ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4· VOLUME III
1935

PUBLISHED BY THE
ARNOLD ARBORETUM
JAMAICA PLAIN, MASSACHUSETTS

ILLUSTRATIONS

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. III MARCH 22, 1935 NUMBER 1

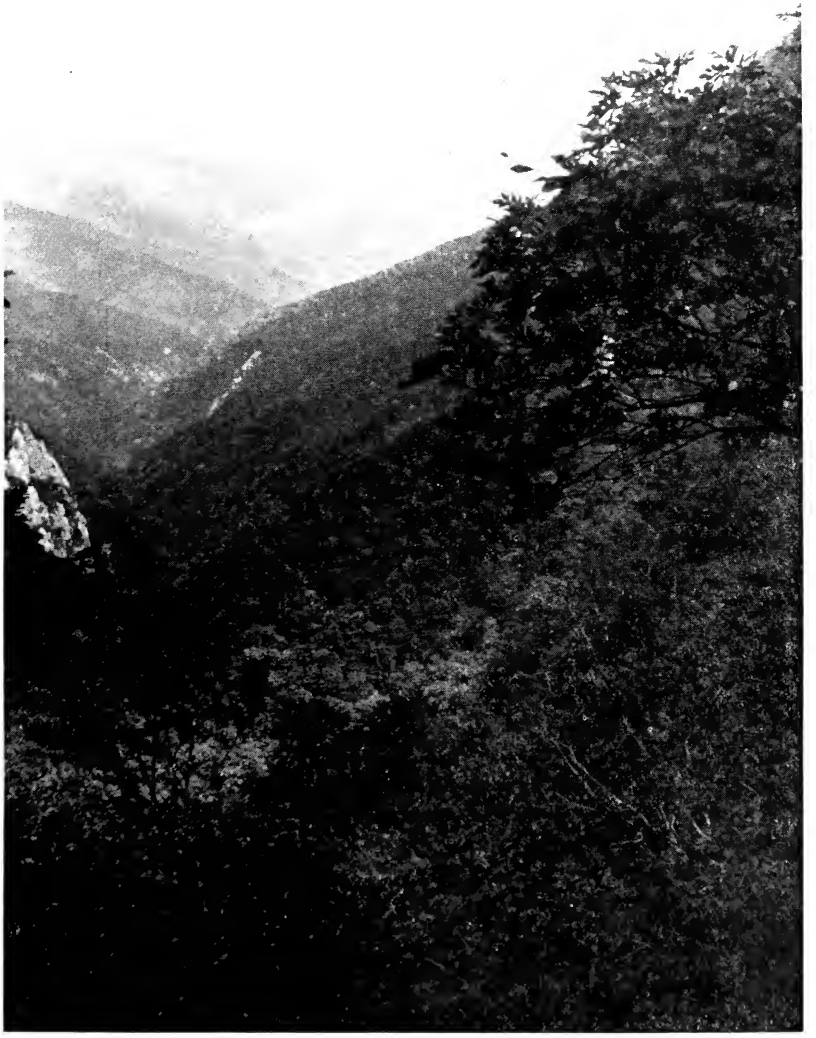
A VISIT TO THE HOME OF THE LILAC. To one who has known the lilac as a garden plant the first sight of it in its native home is almost certain to come as a shock. In the central Balkans, a dry and dusty land, whose climate roughly approximates that of central Nebraska, *Syringa vulgaris* picks out some of the driest, rockiest situations. At Pancherevo, Bulgaria, where I first saw it, there were scattered individuals growing in full sunlight in rock crevices above the roadway. They grew out sideways from the cliff and hung over the road in low tufts of foliage bearing here and there, for it was late in the summer, loose panicles of ripening seed capsules. I saw scattered specimens again near Gabrovo, at the foot of the Stara Planina, the mountain range which forms an east-west backbone across northern Bulgaria. There too they were growing in rock crevices but in this case the cliff rose above a stream and was covered with English ivy (*Hedera helix*).

Not until I came to Cazan Pass in southwestern Rumania did I find *Syringa vulgaris* growing in great abundance. At Cazan the Danube River is confined to a narrow gorge whose cliffs rise mountain high on either side. In a series of sharp turns the river, like a thwarted serpent, bends violently from left to right until it finally passes through the Iron Gates and reaches the level plain beyond the mountains. The lower Danube, like the lower Mississippi, is a great yellow-brown flood. Through the long level stretches of the Hungarian and Rumanian plains an American traveller might well believe himself at home. For all that he sees from the river steamers, the willow swamps and shifting sand bars might well be those of Arkansas or Tennessee. But when the Danube throws itself against the Iron Gates there is little to remind him of the American scene. It is as if the Mississippi, instead of skirting the flanks of the Ozark Mountains, were to pass directly through them on its way to the sea. For so large a river the gorge is surprisingly narrow. At Cazan it is only a little over 100 yards across.

Steep cliffs rise almost vertically on each bank with narrow roadways at their bases. The road on the Jugoslavian side of the river is in ruins, as well it might be, for it was constructed over 1800 years ago by the Emperor Trajan. It was a marvelous piece of engineering for that day, or for any day, since the road for much of the way had to be hollowed out of the rock. One can still see the holes drilled in the cliff to hold the beams on which the bridges were carried and at one spot there is a tablet with an inscription in Latin. On the Rumanian side of the river there is a similar road, a modern automobile highway, and, like the old Roman road, it now tunnels through the rock, now hangs on the foot of the cliff.

The lilacs were everywhere, particularly on the sunnier Rumanian bank. Some grew on the talus slopes, others seemed to spring from the bare face of the rock itself, and an almost continuous fringe of them lined the cliff edge a thousand feet above the river. The pass must be a marvelous sight in spring time. On inaccessible ledges wild tulips grow in profusion and make spots of color which can be seen from the river steamers. Flowering ash (*Fraxinus Ornus*) with its filmy yellow-green flowers forms a natural foil for the lilacs and all these colors are backed by the bright gray-white of the limestone.

There can be no possible doubt that *Syringa vulgaris* is native at Cazan. It is not only that it is abundant and that it grows on inaccessible cliffs, the same can now be said for the American black locust (*Robinia pseudoacacia*), which is thoroughly naturalized along the Danube and at Cazan is a common sight at the base of talus slopes. A much more compelling argument is the form of the plants and the remarkable variation which exists among them. The wild lilacs of Cazan do not at all closely resemble cultivated lilacs run wild. Their flowers are not borne in tight little bunches, but in great open sprays. Even on small bushes wedged in between limestone boulders, the panicles may reach two feet in length. Nor does the general form of the bush follow closely a single pattern as in the cultivated lilacs. This can best be seen back from the cliff edge where the lilacs grow in their greatest profusion, on the limestone plateau above the river. Here they form open thickets among the rocks, much as does the redbud (*Cercis canadensis*) in similar situations in our own southern states. From bush to bush there is striking variation in form and habit. Some are dense, some open. In some the two branches of the panicle are widely divergent, in others they ascend stiffly, side by side. There is, in other words, that rich and manifold variation which characterizes most plants in their native home, but which is not found in the few strains which are brought into cultivation. In flower color and size, there may be greater variation



among the cultivated varieties, but the plant as a whole will show greater diversity in its native home.

It was from these Balkan cliffs and mountains that the lilac passed into cultivation. From Constantinople it was introduced into northern Europe in the 16th century. The botanists of that day, unaware of the richness of the Balkan flora, supposed that like many other plants cultivated by the Turks it had come from the Orient. This legend, once established, was hard to shake. In 1828, Anton Rochel first reported the lilac as native to the Balkans but not for fifty years did botanists as a whole accept the evidence.

Had the Romans been as good gardeners as they were soldiers the lilac might have been introduced into cultivation a good fourteen centuries earlier. So plentiful is it in this part of the Balkans that it must have been known to the Romans when they occupied the country. At Cazan it festoons the road which Trajan's workmen hollowed from the rocks. At Băile Herculane ("Hercules Bath") it grows profusely on the limestone cliffs rising above the hot springs which have been known since Roman times. There, on the hot southern face of Mt. Domogled, *Syringa vulgaris* is found in a variety of situations. It springs from crevices in the bare rock, it forms thickets along dry gullies, and on the grassy slopes below the summit it assumes the character of an alpine shrub. As one ascends, the lilac bushes become smaller and more dense. At first they arch over the pathway, higher up they form dense clumps beneath the black pines, and just below the summit, they are barely knee high.

There, among the rocks, they grow into broad mats of foliage from which the long open panicles rise conspicuously. In late September, at the time of my visit, the seeds on these alpine lilacs had just begun to ripen and most of the capsules were a delicate yellow-green. The Rumanian Forest Service, however, has been kind enough to collect seed for the Arnold Arboretum and many seedlings have already germinated. What will they look like in twenty years? One can only guess. Some alpines retain their dwarf habit when grown in the lowlands; others do not. It is quite likely that, under cultivation, they will grow more luxuriantly than on the mountain top but there is a reasonable chance that they may not exceed three or four feet in height even when grown in fertile garden soil. If so they will fill a distinct place in American gardens.

EDGAR ANDERSON

EXPLANATION OF THE PLATE

View from Mt. Domogled showing dry limestone slopes on which **Syringa vulgaris** is found.

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. III APRIL 27, 1935 NUMBER 2

THE LAST WEEK IN APRIL finds the pageant of spring well under way at the Arnold Arboretum. From the rising ground at the edge of the maple collection the view across the meadow to the Administration Building forms a picture in soft pastels. At the right are the yellow greens of the willows and the blood reds of the swamp maples; at the left are the Katsura trees (*Cercidiphyllum japonicum*) whose fan-shaped branches, lined with leaves and tiny opening flowers, are a haze of bronze red until the late afternoon sun lights them from the side and they glow with a deeper color. Forming a focal point in the center of the picture are the blossoms of the earliest Chinese magnolias, a striking chalk white as seen from the distance. *Magnolia stellata* has as usual been the earliest to flower and this year its starry, narrow-petaled flowers have not as yet been sullied by late frosts or heavy rains. Near the road *Magnolia stellata* var. *rosea* is showing bright pink though not yet really in bloom. The creamy white flowers of *Magnolia denudata* (the *Magnolia conspicua* or *Magnolia Yulan* of most nursery catalogues) are already spreading their delicious fragrance. The large velvety buds of the hybrids known as *Magnolia Soulangeana* are beginning to open and will soon add color to the collection. On the hill behind the building is the hardiest of all the oriental magnolias, *M. kobus* var. *borealis*. It has not yet reached the age where it may be relied upon for a fine show of bloom every year for this variety unfortunately does not blossom well until it is mature and this year there are only a few flowers scattered among the lower branches.

Magnolia kobus, *M. stellata* and *M. denudata* are all early-flowering and are all white-flowered or nearly so. Those who have trouble in distinguishing the three will find that it can be done quite simply by examining the flowers. *Magnolia kobus* has six petals and outside them three tiny sepals of greenish white. In *Magnolia denudata* the three

sepals are so large as barely to be distinguished from the petals so that the flowers appear to have nine petals which are creamy greenish white, gracefully cupped in an upright position. In *Magnolia stellata* the sepals are also petal-like and since there are more petals in this species the flower has the appearance of having a dozen or more petals set in an open sunburst of pinkish white.

Although there were no really conspicuous floral displays until the Magnolias broke into flower there has been continuous bloom all the month in spite of a somewhat tardy spring. *Hammamelis vernalis* carried its fragrant flowers well into April this year although even in New England it is properly to be reckoned as a winter-flowering shrub. Gardeners planning to use this species would do well to plant it, if possible, well to the south of the point from which it will ordinarily be viewed. Placed in this way it will catch the level rays of the winter sun and if the color is even then not really brilliant, it will at least be a good deal brighter than when seen from the other direction.

While it does not flower until later, *Ribes cereum* comes into leaf so early and so attractively that it is of distinct interest in the early spring garden. This year as usual it was the first plant in the shrub collection to put out its new leaves and by the first week in April its fragrant foliage was already attractive. It is unfortunate that quarantine regulations prevent this interesting western American shrub from being more widely known and grown.

Early April also saw the first spring blooms on *Viburnum fragrans*. This surprising shrub opened a few flowers in last autumn's long Indian Summer and it was feared that the buds were so far advanced that they would be hopelessly damaged during the winter. Some of them evidently were killed but there has been a continuous glow of pink and white among the bare branches during the month and they are now conspicuously in flower and delightfully fragrant.

It is in tardy springs that the Cornelian Cherry (*Cornus mas*) shows its worth as a spring shrub. Although not quite so conspicuous as the more commonly used Forsythia it is regularly and dependably a little earlier to bloom. This year with no early burst of spring heat, it has been a good fortnight ahead of its rival and is now in full bloom. Its small yellow flowers are borne in conspicuous clusters and are particularly effective when used as decorative sprays for the hall or living room. The closely related oriental species, *Cornus officinalis*, has been very much used for this purpose in Japan as any collection of pictures of Japanese flower arrangements will show. This latter species, differing chiefly in its longer-stalked flowers and its flakier bark, is also in

full flower. It will be of interest to the horticultural connoisseur and to the botanist, but for the average gardener it is if anything inferior to *Cornus mas*. When in flower both of these shrubs have a slightly offensive odor, something like that of a wet dog. Fortunately it is not so strong as to be objectionable, since in addition to earliness and hardiness, *Cornus mas* has several qualities which recommend its more frequent use in American gardens. For one thing it is very tolerant of smoke and has done surprisingly well in the smokier parts of some of our large cities. Furthermore although seldom used in this country (except by the birds), the fruit of *Cornus mas* has distinct possibilities. Late in the summer it bears glossy red-purple drupes and in southeastern Europe where the shrub is native they are much esteemed for the making of preserves. In Bulgaria large fruited varieties have been developed and are to be found in the markets in August and September. Seeds of several of these strains were obtained last Autumn for the Arnold Arboretum and may some day be of interest to discerning American gardeners.

Forsythia ovata, the Korean Forsythia, is giving a good account of itself this year as last. It is already in full bloom as is its close relative, *Forsythia japonica saxatilis*. Both of these northern Forsythias are hardier, earlier, though smaller-flowered than the Forsythias commonly grown in New England.

Although it is a fine shrub a little further south, *Lonicera fragrantissima* can not be unqualifiedly recommended for New England gardens. It was killed back practically to the ground last year and this spring it is flowering only on those branches which were protected beneath the snow during the winter. Two of its lesser known relatives, however, are giving much better accounts of themselves. *Lonicera Standishii* is in flower on the Overlook. While not as handsome either in habit or in flower as *Lonicera fragrantissima*, its behavior last spring and this have demonstrated its greater sturdiness in cold winters. A much rarer honeysuckle, the Korean *Lonicera praeflorens*, flowered profusely this spring in the shrub collection, by no means the choicest spot in the Arnold Arboretum for an early-flowering shrub. By the second week in April it was covered with bloom and although its spidery blossoms were browned once or twice by late frosts it was most attractive. The flowers are fragrant and of a pale greenish yellow tinged with red-purple.

An even rarer shrub, *Abeliophyllum distichum*, is now in full flower in the same section of the shrub collection. Another specimen trained as a vine on the nearby trellis has blossomed in previous springs, but

the shrubby one has never flowered well until this spring. Since they were only introduced from Korea in 1924 they are just now beginning to reach the age where one may judge of their ultimate value for New England gardens. They have come through two trying winters in good condition and if they continue to thrive they may prove to be a promising addition to the early spring shrub garden. The flowers are a creamy white with a deep yellow center. They are very much like those of Forsythia in shape and are borne in short racemes near the ends of the branches. In general aspect *Abeliophyllum distichum* gives the appearance of a more delicate Forsythia with creamy white flowers instead of yellow ones.

On the Overlook in addition to *Lonicera Standishii*, may be seen the curious flowers of *Euptelea polyandra*, conspicuous chiefly by reason of their bronze red stamens which are thickly hung along the branches. Although introduced from Japan in 1892 it is seldom seen in this country. It was somewhat injured in the severe cold of 1933-1934 but has apparently quite recovered. A little further along the path, under the sentinel white pines at the brow of the hill, *Rhododendron dauricum mucronulatum* is making a brilliant display and is now in full flower. The bright magenta-pink flowers clustered thickly on bare branches, form a striking contrast to the dark green of the old pines. The cool spring has been a positive benefit in holding back the blooms until warmer weather actually arrived and while the flower buds have been late in opening the flowers are larger and more perfect than usual. There is a good deal of variation from bush to bush in size and color of the flowers, the latter varying from "mallow pink" to "light mallow purple" in terms of Ridgway's Color Standards. *Rhododendron dauricum mucronulatum* is sometimes known as the "Mongolian Azalea," although technically it belongs with the true Rhododendrons and not in the sub-genus with the Azaleas. Those amateurs who might question this disposition of *Rhododendron dauricum* will be interested in another variety, *R. dauricum semperrirens*, which is also flowering well this spring and which may be seen a little further down the slope of the hill. The flowers are very similar to those of *Rhododendron dauricum mucronulatum*, but the leaves are quite evergreen and give the species much more the aspect of those Rhododendrons with which the average gardener is acquainted.

Many of the cherries and plums are showing color in the bud and will be attractive by the first week in May. *Prunus tomentosa* is already opening its flowers near the Forest Hills gate, and the Sargent Cherry, *Prunus Sargentii*, will shortly follow.

EDGAR ANDERSON

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. III MAY 27, 1935 NUMBER 3

THE FLOWERING QUINCES. THE flowering quinces are as difficult to classify as they are beautiful to look upon. Even as their flowers are borne upon twisted thorny branches so the whole question of their nomenclature forms a spiny and painful thicket which must be penetrated before any precise discussion of garden-worthy varieties can be undertaken. In the first place the flowering quinces belong to a subfamily of the Rosaceae, the Pomoideae, a group of trees and shrubs which seem to present their own peculiar difficulties of classification. This group of plants includes, for instance, the mammoth genus *Crataegus*, long an object of special study at the Arnold Arboretum and a genus in which detailed investigation has served mainly to reveal the terrific complexities of relationship which exist between the plants classified under that name. Whatever the ultimate reason for such behavior, similar complexities seem to exist among all the genera of the Pomoideae, in common speech those plants whose fruits have a core: apples, pears, medlars, quinces and the like.

It is largely due to these complexities that botanists are not even yet agreed as to the generic name under which the flowering quinces should be classified. A few still hold out for *Pyrus*: many others classify them, together with the edible quince, under the genus *Cydonia*; an increasing number follow the same practice as the Arnold Arboretum and consider them all members of the genus Chaenomeles. One authority, however, has gone so far as to split the flowering quinces themselves into two separate genera, raising the Chinese quinces, which we shall refer to below as *Chaenomeles sinensis*, to the status of a separate genus, *Pseudocydonia*.

As if this natural confusion were not enough it has been further confounded by the production of garden forms and garden hybrids during the centuries that the flowering quinces have been in cultiva-

tion in the Orient. So although there were originally two distinct species, a large growing one native to China, *Chaenomeles lagenaria*, and a low spreading shrub, *C. japonica*, in northern Japan, these are now accompanied in our gardens by a set of intermediates, *C. superba*, which arose as garden hybrids between the two species.

