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HARVARD UNIVERSITY

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THE PAST WINTER AT THE ARBORETUM

THE past winter at the Arboretum has been spent chiefly in sawing wood—literally sawing wood, for with about 1500 trees destroyed, their removal became a major project. In the Bulletin of Popular Information of October 7, 1938, a graphic description was given of the damage done by the hurricane of September 21. Although a great deal remains to be done, a majority of the fallen trees have been removed, particularly those adjacent to the roads and walks. Because an extra force of men has worked full time all winter, the casual visitor in the Arboretum this spring will see few fallen trees, but will notice hundreds of stumps here and there in the collections where trees once stood—grim reminders of the fury of the September storm.

A great deal of necessary pruning is being done now. It will take at least three months to complete this pruning program. Trees that were otherwise uninjured have many broken branches which must be removed and clean cuts made in order to prevent trouble from insects and diseases later on. Everyone in New England is fully aware of the extreme damage done to trees in the path of the September hurricane. The Arboretum has done everything within its power to make the plantings look presentable for the flowering season this spring. Even with an extra force of men it has been necessary to omit the ordinary routine tasks normally taken care of in the fall and winter. Although there is mueh obvious repair work yet to be done, it is hoped that spring visitors will appreciate the progress that has been made.

There are at least three areas in the Arboretum so badly damaged by the hurricane that they will have to be replanted. One of these is at the rear of the administration building, another at the top of Hemlock Hill and the third, the hill along South Street where so many of the beautiful torch azaleas were planted by E. H. Wilson about ten

years ago. Evergreens will be used to replant these areas, but they will not be placed until late August or early September, for that is the season when such trees are best moved. Since it will be impractical to water the plants after they are once in place, it is far better to plant them in the fall, rather than in the spring when they will have to go through the hot, dry summer months with little attention.

Hemlocks will be used for replanting the top of Hemlock Hill. Some of the venerable specimens uprooted in the September storm were growing when George Washington was President, others are much younger. It will take the better part of a century before the magnificent grove on Hemlock Hill will again approach its perfection of September 1938. The soil is extremely shallow, in some places being only about eighteen inches deep. Because of such poor growing conditions, it has been thought advisable to replace the large trees with smaller ones, each young tree with a ball of earth around its roots. This will enable them to get a quick start. Providing the weather conditions prove too much for the first planting—several hundred 2–3 foot plants have been acquired to be cared for in the nursery through two growing seasons. After this time they will be planted in the more open places on Hemlock Hill or where some of the other young plants may have died. It was thought better to replant in stages, rather than to do the entire task at once and thus take a chance on weather conditions; for if one long dry spell occurred after the first planting, many of the plants might suffer severely or be lost entirely.

The bank at the rear of the administration building was originally planted with white and red pine. Later, other interesting evergreens were added. The large grove of white pines was practically eradicated in the hurricane, and this area will be replanted with small white pines. Some of the young exotic spruces will be rearranged in the fall, but to make this planting beautiful once more, it will be necessary to plant some larger trees. For this purpose, some splendid Carolina hemlocks approximately fifteen feet tall will be moved from the Walter Street tract to the hill back of the administration building. With such good plants, once in place, an interesting evergreen planting should be established in a very few years.

Red pines will be replanted on the South Street hill. One of the last plantings that E. H. Wilson authorized was that of approximately one thousand torch azaleas on this bank. The bank was well adapted for such a planting for on it were growing many vigorous red pines which gave sufficient shade to protect the delicate azalea flowers. When exposed to the full strength of the sun for any length of time, the flowers of the torch azalea fade in a very few days, but when given some shade during the day, they may last for a week or longer. The hurricane destroyed the majority of red pines on this bank. The thousand azaleas are still there, mostly unharmed, but in mid-May when

they will be in bloom, their flowers will be sadly in need of some protection from the bright sun. Since the red pine is of very vigorous growth, it is expected that the three foot plants which will be placed there this fall will develop rapidly enough to give the needed protection within a few years.

A large number of stumps still remain. It is hoped that during the summer the smaller stumps can be removed. A tractor has been needed in the Arboretum for a long time and one was acquired this spring to be used especially for stump removal and to take care of the heavy work connected with moving the large Carolina hemlocks this fall. Larger stumps will be cut close to the ground and allowed to rot in place, as their immediate removal is a very expensive undertaking. It is a comparatively simple matter with proper equipment to remove one stump after the other along the highway or street, but when such stumps are on steep banks and among closely planted trees and shrubs, it becomes practically impossible to remove them without injury to adjacent plantings except at very great expense.

Age of Trees Destroyed

Bulletin readers may be interested in the age of some of the trees destroyed by the hurricane. In the case of those trees about 70 years of age or older, the figures were obtained by ring counts. For the younger trees, data were compiled from our planting records, as accurate data have been maintained appertaining to all trees planted since 1872.

	Age
Canadian Hemlock	157
" "	154
" "	151
" "	139
English Elm	133
White Oak	115
Sugar Maple	110
Horse Chestnut	98
Tulip Poplar	93
Cucumbertree	69
Red Pine	66
Douglas Fir	65
White Fir	65
White Spruce	65
Blue Spruce	65
Kentucky Coffeetree	64
Engelmann Spruce	60
Green Ash	59
Pin Oak	56
American Ash	55
Carolina Hemlock	53
Common Pear	50

European Mountain-ash	45
Japanese Hemlock	42
Poplars (practically the entire collection)	40
London Plane	34

(Note): All these were perfectly healthy trees with solid trunks. Other trees were blown over, many of them natives but with rotten trunks. Many of these were very old, possibly older than any listed above, but it was impossible accurately to estimate their age because of the decayed interior parts of the trunks.

A fourth area which will be replanted within a year or two is the slope at the base of Peter's Hill where the older poplar collection was located. Since this slope faces the tracks of the New York, New Haven and Hartford Railroad (Dedham Branch) it affords an excellent amphitheater for a display of flowering trees. It had been decided to replant this area with a comprehensive collection of the oriental flowering crabapples. The plants are being grown in the nursery now and will be ready for transplanting to this bank in a year or two. These trees are most attractive when in full bloom, and because of their heavy crops of small colored fruit are again attractive in the fall. In some species and varieties the fruits remain on the trees well into the winter.

Individuals familiar with the Arborway may regret to notice the removal of most of the large willows immediately within the fence. Because of their age and their brittle nature it was decided in 1937 to remove about one third of them in the winter of 1937-38, which was accomplished. The plan was to remove another third in the winter of 1938-39, and the remainder the following winter. Because of the extreme breakage during the September storm, most of the remaining trees were removed this past winter, and the few that are left will be taken out next winter. They are to be replaced by intermixed plantings of red maple, tupelos and sour woods.

DONALD WYMAN

(Note): Subscription renewals for 1939 are now due. Those who have not resubscribed, and who desire to continue to receive the Bulletin, should remit $1.00 to the Bulletin of Popular Information, Arnold Arboretum, Jamaica Plain, Massachusetts, at an early date to insure continuity in the receipt of the numbers as issued.

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

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RHODODENDRONS IN THE PACIFIC NORTHWEST

BY
HERBERT IHRIG
Chairman, Rhododendron Committee Arboretum Foundation
Seattle, Washington

THE greatest area in America for growing rhododendrons is the Pacific Northwest. This territory extends along the coastal region from British Columbia through Washington, Oregon and northern California. Owing to the warmth of the Japanese current, climatic conditions are mild with an absence of extreme heat and cold, but while the rainfall is generally less than either Boston or New York, the periods of rain are much longer. This moist weather and a naturally acid soil seem to meet their requirements to a remarkable degree. Whether they come from the higher elevations of the Himalayas, the jagged gorges of Upper Burma or China, or the open moorlands of Tibet, they readily adjust themselves to our garden and woodland.

These facts have long been known to students of horticulture, but are not today generally understood in this country. While England has experimented for more than one hundred years and developed a literature that reflects a long and continued appreciation of rhododendrons, it is only in recent years that we have made worth while contribution.

Not only has plant material representing very numerous species been unavailable, but owing to the embargo that existed for some time, we failed to keep pace with the hybrid developments abroad, especially in England and Holland. Occasionally some individuals imported seed or a few new hybrids, but little or no record was kept

of their results, so that interested amateurs like myself were at a loss as to what to buy or where to buy.

It was for that purely selfish reason that I first began my importations. I wished to test some of the better things and to determine what was hardy in our locality, what really constituted "garden value," and what the conditions of soil and growth were.

I started with one great advantage in that most of the English rhododendron literature is applicable to our climatic conditions, and the work of the Rhododendron Association in establishing standards was invaluable as a guide. Its ratings, when criticised as not suitable for the United States are misunderstood, for obviously those on hardiness apply only to the British Isles and each rating is so defined. These ratings give one an established starting point and should be even more valuable to the eastern experimenter than to one on the Pacific Coast.

Ratings are as follows:

(A) Hardy anywhere in the British Isles and may be planted in full exposure if desired.

(B) Hardy anywhere in the British Isles, but requires some shade to obtain the best results.

(C) Hardy along the seaboard and in warm gardens inland.

(D) Hardy in south and west, but requires shelter even in warm gardens inland.

(E) Requires shelter in most favored gardens.

(F) Usually a greenhouse shrub.

In our Northwest area a plant with an "A," "B," or "C" rating is hardy in most locations. A plant with a "D" rating is generally hardy, although inclined to be a sparse bloomer except in occasional years. A plant with an "E" rating can be grown in favorable locations, and in my garden *R. Barclayi* "Helen Fox," a large, broadleaf variety, which is rated "E," blossoms in early March and has never missed a year since it reached a blossoming age. I have, also, grown plants with "F" ratings with light winter protection.

As to "Garden Merit" the English Association's ratings, like all such, are subject to change as standards improve and experience varies, but they can generally be accepted as the best guide available.

On the basis of these ratings, as borne out by local experience, there are no less than two hundred and sixty seven different species of garden merit that can be generally grown out of doors in the Pacific Northwest; nineteen others are suitable for favored locations, and more than four hundred that are questionable or untried.

These numbers in themselves give a general idea of the variety of species, but no figure can impart the beauty and variety of types that are encompassed, ranging from tiny creepers only a few inches high to huge trees.

These naturally divide themselves into definite botanical groups, but for the layman these can be grouped in five general subdivisions:

(1) The broad-leaf varieties
(2) The narrow-leaf varieties
(3) The Alpine or rock garden varieties
(4) The Azalea group
(5) The Hybrids

The Broad-leaf Varieties

In the broad-leaf division lies the parentage of most of our lovely garden hybrids, and the finest stock comes from India, northern Burma, and western China. Representatives of such series as *Barbatum*, *Fortunei*, *Irroratum* and others do wonderfully well in this area and embrace many lovely varieties. They range from small shrubs to huge tree forms, some of which eventually reach the height of forty to sixty feet (*R. Calophytum* 30′–40′; *R. Barbatum* 30′–60′). Conditions under which they grow in their native home, however, vary greatly. Some come from rain forests; others high, open woodlands; and the American grower's chief task is to find the conditions of soil, exposure, sun, and shade best suited to their success. While I have grown several thousand plants of nearly two hundred different species, my experience is too limited to make any dogmatic statements. Generally I have found that the larger the leaf the more shade required. Shade, however, is a comparative term. It varies in density and moisture content, two factors of importance and different in various localities. None seem to do well in "deep shade" or beneath overhanging branches. They do best with the sky overhead, and their shade intermittently broken with sunshine such as comes through tall abutting trees.

The Narrow-leaf Varieties

The narrow-leaf group, in which I have included such species as *R. rubiginosum*, *yunnanense*, *lutescens*, *Davidsonianum*, *heliolepis*, and others, will stand considerable sun and a dryer location.

A number of these have beautiful flowers, but are difficult to place in a garden as they are sometimes inclined to be unshapely. In an open, naturalistic planting, however, they are a real joy, and a number of *R. yunnanense* planted with our native Salal (*Gaultheria Shallon*) and Oregon Grape (*Mahonia Aquifolium*) is a sight worthy of a long pilgrimage.

The Alpines

When we consider the alpines and other rock garden varieties even a general statement is apt to be misleading in that there are many different ideas as to what constitutes a rock garden type.

Low alpines such as *R. myrtilloides*, *pemakoense*, *imperator*, *Calostrotum*, *keleticum*, *radicans*, and similar species have done well in full sun, but I always try to get their roots well under rocks where they are protected from direct sun rays and do not dry out.

Almost all of the Lapponicum series which include such varieties as *R. fastigiatum*, *impeditum*, *intricatum*, *russatum*, *scintillans*, etc. do well in full sun. I grew them in semi-shade for several years and they were leggy, poorly shaped and sickly, but when moved into full sun sent out new shoots from the base and main stock so that in two years they were shapely, healthy, well-grown plants.

R. ciliatum grows to six feet in favorable locations, but when exposed to full sun breaks out at the base and forms one of the best rock plants I know. Occasionally a precocious shoot may try to attain height, but can be easily cut back.

R. glaucum is another that shapes better and remains comparatively low in the sun. *R. moupinense*, which I have always protected, as it blossoms in February, has been moved to full sun and shows material improvement. *R. racemosum* does nicely in any location. *R. Tephropeplum* seems to prosper in either sun or shade, but remains lower in the sun. Then there are some like *R. repens* that I have been unable to make happy in any location.

