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ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOLUME II
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NUMBER 1

HAMAMELIS VERNALIS SARG. THE OZARK WITCH-HAZEL. WITH 1934, the Ozark witch-hazel may be said to have reached its majority as a cultivated shrub; it was just 21 years ago this winter that it flowered for the first time at the Arnold Arboretum. As early as 1845 the Saint Louis botanist, Dr. George Engelmann, had found it growing along the upper reaches of the Meramec River but not until 1911 did Professor Sargent call it to public attention by recognizing it as a distinct species. Young plants were brought on from Missouri and in January 1913 they blossomed for the first time. This year, as every year, their tawny blossoms have made a good showing on bright sunny days during the winter and on one bush or another there was almost continuous bloom from Christmas until Easter.

Hamamelis vernalis has a curious method of accomodating itself to this unusual blooming season. Each flower has four strap-shaped petals which in color and texture remind one of tiny shavings from the outer rind of an orange. In the bud each little petal is rolled in toward the center. When the bud opens the petals roll out, something like opening fern fronds. In the witch-hazel this process is reversible and if the weather turns cold (as it usually does) the little petals roll back again. It is a surprising experience to visit the same bushes on successive days during the winter. One day will be warm and sunny and there will be quite an array of bloom. If the next day is cold and cloudy only in the very center of the buds can one catch sight of the bright little petals which were displayed so attractively the day before. When another warm spell arrives, back roll the petals and the bushes are in flower again.

In its native home in the Ozark mountains, *Hamamelis vernalis* is a glorious sight when in full bloom. Unlike our New England witch-hazel it forms dense thickets, confining itself very largely to gravelly banks

and beds of creeks and small rivers. Seen close at hand, the flowers are clear and bright and though small are borne in great abundance. On any one bush the color is much the same but from bush to bush there is great variation in the color of the flowers. The underlying tone is pale yellow varying from lemon in the petals to a dull greenish gold in the sepals. This is overlaid in varying amounts by a clear dark red; "dragon's blood red" is the technical name for the exact color. Occasionally there are bushes of a clear green gold throughout, with no trace of red; at the other extreme are those bushes whose petals and sepals are completely suffused with red, leaving only the very tips of the petals to display the underlying yellow. Between these two extremes are many intermediates, the commonest form being one in which the green gold sepals bear a red line down the center and the petals are flushed with red at the base. Though almost brilliant when seen close at hand in the bright sunlight, these varying reds and golds fade into one another at a little distance producing a tawny blend which is similar to the rich tones of a turkish rug. The general effect of the bushes is made even more sombre by the dead leaves of the previous year. In the Ozark witch-hazel they persist well into the winter, much as do oak leaves. Thus a river thicket of witch-hazels is already rusty brown before the flowers appear.

The fragrance of the flowers is as surprising as the date of their appearance. While often compared to that of grapes, it is even closer to the odor of a Vanda orchid. It has not only the rich, heavy fragrance of the ripening grapes, but in addition an overtone which is almost spicy, a sort of nutmeg odor. Only on the warmest February days can it be detected out-of-doors in New England, but in the Ozarks where the weather is somewhat warmer, it is often given off in great abundance. To find this rich tropical perfume on a winter's day is a surprising experience. Though the temperature is above freezing and the sun is bright, the wind is raw and cold and the woods are bare. Across the muddy wheat field, a quarter of a mile or more away, a tawny line in the landscape shows where the Ozark witch-hazels are growing along the creek. Yet so heavy is the perfume and in such abundance is it produced that the whole field is flooded with its tropical fragrance.

While *Hamamelis vernalis* seems to be the most dependable species for winter blossom in New England gardens, all members of this interesting genus have a tendency towards winter-flowering. Our common eastern witch-hazel, *Hamamelis virginiana*, flowers late in the autumn just as the leaves are falling and bushes will occasionally be found in bloom as late as December. The Japanese witch-hazel,



HAMAMELIS VERNALIS



HAMAMELIS VERNA



C. E. Faxon del.

Hamamelis japonica, flowers at the Arnold Arboretum in the very early spring. The most conspicuous species of all is *Hamamelis mollis*, the Chinese witch-hazel. It is a lovely sight when in full flower for the petals are very large and the yellow is clear and bright. Unfortunately, with us it has proved to be a somewhat fickle prima donna. None of the bushes at the Arnold Arboretum flowers regularly every year and some of them have never given a really fine show of blossoms.

Though its flowers are much smaller, the Ozark witch-hazel blossoms regularly in the Arnold Arboretum; each bush is well covered with flowers every year. So reliably does it bloom that in France it has been used as a potted shrub for flowering indoors, grafted on stock of *Hamamelis virginiana*. Such grafting can also be resorted to if one wishes a specimen with a single stem, since *H. virginiana* does not sucker from the root as vigorously as does *H. vernalis*. For the ordinary shrub garden this latter habit is really an asset since it produces a dense head of flowering branches and if one stem dies there are others to replace it. In such plantings *Hamamelis vernalis* is most effective if several different bushes are used. The variation in flowering date will insure a longer flowering season and the mingled reds and yellows will produce a richer effect in the landscape.

Hamamelis vernalis does not seem to exhibit any marked soil preferences. In Missouri it is usually found in coarse river gravel on the banks of small streams, or like alders forming thickets in the stream bed itself. At the Arnold Arboretum it is doing well in several situations all of which are well drained. Surprisingly enough it takes kindly to city conditions and has flowered regularly in shady and smoky city gardens. Heavy shade is scarcely to be recommended, however, since the natural habitat of the species is in full sun or partial shade.

Though its general landscape effect seldom exceeds a rich tawny smudge of color, *Hamamelis vernalis* has many qualities which merit a greater recognition. It has clean, attractive foliage and its curious flowers are fragrant and decorative when brought indoors. Certainly any shrub which blossomed faithfully out-of-doors through the entire winter of 1933-34 is worth knowing, if for no other reason.

EDGAR ANDERSON

EXPLANATION OF THE PLATES

Page 3. **Hamamelis vernalis** Sarg.

(From drawings by C. E. Faxon for Sargent's "Trees and Shrubs.")

Insert. Flowering branches of **H. vernalis**.

(Photographed in the Arnold Arboretum, March 1934.)

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HARDY FLOWERING CHERRIES. To a horticulturist, the collection of flowering cherries at the Arnold Arboretum is of particular interest this spring. The phenomenal cold of the past winter has provided a severe test of winter hardiness. On eight different nights the thermometer at the Arnold Arboretum greenhouse fell below zero, and on February 9th it reached 18° below, an all time record. Taken as a whole, the flowering cherries have withstood this extreme cold surprisingly well. A few of the tenderer varieties are apparently badly injured, just how badly it is still too soon to tell. A large proportion, though escaping permanent injury, have lost all, or nearly all, of this year's flower buds.

But New England gardeners may be of good cheer, for at the other extreme there were several varieties which were practically unharmed by the severe cold and are this spring as lovely a sight as ever. Foremost among these hardy varieties is the Sargent cherry, *Prunus serotina sachalinensis*, one of the forest trees of Northern Japan. At the Arnold Arboretum it has been planted in several situations and in all of them it came through the winter in excellent condition. Since in its own way it is one of the loveliest of the Japanese cherries, as well as the most reliable for northern gardens, its behavior this spring should bring it well-merited attention from New England gardeners. It has many outstanding qualities. It is quick growing, long-lived, and eventually becomes a full-sized tree as large as a sugar maple and of much the same shape. Its flowers are usually a bright pink, and the red-bronze of the opening leaves, which appear with the flowers, reinforces their color effectively. Though the flowers themselves are smaller and less abundant than in some of the more tender varieties, none of these at flowering time are as conspicuous at a distance. When planted in well drained situations, the leaves develop clear autumnal tints of gold

and russet and orange. The tree is shapely and clean limbed, particularly so for a cherry, and it is attractive in the landscape throughout the year.

In his "Cherries of Japan," Dr. Wilson has given a brilliant description of the Sargent cherry as he knew it in its Japanese home and as a cultivated tree.

"In the woods and forests it makes a tall tree with a clean trunk and relatively short ascending or ascending-spreading branches, which form a shapely head. But on the margins of woods and in thickets where it is usually met with, and more especially as a planted tree in open places, the trunk, within a few feet of the ground, breaks up into several thick ascending stems. From these rise thick wide-spreading branches which form a flattened crown..... On the trunk and old branches the bark is dark and rough, but on the branches and branchlets it is polished chestnut-brown; one-year-old shoots are pale gray. Like the shoots, the leaves are everywhere glabrous and when they unfold are bronze metallic green, and in the autumn change to shades of yellow, orange and crimson; the under side of mature leaves is more or less glaucescent; the serration is simple and double to a greater or less degree on nearly every leaf, and the gland-tipped teeth are mucronate or aristate; on the very young leaves aristate teeth are most noticeable and as the leaves grow and the teeth expand this character becomes less marked. The bud-scales subtending the unfolding leaves and flowers are viscid without and ciliate glandular. The flowers are inodorous, everywhere glabrous and appear slightly before or at the same time as the leaves, and in color vary from rose and pink to white or nearly white,..... The peduncle is only very slightly if at all elongated; the petals are notched, the anthers small and yellow and the stamen-filaments and calyx are more or less tinged with color. The fruit is globose or subglobose, jet black, about the size of a garden pea and of sweetish flavor."

In late years, since the beautiful Japanese cherries at Washington have begun to attract general attention, there have been repeated efforts to establish similar plantings in other parts of the country. Most of these experiments unfortunately are in the north and middle west and many of them are doomed to disappointment. Lovely as Japanese cherries are when seen reflected in the water, they do not, in the north, do their best in such situations. Their roots demand well drained soils and these are seldom to be found on river banks and the margins of ponds. Someone with imagination, reinforced by horticultural ex-



perience, will some day design a new kind of cherry display for the north. He will use the Sargent cherry, knowing that it is hardy there. He will set his garden on a slope where the soil is well drained, and where the cherries can be seen from a distance. He will back up his cherries with Norway maples and willows, which flower at the same time forming a bright yellow green foil for the pink of the cherries. He will know that these Japanese cherries are long-lived and that they eventually grow into very large trees and he will design his garden accordingly. He may not live to see it reach maturity, but he will have the satisfaction of having created a cherry garden which will fit American conditions as well as Japanese gardens fit Japanese conditions.

While the Sargent cherry has come through the winter in better condition than any of the other tree cherries, some of the lower growing species have done equally well. The following table lists the main species and varieties in the collections of the Arnold Arboretum and tabulates their bud hardiness and winter injury, as well as these could be estimated on April 26th.

Name	Injury to buds	Injury to tree
<i>Prunus pilosiuscula</i>	buds entirely killed	slight
" <i>venusta</i>	most of the buds killed	
" <i>cyclamina</i>	buds entirely killed	
" <i>tomentosa</i>	completely bud hardy	
" " <i>leucocarpa</i>	" " "	
" " <i>endotricha</i>	" " "	
" <i>serrulata spontanea</i>	most of the buds killed	
" <i>incisa serrata</i>	buds killed in part	
" <i>triloba</i>	a few buds killed	slight
" <i>subhirtella pendula</i>	buds entirely killed	
" " <i>ascendens</i>	most of the buds killed	
" <i>yedoensis</i>	" " " " "	slight?
Large-flowered named varieties (<i>Prunus Lanesiana</i> & its hybrids)	" " " " "	extensive injury to trees in some varieties

EDGAR ANDERSON

EXPLANATION OF THE PLATE

Prunus serrulata Lindl. var. **sachalinensis** Mak. (= **Prunus Sargentii** Rehd.) after Makino in *lc. Fl. Japon.* (1900).

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HARDY FORSYTHIAS

WITH A SHORT ACCOUNT OF THE HISTORY OF GARDEN FORSYTHIAS
AND REMARKS REGARDING THEIR POSSIBLE FUTURE DEVELOPMENT.

THREE SPECIES of *Forsythia* have proved thoroughly hardy at the Arnold Arboretum this spring: *Forsythia ovata*, *F. europaea*, and *F. japonica*. In an ordinary year they are relatively inconspicuous members of the collection. This spring, as full of bloom as ever, they stand out in dramatic contrast to the bare branches of the commoner sorts. Of the three, the Korean Forsythia, *F. ovata*, is probably of the greatest garden merit. Though its flowers, as shown in the accompanying plate, are smaller than those of most garden varieties, they have a delicate and airy grace. Wholly aside from its hardiness, *F. ovata* would in certain situations be preferred to other Forsythias by reason of its flower color and habit of growth. The flowers are borne closely clustered on the branches and are of a soft, light yellow.

The Korean Forsythia was introduced into western gardens in 1917, when Dr. Wilson brought back seeds from the Diamond Mountains of Korea. He tells us that in its native home it is "a straggling, often sprawling shrub of no great size." In cultivation it makes a small upright bush, less diffuse in habit than are most members of the genus. It is not only among the hardiest of all Forsythias, but it is with us distinctly the earliest to bloom. All in all, it is decidedly worth growing, and there are many situations where its smaller size, neater habit, and more delicate flowers make it preferable to any other variety.

Forsythia japonica (under which name may be considered as well the barely distinct *F. saxatilis*) has been grown at the Arnold Arboretum since 1924, when cuttings were received from the Botanical Garden

at Tokyo. In flower and leaf it is very similar to *F. ovata*, its most important difference, so far as its use in gardens is concerned, is its lower habit of growth. Like many Forsythias it is a native of rocky places, and it might find its happiest use as a low shrub for the rock garden.

Forsythia europaea, while of great botanical interest, is of little importance horticulturally. American plant breeders should be interested in its hardiness and its profuse bloom. These should prove useful in building up an American race of garden Forsythias. In itself the species is too weedy and coarse for customary garden use. Botanically it is noteworthy as the only species which is not native to the Orient. It grows abundantly in combination with similar weedy shrubs in scrublands of the Balkan Peninsula, where it was first discovered by Dr. Baldacci in 1897. Its natural habitat in dry situations suggests that it might be worthy of extended trial in the more arid parts of the middle west.

Comparatively speaking, Forsythias are newcomers to our western gardens. It was just a century ago that the first plants were brought back to Holland from Japan. Actually, the genus did not become well known until Robert Fortune sent *Forsythia viridissima* to the garden of the Horticultural Society of London in 1844. The following account is taken from a letter he sent back to the society.

“I first discovered it growing in a garden...which belonged to a Chinese Mandarin, on the island of Chusan, generally called the ‘Grotto Garden’ by the English. It is a great favourite with the Chinese, and is generally grown in all the gardens of the rich in the north of China. I afterwards found it wild amongst the mountains of the interior in the Province of Chekiang, where I thought it even more ornamental in its natural state amongst the hedges than when cultivated in the fairy gardens of the Mandarins.”

