornish elm (*cornubiensis*)

and the Wheatley elm (*sarniensis*), incorrectly called *wheatleyi*, though also known as the Guernsey or Jersey elm, are narrow, pyramidal trees with dense, erect branches. The Wheatley elm, almost columnar in habit, has a slightly broader head and wider leaves than the Cornish elm, with branches more stiffly erect. The variety *dampieri* is a fastigiate tree with a very narrow, pyramidal crown and deeply double-toothed leaves; *wredli* is similar but its leaves are yellowish. Another variety, named *suberosa*, is little more than a dense shrub, irregularly cylindrical in outline, the young sucker branches of which frequently develop opposite corky wings. Somewhat similar to *suberosa* is the variety *propendens*, the branches of which are pendulous and its leaves are very small, only being about one inch long. An outstanding elm was sent to Germany from Persia in 1878 and has since been named the variety *umbraculifera*. This is a dense growing, small tree with a globose or sometimes flat top and erect branches. Closely associated to it is the variety *koopmanni*, which is definitely more globose in outline but just as dense. Trees of these two varieties in the collection at the Arnold Arboretum are well clothed with branches from top to bottom.

These unusual forms are not to be desired in preference to other more ornamental trees and shrubs in the landscape, but they do have a definite use. Sometimes there is a place in a large plant area for a small tree with a definite outline — something which does not require constant pruning to keep it in shape. These varieties of the smoothleaf elm supply just such an accent point. Indiscriminate use of these trees, however, should be guarded against.

The other elm species which is native of Europe as well as certain parts of western Asia, is the Scotch or Wych elm, *U. glabra*, sometimes formerly called *U. montana* or *U. scabra*. This tree, with wide-spreading branches and often flat-topped head, is used considerably in America as an ornamental. The dark green leaves, sometimes with two or three points near the apex, are broader beyond the middle, very rough above and downy underneath. The petioles are about $\frac{1}{8}$ inch long. Unlike many of the other elms, this one does not produce suckers: and on account of this good trait, it has been used much as an understock in grafting. Unfortunately, it is one of the first elms sought by the elm leaf miner and in locations where there are several varieties, this pest does more injury to this tree than to most of the others.

This elm can always be distinguished from other European elms by the fact that the seed is in the middle of the fruit, the petioles are very short, the upper surface of the leaves is rough and there is an absence of corky ridges on the two-year branches. The specific name *glabra* comes from the fact that the branches are very smooth, not rough like most of the other elms.

A number of varieties of this are grown. The most popular is the Camperdown elm (*camperdowni*) which, when grafted on an upright stem, has a wealth of pendulous branches forming a globose head. Many such trees can be seen even in this country, forming natural arbors, under which chairs and tables are placed.



PLATE XX

The Moline Elm as it is growing in Moline, Illinois. (Courtesy of the Schultz Studio and the Park Department, Moline, Illinois.)

Another form (*pendula*) has rather horizontal branches with pendulous branchlets and grows into a low flat-topped tree. There is a fastigiata variety, called the Exeter elm (*exoniensis*, formerly *U. montana fastigiata*), with rather small, often wrinkled leaves, but with branches rigidly upright. One variety (*purpurea*) has leaves which are purple in color when they are young; another variety (*atropurpurea*) retains the color in the leaves for a longer period. A compact shrub with smaller leaves is the variety *monstrosa*. A lower growing bush is *nana*, which seldom grows over 6 feet tall. Sometimes this bush elm is grafted 6 feet up on the trunk of *U. glabra*, resulting in a dense, compact, round-headed tree. A curious, slow-growing form with leaves that are narrow and crinkled is called *crispa*—used sometimes because of its queer foliage.

This is not the time nor the place to enter into a discussion of the two serious pests that are now doing tremendous damage to the elms. Much has been written recently about the inroads of these two serious diseases east of the Mississippi River, and the Dutch Elm Disease is now as far west as Denver, Colorado. Much research work is being done by the U.S. Department of Agriculture on control methods for these pests, and anything that might be said on that score here, might well be antedated in a year or so.

Suffice it to say, that most elms are susceptible to both diseases, some species more than others. Vigorous, well-grown trees, well pruned, sprayed and fertilized, seem to have a better chance of escaping these diseases in infested areas than do sickly trees that are greatly in need of attention. It would seem that no one should plant elms without a thorough knowledge of the situation. Especially is this true of those responsible for the expenditure of large amounts of public funds in planting trees along the streets and highways, for they have a responsibility to the future population as well as the present. If a long line of elms were set out now, with trees dying out intermittently during the next fifteen or twenty years, this would indeed be poor planning. There are enough other trees from which to choose for street or highway planting, so that elms might be overlooked in such planting plans for the time being at least.

The policy should be, especially in disease areas or those adjacent to them, to use other trees where at all possible. Latest control methods should be thoroughly known and understood when planting large numbers of elms. Elms should now be planted only in situations where it is a foregone conclusion that they will receive the best annual care.