The alpine group is so extensive and varied that it is impossible to discuss it fully at this time, but it offers perhaps more immediate interest than any other group because of its beauty, and the demand for new and interesting rock plants. From it will, no doubt, come varieties and hybrids that can be generally grown throughout the United States, and a wealth of beauty awaits the hybridist.

The Azaleas

Experience on the west coast with deciduous azaleas differs little from that in the east, but in evergreen types we have a great many new comers such as *malvaticum* × *Kaempferi* and Japanese crosses of *eriocarpum*, *indicum (macranthum)*, *scabrum*, and others. These undoubtedly have a very definite place in the future. At present these crosses have become intricate and variations are so slight that the entire group is sadly in need of standardization.

This will come with time, but meanwhile we will continue to grow many varieties, all beautiful and interesting, and hope that out of

PLATE I

A typical rhododendron planting in the Northwest.

them will come more hardy varieties that will be available to a larger section of the country.

The Hybrids

To the average layman a hybrid is just another Rhododendron, but it is in reality something quite different. It is the result of a scientific effort to adjust or improve plants for garden use. It has the heritage of long years of effort in crossing and recrossing species with species or with other proven hybrids. These are grown under garden conditions and take more kindly to garden change. The aims of the hybridist have been varied. Some have sought to improve hardiness, some color, form or foliage, and their success has advanced our standards to a remarkable degree.

It is true that in "hardiness" this advance has not been all that could be desired; for the hybridists have not as yet developed a wide range of Rhododendrons with color and beauty which are capable of withstanding the rigors of our northern winters, as has been done for the more favored climates. But in other ways, such as size and texture of blossom, clearness and beauty of color, and richness of foliage, their results are conspicuous.

In the Pacific Northwest area most of these new hybrids are being grown such as "Blue Tit," "Betty Wormald," "Brittania," "Butterfly," "Cornubia," "Corona," "Dr. Stocker," "Glory of Littleworth," "Goldsworth Yellow," and many others, but their names are still strange to most gardeners, and there are many old favorite stand-bys that have been replaced, not for a whim or a passing fancy, but because of the inexorable advance of science in a field of beauty. I do not depreciate the lovely old favorites as there is a beauty of age in most Rhododendrons for which nothing can be substituted, but I do urge those who are contemplating new acquisitions to study these new plants before making their decisions. I am sure that when they have seen the gorgeousness of a "Beauty of Littleworth" or a "King George" most other white rhododendrons will pale into insignificance.

This is equally true of the other colors: blush, pink, rose, red, scarlet, yellow and apricot. Only in the blue and orange ranges does one feel the need of better colors, and even here "Blue Tit" (*impeditum* × *Augustinii*) and the new *R. Dichroanthum* crosses are doing much to make up this deficiency.

Those who are familiar only with the American and early English hybrids have a real treat in store for themselves, for while these earlier varieties had the advantage of being hardy, they were largely from North American stock, *R. maximum* and *R. catawbiense*, the first

of which produces small papery flowers, while the Catawbiense crosses have a tendency to revert to a purple or unpleasant magenta shade.

The newer hybrids made with Asiatic species have acheived not only size and texture of blossom, but a clearness and depth of color that must be seen to be fully appreciated. Some even surpass the catalogue descriptions!

Many British hybridists believe that the use of the hardier Asiatic rhododendrons, especially those from the higher altitudes, will eventually produce a race of hybrids beautiful in color and size and suitable for general use in our colder sections. Already Mr. C. O. Dexter of Sandwich, Massachusetts, has done much along this line with Fortunei hybrids, but there are still many other sturdy varieties unknown and untried.

Most of these better hybrids, as well as the Asiatic species, are now in west coast arboreta and private collections and should be available to the hybridist who wishes to develop a new field of beauty.

Culture

Much has been written about proper soil conditions, but I have seen and purchased rhododendrons grown in almost every conceivable soil from California "gumbo" to loose sand and gravel, so I am led to believe that other than being on the acid side there are other factors that are important. My own experience is that lime in any form is not only unnecessary, but dangerous. My soil is only slightly acid and every attempt to treat it with a lime-bearing fertilizer has been disastrous. I have had splendid success with a soil made up of a mixture of $\frac{1}{2}$ leaf mold, $\frac{1}{4}$ peat moss, and $\frac{1}{4}$ loose sandy soil. Some variation of this formula will meet almost any eondition, provided the planting area is well drained.

Rhododendrons need moisture, but at the same time drainage is important, for few if any will prosper in wet, soggy ground. In their natural habitat, most rhododendrons grow in loose, rocky soil with plenty of moisture around their roots, so that if the soil is loose or sandy (with excessive drainage) it is well to add leaf mold or peat moss to aid in retaining the moisture.

The very word pruning is an anathema to rhododendron growers and properly so when considered in the usual sense of the term. However, used judiciously it can do much to improve the plants both in looks and growth. I began experimenting on our native rhododendrons, *R. macrophyllum* (*R. californicum*), cutting out weak or unsightly growths. Now I do not hesitate to do this on finer hybrids and

trim them for shape as well. Sometimes this is done for height or bushiness, sometimes to eliminate crossing branches. Properly done it will help in the development of good growth, appearance and flower.

There is another form of pruning that will help the shapeliness of a rhododendron and that is disbudding. This is better than permitting growth that should later be cut out. Some varieties like "Earl of Athlone" tend to crowd their upward growth and both flowers and foliage are at a disadvantage. By proper disbudding this new growth can be encouraged to spread out, giving much more room for both flowers and foliage.

Fertilizers

This is also a controversial subject. Some growers recommend well-rotted cow manure, others oppose it. Some avoid commercial fertilizers in any form. I use both with good results. Of course, I do not mean the promiscuous use of fertilizers, many of which contain ingredients that are poisonous to rhododendrons, but there are good fertilizers available, or one can use an accepted formula.

In selecting a fertilizer it is important to select one with an acid rather than an alkaline reaction, and to get the right proportion of available food minerals with which to supplement the soil.

What constitutes proper soil balance has not been scientifically determined, for as previously stated, I have found them doing well in various soils, but a common factor in all successful formulae that I have tried seems to be a large potash content. Whether this is due to a soil deficiency or a special plant requirement, I do not know.

The formula that seems best for Puget Sound requirements according to my own experience is as follows:

10 lbs sulphate of ammonia	— Reaction —	acid
35 lbs superphosphate	"	neutral
20 lbs sulphate of potash	"	"
20 lbs cotton seed meal	"	acid
15 lbs aluminum sulphate	"	strictly acid

This I apply at the rate of one handfull to a small plant and to larger ones in proportion. This is simply spread on top of the ground over the root area and is best done in early spring. Late summer applications may start new growth that will not harden sufficiently to resist the winter cold and consequently be cut by frosts. Woodland plantings require less treatment, and the usual mulch of leaves and pine needles will generally suffice.

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SERIES 4. VOL. VII APRIL 29, 1939 NUMBER 3

THIS HESITANT SPRING

BUDS are swelling at the Arboretum, but their opening is far behind schedule. The continued cold, cloudy spell will be responsible for many peculiarities in blooming dates this year. Some plants are as much as three weeks late in flowering. *Viburnum fragrans*, for example, is just now starting to flower. Only half of the flowers of *Magnolia stellata* are open at the time this is being written. About half of the buds near the top of the trees came into bloom last week, but the rest have remained tightly closed, awaiting warmer weather.

Forsythias should be in bloom now. There are many bushes at their height of color in warm, protected places in the city, but at the Arboretum, forsythias are just beginning to show patches of yellow here and there. *Forsythia ovata*—normally opening a week before the rest—came into flower only a few days ago. The spice bush is not yet in full bloom, but various species of *Corylopsis* have been in flower for about a week. *Rhododendron mucronulatum* is not a mass of colorful flowers—yet. Many of the flowers opened on a warm day last week, but the weather has been so cold since that the majority of flower buds are still closed. When these buds do open the flowers which have been out for some time will undoubtedly begin to fade, so that the display of color made by these plants this year will be mediocre. The same is true of *Magnolia stellata* plants gowing in front of the Administration Building. Fortunately the plants of *M. stellata rosea* in the lawn in front of the building are still in tight bud; and if we have a warm spell of several days' duration, these plants should make a splendid display.

The winter has been a very mild one, at least as far as the woody plants at the Arboretum are concerned. It is true that some of the

evergreens have been slightly burned, but this was done by the hurricane of last September and not by the winter. Apparently, there has been no serious winter injury to flower buds. One of the "indicator" plants in this respect is *Viburnum fragrans*, which is injured so frequently by cold in the winter. This spring all the flower buds are in excellent condition, and now they are gradually opening. This is a fine plant for early spring flowers, but is best used south of New England where it is reliably hardy. The late season is well illustrated by a list of blooming dates kept by Mr. W. H. Judd, of the Arboretum staff, and reproduced in part on page 16.

Notes

Dr. E. D. Merrill, Administrator of Botanical Collections, Harvard University, and Director of the Arnold Arboretum, has just received through the State Department, the gold medal of the Ministère de l' Agriculture of the French Republic and the corresponding diploma of the Société Nationale d'Acclimation de France. These were conferred on Dr. Merrill at a session of the Société d'Acclimation in Paris on February 12, 1939, in appreciation of his services to French horticulture.

Estimated Blooming Dates for the Arnold Arboretum, 1939

Magnolias	May 3-7
Single-flowered Japanese cherries, shadbushes	May 3-7
Crabapples, double-flowered Japanese cherries	May 15-20
Torch azaleas	May 18-24
Lilacs, wisterias, deutzias. hawthorns	May 20-24
Rhododendrons	June 10-15

It is extremely difficult to predict reasonably accurate blooming dates in advance this year. Those given above should be considered only as approximations. A very warm spell in early May will change them all.

Donald Wyman

PLATE II

Viburnum fragrans

Photographed in the Arnold Arboretum, April 15, 1931,
by Professor Oakes Ames

Blooming Dates of Individual Plants in the Arnold Arboretum*

Year	'31	'32	'33	'34	'35	'36	'37	'38	'39
Abeliophyllum distichum	—	—	—	21	17	1	—	1	24
Acer rubrum	10	—	1	9	18	M30	14	M23	20
Acer saccharinum	M1	J15	J24	M17	M11	M17	J14	M23	M5
Benzoin aestivale	—	21	29	19	—	19	19	15	28
Cercidiphyllum japonicum	12	20	21	18	20	12	17	14	28
Cornus mas	7	3	1	13	17	16	10	1	20
Corylopsis pauciflora	25	23	29	22	19	3	—	15	25
Daphne mezereum	5	—	9	1	M25	—	8	M25	20
Dirca palustris	3	10	9	7	21	M30	14	14	20
Forsythia ovata	10	17	—	18	19	1	4	1	20
Hamamelis mollis	F25	J15	J25	—	M7	M20	J11	—	—
Hamamelis vernalis	N29	D3	N28	N21	D12	D13	D19	N21	—
Lonicera praeflorens	2	2	M30	7	10	M27	9	1	13
Lonicera standishi	12	J21	19	18	18	—	—	1	22
Magnolia denudata	17	21	—	19	20	22	20	15	29
Magnolia kobus borealis	17	20	29	19	—	19	19	15	m?
Magnolia soulangeana speciosa	18	24	—	21	25	23	23	m1	m?
Magnolia stellata	10	17	19	15	19	M31	12	14	29
Prunus armeniaca "Mikado"	20	21	—	—	—	22	25	16	m?
Prunus concinna	22	29	29	—	—	23	m1	19	m?
Prunus davidiana	10	6	9	—	—	M30	9	1	22
Prunus incisa	22	28	m1	26	27	24	m1	20	m?
Prunus mandshurica	17	20	—	20	—	14	17	13	m?
Prunus nigra	30	m1	—	m1	m1	—	m7	20	m?
Prunus sargenti	20	29	m1	22	26	22	m1	20	m?
Prunus subhirtella	22	29	21	—	27	25	m1	20	m?
Prunus subhirtella pendula	22	29	29	—	27	—	m1	20	m?
Prunus tomentosa	20	21	—	25	27	23	25	16	m?
Prunus triloba multiplex	22	m1	—	—	28	m1	m1	20	m?
Rhododendron dauricum	—	J13	—	—	—	—	10	M27	20
Rhododendron schlippenbachi	m3	—	—	—	m1	—	m5	28	m?
Rhododendron vaseyi	m9	—	—	m6	—	m8	m13	m1	m?
Ulmus americana	3	3	—	3	1	M29	M13	M23	M20
Viburnum fragrans	5	J14	8	15	19	M30	J15	10	20

*These figures have been supplied by Mr. W. H. Judd, Propagator at the Arnold Arboretum. The dates represent the first day each plant could be considered to be in full bloom. The same plant has been inspected each year for this information.

Note: All dates given are for **April** unless otherwise noted.

N = November
D = December
J = January
F = February
M = March
m = May

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. VII MAY 5, 1939 NUMBER 4

NEW ENGLAND MUST PLANT TREES THIS SPRING!