On a subsequent trip Fortune introduced the variety of *Forsythia suspensa* which still bears his name. Nearly all of our garden Forsythias trace back at least in part to the very plants introduced by Robert Fortune. In his day it was no easy matter to bring back living plants from the Orient. He has left us a detailed account of the careful way in which his precious collections were prepared for the long sea-voyage by sailing vessel.

“As I had now secured living specimens and seeds of all the ornamental trees and shrubs of this part of Japan which I was likely to meet with at this season of the year, the whole were removed across



the bay to Yokohama, and placed for safety in Dr. Hall's garden* until Ward's cases were ready for their reception....

“But the latter part of the business was no easy matter. To go from England to Japan was easy enough; to wander amongst those romantic valleys and undulating hills was pleasure unalloyed; to ransack the capital itself, although attended by an armed guard, was far from disagreeable; and to get together such a noble collection as I have just been describing was the most agreeable of all. The difficulty—the great difficulty—was to transport living plants from Yedo to the Thames, over stormy seas, for a distance of some 16,000 miles. But thanks to my old friend Mr. Ward, even this difficulty can now be overcome by means of the well-known glass cases which bear his name....

“In a foreign country, however, even Ward's cases cannot be made without some difficulty.... Luckily, however, a sufficient number of cases were got ready to enable me to carry the collections on to China. The steam-ship ‘England,’ Captain Dundas, being about to return to Shanghae, I availed myself of the opportunity to go over to that port with my collections, in order to ship them for England, there being as yet no means of sending them direct from Japan. Mr. Veitch had also put his plants on board the same vessel, so that the whole of the poop was lined with glass cases crammed full of the natural productions of Japan. Never before had such an interesting and valuable collection of plants occupied the deck of any vessel, and most devoutly did we hope that our beloved plants might be favoured with fair winds and smooth seas, and with as little salt water as possible—a mixture to which they were not at all partial, and which sadly disagrees with their constitutions...

“A defect in the construction of many of these cases is the shortness of their feet. The bottom of the case should always be at least six inches raised from the deck of the vessel... Washing decks is the first part of the sailor's business every morning at sea, and they are not generally very particular as to where they throw the water. If the feet of the plant-case are shorter than six inches, there will not be sufficient room for the sailors to dash the water below it, and consequently the bottom and sides will stand the chance of being washed every morning as regularly as the decks. In the course of a four or five month's voyage, the salt water is certain to find its way into the soil, which it then saturates, and destroys the roots of the plants....

*This was, of course the Dr. Hall of Bristol, Rhode Island, who introduced many Japanese plants into American gardens.

“When the vessel is about to sail the cases should be closed firmly, and the joints must be made perfectly tight. Narrow strips of canvass dipped in a boiling mixture of tar and pitch, and put on the outside of the joints, answer the purpose admirably, and should always be used where there is any difficulty in making the joints close. Large vessels with poops are the best for plants, and should always be preferred where there is any choice, as their decks are higher, and consequently less liable to be washed by the sea. The poop, either in small or large ships, is the best place for the cases to be placed: in small vessels they should either be put there or not sent at all. The main or mizen top is sometimes recommended; but most captains object to have such heavy articles placed so high above the decks.”

The little plants which travelled back to England in tight glass cases, thrive amazingly well in Europe. In a few decades Forsythias were commonly grown in Europe and America. Both there and here, natural hybrids occurred in nurseries and botanical gardens. Zabel, the Curator of the Arboretum at a forest school in Hanover, was the first to give them the name of *Forsythia intermedia*. His sharp eyes noted the peculiar leaves of one set of seedlings and he thought they might be hybrids of *Forsythia suspensa* and *F. viridissima*. When they came into bloom his suspicions were verified and many of the garden Forsythias grown today are the ultimate result of these or similar crosses and are classified as varieties of *Forsythia intermedia*. One of the loveliest of the new varieties, the Primrose Forsythia, *F. intermedia* var. *primulina*, originated at the Arnold Arboretum as a chance seedling. It was discovered growing among the great mass of Forsythias on the side of Bussey Hill, by Professor Rehder, whose sharp eyes noted the lovely soft yellow tone of its flowers. To sensitive gardeners, the rich butter-yellow of most Forsythias is a little too bright, particularly so in a shrub which in ordinary years produces such large masses of color. The soft primrose yellow of *F. intermedia* var. *primulina* is less tiring to the eye and forms a beautiful background for the brilliant colors of early spring flowers.

The past century has seen a rapid development of garden Forsythias. Riding safely to Europe in little glass cases on the decks of sailing vessels, these oriental shrubs have increased and multiplied. Sharp-eyed botanists and nurserymen have selected the showiest of their hybrids. Collectors have assembled new species from Albania and Korea. Will another century show a correspondingly great development? Will these new species be incorporated, as they easily could be, in outstanding garden varieties? One looks forward hopefully to the new American

Forsythias which may soon be originated; Forsythias which will combine the hardiness of the European and Korean species with the larger flowers of the Chinese species and hybrids; Forsythias whose flowers will be less glaringly yellow and more light and airy in their carriage; which will somewhere in their development lose the coarse and weedy habit which characterizes the wild species and which unfortunately is not even yet eliminated from our cultivated varieties.

EDGAR ANDERSON

EXPLANATION OF THE PLATE

Forsythia ovata Nakai. Natural size. In the lower right hand corner a spray of X **Forsythia intermedia** Zabel has been drawn at the same scale for comparison.

(Drawing by Blanche Ames Ames.)

PLANTS OF CURRENT INTEREST. THE warm weather of the past fortnight has hurried many plants into bloom and the Arboretum is now in the height of its spring glory. Though that glory is this year somewhat dimmed by the ravages of last winter, some of the collections are in fine condition. The lilacs promise well. The earlier flowered *Syringa oblata* and its hybrids with the common lilac are in full bloom at the moment of writing (May 9th) and a few warm days will bring out the rest of the collection. The crab-apples likewise were practically unharmed by the cold winter and are now a lovely sight, though few visitors, unfortunately, find the large plantation at the foot of Peter's Hill. A number of small specimens planted several years ago to carry the line of apple bloom around to the conifer collection are flowering well this spring. In a few more years when they are larger and more conspicuous they will form a beautiful contrast to the evergreens and will lead many visitors to the main collection which is practically hidden from the road.

Many of the azaleas are showing very little color this spring. The Mongolian Azalea, *Rhododendron dauricum* var. *mucronulatum*, flowered very scatteringly. Some bushes showed no blossoms at all, many had flowers only on those branches which were below the snow line, and one or two bushes were nearly up to normal. *Rhododendron obtusum Kaempferi*, the Torch Azalea, will apparently flower well this year only where protected by deep snow. The same is true of *Rh. Schlippenbachii* and the Poukhan Azalea, *Rh. yedoense* var. *poukhanense*. Our native Azaleas, on the other hand are giving a good account of themselves. The charming *Rhodora*, *Rhododendron canadense*, is in fine flower as is also its showier southern relative, the Pinkshell Azalea, *Rh. Vaseyi*. A similar condition prevails in other groups such as Viburnum and Berberis. Speaking very generally the Chinese plants have suffered the most, particularly those from Western China. American species, even those native to the south, have given a good account of themselves and many things from northern Japan and north China are in excellent condition. By and large the botanical and horticultural curiosities from western China have been extensively injured though it is still too early to gauge accurately the full amount of the damage. The Dove Tree, *Davidia involucrata*, has been very badly killed back and there is much injury to *Euptelea polyandra* and *E. Franchetii*. *Dipelta floribunda* has been killed to the ground. Among the Viburnums it is the species from western China which have suffered most. The following species have either been killed to the ground or have been so badly injured that it was necessary to cut them back practically to the roots: *Vibur-*

num ovatifolium, *V. hupehense*, *V. lobophyllum*. *Viburnum erosum*, *V. erubescens*, and *V. tomentosum* and its varieties have been somewhat less extensively damaged. *Viburnum Sieboldii* was only slightly hurt and is now looking very decorative with its sturdy branches and crisply held leaves. The behavior of *Viburnum mongolicum* was particularly instructive. Bushes on their own roots were scarcely touched by the cold and are now in full flower. Those which had been budded on *V. Opulus* were very badly injured and will apparently have to be cut back to the ground.

It is encouraging to report that *Viburnum Carlesii* and the closely related *V. bitchuiense* are uninjured. Their fragrant pale pink flowers are borne in as great abundance as ever and are attractively set off by a full coat of foliage. *V. bitchuiense* is sometimes described as being decidedly inferior in flower to *V. Carlesii*. While it is true that its flowers are somewhat smaller and its flower clusters less compact, it has by reason of these very characteristics a grace which is lacking in the sturdier *V. Carlesii*. There must undoubtedly be situations in which its more delicate aspect would make it the more desirable of the two.

Both on the Overlook and in the Shrub collection, *Spiraea Henryi* and *Spiraea Veitchii* were very badly injured and have been cut back to the ground. *Kerria japonica* here, as elsewhere, has more dead wood than live among the branches. *Deutzia Vilmorinae*, *D. reflexa* and *D. scabra* and its varieties have been cut back to the ground.

Even the Beautybush, *Kolkwitzia amabilis*, did not escape injury. Young specimens received relatively little injury but the fine old bushes in the shrub collection and on the Overlook have been severely killed back, apparently to the roots.

EDGAR ANDERSON
LOUIS VICTOR SCHMITT

ARNOLD ARBORETUM
HARVARD UNIVERSITY



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THE GENUS *AKEBIA*. THERE are two species of *Akebia*, both natives of China and Japan and both represented for some years in the collections of the Arnold Arboretum. They are graceful vines with curious but inconspicuous flowers and are valued chiefly for their foliage which is of a pleasing texture and which holds its green color far into the fall months. Both species are ordinarily considered hardy in Boston, but this spring finds *Akebia trifoliata* (formerly known as *A. lobata*) killed back to the roots at the Arnold Arboretum, while even *A. quinata* has been somewhat injured. The latter is horticulturally the more important of the two, since *A. trifoliata* is coarser in leaf as well as less hardy. The two species, though obviously closely akin are easily told apart. *Akebia quinata* has delicate leaflets which are borne in groups of five. *Akebia trifoliata* has larger leaflets which are in groups of three and have a more or less wavy margin, so that its general appearance is not unlike that of our common poison ivy.

The flowers of both species are very similar to each other but are quite unlike any flower known to the average gardener. They are borne in graceful clusters composed of one or two female flowers, accompanied by a slender raceme of smaller male flowers. Their color is curious, being very close to that of raw liver. At its brightest and seen with the light shining through the petals, it may approach a rosy maroon; in the shade it is reduced to a dull chocolate brown.

The flowers, in favorable seasons, are followed by fruits which ripen in the early fall. They are even more fantastic than the flowers and look like chunky bananas of pale blue leather. The blue has to be seen to be believed; it is not a shade common to fruits, such as the blue of a plum or a grape; it is a brilliant violet or indigo, softened by a delicate gray bloom, and is altogether more reminiscent of a suede dancing pump or a fancy coin purse than it is of flowers or fruits. When fully





ripe, the fruit splits open, revealing the soft whitish flesh thickly studded with small black seeds. Though it is said to be an article of diet in the orient, it is insipid and watery to most western palates.

Akebia quinata has been in cultivation in western gardens for nearly a century, having been introduced into England by Robert Fortune. He first discovered it on the island of Chusan where, to quote his own words, it was "growing on the lower sides of the hills in hedges where it was climbing on other trees and hanging down in graceful festoons from the ends of their branches." While it has often grown well in American gardens, in few places has it become thoroughly at home. On the Proctor estate in Topsfield, Massachusetts, it grows in almost its native profusion. It has there run wild in a small woodland and has climbed to the tops of small trees, forming a graceful curtain of delicate foliage. It must be admitted, however, that in climbing up some of the smaller trees, it has twined so tightly that the tree has been killed. Were *Akebia quinata* to become extensively naturalized, it might become a serious pest in plantations of small trees.

Two years ago both species of *Akebia* flowered profusely at the Arnold Arboretum and Dr. Sax of the Arboretum staff fertilized the female flowers of *A. quinata* with the pollen of *A. trifoliata*. The resulting hybrids are now vigorous small seedlings which may eventually prove of some horticultural merit. From their foliage they are apparently intermediate between the two species and while this may not add to their beauty, it will probably, as in the case of many specific hybrids, produce a more vigorous individual. Before the question of their desirability can be answered, the seedlings must be raised to maturity and tried out in the Arnold Arboretum and elsewhere. There are a few extra plants which will be available next fall to those readers of the Bulletin who have the facilities for taking care of them and who will grow them carefully and report on their behavior. If those who are interested will send their names and addresses to Mr. W. H. Judd, Arnold Arboretum, Jamaica Plain, Massachusetts, the requests will be put on file. When the seedlings are large enough, probably early next fall, requests will receive attention in the order of their receipt, in so far as material is available.

EDGAR ANDERSON

EXPLANATION OF THE PLATES

Leaves, flowers, and fruit of *Akebia quinata* Decne.

(From drawings in *Lavallée: Arboretum Segrezianum; Icones Selectae...*)

ARNOLD ARBORETUM
HARVARD UNIVERSITY



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RHODODENDRONS. WHAT a privilege it would be, if we could call back as we walk through the collection, the men who have contributed to the development of our garden rhododendrons. They would make an interesting and varied assemblage – Dean Herbert, the Earl of Carnarvon, Sir J. D. Hooker, blunt Anthony Waterer, John Fraser, gentle Peter Collinson in his Quaker garb, and Baron Ungern Sternberg. For the rhododendrons of our gardens are quite literally something new under the sun; there is nothing just like them in nature. Aristocratic cosmopolites, they came into being in Victorian England when species from the Old World and the New were sympathetically gathered by plant collectors and intelligently blended by a few hybridizers.

The contributing species are all mountain lovers. From the lower slopes about the Mediterranean and Black Seas comes *Rhododendron ponticum*; higher up in the Caucasus are the hardier *R. caucasicum* and *R. Smirnowii*. Our own southern mountains contributed the hardy and attractive *R. catawbiense* which occurs by thousands of acres on the upper slopes of the southern Alleghanies. Near the North Carolina boundary among the open balsam woods and natural meadows which form the summit of Roan Mountain it reaches as far as the eye can see, growing in scattered groups in the open meadows and forming a dense undergrowth beneath the balsams. It was from this very locality that it was first collected for European gardens by John Fraser, over a hundred years ago. Fraser was a Scotchman, who as a very young man, like many another Scotchman, had gone to London to seek his fortune. He eventually became one of the most successful of those early plant collectors who ransacked the American continent to provide novel and beautiful plants for European gardens. He had phenomenal success in Russia where he became a favorite of Catharine the Great. After

her death, by Imperial ukase, he was sent back to America with orders to furnish rare and novel plants for the imperial collections. "Accompanied by his eldest son, John, he embarked in the year 1799 for the southern states of North America, where he prosecuted his researches in various unexplored parts of the continent. On the summit of the Great Roan or Bald Mountain, on a spot which commands a view of five states, it was Mr. Fraser's good fortune to discover and collect living specimens of the new and splendid *R. catawbiense*, from which so many beautiful hybrid varieties have since been obtained by skillful cultivators." (Condensed from the account by Sir William Hooker, in the "Companion to the Botanical Magazine.")