An even further complication has been added by the fact that though the early work on classification was done by European botanists, the flowering quinces are all native to the Orient, a region which in those early days was very imperfectly known to western naturalists. Therefore, while the true *C. japonica* is the low shrub with orange-red flowers, which is actually native in northern Japan, its taller Chinese relative, *C. lagenaria*, very commonly cultivated in Japan, was commonly mistaken for it by botanists and gardeners alike. Thus it has come about that the Chinese plant bears as its commonest English names, "Japonica" or "Japanese Quince," while the true *C. japonica* is still most commonly known as *C. Maulei*.

The true *C. japonica* is a charming little shrub, much more neat and graceful than its Chinese substitute. Even in old well-established plants the slender branches seldom rise more than two or three feet above the ground. The leaves are smaller, as well, and are less buckled and rolled than those of the Chinese species. They are proportionately a little broader and the teeth along the margin are larger and fewer. The size and number of these teeth are one of the most useful characters to use in distinguishing *C. japonica* and *C. lagenaria*. Classifying a collection of garden varieties of flowering quinces is at best a finicky business. The connoisseur of quinces, like a judge of horses, may even be driven to counting the actual number of teeth. For such students it may be useful to note that in *C. japonica* a normal leaf has 20 to 30 teeth on each side, that in *C. lagenaria* the number is usually from 40 to 60, and that in *C. superba*, it is about 35 to 40.

In the Orient, *C. lagenaria* has been grown as an ornamental shrub for centuries in Japan as well as in China. Even in its native home in central China most of the specimens which have been collected are either from cultivated bushes or from plants which have run wild near gardens or along hedgerows. With such a long horticultural history it is not surprising to find that there are many cultivated varieties. There are white, pink and red-flowered forms, varieties with double and semi-double flowers, prostrate types and others which are almost tree-like. Many of these have been introduced into western gardens and fifty years ago there was quite a rage for them in Europe. Relatively few of these horticultural varieties have been at all well known

in America and in 1905 the Arnold Arboretum assembled a comprehensive collection, most of the plants coming from the old well-known firm of Spaeth in Germany.

The collection has done well and has long been an attractive feature of the shrub garden. For a time the prevalence of San Jose scale made it difficult for the average gardener to grow shrubs such as the flowering quinces which are subject to the scale. As time went on, however, natural enemies of the scale have asserted themselves; the development of oil sprays has made the control of San Jose scale a relatively simple matter, and the last decade has seen a revival of interest in the flowering quinces. A number of American nurseries are now offering named varieties of Japanese quince, many of them obtained either directly or indirectly from the Arnold Arboretum.

Most of the varieties on the market belong to the Chinese species, *C. lagenaria*, a few are to be classed as hybrids between that species and *C. japonica* (*C. superba*). The true *C. japonica* (*C. Maulei*) is not as well known as it deserves to be. From New York southward another species, *C. sinensis*, is occasionally grown as a large shrub or small tree. In aspect it is intermediate between the true quinces and the flowering quinces. The pinkish flowers are scattered on little leafy twigs among the foliage instead of being clustered tightly along the branches as in the other flowering quinces. This species is not so hardy as the others and while it flowers, and in some years even fruits in the Arnold Arboretum, it is not to be recommended for most New England gardens. Of the bushier sort the following species and varieties are included in the collections of the Arnold Arboretum, together with several other varieties of doubtful identity.

Chaenomeles lagenaria

"Alba". Flowers white. Habit low and spreading.

"Baltzii". Introduced by Spaeth in 1885-86. Large red flowers well distributed towards the tips of the branches.

"Columbia". Flowers light red. Fruits large, well-developed.

"Cardinalis". Flowers dark red, slightly double. Diffuse habit of growth.

"Kermesina semiplena". Flowers light red, slightly double. Twigs thorny.

"Macrocarpa". Flowers light red. Fruits large.

"Marmorata". Flowers pale red and white.

"Nivalis". Flowers white. Bush compact, symmetrical.

"Rosea plena". Flowers light red, very double.

"Sanguinea semiplena". Flowers red, double.

"Simonii". Very distinct. Flowers dark red, semi-double. Growth low, thorny and spreading. Long horizontal branches. A very decorative plant.

Chaenomeles superba (*C. japonica* × *C. lagenaria*).

"Perfecta". Flowers very pale orange-red. Bush thorny, compact.

Chaenomeles japonica

Flowers light orange-red. Bush low, upright.

Chaenomeles japonica alpina

Many of the plants in cultivation in American gardens, like the original plant brought from Japan by Professor Sargent bear two colors of flowers, dark orange red and pale orange red. Bush low, thorny, slightly prostrate.

Though few gardeners are aware of the fact, the flowering quinces are sometimes grown for their fruit and large fruited varieties such as "Columbia" have been deliberately selected for that purpose. The fruits are seldom seen, partly because they are yellowish green and are borne inconspicuously along the branches, but chiefly because the flowering quinces like many of our orchard fruits are more or less self-sterile. That is to say that most varieties will not serve as good pollinizers for their own flowers and hence set little or no fruit when grown by themselves. When two such varieties are interplanted, each may pollinate the other and a better set of fruit may be expected.

While pleasantly aromatic, the fruits are unpalatable when fresh. Hard as bricks and sour as lemons, they derive their culinary possibilities from an unusually high pectin content. For the home gardener they are useful in jelly making; a very few added to other fruits improve the "jelling" propensities of the mixture and impart a pleasant aroma to the jelly. Used alone the flowering quinces make a jelly which is beautiful to look at but with a flavor too rich for the average palate. Commercially the flowering quinces are of some interest as a source of pectin. To the jelly manufacturer they present the desirable combination of a high pectin content, a high percentage of malic acid and an absence of starch. It is the presence of the latter in cultivated quinces which clouds the juice and renders it unfit for commercial jelly making. The flowering quinces are not only without this undesirable feature but they provide a source of malic acid unaccompanied by other less desirable fruit acids. At one or two experiment stations in this country, selected strains of flowering quinces are being developed as bush fruits. Ultimately they may become a dual purpose shrub for the home garden, producing decorative bloom in the spring and useful fruits in the autumn.

EDGAR ANDERSON

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. III JUNE 4, 1935 NUMBER 4

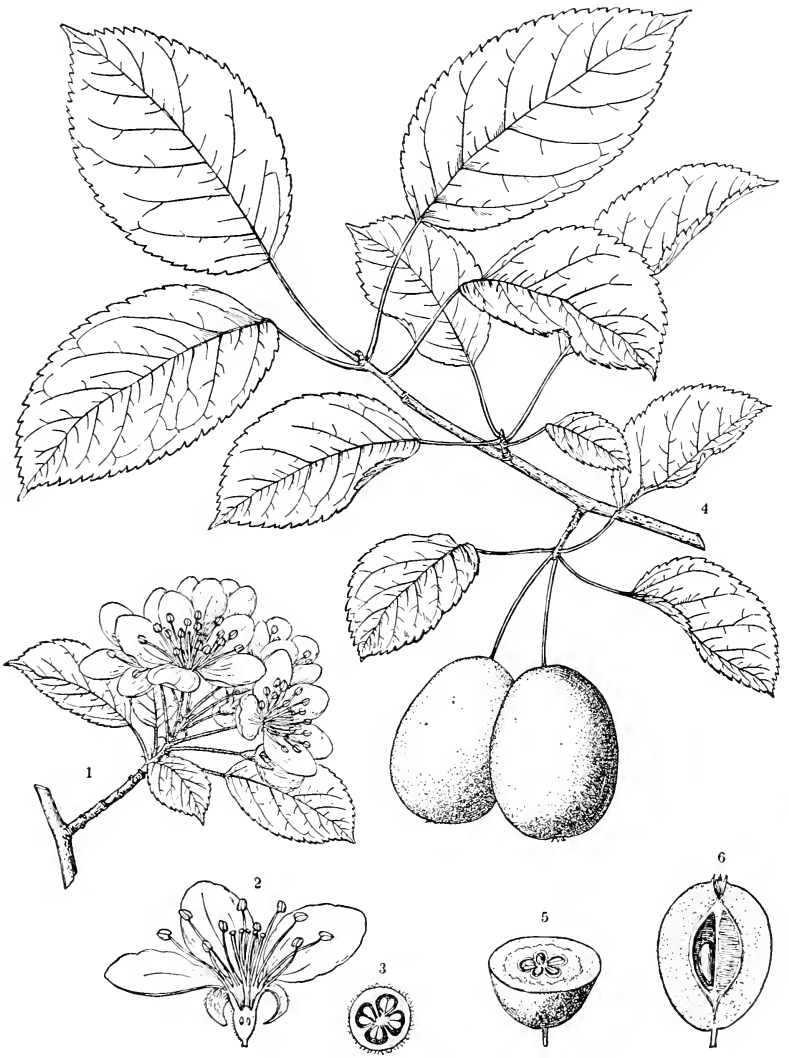
WITH THE last week in May the lilacs have finally come into their prime. The long, cool spring has not hurried them into bloom and seldom, if ever, has the collection been in more perfect condition. The wisdom of the severe pruning which was given them several years ago is now readily apparent. Not only are the bushes in excellent health but the blooms are now at a height where they can be seen and admired by every visitor. The profusion of bloom is noticeable even at a distance. Seen from the Arborway, the lilacs form a richly patterned carpet of subtle lavenders and blues, mantling the lower slopes of Bussey Hill.

The crab-apples, too, have been in splendid condition this spring. One or two varieties, including unfortunately the popular Parkman's crab (*Malus Halliana Parkmanii*) have been somewhat injured by the severe cold of the past two winters. The remainder of the collection has been untouched, or in some cases seems to have derived a positive stimulus from the low temperatures. The Mandshurian crab-apple (*Malus baccata mandshurica*) was a glorious dome of white in early May and another variety of the same species, *Malus baccata* var. *gracilis* was a lovely sight for another fortnight. While most of the varieties of *Malus baccata* are noteworthy parts of the collection both in spring and fall, *M. baccata* var. *gracilis* has been outstandingly so during the past several seasons. In the springtime, its somewhat smaller flowers, abundantly produced, make the other varieties seem a little coarse by comparison. In the autumn after the leaves have fallen, its slender twigs, profusely set with small fruit, make a delicate and graceful pattern against the sky. Two crab-apples of great botanical interest are flowering well this spring, *Malus fusca* a curious species from Oregon and × *Malus Dawsoniana* (illustrated in the accompanying plate) a hybrid between it and the cultivated apple which was raised

some years ago at the Arnold Arboretum. It is unfortunate that the large collection of crab-apples is somewhat hidden at the foot of Peters Hill in a part of the Arboretum which is relatively unknown to the average visitor. This neglect was somewhat remedied several years ago by moving the small crab-apples from the lawn adjacent to the Administration building and planting them along the roadway leading from the Pinetum to the crab-apple collection. The trees have taken kindly to their new home and are now reaching a size where they are quite conspicuous at flowering time. In a year or so as they reach maturity, they will form a conspicuous mass of pink and white, set off to advantage by the dark pines in the background and should serve to guide more visitors to the large collection now hidden to all but the most inquiring around the brow of the hill.

In contrast to the apples, the flowering-cherries have been disappointing this spring. Winter injury has been serious again this year and the fine old tree of *Prunus yedoensis* near the shrub collection was killed outright. *Prunus incisa*, the Mt. Fuji cherry, gave a very good account of itself as did the hardy Sargent cherry (*Prunus Sargentii*). The latter species is so brilliant when in flower, its pink petals made even brighter by the reddish color of the unfolding leaves, that it is a pity its blossoms come and go so quickly. Among the seedlings which have been raised from the original trees at the Arnold Arboretum, there is one, apparently a hybrid with *Prunus yedoensis*, which is a distinct improvement in so far as duration of bloom is concerned, and which last spring and this has been one of the finest trees in the entire collection. It is of distinct promise for New England gardens and will be named and described in an early number of the Journal of the Arnold Arboretum.

Winter injury has been apparent in a curious way in many of the collections this spring. Branches which were beneath the snow line escaped practically uninjured, while those just above the snow lost all their flower buds. On many bushes the bloom was so heavy below the snow line and so sparse above it, that they presented a curious appearance at flowering time, like old-fashioned ladies in plain dark skirts with bright ruffled petticoats showing beneath them. Among the bushes which bloomed in this manner, the Chinese almonds were particularly conspicuous in the collection near the Forest Hills gate. On the Overlook they escaped any great amount of injury and presented an almost normal complement of bloom. One variety introduced and grown at the Arnold Arboretum is worthy of special mention. It was discussed in the Bulletin of Popular Information for May 3, 1928, but the sci-



C. E. Faxon del.

MALUS DAWSONIANA, Rehd.

entific name there given it, *Prunus triloba multiplex*, should not be restricted to this variety alone but is meant to characterize all the double-flowered varieties of this Asiatic shrub. It may accordingly be designated as "Purdom's variety" since it was raised from seeds sent to the Arnold Arboretum by the late William Purdom in 1900. It is a most superior variety, very distinct from the double-flowered forms. The flowers are very large and only semi-double, so that when wide open the center is seen, making the flowers look less like powder puffs and more like real blossoms with a form and grace of their own. The color is a brilliant pink, shading from very deep rose pink to nearly white and reinforced by yellow at the center of each flower. The pink, the white and the yellow, are all clear and clean, the flowers are large, and when in bloom the whole bush glows with color.

Another introduction of the Arnold Arboretum which is practically unknown is a Korean variety of *Prunus Padus* collected by the late Dr. E. H. Wilson in Korea in 1917. Originally designated as *Prunus Padus* var. *glauca* (Wilson no. 10689) it does not have the glaucous leaves characteristic of that variety and is apparently a form of *Prunus Padus* var. *commutata*, an Asiatic variety of wide distribution. During the past several seasons it has been one of the most conspicuous members of the Prunus collection. The flowers are really very similar to those of our own choke-cherry (*Prunus virginiana*) but they are so large and so abundantly produced that the little tree when in bloom has had more the general appearance of a white wistaria. The flowers appear very early, at the same time as the first of the Japanese cherries, and remain in bloom from a week to ten days. The Arboretum originally had several small trees but only the one remains. It has been very much admired by visitors during the last few seasons and it is hoped that it will not only continue to live and flourish, but that it may serve as a source of scions from which other specimens of equal beauty may be raised.

EDGAR ANDERSON

EXPLANATION OF THE PLATE

Page 15. **Malus Dawsoniana** Rehder

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

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. III AUGUST 7, 1935 NUMBER 5

AFTER MONTHS of abundant rain the midsummer green of the Arnold Arboretum is opulently attractive. For a full fortnight there is a pause between the brilliant flower displays of spring and the rich autumnal coloring of leaf and fruit. Such flowers as appear are mostly white, and the few fruits which color towards the sun, are masked by the all prevailing foliage. Here and there a shrub with unusual leafage stands out attractively: *Lonicera microphylla* with bold flat leaves of blue-grey and *Rosa rubrifolia* with the clear, rosy purple cast of its mature foliage. The varied tones of the conifers compel attention, and the golden larch, *Pseudolarix amabilis*, is particularly attractive in the Bussey Brook meadow. Golden is scarcely an appropriate term for *Pseudolarix amabilis* at this season of the year for the foliage has, if anything, a bluish green cast. In spite of the recent cold winters the trees are still fruiting abundantly. The wide-scaled cones have now reached almost their full growth and will be attractive for at least another month. In color and form they are of an almost impossible perfection. As beautiful as flowers, like roses of soft celadon green, they are clustered upon the upper branches.

Of actual flowers there are but few and for the most part these few are either passing their prime, like the hydrangeas and stewartias, or have barely yet come into flower. In this latter class belongs one of the loveliest and most reliable of summer flowers, *Vitex Negundo incisa*. For years this variety has flowered attractively every August at the Arnold Arboretum, but it is still almost unknown in American nursery catalogues. Properly a shrub, in New England it needs to be cut back to the ground every spring and so has somewhat the aspect of a strong perennial. It thrives under this severe treatment when once established and is much more graceful and garden worthy than its better known

relative, the chaste tree, *Vitex agnus-castus*. Its long, wand-like shoots are thickly set with deeply cut leaves and throughout August the bush is covered with graceful plumes of small lavender flowers of a clean, spicy fragrance.

Only two species can actually be said to be in full flower at the moment — the golden varnish-tree, *Koelreuteria paniculata*, frequently mentioned in these Bulletins, and the lovely sourwood, *Oxydendrum arboreum*. In the last two decades the original specimens of this species in the collections of the Arnold Arboretum have attained full maturity and have been supplemented by additional plantings so that they now make quite a showing along the north side of Hemlock Hill. The individual flowers are small, and only greenish white, but they are borne in great spidery panicles which droop gracefully outward and downward as they develop in long sweeping curves. Since *Oxydendrum* is, in truth, a small tree rather than a large bush, these large interlacing panicles produce a graceful cobwebby effect above the branches. Nor are the flowers the tree's only recommendation. Like many other members of the Heath family, its leaves color splendidly in the fall, but whereas the clear red purples of a blueberry bush are more or less hidden under foot, the same colors in a sourwood are carried by large leaves high up in the air, and of all the fall colorings at the Arnold Arboretum none are more rich and varied, none lovelier in the delicate shadings from rose-red to purple to brown.

In the shrub collection near the Forest Hills gate and on the rocky slope below Bussey Hill the heathers are in full flower. Two severe winters have taken their toll and there are a few bare spots in the collection, but by and large they make a most creditable showing and are horticulturally one of the most interesting groups to study at the moment. There is, in all the world, only one species of true heather, *Calluna vulgaris*, distinguished from the other heaths by the fact that its calyx is petal-like and the little flowers consequently when closely examined have the appearance of possessing two corollas, one outside the other. European gardeners have selected many horticultural forms from the original species, some with fully double flowers, some white some deep red, others with bronzed or golden-green foliage. A comprehensive collection of horticultural varieties of this one species may be quite a large affair. That at the Arnold Arboretum is in no sense a complete one, but it does include varieties which have proved dependable in the New England climate. The following are among the most important varieties:

Calluna vulgaris var. *alba*
Flowers pure white.