THERE is ample opportunity for every town in New England to initiate a carefully planned tree planting program this spring, and the need for this is very great. After the devastating hurricane of last September, the streets of many towns have been frightfully marred by the loss of valuable trees, and civic organizations everywhere in New England are uniting in planning intelligent tree planting programs for the streets and highways as well as on private property.

There are a few important points to be kept in mind when planting trees anywhere; some are common knowledge, but others may be unknown to the individual who has had little or no previous experience in this field. Briefly, these points are as follows:

Transplanting in the spring should only be done when the soil is well dried and in workable condition. When soil is wet or muddy, any handling or working will "puddle" it; that is, the air spaces will be closed up when worked, and the soil may dry out in almost brick-like consistency. In such soil it is almost impossible for plant roots to grow. Consequently, the time of actually planting trees will vary considerably over the New England area. As soon as the soil is in good condition plant immediately, for the longer the period in which the tree has to grow, the better off it will be.

The hole dug for the tree should be deep and ample. The tree itself should be set not more than two inches deeper than it was formerly. Remember that it is always better to plant a fifty-cent tree in a three-dollar hole than a three-dollar tree in a fifty-cent hole.

If drainage is poor, a drain should be put in the bottom of the hole. If there is a hard clay bottom, it should be broken up with a pick axe. If the soil is very poor, it might well be removed entirely, a good layer of well-rotted manure (never use fresh manure) placed on the bottom of the hole, and good top soil filled in firmly underneath and on top

of the roots. Sometimes a tamping stick is used for this, since it is imperative to get plenty of soil well-firmed under the roots as well as on top of them. Some tender barked trees, such as birch and beech may do better if their trunks are wrapped in burlap for several months after transplanting.

It may be advantageous to leave a slight depression around the tree in order to catch water, for the newly transplanted tree needs much water, and it should be carefully and conscientiously watered during the dry periods the first year. At the time of transplanting, the tree should be either staked or guyed with wires which are run through a rubber hose around one side of the tree only, so that it will become established in the correct upright position. The wires should be left on for the first year or two.

A word of caution is needed for the person who wants to dig and transplant trees from the woods. Sometimes this proves successful, but more often it results in failure because the roots have never been pruned. Such trees are very difficult to transplant unless every root is carefully dug and protected against drying out during the transplanting process, and the roots are apt to be greatly elongated. It is usually better to buy trees from nurseries, for such trees have been periodically root pruned, thus rendering it easier and safer to transplant them.

Pruning and Later Care

It is a comparatively simple matter to plant a tree. Anyone can do it. If reasonable care be taken in the transplanting operation, the tree will live. However, no planting program is complete without a word of caution concerning the later care of the tree. It must be pruned somewhat as soon as it is in its new situation. The pruning of branches is necessary to compensate for the loss of roots cut off in the transplanting operation. Trees which were severely wrenched or tilted by the hurricane might also have some branches removed. This is frequently hard to do, but results in much better growth. The tree must be carefully watered; evergreens must have their tops sprayed in the evenings of particularly hot summer days; bad crotches among the branches must be located and eliminated; disease and insect troubles must be cared for as they appear, and often it is wise to take preventative measures before they appear. The experienced gardener knows these things and is always prepared to act when such difficulties arise.

What Trees to Plant

Contrary to popular belief, there is a wide variety of trees which can be planted along the streets of New England towns. There is nothing quite like the American elm and the sugar maple, both of which are native here. Yet, since the time our forefathers planted the streets so marred by the hurricane, a surprisingly large number of hardy exotic

trees have been introduced and tested, and these offer splendid opportunities for interesting planting. Then, too, there are many trees native to this country which might very well be included in any tree planting program. All the streets of a town do not have to be planted with the American elm or sugar maple. If the property owners on a certain street unite in the desire "to plant something different," let them, by all means! They might try the beautiful flowering Sargent cherry, the mountain silverbell, or even the flowering dogwood! If they want brilliant autumn color combined with splendid summer foliage and flower, they might use the southern sourwood. The sweetgum is also a possibility. If the street is very narrow, there are other plants besides the Lombardy poplar. The upright growing variety of the English beech, ginkgo or hornbeam are all possibilities.

New England towns now have a splendid opportunity for making their streets interesting to a public which is becoming increasingly plant conscious. The following suggestions are given to indicate some of the trees that might be used. All are available from nurseries, and if they cannot be located in local nurseries, the Arnold Arboretum will be glad to indicate where they may be obtained.

Suggested List of Trees for Planting in New England

(Those marked with an asterisk are not hardy in the northern parts of Maine, New Hampshire and Vermont.)

Trees for Wide Streets

Acer saccharum	Sugar Maple
Celtis occidentalis	Hackberry
Sophora japonica	Katsura-tree
Fraxinus americana	White Ash
Fraxinus lanceolata	Green Ash
Gleditsia triacanthos inermis	Thornless Honeylocust
Liriodendron tulipifera	*Tuliptree
Phellodendron amurense	Amur Corktree
Platanus acerifolia	*London Planetree
Populus alba	White Poplar
Prunus sargenti	*Sargent Cherry
Quercus palustris	*Pin Oak
Quercus rubra	Red Oak
Ulmus americana	American Elm
Ulmus campestris	*English Elm

Trees for Medium Width Streets

Acer platanoides	Norway Maple
Acer platanoides schwedleri	Schwedler Maple
Crataegus crusgalli	Cockspur Thorn
Halesia monticola	*Mountain Silverbell
Liquidamber styraciflua	*Sweetgum
Magnolia acuminata	*Cucumbertree

Oxydendrum arboreum	*Sourwood
Quercus coccinea	*Scarlet Oak
Quercus phellos	*Willow Oak
Quercus imbricaria	Shingle Oak
Nyssa sylvatica	*Tupelo
Sassafras albidum (S. officinale)	*Sassafras
Tilia cordata	*Littleleaf European Linden
Tilia vulgaris	*Common European Linden
Tilia tomentosa	*Silver Linden

Trees for Narrow Streets

Carpinus betulus fastigiata	*Pyramidal Hornbeam
Carya glabra	Pignut Hickory
Cercis canadensis	*American Redbud
Cornus florida	*Flowering Dogwood
Crataegus phaenopyrum	Washington Hawthorn
Crataegus phaenopyrum fastigiata	Pyramidal Hawthorn
Fagus sylvatica fastigiata	*Dawyck Beech
Ginkgo biloba fastigiata	Columnar Ginkgo
Populus alba pyramidalis	Bolleana Poplar
Quercus robur fastigiata	*Pyramidal English Oak
Tilia platyphyllos fastigiata	*Pyramidal European Linden
Ulmus americana "Moline Elm"	Moline Elm

Other Trees and Tall Shrubs for Ornamental Planting on the Home Grounds

	Oriental Crabapples (many types valuable for flowers and fruits)
	*Magnolias (for flowers)
	*Japanese Cherries (for flowers)
Fagus sylvatica	*European Beech (several varieties for interesting form and color)
Ilex opaca	*American Holly (for fruits)
Cladrastis lutea	*Yellowwood (for white flowers)
Syringa japonica	*Japanese Tree Lilac (for flowers)
Caragana arborescens	Siberian Pea-tree (for yellow flowers)
Viburnum lentago	*Nannyberry (for flower and fruit)
Viburnum prunifolium	Blackhaw (for flower and fruit)
Elaeagnus angustifolia	Russian-olive (for gray foliage)
Amelanchier laevis	Allegheny Shadblow (for flowers)
Pseudotsuga taxifolia	Douglas Fir (evergreen)
Pinus resinosa	Red Pine (evergreen)
Pinus strobus	White Pine (evergreen)
Tsuga canadensis	Canada Hemlock (evergreen)
Tsuga caroliniana	Carolina Hemlock (evergreen)
Picea omorika	*Serbian Spruce (evergreen)

DONALD WYMAN

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. VII MAY 12, 1939 NUMBER 5

THE NORTH MEADOW

THE Jamaica Plain Gate is one of the most attractive approaches to the Arnold Arboretum in the first warm days of spring. The magnolias planted about the Administration Building, which stands just inside the gate, are among the earliest flowering shrubs to open their buds. They enjoy particularly good conditions here because, being mainly on the south side of the building, they are exposed directly to the warm sun; also they are protected from cold winds by the building and the hill behind it. About the same time the red maples on the opposite side of the road are opening their scarlet flowers, and the willows nearby are producing catkins.

It was decreed in the original plan of the Arboretum that the trees and shrubs should be arranged in a sequence which would conform to a commonly accepted view of their relationship. The scheme chosen was that of the great British botanists of the last century, Bentham and Hooker. Consequently, as one goes along the Meadow Road past the magnolias, he first finishes the Magnolia Family by passing their relatives, the tulip-trees, which grow on the hillside near the place where the bridle-path turns off. These trees do not flower until late May. Just to the south of the road and partly hidden by tall shrubbery is a grass path along which is a large planting of gooseberries and currants which flower attractively in May. The old-fashioned golden currant, *Ribes odoratum* is one of the most fragrant and most popular in this group.

Proceeding along the road one notes that it is on a low embankment, with wet meadow on the left and park-like expanse on the right. The embankment itself had been planted with *Cercidiphyllum*, *Phellodendron*, and *Evonymus* on the right, and with Cercidiphyllum, shad-

bushes, maples, buckthorns, and sumacs on the left. The Cercidiphyllums put forth their bluish-green leaves early, but these are preceded by a wealth of small flowers that have bright red stamens. Although of an unfamiliar sort, the Cercidiphyllums have a form more or less characteristic of our native deciduous trees. The Phellodendrons, on the other hand, possess an "awkward," unsupported branching form that is foreign to our usual eastern American concept of what a deciduous tree should look like.

The linden and horsechestnut collections are among the finest of their kind in America. They appear to be thriving in the low but fairly well-drained field which extends from the road westward to the wooded gravelly knolls nearby. In late May the horsechestnuts and buckeyes are covered with their upright, conical inflorescences, ranging from white or cream-color to deep pink and red.

Between the Meadow Road and the Arborway is a low swampy area which remains wet during a large part of the year. At its lower end, just across from the Administration Building, are the remnants of a once-large willow collection. Strangely enough many species have failed to do well here, chiefly because the water table has been at such a high level that even willows cannot survive! A row of tall willows along the Arborway fence had grown so large that its overhanging branches threatened traffic on the street. A part of these were removed in the winter of 1937-38, and the remainder were so severely damaged in the hurricane of September, 1938, that most of them were taken out last winter, leaving a few surviving veterans to be disposed of later. It is being replaced with a planting of red maples and tupelos whose brilliant red autumn color will eventually become one of the Arboretum's outstanding autumnal displays. On the opposite side of the low ground, northwest of the lindens and Cercidiphyllums is a curving grass path lined with honeysuckles and viburnums. Back of this is the bridle path, recently improved by the city from a mudhole to a well-drained roadway.

As in most of the Arboretum, the evidences of earlier history are here nearly all erased. Along the bridle path, and roughly bordering the property of the Adams Nervine hospital, is a row of tall ash trees (now badly damaged by the hurricane) which appear to have marked an old boundry of the low meadow. Although it is not now visible, one of the oldest surveyed lines in the town of Roxbury passes through this tract. When the original settlers in the town divided among themselves the lands in the outlying districts, they laid down a line, trending roughly northwest and southeast, as a base from which to

PLATE III

When the Arboretum was young. Picture taken at Jamaica Plain gate, 1890.

measure. This was known as the "headline of the first division," and in our area extended from a point among the shadbushes and Cercidiphyllums across the wet meadow and the Arborway so as to margin the westerly curb of Park Road. Farther over the hill the line marks the end boundary of the Bussey Institution grounds. This line was the northeast boundary of the original Arboretum. Later the present extensions of the tract to the Jamaica Plain Gate and to Centre Street were added by the city or by the University.

Most of the low ground, notably that west of the Meadow Road and the southerly half of the remainder, is mentioned in the oldest land records in Roxbury as "Gore's Meadow." It remained a meadow throughout its history to the time of the Arboretum plantations. As such it was in demand among the early settlers who had to have natural feed for their stock. Most of the countryside was originally wooded except, perhaps, for the low stream margins and swampy areas; and even when cleared, the production of forage in the dry hillside pastures was meager. Consequently the farmers used the coarse grasses and sedges of the natural meadows to good advantage, and utilized every means at their command to drain the wetter parts so that they could be used. The old maps of our wet meadow show the arrangement of these early drainage ditches, which were also the dividing lines between small parcels of land which were bought and sold separately. The part west of the road was evidently most in demand because it was higher and needed less artificial drainage. Parts of it changed hands twenty or more times during the first 200 years after the lands were granted.

The original vegetation can only be suggested. It was probably a grassy or sedgy meadow, for this term was used for it in the earliest land records. Nevertheless, at some early date it must have had a swampy forest, for cedar logs have been taken from excavations in the underlying peat. The only record we have that the peat was ever used for fuel is in a deed given by Eleazer Weld to one Daniel McCarthy in 1784, giving the latter the right "to cut Sufficient Turff for fuel for the Necessary Support of Two Families . . . so long as Turff can be cut on said . . . meadow land."