Another American species, the rosebay, *R. maximum*, has been little used by the English hybridizers, unfortunately so for American gardeners, since it is one of the hardiest of the lot. It is of particular interest to New Englanders for it is occasionally found native as far north as Sebago Lake and southern New Hampshire. It was among the American plants introduced into England by the Quaker botanist Peter Collinson. The religious bond between English and American Quakers kept up a lively interchange between the two countries. Quakers had always been interested in gardening: George Fox, the founder of the Society of Friends, had specified that the "nature of herbs, roots, plants, and trees" should be taught in Quaker schools. What more natural then, but that packets of seed and pressed plants and much garden information should pass back and forth between the two countries. In this way *R. maximum* was sent from the New World to the Old and in Peter Collinson's "Commonplace Book for June 26, 1756" we find the entry, "The great mountain laurel or rhododendron flowered for the first time in my garden."

One other species, the showiest of the lot, *R. arboreum*, came from the foothills of the Himalayas. It contributed splendor to the garden rhododendrons for it is a great shrub-like tree with large flowers of bright red, varying in different strains from blush pink to a black crimson. Unfortunately, it brought in a tropical aversion to cold along with all this tropical splendor. *Rhododendron arboreum* itself can barely be grown out-of-doors even in England; it was not until it had been hybridized with hardy American species that a plant was produced which could withstand the English winters. English hybridizers, however, have continued to use *R. arboreum* and other lovely but tender species in their work. The result is a glor^us group of flowering shrubs but one which Americans must cross the ocean to see. Only a few of the thousand or more named varieties will stand our hot summers and cold

winters. Among the pinks we can recommend "Mrs. C.S.Sargent" and "Henrietta Sargent" in deep pink and "Lady Armstrong" and "Roseum elegans" in rose pink. The hardiest reds are "Charles Dickens," and "H.W.Sargent." In dark purple the best are "Purpureum grandiflorum" and "Purpureum elegans."

Most of these iron-clad varieties are the creations of one man, Anthony Waterer, an English nurseryman who became a sort of god-father to American gardeners. His particular affection for Americans came about in an interesting way. When Andrew Jackson Downing laid out the grounds about the National Capitol, he ordered plants from Waterer. The plants were received but before payment was made Downing had died. His friend and neighbor, Henry Winthrop Sargent, when settling the estate found Waterer's unpaid bill. By the influence of his college classmate, Charles Sumner, he got a special bill through congress and Waterer was eventually paid. Now, Anthony Waterer was a forthright, John Bull sort of a man, as strong in his likes as in his dislikes. Sargent's action lead to a life long friendship, one which was large enough to include Sargent's friends and his friend's friends as well. It was Henry Winthrop Sargent who brought Anthony Waterer and his rhododendrons to the attention of his cousins, H. H. Hunnewell and Charles Sprague Sargent. It was this friendship which lead to the great rhododendron collections at the Hunnewell estate in Wellesley, at Professor Sargent's home in Brookline, and at the Arnold Arboretum.

In growing rhododendrons it is necessary to remember their likes and dislikes. They hate a limey soil. They dislike hot sun in the spring and summer, cold winds in winter. They like partial shade and a soil which is well drained but moist at the roots. The situation provided for them in the Arnold Arboretum is almost ideal. The bold ridge of hemlocks to the south screens them from the sun and helps to keep the soil moist at the roots. Even there they could be grown in greater perfection if they were more sheltered from winter winds and from adventuresome small boys. This latter pest is a very real problem in growing rhododendrons at the Arboretum. Anyone who was ever a boy does not blame the urchins for wanting to play about in the Bussey Brook and to crawl up through the rhododendron beds among the giant bushes. Yet anyone who knows rhododendrons and their needs knows that this crawling is very hard on the bushes. Twigs snap off and sunshine strikes at the roots. The passing of hundreds of pairs of little feet, and little knees as well, wears out the very soil. The rich, cool mulch which has so carefully been built up is scuffed away and bit by bit the collection succumbs.

Of late years rhododendrons here and elsewhere in New England have been attacked by the lace wing fly. These bizarre little creatures are scarcely larger than the head of a pin. Under the microscope they appear like hump-backed monsters dressed in lace. Monsters they are in action as well as appearance, for they gather under the rhododendron leaves and suck its juices. They can be successfully controlled by using an oil spray but their attacks are kept to a minimum if the rhododendrons are planted in semi-shade. The insects dislike the shade; the shrubs prefer it, therefore such a situation is doubly preferable.

One of the Caucasian species, the handsome *R. Smirnowii*, thwarts the lace wing fly by clothing its leaves below with a mat of woolly hair. So protective is this covering that even the hybrids between *R. Smirnowii* and the other species are practically immune. Fortunately, for the next generation of American gardeners, hybridizers are at last at work creating new varieties for this country, varieties which will be winter hardy and summer hardy, which will at least discourage attack from the lace wing fly and which will, nevertheless, compare with present day English varieties in the size and beauty of their flowers.

EDGAR ANDERSON

RHODODENDRONS. IN spite of last winter's devastating cold there has been quite a show of bloom among the hybrid rhododendrons during the last month, the hardy Caucasian hybrid, "Boule de Neige" flowered profusely and the late-blooming variety "Delicatissimum" made a very good showing. Pending a more complete report on the collection as a whole it may be briefly recorded that in addition to these varieties the following gave at least a fair account of themselves: "James Bateman," "Echse," "Anton," "Lady Armstrong," "Henrietta Sargent," and "H.W. Sargent."

AREPORT ON WINTER INJURY. THE effects of the severe winter of 1933-1934 on the collections of the Arnold Arboretum are proving to be of great scientific and horticultural interest. Under the leadership of Professor J.G. Jack there is accordingly being prepared a comprehensive report on winter injury at the Arnold Arboretum. It will comprise one or more numbers of the Bulletin of Popular Information and will be published in the autumn of 1934.

EXPLANATION OF THE INSERT

Rhododendron maximum L.

(From drawings by C.E. Faxon for Sargent's *Sylva of North America*.)





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THE SHRUBBY ROBINIAS. DURING late May and early June the robinia collection is a beautiful sight along the Meadow Road at the Arnold Arboretum. While all the species of the genus are native to North America, several of them have very restricted distributions, and a really comprehensive collection is seldom seen, even in botanical gardens. The species are all woody, ranging in size from forest trees, such as the black locust (*Robinia pseudoacacia*), to low, trailing shrubs which barely rise from the ground.

Under the title of shrubby robinias we may conveniently group together about a dozen species which are shrub-like in form and size. Most of them are rather low shrubs with pinnate leaves, and pink flowers borne in drooping racemes. Of the dozen species, four are of more than ordinary horticultural importance: *Robinia hispida*, *R. Kelseyi*, *R. fertilis*, and *R. Hartwigii*. While they are quite similar, they may be distinguished as follows:

Petioles and peduncles viscid *R. Hartwigii*

Petioles and peduncles never viscid.

Leaflets oblong to oval, twigs hispid.

Plants 1-4 ft. high, pods very rarely developed . . . *R. hispida*

Plants 4-8 ft. high, pods always developed . . . *R. fertilis*

Leaflets lanceolate, twigs never hispid *R. Kelseyi*

Several of the terms used in the above key may require a word of explanation. "Viscid," when used as a botanical term, means that the particular part of the plant referred to is clammy or sticky to the touch. "Hispid" indicates a bristly, hairy condition. "Petiole" and "peduncle" are the botanical equivalents of leaf stalk and flower stalk, respectively.

Robinia hispida was the first shrubby species to be introduced into cultivation. Sir John Colliton imported this plant from the Carolinas into Exmouth, England, in 1741. It is easily distinguished from *R.*

Hartwegii by the characteristic dense coat of bristly, glandular hairs, which cover twigs, petioles, and peduncles, and from *R. fertilis* and *R. Kelseyi* by the fact that it rarely, if ever, develops seed pods. Thomas Meehan, in 1893, reports that he examined several thousand plants in their native habitat and found two or three under-developed seed pods as a result of his efforts. This species produces shell-like, rose-colored flowers in great profusion. Probably owing to the absence of seed production, plants of *R. hispida* have an exceptionally prolonged flowering season. It is perhaps the most commonly cultivated shrubby robinia. Because of its rather prostrate, straggling habit, and tendency to produce numerous root suckers, it is the least desirable species for garden planting. Used as a bank cover on sandy slopes, it is of considerable value; in such a location it is attractive and useful. *Robinia hispida* is completely hardy, at least as far north as Boston. It has endured the severe weather of the past winter with little if any damage.

Robinia fertilis when better known, should prove to be one of the most popular members of this group of plants. It is a native of the Carolinas, and has been in cultivation for some time, but seems to have been confused with other closely related forms. It is often difficult to distinguish between *R. fertilis* and *R. hispida*. Bristly, glandular hairs cover the twigs, petioles, and pedicels in both species. In general, *R. fertilis* is a somewhat taller shrub than *R. hispida*, the leaflets are oblong rather than round, and the flowers are usually smaller, although the latter distinction is quite variable. *Robinia fertilis* is a freely fruiting species; consequently after the onset of the fruiting season, it is easily distinguished from *R. hispida* by the plentiful crop of bristly, reddish-brown pods produced. It seems to be a more desirable ornamental than *R. hispida*, chiefly because of its upright stature, and the interesting appearance it makes in the fall, when its branches are attractively decorated with bristly, brown pods. This species seems to be slightly less hardy than either *R. hispida* or *R. Kelseyi*.

Robinia Kelseyi, introduced by Mr. Harlan P. Kelsey in 1900, is one of the most handsome of the robinias. It was found growing by Mr. Kelsey in the Blue Ridge Mountains, south of Pineola, North Carolina. It is readily separated from the other species of shrubby robinias by its lanceolate leaflets and its upright habit of growth. Like other robinias it flowers profusely, and in the late summer it is gracefully covered with dark, reddish-brown seed pods. This species seems to be fully as hardy as *R. hispida*. The rose-pink flowers, and rather upright stature of this species make it an excellent subject for planting as a background in iris gardens. The blooming period is about the same as that of iris. The blues and purples of the tall, bearded irises make a



pleasing contrast with the soft pink of *R. Kelseyi*.

Robinia Hartwigii (*R. viscosa* var. *Hartwigii* Ashe) has only recently been described as a distinct species. It becomes a thick, spreading shrub or small tree, with dark-green, graceful foliage. The handsome foliage borne by this shrub makes it a charming sight throughout the summer. It can easily be distinguished from the other robinias dealt with at this time by the clammy, viscid nature of the petioles and pedicels. The flowers except for a pale rose blush, are almost white. It can be separated from its nearest relative, *R. viscosa*, by the fact that the twigs are very seldom viscid. In addition, the flowers have less color; it is more spreading and hence never becomes a tree as *R. viscosa* very often does. *Robinia Hartwigii* has a marked tendency to flower continuously during the summer and fall. In a garden planting it seems to be preferable to *R. viscosa* because of its shrubby habit, handsome foliage, and prolonged flowering season. During the past season this species has suffered considerable damage, and it seems to be noticeably less hardy than the three previously mentioned species.

For the successful cultivation of the shrubby robinias, the selection of a well sheltered location is of major importance. The wood of these species is exceptionally brittle, and the plants are prone to suffer severely from wind damage. Robinias do not have a rigid soil preference, doing well on any soil of moderate quality, preferably a light well-drained one. It is usually desirable to propagate by seed, in species where viable seed is matured. *Robinia hispida* and *R. Kelseyi* are very often grafted on *R. pseudoacacia* stock, in which case they become small trees. This practice should be discouraged because the plants are usually short-lived when propagated in this fashion. High winds very often snap off the trunk at the union. *Robinia hispida* and *R. Kelseyi* are propagated easily by root suckers.

Probably owing to their shrubby habit, the four species of robinia enumerated above suffer far less from the depredations of the locust borer (*Cyllene robiniae*) than does the black locust (*R. pseudoacacia*). The large trunk and branches of the latter species apparently offer a more suitable site of entrance for the borer than do the shrubby types.

While the shrubby robinias are in general aspect, often weedy, particularly in the winter time, and while they usually look a bit unkempt because of occasional dead twigs, their leaves are light and graceful, and their flowers are superbly beautiful in form and color. Understandingly used they have a place in many gardens.

THOMAS W. WHITAKER

EXPLANATION OF THE PLATE

Flowering branch of ***Robinia fertilis***.

(Photographed in the Arnold Arboretum, June 1934.)

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WINTER HARDINESS OF TREES AND SHRUBS
GROWING IN THE ARNOLD ARBORETUM

I

THE WINTER OF 1933-34 ranks as one of the severest ever experienced in New England and other portions of northeastern North America. With its passing, evidences of damage to trees and shrubs from the unusual conditions began to appear and these became increasingly apparent as the season of growth progressed. Full appraisal of resultant injury was not immediately possible because in addition to outright killing of plants or obvious parts of them, it was uncertain to just what extent root systems and the vegetative tissues of stems has been affected. Even now, an estimate cannot be complete and secondary results due to inhibitory effects on buds, reduction of nutritional organs and the attacks of disease-causing organisms that find their way in through injured parts will continue to express themselves for some time. However, a considerable part of the picture is now clear and the purposes of this article are to sketch its outlines, present such detailed data as have been assembled, offer suggestions as to how woody plants should be made ready for winter and advise as to the treatment of winter-injured trees and shrubs.

Still fresh in the memories of most readers of the BULLETIN, little need be said concerning the rigors of the winter of 1933-34. The records of the Weather Bureau for all the years of its existence do not show more severe and long-continued cold throughout the greater part of northeastern North America. Winter began early and persisted well into the following spring. As for New England, the monthly mean temperatures from November to March inclusive, January excepted, were below the averages of the last 47 years. The official figures for the deviation from the means are: November 5.4° F. below the average,

December 5.8° below, January 0.1° above, February 10.7° below, March 1.8° below. Very low temperatures featured especially the last week in December and the entire month of February. Referring to the latter the U. S. Weather Bureau in its "Climatological Data for New England" (Vol. 46, p. 7) remarked - "The coldest month ever recorded, since the compilation of Section averages, passes into New England history as the temperatures during February, 1934, are brought into comparison with earlier occurrences." It is also pertinent to add that the cold was sometimes accompanied by strong winds. In fact, the winds from November to March inclusive were of more than normal mean intensity.

Important as these official records are when considering the effects of the winter on plant life, or in drawing conclusions as to the hardiness of plants, it must be borne in mind that there are other critical meteorological data of which no account is taken. Reference is made particularly to the modifying influences of snow-cover and shelters, and local variations in temperatures as between those of the "cold pockets" of depressions and the various facies of elevations of land. Differences in snow-coverage or site often account for differences in winter damage to plants of the same kind proximately located.