C. vulgaris var. *cuprea*
Foliage coppery red in winter and early spring.

C. vulgaris var. *multiplex*
Flowers double, like little pink roses.

C. vulgaris var. *nana*
Dwarf, branches short.

C. vulgaris var. *hirsuta*
Foliage grayish green. Branches spreading.

C. vulgaris var. *coccinea*
Flowers reddish purple.

Calluna vulgaris is native to the colder northern parts of Europe and more than one American gardener has been puzzled to learn that while we can grow many central European plants successfully out-of-doors in New England, heather is hard to bring through the winter. To those few Americans who have lived through a winter in England or North Germany, this is no cause for surprise. Summer in England and in New England, while they may differ in details, are relatively the same sort of season. But winter in England and winter in Boston, U.S.A., represent experiences so totally different that one should have totally different names for the two seasons. London, as many Americans usually forget, is as far north as Labrador; the sun in December rises in mid-morning and sets early in the afternoon; not even at noon is it high in the sky. From sometime in November until early March the dew does not dry off the grass. On all but the driest southern slopes there is continuous damp or frost next the earth. If the sun comes out warmly, the cool moist earth steams and a ground fog rises knee high, or shoulder high, or even higher. To an American accustomed to the sparkling dry cold air and the bright blue skies of a Boston winter it seems as if he were living on the cool damp northern side of a mountain. It is small wonder then that heather, in its own country a plant of misty mountain slopes, should object to the clear dry cold and brilliant sunshine of our American winters. It is surprising rather that we are able to grow the species at all. Fifty years of trying are beginning to produce results and while it is too early to boast of complete success, the time has certainly come when we can give useful advice. The following methods have been gradually worked out at the Arnold Arboretum by the late Dr. E. H. Wilson and by Mr. L. V. Schmitt.

A good rhododendron soil is to be preferred. The beds at the Arnold Arboretum were prepared with very well-rotted oak leaves and clean sharp sand. They were started from pot grown plants set out fairly close together in the early spring. Larger specimens are more difficult to establish and do not look attractive. For several years after planting there is no particular summer care other than cultivating when necessary to remove weeds and grass. Every winter, however, a light covering is applied not later than the middle of November, to shield the plants from the sun and wind during the winter. This covering should be coarse so that the air can circulate; a light dressing of coarse, weedy hay has been found excellent. This remains on the bed until early April.

After the plants are established and have thickened together into more or less of a mat, they are clipped every spring. They should not be cut back too far lest the sun get in at the roots. Cutting back far enough to remove all the long, straggling ends and give the bed a neat appearance is sufficient. The beds are dressed every year with well-rotted oak leaves. Any good rhododendron compost should suffice, but if manure has been incorporated it must be thoroughly composted since the little heather leaves lie close to the soil and are easily burned by raw fertilizer. Treated in this fashion the beds of heather have responded nobly and they now present the appearance of sleek turf thickly set with tiny blossoming spires of white or lavender or pink. Seen close at hand the plants are charming with their delicately shaded flowers and browning seed capsules. In springtime, when many of our flowering shrubs are at their best and the heathers look brown and mangy after the winter, one is apt to think that perhaps it is a mistake to spend so much energy in trying to grow them in New England but in August when they produce delicate sheets of bloom, the labor seems well spent.

EDGAR ANDERSON

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. III OCTOBER 7, 1935 NUMBER 6

THE ORIENTAL CRAB-APPLES. IT is difficult to write comprehensively about the oriental crab-apples; there are so many of them and they are such a varied lot. In Asia the crab-apples behave in somewhat the same bewildering way as do the hawthorns in this country; taken as a whole they form a complex assemblage, difficult to sort into such conventional pigeonholes as species and varieties. They probably hybridize in nature, they most certainly do in cultivation. Some are low shrubs, others are forest trees. Some bear fruits closely resembling the cultivated apple in size and shape; others have fruits so tiny that one must look closely to see any resemblance to an apple. While the flowers in truth are mainly white or pink, they too may vary, for there are a number of varieties of such a brilliant rosy purple that the color must be seen to be believed.

One of the most distinct as well as one of the finest from an ornamental standpoint is *Malus toringoides*, now displaying its brilliant fruits near the Forest Hills gate and on the Overlook. They are rather more pear-shaped than apple-shaped and are borne in gracefully drooping clusters along the branches. Late in August they begin to turn color, flushing brilliantly where the sunlight strikes them, deepening their shade week after week until they are finally caught by the hard frosts of mid-autumn. From green they pass quickly to orange overlaid with a flush of scarlet, which deepens to crimson and may finally cover the whole fruit. These clear bright colors are brought to an even greater perfection by the waxy surface of the little apples which causes them to shine and sparkle among the leaves. The leaves are in themselves somewhat ornamental, being so deeply cut that they resemble those of the English hawthorn and for this reason *Malus toringoides* is sometimes known as the "hawthorn-leaved crab." Its flowers are pure white, borne after most of the oriental crab-apples have finished

blooming. It grows rapidly, producing a pyramidal small tree, not very dense so that the attractive leaves and fruits are well-spaced and exhibited to good advantage.

Another distinct crab-apple is *Malus brevipes*, valuable in certain situations for its low, dense habit of growth. Old specimens retain their mound-like shape, flowering and fruiting profusely though only a few feet high. The flowers are pink in the bud, fading to almost pure white when in full flower. The fruits are unlike the other oriental crab-apples in that they have short, stiff stalks. Fruit and stalk have the same proportion as in the cultivated apples and since the color is a bright red, they have the appearance of miniature market apples, no larger than the end of one's thumb.

In one technical detail they can be readily distinguished from such apples and since this detail is among the most important characters in the classification of crab-apples it may be well to describe it in full. Country people, like botanists distinguish between the two ends of an apple and we may well use their expressive terms, "stem end" and "blow end." If the blow end of the cultivated apple is examined carefully it will be seen that the five greenish leafy points which originally protected the flower in the bud have still persisted, though the petals have long since opened out and fallen off. On *Malus brevipes* as on many of the flowering crab-apples, the blow end is as smooth as the stem end for these little leafy points fall like the petals, leaving only a slight scar. The technical term for such a condition is "deciduous sepals," while cultivated apples and a few of the crab-apples which resemble them are said to have "persistent sepals." The other technical detail of prime importance in classifying the crab-apples is the degree to which the leaves are cut. The cultivated apple has "entire" leaves, that is, they have a simple outline, something like that of an egg or a football, without any gross indentation. Most of the flowering crabs have their leaves more or less lobed or cut, particularly on the vigorous new shoots at the ends of the main branches. Using these two sets of characters we can make four pigeonholes in which to classify the apples and crab-apples:

1. leaves undivided, calyx persistent
   Malus prunifolia, *Malus spectabilis*, *Malus micromalus*, cultivated apples
2. leaves undivided, calyx deciduous
   Malus baccata, *Malus hupehensis*, *Malus Halliana*
3. leaves undivided, calyx persistent
   Malus ioensis, *Malus coronaria*

4. leaves divided, calyx deciduous

Malus floribunda, *Malus brevipes*, *Malus zumi*, *Malus Sieboldii*, *Malus Sargenti*

Not all the oriental crabs are decorative in fruit as well as in flower. *Malus hupehensis* (*M. theifera*) which is superlatively beautiful at flowering time, bears little apples which are at best a dull reddish green. It is well worth growing, however, for its flowers alone and its shape and size makes it a good tree for avenues or in formal gardens. Its main branches grow outward and upward at a slight but relatively constant angle (to be exact, something like the main ribs of an old-fashioned clothes-reel). Thickly set with small fruiting branches or spurs which hug close to the main branch, they seldom fork, continuing upward and outward at the same slope. At flowering time when the spurs are thickly covered with flowers, the main branches have the appearance of being graceful wands which have been artificially wound with bloom. For this reason this species is sometimes known as the "garland crab."

One of the commonest of the oriental crab-apples, *M. baccata*, includes a variety which is not as well known as it deserves to be. Like many another outstanding variety it was sent out from China by William Purdom, one of the Arnold Arboretum's most discriminating collectors. Purdom apparently had a good eye for plants or varieties of particular garden merit. In several instances (the lovely *Viburnum fragrans* is one example) a species will be represented in the Arboretum by specimens sent in by several collectors, Purdom among them, and the plants raised from his seed will be outstanding as garden plants. So it is with *Malus baccata* var. *gracilis* which is only slightly different from the many collections of *Malus baccata* which have been received at the Arnold Arboretum from the orient. Yet that slight difference is important from the standpoint of horticulture, and it is to be hoped that *M. baccata* var. *gracilis* will shortly become better known. Like the species, it forms a fair-sized round-topped tree with clouds of white flowers in the spring and tiny red fruits in the autumn. It differs in its smaller flowers, narrower leaves and more graceful habit. Though the flowers are smaller they are, if anything, more abundant and at flowering time when they are grown in great profusion on graceful twigs their delicacy makes *M. baccata* look a little coarse by comparison. In the late autumn when the leaves have fallen and the tiny fruits persist plentifully the tree is a lovely sight. The whole top of the tree is covered with the graceful drooping lines of the fruiting twigs, like raindrops blown slantwise in a shower.

These are only a few samples of the interesting and varied members of the crab-apple collection. Many more are equally deserving. There are the various purple crabs with flowers of an incredibly bright rosy pink and with leaves and fruits tinged with red or purple. There are the Soulard crabs and their relatives, natural hybrids between cultivated apples and the native American "prairie crabs": these lusty hybrids are bowers of pink in the spring and hold their abundantly borne large green apples late into the winter. There is *Malus Sargenti* from Japan, a low growing spreading shrub with all the delicacy of a Japanese screen, yet reliably winter hardy. All in all, the crab-apples have gradually grown to be the finest single display at the Arnold Arboretum, fragrant and beautiful in the springtime, brilliant in the fall, and to the birds at least, attractive far into the winter. When their special merits are recognized and their care is understood they will be very generally used in New England, some for foundation planting, some for avenues and drives, others for naturalistic plantings and to furnish winter food on game preserves.

EDGAR ANDERSON

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. III NOVEMBER 18, 1935 NUMBER 7

COMPARATIVE STUDIES OF WINTER INJURY IN THE ARNOLD ARBORETUM. MATERIAL for this study of winter injury in different parts of the Arboretum was accumulated during the growing season of 1934. The preceding winter had been one of unusual intensity, and the damage incurred by the plants had been so great that a special survey was made of it in the spring and early summer. The results of the survey were published in four bulletins (1) which included lists of plants killed outright, killed to the ground, and injured but not killed to the ground. In the first of these 27 species and varieties were noted, in the second 248, and in the third 225, but no information was included as to the location of the plants injured. It has been known for some time that certain parts of the Arboretum are more suitable than others for semi-hardy species, and it has been suggested that, by classifying the winter injury of 1933-34 as to locality, some rather concise data may be found which would clarify the existing differences in growing conditions. To this end the writer has had recourse to the original field notes made by the committee investigating winter injury, and has compiled a list of 62 species and varieties which were growing in more than one situation during the winter of 1933-34 and were injured in at least one of these places. It is recognized that the conditions of age and pruning under which the same species entered the winter may have differed to a certain extent in different places, but it is safe to say that nearly all of them were in good condition and did not differ greatly in these respects. These 62 plants should, therefore, be the best indicators available of the variations in growing conditions.

Most of the notes are on shrubby species which are more or less con-

(1). Winter Hardiness of Trees and Shrubs Growing in the Arnold Arboretum. By J. H. Faull, J. G. Jack, W. H. Judd, and L. V. Schmitt, Arn. Arb. Bull. of Pop. Information. Ser. 4. Vol. ii. Nos. 7, 8, 9, 11 (1934).

centrated in three areas: the shrub collection just inside the Forest Hills Gate, the so-called Chinese collection on the south knoll of Bussey Hill, and the Centre Street Path area which lies in the neighborhood of the Pterocarya group. The shrub collection, which is checked over thoroughly each year, is the only one for which complete data are available. That is, in addition to lists of damaged plants in it, we have also a list of all the plants growing there. In the other two localities only injured plants are listed.

The writer is indebted to the members of the committee who prepared the original lists of injured plants; particularly to Messrs. Judd and Schmitt, who have contributed a great deal toward the following analysis of the field notes.

Table I. Plants growing in more than one locality in the Arboretum during the winter of 1933-34, and injured in at least one of these localities:

Table I

k–Killed o–Killed back to ground x–Damaged but not killed back u–Uninjured	Shrub Collection	Bussey Hill	Centre St. Path	Group	Nervine Border	Bussey Hill Rd.
Baccharis halimifolia	o					
Benzoin aestivale	xo					
Berberis aggregata	o	o	u			
Berberis aggregata var. Prattii	o	o	u			
Berberis aggregata var. recurvata	o	o				
Berberis dictyophylla	o		u			
Berberis Francisci-Ferdinandi	o	o				
Berberis polyantha	o	o				
Caragana Boisii	o	u				
Ceanothus americanus	o		u			
Cornus kousa var. chinensis		k				u
Cornus paucinervis	o		u			
Cytisus albus	x	o				
Cytisus elongatus	o	u				

	Shrub Collection	Bussey Hill	Centre St. Path	Group	Nervine Border	Bussey Hill Rd.
Cytisus nigricans	x	u				
Cytisus purgans	x	u				
Cytisus purpureus	x	u				
Cytisus ratisbonensis	x	u				
Deutzia hypoglauca	o		x			
Deutzia hypoleuca	o		o			
Deutzia magnifica	o		o			
Deutzia rosea	o		o			
Deutzia scabra var. plena	o		o			
Dipelta floribunda	u		o			
Dipelta ventricosa	u		o			
Eucommia ulmoides		x	u		u	
Forsythia suspensa var. atrocaulis	o	o				
Forsythia viridissima	o			u		
Genista pilosa	o	u				
Genista tinctoria	x	x				
Genista tinctoria var. virgata	x	x				
Grewia parviflora	o		o			
Helianthemum nummularium var. straminium	x	u				
Helwingia japonica	o	u				
Holodiscus discolor var. ariaefolius	o		u			
Indigofera amblyantha		k	u			
Kerria japonica var. pleniflora	o	u				
Kolkwitzia amabilis	o	xo				u
Lespedeza cyrtobotrya	o		u			
Lespedeza formosa	o	u				

	Shrub Collection	Bussey Hill	Centre St. Path	Group	Nervine Border	Bussey Hill Rd.
Lonicera gynochlamydea	o	o				
Lonicera Henryi	o	u				
Lonicera Maackii var. podocarpa	o	x			u	
Lonicera Standishii var. lancifolia	o	o				
Lonicera Vilmorinii	o				x	
Neillia sinensis	o	o	o			
Neillia thibetica	o	u				
Pachistima myrsinites	x		u			
Prunus mira	o			u		
Prunus serrulata horinji		u				
Rosa multibracteata	o	u				
Rosa omeiensis var. pteracantha	o	u				
Salvia officinalis	o		u			
Sophora viciifolia	o	x	xo			
Spiraea Henryi	o	x				
Spiraea Miyabei var. glabrata	o	o				
Spiraea nipponica	x		u			
Spiraea Veitchii	o	x	u			
Stephanandra Tanakae	o	u				
Viburnum betulifolium		o		o		
Viburnum lobophyllum				x		o
Viburnum setigerum		u		x		

Miscellaneous notes from localites not mentioned in this table show that *Baccharis halimifolia* was uninjured in the South Street nursery, *Benzoin aestivale* was uninjured where it grows near the Peach Collection, and *Prunus serrulata horinji* was killed outright near the Forest Hills Gate although it was undamaged on Bussey Hill.

Table II. Distribution of the various kinds of injury in different localities:

Table II

	Killed	Killed back	Damaged	Uninjured	Totals
Shrub Collection		43	11	2	56
Bussey Hill	3	12	8	18	41
Centre St. Path		9	2	13	24
Group		1	2	2	5
Nervine Border			1	2	3
Bussey Hill Road		1		1	2
South St. Nursery				1	1
Near Peaches				1	1
Forest Hills Gate	1				1

The Shrub Collection appears by far the most rigorous testing ground of all. Of the 55 species common to it and other places, 37, or about 67.3%, wintered more successfully elsewhere. Fifteen, or about 27.3%, were equally damaged elsewhere, while only 3, or about 5.5%, suffered less in the Shrub Collection than elsewhere.

Thirty-four species and varieties were common to the Shrub Collection and Bussey Hill. Twenty (58.8%) of them were less injured in the latter place, 12 (35.3%) showed no differences, one (2.9%) was injured on Bussey Hill more than in the Shrub Collection, and one was indefinite.

The figures for the Centre Street Path area are somewhat similar. Here there were 21 forms available for comparison, of which 12 (57.1%) passed the winter more successfully than in the Shrub Collection, 6 (28.6%) showed no variation, and 2 (9.5%) were injured more than in the Shrub Collection.

Comparisons between the Bussey Hill and Centre Street Path areas are too limited to be of much significance. Only seven species of injured plants were found common to the two, but of these, five were less injured in the latter place, one showed no variation, and one was indefinite.

Notes on the injury of plants in a few other localities have been included in the tables for the light they may eventually throw on the problem of causes. *Baccharis halimifolia*, though killed back to the ground in the Shrub Collection, was injured in the South Street Nursery, a situation lower in elevation and probably much colder. *Benzoin aestivale* suffered variously in the Shrub Collection, part of

the plants being killed back and others only slightly damaged. Across the Meadow Road, however, in the neighborhood of the peach trees and the nearby wooded knoll, it was uninjured. *Cornus kousa* var. *chinensis* was killed outright on Bussey Hill, but along Bussey Hill Road near the lilacs it was uninjured. Likewise, *Kolkwitzia amabilis* was badly injured in the Shrub Collection, variously damaged on Bussey Hill, but not at all on Bussey Hill Road. Two species of *Lonicera*, killed back to the ground in the Shrub Collection, were uninjured or only damaged a little in the beds along the Nervine Border of the Arboretum, although the latter are in very low ground. *Forsythia viridissima* was killed back to the ground in the Shrub Collection but on the nearby hillside, in the Forsythia Group, it was uninjured.

From the above notes, it becomes quite clear that the Bussey Hill and Centre Street Path areas are much more suitable for the growth of semi-hardy plants than the Shrub Collection. This fact is generally in accord with those gained from past experience in the growing and establishment of shrubs in the Arboretum. The causes for the differences, however, are not so clear. It is not the purpose of the present paper to go into these causes, but a brief statement of the problem will not be amiss.

Differences may be looked for in soils, local temperatures, relative exposure to bright sun during the winter and spring days, and relative protection from winds. In all of these except the first there appears, with present knowledge, to be some correlation with the winter injury of 1933-34. No detailed soil studies have been made, but general observations suggest that the soils of the Shrub Collection and the Centre Street area are more nearly similar to each other than to those of Bussey Hill. Available temperature data indicate that the Shrub Collection suffers lower minima than either of the other two, and that of the latter the Centre Street Path is the colder by half. Exposure to bright sunlight is probably greatest in the Shrub Collection and least along Centre Street. The Centre Street Path area suffers notably less from strong winds, particularly those from the northwest, than the other places.

The relative suitability of other parts of the Arboretum for the experimental growing of plants has not been studied extensively in this way, but it is reasonable to expect that if at least the major causes can be established for the differences set forth above, the projection of the investigation into other areas should be greatly simplified and rendered more efficient. Studies of temperatures are already under way, and data have been gathered for a map showing the parts of the Arboretum protected from the northwest wind.

Hugh M. Raup

Notes: Continued mild weather during the autumn has encouraged a comparatively large number of plants in the Arboretum to put forth late flowers.