The Meadow Road was built by 1890, making possible the plantations on its borders soon after. The Arborway was completed in 1895, and its border plantation of willows was put in about that time. A small stream known as Goldsmith Brook, which rises in the hills west of Centre Street, formerly had a channel through the meadow. It was brought under partial control in 1892; and the lindens, horsechest-

nuts, and neighboring groups were planted in 1894. The arrangement did not prove satisfactory, however, and the brook was finally confined to an underground conduit in 1905. Drainage from the lower part of the meadow was somewhat improved in 1900 when the eastern sewer level was lowered between the Arborway and Stony Brook. It is still unsatisfactory, however, for the meadow is flooded at least once a year, often nearly to the level of the Meadow Road. Since nothing can be planted there, the weeds are allowed to grow rankly throughout the summer. Fortunately they are composed largely of wild asters, mints and goldenrods, which make a blaze of color in late summer and early autumn when the Arboretum is otherwise reduced to browns and dull greens.

These low grounds at the northeasterly end of the Arboretum have been difficult to make attractive. Nothing could be done at all until the water level was lowered by local ditching or by lowering the sewer barriers. The Meadow Road gave a mass of stable and well-drained soil which could be used for suitable border plantings. We owe a tribute to the foresight and sense of proportion which were shown by the founders of the Arboretum in laying out the plantings. They had to visualize as best they could the mass effects of trees and shrubs as they would appear 50 to 75 years after they were planted. That they accomplished an admirable task is evident on every hand in the Arboretum, and no more so anywhere than in the north meadow. But much remains to be desired in the low swamp across from the Administration Building. The variety of possible plantations will always be limited by the excessive peaty substratum. If the whole were to be filled up it would be necessary to open it as an unsightly dumping ground for a considerable period of years.

It has been suggested that a permanent pond for hardy water lilies might be established by excavating a portion of the peat bog and utilizing the excavated material for filling other parts of this area. This would add a very attractive feature to the meadow and should at the same time increase the area of higher land which might be used for permanent plantings.

This might be a feasible solution, for there is an abundance of water both from the brook which enters the lowland from a culvert just east of the building and from the old Goldsmith Brook. Both of these flow throughout the summer.

Hugh Raup

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. VII MAY 19, 1939 NUMBER 6

FLOWERING CRABAPPLES FOR SPRING AND FALL

AT THIS TIME of year in New England and New York, the flowering crabapples are in full bloom. Collected from widely segregated places in the northern hemisphere, nurserymen in this country are able to offer over fifty of them to the public. Generally, they can be grown wherever the common apple does well, and, though subject to similar apple troubles such as borer and scale, they are an asset to any garden. The sizes and shapes of the twenty-five different crabapples listed in this bulletin differ greatly.

Malus baccata mandshurica is not only the first to bloom, starting this year while the Japanese cherries were still in flower, but is also the tallest, growing fifty feet high or more. On the other hand, *Malus sargenti* is the smallest, often growing twice as broad as it does high and seldom becoming over 8 feet tall. This might be the best crabapple for the small home garden where space is the limiting factor. Unfortunately, nurserymen often grow it from seed which has not been collected from pure stands, resulting in trees that do not have the typical low-growing habit but are much more upright. Since there are few, if any, pure stands in this country, grafting might better be resorted to in order to insure the typical form. The rest of the flowering crabapples range in height from 15 to 30 feet, the majority of them being 15 to 25 feet tall. Some, like *M. halliana parkmani*, rarely exceed 15 feet, while others like *M. ioensis plena* and *M. floribunda* may attain 30 feet. Some of the varieties, like *M. prunifolia rinki*, are upright and spreading in habit of growth; others, like *M. floribunda* and *M. arnoldiana*, are generally mound-like in appearance.

The most picturesque in habit is the tea crab, now called *M. hupehensis*, but listed in nursery catalogues as *M. theifera*. The main branches,

originating from the trunk, are long with few side branches, appearing from a distance somewhat like a huge fan. It is always outstanding, particularly when planted in front of grouped pines or hemlocks.

Like the common apples, the flowering crab has a strong tendency to be alternate bearing, that is, fruit production is poor one year but good the next. Though this may not be particularly noticeable in the flowering, it is very noticeable and often disappointing in the fruiting habits. For instance, the best fruiting tree in the group at the Arboretum *(M.toringoides)* was marvelous in fruit during the fall of 1936, but in 1937, even the largest plant was uninteresting because of few fruits.

The Oriental crabapples (see table) are the first to bloom, followed shortly afterwards by the native species. The flower display lasts about a week, but, of course, depends entirely upon the weather, and this year is considerably retarded because of the unseasonable cold weather. When this issue of the Bulletin reaches its readers the crabapples will be in full bloom at the Arboretum. Some years when the weather is particularly cool the beauty of these plants is prolonged.

For instance, the Tea Crab is charming with its long slender branches clothed with delicately-colored flower buds. It is almost the ideal among crabapples, since the deep pink of the buds, touched here and there with a tinge of white, blends beautifully with the bright green of the unfurling leaves. When these buds begin to open, it is noticed that the petals are white inside and this color becomes predominant, the pink on the under-side slightly fading to white, so that instead of having a pink-flowered crabapple as might be reasonably supposed from a view of the pink buds, actually the flowers are white in color. Although most of the crabapples are either red to pink or white in flower, the Purple Flowered Crab *(M.purpurea)* is unusual with its striking reddish-purple flowers that are particularly conspicuous. The fruits, veins of the leaves and even the wood of the twigs of this peculiar plant are all a slightly reddish-purple shade.

One of the best of color combinations can be obtained by planting a single Carmine Crab, *(M.atrosanguinea)* the flowers of which are a very beautiful deep carmine, in front of two Japanese Flowering Crabs *(M.floribunda)*. These latter are light pink as the flowers open but fade to white almost immediately. Since the Carmine Crab and the Japanese Flowering Crab are about the same height, seldom over twenty-five feet tall, dense, bushy and mound-like in habit of growth, and bloom at the same time, such a combination is never forgotten,

PLATE V

Bechtel's Crab, *Malus ioensis plena*

particularly when planted so that they are viewed with an evergreen background of pine or hemlock foliage.

In the late summertime, the crabapple fruits begin to color, naturally becoming conspicuous against the green background of leaves. The fruits of a few species are an inconspicuous green, the fruits of the Purple Crab, purple. Many fruits are red like those of the Zumi Crab, some are bright yellow, but the ones we value the most are red and yellow, red on the side towards the sun, and yellow on the side away from the sun. Such is the fruit of the Cherry Crab, and the Cutleaf Crab, *M. toringoides*, the best of all the crabapples for ornamental fruit. It was introduced into this country for the first time in 1904 and since that time has proved itself the best in fruit of the hundred different kinds growing at the Arnold Arboretum in Boston. The individual fruits are almost half an inch long, slightly pear-shaped, and colored a glorious mixture of red and yellow, red on the side turned towards the sun and yellow on the side shaded from the sun. For a good yellow-fruited form, the Arnold Crab, originating in the Arnold Arboretum before 1883 as a chance hybrid, is probably the best since its fruits are a brilliant golden yellow. It is difficult to say what varieties are most enticing to birds, for in years when birds are numerous almost all of the varieties prove attractive, although there is a tree here and there which for some reason may be left untouched.

In New England and parts of New York, past winters have demonstrated that the double-flowered Japanese cherries are not dependably hardy. Gardeners in general should realize that the crabapples are considerably hardier and that there are also double-flowered forms (see table). Though these may not be considered as worthy substitutes for cherries, they can at least be depended upon for bloom. The least hardy of all the crabapples is the Parkman Crab, *M. halliana parkmani*, which was injured considerably during the winter of 1933-1934, both in New York and at the Arboretum.

The method of propagating these plants varies considerably. Many of the species can be easily grown from seeds, but in botanic garden collections, where a number of species are in close proximity, there is ample opportunity for cross polliniation; and it has been definitely proved that *M. sargenti* when grown from seed thus collected does not give plants with the desired low-growing habit but rather plants with a more upright form. It is much safer to bud or graft all forms, obtaining buds or scions from stock plants with known characteristics. There is a confusion in the nomenclature of the crabapples in many

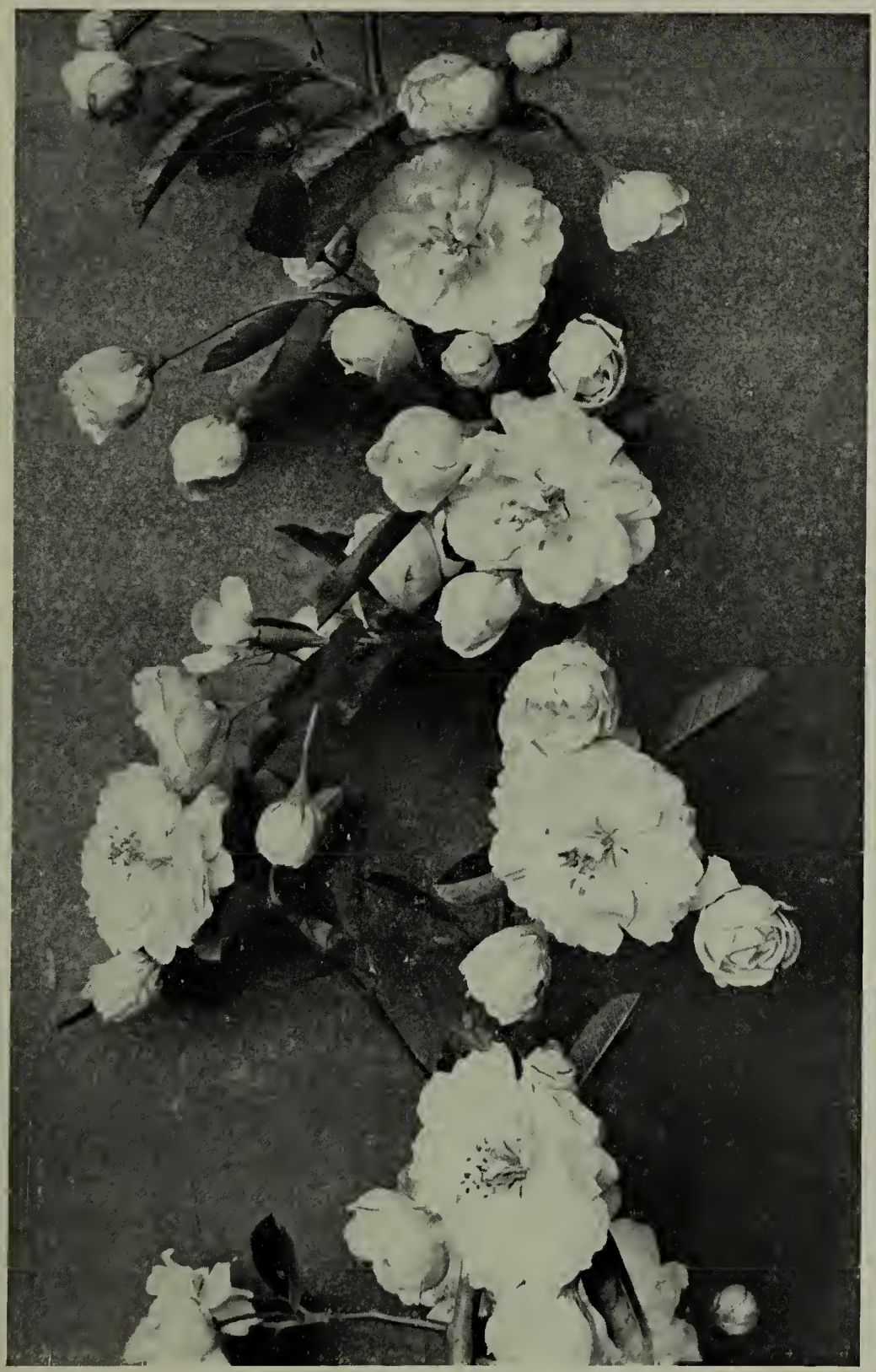

PLATE IV

Malus ioensis plena

Photographed in the Arnold Arboretum, May, 26, 1931,
by Professor Oakes Ames.

nurseries today, simply because large scale production from seed has resulted in many variations from true types.

Asexual reproduction naturally brings up the problem of understocks, which is by no means definitely settled. The American species are best grafted on seedlings of *M. ioensis* or *M. coronaria*. Both French crab seedlings and those of the various Asiatic species have proved successful for the Asiatic forms, especially *M. robusta*.

Crabapples are hosts of Juniper rusts, and the Arnold Arboretum has found the Asiatic species to be the least susceptible. There are places around Boston where Bechtel's crab becomes so disfigured with this disease that it is not grown. Bordeaux has been used in efforts at control but with little success. After several years of careful investigation, the Arnold Arboretum recommends the following for the control of this troublesome disease on ornamental flowering crabapples: Use 5 to 6 pounds of "Linco," a colloidal sulphur spray produced by Linder & Co. Inc., 296 North Beacon St., Boston, Mass., with 100 gallons of water with 3 pounds of "S. S. S.", a commercial "spreader" available at any store selling spray materials. Spray at first when the young leaves become visible and follow with four or five sprays at six to ten day intervals. Spraying just before a rain gives optimum results. To control chewing insects, add 4 pounds of lead arsenate to one of the later applications.