Regarding the phenomenon of winter hardiness of plants, that is, their resistance to cold, much remains to be learned. Basically it is an inherited character and, as do all inherited characters, shows minor variations only among individuals of the same kind under identical conditions. Its stability is indicated by the fact that a hardy race cannot be evolved from a tender one or vice versa simply by changing the environment. Thus, the progeny of plants reared in a climate foreign to them retain unimpaired their natural hardiness on being restored to their native surroundings. On the other hand hardier or more tender races can be evolved by appropriate methods of breeding.

Although hardiness is inherent, it is subject, just as are other inherent characters, to considerable modification in the individual resulting from changes in the environment. Indeed, hardiness is in some instances so delicately attuned to a given environment that certain species desired for introduction elsewhere, even into regions of the same latitude, may prove satisfactory or otherwise according to whether they originate on one side or the other of a mountain range. Differences in temperature, altitude, rainfall, season of rainfall, snowfall, proximity to the sea, physical and chemical soil conditions and various other factors may be of dominant importance in their effect on hardiness. In determining the fitness with respect to this feature of a species or race for introduction no rule of thumb applies; the answer can be

learned only by actual test. Such experimentation is one of the many functions of the Arnold Arboretum and similar institutions.

Finally, it should be observed that even in the cases of plants, native or introduced, suited to a given regional area, their natural resistance to cold may be weakened by such controllable factors as unfavorable soil and water conditions, crowding, wounds, recent transplanting, unfavorable sites, propagation on tender rootstocks and unseasonable or otherwise injudicious fertilization. Conversely, hardiness can be fortified by providing conditions favorable to good growth in the summer and suitable preparation for timely dormancy in the fall.

From all that has been said above it is apparent that the explanation of instances of winter injury and the passing of judgment on the normal hardiness of any kind of plant involves a wide range of considerations.

Just what it is in the organization of a plant that makes it winter hardy, just what happens when its tissues "ripen" for dormancy in the fall and ensures dormancy until the insistent call of spring comes are phenomena not yet fully understood. They have been studied, however, from many angles and much of interest has been learned even though the riddles evade solution. Among these studies, some on the action of cold and frost on living cells, have resulted at least in producing plausible theories. Various theories, some more or less fanciful, others based on reasonable experiment, have been advanced in explanation of the nature of frost injury. Formerly it was believed that cell walls were ruptured by the formation of ice crystals, but observations show that generally this is not the case. It is now commonly believed that the ice crystals permanently disturb the organization of the living substance within the cells to such an extent as to render them incapable of retaining water. Inferentially then "water retention is the basis of hardiness." One investigator, (W. Stiles) in a recent paper summarizes his views as follows - "In case of frost resistant plants, however, it is probable that water is bound to hydrophilic colloids of the protoplasm and is non-freezable, so that the formation of ice crystals and the consequences of their formation to which the death of the cells is attributed do not take place."

The extent and the kind of winter injury to woody plants present many aspects, some obvious and readily diagnosable, others insidious and difficult to diagnose unless the full history of the case is known. In all instances observations should be made as early as possible after winter closes because later on confusion may result from the inroads of destroying fungi or other disturbing agents, or from the similarity of symptoms that follow causes other than frost. The extent and the

kinds of winter injury vary from complete killing, immediate or delayed, to localized affections as expressed by twig, bud, bark or root injury, dieback of crown, frost cracks and discoloration of internal tissues. Akin to these, but not included in this presentation, is the damage by early fall frosts to stems not yet fully hardened, and to premature growths by late spring frosts; nor are included "heaving" and so-called "winter-browning," a browning on evergreen foliage on the sun-exposed sides of crowns that takes place in late winter or early spring, the result of excessive loss of water from the leaves while the ground is still frozen and the roots are inactive.

Turning now to the compiled lists that follow under self-explanatory headings, it should be stated that a classification free from some overlapping and some likelihood of modification is impossible. A perusal of this introductory section, in which attention is called to natural variations and to the many ponderable and imponderable influences that affect hardiness, will afford explanations of why that is so. Further, there are examples in which injury may appear to be so much greater or so much less at the outset, than eventually materializes that incorrect initial listing results. Thus, what may seem at first to be simply a non-fatal dieback or a temporary inhibition of buds may be of such a nature that subsequent growth is never satisfactory and a year or two hence the plant dies. Indeed, especially with introduced species, experience alone over a long period of years is essential before one knows their reactions and can unfailingly interpret their manifestations under the various conditions and treatments in their new environment. Another difficulty arises from the circumstance that a species recognized under a commonly accepted name may actually comprise several unrecognized or unnamed strains differing inherently from one another in hardiness. The history of at least some of these would probably reveal that they represent strains of dissimilar geographical origin. Not so perplexing, yet worthy of mention, are those woody plants, both native and introduced, that die back more or less every winter because of their habit of continuing growth until checked by frost; in the course of the winter these always die back to the "ripened" wood. It is planned to extend and perfect these above mentioned lists as opportunity affords.

A third section of this article is devoted to advice on the treatment of winter-injured plants and to a discussion of practical procedures in preparing and in protecting trees and shrubs so as to enable them best to resist the inclemencies of winter.

J. H. FAULL, J. G. JACK
W. H. JUDD, L. V. SCHMITT

II

1. Plants killed at the Arnold Arboretum in the winter of 1933-34.

Acanthopanax Simonii	Helianthemum glaucum
Berberis atrocarpa	Stoechadifolium
Berberis pruinosa longifolia	Hypericum Hookerianum
Chaenomeles lagenaria cathayensis	Juglans regia
Cladrastis Wilsonii	Ligustrum Quihoui
Colutea arborescens bullata	Picasma quassioides
Cytisus multiflorus	Platycarya strobilacea
Cytisus scoparius	Polygonum Auberti
Cytisus scoparius Andreanus "Compacta"	Prunus avium plena
Euptelea Franchetii	Prunus Lannesiana affinis
Exochorda macrantha	Prunus Padus Purdomii
Helianthemum alpestre	Prunus serrulata horinji
Helianthemum nummularium "Carmine Queen"	Sinowilsonia Henryi
	Sorbaronia Dippelii
	Viburnum ovatifolium

2. Plants killed to the ground at the Arnold Arboretum in the winter of 1933-34.

Abelia Engleriana	Berberis Wilsonae Stapfiana
Acanthopanax setchuenensis	Berberis Wilsonae subcaulialata
Actinidia melanandra	Berchemia racemosa
Akebia trifoliata	Callicarpa Bodinieri Giraldii
Ampelopsis brevipedunculata elegans	Callicarpa dichotoma
Baccharis halimifolia	Callicarpa japonica
Benzoin praecox	Campsis chinensis
Berberis aemulans	Caragana Boisii
Berberis aggregata	Ceanothus americanus
Berberis aggregata Prattii	Ceanothus Fendleri
Berberis aggregata recurvata	Ceanothus pallidus roseus
Berberis candidula	Celastrus hypoleuca
Berberis dictyophylla	Celastrus Loeseneri
Berberis Francisci-Ferdinandi	Celastrus Rosthorniana
Berberis Gagnepainii	Celastrus rugosa
Berberis Julianae	Clematis paniculata
Berberis polyantha	Clerodendron trichotomum
Berberis sanguinea	Colutea arborescens
Berberis Soulicana	Colutea cilicica
	Colutea media

<i>Colutea orientalis</i>	<i>Deutzia magnifica eburnea</i>
<i>Cornus kousa</i> . Younger plants were uninjured.	<i>Deutzia magnifica erecta</i>
<i>Cornus kousa chinensis</i>	<i>Deutzia magnifica gracillima</i>
<i>Cornus paucinervis</i>	<i>Deutzia magnifica latiflora</i>
<i>Coronilla emeroides</i>	<i>Deutzia maliflora</i> "Avalanche"
<i>Coronilla Emerus</i>	<i>Deutzia mollis</i>
<i>Corylopsis platypetala</i>	<i>Deutzia myriantha</i>
<i>Corylopsis spicata</i>	<i>Deutzia reflexa</i>
<i>Corylopsis Veitchiana</i>	<i>Deutzia rosea</i>
<i>Cotoneaster affinis bacillaris</i>	<i>Deutzia rosea campanulata</i>
<i>Cotoneaster bullata macrophylla</i>	<i>Deutzia rosea eximia</i>
<i>Cotoneaster glabrata</i>	<i>Deutzia rosea floribunda</i>
<i>Cotoneaster microphylla</i>	<i>Deutzia scabra crenata</i>
<i>Cotoneaster salicifolia floccosa</i>	<i>Deutzia scabra eminens</i>
<i>Cytisus albus</i>	<i>Deutzia scabra Fortunei</i>
<i>Cytisus albus pallidus</i>	<i>Deutzia scabra</i> "John Richardson"
<i>Cytisus multiflorus</i>	<i>Deutzia scabra macrothyrsa</i>
<i>Cytisus sessilifolius</i>	<i>Deutzia scabra plena</i>
<i>Davidia involucrata</i>	<i>Deutzia scabra</i> Pride of "Roch- ester"
<i>Davidia involucrata Vilmorin- iana</i>	<i>Deutzia scabra suspensa</i>
<i>Decaisnea Fargesii</i>	<i>Deutzia scabra Watereri</i>
<i>Deutzia candida</i>	<i>Deutzia Schneideriana laxiflora</i>
<i>Deutzia carnea</i>	<i>Deutzia Sieboldiana Dippeliana</i>
<i>Deutzia carnea densiflora</i>	<i>Deutzia Vilmorinae</i>
<i>Deutzia carnea stellata</i>	<i>Deutzia Wilsonii</i>
<i>Deutzia discolor</i>	<i>Diervilla hortensis</i>
<i>Deutzia discolor major</i>	<i>Diervilla praecox</i> "Avant- garde"
<i>Deutzia elegantissima</i>	<i>Dipelta floribunda</i>
<i>Deutzia elegantissima fascicu- lata</i>	<i>Dipelta floribunda parviflora</i>
<i>Deutzia glomeruliflora</i>	<i>Dipelta ventricosa</i>
<i>Deutzia hybrida</i> "Contraste"	<i>Evonymus patens</i>
<i>Deutzia hybrida</i> "Magicien"	<i>Evonymus Wilsonii</i>
<i>Deutzia kalmiaeflora</i>	<i>Forsythia suspensa atrocaulis</i>
<i>Deutzia longifolia</i>	<i>Forsythia suspensa Fortunei</i>
<i>Deutzia longifolia Veitchii</i>	<i>Forsythia viridissima</i>
<i>Deutzia longipetala</i>	<i>Genista cinerea</i>
<i>Deutzia macrocephala</i>	<i>Genista hispanica</i>
<i>Deutzia magnifica</i>	<i>Genista pilosa</i>

Grewia parviflora	Lonicera trichosantha acutius- cula
Helwingia japonica	Lonicera Vilmorinii
Holodiscus discolor	Lycium chinense
Holodiscus discolor ariaefolius	Meliosma Beaniana
Hovenia dulcis	Neillia affinis
Hydrangea quercifolia	Neillia sinensis
Hypericum arnoldianum	Neillia thibetica
Hypericum Kalmianum	Parrotiopsis Jacquemontiana
Indigofera amblyantha	Periploca graeca angustifolia
Indigofera decora alba	Philadelphus argyrocalyx
Indigofera Gerardiana	Philadelphus Lemoinei
Indigofera Kirilowii	Philadelphus subcanus
Itea virginiana	Physocarpus capitatus
Kerria japonica	Physocarpus glabratus
Kerria japonica picta	Physocarpus malvaceus
Kerria japonica pleniflora	Poncirus trifoliata. Killed to the ground in some places, else- where uninjured.
Leptodermis oblonga	Prunus mira
Lespedeza Buergeri praecox	Pterocarya hupehensis
Lespedeza cyrtobotrya	Rhododendron "Album splen- dens"
Lespedeza formosa	Rhodotypus scandens
Ligustrum acuminatum	Ribes Vilmorinii
Ligustrum ovalifolium	Rosa arnoldiana
Lonicera chaetocarpa	Rosa caudata
Lonicera deflexicalyx	Rosa centifolia cristata
Lonicera discolor	Rosa centifolia muscosa
Lonicera fragrantissima	Rosa centifolia muscosa "Salet"
Lonicera Giraldii	Rosa damascena trigintipetala
Lonicera gracilipes	Rosa damascena versicolor
Lonicera gynochlamydea	Rosa dumetorum Deseglisei
Lonicera Henryi	Rosa filipes
Lonicera involucrata flavescens	Rosa gallica officinalis
Lonicera involucrata serotina	Rosa Gentiliana
Lonicera Ledebourii	Rosa Helenae
Lonicera Myrtillus	Rosa Lheritierana
Lonicera Periclymenum	Rosa mollis arduensis
Lonicera Periclymenum belgica	Rosa multibracteata
Lonicera quinquelocularis trans- lucens	Rosa multiflora cathayensis
Lonicera saccata	
Lonicera Standishii lancifolia	
Lonicera subdentata	

Rosa Noisettiana	Spiraea japonica acuminata
Rosa omeiensis	Spiraea Miyabei glabrata
Rosa Pouzinii	Spiraea revirescens
Rosa rugosa Chamissonis	Spiraea Rosthornii
Rosa rugosa "New Century"	Spiraea Sargentiana
Rosa rugosa "Nova Zembla"	Spiraea semperflorens
Rosa rugosa "Parfum de l'Hay"	Spiraea Veitchii
Rosa rugosa Schweinitzii	Spiraea Zabeliana
Rosa "Ruskin"	Staphylea colchica
Rosa sericea	Staphylea colchica Coulombieri
Rosa spinosissima "Dominie Sampson"	Staphylea holocarpa
Rosa spinosissima "Iris"	Stephanandra incisa
Rosa spinosissima "King of the Scots"	Stephanandra Tanakae
Rosa spinosissima "Plato"	Symphoricarpus Chenaultii
Rosa spinosissima "Pythagoras"	Viburnum betulifolium
Rosa tomentella obtusifolia	Viburnum erubescens
Rosa villosa	Viburnum hupehense
Rosa villosa duplex	Viburnum ichangense
Rosa villosa recondita	Viburnum mongolicum
Rosa Waitziana macrantha	Viburnum ovatifolium
Rosa Watsoniana	Viburnum rhytidophyllum
Sorbaria arborea subtomentosa	Viburnum tomentosum grandiflorum
Spiraea Billiardii	Viburnum Veitchii
Spiraea blanda	Vitis Champini
Spiraea brachybotrys	Vitis Davidi
Spiraea fontenaysii alba	Vitis Piasezkii Pagnuccii
Spiraea Henryi. Some not injured, others more or less so.	Vitis pulchra
	Zanthoxylum schinifolium
	Zanthoxylum simulans

(To be continued)

ARNOLD ARBORETUM
HARVARD UNIVERSITY



BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. II

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NUMBER 8

WINTER HARDINESS OF TREES AND SHRUBS
GROWING IN THE ARNOLD ARBORETUM

(Continued)

3. Plants injured, but not killed to the ground, at the Arnold Arboretum in the winter of 1933-34.

Abelia Zanderi. Tips of branches killed.