Notable among these are:

Iberis Tenoreana
Prunus subhirtella var. autumnalis
Genista tinctoria
Daphne Mezereum
Rhododendron dahuricum var. sempervirens
Erica carnea
Forsythia suspensa
Lonicera fragrantissima
Lonicera praeflorens
Viburnum affine
Viburnum erosum
Viburnum fragrans

In addition to the cultivated shrubs there were over fifty species of wild plants in blossom on the same date the above list was made, November 16.

Fruiting has been abundant this year, and many species are holding their fruits well into the winter. Viburnum, Malus, Symphoricarpos, Crataegus, Berberis, Cotoneaster, Acanthopanax, Aronia, and Ilex are all represented among these, and add touches of color to the otherwise gray landscape, as well as provide food for the birds and small mammals which are regular winter residents.

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. III NOVEMBER 25, 1935 NUMBER 8

INJURIOUS EFFECTS OF WINDS IN THE ARNOLD ARBORETUM. On January 23rd and 24th, 1935, that part of New England in which the Arnold Arboretum is situated was blanketed with a snowfall of 18 to 24 inches. The colder and drier weather with northwesterly winds which followed caused a great deal of drifting in the light snow, the amount varying with slope and exposure. During the succeeding week the temperature remained so low that no appreciable thawing occurred, and on the nights of January 25–26 and 28–29 an inch or more of additional snow fell and was later added to the drifts. Working on the assumption that the relative amounts of drifting in various parts of the Arboretum would afford data on the distribution of effectiveness of the northwest wind near the surface of the ground at this time of year, some notes were made which are embodied in the accompanying map. It will be seen at once that many small details are omitted, but the larger drifted areas are rather clearly outlined.

The general climatic conditions leading up to this fall of snow were not unusual. Several days of mild weather had considerably reduced an earlier snow cover of 6–8 inches, forming a hard crust. On the morning of January 22nd a low pressure system was central over northern Georgia and South Carolina, a poorly defined high pressure area was central over Illinois and Missouri, and a prominent high was over the Canadian prairie provinces. Another low pressure which had previously brought heavy snows to the lake states has passed northeastward over the Gaspé region. The southern low pressure area had moved northeastward by the morning of the 23rd to be central over Cape Hatteras, and a strong high pressure had centered over South Dakota and neighboring Minnesota. Snow began to fall in the Boston district about noon, accompanied by northeast winds, and by evening 6–8 inches had accumulated. The fall continued throughout the night.

On the morning of the 24th the coastal low pressure was central over the Gulf of Maine, its movement bringing northwest winds, lowering temperatures, and clearing skies. The advancing western high pressures were central over Illinois and Ontario, and were accompanied by intense cold. In the late afternoon of the 23rd the temperature in the Arboretum averaged about 18° F., and about midnight reached a minimum of about 11°. On the morning of the 24th the temperature rose to about 13° and during the day reached 18°–19°. After noon on the 24th it began to fall rapidly, and reached minima of 10° to 17° below zero during the succeeding night. In the period between the morning of the 24th and noon of the 25th the relative humidity fell from 90% to 38%, with only minor advances in the afternoon of the 24th and the early morning of the 25th. In brief, a well-defined low pressure system moving northeastward along the Atlantic coast and passing to the southeast of Boston, brought moisture-laden northeast winds and abundant snow. These winds caused a certain amount of drifting as the snow was falling, but the drifts so made were soon obliterated by the strong, dry and cold, northwesterly wind which immediately followed the passage of the storm. As will be noted below, the earlier drifts persisted only in a few places in the Arboretum.

A strong subjective element was necessarily present in making a judgment on the relative amount of drifting in any given area: but the general criteria may be divided roughly into three classes. First, the "hardness" of the snow as indicated by the way in which snowshoes sank into it in ordinary walking: second, the number and kind of "ripple marks" and other surface sculpturings: and third, the distortion of the normal configuration of the snow about the bases of trees and shrubs. Where little or no drifting was present there were nearly circular depressions in the snow around the bases of trees, but where the wind blew hard the depressions were variously distorted and oriented according to the direction and force of the blast.

In the order of diminishing intensity the most drifted portions of the Arboretum were the north and northwest slopes of Peter's Hill, most of the 14-acre Weld Street tract, the north and northwest faces of Bussey Hill, and the southeastern part of the North Meadow. The first three were exposed to the full force of the northwest wind because of their elevation and the absence of large or dense plantations. The southeast end of the open meadow is so far away from the low hills to the northwest of it that their protection is lost. The influence of this wind which sweeps the meadow is felt as far as the Forest Hills entrance since the open plantings of maples are not enough to

check it. Peter's Hill is so open on its flanks that the hard drifting is carried far around to the southeast and southwest sides, as shown on the map. Similarly a strong component of the wind which affects Bussey Hill sweeps down the Valley Road to produce hard drifting in the walnuts, in the upper part of the oak collection, and in the area about the old chestnut collection.

Nearly all of the drifted areas had their surface markings clearly oriented to the northwest wind. Some modifications were caused by the larger topographic features, as in the crab-apple collection where the wind currents evidently came down the valley between Hemlock and Peter's Hills in an easterly direction. The only notable exceptions to the northwest drifts were the remnants of the northeasterly trend of the main storm. These were most prominent in that part of the South Street tract which lies southwest of the pond. All of this area was apparently well protected from the later winds by Bussey Hill. The only other place where this was observed was in the northern part of the linden collection where the northeast wind blew with considerable force across the north end of the meadow, but where the northwest wind was completely stopped by the nearby hills and woods.

In protected places the snow remained soft and powdery, with almost no surface markings. As would be expected, the larger of these areas lay on the lee sides of the hills, especially where the latter are more or less wooded. Smaller ones were caused by patches of natural woods or dense plantations. One of the largest of the protected areas lay along the northwestern boundary of the Arboretum, extending from the Jamaica Plain entrance to Centre Street and including the northern end of the linden collection. Southeastward its boundary was ill-defined, with a gradual increase in the amount of drifting at greater distances from the base of the hill. As noted above, the northern part of this strip showed some results of the northeast wind, but near Centre Street there was little evidence of drifting of any kind. Another prominent "driftless" area lay at the northeastern base of Bussey Hill, taking in the collections of leguminous trees, the lower end of the lilacs, the plantings around the two westernmost of the small ponds, and a small portion of the shrub collection. The protection here is afforded by the wooded knolls which project northeastward from the larger hill.

On the south side of Bussey Hill the plantings of pines, beeches, and a large portion of the azaleas were under soft snow. The northwestern part of the beech group and that part of the oak collection which lies below the small transverse ridge in this valley were only

partially drifted. Another prominent protected area lay along Centre Street, taking in most of the hickory group, the pterocaryas, and the miscellaneous plantations of shrubs and small trees in this vicinity. It was caused by the high hill to the northwestward and accentuated by the presence of the embankment of the street itself. Most of the land occupied by the smaller conifers and hornbeams was also protected, in this case by the low, partially wooded ridge which crosses the Valley Road in the neighborhood of the spring. The lower end of this area, however, near the place where the small spring-fed tributary enters Bussey Brook, was farther away from the barrier and was partially drifted.

Most of the northern slope of the Bussey Brook valley was undrifted, protected by the nearby hills and large plantings. Near Bussey Street, where the brook flows through a broader expanse of meadow, the wind became effective on both sides of it, producing hard drifts. The shoulder of the hill among the spruces and firs was drifted, but farther up in this direction the Centre Street embankment and wall again brought protection.

South of Bussey Street the largest sheltered area lay south and southeast of Hemlock Hill and its projection around the old quarry. This land is partly in natural woods, partly in a miscellaneous plantation of trees near South Street, and contains the collections of pears and some of the crab-apples. The shelter in its extension toward South Street and the railroad is increased by the high embankment of the Peter's Hill Road. As would be expected the low ground in the old quarry is also protected, but the high rocks on its rim were drifted hard. The only land on Peter's Hill proper which achieves any protection to speak of is on the south slope in the lee of the natural woods, the larch plantation, and the old nursery. In the Weld Street tract the only protection is from a small thicket near the eastern end and in a small low area between the two hills.

Most of the drifting in the natural woods was confined to the ridge tops and windward slopes where these do not carry much undergrowth. The hardwood timber is so open that drifting was common wherever the wind could get through the trees, but on Hemlock Hill only the top of the ridge was affected, the lower slopes being mantled with loose powdery snow.

Drifting on the Bussey Institution land is not shown on the map, but follows the main outlines of the topography. It was greatly modified, of course, by the presence of the buildings. The steep slope southeast of the Bussey Mansion was not much drifted, but that to

the northeast is swept by winds from the open slopes of Bussey Hill, and was drifted hard. The top of the low bluff which forms most of the northwestern boundary of the land carried heavy drifts, and most of the plain eastward of the building bore strong surface markings.

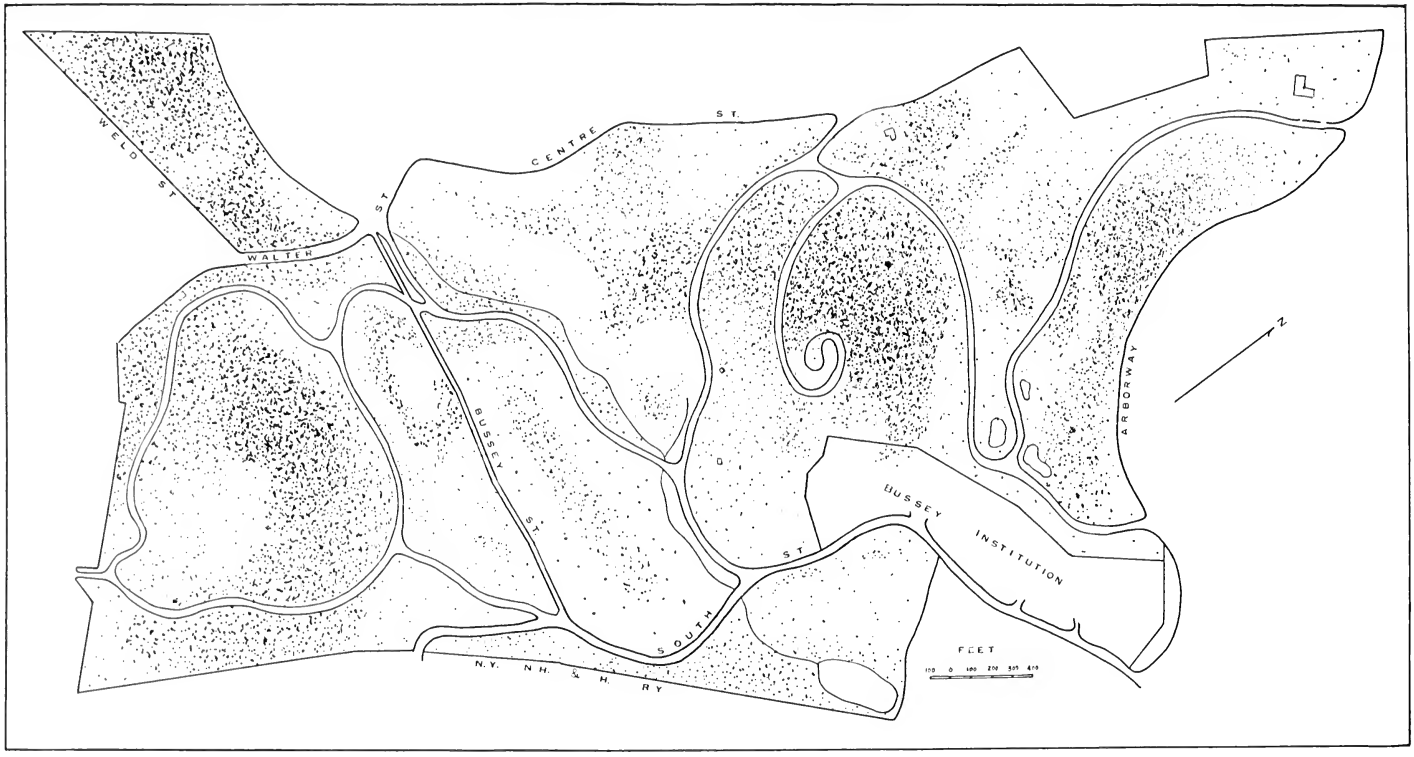
Among the factors reducing the winter hardiness of plants in our region is that of the dry winds which blow during cold clear weather. There is evidence among the plants in the Arboretum that the northwest wind which commonly follows a cyclonic storm is the most significant in this respect. It regularly blows briskly and brings clear weather with rapidly lowering temperature and relative humidity. In contrast, winds from other quarters during winter and spring usually presage cloudy skies with higher humidities and temperatures. For some years the land along the Centre Street Path in the vicinity of the pterocaryas has been regarded as especially suitable for plants which have not wintered successfully elsewhere. Although this, as well as the vigorous growth of the crab-apples, conifers, tree legumes, and lilacs might be attributed to soil or other factors, there can be no doubt that the protection of the areas in which they grow from drying winds must also be taken into consideration. Reference to the map will show that a portion of the shrub collection lies in the protected area in the lee of the wooded knolls along the Meadow Road, while the remaining part is considerably more affected by winds across the North Meadow. The protection afforded is not so great as that immediately across the road, since the low elevation of the knolls and the openness of the oak woods permits a good deal of the wind to pass through. Nevertheless the protected northwest corner of the collection suffered slightly less injury during the winter of 1933-34 than the remainder, and since there is a fairly even distribution of hardiness throughout the whole collection this difference, small though it is, may be considered significant.

A more direct suggestion as to the importance of the northwest wind is to be found in the distortion of the crowns of trees and shrubs. This is clearly observable in many parts of the Arboretum. It is perhaps most striking on Bussey Hill among the old white pines which were planted there by Benjamin Bussey early in the nineteenth century, but it is also well-defined among the elms, birches, and hawthorns. One of the outstanding features of it is a change from radial to bilateral symmetry in the crowns, with an orientation clearly correlated with the northwest wind. It is generally understood that the distortion is due mainly to the drying effects of air movements rather than to mechanical injury, a condition which, in the light of what

has been said above, relates it to the dry northwest wind rather than to other, more moist ones. Furthermore, if a map were made of the relative intensities of distortion throughout the Arboretum, the main outlines would coincide with those of the relative amounts of drifting.

Evidence that the northwest wind is a damaging agent of no mean significance is therefore strongly suggested by the distribution of winter injury to semi-hardy shrubs, and is found abundantly in the forms of trees and shrubs in exposed places. It should be considered one of the more important factors outlining the natural biological divisions of the Arnold Arboretum or of other similar plantations, and protection from it should add substantially to the chances for success in bringing tender species through the winter in this part of the country.

Hugh M. Raup



Map of the Arnold Arboretum showing relative amounts of drifting in the snow of January 23-24, 1935. The heavier shading represents the greater amount of drifting.

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4, VOL. III DECEMBER 23, 1935 NUMBERS 9–12

NOTES ON THE EARLY USES OF LAND NOW IN THE ARNOLD ARBORETUM

INTRODUCTION. AMONG THE biotic factors affecting the growth and development of plants in settled regions the most important is that of the human modification of primeval conditions. This is especially true in areas such as the Boston District which is among the oldest settlements in eastern America. But with the longer period of human intervention goes increasing difficulty not only in evaluating the factor as a whole, but also in describing its varying nature, since the uses to which parcels of land have been put become increasingly obscure with age. It is the purpose of the present paper to draw up in broad outlines the effects of man's influence upon the vegetation, soil, and topography of the Arnold Arboretum. The periods of time, especially in their relation to the present, during which certain areas have been in natural woodland, in pasture, or under cultivation, together with local modifications of drainage, will be the rough units with which such an investigation must deal. It is recognized at the beginning that many important details are as yet unavailable, but it is hoped that the general results will make possible a clearer understanding of the potentialities for growing both native and exotic plants in the Arboretum's array of local habitats.

The most fruitful sources of information are in the registered deeds of conveyance, and in the probated records of wills, inventories and divisions of estates touching upon the lands involved. For the Arboretum these must be sought in two places, since the government of West Roxbury has been moved repeatedly. For the years between 1639 and 1793, as well as for those between 1874 and the present, the records are in the Suffolk County Court House in Boston, while those for the intervening period, 1793 to 1874, are in the Norfolk

County Court House in the town of Dedham. By means of these records and occasional old maps it has been possible to establish most of the ancient property lines and to trace the titles for most of the Arboretum land back to about 1700, and some of them to the original grants made prior to 1654.

Next in importance, as suggested above, are old maps which are to be found in the various libraries in the vicinity. Two of these are by far the most significant for the present study. One was published in 1843 from surveys made by Charles Whitney, and gives the approximate boundaries of timber lands in Roxbury at that time. The other is a topographic map surveyed under the direction of Frederick L. Olmsted about 1878. It is of particular interest because it contains lines, evidently indicating fence-rows, which divided the old Bussey estate into parcels of varying size and shape. These lines and the areas they define have proved to be of considerable historic significance since they may be traced intact through several generations of proprietors. The natural woodlands in the Arboretum have yielded much information also, in the way of tree rings and the growth forms of the trees themselves. Likewise the rather extensive notes on the distribution and habits of the spontaneous herbaceous flora made in recent years by Mr. E. J. Palmer contain suggestions of past changes in vegetation or drainage. General histories of the vicinity, chiefly devoted to the political and social doings of the inhabitants have proved of some value, as have also geneological papers dealing with the families which have owned Arboretum property in times past. From the establishment of the Arboretum in 1872 to the present the annual reports of the Director, Professor C. S. Sargent, and later those of the Supervisor, Professor Oakes Ames, give a fairly detailed account of major changes in local conditions. Also Professor Sargent's excellent description of the Arboretum's accomplishments during its first fifty years, published in 1922, has been of considerable value.

The writer is much indebted to various persons in the libraries of the Massachusetts Historical Society and the New England Historic Geneological Society, and to others in the offices of the Clerk and of the Chief Engineer of the City of Boston for searching out old maps and other historic documents. Professor Kirk Bryan of the Department of Geology and Geography at Harvard has made several valued suggestions regarding the interpretation of the data. The author is especially grateful to those older men among his associates at the Arboretum who have had to endure his endless questioning and who have supplied a wealth of inspiration and knowledge out of their practical experience with our growing plants.

Historical Sketch. The Arnold Arboretum is situated on a tract of about 260 acres in the western part of the old town of Roxbury. It is now in the park system of the City of Boston, and is in the municipal divisions of Jamaica Plain and West Roxbury. The greater part of the Arboretum land, about 210 acres, came from the estate of Benjamin Bussey who willed it, subject to certain restrictions, to Harvard College at his death in 1842. The remaining acreage has been added in various purchases, either by the City or by the College.