It should be mentioned that crabapples must be sprayed for scale. At the Arboretum Sunoco Oil is applied as a dormant spray, one part of oil and 15 parts of water, the application being made sometime between the middle of February and the first of April.

During the next few years the Arboretum will replant the slope at the base of Peter's Hill where the poplar collection was located before the hurricane. This has already been mentioned in a previous issue of the Bulletin (Vol. VII, No. 1; April 14, 1939). Over a thousand seedlings are now being planted in our nurseries and will be ready to plant in the permanent collections within a few years. This is the result of a definite plant breeding program and it is hoped that at least a few new and interesting varieties will be found in this large number of seedlings.

Crabapples are easily grown in a large number of soils and situations. They are of ornamental interest several seasons of the year and are excellent for attracting birds. We should recognize these sterling qualities and plant more of them!

THE BEST FLOWERING CRABAPPLES (Malus)

	Characters of FLOWER			and FRUIT			
	Single or Double	*Color*	*Landscape Value*	*Size in Centimeters*	*Color*	*Landscape Value*	*Year discovered or introduced— Remarks*
°M.angustifolia	S	light pink	good	1.5-2.5	yellow green	poor	Native; thorny
M.arnoldiana	S	pink	excellent	1	yellow	good	1883; Hybrid (floribunda x baccata)
M.atrosanguinea	S	deep carmine	excellent	1	dark red	good	1905; (halliana x sieboldi)
°°M.baccata mandshurica	S	white	excellent	1 2	yellow or red	good	1825
°M.coronaria	S	pink	excellent	3	green	poor	Native; thorny
M.coronaria charlottae	SD	pink	excellent	3	green	poor	1900
°°M.floribunda	S	pink, fading white	excellent	0.6-0.8	red and yellow	good	1862
°M.glaucescens	S	pink	fair	3-4	pale yellow	poor	Native; thorny
°°M.halliana parkmani	D	bright rose	excellent	0.6-0.8	red purple	poor	1862; least hardy of all
M."Hopa Crab"	S	rose red	good	1.5-2	red	good	1920; (baccata x pumila niedzwetzkyana)
°°M.hupehensis (M.theifera)	S	pink, fading white	excellent	1	greenish yellow, red cheek	poor	1900
°°M.hupehensis rosea	S	pink	excellent	1	greenish yellow, red cheek	poor	1900
°M.ioensis plena	D	pink	excellent				1888; often thorny
M.micromalus	S	pink	excellent	1-1.5	red or yellow	good	1856; Hybrid (baccata x spectabilis)
°°M.pumila niedzwetzkyana	S	red	fair	2	red	good	1891
°°M.prunifolia rinki	S	pink	excellent	2	yellow to red	good	1850; upright growth
M.purpurea	S	red purple	excellent	1	red	poor	1915; Hyb. (atrosanguinea x niedzwetz.)
M.purpurea eleyi	S	vinous red	excellent	1	red	poor	1920
°°M.sargenti	S	white	excellent	1	dark red	good	1892
M.scheideckeri	SD	pale pink	excellent	1-1.5	yellow	poor	1882; Hyb. (spectabilis x micromalus)
°°M.sieboldi	S	pale pink, fading white	good	0.6-0.8	red to yellowish	poor	1853
°°M.spectabilis	SD	pink	excellent	2	pale yellow	poor	1780
M.spectabilis albi-plena	D	white	excellent				
M.spectabilis riversi	D	pink	excellent				1872
°°M.toringoides	S	white	poor	1-1.2	yellow with red cheek	excellent	1904

°Species native to the United States.
°°"Oriental Flowering Crabapples" native to China and Japan.
SD=semi double

Notes

At the time of writing the weather is still unusually cold. There have been frosts for the past three nights with strong indications of another tonight. At the present time the Magnolia soulangeana varieties are still at their height of bloom. Amelanchiers have been at their best for the past few days but will soon drop their petals rapidly. Forsythias are still gorgeous, but they too, will lose their brilliance as soon as one or two warm days force the vegetative shoots into growth. The single flowering cherries are past but the double flowering cherries will soon be at their height of bloom.

This week end will find the Japanese quinces in full bloom; the crabapples approaching their peak and some of the early flowering azaleas like the royal azalea and the pink-shell azalea will be particularly conspicuous.

Lilacs should be in full bloom during the week end of May 27, with May 28 **being Lilac Sunday.** At this same time the thousands of torch azaleas planted on the hills in the Arboretum should be at their best.

DONALD WYMAN

A last minute inspection of the lilacs discloses the fact that they show more flower buds than they have for many previous years.

Consequently the lilac display this coming week will certainly be worth a trip to the Arboretum.

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. VII JUNE 23, 1939 NUMBER 7

SOME TWINING VINES

ASK any gardener how many species of hardy ligneous twining vines there are, and the answer may be from six to twelve; yet, the Arnold Arboretum has approximately 65 species and varieties of hardy twining vines growing within its boundaries. Truly a surprising number! And this is not all, for if the other climbing vines are added to this list, the total number of woody vines actually growing in the Arboretum today is well over 150. All of these are not good landscape plants, but there are some which might well bear further investigation by the interested gardener.

Old-fashioned vines like *Actinidia arguta*, *Aristolochia durior*, and *Celastrus scandens* are all grown here, of course. So are the Chinese and Japanese wisterias (*Wisteria sinensis* and *W. floribunda*). However there are 34 other wisteria species and varieties being grown also, many of which have been added to the collections during the last three years. It is doubtful if all the varieties in this genus now being offered by American nurseries are distinct and worthy of individual varietal names; nevertheless, all are now being grown on a long arbor recently erected near the old Bussey Institution Building, and after they become well established and produce flowers, it will doubtless be most interesting to study their differences.

Akebia quinata can be considered as one of the best of these vines for foliage. Its palmately compound leaves are semi-evergreen, and its small purplish colored flowers—though not conspicuous—are most interesting and unusual. *Akebia trifoliata* (*A. lobata*) has three leaflets instead of five and is somewhat coarser in texture because of this character. There is a vigorously growng hybrid (*A. pentaphylla*) between the two now growing in the Arboretum. This plant has leaves with

three, four, and five leaflets. All three have tuberous roots, are easy to divide and of very vigorous growth once they become well established. When not allowed sufficient space in which to expand, the foliage becomes so dense that some of the inner leaves are shaded to such an extent that they often become yellow and drop off.

The bower actinidia *(Actinidia arguta)* is perhaps the most vigorous of all these climbers (actually *Pueraria thunbergiana* is, but this plant is not winter-hardy at the Arnold Arboretum). The sexes are separate, and the pistillate plant bears fruits that are about the size of a gooseberry and very good for making jelly. At one time the Hicks Nurseries at Westbury, Long Island, had five strains of this species selected primarily for their large fruits. These are now represented in the collections at the U. S. D. A. Bureau of Plant Introduction Station, Bell, Maryland. *Actinidia polygama* is another climber, very enticing to cats. Several plants have been literally chewed to death in our vine collection. A few years ago Mr. Judd grew some in the greenhouse for a time, and he states that cats were so attracted by the delicious odor from this plant that they actually crept through the overhead greenhouse ventilators to get a taste of it. This vine is relatively rare in American gardens and if grown should be protected by wire screening of some sort.

Two species of *Celastrus* are commonly used, *Celastrus scandens*, native to the United States, and *C. orbiculata*, *(C. articulata)* native to Japan and China. Both are excellent for their ornamental fruits, and vigorous twining habit of growth. The peculiar *C. flagellaris* from northeastern Asia makes an unusually effective barrier because it has stipular spines that are very effective indeed. It is the only hardy twining vine with thorns that thrives with us and consequently should have many uses. (*Smilax* also has thorns, but this is not considered to be a twining vine). This *Celastrus* is perfectly hardy in the Arboretum and might very well be tried elsewhere.

The common moonseed *(Menispermum canadense)* is a vigorous twining vine that spreads rapidly over the ground and quickly climbs up any means of support with which it comes in contact. It easily becomes a pest, for it escapes its bounds rapidly, but is not as bad in this respect as *M. dauricum*; it should be used with some discretion. These vines are not very woody and usually die down to the ground in winter, but on the trellis in the Shrub Collection, some of the vines have already grown as much as eight feet high this spring alone.

The two silkvines *(Periploca graeca* and *P. sepium)* suffer winter injury frequently here in the Arboretum. The Grecian silkvine *(P.*

graeca) is the taller growing of the two, has more foliage, but is not as hardy as the Chinese silkvine *(P.sepium)*. Their fruits are long pods, which, when they open in the fall, are full of fluffy seeds reminding one of the milkweed.

There are actually 36 named wisterias growing in the Arboretum. The differences between some of the varieties of *W.floribunda* may not be very marked, but most of these forms are being offered in the nurseries of the United States. In the Chinese wisteria the flowers of each cluster open at once, while in those of the Japanese wisteria the flowers open progressively from the base of the long cluster to the end. Both are good plants, with deliciously fragrant flowers, the Chinese form being more common in landscape use, although the *W.floribunda* is somewhat hardier. It is from specimens of our native *W.frutescens* that this genus was first named by Nuttall in 1818. Seeds of the Japanese wisteria were first sent to this country by Dr. George R. Hall, to his friend Samuel Parson, of Flushing, Long Island, in 1862. Today "wisteria" and *W.sinensis* are synonymous to many Americans, but nurserymen are beginning to offer some forms of the Japanese wisteria with long racemes, so that it will not be long before these also become familiar.

It may be of interest to Bulletin readers to note in which direction the various vines twine. One of the catch questions in many a quiz on garden matters centers on this interesting point. There is not a haphazard method of twining, but the plants of each species invariably twine consistently in one direction. In training young vines, this should be kept in mind, for it is just as easy to wind young plants around their supports in the right direction, and the chances are that this will be much more likely to be permanent. I have just now inspected all the vines listed here and have noted their habit in this respect. It will be seen that the species of each genus consistently twine in the same direction in all cases, except the wisterias. Three species of this genus twine by climbing from left to right, and two species twine by climbing in the opposite direction (i.e., from right to left). All our plants at the Arboretum have been examined in this respect, and in the case of *W.floribunda* two plants of more than a dozen examined were found that twined in the opposite direction from the majority of this species. Consequently we should welcome correspondence on this subject particularly if some plants of the species named are found which do not twine in the manner noted below.

TWINING VINES

Twining by climbing from left to right

Actinidia polygama	Silvervine
" purpurea	Purple Actinidia
" melanandra	
" kolomikta	Kolomikta
" arguta	Bower Actinidia
Akebia pentaphylla	
" trifoliata	Threeleaf Akebia
" quinata	Fiveleaf Akebia
Aristolochia durior	Dutchman's Pipe
" kaempferi	
" manshuriensis	
Celastrus flagellaris	Korean Bittersweet
" orbiculata	Oriental Bittersweet
" scandens	American Bittersweet
" loeseneri	
" hypoleuca	
Menispermum canadense	Common Moonseed
" dauricum	Asiatic Moonseed
Periploca graeca	Grecian Silkvine
" sepium	Chinese Silkvine
Wisteria frutescens	American Wisteria
" macrostachya	Kentucky Wisteria

Twining by climbing from right to left

Berchemia racemosa	Japanese Supplejack
Dioscorea villosa	Wild Yam
Lonicera henryi	Henry Honeysuckle
" japonica halliana	Hall's Honeysuckle
" sempervirens	Trumpet Honeysuckle
Schisandra chinensis	
*Wisteria floribunda	Japanese Wisteria
" formosa	(W. sinensis × W. floribunda)

*Of about fourteen plants of this species examined, all but two twined by climbing from right to left. Those two twined by climbing from left to right! The experiences of others are welcomed on this interesting and often controversial subject.

DONALD WYMAN

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. VII JUNE 30, 1939 NUMBER 8

INDEX KEWENSIS IN IMPROVED LOOSE LEAF LEDGER FORM

IN 1932, at the New York Botanical Garden, I initiated the pasting of all the entries in Index Kewensis and its seven supplements then published, in loose leaf ledger form, the first time that the task was consummated on the basis of modern business technique in any institution. The actual work was done under the personal supervision of Mr. G. L. Wittrock, by assistants provided by the Emergency Work Bureau of New York City. Since the New York set was completed two additional supplements have been issued. This fundamental work, now consisting of over 6,000 folio pages with about 700,000 binomial entries is the most used single work in all institutions where systematic botanical work is a major activity. The importance of a single generic sequence is at once realized when one considers that if the several *addenda* and *emendanda* be included, there are as many as fifteen different generic entries in the eleven volumes now published for some groups. This means that one must, or should, search in fifteen different places when consulting the work when one is interested in determining whether or not such and such a specific name has been used, and if so, where it was first published.

In February, 1939, the task of pasting up all entries in the original work and its nine supplements in one generic sequence was initiated at the Arnold Arboretum and was completed early in June. The improvements in the Arnold Arboretum set over the style selected at New York are in the adaptable auto-flex four post binders manufactured by the Wilson-Jones Company, pig skin binders rather than buckram being selected for permanency; chain lock mechanism for holding the sheets firmly in place and providing for future easy addi-

tions of extra sheets; the individual sheets reinforced by tough cloth strips on the binding edge; and a very much greater amplification of the pasted-in data, thus providing ample space for future additions without breaking sequences as additional quinquennial supplements appear; and in the case of all large genera, an indefinite amount of space for this purpose.