Abies chensiensis. Buds extensively inhibited but some breaking at end of May.

Abies cilicica. Flower buds and large proportion of vegetative buds killed.

Abies Fargesii. Buds badly injured but some breaking at end of May.

Abies Faxoniana. Buds badly injured but some breaking at end of May.

Acanthopanax lasiogyne. Ends of many branches killed back 2 to 3 feet.

Acanthopanax leucorrhizus. Old wood killed badly; young wood uninjured.

Acanthopanax leucorrhizus scaberulus. Slightly injured.

Acanthopanax setchuenensis. Variously injured; mostly killed to the ground.

Acanthopanax ternatus. Severely injured.

Acer griseum. Some branches badly injured, others killed.

Actinidia arguta. Considerable injury; buds breaking slowly at end of May.

Albizzia julibrissin rosea. Killed back some; inhibited buds began to break in June.

Ampelopsis brevipedunculata Maximowiczii. Killed back badly.

Benzoin aestivale. Badly killed back; plants in higher elevations uninjured.

Berberis Beaniana. About one-third of branches killed.

- Berberis Mouillacana*. More than half killed; some stems developing leaves in early June to near their tops.
- Berberis Poirleti*. About one-third of branches killed.
- Berberis Sargentiana*. Badly injured.
- Berberis thibetica*. Somewhat injured.
- Berberis Tischleri*. Considerably injured.
- Berberis triacanthophora*. Severely injured.
- Berberis verruculosa*. Severely injured.
- Buddleia alternifolia*. Ends of branches killed.
- Calluna vulgaris*. Injury variable; sometimes uninjured.
- Calluna vulgaris alba rigida*. Full of intermixed dead wood.
- Calluna vulgaris Alportii*. Laterally injured.
- Calluna vulgaris aurea*. Full of intermixed dead wood.
- Calluna vulgaris compacta*. Slight injury.
- Calluna vulgaris cuprea*. Slight injury.
- Calluna vulgaris elata*. Slight injury.
- Calluna vulgaris erecta*. Slight injury.
- Calluna vulgaris Hammondii*. Considerable injury.
- Calluna vulgaris hirsuta*. Severely injured.
- Calluna vulgaris humilis*. Slight injury.
- Calluna vulgaris hypnoides*. Slight injury.
- Calluna vulgaris nana*. Slight injury.
- Calluna vulgaris rosea*. Severely injured; nearly killed.
- Calluna vulgaris Searlei*. Severely injured.
- Calluna vulgaris spicata*. Slight injury.
- Caragana Boisii*. Some stems killed back 2 to 3 feet; one plant, 12 to 15 feet high, very little injured but flower buds killed.
- Carpinus betulus quercifolia*. Half of crown killed.
- Carpinus cordata chinensis*. Many branches killed.
- Carpinus japonica*. Three plants - a, b, c; (a) many twigs and buds killed, (b) some branches injured, (c) crown more than half killed.
- Carpinus orientalis*. Considerable injury.
- Carpinus Turczaninowii*. Some branches, many twigs and most flower buds killed.
- Carpinus Turczanowii ovalifolia*. Tips of branches and some branches injured.
- Cedrus libanotica*. Needles browned and many dropped but buds not injured.
- Cercis canadensis alba*. Very severely injured.
- Cercocarpus montanus*. Slight injury.
- Chaenomeles lagenaria semiplena*. Severely injured.

Chaenomeles lagenaria Moerloosii. Severely injured.
Cladrastis sinensis. Very severely injured.
Cotoneaster bullata floribunda. Severely injured.
Cotoneaster Dielsiana. Severely injured; full of dead wood.
Cotoneaster divaricata. Some branches killed.
Cotoneaster foveolata. Somewhat injured.
Cotoneaster Francheti. About one-half killed.
Cotoneaster horizontalis. Considerable injury.
Cotoneaster horizontalis perpusilla. Severely injured.
Cotoneaster microphylla. Severely injured; full of dead wood.
Cotoneaster moupinensis. Some branches killed.
Cotoneaster racemiflora. About one-half killed.
Cotoneaster Zabeli. Severely injured.
Cyrilla racemiflora. Partly killed; buds inhibited and broke slowly.
Cytisus elongatus. Severely injured.
Cytisus praecox. Much damaged.
Cytisus purgans. Severely injured but flowering.
Davidia involucreta Vilmoriniana. Killed to the ground except for a few leaves here and there on some branches.
Deutzia candelabrum. Severely injured; full of dead wood.
Deutzia grandiflora. Severely injured; full of dead wood.
Deutzia hypoglauca. Slight injury; full of dead twigs.
Deutzia Lemoinei compacta. Slight injury.
Deutzia longifolia elegans. Slight injury; many dead shoots.
Deutzia magnifica formosa. Severely injured; full of dead wood.
Deutzia maliflora "Boule Rose." Slight injury; full of dead twigs.
Deutzia parviflora musaei. Much injured; full of dead wood.
Deutzia parviflora ovatifolia. Slight injury.
Deutzia Sieboldiana. Severely injured; full of dead wood.
Doryenium hirsutum. About one-half of stems killed.
Ehretia thyrsoiflora. Killed back several feet.
Enkianthus perulatus. Somewhat injured.
Erica carnea. Severely injured.
Eucommia ulmoides. Much killed back; some branches dead.
Euptelea polyandra. Flower buds killed, also many stems and branches.
Evodia Daniellii. Many branches killed or injured; small trees show little or no injury.
Evodia hupehensis. Buds inhibited; broke later with little apparent injury.
Evonymus europaea aldenhamensis. Killed back badly.
Fagus lucida. One small tree (15 ft. high) killed, another severely

- injured.
- Genista germanica*. Injured but flowering well.
- Genista pilosa*. Severely injured but producing some flowers.
- Genista radiata*. Many twigs killed but flowering fairly well.
- Hamamelis mollis*. Very slight injury.
- Hedera helix baltica*. Leaves on northerly exposure considerably browned and all of growth of 1933 killed.
- Helianthemum appenninum*. Partly killed.
- Helianthemum nummularium* varieties. Mostly much injured but producing some flowers.
- Ilex dubia monticola*. Tips of branches killed back 6 to 12 inches.
- Indigofera amblyantha Purdomii*. Some stems killed, others flowering.
- Kalmia latifolia*. Many of the flower buds killed outright or injured.
- Kerria japonica pleniflora*. Tips of branches injured but flowering well.
- Koelreuteria apiculata*. Killed back badly.
- Kolkwitzia amabilis*. Some seriously injured, others wintered well.
- Lespedeza bicolor*. Killed back to the old wood.
- Ligustrum acutissimum*. About half of twigs killed.
- Ligustrum ibota nana*. Injured somewhat.
- Ligustrum insulare*. One plant injured severely ; another only slightly.
- Ligustrum obtusifolium*. Some plants very slightly injured near tops ; others uninjured.
- Ligustrum vulgare*. Tips somewhat weakened.
- Lonicera Henryi*. Killed back severely.
- Lonicera Maackii podocarpa*. Many branches and branch tips killed.
- Lonicera Standishii*. More or less severely injured.
- Lycium pallidum*. Killed back badly.
- Morus acidosa*. Severely injured ; full of dead wood.
- Myrica Gale tomentosa*. Severely injured.
- Ostrya japonica*. Slightly injured.
- Pachistima myrsinites*. Very severely killed back.
- Parthenocissus quinquefolia*. All grades of injury between none and killing to the ground.
- Pertya sinensis*. Severely injured ; full of dead wood.
- Petteria ramentacea*. Severely injured ; full of dead wood.
- Philadelphus cymosus*. Severely injured ; full of dead wood.
- Philadelphus microphyllus*. Severely injured.
- Philadelphus sericanthus*. Severely injured.
- Philadelphus virginialis* "Argentine." Severely injured.
- Physocarpus opulifolius Krynsii*. One plant killed to the ground ; another one uninjured.

- Picea* species. Some of the spruces from central and western China were more or less injured.
- Prunus Armeniaca*. One plant dead; another one severely injured.
- Prunus Armeniaca ansu*. Killed back considerably.
- Prunus Armeniaca* "Mikado." Killed back considerably; no flowers.
- Prunus avium aspleniifolia*. Some injury.
- Prunus blireana*. Severely injured.
- Prunus dasycarpa*. Considerable injury.
- Prunus Lannesiana erecta*. Severely injured.
- Prunus Lannesiana grandiflora*. Severely injured.
- Prunus Lannesiana moutan*. Severely injured.
- Prunus Lannesiana sirotae*. Branches killed back considerably.
- Prunus mume*. Severely injured.
- Prunus Persica*—double pink. Severely injured.
- Prunus pumila susquehanae*. Considerable dead wood.
- Prunus serrulata chosiohizakura*. Severely injured.
- Prunus serrulata sekiyama*. Severely injured.
- Prunus Sieboldii*. Severely injured.
- Prunus spinosa*. Twigs with dead ends.
- Prunus subhirtella*. Considerable dead wood.
- Prunus subhirtella ascendens*. Some branches severely killed back; others dead; no flowers.
- Prunus subhirtella pendula*. More than half of lower branches dead; flower buds partly killed.
- Prunus tangutica*. Severely injured.
- Prunus venulosa*. Severely injured.
- Prunus virginiana demissa*. Severely injured to killed.
- Pterostyrax hispida*. Severely injured; full of dead wood.
- Quercus aliena acuteserrata*. Some branches and buds killed.
- Quercus aliena calvescens*. About one-half of twigs and buds killed.
- Quercus serrata*. Severely injured.
- Quercus variabilis*. Considerable injury; about one-half of buds and twigs killed.
- Rhododendron* "Adalbert." All flower buds killed except those covered by snow.
- Rhododendron* "Albert." All flower buds killed except those covered by snow.
- Rhododendron* "Album elegans." A few scattered trusses but reduced to three or four flowers each.
- Rhododendron* "Album grandiflorum." Trusses fairly abundant but not full.

- Rhododendron "Anton" (pink). Trusses reduced in number.
- Rhododendron arborescens \times obtusum crispifolium. Nearly dead.
- Rhododendron "Bicolor." Flowering throughout but number of flowers in trusses reduced.
- Rhododendron "Boule de Neige." Most of flower buds killed.
- Rhododendron "Caractacus." Flower buds on some plants killed; on others uninjured.
- Rhododendron carolinianum. All flower buds killed.
- Rhododendron catawbiense. Not as full-flowered as usual.
- Rhododendron catawbiense album. Sparsely flowered; all trusses reduced to 2 or 3 flowers.
- Rhododendron "Charles Dickens." Well-flowered both in shade and open but number of flowers in trusses more or less reduced.
- Rhododendron "Desiderus." Fair but number of flowers in trusses much reduced.
- Rhododendron "Diana." Flower buds all killed and plant much injured.
- Rhododendron "Donar." All flower buds killed except those covered by snow.
- Rhododendron "Duke of York." All flower buds killed.
- Rhododendron "Echse." Fair throughout; some reduction in number of flowers in trusses.
- Rhododendron "General Grant." Fair throughout; some trusses with reduced number of flowers.
- Rhododendron "Hanna Felix." Nearly all flower buds killed.
- Rhododendron "Henrietta Sargent." Good but reduced number of flowers in trusses.
- Rhododendron "Ignatius Sargent." Flower buds killed throughout.
- Rhododendron "James Macintosh." All flower buds killed.
- Rhododendron "Lady Armstrong." Fair; flower buds in trusses much reduced.
- Rhododendron laetevirens. All flower buds killed except those covered by snow.
- Rhododendron "Lee's Purple." All flower buds killed.
- Rhododendron "Madame Carvalho." All flower buds killed.
- Rhododendron "Milton." All flower buds killed.
- Rhododendron minus. All flower buds killed except those covered by snow.
- Rhododendron Morelianum "Everestianum." Poor; number of flowers in trusses reduced.
- Rhododendron "Mrs. Harry Ingersoll." All flower buds killed.

- Rhododendron "Norma." All flower buds killed.
- Rhododendron obtusum Kaempferi. All flower buds killed; some injury to branches.
- Rhododendron "Old Port." All flower buds killed.
- Rhododendron "Perspicuum." All flower buds killed except those covered by snow.
- Rhododendron "Purpureum elegans." All flower buds killed.
- Rhododendron "Purpureum grandiflorum." Some plants killed or severely injured; others well-flowered but with number of flowers in trusses reduced.
- Rhododendron Smirnowii. Nearly all flower buds killed.
- Rhododendron "Viola." All flower buds killed.
- Rhododendron Watereri. All flower buds killed.
- Ribes Giraldii. Severely injured; full of dead wood.
- Ribes nigrum × sanguineum. Severely injured.
- Rosa arvensis. Badly killed back.
- Rosa eglanteria. One plant killed to ground; another one scarcely injured.
- Rosa Moyesii. Severely injured but some buds developing leaves.
- Rosa spinosissima hispida. Severely injured; killed nearly to the ground.
- Sciadopitys verticillata. Three plants lost most of leaves and some twigs near top were killed; two plants retained normal full foliage.
- Sophora viciifolia. Severely injured; some large branches dead to ground, others with living buds throughout but breaking slowly; amount of injury depends very much on location.
- Spiraea bumalda "Anthony Waterer." Considerable amount of dead wood.
- Spiraea bumalda Froebeli. Considerable amount of dead wood.
- Spiraea Douglasii. Full of dead wood.
- Spiraea Henryi. Severely injured; full of dead wood.
- Spiraea Menziesii. Severely injured; full of dead wood.
- Spiraea mollifolia. Killed nearly to ground.
- Spiraea nipponica. Severely injured; full of dead wood.
- Spiraea Veitchii. Severely injured; much dead wood.
- Stewartia monadelphica. Killed down for about three-quarters of height.
- Styrax obassia. Severely injured; buds breaking slowly.
- Taxus baccata. Suffered severely in some cases; many inhibited buds and some dead branches and branch tips.
- Taxus cuspidata. In general without much injury; some arrested development of terminal buds and a checked growth from dormant buds that broke as the season advanced.