The Key

The following key is offered as an aid to the identification of elm species on the basis of foliage characters. More exact keys have been made, in which the flowers and fruits are used, but many an amateur is confronted with the perplexing problem of identification when flowers and fruits are not available; hence this key. Every one of the elm species varies greatly, and to make a key using only

one or two characters is not very satisfactory. Therefore, this key is not infallible, but it may serve its purpose to many who are perplexed concerning the identification of these elms.

To the individual not familiar with the use of keys, this may at first seem confusing, but careful study may prove its simplicity. For instance, all elm species fall into one of four groups (marked by the figure 1), because of corky ridges on the branches, or leaves with several points at the apex, or leaves simply serrate, or leaves doubly serrate. To place a plant in one of these four groups, these four characteristics should be used *in this sequence*. Once done, the remaining points should be taken up in the particular group, *in the sequence suggested in the key*. Identification will be aided materially if the habitat of a tree is known. For instance, in the first group (corky ridges on the branches) *Ulmus crassifolia* would not be found in northern Minnesota, nor would it be likely that *U. procera* and *U. japonica* would be found growing wild in the woods.

Be certain that the tree is examined carefully for all possible marks of identification, and that many leaves are examined since one alone would not tell the full story.

It should be noted that this key does not take into consideration the varieties of these species, many of which can be identified by their form alone. Also, and this is very important, it should be noted that the following species are not common in America except in botanical collections: *U. japonica*, *laevis*, *ploti*, and that other species, like *U. thomasi* and *serotina*, are used very little in landscape work. A knowledge of these facts should make this key much more usable.

The elms are so variable that it is likely they will continue to be difficult to identify for many years to come. These notes and suggestions are offered merely as aids to those interested in this group of trees.

ABBREVIATED FOLIAGE KEY TO COMMON ELM SPECIES

1. Corky ridges or wings on younger branches

- 2. Leaves simply serrate *Ulmus crassifolia*
- 2. Leaves doubly serrate
 - 3. Young twigs glabrous or nearly so
 - 4. Wings usually two and opposite *U. alata*
 - 4. Wings several, not necessarily opposite, flowers in spring, not native *U. carpiniifolia suberosa*
 - 4. Wings several, not necessarily opposite, flowers in fall, native *U. serotina*
 - 3. Young twigs pubescent



PLATE XXI

Ulmus americana columnaris. Several clones of this upright variety have been named and are available from commercial sources. This picture was taken by R. E. Horsey, formerly of the Rochester, N. Y. Park Department, at the time the tree was 60 feet tall with a branch spread of only 18 feet.

4. Tree irregularly columnar *U. thomasi*
4. Tree not irregularly columnar, oval or rounded in outline
5. Leaves 2-3'' long, wings occasionally *U. procera*
5. Leaves 3-4.75'' long, wings occasionally *U. japonica*
1. **Leaves three pointed at tip or occasionally so, branches not corky**
2. Mature branches reddish brown, hairy while young; leaves occasionally with one or two extra points at apex *U. glabra*
2. Mature branches pale yellowish or grayish brown, glabrous or nearly so when young; most of the leaves three-pointed at apex *U. laciniata*
1. **Leaves simply or nearly simply serrate, 0.75-2.75'' long**
2. Leaves often nearly equal at base, many leaves showing indications of double serration, young branches pubescent or glabrous, stipules broad, flowers in spring *U. pumila*
2. Leaves usually unequally rounded at base, young branches pubescent, stipules linear, flowers in fall *U. parvifolia*
1. **Leaves doubly serrate**
2. Young branches glabrous
3. Leaves 2.75-6'' long
4. Leaves usually twice as long as wide, no conspicuous axillary tufts of hair *U. americana*
4. Leaves less than 1½ times as long as wide, usually with conspicuous tufts of hair in axils of veins on under surface of leaves, considerably variable *U. hollandica*
3. Leaves 1.25-3.25'' long
4. Petioles 0.25-0.5'', leaves 2-3'', smooth above *U. carpinifolia*
4. Petioles less than 0.25'', leaves 1.25-2.25'', slightly scabrous above *U. ploti*
2. Young branches pubescent
3. Leaves often glabrous beneath *U. americana*
3. Leaves pubescent beneath
4. Leaves 2-3'' long *U. procera*
4. Leaves longer
5. Leaves often widest at middle, 4-8'' long

- | | | |
|----|---|--------------------|
| 6. | Branchlets grey to light brown, buds covered with rusty brown hairs | <i>U. fulva</i> |
| 6. | Branchlets dark brown, buds without rusty brown hairs, leaves sometimes showing a tendency to be three pointed at tip | <i>U. glabra</i> |
| 5. | Leaves usually widest above middle, 2.5-4.75'' long | |
| 6. | Leaves scabrous and pubescent above, corky wings on branches occasionally | <i>U. japonica</i> |
| 6. | Leaves usually glabrous above, very unequal at base | <i>U. laevis</i> |

DONALD WYMAN



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