In preparation for this work two complete sets of Index Kewensis and its nine supplements were clipped. Each entry was stamped "IK", "IKS1", "IKS2", etc., and when this part of the task was completed, the clippings were arranged alphabetically under the generic heads, and chronologically in accordance with the sequence of the several supplements. After carefully checking for alphabetic sequences and proper spacing between entries, the items were pasted on the standard sheets selected. The estimated amount of space for future additions under each small genus was approximately determined by scanning the several Supplement entries, but all large and medium sized genera were left "hanging" for indefinite future additions, the blank part of the last page to be filled first and then new sheets, as necessary, to be inserted. In all large genera the entries were pasted in solid, covering both sides of the sheet, regardless of the amount of space left on any last page, but except for such groups the items were pasted on one side of the sheet only. Thus in one of the open loose leaf ledger books shown in the illustration, it will be noted that the third and last page of *Gladiolus* is nearly full; but when the tenth supplement appears, the small amount of remaining space will be used and then a new sheet will be inserted to take the remainder and future additions.

When Supplement ten appears, five years hence, it may be necessary to break sequences to provide for some of the newly published genera, and occasionally it may be necessary to do this in a few cases where a very large number of new binomials under any old generic name may be published. The breaking of sequences can, however, be readily obviated by steaming the sheets, removing the pasted entries, and expanding the arrangement to meet future contingencies. This provision for the insertion of additional sheets is the great advantage of the modern loose leaf ledger format over the older system of permanently bound volumes, such as that initiated at Kew many years ago. The system of a single sequence is, for practical purposes, superior to the form used at the Rijks Herbarium, Leiden, where the generic entries were first sorted into families, and then arranged alphabetically by genera, each genus commencing a new page.

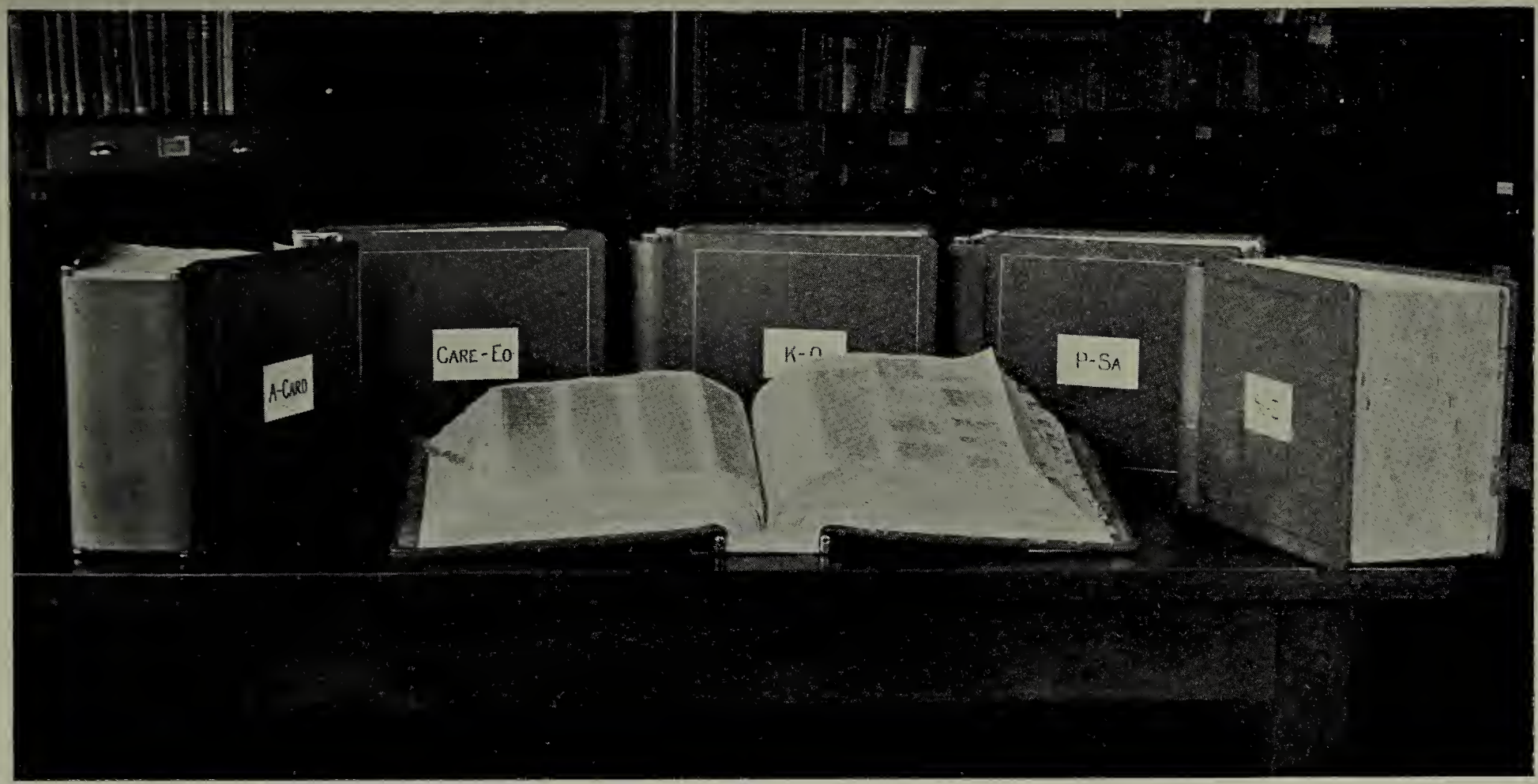

PLATE VI

Index Kewensis in Its New Loose Leaf Form at the Arnold Arboretum.

Space remains on the right-hand page of the open volume for additional insertions. On the left-hand page, the genus *Gladiolus* takes the entire space. Further additions to this genus will be taken care of by inserting another sheet. Only in some of the long genera was pasting done on the reverse side of the page.

The page size selected is the same as for the New York set, 17 by 14 inches, four column format. The sheets are arranged in one generic sequence occupying six binders, each about five and one-half inches thick, about 550 sheets to a binder. The net advantages to the numerous users of this indispensable work is the actual saving of a vast amount of time when one has to check the published binomials in any genus of flowering plants, the time actually saved in this connection often amounting to as high as 90 percent.

E. D. Merrill

NOTES

The loose leaf ledger system is ideally adapted to the purpose of keeping scattered bits of information together and in order. Various sizes of binders are available from the Wilson-Jones Company, 100 S. Elmora Avenue, Elizabeth, New Jersey. A special glue, known as "Mikah" remoistening gum, manufactured by the National Adhesive Corporation, 15 Elkins Street, Boston, Massachusetts, was used in pasting, and its excellent adhesive qualities make it most satisfactory for this type of work. This adhesive has been used by the Arboretum in some other extensive pasting work which is in perfect condition years after being applied. In making the references of the voluminous Index Kewensis thus quickly accessible, Dr. Merrill investigated a considerable number of adhesives, most of which he discarded as being unsatisfactory for one reason or another. Horticulturists in general might well profit from Dr. Merrill's experience and adopt some standard loose leaf binder as a highly satisfactory method of filing miscellaneous articles, reports, clippings, notes, programs, and the thousand and one other bits of garden information that are constantly appearing and should be kept—provided they can be filed so they are readily accessible when needed.

Donald Wyman

Addition to Twining Vines (Bulletin of Popular Information, Vol. 7, No. 7, June 23, 1939).

In the lists of twining vines on page 36 the Chinese Wisteria (*Wisteria sinensis*) was unfortunately omitted. This should be added to the group **Twining by climbing from left to right.**

D. W.

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. VII AUGUST 11, 1939 NUMBER 9

DROUGHT AT THE ARBORETUM

THE extended drought of the past six weeks has been broken—we hope! Never before in the history of the Boston Weather Bureau was there so little rain in July, and accurate records have been kept in this area 121 years. Friends of the Arboretum will be glad to know that the heavy thunderstorm of August fourth, brought considerable relief to the many plants at the Arnold Arboretum, and alleviated the acute condition for the time being, at least.

In any large area the size of the Arboretum, there are always places which can normally be expected to become considerably dry when rainfall is low—particularly in the summer time. In the Arboretum, for instance, one of the azalea beds along the Meadow Road is always among the first to suffer from lack of water. Some of the plants in the Chinese collection on Bussey Hill can be expected to show lack of water readily, and it is usually necessary to water the rhododendron collection at least once during the summer, although efforts are made annually to incorporate more humus into the soil about the plants.

There is a rain gauge in the small nursery adjacent to the greenhouse and readings are taken there daily for the Boston Weather Bureau. Though the official rainfall for the month of July for the Boston area was given as .75 of an inch (nearly 3 inches below normal) only .34 of an inch was recorded at the Arboretum during the same period, about the lowest of any area in the vicinity of Boston. The previous July record low for rainfall in the Boston area was in 1849 when only .85 of an inch was recorded.

With an excess of rain (11.10 inches total rainfall in July) and flooded conditions throughout Massachusetts for the same period last year (later followed by a hurricane), it would seem that the plants in eastern Massachusetts are being subjected to all the vagaries which an unpredictable Nature can provide in the short period of one year! It is fortunate, indeed, that the heavy rainfall of August fourth came

when it did. The rain gauge recorded a fall at the Arboretum of .99 of an inch, practically three times as much rain as had fallen during the entire month of July!

Plants Affected

Foremost among the plants which showed noticeable wilting were the large lilacs in the lilac collection growing between the walk and the road, and the Philadelphus on the opposite side. These were wilting consistently and it became necessary to water them every few days in order to keep them from losing their leaves. The rhododendrons were beginning to show wilting about the middle of July. Because of the great value of these plants it was necessary to water them continuously for a full week.

Many of the younger trees and shrubs planted in the collections during the past two and three years suffered considerably. Attempts were made to water them but some were so far from the road that it was impossible and as a consequence some undoubtedly will die.

Near the end of July, particularly during the last few days, trees began to show the effects of drought at an alarming rate. Some of the small Japanese cherries near the Administration Building dropped some of their leaves. Several of the viburnums in the collection were in very poor condition, and such rugged plants as *Viburnum dentatum* and *V. lentago*, growing at various places in the Arboretum showed an increasing number of wilted and fallen leaves. The bank of Forsythias below the lilac collection started to wilt about July thirty-first. It was nothing serious, for the leaves did not dry up entirely as did those of many other plants, but they did show pronounced wilting and the rain came in the nick of time to save them from more serious injury.

Fires

During the latter part of July the danger to the plants from fire was as great as the danger from lack of water. One day during the last week of July there were three fires within the boundaries of the Arboretum, two of them burning simultaneously. Most of the fires, (they averaged about one a day for over two weeks) were small grass fires, started by dropped matches or cigarettes and were easily controlled by Arboretum workmen, but for some it was necessary to call the fire department in order to obtain quick control. No serious damage was done to any of the valuable trees and shrubs, due to the prompt control methods of the Arboretum force and the firemen.

It is hoped that the heavy rains of August fourth will be followed shortly by others. At the time this is written, plants in the Arboretum can be said to have recuperated fairly well, but with a pronounced deficiency of rainfall to date, considerably more rain is needed before the trees and shrubs can be considered safely out of danger for the rest of the summer.

PLATE VII

Logs awaiting the saw mill in Tom Swamp Pond of the Harvard Forest, Petersham, Mass., mute evidence of the terrific destruction caused by the hurricane last fall. One might judge that Nature had run through the entire gamut of weather tricks since July of last year.

An Important Introduction of Seeds from Western China to the Arnold Arboretum

Within the past few years it has been the policy of the Arnold Arboretum to make modest grants to strategically located institutions and individuals in support of cooperative collection of seeds as well as botanical specimens essential to the proper identification of the former. Last year the very large seed collection, comprising about 2300 numbers, made by Mr. Yu in 1937 in western China was distributed through the Arboretum. From a grant made in the early part of 1938 to the Fan Memorial Institute of Biology in Peiping the Arboretum has just received, in one shipment, 585 packages of seeds from Yunnan-Sikang, in southwestern China. Over one-half of the numbers represent woody species, the remainder herbaceous forms. The field work was done by Mr. T. T. Yu during the past collecting season. The seeds were shipped from Yunnan-fu in April and delivered in Boston on July 12, a commentary on the delays in transportation to which such material is subject due to present unsettled conditions in China. The botanical material, shipped at the same time, has not yet been received.

Selections from the woody species will be made for trial at the Arboretum, while excess material will be distributed to the various correspondents of the institution who may be interested in new introductions. With little information as to whether or not the various species may prove to be hardy in New England, it seems to be better policy to give such current introductions rather wide distribution, so that if the species fails to survive with us, it may be found to thrive elsewhere.

The seeds of the herbaceous species, mostly determined to the genus, have been turned over to the Massachusetts Horticultural Society for distribution to its members. This current shipment from war-torn China is potent evidence that plant hunting is still actively going on in these unsettled times.