- Taxus* hybrids between Japanese and European yews. Intermediate in hardiness between parents.
- Thymus nitidus*. Much injured.
- Torreya nucifera*. Top half killed, leaves and twigs on lower half killed and shedding; leaves near ground are green; new buds and shoots are developing at bases of whorls of dead twigs. (June 22, 1934).
- Viburnum erosum*. Severely injured; full of dead wood.
- Viburnum lobophyllum*. Severely injured; full of dead wood.
- Viburnum nudum*. Severely injured.
- Viburnum setigerum*. Severely injured; much dead wood.
- Viburnum setigerum aurantiacum*. Severely injured.
- Viburnum tomentosum rotundifolium*. Killed mostly to ground.
- Viburnum tomentosum sterile*. Severely injured.
- Vitis Doaniana*. Killed mostly to ground.
- Vitis Kaempferi*. One plant killed to ground; old plants (1905) not injured.

(To be continued)

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WINTER HARDINESS OF TREES AND SHRUBS
GROWING IN THE ARNOLD ARBORETUM
III

(Continued)

(A) TREATMENT OF WINTER-INJURED TREES AND SHRUBS.

EVERY SPRING the Arnold Arboretum, with its large representation of native and foreign introduced trees and shrubs finds that some have suffered more or less from winter injury, though never so much as in the spring of 1934. Such plants require attention with the purposes in view of improving their appearances and assisting them to become re-invigorated. Each plant is a problem by itself and calls for treatment based on experience and judgment. Pruning is the first procedure. Whenever killing to the ground has taken place the entire crown should be removed as soon as possible. If, however, there are signs of life in the wood, as is often the case with deutzias, spiraeas, privets, viburnums and dogwoods, the stems with apparent life should be left until the last of April or until it is certain that their buds will not break. Cutting back forces new growth if the root system is alive and well established, and is likely to result in new, healthy crowns. If the killing has involved branches or parts of branches one should prune back to living wood. Considerable care should be given in pruning young trees: they should be examined from time to time and headed back to live wood above crotches, leaving clean cuts. This should be practiced as soon as dead parts are detected so as to throw strength into the new wood.

After new growth has started and the plants appear to be fresh and moist, a dry period is likely to cause disaster. In early May a mulch of well rotted stable manure will both stimulate growth and serve as

a protection against drying out by retaining moisture in the soil. It should be noted here by way of precaution that fertilizers should not be added during the growing season subsequent to the middle of June, otherwise tender growths are forced and these may not sufficiently "ripen" before the onset of frost in the fall. Mulching with manure or treating with other fertilizers should be done only in late autumn or early spring.

(B) PREPARATION OF PLANTS FOR WINTER.

RHODODENDRONS, FIRS AND SPRUCES should go into the winter in a moist condition. These groups should be watered thoroughly in the early fall, especially after a dry summer. Oak leaves or well rotted cow manure are often used as protection and mulch on rhododendrons and mountain laurel.

Small trees and shrubs, planted in early spring, should be protected by mulch. Medium sized trees should be looked over in late summer for dead wood and all cavities and wounds cleaned and painted with good wound preservative such as a coal tar product.

The following lists indicate for various kind of trees and shrubs the methods used in winter protection at the Arboretum. For the plants protected by earth mounds it is important that soil be taken a safe distance from plants so as not to expose or lessen protection of the root system, otherwise the roots are likely to suffer winter injury. Additional protection for these would be afforded by a good mulch of leaves, straw or manure over the root systems, extending the cover some distance from the stems of the plants.

1. Plants protected by earth mounds, or earth and straw.

Actinidia melanandra	Clematis florida
Berberis buxifolia nana	Clematis Jackmani
Berchemia racemosa	Clematis lanuginosa
Buddleia albiflora	Clematis orientalis
Buddleia Davidii	Clematis patens
Buddleia Davidii magnifica	Clematis Simsii
Buddleia Davidii superba	Clematis—others of large-flow-
Buddleia Davidii Veitchiana	ered group than those listed
Buddleia nivea yunnanensis	above.
Celastrus hypoleuca	Clerodendron trichotomum
Celastrus Loeseneri	Cocculus trilobus
Clematis Fargesii	Cotoneaster salicifolia floccosa
Clematis Fargesii Souliei	Cyrilla racemiflora

Cytisus scoparius Andreanus	Meliosma Beaniana
Gordonia alatamaha	Polygonum Auberti
Helwingia japonica	Rosa Gentiliana
Hydrangea macrophylla	Rosa – tender climbers
Hydrangea quercifolia	Rubus Giraldianus
Hydrangea serrata and vars.	Rubus innominatus
Hypericum patulum	Rubus Linkianus
Hypericum patulum Henryi	Schisandra chinensis
Ilex pedunculosa	Vitis Davidi
Leptodermis oblonga	Vitis pulchra
Ligustrum Quihoui	Vitis vinifera

2. Plants protected by pine or other evergreen branches.

Aukuba japonica	Buxus microphylla koreana
Berberis atrocarpa	Buxus sempervirens and vars.
Berberis Beaniana	Mahonia Aquifolium
Berberis Gagnepainii	Mahonia Bealii (Berberis japonica in some gardens)
Berberis Julianae	Mahonia repens
Berberis Sargentiana	Rhododendron – evergreen hybrids and exotic species
Berberis triacanthophora	
Berberis verruculosa	
Buxus microphylla japonica	

3. Plants covered with coarse hay.

Calluna vulgaris and vars.	Pachistima Canbyi
Chrysanthemum sibiricum	Pachistima myrsinites
Daphne Cneorum	Paeonia suffruticosa and various forms
Helianthemum – various species and forms	

(To be continued)

PLANTS OF CURRENT INTEREST. AT this season the question is sometimes asked – “What is there in bloom at the Arboretum now?” Since the Arboretum is devoted exclusively to hardy plants with woody stems and has no greenhouses for growing tropical trees and shrubs, blooms in the latter part of October are rare, for killing frosts are liable to occur a month earlier.

The outstanding shrub or small tree in flower at this time is our eastern American witch-hazel, *Hamamelis virginiana*, which may be found as a medium-sized shrub with from one to several stems in New England, the middle states, and Canada, or as a small tree on the slopes of the Allegheny Mountains in North and South Carolina and Tennessee where it attains a height of 25 to 30 feet.

From its wide geographical range we might expect considerable variation. This is so, particularly with regard to flowering. In this part of New England the common witch-hazel is now in about its best flowering condition. The time of blossoming varies much, however, in individual plants and in the same species in different places. It may be found in flower on the Island of Orleans, opposite Quebec city, at the end of August. It is commonly to be found in flower in October and November in eastern Massachusetts and excellent specimens in bloom have been gathered in Boston in the middle of December.

The only other plant in good normal bloom in the Arboretum at this season is the Siberian or Korean chrysanthemum, *Chrysanthemum sibiricum*, which is listed in some commercial nursery catalogs as *C. coreanum*. This was collected on the mountain Pukhan, near Seoul, Korea and brought to the United States in 1905, apparently its first introduction into cultivation in this country. Within a few years it was offered to the trade by local nurseries and it has now become well distributed. The species appears to be quite hardy and increases by underground stems, soon forming large clumps. It also grows easily from seed and, by selection, improved forms may be obtained. While normally white and much resembling our well known oxeye-daisy (*C. leucanthemum*), attractive flowering forms with decidedly rose-tinted flowers may be obtained from seed. *Chrysanthemum sibiricum* has already been used with gratifying success in hybridizing with some of the hardy kinds of *Chrysanthemum* with colored flowers cultivated in our gardens. Although this species would normally be called herbaceous, it is retained in the Arboretum collections because the stems are often more or less ligneous and retain life for six inches to a foot above ground.

J. G. JACK

ARNOLD ARBORETUM
HARVARD UNIVERSITY



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GAME FOODS IN THE ARBORETUM. THE LARGE collection of woody plants at the Arnold Arboretum, drawn from all parts of the world having a climate similar to that of New England, affords an unequaled field for the study of plants available for game food. While scarcely a beginning has yet been made in this direction, it is the purpose of this bulletin to call attention to the possibilities of the Arboretum as a contributing source towards furnishing information and material of value to those interested in game preservation.

History has repeatedly shown that, as human population increases, game management passes successively through the stages of restriction of hunting, predator control, refuge establishment, artificial stocking and environmental control. In our most thickly settled regions the first four stages have been passed and the last step is necessary in order to keep a satisfactory stocking of game¹. In spite of shortened open seasons, bag limits, sanctuaries and heavy stocking with artificially reared stock, game has more often decreased than increased. In the absence of suitable food the continued release of game, no matter how persistent, will lead to no permanent results. In order to produce game on areas deficient in food and to produce heavy stockings on limited areas such as estates and club grounds, food plant propagation is necessary.

In the Harvard Forest and adjoining areas, under semi-natural conditions, observations have been carried on during the past year with this idea in view, particular attention being paid to the sorts of food consumed by deer and other game animals, to the amount available, and to the possibilities of increasing it so as to maintain or increase the game population.

¹ Leopold, Aldo. *Game Management*, pp. 3-21, Charles Scribner's Sons, New York, 1933.

To be most useful, a plant propagated for game food must meet certain requirements. It must produce food which will be used by the game for which it is planted. Some game species will starve with food all around them simply because they are unaccustomed to eating particular things and their habits are not so adaptable that they will try out new things. Secondly, the plant must produce food for use during a critical season of the year. During spring, summer, and early fall there is no food shortage, but during winter many species can find no food in much of New England. The food must also be available when needed. A good fruit crop buried under deep snow is next to useless. Such fruit must remain above the snow for use by most game. The plant must obviously fruit regularly and heavily. For most areas the plant must not require much care, and fast growth coupled with early fruiting are desirable.

Woody plants are already coming to play an important part as propagated game food. They are, in general, long lived, require little care and, where species with persistent fruits are used, are an efficient means of solving the food problem during deep snow.

While little is known about the value of hundreds of woody species having good possibilities, studies here and there are beginning to show that some species are valuable for one or more kinds of game. The apples undoubtedly head the list as the most important both in respect to numbers of game species using them and to the volume produced and eaten. The mammals and birds using apples for food include almost a complete list of the New England game species. The deer feeds on apples from October until March at least. The black bear often breaks apple limbs in trying to reach the fruit. The United States Biological Survey in a study of 93 grouse stomachs taken during winter in the northeastern states found that, of 75 kinds of vegetable food taken, apple fruit, twigs, buds and leaves formed the greatest bulk, or ten per cent. The pheasant is also very fond of apples. A flock of them feeding on the persistent, small fruits of *Malus floribunda* just outside the Administration Building at the Arboretum is a common sight. Rabbits, squirrels, raccoons, muskrats, and even the fox and mink eat them.

Of the many apples bearing fruit at the Arboretum, *Malus Soulardi*, a cross between the common apple of the old world and *Malus ioensis*, a crab apple of the central United States, is especially outstanding. It is very vigorous in growth; it bears a heavy crop annually; the fruit persists well and remains firm until late in the season.

There are some fifteen species of *Viburnum* in the Arboretum which

hold their fruit until spring. Of these the highbush cranberry, *V. Opulus*, is a proven food of the ruffed grouse and pheasant, and other species of this genus would probably be eaten.

The common barberry, *Berberis vulgaris*, and the native bittersweet, *Celastrus scandens*, are both eaten by the ruffed grouse and pheasant. The fruits of both species persist well.

The fruit of the buckthorn, *Rhamnus cathartica*, is eaten by grouse, but is all gone by early winter.

Both the grouse and the squirrels feed on the berries of our native black alder, *Ilex verticillata*, which persist well through the winter.

The fruit of *Crataegus*, is a staple food of ruffed grouse, pheasants, rabbits, squirrels and probably others. This tree with its beautiful blossoms and showy fruit is a fine addition to any rural landscape. However, judging from the hundreds of specimens at the Arboretum, it is not the native species but those from the central and southern states which hold their fruit through the winter in our climate.

Two of the native sumacs, *Rhus typhina* and *Rhus glabra*, are valuable as game foods. The grouse eat the fruits and the deer eat both the fruiting heads and the ends of the branches. These species grow rapidly and hold their fruits until spring, but are easily killed where shaded by taller growth.

The importance of the wild grape, *Vitis* spp., as a fall grouse food is well known to every experienced New England hunter. The pheasant will also eat this food; it is eagerly eaten by the black bear, and the seed has been found in a deer stomach. Two or three species of this genus are native and many others can be easily cultivated.

The so-called bittersweet, *Solanum Dulcamara*, is very colorful with its purple flowers and red berries and the pheasant relishes its fruit until late winter.

From the nut trees the acorns and beech nuts are important game foods. They are used by deer, bear, grouse, raccoons and squirrels. It takes many years to raise either oak or beech trees to bearing age and the beech especially is very uncertain in respect to seed crops. The larger, heavier shelled nuts such as the hickory nut, black walnut and butternut are, of course, usable only by the squirrels.

On estates and even around homes having fair sized grounds, the selection of species usable and attractive to birds and other wild life, as well as ornamentally acceptable, will give to landscape plantings a much greater value.

NEIL W. HOSLEY
ERNEST J. PALMER

EXPLANATION OF THE INSERT

Fruiting branch of **Malus Soulardi**.

(Photographed in the Arnold Arboretum, September 1934.)

Fruiting branch of **Malus floribunda** var.

(Photographed in the Arnold Arboretum, September 1934.)



MALUS SOULARDI



MALUS FLORIBUNDA VAR.

ARNOLD ARBORETUM

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WINTER HARDINESS OF TREES AND SHRUBS GROWING IN THE ARNOLD ARBORETUM

(Concluded)

CONIFERS AFTER A SEVERE WINTER. In recent numbers of this Bulletin, (Nos. 7, 8, and 9), beside a consideration of the factors contributing to winter injury, lists have been given of injuries or destruction caused among the collections of the Arnold Arboretum by the extremely severe winter of 1933-34. These lists pertained largely to deciduous plants, particularly shrubs and woody climbers. References to conifers were purposely deferred because injuries were less immediately noticeable. Even now, at the end of the growing season, the real extent of the damaging effects of the winter cannot be fairly estimated.

The following observations were made mostly in the Arnold Arboretum, but many plants in gardens and plantations in and around Boston have been used as checks or for the purpose of comparison.

The yew and the conifer families suffered much from the cold although on the whole the damage was less than the injury to many of our broad leaved, deciduous trees and shrubs. On some species of conifers the flower buds, or most of them, were destroyed. In some instances the buds which ordinarily would have developed into new shoots or twigs were so greatly injured that they failed to make normal growth. As a result, affected trees will probably lose many of their branches and much of their symmetry, or may even die. While the Japanese yew, *Taxus cuspidata*, generally passed safely through the winter there were many plants of this species which distinctly showed some injury. This often took the form of arrested development of the terminal buds and shoots which usually showed a browning of leaves.

Generally the dormant buds had started and a checked growth developed as the season advanced. The European or English yew, *Taxus baccata*, suffered severely in some instances. Branches have died or tips of branches have failed to show life and pruning has become necessary. A careful inspection of such injured branches in June showed very small latent buds developing in the axils of leaves or leaf scars. These in another year should develop into good normal shoots or branches. In such cases pruning should be done and then very carefully. It should be noted that some of the plants which have been named as hybrids between the Japanese and European yews have shown less hardiness than the Japanese parent, though hardier than *Taxus baccata*. Several plants of *T. media*, one of such hybrids, show some injury on the tips of the branches, while *T. media Hatfieldii* was much more seriously hurt.