The Arboretum was started in 1872 on that part of the Bussey estate which lay north of Bussey and South Streets, excluding the area already occupied by the Bussey Institution. In 1883 this land was taken into the Boston Park System and leased back to Harvard College, tax-free, for one thousand years. At the same time the City added to it several pieces of land and undertook to build and maintain its fences and roadways. The additions at this time included about 10 acres in what is now the collection of larger conifers, near the corner of Walter and Bussey Streets; about 11 acres on the north slopes of Bussey Hill and reaching northward through the linden and horse-chestnut collections; and about 17 acres covering most of the present area of the North Meadow and the hillside at the base of which the Administration Building now stands. Further additions were made between 1890 and 1895 when the Peter's Hill section was taken over from the Bussey estate; another five acres were acquired along Centre and Walter Streets at the corner of Bussey; and two areas formerly reserved by the City, one on Bussey Hill and the other in the North Meadow, were finally leased for Arboretum purposes. About 15 acres bounded by Walter, Weld, and Centre Streets were acquired by purchase in 1922, and the property between South Street and the railroad was taken from the Bussey estate at about the same time. The latest acquisition consists of about eight acres along Centre Street purchased from the Adams Nervine Asylum in 1926. Benjamin Bussey acquired his part of the future Arboretum by purchase between the years 1806 and 1837. He bought it in six parcels, two of which cover most of the area and came from the estates of the Weld and Davis families.

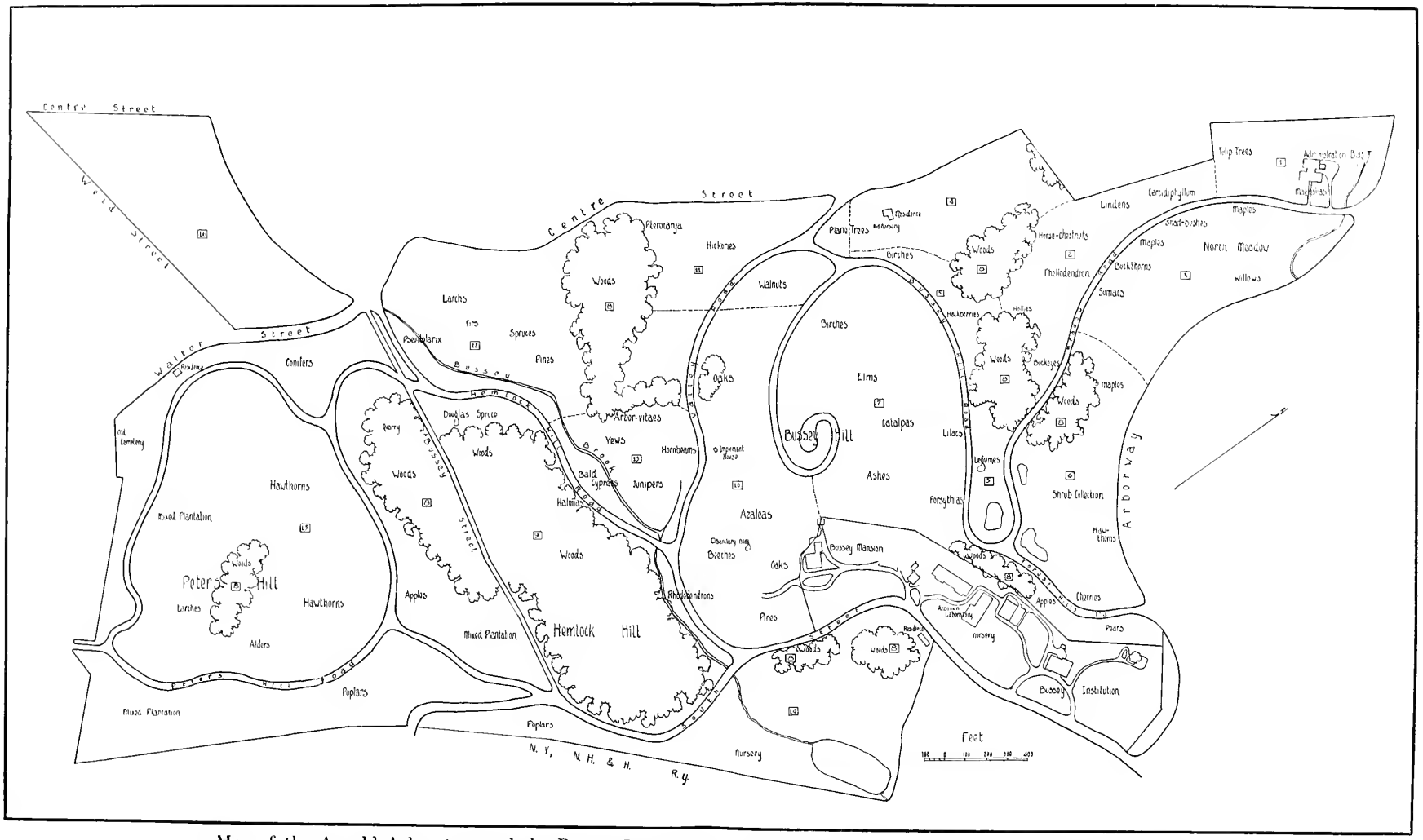
A glance at the titles to these several pieces of property shows that their boundaries persisted through many generations of ownership and conveyance, many of the lines having set off parts of the original colonial grants. It is quite evident further that although they conform in many cases to topographic and soil boundaries, they have but little in common with the modern arrangement of roads and plant-

ings. Therefore it is deemed advisable in the following discussion to use these modern divisions as unit-areas, with constant reference to the old property lines which affect them. Plate I is a recent map of the Arboretum upon which the unit-areas are numbered and separated by dotted lines.

1. The earliest mention of the hillside which lies back of the Administration Building, extending westward to include the collection of tulip-trees, is in the will of Jabez Totman, probated in 1705. Judging by the inventory of his estate the land was part of a farm upon which there was considerable grazing stock, and which was in pasture, orchard, and possibly in part planted to hay. It seems clear that its original timber was removed before 1700. It continued to be farmed by various owners until its incorporation in the Arboretum in 1883, but specific references to its uses are rare. The western half was described in the inventory of the estate of John Morey in 1771 as pasture. The Meadow Road was finished in the early 1890's, and the Administration Building in 1892. The magnolias were planted in the following year, the tulip-trees about the same time, and the pines which now cover the hill-top, sometime in the late 80's. In very recent years an attempt was made to grow small conifers on the southward-facing slope, but this was abandoned and the area is now largely in grass, made beautiful in spring by an abundance of daffodils.

2. Along the west side of the Meadow Road there is a stretch of nearly level ground perhaps 10-12 acres in extent and reaching westward and southward to the bases of the gravelly knolls which are now covered with natural woods. This area is very low and was once part of the North Meadow, but it is now drained and contains the planted groups of *Cercidiphyllum*, *Tilia*, *Phellodendron*, and *Aesculus*. East of the Meadow Road the shadbushes, buckthorns, and sumacs grow on similar ground, with some of the maples.

All of this lowland was known in early times as "Gore's Meadow," and we find it mentioned as the property of John Gore in the oldest record of Roxbury land holdings, the "Ancient Transcript" (1654). Like others of its kind it was of particular value because it supplied a ready source of hay to settlers in a wooded wilderness largely devoid of natural grassland. Furthermore, it was the higher part of the whole meadow area which lies in this section of the Arboretum, and could be successfully drained to increase it productiveness. It was variously divided at different times into halves and thirds during the long and complex history of its ownership, but continued to be used for its original purpose, as hay meadow, until after it became a part of the Arboretum by purchase from the Adams Nervine in 1883. Par-



Map of the Arnold Arboretum and the Bussey Institution showing the numbered areas described in this bulletin.

tial control of Goldsmith Brook which flowed through it was attained in 1892, about the time the Meadow Road was finished, and the resulting drainage made possible the planting, about 1894, of the lindens and horse-chestnuts as well as the other neighboring groups. The control of the brook did not prove entirely successful however. In 1905 a culvert was put under the Meadow Road and the whole brook led underground from Centre Street to the place where it discharges under the Arborway. In 1902 the ground under all of these plantings was laid down permanently to grass which yields a good crop of hay each year, just as its predecessors did in generations past.

3. Lying between the Arborway and the Meadow Road is a marshy tract of several acres, formerly much wetter than now, but still too swampy for extensive plantings. Along the embankment formed by the Meadow Road, and also along that by the Arborway, plantings have been made, and a part of the eastern side of the area has been utilized for willow and alder collections, but otherwise the ground is left to itself.

In earlier times the meadow was divided into two parts by a straight line beginning near what is now the shadbush collection and extending to the Arborway so that a projection of it would follow the westerly side of Park Road, recross the Arborway, and form part of the northeastern boundary of the Bussey Institution property between the street and the Bussey Dormitory. This is one of the oldest surveyed lines in West Roxbury, being known in the original apportionment of the town's property as the "headline" of the "first division of outlands." It was the northeastern boundary of the Bussey estate and so of the original Arboretum.

Throughout its long and somewhat complicated titulary history this area has been described as "meadow." It appears to have been drained with fair success in early times to produce natural hay. In winter and spring it was probably ponded, as it still is after especially heavy thaws or rains. Whitney's map (1843) shows only meadow with no standing water, but a map made about 1879 shows a small pond. The completion of the Meadow Road made possible, in the early 1890's, the border plantings along the western margin of the low ground, but even semi-adequate drainage was not available until better sewer arrangements were made eastward from the Arborway to Stony Brook. This was done about 1900. The Arborway was completed about 1895, and the border plantation of willows was put in at that time. After better drainage conditions came, a willow collection was started (about 1908) in the low ground across from the Administration Building, but for various reasons among which injurious in-

sects and the excessively peaty substratum are important the collection has not been enlarged. The main part of the meadow is regularly cut and burned off in the autumn and allowed to come up to weeds in the following summer. The asters and goldenrods which blossom abundantly in the late summer supply a mass of brilliant color at a time of year when greens predominate elsewhere in the Arboretum.

4. One of the Arboretum's most recent accessions is a small parcel of land along Centre Street lying between the Adams Nervine property on the north and the plane-tree collection on the south. Eastward it is bounded by a timbered ridge on the north slope of Bussey Hill, by the collection of river birches, and by the lowland containing the linden group. In the northern part it is quite low and is traversed by Goldsmith Brook which is now entirely underground. Southwesterly it slopes upward and forms part of the base of the high hill lying just across Centre Street. At the southwestern corner is the old Lewis house, recently renovated, in which lives a member of the Arboretum staff.

The earliest mention of this land found thus far is in a description of the holdings of Samuel and John Gore in 1708, where their northwestern boundaries are noted as on property of Thomas Morey. It is assumed that the latter acquired it either by purchase or indirect inheritance sometime after 1654 since no one of the name of Morey was among the original settlers, nor among those who contributed notes to the "Ancient Transcript." The original Morey parcel contained about 14 acres (see Plate II), and was described as planting land, meadow, and orchard when it was transferred to John Morey in 1714. It is presumed that the meadow was on the low ground along Goldsmith Brook, and that possibly the planting land was on the more level areas about the house site and southeastward, leaving the sharper slopes and the morainic ridge now in natural woods for orchard.

The land remained in the Morey family until 1783, and was the nucleus of that part of the large Morey farm which lay west of the road. The only descriptive matter available in subsequent years is that the land was a farm and that part of it was a "sheep pasture" in 1806. The whole 14-acre piece will be referred to again as different parts of it are discussed. The area southeast of Bussey Hill and that occupied by the plane-trees and river birches were bought by the city for the Arboretum in 1883, but the remainder was not purchased from the Nervine until 1926. For many years the Arboretum rented the old Lewis house as a residence for Jackson Dawson, its first superintendent; and some neighboring Arboretum land was utilized for nurseries at an early date. The nurseries are still in use, but are now

planted mainly to roses. The Valley Road from Centre to South Streets was finished about 1885, and the plane-trees were planted about the same time. Just north of the Lewis house is the foundation of a large building put up by the Nervine. The large terraces around it have involved a great deal of filling, and the excavations found on the hillside to the north probably date from its construction. The lower slopes of the hill as well as the meadow are now in grass, soon to be planted with birches and shrubs. The lowering of Goldsmith Brook in the early 90's and its final "submergence" about 1905 have rendered the bottom land progressively drier and more suitable for present purposes. In very recent years neat conical stacks of hay, cut and put up on this bit of open ground, have added a quaintly rural aspect to the local scene, and have brought up to date the nearly continuous use of the land for farming through nearly two and one quarter centuries.

5. On the lower north and northeast slopes of Bussey Hill are two areas which are bounded on the upper side by Bussey Hill Road, and separted from each other by a strip of natural woods. Northeastward they are bounded in part by the Meadow Road, by other natural woods, and by the lowland of the horse-chestnut collection. The westerly one is planted to viburnums, river birches, and hackberries, while the lower is devoted to a variety of trees and shrubs which are chiefly leguminous. Surrounding the pond at the eastern end are persimmons, tupelos, dogwoods, witch-hazels, etc.

The history of the western area has already been outlined in the account of the 14-acre parcel of Thomas Morey. The more easterly section had an entirely different history, and was part of the Weld land purchased by Bussey in 1806. The western part of it, now containing most of the leguminous trees, was probably in the possession of the Gore family in 1692, and was bought by Joseph Weld in 1718. The land now around the pond was probably part of the original Weld grant. This whole area will be treated in more detail below in connection with the northeastern side of Bussey Hill, but it should be noted that in 1708 and again in 1718 the Gore part was described as pasture, and that all of it probably came under that heading in 1760.

The building of the road, which was finished in 1892, greatly modified the land below it on account of the large amount of grading necessary. A terrace was constructed all along the hillside and a large amount of subsoil thrown over the lower ground. Also a new form of drainage was started with the guttered roadway to carry off surface water from the hill. A temporary spring among the river birches may have become localized in its outlet at this time. Its presence probably accounts in part for the great vigor of the birches. The Meadow Road

separated off the small pond from its neighbors, and the main plantings were finished over the whole lower area in the early 90's. The birches and hackberries had been put in during the late 80's. The attractive color and scent among the locusts in early summer, the rich reds of the tupelo leaves in the autumn, and the delicate tracery of the birch twigs against the winter skies help to make these spots among the choicest in the Arboretum.

6. Along the Arborway is a strip of relatively level land bordered on the north by the meadow. Its south and southwest boundaries are the Forest Hills and Meadow Roads and a stand of natural woods. It is occupied mainly by the maples and the shrub order, but along the roads are plantings of hawthorns, cherries, and plums. Like the land just west of it, this was all part of the Bussey property bought of the Welds in 1806. Likewise its northern part was in the Gore property in 1692 which was sold to the Welds in 1718. The latter was described as pasture in 1708 and 1718, and it is probable that the whole area was in pasture or hay land in 1760. Its more detailed history will be found in another place.

Almost immediately after the Arboretum was founded, the land now occupied by the Shrub Order was utilized as a nursery for starting the thousands of trees and shrubs needed for border and group plantings. There is fairly good soil and a sufficient slope to the westward to insure good drainage. After the bulk of the plantings had been made other nurseries were started, and during the 90's this area was rearranged to serve as a systematic collection of shrubs. A further reorganization and enlargement of the beds to their present condition was finished in 1907. At this time some grading and draining were done, and the large modern trellis was put up. The plums and cherries were planted in 1894, soon after the roads were finished, but the maple group had been started in 1891. The hawthorns along the Arborway seem to have been planted in the early 90's. The land under the maples was not laid down to grass until 1900.

7. The northerly and northeasterly slopes of Bussey Hill have a certain uniformity of aspect produced by the rather open plantings of large trees which cover them, and have been grouped together for purposes of description. The area in question is inclosed by the Bussey Hill Road as it "spirals" up to the Overlook, and bounded southeasterly by land of the Bussey Institution. It is occupied by the collections of birches, elms, mulberries, catalpas, ashes, oleasters, lilacs, forsythias, and privets.

The lower part of the birch collection, as already noted, was mainly in the Morey land which came from the Adams Nervine in 1883. All

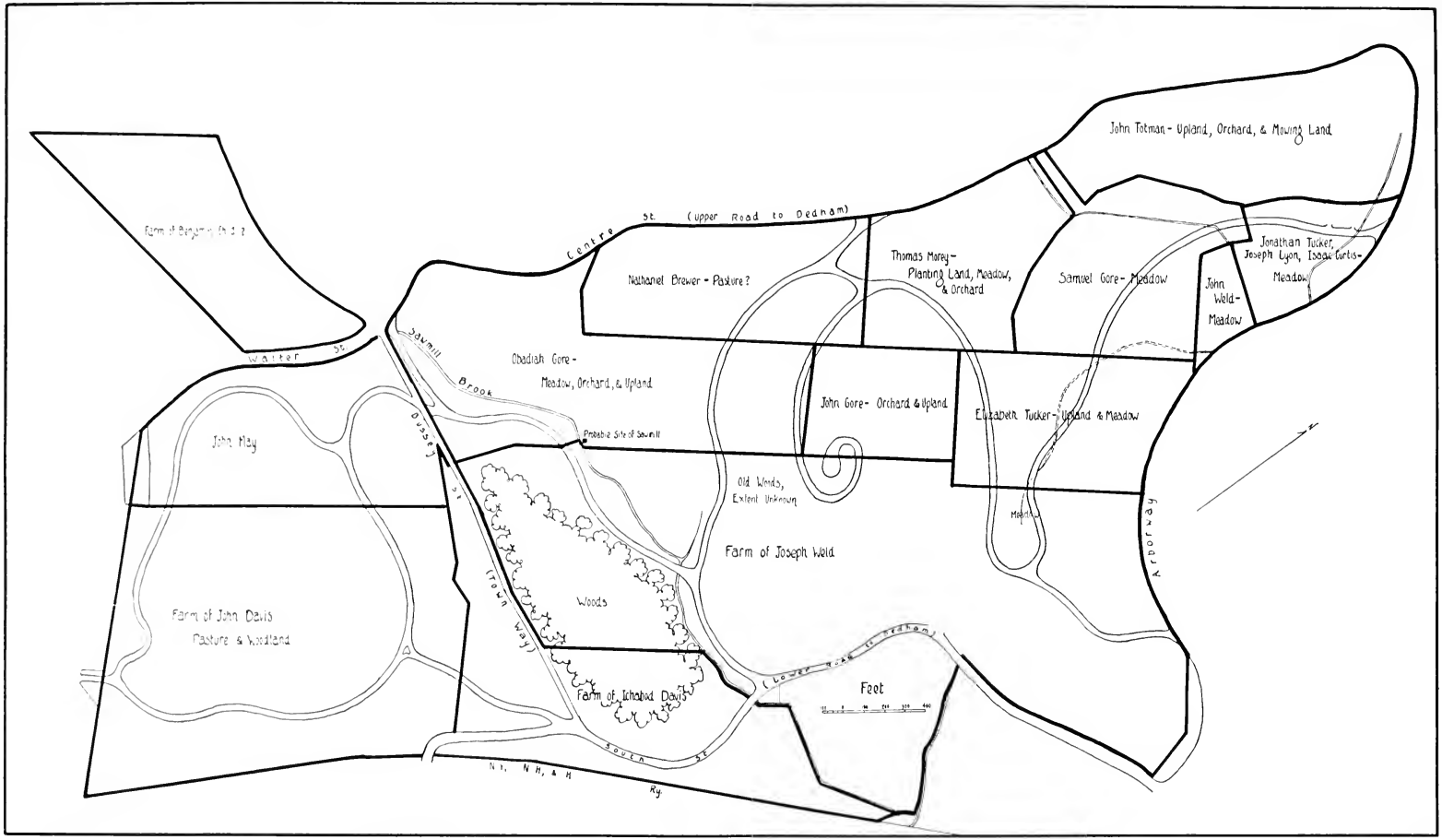


Plate II. Map of lands in the Arnold Arboretum about the year 1710.

of the remainder of the hillside was in the Bussey estate purchased from the Welds in 1806. Although the old Weld estate is represented in several other areas described elsewhere, its history as a whole will be discussed here.