Note

The Arboretum is always recommending new plants to the horticulturally minded public, though it is not always possible to get such new things in large quantity. Both *Prinsepia sinensis* and *P. uniflora* are two excellent, vigorous-growing, thorny shrubs which are not grown much in this country outside of botanic gardens but they have been described from time to time in this Bulletin and recommended. The trouble has been the inability to get seed. Now it may be obtained for $0.50 per pound (cleaned, packed, and delivered to the Post Office at Harbin, Manchoukuo) from:

Mr. A. Woeikoff, The Garden of Manchurian Flora, P. O. Box 33, Harbin, Manchoukuo. Those interested should write immediately.

DONALD WYMAN

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. VII NOVEMBER 3, 1939 NUMBER 10

SALT WATER INJURY OF WOODY PLANTS RESULTING FROM THE HURRICANE OF SEPTEMBER 21, 1938

SINCE last year's Hurricane, it has been particularly interesting to note the rapidity with which certain trees and shrubs recovered from salt water injury. Many plants have shown a remarkable ability to withstand immersion in salt water for twenty-four hours and longer. Because of this, a study was made of certain sections around Woods Hole and Falmouth, in Massachusetts; Newport, Rhode Island; and places along the north shore of Massachusetts, a year after the hurricane, in an attempt to see how well injured plants were recovering. As a result of these observations, the appended lists are presented. These data were compiled on special trips to the areas indicated and have been checked by several individuals who have been doing landscape work in the regions. Mr. Wilfred Wheeler, of Hatchville, Massachusetts, has been particularly observant and helpful, and assisted materially with his important observations and has also checked the lists.

Lawns

Many lawns were flooded with salt water, and in the spring anxious property holders sent many soil samples to the Rhode Island Experiment Station for analysis. Several of these samples were analyzed but in no case was a sufficiently heavy accumulation of salts found to cause permanent injury to the soil. No great accumulation of salt in the soil took place because the ground was thoroughly saturated with water before the storm struck. It had been raining steadily during the four days preceeding the storm, and in the months following there was plenty of rain and snow, so that much of the salt remaining after the storm was leached out before spring. However, there were many cases

where either the grass foliage or the grass roots or both were killed.

Standard practice for renovating immersed lawns was to apply ground limestone at the rate of 20–50 pounds per thousand square feet and thoroughly water the areas after the limestone was applied. If the grass roots were not killed, new growth appeared in the spring. If the grass roots were killed, the soil was dug up and the affected areas were reseeded, standard applications of regularly recommended fertilizers being made at the same time. Different grasses reacted in different ways. Bent grass and Kentucky Blue grass were easily killed, while the omnipresent crabgrass eventually appeared even after being submerged 24 hours or more. Several areas around Woods Hole where salt water had stood for 24 hours, observed one year later, were a good green—from a distance. On close examination, the grasses and weeds making this green color were of some of the coarser and more objectionable sorts, but, nevertheless, the fact remains that they were not killed and made an excellent recovery.

Trees and Shrubs

Although considerable care was taken in observing the extent of salt water injury on trees and shrubs, conditions differed widely, and plants that may have suffered severe damage in one place may have been unharmed in others. This may be on account of variations in soil, drainage, and the length of time the salt water stood about the plant roots. Salt-spray injury also differed widely, perhaps chiefly because of varying degrees in exposure, wind velocities at the time of the storm, height, age and condition of the plants, and other factors.

Consequently, the information included herein should be taken only at its face value. It merely represents observations made in areas where salt water damage to woody plants was greatest. Many commonly grown plants were not observed in the flooded areas examined; consequently numerous additions to the lists can and should be made as additional data becomes available. Fortunately, with hurricanes in the east spaced 100 years apart, it is not necessary that the fear of another in the immediate future should govern present seashore planting. Since continual planting is being done, it is hoped that the following lists may prove helpful to those engaged in selecting the right kind of plant material for exposed seashore situations. It is very seldom that such a golden opportunity is offered to study the effects of wide-spread salt water damage to woody plants, and, since the opportunity has presented itself, it was thought advisable to take advantage of it and make careful notes on individual species before the damage became minimized by the soothing effects of time.

PLATE VIII

Pictures taken in Eel Pond swamp, Woods Hole, September 29, 1939.

At the top, Sycamore maple, Acer pseudoplatanus is growing unharmed though its roots were submerged with salt water for 24 hours. Nearby, red maple, elm and birch have been severely injured.

Lower picture shows red maple and Pinus rigida killed, while white willow, bayberry, azalea and various grasses are growing well.

The following plants were submerged in salt water for at least 24 hours after the hurricane and were recovering satisfactorily when observed one year later.

(In all cases the roots were submerged, and in many cases the plants themselves or portions of them. Satisfactory recovery means that, although injured, these plants were sending out vigorous suckers from the base or from the larger stems, or the tops were sending out new shoots. It should be noted here that if the inundation had come after a long drought and the soil had not been saturated with water, there might have been a considerably greater injury.)

Acer pseudoplatanus
Aesculus hippocastanum
Ailanthus altissima
Aronia arbutifolia
Calluna vulgaris
Campsis radicans
Catalpa speciosa
Clematis paniculata
Clethra alnifolia
Comptonia asplenifolia
Corylus americana
Cryptomeria japonica
Hibiscus syriacus
Ilex glabra
Juniperus chinensis pfitzeriana
Juniperus virginiana
Juniperus virginiana glauca
Ligustrum amurense
Ligustrum ovalifolium
Malus sylvestris
Myrica pensylvanica (M. carolinensis)
Nyssa sylvatica
Parthenocissus tricuspidata
Populus grandidentata
Picea canadensis
Picea pungens kosteri
Pinus sylvestris
Pinus thunbergi
Prunus martima
Prunus serotina
Prunus virginiana
Pyrus communis
Quercus alba
Rhododendron viscosum
Rhus aromatica (R. canadensis)
Rhus copallina
Rhus glabra
Rhus toxicodendron
Rhus typhina
Rhus vernix
Robinia pseudoacacia
Rosa (Ramblers)
Rosa rugosa
Rosa virginiana
Rosa wichuraiana
Salix alba
Sambucus canadensis
Smilax glauca
Spiraea prunifolia
Tamarix parviflora
Tilia cordata
Ulmus pumila
Vaccinium corymbosum
Viburnum dentatum
Vitis labrusca
Wisteria sinensis

PLATE IX

The Japanese Black Pine (P.thunbergi) was outstanding in its resistance to salt water. This one, only a few hundred feet from the shore at Woods Hole. was exposed to the worst of salt spray and was even covered with salt water, yet it came through in perfect condition.

Plants subjected to salt spray and either uninjured or not injured seriously

(The hurricane came only a few weeks before most deciduous trees dropped their leaves; consequently, salt spray injury was comparatively worse on the evergreens. The amount of salt spray varied considerably in different locations, and many of the plants in this list would be injured in one place and uninjured in another. Many other plants may have weathered salt spray injury satisfactorily but do not appear on this list because they were not observed. These facts should be kept in mind when studying the list.)

Acer platanoides
Acer pseudoplatanus
Actinidia arguta
Ailanthus altissima
Amelanchier canadensis
Arctostaphylos uva-ursi
Baccharis halimifolia
Cedrus atlantica glauca
Cephalanthus occidentalis
Chamaecyparis pisifera plumosa
Chamaecyparis pisifera squarrosa (damaged somewhat)
Clethra alnifolia
Crataegus crus-galli
Cytisus scoparius
Elaeagnus angustifolia
Elaeagnus longipes
Fagus sylvatica
Forsythia species
Hippophae rhamnoides
Hydrangea macrophylla (H. hortensis)
Ilex glabra
Ilex opaca
Juniperus communis
Juniperus communis depressa
Juniperus excelsa stricta
Juniperus horizontalis
Juniperus virginiana
Juniperus virginiana glauca
Kalmia angustifolia
Ligustrum amurense
Lonicera japonica halliana
Lonicera morrowi
Lonicera tatarica
Malus sylvestris
Myrica pensylvanica (M. carolinensis)
Parthenocissus tricuspidata
Physocarpus opulifolius
Picea abies
Picea asperata
Picea canadensis
Picea glauca
Picea orientalis
Picea pungens kosteri
Pieris japonica
Pinus mugo mughus (varied responses on different soils)
Pinus nigra
Pinus thunbergi
Populus alba
Prunus maritima
Pyrus communis
Quercus marilandica
Rhamnus cathartica
Rhus copallina
Rhus glabra
Rhus toxicodendron
Rhus typhina

Robinia pseudoacacia
Rosa (ramblers)
Rosa blanda
Rosa humilis
Rosa nitida
Rosa rugosa
Rosa virginiana
Rosa wichuraiana
Salix humilis
Sambucus canadensis
Spiraea species
Syringa vulgaris (if submerged, it was killed)
Tamarix parviflora
Taxus species and varieties (even took submergence for 2–3 days in some instances though they did not respond as well as Pfitzer's juniper).
Tilia americana
Tilia cordata
Tilia vulgaris
Thuja occidentalis varieties
Ulmus pumila
Vaccinium corymbosum
Viburnum cassinoides
Viburnum dentatum
Wisteria sinensis

Plants killed or very seriously injured by salt water

(If salt water stood on the soil long enough it would kill all the roots of most trees and shrubs, except a very few like Baccharis. The plants listed below were killed or seriously injured by salt spray, by submergence in salt water, or by both.)

Abies concolor
Abies pinsapo
Acer rubrum
Azaleas (evergreen types)
Berberis thunbergi
Betula papyrifera
Betula populifolia
Buxus sempervirens
Buxus sempervirens suffruticosa
Cephalanthus occidentalis
Chamaecyparis species and varieties
Clematis virginiana
Euonymus species and varieties
Ginkgo biloba
Hedera helix
Larix decidua
Liquidambar styraciflua
Liriodendron tulipifera
Lyonia ligustrina
Parthenocissus quinquefolia
Pinus rigida
Pinus strobus
Pseudotsuga taxifolia (P. douglasi)
Rhododendrons (evergreen types)
Rosa—(Any grafted or budded rose) Injury may have been due to sudden freeze late in the fall, more than to salt water injury.
Sassafras albidum (S. officinale) (but coming up from roots)
Tsuga canadensis
Ulmus americana
Ulmus fulva
Weigela species and varieties

NOTE

Through the support received from a number of friends of the Arnold Arboretum it has been possible to establish a Fellowship for 1939-40 which has been assigned to Miss Luetta Chen, a Chinese student taking graduate work in botany in Radcliffe College. This has been designated the "George B. Emerson Fellowship" in memory of Mr. Emerson, one of the trustees of the James Arnold estate, and the individual who actually suggested the establishment of the Arnold Arboretum. Because of his enthusiasm and interest, the trustees of the Arnold estate were inspired to transfer the initial endowment of $100,000 to Harvard University, provided the University would set aside a part of the Bussey farm as a site and foster the establishment of the Arnold Arboretum.

Donald Wyman

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. VII NOVEMBER 29, 1939 NUMBER 11

THE ORDER OF BLOOM OF TREES AND SHRUBS AT THE ARNOLD ARBORETUM

IN order to establish a beautiful planting of flowering trees and shrubs, one must have a knowledge of those plants which effectively bloom together. Although the actual day on which a certain plant may come into bloom varies from year to year according to the weather, there are some that always bloom together, and it is this information that gardeners should always have available when planning their gardens. In this bulletin a large number of the more ornamental trees and shrubs growing at the Arboretum are listed according to their sequence of bloom. Many varieties have been omitted because of lack of space, but the list is of sufficient length to serve as a basic list to which future additions may be made. Of particular interest could be the addition of notes on the length of bloom of these plants, and in making additions and notes of this character the list should become of increasing value.

Many have had the opportunity of following the spring from the South into the North. In fact, one could enjoy the beauties of any particular period in the spring a full three months simply by travelling in slow stages from Florida to Maine. The following schedule shows the approximate times the mountain-laurel *(Kalmia latifolia)* blooms at different places in the United States. Though these vary according to the weather during the particular year in question (see Bulletin, No. 3, April 29, 1939, page 16, for other information on this same point), nevertheless, there is a progressive display of mountain-laurel from the South to the North over a two-month period.

The time Kalmia latifolia blooms in different regions

Augusta, Georgia	Mid April
Glen St. Mary, Florida	Late April
Monongahela National Forest, West Virginia	Mid May
Shenandoah Valley, Virginia	Mid May
St. Louis, Missouri	Late May
Philadelphia, Pennsylvania	Late May
New York, New York	Early June
Columbus, Ohio	Early June
Chicago, Illinois	Mid June
Rochester, New York	Mid June
Boston, Massachusetts	Mid June
Seattle, Washington	Late June

Since most of the hybrid rhododendrons bloom slightly before the mountain-laurel and most of the *Philadelphus* species and varieties bloom at about the same time, it is easy to correlate the time of bloom of other plants with those in such a list. With this in mind, the list offered in this bulletin is really applicable anywhere since **the sequence of bloom is the same,** even though the actual time mentioned is for the vicinity of Boston, Massachusetts.