After growing in the Arboretum for many years, during which time it flowered and fruited, the Japanese *Torreya nucifera* was nearly killed but, although the terminal parts of the branches failed to recover, new shoots developed on the basal portions so that there is a prospect of the trees regaining a green aspect and good form after several years.

Among the conifers, the pines as a group suffered less than some other genera. Browning of the foliage occurred in some foreign species, even in Scotch pine, but during the summer, twigs and buds have developed a normal number of leaves which cover superficially any defects. Individuals of the same species varied much in their resistance to damage. Injuries to flower buds were noted in some foreign species.

On the whole, the hardy native American spruces (*Picea*) wintered well. On the other hand, the fine Sitka spruce, *Picea sitchensis*, cannot be grown here, while the very rare Brewer or weeping spruce, *Picea Breweriana*, of the mountains of southern Oregon and northern California, will live but does not thrive well. The single plant, now 7 feet high, in the Arboretum had most of its buds killed last winter. Some of the stronger terminal buds survived and have developed new growths of from one to two or three inches in length. It is a straggling plant difficult to grow and unworthy of planting in this climate. Some of the long-introduced foreign species have done well. The Norway spruce is bearing a good crop of cones and the trees show little or no winter injury. This condition may be due to the fact that the original seed came from a northern part of its range in Europe, rather than from a southern district. The spruces which show the greatest damage from the severity of the winter are those which were collected for us in central and western China, in the provinces of Hupeh and Szechuan. The latitude ranges from about 28° to 33°. Probably few interested

people realize that the latitude of this Chinese collecting ground, which has been repeatedly explored to furnish plants for our northern gardens, largely correspond to that of northern Florida and the southern half of Georgia. Florida ranges from a few feet above sea level over the greater part to rarely 300 or 400 feet at the highest points. Southern Georgia averages higher than Florida, but much of the territory is well under a thousand feet in altitude and rarely exceeds two thousand, although higher hills and mountains are more common above 33° of latitude. Trees or shrubs from the Florida and Georgia zones would rarely be considered as worth introducing for permanency into our northern states. The climate of the same latitude in western China, however, has the advantage of the general altitude of the country, which is from one or two thousand feet on the lower levels to ten or twelve thousand feet in the higher mountains. However, the rule which compensates latitude by altitude does not always work out satisfactorily because of precipitation, prevailing winds, temperatures, geologic features, soil and other factors. This estimation of latitude as related to altitude may be roughly stated in the allowance of one degree of latitude to 450 or 500 feet of altitude. As already stated much depends upon other ecological factors. Later studies have shown that the dozen or fifteen supposedly new species and varieties of spruce recently brought from China may easily be reduced to less than half a dozen species, some of which had already been found by earlier collectors and had been given names. Some of these species or so-called species show very serious injury from the effects of the past winter. For all practical or ornamental purposes they would be generally worthless for eastern Massachusetts if we had occasional repetition of such a winter as that of 1934.

Picea asperata and its described forms have proved to be undependable and undesirable under such conditions as prevailed last winter. In the Arboretum an examination of several trees in August showed that about fifty per cent of the winter buds failed to develop or to make any appreciable growth. When such a large proportion of buds is killed, the surviving terminal or other buds often produce unusually long new shoots due to the concentration of growth into a few rather than many twigs. Under such circumstances the trees are likely to become permanently unsymmetrical. The difference in hardiness of the plants which have been called *P. asperata* may well be due to altitude, latitude and other ecological factors occurring within its natural range. This species is clearly not adapted for successful plantings in regions with more severe winter climate than that prevailing at Boston

and even here it is liable to serious damage in unusually severe years or situations, although there are nurseries or plantations in the vicinity where the plants are reported to have come through in fairly good order. It may be that hardier races will be found in western China.

Picea Balfouriana, which is probably the same as the older known *P. likiangensis*, is another of the so-called new species which has suffered such damage from the cold of the past winter that it may be considered unsuitable to plant in this climate for permanent landscape effects. A tree 14 feet high showed all buds dead or badly checked. On August first, the tree showed new leaves forming about the old dormant buds, but no new growth of twigs.

Picea purpurea, which is possibly still another synonym for *P. likiangensis*, was very badly injured and is rather unpromising for this region although it may be a very desirable acquisition under less severe conditions.

Picea Watsoniana, 12 feet high, showed in August a very large proportion of buds permanently blasted; a few escaped unhurt and exhibited extra long new shoots. These few abnormally vigorous twigs surviving among the multitude of buds which have failed must eventually produce an unevenly developed and undesirable tree for northern gardens.

The true firs, belonging to the genus *Abies*, have long had a peculiar attraction for gardeners and landscape planters. Naturally, there is an especial interest in all species which are reported hardy in our New England climate. We have few American species which thrive satisfactorily in the climate of Boston, probably the best being *Abies concolor* or the white fir of our western mountains. But to be hardy and satisfactory in New England the seed of this species must be procured from the drier, colder territory east of the Rocky Mountains, as in Colorado, for if grown from seed collected from west of the Rockies, in the same latitude, the results are far less satisfactory. This is true of all other splendid Pacific coast firs: they are far too tender for satisfactory growth in central New England. European firs, like the Nordmann fir, *Abies Nordmanniana*, and the Cilician fir, *A. cilicica*, have long been grown here with much satisfaction but the past winter proved seriously injurious to both species. The injury took the form of causing the death of the hearts of a great many of the winter buds. The percentage of injury varied on different trees in different exposures. Usually on the most damaged trees some buds escaped. The result has been that by the first of August, when all new length growths should have been completed for the season, the major part of the twigs and

buds still appeared the same as last winter except for a few twisted green leaves developing at the sides of the dead buds, or new, very short twigs being found. The few buds which escaped injury have produced abnormally long new shoots as a result of the failure of a majority of the buds to develop. The twigs, apparently dormant even now, may be found developing scattered, small buds in the axils of the leaves of last year. These new buds on old shoots should grow next spring and carry on growth a year late. The result is likely to produce very irregular and undesirable trees for ornamental purposes.

It was hoped that the introduction of firs from Japan and western China would add greatly to our available ornamental trees. However, the experience of the past winter has shown that, danger from climatic changes is risked in using most of these species. In favored situations, they may appear to be doing well during a number of ordinary winters. Still a time may come when their growth may prove very disappointing. On the large trees of the Japanese Nikko fir, *Abies homolepis*, for example, planted on low ground, a goodly proportion of buds were winter killed and the struggle to produce new buds and leaves is very apparent. If these new buds survive and continue growth next year, the result will be, unattractive or unsymmetrical trees. On higher, sheltered ground with good air drainage the trees show only a small amount of injury, although the conspicuous male flower buds, a third of an inch long, still remain hard and inert and are black and dead within. The beautiful *Abies Veitchii* shows similar disheartening effects of the winter. Recent studies of the firs introduced from western China tend to show that the number of species credited to that region is less than has been claimed.

The behavior of the Japanese umbrella pine, *Sciadopitys verticillata*, was interesting inasmuch as out of the six trees growing near together in the Arboretum three retained their usual number of leaves while the other three lost most of their foliage. As the buds were still sound a new growth of leaves developed to carry on growth. The end of the growing season, however, shows the damaged trees much less attractive and with fewer leaves than those which were uninjured.

The deciduous bald cypress, *Taxodium distichum*, of our southern states, in this latitude usually loses the tips of branches and twigs but this defect is soon overcome by new growth. In the past winter this trouble was decidedly more apparent but as the trunks and main limbs withstood the test they have put forth belated new shoots and leaves. But the trees are not ornamental.

Rather curiously, the pond cypress, *Taxodium ascendens*, which we

have regarded as more tender than the other since its range is more southerly, came through the winter in fine condition and quickly produced its cover of light green foliage. As the two species are growing on the same northerly incline and within a few yards of each other the disparity in behavior is very interesting and unexpected.

The arborvitae (*Thuja*) behaved much as in other seasons, the giant western arborvitae, *Thuja plicata*, wintering wonderfully well both on the top of Hemlock Hill and in the cedar and juniper collection near its base. This was true also of the genus *Chamaecyparis*, commonly called cedar or cypress, names also applied to some other genera. Perhaps more than usual injury was caused by browning and other minor injuries. Similar damages may be noted after the average winter. Even the somewhat uncertain Lawson cypress, *Chamaecyparis Lawsoniana*, came through with apparently little injury on Hemlock Hill although it makes poor growth on low land. Some injury was noted on junipers (*Juniperus*), sometimes causing the shedding of minor twigs with their leaves so that the trees or affected portions lost their full, clean greenness. But the branchlets usually appeared alive to near the tips, new growths appearing and giving promise that in another year the trees may present a more normal appearance. The dwarf spreading and the dwarf pyramidal junipers occasionally showed dead branches which probably succumbed after being weakened by other causes.

Incense cedar, *Libocedrus decurrens*, 35 feet high, in the shelter of hemlocks on Hemlock Hill, wintered much better than might have been expected considering that it is a Pacific coast tree, west of the crest of the Rocky Mountains.

The hardy race of Cedar of Lebanon (*Cedrus libanotica* or *C. libani*), introduced from Asia Minor, proved gratifyingly resistant to the unusual cold to which it was subjected. Some trees lost a considerable proportion of their foliage in the spring, giving them a very open and naked appearance, but as few leaf buds were injured beyond recovery new leaves soon appeared so that by next year the trees will probably have returned to almost normal aspect.

The larches (*Larix*) came through the winter in good order except that in some cases the flower buds were destroyed.

For several successive years the Japanese golden larch, *Pseudolarix amabilis*, has flowered and fruited freely. This past winter all of the flower buds were destroyed by the extreme cold, so that the trees are not bearing any of their interesting cones this season. The trees, however, were otherwise apparently uninjured, a fortunate circumstance as the species is one of the most beautiful and interesting of hardy



deciduous conifers.

The famous *Cryptomeria japonica*, of Japan and China, unfortunately has so far proved unadaptable to the climatic conditions of Boston although it may be long persistent and attain some size. In the past winter trees 20 or 25 feet high had a large proportion of the weaker lateral twigs and leaves killed but stronger buds at and near the ends of the branches survived and carried on new growth.

J. G. JACK

EXPLANATION OF THE PLATE

Fruiting branch of ***Pseudolarix amabilis*** showing cones produced during a normal season.

(*Photographed in the Arnold Arboretum.*)

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INDIAN RELICS OF THE ARNOLD ARBORETUM. WITH more than three centuries of recorded history intervening between the present and the indefinitely long period when the region that is now Boston was occupied by the Indians it is interesting and not a little surprising to find that evidences of these earlier inhabitants and examples of their work can still be found here. For at least half of this historic period it is probable that no Indians have lived here under the primitive conditions of the stone age, nor have any of the implements been made that we find on their old hunting and camping grounds. During much of this time, and especially since the middle of the nineteenth century, Indian relics have been collected assiduously, and yet a diligent searcher even in such a frequented place as the Arnold Arboretum can still find abundant traces of former Indian occupancy in the indestructible stone implements made and used by them in the chase and in war and in their domestic life.

Beginning with a chance find several years ago I became interested in looking for Indian evidences here, and a persistent search carried on at odd times in walks through the Arboretum has resulted in the building up of an interesting little collection, a part of which is shown on the accompanying plate.

Aside from the sentimental and romantic interest of these bits of prehistoric art, their chief value lies in the deductions that can be made from them in regard to the life and customs of the people who made them and in locating the sites of habitations occupied probably long before the coming of the first white colonists. And this in turn helps us to reconstruct some picture of what the local conditions must have been in those times and of the significance of the changes that have ensued.

The variety of artifacts remaining on the site of any prehistoric settle-

ment after the lapse of centuries, at least in a climate like that of New England, is naturally quite limited and includes only objects made from the most indestructible materials, such as stone, or perhaps under more favorable circumstances, of shell, bone, or clay in the form of pottery. And it is also highly probable that in a thickly settled and much frequented locality such as the Arboretum, most of the larger and more conspicuous objects originally left on the site would have been found and carried away long ago by earlier collectors. But even with the very limited material that can still be found on these old camp sites it is possible to learn much about the habits and culture of the Indians who occupied them, and a number of deductions can safely be made as to what the physical conditions must have been that induced them to select certain places for their camps or villages.

Most of the Indian artifacts that have been found recently in the Arboretum are of chipped stone and would popularly be called arrow heads, although probably only a few of the smaller ones were used for that purpose. Some of the larger and heavier ones may have been used for lance or spear heads and others for knives, scrapers or digging tools. A few of the rougher pieces that show evidence of chipping were probably unfinished or rejected objects. Besides the chipped implements, a few pieces have been found that were fashioned by pecking or grinding into hammer-stones, celts, scraper, and other objects, some of them of doubtful use.

Stones accidentally shaped by natural agencies, such as small round boulders or sharp chips and flakes of the harder rocks, were no doubt made use of by the Indians with little or no improvement on their original condition, and in a few cases it might be difficult to say whether a particular object should be regarded as an Indian relic or not. But it is nearly always possible for the experienced archaeologist to distinguish between even the roughest object of human handicraft and natural or unworked stones of similar shapes by the evidence of fine chipping or pecking found on the former and because of the obvious design shown in all the lines of fracture or polishing.

In selecting material for his work, the ancient craftsman, guided by experiment and experience, used as a rule only the best that was readily available for his purpose, but in emergencies inferior stones or other materials were sometimes employed. For the manufacture of chipped stone implements some hard fine grained variety from which small flakes could be struck off without shattering the whole mass was essential, and the finest points with a keen cutting edge could only be fashioned from a stone that broke with a clear conchoid fracture.

Hard stones are abundant in the Boston area, although the material available to the Indian artisan here was not as good as that found in many other parts of the country. And all the relics found in the Arboretum, with one possible exception, are made from local material or from such as may be found in eastern Massachusetts.