Among the Roxbury settlers were two Weld brothers, Thomas and Joseph. For various considerations, among which was his military service to the colony during its early dealings with the Indians, Joseph Weld acquired a large grant of land in West Roxbury about 1640. The location of all this land, upwards of 270 acres, is not clear, but it is known that a large part of it lay on both sides of South Street, then called the "Lower Road to Dedham" or the "Highway to Bare Marsh," in the neighborhood of what is now Forest Hills, and that it was farmed by John Weld, a son of Joseph. Early descriptions of this property are so confusing that it seems all but impossible to define their meaning at present. At any rate it is certain that a considerable portion of the Arboretum land was still in primeval forest in 1691 and later, and that John Weld's son Joseph inherited from his father 60 acres, "partly plowland part meadow and pasture and woodland," which evidently lay west of the road and was the Arboretum property in question. For the boundaries of this land reference should be made to Plate II. The area was apparently underestimated at 60 acres, and continued to be underestimated until accurate surveys were made in 1861. It is presumed that the meadow mentioned in the above note was that now represented in the ponds near the Shrub Order. The relatively good soil on the "Plain-field" (Bussey Institution land along South Street) was undoubtedly utilized as at least part of the plowland, leaving the pasture and woodland for Bussey and Hemlock Hills.

After the death of Joseph Weld in 1712 the 60 acres passed to his son Joseph, but with no additional evidence as to land uses at that time. This Joseph Weld greatly increased the property by purchases from the Gore family in 1718.

The inventory of the estate of Samuel Gore, probated in 1692, affords the first definite record of a large part of the Arboretum land. There is reference to "About 22 acres of Meadow and Upland lying before the house. . . About 40 acres of Land, extending from sd. Meadow to the Sawmill, & taking in somewhat in the Second division for the advantages of the sd. Mill, Together with the Mill being almost rotten & the Dam broken. . . ." The first item refers to the low ground of the horse-chestnut and linden collections and to the lowland southeast of it. The second includes a strip of land about 550 feet wide northwest of the Weld property described above, and ex-

tending into what is now the collection of larger conifers. It then included all of the 15 acres now occupied by the latter (see Plate II). Mention of a sawmill and dam is of considerable significance since the mill and its equipment had, as early as 1692, seen a great deal of service and must have accounted for the reduction of a great deal of the primeval forest of the Arboretum prior to that date. It is also of interest because the earliest name of Bussey Brook was "Sawmill Brook," which clung to it until the time of the Bussey estate.

The disposition of the Gore property between 1692 and 1718 contains so much descriptive matter that it will be noted in some detail. After the death of Samuel Gore his estate was not finally divided until 1708. In this division the oldest son, Samuel, received most of the meadow land (northern part). His mother, Elizabeth Tucker, had a piece which included land now in the collections of lilacs, tree legumes, part of the maples, natural woods, and a part of the Shrub Order. Her land was designated as upland[1] and meadow. Another son, John Gore, received about eight acres in a roughly rectangular piece just southwest of the last. It now contains the elms, mulberries, and parts of the catalpas, lilacs, and birches, and was described in 1708 as upland and orchard. A third son, Obadiah Gore, had about 15 acres bounded southwesterly and southerly by Bussey, Walter, and Centre Streets, and now containing the larches, firs, spruces, and pines. He also had about 10 acres lying between this and John Gore's eight acres. The whole of Obadiah Gore's 25 acres was described as meadow, orchard, and upland. It is of interest that none of the Gore property was noted as woodland or plowland at this time.

Subsequently Samuel Gore acquired all of his mother's and John Gore's shares, and sold all but a part of the meadow to Joseph Weld in 1718. In the latter transaction the whole area was mentioned as meadow, orchard, and pasture, with still no mention of timber or cultivation, and confirming the definition of "upland" as pasture. Obadiah Gore's share had an entirely different history. The Joseph Weld property, as now constituted, was substantially the same as that later bought by Benjamin Bussey.

The last Joseph Weld died in 1760, leaving the future Arboretum land to his son Eleazer. A rather detailed inventory of his estate is given, the significant items being as follows: "about 6 Acres of Orchard adjoining the house. . . 9 Acres of the Plane Eastward of the

[1] The term "upland" evidently referred to upland pasture rather than to woodland. It is often given in a list of properties, others of which are definitely designated as woods.

barn. . . about 10 of fresh Mowing, & 3 of Woodland. . . about 8 Acres of Meadow Called Gores Meadow. . . About 44 Acres of Pasture & Woodland. . .'' He had in addition considerable livestock including 21 sheep, 6 horses, 4 oxen, 13 cows, 4 ''young Cattle,'' and 3 pigs. There is also mention of a ''Mill house Including about Nine Thousand of Shingles.'' Providing the farm house was, like the barn, west of the road, the six acres of orchard and nine of the ''Plane'' would account for all or most of the present Bussey Institution land. The 10 acres of fresh mowing is presumed to have been in part fresh meadow, either in the lowland at the eastern end of the farm or somewhere on Bussey Hill. Gore's Meadow was evidently the roughly triangular piece at the northeastern corner of the farm. The 44 acres of woodland and pasture, therefore, were probably confined between the old lines of the Weld, John Gore, and Elizabeth Tucker lands on the northwest, and the boundaries of the Bussey Institute area on the southeast. There is every indication that Hemlock Hill was never entirely cleared and made into pasture, so that it may be regarded as at least part of the woodland. A large oak tree in the azalea collection on Bussey Hill, which was killed by lightning in 1931, proved to be solid to the center, and to be 264 years old. Its rings show that about 1763 the primeval forest in which it had spent the first part of its life was finally cleared, and that after that time it remained in the open, undoubtedly in pasture since the steep slope would preclude cultivation. The width of the rings prior to 1763 indicate that no appreciable clearing had been done around it in the preceding 96 years, and certainly none could have been expected before that time because all of the earliest rings are very narrow. Since all of the original Gore land had already been cleared, the conclusion seems justified that the woodland part of the 44 acres was confined to Hemlock Hill, a part of the southern slope of Bussey Hill, and possibly some of its southeastern slopes. It is probable, however, that all of the eastern and southeastern sides were open, and that the three acres of woods mentioned with the 10 of fresh mowing, were an isolated lot in this vicinity.

There is nothing in the records of Eleazer Weld's estate when he died in 1800, nor in the sale of it to Bussey in 1806, to indicate the trend of uses in this area. The next pertinent information is on the Whitney map of 1843, which shows most of the land except Hemlock Hill still open, but with clumps of natural woods here and there. The history of these wooded areas will be taken up in another place.

From the above notes it seems clear that most of the land in area no. 7 was clear and in pasture or orchard or both in 1708, and that the northwestern end may have been under cultivation; also that the

southern end, where the privets, ashes, and parts of the catalpas are, was probably clear and in pasture prior to 1760. Furthermore, there is no indication that any of this land was allowed to grow up to natural woods subsequently, nor is there much evidence of cultivation in these early times.

Bussey planted a double row of lilacs, among which were white pines, in a sort of rectangular arrangement around the top of the hill back of his mansion. A few of the pines are still standing near the azalea collection and long lines of lilac bushes remain on the east side of the Overlook. The fence row which separated the John Gore and Elizabeth Tucker properties was still in existence in the early 1890's, as shown on an old photograph in the Arboretum Library, and the ones between the John and Obadiah Gore lands, as well as that between the former and the Brewer and Morey properties in part, were perpetuated in Bussey's lilac plantings which followed the old lines. The ashes, elms, catalpas, and birches were started in 1886, and the ground beneath them was laid down in grass about 1900. The lilac and forsythia groups appear to have been started early in the 1900's, very near the road, while the bank above the lilacs was still planted in privets. The lilacs were not expanded up the bank until somewhat later.

8. There are several stands of natural hardwood timber in the Arboretum which have had a somewhat varied history. It seems clear that during most of the 1700's the Arboretum was for the most part devoid of deciduous woods, but the ancient oaks on the southwest slopes of Bussey Hill indicate that there were occasional trees which had their origin in the primeval forest, and at least one patch of woods which persisted until the 1760's. Since the present woodlots are mostly of even-aged trees it is possible to "date" within a very few years the several stands.

At the northeastern base of Bussey Hill are several gravelly knolls upon which most of the oldest trees are 100-110 years of age. There are two parts of the woods, separated by a clearing below the hackberries. The oldest trees in the westerly portion are mostly of sprout origin, while in the easterly tract there is a much greater number of trees which started as seedlings. The trees east of the Meadow Road, as well as a few around the base of the knolls just west of it, are older (130-140 years). Also, they are nearly all of seedling origin. All of these trees had a very rapid growth at the start, and show nothing but a gradual diminution in the rate subsequently.

The woods on the rocky hill along Centre Street north of the conifers is somewhat less even-aged than the others, the oldest trees rang-

ing from 120 to 140 years. All of those counted except one had a rapid growth at the start with gradual slowing, and were seeded in. The exception was a 140-year-old oak which grew rather slowly during its first 10 years.

The open woods on the knolls southeast of South Street appear to be about 120 years old, and to have started mostly as seedlings. They grew rapidly at the beginning and slowly later. At the southeastern end of the tract there are a few large white and red oaks which probably antedate the others.

Southwest of Bussey Street, on the rocky upland adjoining Hemlock Hill, is a piece of woods which evidently started by seeding about 130-150 years ago. Many of the older trees have been cut for some time so that it is difficult to count their rings. A sufficient number of sound stumps of recent cutting are available, however, to set the above ages. Like most of the other stands this also shows nothing but a steady diminution in the rate of growth.

The small piece of woods on the easterly side of Peter's Hill appears to be about 100 years old, and to be of seedling origin, with a gradually slowing growth rate.

As shown above there is no indication of woods in the descriptions of the lands at the northeastern base of Bussey Hill in the early 1700's. The westernmost of the knolls was Morey land, and was probably in orchard or pasture in 1714. The remainder was Gore property, in orchard or pasture in 1708 and again in 1718. Subsequent history of the westerly piece is obscure, but the large percentage of sprout origin is evidence that the present woods were preceded by another. However, the position of the sprouts does not indicate a previous forest of very large trees. It is presumed therefore that the land was abandoned and seeded sometime in the late 1700's. As will be noted elsewhere, the breaking up of the Morey estate occurred in 1783, and this may have been the period of abandonment.

The more common seedling origin among the trees on the knolls farther east indicates that this land was maintained in orchard or pasture for a longer time. If this is not the case then it is necessary to assume that approximately between 1718 and 1830 a woodlot was started, allowed to grow, and then was so completely eradicated as to preclude sprout origin for a large percentage of the later trees. It is more reasonable to assume that the woods started in long-open ground, some of the young plants being grubbed out in the early stages, giving rise to a certain amount of sprout growth. Further, there is little in the 1760 inventory of the Weld estate to indicate woods in this area. The timber east of the Meadow Road evidently had about the same

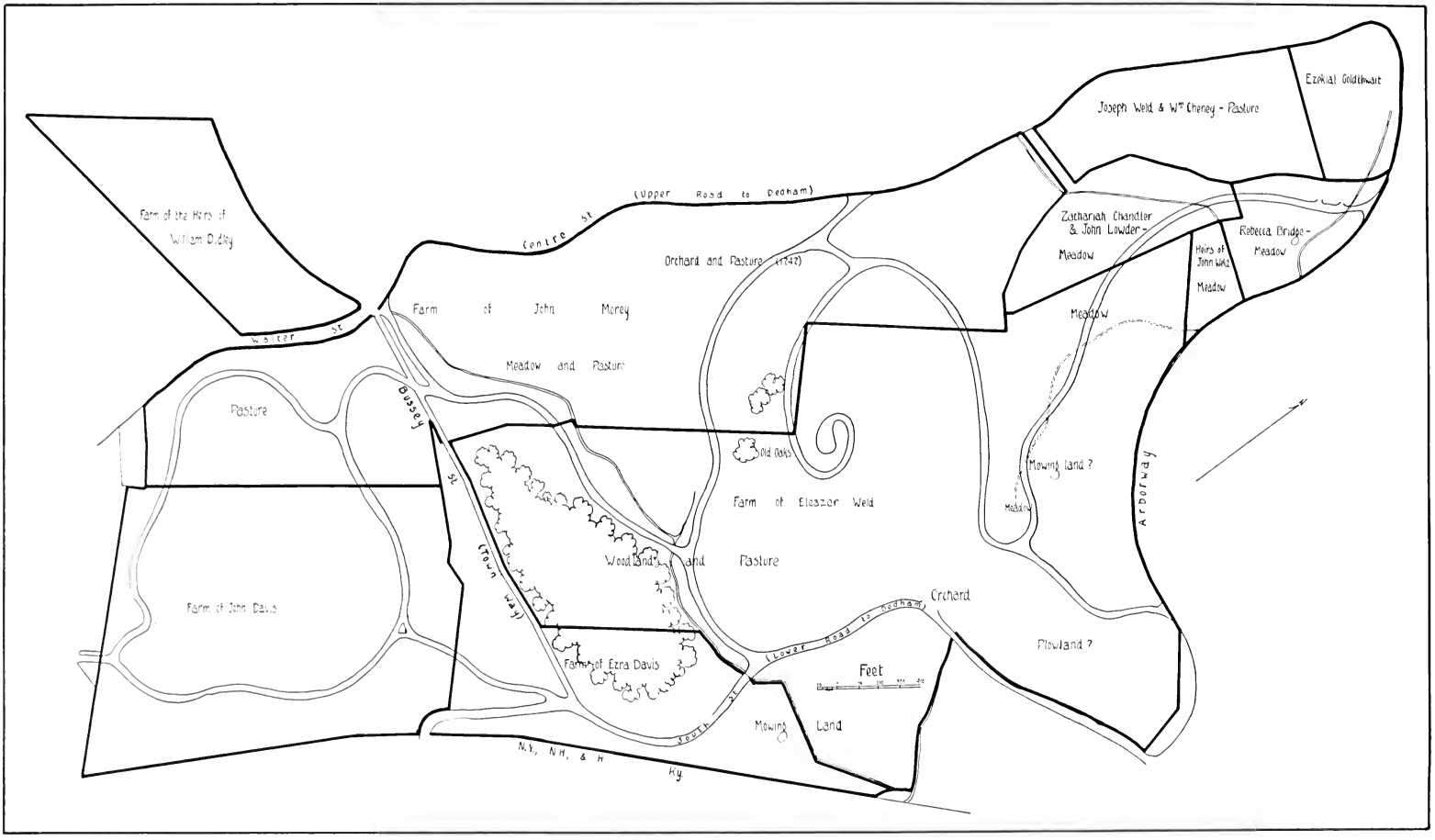


Plate III. Map of lands in the Arnold Arboretum about the year 1770.

origin, but started earlier, about 1800. Here again the abandonment of the land might be correlated with a major property transfer, since 1800 was the year of Eleazer Weld's death, and his heirs sold his ancestral estate to Benjamin Bussey in 1806.

The upland rocky woods along Centre Street was partly in the estate of the Brewer Family for several generations prior to 1764 when it was sold to John Morey. In 1733, and again in 1747 the probate records show that it was part of a 17-acre parcel along the road, bounded by John Morey on the northeast, by Joseph Weld on the southeast, and by the land formerly of Obadiah Gore on the southwest (see Plate II). In both years it was described as pasture. The woods farther to the southeast, between the pines and the former chestnut group, is on the Gore property described as orchard and pasture in 1708, and as pasture in 1771. It seems clear therefore that this land remained open and mainly in pasture until the present woods seeded in, which evidently occurred after about 1790. This might also be correlated with the final dissolution of the Morey estate in the 80's.

The northwestern part of the woods just south of Bussey Street is on land which was also part of the Morey farm and was sold to John Davis in 1777. It was described as pasture in 1730 in an inventory of the estate of John May, in 1771 in an inventory of the estate of John Morey, and again in 1802 in the division of the property of John Davis. This brings it to about the time when the present woods seeded in. The southeastern end of the tract was mostly in the farm of Ezra Davis which was purchased by Bussey in 1832. Earlier history of this is very obscure in the records, there being almost nothing descriptive of the Ezra Davis land except that it was a farm. It is probable, however, that the present woods seeded into old pasture or possibly old orchard in the late 1700's and early 1800's.

The knolls below South Street were in the Weld estate, but their early history is obscure on account of the small amount of data available on the boundaries or uses of the land in this section. The present woods evidently seeded into open ground in the early 1800's, at about the time Bussey purchased the property.

The small patch of woods on Peter's Hill is evidently but little over 100 years old. There is little information as to the earlier history of the land, as will be shown later, but the present timber seeded in about the time the land was purchased by Bussey in 1837 from the Davis family which had held it through several generations.

This brings the discussion to the Whitney map published in 1843, the year following the death of Benjamin Bussey. On this map there are no woods shown on the knolls at the northeastern base of Bussey

Hill except those between the Meadow Road and the maples. Likewise there is none on Peter's Hill. The other tracts are shown essentially as they are at present except that the one by the conifers had a large extension northward to cover the sites of most of the present walnut and hickory collections. There is evidence of this extension in the abundant undergrowth now existent especially under the walnuts.

It should be noted that the only woods omitted from the map are those approximately 100 years old. When the map was made they were but thickets of young saplings 10-15 years old, and were therefore not regarded as woodlots. The other tracts were young stands 25-50 years old.

As for the period between Bussey's death and the starting of the Arboretum there is little information of any kind. There was a note in one of the codicils of Bussey's will, however, that no timber was to be cut off the land until the University took it over. Consequently it is fairly certain that the areas of natural timber remained intact until the Arboretum era. Professor Sargent mentions repeatedly the thinning and pruning of the natural woods, especially in the early years, but nowhere is there mention of clearing operations. Whether the present hickory and walnut areas were thinned out by him or by someone cutting between 1861 and 1872 is uncertain, but it is probable that the present condition was made in the 80's when the groups were planted. Pruning and the elimination of old decrepit trees still goes on with good results in the growth of young stems which will insure the continuity of the timber as a whole. Undergrowth and ground cover are allowed to develop as they will except in a few cases where azaleas or other shrubs have been planted in the more open woods.

9. The entire history of Hemlock Hill prior to the Bussey purchase is to be looked for in the records of the Weld and Davis families, and in the trees themselves (see Plates II, III, and IV). Whether Bussey did any cutting of trees during his lifetime is unknown. It is presumed that since his death little has been done except for the removal of dead wood, but in the growth rings of trees cut recently from the steep eastern slope there is evidence of the release of formerly slow-growing trees. This indicates that some of the thinning operations started by Sargent were probably carried out in this area. Elsewhere on the hill the release is not shown. On the middle part of the eastern slope there are several recently cut stumps which show a release about 125 years ago of such a nature as to indicate considerable cutting about that time. The trees are 140-160 years old.

On the northern slope of the hill the older trees range from about 100 to about 140 years old. The younger of these (about 100-120

years) are near the brook at the base of the hill, while the older ones (135-140 years) are part way up the slope. All of these trees grew very rapidly at the start and show no evidence of release except in one case where there is a slight indication of it about 60-65 years ago. Otherwise they all show a rather steady diminution in rate of growth after very rapid starts. Young trees in the dense shade on the lower slopes are now growing very slowly, even from the seedling stage. There is every reason to believe, therefore, that this hillside was either clear-cut or heavily culled about 140 years ago. The younger trees near the brook could still have had a rapid start many years later both on account of the better light at the edge of the timber and because of nearness to water.

The southerly slope of the hill is also steep and rocky, but is notable for a large admixture of hardwoods. The older of these appear to range from 135 to 150 years of age, and to have grown continuously in the open when they were young.

From the above notes it is evident that Hemlock Hill has been the scene of a certain amount of lumbering. It is apparent that in the early 1800's considerable was done on the Davis land at the eastern end, and in the 1790's the north slope was rather heavily cut. The trees on the top of the hill are rather uneven-aged (80 to 160 years), but all show fairly rapid growth at the start which might indicate either continued culling of the stand or a relatively open timber growing there naturally. The writer is inclined to the latter opinion, especially since young trees now starting have the same sort of rapid growth. The forest has undoubtedly suffered considerably from the continued trampling of picnickers and hikers. Fences recently put up are intended to discourage climbing on the steep rocky cliffs on the north side where most of the damage is done. The partial drying up of Bussey Brook, and the change in its channel effected several years ago have also done some damage to the trees near it. On the other hand there is a wealth of young birches in the woods, and with them young hemlocks which bid fair to perpetuate the forest provided they and the pittance of soil they grow in can be preserved.

10. Most of the steep southwestern slopes of Bussey Hill are now devoted to collections of oaks and beeches. A ridge-like extension of the hill south of the Overlook carries on its top and upper slopes a miscellaneous collection of shrubs and small trees among which the azaleas are the most conspicuous. There are a few ancient oaks on the hillside which are remnants of an old forest, but most of the woods there now consist of planted trees. The old remnants appear to be the oldest trees in the Arboretum, at least some of them dating back

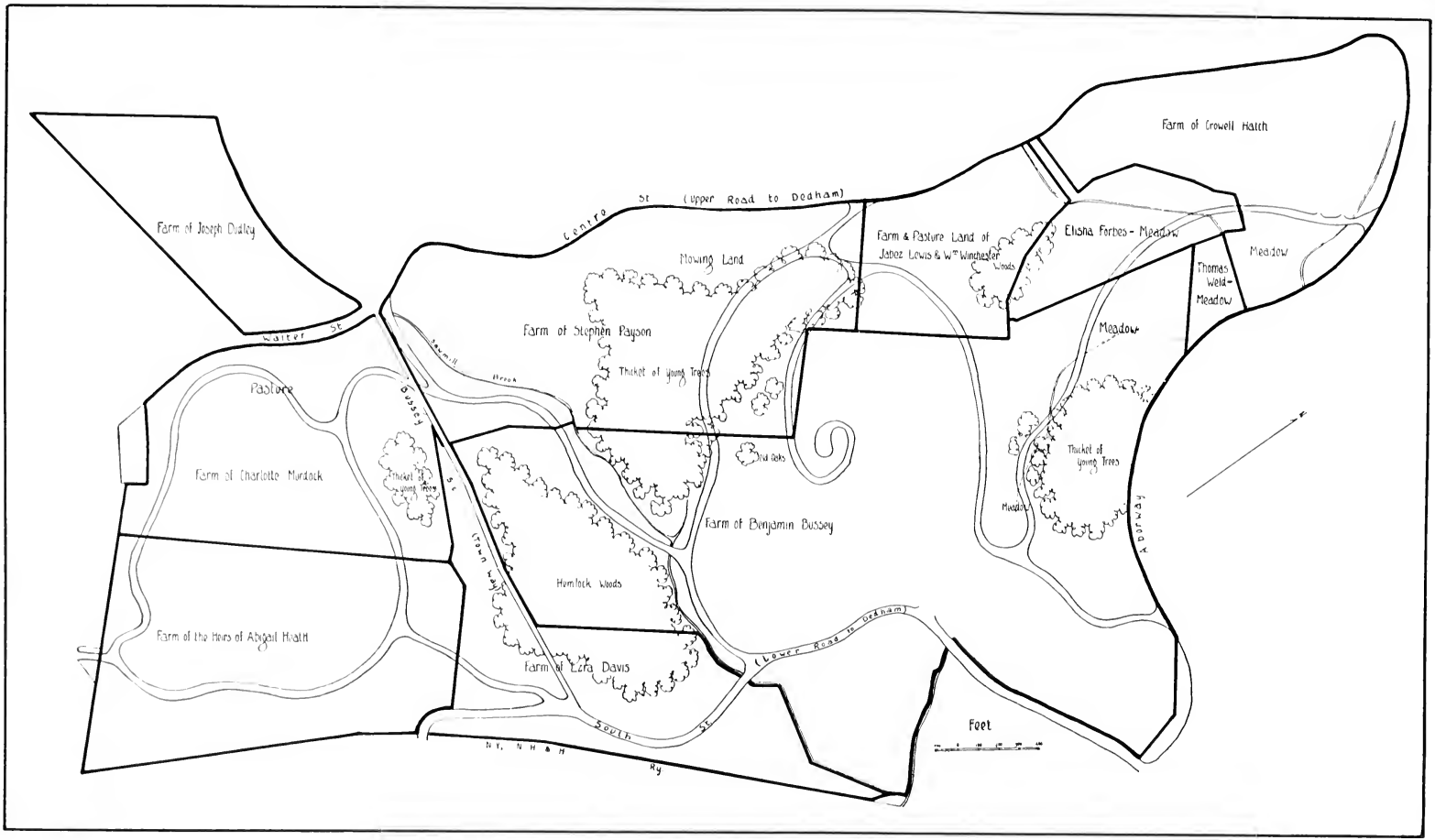


Plate IV. Map of lands in the Arnold Arboretum about the year 1810.

to the primeval forest.

The northern part of the area, containing most of the oaks, was the property of Samuel Gore in 1692 and, as stated above, was described in 1708 as orchard and pasture when it came by inheritance to Obadiah Gore. The latter sold it in 1710 to William Dudley, in which transaction it was part of a larger piece called "Orchard & meadow." This would suggest that the upland part now under consideration, since it could not have been meadow, may have been entirely in orchard. In 1771 when an inventory of the Morey estate was made, it was noted as pasture. After 1771 there is no descriptive matter referring to the use of this land, but it is presumed that the western part of it was abandonded as farm land about 1800 or earlier, since it was in woods on the Whitney map of 1843. The upper, eastern part appears to have been still open at that time except for a few clumps of old trees.

The slope of the hill farther southeast, where the beeches and azaleas are, was part of the Weld estate which, as noted elsewhere, is somewhat obscure in its land history. Evidence from the old stump in the azalea collection shows that the primeval forest in its vicinity was not cleared until about 1763, and that subsequently the land must have remained open, probably in pasture, to the beginning of the Arboretum. Whether this evidence applies to the whole hillside is unknown, but there are a few old oaks in other parts which may eventually throw light on the question. In 1843 the only woods shown on the Whitney map for the whole area are a few clumps, evidently of these old trees.

The first road built in the Arboretum was that between the Centre and South Street gates, finished about 1884. The beeches were planted in 1886 and the oaks in 1887. The boundary plantation of pines next to the Bussey Institution land was probably started in the late 70's. The top of Bussey Hill was held as a reservation by the City until 1895. The azalea collection was not started until 1907, and the influx of the late E. H. Wilson's plants inaugurated the so-called Chinese collection around the knoll south of the Overlook. The sanitary building was put up about 1903. Apparently no attempt was made to lay down a cover of grass under the oaks and beeches, and the open ground just above the road inside the South Street gate probably dates back to very old pasture or cultivated land, as does also that on the top of the knoll above the Chinese collection.

11. The walnuts, hickories, and a miscellaneous group of species in the vicinity of the pterocaryas are planted in an area of approximately 10 acres along Centre Street and bounded southeasterly by the old

chestnut collection, the oak collection, and part of the birches. There is a natural boundary line on the southwest made by the rocky woods, but the northeastern boundary has been set rather arbitrarily in the plane-tree group.

This land was part of the 17-acre Brewer parcel described in connection with the natural hardwoods. The first direct mention of it is in the inventory of the estate of Nathaniel Brewer probated in 1733, where it was described as pasture land. In 1747 another Nathaniel Brewer also noted it as pasture, but after that there is no definite record of its use for many years. At the time when an adjacent piece was purchased by Bussey, in 1813, it was noted as a "mowing lot," which indicates that it had not lost its character as open land at that time.

Whitney's map of 1843 shows approximately the southeastern third of the area in woods, the age of which is uncertain. The 1813 conveyance suggests, however, that the timber did not start until after that date, but that it must have been soon after in order to make an impression upon the map maker as woodland. In the edge of the present woods on the southwestern side of the tract is the bed of an old stone wall.

The hickories were planted in 1886 soon after the finishing of the Valley Road, and the walnut group was started in 1886-87. The pterocaryas were planted in 1887. Like the ground under the oaks, no attempt appears to have been made to start grass in these groups. A part of the land lying on the gentle slopes east of the pterocaryas was used many years ago for nursery purposes, and now contains a miscellaneous collection of shrubs among which are *Deutzia*, *Spiraea* and others. Judging by Whitney's map the woods which came up did not reach the site of these beds of shrubs, so that it probably remained open from the time of the Brewer pastures of the 1730's or earlier.

12. A roughly rectangular piece of ground containing about 15 acres and bounded southerly and southwesterly by Centre, Walter, and Bussey Streets, is now devoted to the larger conifers such as the pines, spruces, firs, larches, and the handsome golden larch.

A narrow place in the channel of Bussey Brook which occurs near the eastern corner of the parcel was the probable site of the sawmill which was built on this land very early in the history of its occupation. As noted above the inventory of Samuel Gore's estate in 1692 described the mill as being very old and the dam which produced its power broken down. The whole 15 acres, with 10 acres northeast of it, were described in 1708 as meadow, orchard, and pasture, and in 1710 as meadow and orchard, suggesting that the orcharding may have

been extensive at that time since the meadow was necessarily small. The Morey inventory of 1771 calls it the "Saw Mill pasture & Meadow."

After 1771 the records, which are exceedingly complicated as regards ownership, show no descriptive matter other than boundaries. The Whitney map, however, shows that the land was clear in 1843. The extent of the meadow could not have been very great, as shown by the contours of the ground; and the length of time it lasted, depending upon the activities at the site of the old sawmill, is quite unknown. The inventory of Joseph Weld's estate in 1760 mentions a "Mill house Including Nine Thousand of Shingles," but fails to tell where the house was.

The history of a small triangular piece of land at the western corner of this area, containing less than half an acre, indicates a change in the course of Bussey Street. The position of the road was evidently moved northward at the entrance to Walter Street between 1812 and 1835, and the old house site now south of Bussey Street at this corner originally had the street south of it. It is presumed that other changes in the course of the street were made at the same time but what they were is yet uncertain.

Whitney's map shows that in 1843 there was a house along the road on the rocky hill where the natural wood now stands. It may have been the home of negro squatters who are known to have lived in this neighborhood for many years previously. There were also houses at that time near the point where Walter Street turns off of Centre, and on the south side of Bussey Street where it joins with Walter. The foundations of the latter are still in evidence and very conspicuous, as noted above, but those of the former have been nearly obliterated. The former houses, or others on the same sites, belonged to the Kent and Skinner families and remained standing until sometime in the 1890's.

The larger conifers were started in 1886, but the Hemlock Hill Road was not finished until about 1892, the same year in which the deepening of Bussey Brook modified to a certain extent the drainage of the area. There is a sizeable but intermittent spring on the hillside among the spruces. In 1900 the land under the permanent plantations was laid down to grass.

13. Between the Hemlock Hill and Valley Roads there is a roughly triangular piece of ground which now contains the collection of yews, arbor-vitaes, sciadopitys, junipers, bald cypresses, and hornbeams. It is bounded on the northwestern side by the pines and by some natural woods. A striking feature is the clump of old beeches along Bus-

sey Brook. On the northeast side of the area is a small intermittent stream which joins with Bussey Brook near the junction of the roads. It is fed by a spring which issues near the large rock outcrop along the Valley Road.

Nearly all of this land was part of the original Weld grant, and its early history is unknown. Whether the brook and its tributary flowed through open places or were overhung with woods in the natural forest is undetermined, nor do we know when the land was cleared. The interesting investigations by Mr. E. J. Palmer upon aboriginal relics in the Arboretum suggest that part of this area was the site of an Indian camp ground, and if this is the case partial or complete clearing for a very long time might be suspected. The Whitney map shows the woods on both sides of Bussey Brook reaching nearly to the water in this vicinity, while a map of the Arboretum prepared by H.S. Codman in 1887, before Hemlock Hill Road was built, shows natural woods covering about the southern half of the triangle, forming a continuous wooded area from Hemlock Hill to Centre Street. Pictures taken when the road was graded (about 1890) show that it went through a wooded strip, and Sargent, in his historical account published in 1922, says that there was an alder thicket along the brook, presumably in this vicinity. Not much is left of these woods except the old beeches above mentioned and some occasional large oaks. The hornbeams were planted in 1886, the groups of *Taxodium*, *Taxus*, and *Sciadopitys* in 1891, and the arbor-vitaes and junipers probably in the late 80's. The ground was laid down to grass about 1900. The conifers, viewed from several vantage points either in the valley of the brook or on the slopes of the nearby hills, constitute one of the most striking features of the Arboretum, and one of the first to be completed.

14. The wooded part of the South Street tract has already been discussed, and there remains the lower ground where the pond is now situated. The limited amount of planting which has been done there consists mainly of poplars and willows except for a small area near the railway which is being used as a nursery.

Bussey, or Sawmill Brook, as it traversed this lowland, appears to have been the ancient dividing line between the Weld and Davis holdings. Throughout their entire history these properties have been largely in meadow. The low knolls in the southwestern part were presumably in pasture or under cultivation, but there is no specific record of such. The part northeast of the brook came into Bussey's hands with the Weld purchase in 1806, while the remainder was bought from the estate of Ezra Davis in 1832. What is known of the latter will be found in the discussion of Peter's Hill. At the time the tract

was added to the Arboretum the northeastern part was only a wet meadow, but in 1922 work was started, and by 1925 the pond was formed by the excavation of masses of peat. Some of the surrounding land was raised by allowing it to be used as a dump, but beyond this and some border plantings the original project of roads, paths and plantings is still unfinished. With the growth of the trees which will eventually shield the tract from the adjoining railway, it can be made into a useful as well as beautiful addition.

15. Although Peter's Hill exhibits some striking variations among its natural habitats, the history of its human occupation is so uniform and so scanty in detail that for present purposes it is grouped under one heading except for the natural woodlands which have already been discussed.

All of the Peter's Hill land now in the Arboretum with the exception of the small parcel in the old cemetery belonged to two branches of the Davis family when it was acquired by Bussey. An irregular line drawn from a point near the crossing of the Arboretum road on Bussey Street to one near the place where South Street turns under the railway divides the two. This line would probably pass along the northeast side of the apple collection, and was approximately on the "headline" of the ancient "second division" of colonial lands. Two sons of William Davis, one of the earliest settlers in Roxbury, occupied the land sometime in the late 1600's or early 1700's, but how they got it, whether by purchase, inheritance, or grant, is unknown. Ichabod Davis owned the triangular piece along Bussey Street, about seven acres on the eastern end of Hemlock Hill, and a piece of the South Street tract. John Davis originally had upwards of 40 acres of the southeastern part of the remainder.

There is practically no information as to land uses in any of the Ichabod Davis records. The property was carried as a farm through several generations, and was finally sold to Bussey in 1832 by Benjamin Weld, the administrator of Ezra Davis' estate. The Whitney map shows it as open ground except for a small extension of timber across Bussey Street from Hemlock Hill.

The first descriptive matter on the John Davis land is in a will probated in 1705, where the following note is found, "... homestead of Upland & Meadow lying on both sides of the Country Road leading to Dedham—Including in it that pt. of Pasture Land and Woodland Adjoining unto John May & Joshua Seivers." It is assumed therefore that the southeastern 40-odd acres of the hill were in pasture and woodland at this time, but the proportions and arrangements of each are unknown. From 1705 to 1843 there is no indication as to

the relative openness of the land nor to its uses except that it continued to be farmed by succeeding generations of Davises until sold to Bussey in 1837.

The northwestern part of Peter's Hill is more obscure as to the history of its ownership, but there is a fairly good record of land uses during the past 200 years or more. Some mention of it has already been made in the description of the natural woods. At the time of the Davis will noted above there were about 14 acres of land in the northwest corner of the hill area which belonged to John May, but how he came by them is as yet unknown. An inventory of the May estate filed in 1730 describes the 14 acres as pasture. The Morey inventory of 1771 described it as pasture, and it was the same in 1777 when John Davis bought it from the Morey estate. The inventory of John Davis' property in 1802 still noted it as pasture, and it was mostly open land on the Whitney map in 1843. Some rocky land near Bussey Street was abandoned to timber in the very early 1800's, as noted in the discussion of natural woods.

The Davis will of 1705 mentions a piece of Seaver land adjoining the May property, and in a deed given to John Morey in 1740 the Seaver land is also used as a boundary on the southwest. Apparently there was a small piece, perhaps between the burying ground and John May, which was later acquired by John Morey. When the latter bought the larger tract it was noted as 14 acres, and when it was sold it was 17 acres, but no intervening transaction has been found. The cemetery land appears to have come from Seaver property and to have been set off about this time. The first meeting held at the old Walter Street Meeting House was in 1712.

The property of John Davis on Peter's Hill was divided into two parts in 1802. The southern part, about 32 acres, was inherited by his brother Nathaniel, and the northern, about 28 acres, went to a sister, Charity Murdock. Bussey purchased the former directly from the heirs of Nathaniel Davis in 1837. The 28 acres, on the other hand, were sold and resold repeatedly, passing through the hands of six owners before 1833. Bussey purchased it from the last of these in that year. The division made in 1802 has left no evidence on the ground, but over the top of the hill is a low ridge which may have been the base of a stone wall. It is in about the right location for the boundary of the old May pasture.