The material most commonly employed here in the manufacture of chipped implements, judging by the Arboretum collection, was porphyritic basalt or felsite. These two crystalline rocks without the porphyritic structure, as well as quartz, quartzite, chert, and argillite or slate were also used for making projectile points and cutting instruments. Slate, mica-schist, sandstone, greenstone and granite furnished material for the pecked or abraded implements. Porphyritic rocks are those in which crystals, usually either of feldspar or quartz, large enough to be detected with the unaided eye are imbedded in a groundwork or matrix of finer or microscopic crystalline structure. The felsites are of a light color, usually pink, flesh-color or gray; basalt, or trap-rock as it is popularly known, is of a dark slate-color or black on fresh fracture, although often turning to a lighter color on weathered surfaces. Both of these classes of rocks are found in a number of places in the vicinity of Boston, occurring in dikes and ledges and as loose material derived from them, as well as in detached masses in glacial deposits. The harder and finer grained varieties, either with or without porphyritic structure, furnished a very satisfactory material for the fabrication of chipped implements, as is shown by the fine workmanship, sharp points, and keen cutting edges of some of those found in the Arboretum. In other cases the material was not of so good a quality, and as a result the fracture was hackly and the implements thicker and rougher. Quartz is another vein or dike material found abundantly in this region, both *in situ* and as rubble, and also as pebbles or boulders in the glacial drift. When broken it sometimes produces a very keen cutting edge and it was highly prized by the Indians for this quality. But it usually shatters too readily to have been used for any except the smaller implements. Quartzite, which is also common locally, was used sometimes for both chipped and abraded implements, but only the harder and finer grained varieties could be chipped successfully, and most of the points made from this material are rather rough and crude. A few artifacts of chert have been found, although this material was not abundant nor generally of a good quality in this vicinity. Slate furnished a very indifferent material for chipping, but it was sometimes used, though perhaps only in emergencies. It was one of the most easily worked materials for grinding and it was used commonly in this way

for a variety of purposes.

Of about sixty implements, either perfect or broken, in the collection made in the Arboretum, a little more than half were probably used as projectile points, either for arrows or spears. A number of the others, having a sharp edge but often a blunt or rounded point, may have been used as knives. But in some cases it is impossible to distinguish definitely between those two classes of tools, since some of them could have been used for either purpose. One of the pieces shown in the illustration (no. 2) is a small hatchet or celt. Number 5 is a rather rough piece, plain on one side and bevelled on the other, that may have been used as a scraper in preparing buckskin and other hides. There is at least one other scraper in the collection. The largest chipped piece so far found (no. 14) measures in its present broken condition ten centimeters in length and five centimeters in greatest width. The color of the material was originally black, but it has been altered on the surface to an ashy gray by long weathering. Small chips struck off accidentally by the tools of the workmen who unearthed it show that the oxidation has penetrated to a depth of about one millimeter. The break is a very old one, as the truncated end is discolored as completely as the rest of the surface. This piece may have been used as a digger or as a skinning knife. Number 16, a drill or reamer, has undergone a similar alteration in color from the effects of weathering. Such drill points are comparatively rare, at least in a perfect condition, as they are fragile and easily broken. They are supposed to have been hafted and used for drilling holes by being turned with a swift rotary motion.

Amongst the arrows shown in the photograph, numbers 7, 10, 13, 26 and 27 were probably war points. Three of these are of the triangular unnotched type and the others have only a trace of side notches or stem. Such points easily became detached from the shaft and so could not be removed from a deep wound, which was therefore likely to prove fatal.

Number 29 is a flat piece of slate with rounded ends and bevelled on either edge following a natural cleavage plane which may have been ground to a sharp edge to make it serviceable as a scraper. Another interesting piece, not shown in the illustration, is a fragment of coarse gritty sandstone eight centimeters long by about two centimeters in width and a little less in thickness. It is roughly rounded on one side and has a shallow longitudinal groove on the other. This was used in smoothing arrow shafts, much as we would use sandpaper today. Number 30 of the illustration is not Indian work, but is a relic of the white pioneers. This is a gun flint, used in flint lock guns before the inven-

tion of percussion caps. The material is horn flint from the Cretaceous chalk deposits of England, where the quarrying and manufacturing of flints both of this sort and for domestic use with steel and tinder was at one time an important industry. Two other specimens of gun flints have been recovered in the Arboretum.

Most of the relics in the collection were found on the surface in the cultivated strips and beds where groups of shrubs are planted, or in the small plots dug up about individual trees and shrubs. This does not necessarily mean that they are most abundant in such places, but it is only when the covering of grass, weeds, and leaves has been removed that they can usually be seen. As the ground is turned up by the forks of the workmen the implements buried to a shallow depth are brought to the surface, and after a rain the earth may be washed off of them sufficiently for a sharp eye to detect them as they lie partially concealed amongst the other bits of stone and gravel. Although only a small part of the Arboretum is cultivated in this way the spots are well distributed, giving a sort of cross section of the whole area. And this has been sufficient to show that there are certain localities in which the relics are most abundant. Interpreting this with some knowledge of the needs of barbarian life, and with a survey of the present topography and allowance for the changes that we know have been made in it in recent years, it becomes possible to locate with considerable certainty the homes of these first inhabitants of the Arboretum area.

The most pressing needs of Indian life and the considerations that influenced them most in selecting sites for camps and villages were a near-by supply of drinking water, food, and fuel. Considerations of safety, comfort, and economy of labor also induced them to seek a place that was comparatively open, well drained, and as free as possible from rocks and brush that would have to be cleared away. A situation with a fairly level but not too flat surface, near a perennial spring or running brook, shaded by large trees, and with an unobstructed view for some distance in all directions, would offer the maximum of advantages.

Any spot offering most of these attractions was almost certain to have been chosen as a camp site at some time. And if in addition it were situated on some bay, lake, or navigable stream, affording ready means of travel by canoe and an abundant food supply, it was quite likely to have been occupied by a permanent village. Looking over the land today and taking all of the factors into consideration, the trained eye of the archaeologist can locate such places, and he can generally pre-

dict with a considerable degree of certainty that Indian relics will be found there even before he has had an opportunity to search for them.

While scattered specimens of Indian relics have been found in a number of places in the Arboretum, the great majority of them have come from a few limited areas that were evidently occupied as camp or village sites. Nearly half of the pieces in the collection, were picked up within the space of a few acres along Bussey Brook near the center of the Arboretum.

A slight rocky elevation, the upper part of which is still covered by a remnant of the native forest of deciduous trees, extends from the boundary formed by Centre Street towards the brook. Ledges of Roxbury conglomerate outcrop in many places at the higher elevations near the street, and farther east the formation again comes to the surface, crossing the Valley Road and connecting with Bussey Hill. A perennial spring issues from the rocks at a point near the road forming a small rivulet that flows away across the meadow to join Bussey Brook. Towards the brook and in the triangle formed by the channels of the two streams the hill flattens out into a comparatively level bench or small plateau a few acres in extent, which is now occupied by plantings of various conifers and the Juniper group. Some distance back from the main brook there is a depression that may have been a ravine or the bed of another small rivulet, and the surface rises gradually again from this lowest point towards the brook, with the conglomerate coming to the surface at a few points and forming a low bluff or ledge along the narrow valley, with the north slope of Hemlock Hill on the opposite side. The drainage in this triangular area is good: the soil though thin in places is fertile, and under primitive conditions it was probably covered with open oak or mixed woods. A good outlook could be had up and down the little valley and across to Hemlock Hill, while a little farther up, the valley widened into what was evidently a small swamp or bog.

Such a place offered many advantages for a camp or small village site, and it seems to have been the center of an Indian settlement within the Arboretum area. The relative abundance of relics and fragments found here seems to indicate that it was occupied with some permanency. For even more significant than the finished implements are the small flakes or spauls of the different varieties of stone used by the Indians that have been picked up here. These spauls, having a characteristic conchoid fracture, were struck off from the small mass of stone in the process of manufacturing the chipped implements, and they afford an indubitable proof that such an industry was carried on where they are found.

The location of other Indian camps or lodges at several points in the Arboretum is indicated by the number of relics that have turned up. For although a stray arrow or spear may have been lost almost anywhere on a hunting or foraging expedition, such an accident could not account for the presence of a number of relics near one spot, especially when they include implements of domestic use or spauls. After the Spring Brook Village site just described, relics have been found in the largest number along the slopes bordering the low meadow from near the Administration Building to the wooded hills beyond the Linden and Horse-chestnut groups. Until comparatively recent times much of this low ground was occupied by a shallow lake or bog fed by several perennial brooks that have now, with one exception, been obliterated and the water carried under ground through sewers and conduits. Even now the lower part of this area is quite swampy and it becomes flooded in wet seasons, with the water table near enough to the surface to afford homes for muskrats, no doubt the direct descendants of those that were trapped and hunted along with other game by the Indians who once camped along the borders of the bog and lake.

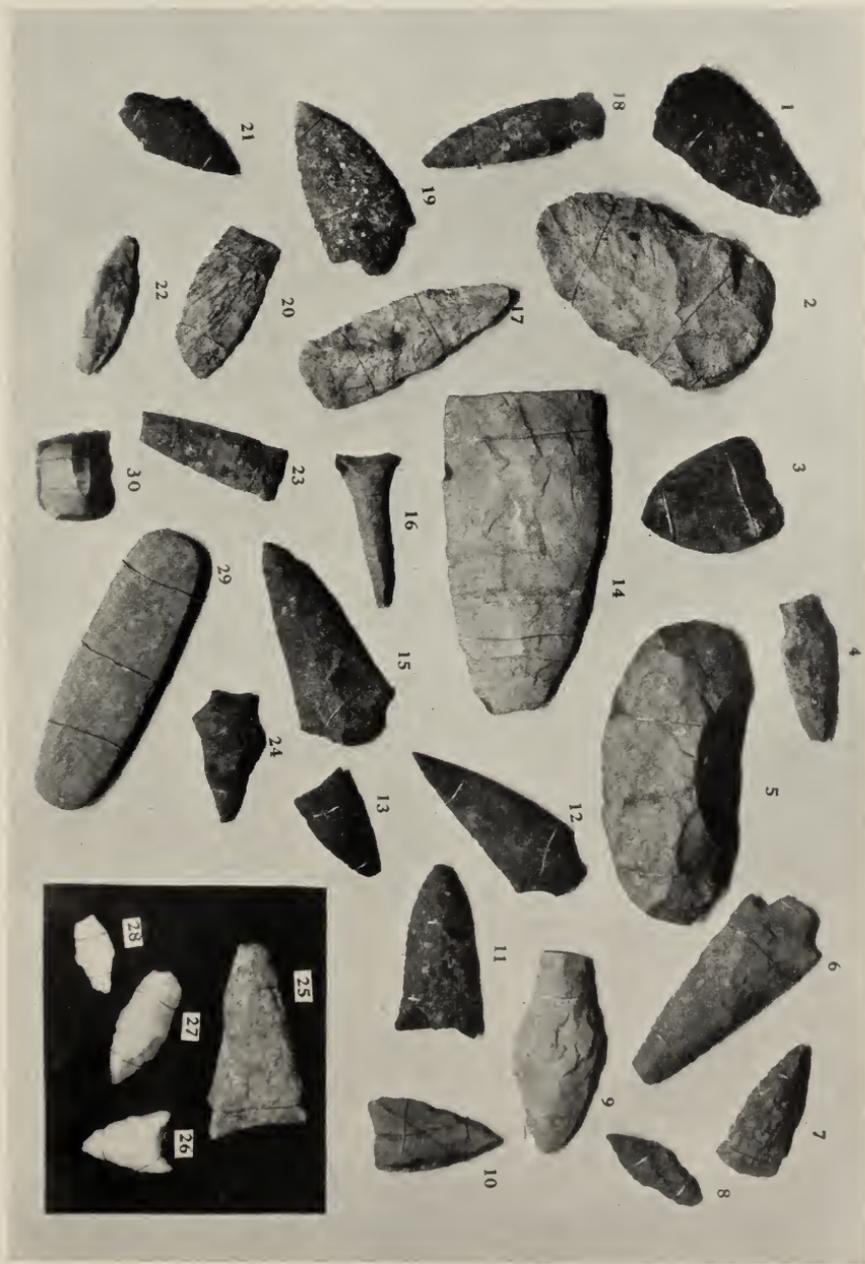
Another Indian camp seems to have been located on the level ground at the east end of Hemlock Hill near the South St. gate and extending across the street. The construction of roadways and other changes have obliterated most of this site, but several relics and fragments have been picked up in a small cultivated area just within the Arboretum wall and in the nursery across South Street. Scattered relics have also been found near the top of Peters Hill, on Bussey Hill, in the shrub collection, on the wooded ridges above the horse-chestnuts, and at several other places.

There is a strong appeal to the imagination in ancient objects with human associations, and the question is often asked as to how old they are. Naturally, this cannot be answered definitely in regard to such relics as those found in the Arboretum. The hard stones from which most of the chipped implements were made are practically indestructible or at least they yield very slowly to the disintegrating forces of time and weathering. The depth to which oxidation has penetrated some of the specimens indicates a considerable antiquity for them. Perhaps some of the pieces are no older than the time when the first white settlers began coming into the country or when the Indians abandoned their crude stone tools for the more efficient metal ones obtained by barter from the Europeans; others may have been made centuries earlier. All that we can say is that they are very old.

ERNEST JESSE PALMER

EXPLANATION OF THE INSERT

1. Projectile point (base and point broken). Material, basalt-porphry. Top of Peters Hill.
2. Celt. Material, felsite-porphry. Foot of Hemlock Hill, east end.
3. Knife? Material, basalt-porphry. Spring Brook Village site.
4. Arrow point. Material, felsite-porphry. Spring Brook Village site.
5. Scraper. Material, chert. Border of meadow, near lindens.
6. Projectile point or knife. Material, quartzite. Hickory group.
7. Arrow point. Material, basalt-porphry. Top of Bussey Hill.
8. Arrow point. Material, argillite (slate). Along brook northeast of Administration Building.
9. Knife. Material, felsite-porphry. Spring Brook Village site.
10. Arrow point. Material, basalt. Spring Brook Village site.
11. Projectile point. Material, basalt-porphry. Centre Street border.
12. Projectile point. Material, basalt. Upper bench, Spring Brook Village site.
13. Arrow point. Material, basalt-porphry. Glacial esker. North Woods.
14. Knife or digging tool (broken at both ends). Material, chert? Meadow near Administration Building.
15. Projectile point. Material, basalt-porphry. Border of Meadow, near horse-chestnuts.
16. Drill or reamer. Material, chert. Upper bench, Spring Brook Village site.
17. Knife. Material, felsite-porphry. Border of meadow, near lindens.
18. Projectile point or knife. Material, felsite-porphry. Border of former brook along Meadow Road, near corkwood.
19. Projectile point. Material, felsite-porphry. Spring Brook Village site.
20. Knife (point broken). Material, chert. Spring Brook Village site.
21. Arrow point. Material, basalt-porphry. Spring Brook Village site.
22. Arrow point (point broken). Material, chert. Upper bench, Spring Brook Village site.
23. Knife (point broken). Material, felsite-porphry. Spring Brook Village site.
24. Arrow point. Material, basalt. Foot of Hemlock Hill, east end.
25. Knife. Material, quartzite. Hickory group.
26. Arrow point. Material, quartz. Centre Street border.
27. Arrow point. Material, quartz. Centre Street border.
28. Arrow point (point broken). Material, quartz. Foot of Hemlock Hill, east end.
29. Knife or scraper? Material, argillite. Border of meadow, near lindens.
30. Gun flint. Material, horn flint. Border of meadow, near horse-chestnuts.



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