The whole area south of Bussey Street was brought into the Arboretum in 1895. In the same year Bussey Street was straightened and the grades improved. The roadways were finished in 1900, and the boundary plantations in the following year. Also in 1901 groups of

willows and poplars were put in on the southeast slopes, the spruces and firs were planted along Walter Street, and the crab-apple collection was started at the northeastern base of the hill. The great *Crataegus* plantations which cover much of the northeast and southeast slopes were mostly planted in 1906-7. In the late 90's a nursery was started near the top of the hill on the southwest side. Later it was abandoned but a great many plants were left so that there is now a miscellaneous collection of exotic trees which seem to be thriving.

When the Arboretum took over the land there were a few large trees scattered over the northwest slopes. These are now nearly all gone, but their stumps, although large, indicate that they grew very rapidly throughout their lives, evidently in open land, and that they were scarcely if any older than 100 years. Drainage conditions were modified considerably throughout by the building of the roads which now carry a great amount of surface run-off. Major changes were also made at the eastern base of the hill. The road leading out to South Street passes over a large fill which crosses the ravine in which the American apples are planted. A part of the southeastern slope is springy and harbors a native flora peculiar in many respects to wet meadows. A large tract along the railway near the southern corner is devoted to a collection of oaks, and on the hillside above it is a group of young larches.

16. A comparatively recent addition to the Arboretum is a parcel of land between 14 and 15 acres in extent on the north side of Weld Street between Walter and Centre Streets. At present it is free of roads and largely unused, having only some small plantations of conifers put out in 1923.

The earliest clear reference to this property is in a deed from Joseph Dudley to Henry Hatch in 1815, when it was a part of a large farm. The Arboretum purchased it from the heirs of Thomas B. Williams in 1922. Throughout the known history of the tract there are no specific data as to its uses. It continued as farmland, and was without timber when the Whitney map was drawn in 1843.

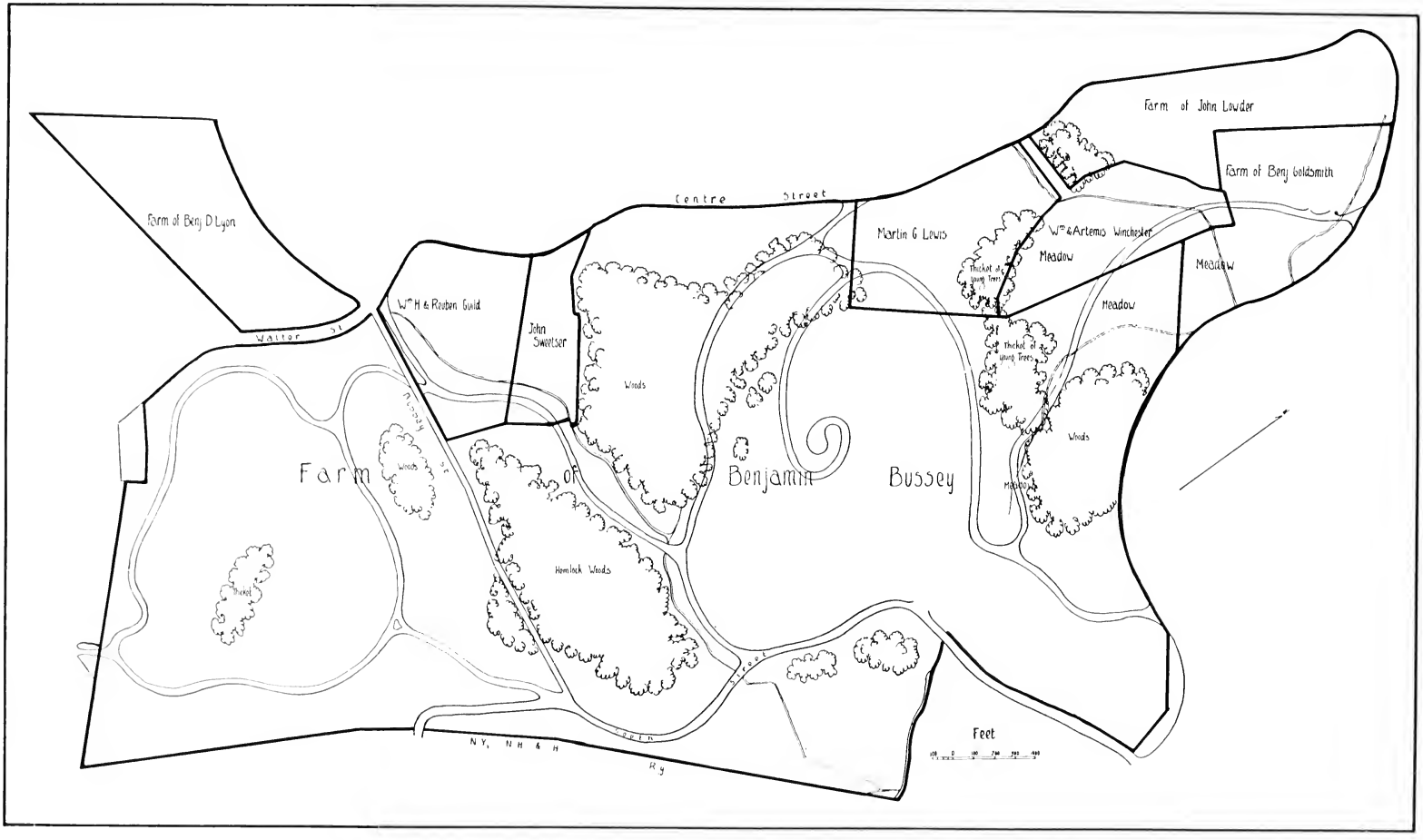


Plate V. Map of lands in the Arnold Arboretum about the year 1840.

Summary. There is every indication that the larger part of the primeval forest was cleared from the uplands of the Arboretum by 1700. The floristic character of the original woods can only be conjectured since no adequate description of them has yet come to light. Furthermore, all the primeval forest has been so long removed from most of southern and central New England that its reconstruction from remnant examples is out of question in most regions. The nearest approach to such an example in the Arboretum is on Hemlock Hill, but this has been so severely cut over and culled that it cannot be regarded as showing primeval conditions. However, it has probably never been made into pasture nor entirely cleared. Consequently, since the hemlock woods are mostly on the cold northerly slope of the hill where such woods would have been expected in the primitive forest, it is presumed that the original facies has not changed a great deal. A certain mixture of white pine, beech, sugar maple, chestnut, linden, and a few other deciduous trees may have been in the original, but if so it has long disappeared.

The old white oak on the south slope of Bussey Hill gives definite evidence of a more deciduous type of forest, rather xerophytic in character, on this area. Also there is evidence that some of this wood was not cut until the middle 1700's. The presence of several of these old white oaks on the hillside shows that they were more than merely occasional.

From this very scanty evidence we may infer that the original timber was a mixture of the deciduous and coniferous trees of the region in which the latter were most abundant upon cold northern slopes, possibly limited to the steep north face of Hemlock Hill. The deciduous woods were probably disposed in such a way that the more xerophytic trees like the white oaks were commonest either on warm southern slopes or on dry rocky or gravelly knolls.

It is probable that the lowlands were in marsh or wet meadow vegetation rather than bog types when the settlers came because of their relatively good drainage. The fact that they were called "meadows" and utilized as such prior to 1654 is indicative of this. Shrubby or timbered bogs were also cleared and used for hay in this region, as the histories show, and it is not impossible that some parts of the Arboretum meadows had such an origin.

One of the outstanding suggestions derived from the historical study is that the actual plowing and cultivation of the land have not been extensive and have been limited to a few localities. Tracts which have been designated at various times as plowland or hay fields are as follows: parts of the old Thomas Morey land along Centre Street, parts

of the lower northeastern slopes of Bussey Hill, the "plain field" east of the Bussey Institution, and possibly also parts of the land now under the larger conifers, some of the ground on the lower slopes of Peter's Hill, and the area now in the hickory, pterocarya, and neighboring groups. Data on the upper slopes of the southeastern part of Peter's Hill are exceedingly few but is is to be inferred from notes on nearby lands of similar nature that it remained in pasture for very long periods. Other parts of the upland may have been plowed and planted for short times but there is no evidence of a long period of cropping which would deprive the soils of their native raw food materials. The records of land holdings and uses, therefore, suggest that the major soil changes due to human occupation during the 230-odd years before the founding of the Arboretum were caused by the clearing of the original forest and the maintenance of open pastures or orchards for long periods. The past 150 years have seen further important modifications on the areas which have been allowed to revert to timber, while during the past 60 years the development of the Arboretum itself has effected changes in many more of the upland soils.

The oft-repeated expression that the Arboretum has been grown upon "worn-out" farm land is true then, judging by the historical findings, only in the sense that the soils of the area have lost some of the qualities originally given to them by the long-standing primeval forest; and that they have been compacted and the distribution of the elements in their layers modified. But they do not seem to have been unduly subjected to surface washing nor to a depletion in mineral salts. In other words the edaphic conditions on the uplands may not be so far removed from those which occurred in the original forest as is generally supposed; and any attempt to build up these soils by feeding or aërating them must take into account their original close mineral relationship to the relatively poor surrounding soils of the region rather than to a former, supposedly better, condition within historic times. Further light is thrown on this matter by the fact that the Arboretum's most successful plantings, among which are the groups of leguminous trees, river birches, lilacs, hickories, pterocaryas, the larger conifers, and possibly also the crab-apples are mainly on lands which seem to have been most cultivated during earlier periods rather than on soils not so utilized.

The chief effect upon the upland soils caused by the development of the Arboretum, other than that immediately upon the spots dug up for planting, has been to change an artificial grassland type of vegetation into one of semi-open woodland, or savannah, in which much of the grassland type is maintained. In some cases, as in the oak col-

lection, one wood has been replaced by another of similar nature. Other important, though local, changes have been along roadways where soil has been removed or added in the building of embankments. The lowland soils have been greatly modified of course by the repeated lowering of the water table. The linden and horse-chestnut collections are possible on their sites largely because Goldsmith Brook has been so controlled, and its bed lowered to such an extent, that the semi-peaty soils have become available.

There has been no uniformity in the manner of the Arboretum's plantings. Some of the earliest ones were made with a great deal of care, using large holes in which rocks, gravel, and sand were replaced with loam and peat. The loam so used was brought from outside the Arboretum and the peat was cut from the low ground where the ponds now are, or from the north meadow. Most of the plantings made before 1887 appear to have been of this nature, but later ones did not involve so much modification of the existing soils. In recent years the condition of some plantings has been improved by the application of manure.

Between 1879 and 1886 nearly 2300 squares of peat were cut for use in improving the soils of the planted areas, and 2000 more were excavated in 1891-2. There is no further record of the cutting of peat until 1921-2 when that which came from the pond in the South Street tract was utilized. There is no evidence in the old deeds or probate records that peat was cut for this purpose in earlier times, although there is a deed from Eleazer Weld to a man named McCarthy in 1784 giving to the latter the right to take peat out of the north meadow for fuel purposes.

The small proportion of tillage land indicated by this study of the old farms is substantiated by historical investigations of all southern New England agriculture as it had developed before 1800. P. W. Bidwell, in his *Rural Economy in New England at the Beginning of the Nineteenth Century*,[1] has an excellent summary of the early growth of agriculture in this region. The individual farms, particularly those of inland towns, were nearly self sufficient economic units, and the farmers persisted throughout most of the first 180 years of the colony in the use of the most antiquated methods, being far behind the mother country in that respect. The chief reason for their failure to evolve better practice appears to have been the lack of markets, and consequently the lack of an incentive to improve production. The only areas in which such an incentive was present to any marked degree

[1] Trans. Conn. Acad. Arts & Sci. xx. 241-399 (1916).

were around the more important coast towns. West Roxbury might be classed as on the less favorable border line of the latter group, not so much due to its position as to its hilly, rocky surface and the small amount of its good soils. Bidwell (p. 320) quotes a letter written by a General Warren of Massachusetts in 1784 comparing English and American farms. "A man in America that farms 150 acres, would think a stock of £150 sufficient. One miserable team; a paltry plow, and everything in the same proportion; three acres of Indian corn, which require all the manure he has; as many acres of half-starved English grain from a half-cultivated soil, with a spot of potatoes, and a small yard of turneps, complete the round of his tillage. . . All the rest of the farm is allotted for feeding a small stock. A large space must be mowed for a little hay for winter; and a large range for a little feed in summer. Pastures are never manured, and mowing lands seldom; . . ." A typical inland farm, according to Bidwell's studies (pp. 321-2) consisted of 100-200 acres, ". . .divided into three roughly equal tracts, one-third being woodland, including wasteland, one-third pasturage, and the remainder divided between mowing lands and cultivated fields in varying proportions. The land under tillage, however, hardly ever exceeded ten or a dozen acres, except in the neighborhood of such commercial towns as would furnish a market." An instance of the latter is cited in Brookline where, on a farm of 100 acres, ". . .12 were in woodland, 20 in pasture, and 68 in mowing, tillage, and orchards." The condition of the Arboretum farms evidently stood somewhere between the two extremes.

The large number of orchards mentioned in the old deeds is also worthy of comment. Further quoting Bidwell (p. 334), ". . .every farm had an orchard of several acres, containing a hundred or more trees. The abundant yield of these trees seems to have been used principally for making cider. . . The orchards suffered much from lack of care. After the original planting, practically nothing was done to preserve the trees or increase their yield except to allow cattle to pasture among them and, very rarely to plow between the trees."

The latter part of the 18th and the early part of the 19th centuries witnessed large improvements in New England agriculture brought on mainly by the development of the industrial towns and the resulting growth of a market for produce. Most of the Arboretum farm land was prevented from immediately profiting by these advantages for at least two reasons. First, in the period between 1783 and 1806 the three large properties of which it was then mainly composed (Davis, Weld, and Morey) were either sold in large or small units, or divided up among a larger number of legatees. The relation of this period to

the abandonment of the areas now in natural hardwood stands has already been mentioned. Second, Benjamin Bussey appeared on the scene in 1806 to begin the series of purchases which finally united most of the land. Bussey was a wealthy merchant and manufacturer who appears to have bought the ground as a site for a home in which he could retire during the later years of his life. The interest in agriculture and horticulture for their own sakes which led to his unique gift to Harvard College seems to have crystallized late in his life and was probably actuated by the increasing current interest in these fields throughout New England as a whole. At any rate, there is little evidence that either during his own life or during the period in which the land was owned by his heirs (1842-61) there was any major change in agricultural practice on the land. The impetus given to farming in the region as a whole by the growth of the industrial towns was destined to be short-lived in any event due to the opening of western lands and to improvement in the transportation of more cheaply produced foodstuffs.

It may be said, therefore, that the data thus far accumulated on the early uses of land in the Arboretum may be closely correlated with the major developments in the rural economic history of this part of New England.

Hugh M. Raup

Ames, Oakes. *Annual Reports of the Supervisor of the Arnold Arboretum for the Years 1927-33.* Printed in the Annual Reports of the President of Harvard College.

Ancient Transcript, The. Document no. 114 (1880), City of Boston (6th Rept. of the Record Commissioners). The original, or an early copy, is in the office of the Clerk of the City of Boston.

Anderson, Isabel. *Under the Black Horse Flag.* Houghton Mifflin Co., Boston (1926). This is a history of a part of the Weld family.

Blake, Sarah Swan Weld. *Francis Minot Weld, M.D. His Life, Diaries and Letters.* Boston (1925).

Bussey, Benjamin. In *The Dedham Historical Register* x. 71-6 (1899). This contains a short autobiography of Bussey, the original of which is in the possession of Harvard College. See also *The Boston Daily Advertiser*, Feb. 10, 1842, for notes on the life of Bussey. His will is to be found in printed form as Document 134 (1881), City of Boston.

Drake, Francis S. *The Town of Roxbury.* Roxbury, pub. by the author (1878). Reprinted as document 93 of the Registry Dept. of the City of Boston (1905).

Dudley, Dean. *The Dudley Geneologies and Family Records.* Boston (1848).

Ellis, Charles M. *The History of Roxbury Town.* Boston (1847).

Leavitt, Emily Wilder, Ed. *A Geneology of One Branch of the Morey Family 1631-1890.* Privately printed (1890).

Merriam, Rufus N. *John and Thomas Totman.* Worcester (1895).

Palmer, Ernest J. *Supplement to the Spontaneous Flora of the Arnold Arboretum.* Journ. Arn. Arb. xvi. 81-97 (1935).

Rockwell, Samuel Forbes. *The Davis Families of Early Roxbury and Boston.* Andover (1932).

Sargent, C. S. *Reports of the Director of the Arnold Arboretum for the Years 1872-1926.* Printed in the Annual Reports of the President of Harvard College. The first two of these reports (for 1872-4 and 1874-5) were printed in full, respectively, in the Bulletin of the Bussey Institution i. 293-9 (1875) and 455-8 (1876). They appear in a somewhat abbreviated form in the President's Reports for 1873-4 and 1874-5.

———— *The First Fifty Years of the Arnold Arboretum.* Journ. Arn. Arb. iii. 127-71 (1922).

Seaver, Jesse. *The Seaver Geneology.* Philadelphia (1924).

List of Maps of Boston, Published between 1600 and 1903. Reprint of Appendix i. Annual Report of the City Engineer of Boston, (1903).

Map of the Town of Roxbury. Surveyed by John G. Hales, 1832. Reprinted in Drake's History of Roxbury in 1878.

Map of the Town of Roxbury. Surveyed in 1843 by Charles Whitney. Copies in the Engineering Dept. of the City of Boston (Surveying Division), in the Harvard College Library, and in the Library of the Arnold Arboretum (photostat).

Plan of the Bussey Estate. Made by William A. Garbett, dated May 25, 1861. The deeds by which the Bussey land was conveyed to Harvard College refer to this plan throughout. A copy is in the Harvard College Library.

Topographical Map of the Bussey Farm Homestead. Surveyed under the direction of Frederick L. Olmsted by Radford and Vaux (1878). There are copies of this and the following at the Arnold Arboretum and in the offices of Olmsted Bros., Brookline.

Topographical Map of Land Adjoining Bussey Farm Homestead (1879).

Plan of the Arnold Arboretum Showing the Progress of the Work. By H. S. Codman (1887). Printed in the Ann. Rept. of the Director for 1886-7.

Guide Book Map. This map is not accurately dated but appears to have been made about 1903 and printed by the Walker Lithograph Co. of Boston. It has gone through many editions and modifications, and was used in the Arboretum Guide Books until 1934.

Bird's-eye View of the Arnold Arboretum. This sketch was made by J. T. P. Bijhouwer about 1927. In slightly modified form it is attached to the current guide book recently published.

(Other maps of considerable interest are those of Peter's Hill and other lands added to the Arboretum after its first planning. Most of these, together with many detailed plans of roadways and other improvements, are to be found in the offices of the Park Department of the City of Boston).

Synonyms are in *italic*; illustrations in **bold face** type.