In consulting the following list it should be kept in mind that, though a certain plant may be listed as blooming the first part of June, it may remain in full bloom and hence be effective from the landscape point of view for at least two weeks or more, and so can be used in combination with plants that normally bloom later. The length of bloom is an intensely interesting study, and because of a long blooming period, many plants are quite useful. As an example *Spiraea prunifolia plena* normally starts to bloom at the Arboretum on May 1. It frequently remains effective for three full weeks. On the other hand, a plant like *Amelanchier canadensis* may remain in bloom only five days or even drop its petals in three days if the weather is unusually warm. Consequently, the length of time the flowers remain on the plant is important and depends upon the weather and the kind of plant. As a rule, the plants with double flowers last considerably longer than do those varieties with single flowers.

The length of time that plants like the flowering crabapple can be enjoyed depends particularly upon the weather. Many are more interesting in bud than in full flower, and if there is a long period of cool, cloudy weather when the buds are full but not open, they may remain in good condition for some time and so may be colorful and

effective for two weeks or more. On the other hand, if a warm hot spell forces the buds to open at once, the flowers may fade in less than a week. Since these conditions vary considerably, those interested in using such plants must study them carefully and consider local conditions as a basis for determining the length of time the flowers may be expected to be of ornamental value.

Wherever possible, yearly records have been kept of individual plants, since one individual of the same variety, growing in a warm, sunny spot, will undoubtedly bloom earlier than another which is more exposed. The following list is based on blooming dates in Boston and has been correlated with records kept by Professor J.G.Jack of the Arnold Arboretum between 1887 and 1893. Because of lack of space, a majority of the varietal names have not been given. Among the large number of Japanese cherries and the hybrid lilacs, there are some varieties that do bloom earlier than others, but this is a study in itself. Not all the plants listed are of value for their flowers, but they have simply been included as a matter of record. A plant is listed only for the particular date when it is in full bloom from the landscape point of view, although its flower buds might be rather conspicuous for several days previous to full bloom. As an example *Pieris floribunda* and *P.japonica* are listed only once each in the following list, yet the flower buds of both are conspicuous a greater part of the late winter. Consequently, it is not to be considered that hard and fast date lines are set up in the following list, but the general sequence and the association of plants blooming together should be of particular value to all interested in woody trees and shrubs.

ORDER OF BLOOM

February

Hamamelis vernalis

March

Acer saccharinum
Hamamelis japonica
Hamamelis mollis
Prinsepia sinensis buds opening
Salix species
(Snowdrop & Crocus)

Early April

Acer rubrum
Alnus incana
" rugosa
Cornus mas
Cornus officinalis
Corylus species
Daphne mezereum
Erica carnea
Forsythia ovata
Jasminum nudiflorum

Lonicera fragrantissima
" praeflorens
" standishi
Pieris japonica
Populus species
Prunus davidiana
Rhododendron dauricum
Viburnum fragrans

Mid-April

Abeliophyllum distichum
Acer negundo
Berberis thunbergi (leaf buds opening)
Betula species
Cercidiphyllum japonicum
Corylopsis species
Dirca palustris
Epigaea repens
Forsythia europaea
" intermedia vars.
" suspensa
Forsythia viridissima
Lindera benzoin
Lonicera morrowi and L. tatarica leaf buds opening
Pieris floribunda
Rhododendron mucronulatum
Salix blanda leaf buds opening
Shepherdia argentea
" canadensis leaf buds opening
Viburnum sieboldi
Ulmus americana

Late April

Acer circinatum
" diabolicum purpurascens
" platanoides
Aesculus species, leaves well advanced
Euptelea francheti
" polyandra
Larix species leaf buds opening
Lonicera altmanni pilosiuscula
" coerulea edulis
" tenuipes
Maddenia hypoleuca
Magnolia denudata
" kobus
" " borealis
" stellata
Malus baccata mandshurica
Myrica gale
Prinsepia sinensis
Prunus apetala
" armeniaca
Prunus canescens
" cerasifera
" concinna
" cyclamina
" dasycarpa
" fenzliana
" incisa
" " serrata
" mandshurica
" nigra
" nipponica
" sargenti
" salicina
" simoni
" subhirtella and varieties
" tomentosa
" tomentella
" triloba
" yedoensis
Vinca minor and varieties

Early May

Acer saccharum
Alyssum gemonense
Amelanchier species
Andromeda glaucophylla
Chamaedaphne calyculata
Crataegus arnoldiana
Chaenomeles japonica
Chaenomeles lagenaria vars.
Cydonia oblonga
Cytisus beani
" decumbens
" elongatus
Daphne cneorum
(Dandelion)
Forestiera acuminata
Iberis tenoreana
Ledum groelandicum
Leitneria floridana
Lonicera canadensis
" coerulea
" gracilipes
" saccata
Magnolia salicifolia
Magnolia soulangeana vars.
Malus astracanica
" brevipes
" micromalus
Mahonia aquifolium
(Narcissus)
Nemopanthus mucronata
Phlox subulata
(Primula elatior superba)
(" polyantha)
Prunus allegheniensis
" americana
" avium
" cerasus
" domestica
" fontanesiana
" hortulana
Prunus incana
" lanata
" maritima
" maximowiczi
" munsoniana
" orthosepala
" padus and varieties
" persica
" serrulata (many double flowered forms starting to bloom and continuing for two weeks at least, depending on the variety, some being slightly earlier than others.)
Prunus slavini
Pyrus amygdaliformis
" communis and varieties
" michauxi
" serotina
" salicifolia
Rhododendron mucronatum
" venstum
Ribes alpestre
" alpinum
" aureum
" diacantha
" gordonianum
" inebrians
" irriguum
" odoratum
" orientale heterotrichum
" pinetorum
" robustum
" setosum
" tenuipes
Spiraea arguta
" chamaedryfolia ulmifolia
" hypericifolia acuta
" media
" multiflora

Spiraea pikoviensis
" prunifolia
" " plena
" thunbergi
(Tulips)
Vaccinium species
Viburnum alnifolium
Viburnum bitchiuensis
" buddleifolium
" burejaeticum
" shensianum
(Violets)
Xanthorhiza simplicissima
Zanthoxylum americanum

Mid-May

Aesculus carnea
" hippocastanum
Akebia lobata
" quinata
Alyssum gemonense
" saxatile
Amelasorbus jacki
Aristolochia mandshuriensis
Aubretia deltoidea
Berberis dictyophylla
" dielsiana
" stenophylla
" thunbergi
Berberis vulgaris
Calycanthus floridus
Caragana species
Cercis canadensis
" chinensis
Coriaria japonica
Cornus florida
Coronilla emeroides
Cytisus praecox
" purgans
" purpurea
" ratisbonensis
" rocheli
" scoparius
" triflorus
Daphne caucasica
" cneorum
Elaeagnus multiflora
Enkianthus perulatus
Euonymus alata
Exochorda giraldi
" korolkovi
" macrantha
" grandiflora
" racemosa
Forestiera neo-mexicana
Fothergilla species
Halesia carolina
" monticola
Kerria japonica
Lonicera alpigena
" gibbiflora
" microphylla
" muendeniensis
" muscaviensis
" syringantha
" " wolfi
" thibetica
" xylosteum
Magnolia fraseri
" liliflora nigra
Malus adstringens
" arnoldiana
" atrosanguinea
" baccata
" denticulata
" floribunda
" glabrescens
" halliana parkmani
" hupehensis
" prunifolia
" pumila niedzwetzkyana
" purpurea

Malus robusta
" sieboldi
" soulardi
" spectabilis
" zumi calocarpa
Pachysandra terminalis
(Papaver orientale)
Potentilla fruticosa friedrichseni
Prinsepia uniflora
Prunus angustifolia watsoni
" glandulosa and varieties
" grayana
" instititia
" maacki
" mexicana
" persica, double flowered varieties
" pumila susquehanae
" sieboldi
" virginiana
Quercus species
Rhododendron canadense
" carolinianum
" fraseri
" obtusum amoenum
" obtusum arnoldianum
" obtusum "Hinodegiri"
" obtusum kaempferi
" reticulatum
" schlippenbachi
" vaseyi
R. yedoense poukhanense
Rhodotypos scandens
Rhus canadensis
Ribes fasciculatum
" sanguineum
" pinetorum
Rosa primula
Sambucus pubens
Sibiraea laevigata
Spiraea canescens
" gemmata
" hypericifolia
" inflexa
" mollifera
" oxyodon
" pubescens
Syringa hyacinthiflora vars.
" oblata dilatata
" " giraldi
" pinnatifolia
" vulgaris; with approximately 300 varieties. It is impossible to list them here as "Early," "Medium or "Late," though some might be so listed.
Viburnum carlesi
" lantana
" mongolicum
" wrighti
Weigela "Fleur de Mai"

Late May

Acer ginnala
Aronia arbutifolia
Assimina triloba
Berberis amurensis
" julianae
" vernae
" verruculosa
" vulgaris
(Buttercup)
Ceanothus ovatus
Celastrus species
Chaenomeles lagenaria
"Kermisina semiplena"
Cornus alternifolia
" controversa
" stolonifera
Coronilla emeroides
Cotoneaster adpressa

Cotoneaster multiflora
" racemiflora
Crataegus oxyacantha
" pruinosa
" punctata
Daphne giraldi
(Daylillies)
Deutzia candelabrum
" gracilis
" hypoleuca
" lemoinei & varieties
" parviflora
" rosea and varieties
Elaeagnus longipes
" umbellata
Enkianthus campanulatus
" deflexus
Fendlera wrighti
Genista pilosa
Iberis sempervirens
Juglans sieboldiana
Leucothe racemosa
Lonicera amoena
" bella rosea
" chrysantha
" korolkowi
" maacki
" morrowi
" punicea
" tartarica and varieties
Magnolia cordata
" glauca
" soulangeana lennei
" tripetala
Malus angustifolia
" bracteata
" coronaria
" " charlottae
" dulca
" glaucescens
" ioensis
Malus ioensis plena
" sargenti
" spectabilis riversi
" sylvestris
" scheideckeri
" toringoides
Neilla sinensis
Paeonia suffruticosa
Petteria ramentaceae
Philadelphus hirsutus
" schrenki
Photinia villosa
Physocarpus amurensis
" monogynus
Prunus laurocerasus schipkaensis
" pennsylvanica
" serotina
Rhamnus cathartica
Rhododendron atlanticum
R. catawbiense "Albert"
R. " "Boule de Neige"
R. " "Charles Dickens"
R. " "Daisy"
R. " "Mont Blanc"
R. catawbiense "Viola"
R. fortunei "Duke of York"
R. japonicum
R. gandavense hybrids
R. molle hybrids
R. nudiflorum
R. roseum
R. smirnowi
Robinia elliotti
" fertilis
" hispida
" kelseyi
" slavini
Rosa acicularis engelmanni
" hugonis
" spinosissima and vars.
" xanthina

Rubus deliciosus
Smilax rotundifolia
Spiraea blanda
" blumei
" cantoniensis
" chamaedryfolia
" cinerea
" nipponica
" trilobata
" vanhouttei
" wilsoni
Staphylea colchica
" trifolia
Styrax obassia
Symplocos paniculata
Syringa chinensis
" julianae
" meyeri
" microphylla
" persica
" pinetorum
" potanini
" pubescens
Syringa velutina
" vulgaris and many varieties
" wolfi
" yunnanensis
Tamarix parviflora
Thymus serphyllum
Vaccinium corymbosum
Viburnum affine
" erosum
" lentago
" macrocephalum
" opulus roseum
" rhytidophyllum
" rufidulum
" sieboldi
" tomentosum
" " plicatum
" trilobum
Weigela, several species & many varieties
Wisteria species and vars.

Early June

Actinidia arguta
Buddleia alternifolia
Chionanthus retusus
" virginicus
Cladrastis lutea
Clematis glauca angustifolia
" recta
Colutea species
Cornus alba
" kousa chinensis
" rugosa
Cotinus coggygria
Crataegus cordata
" crus-galli
" oxyacantha pauli
Daphne pontica
Decaisnea fargesi
Elaeagnus angustifolia
Euonymus atropurpurea
Genista hispanica
Genista tinctoria
Helianthemum nummularium
Hydrangea petiolaris
" xanthoneura wilsoni
Idesia polycarpa
Ilex opaca
" verticillata
Jamesia americana
Kolkwitzia amabilis
Laburnum species
Leucothoe catesbaei
Lonicera maacki podocarpa
" minutiflora
" ruprechtiana

Lonicera xylosteoides
Lycium species
Magnolia parviflora
Phellodendron amurense
Philadelphus schrenki
Physocarpus amurensis
" intermedia
" opulifolius
Potentilla fruticosa varieties
Pterostyrax hispida
Rhamnus frangula
Rhododendron arbutifolium
" calendulaceum
" catawbiense and many vars.
" ferrugineum
R. minus
Rhus potanini
Robinia hartwigi
" pseudoacacia
Rosa acicularis
" arnoldiana
" blanda
" canina
" foetida harrisoni
" " persiana
Rosa multiflora
Rosa rugosa
" spinosissima
" virginiana
" webbiana
" willmottiae
Sassafras albidum
Sorbus aucuparia
Spiraea dasyantha
" trichocarpa
Staphylea pinnata
Styrax americana
" japonica
Syringa henryi varieties
" josikaea varieties
" komarowi
" prestonae and varieties
" reflexa
" sweginzowi
" tomentella
" villosa
" wilsoni
Viburnum cassinoides
" dentatum
" dilatatum
" opulus
" prunifolium
" sargenti

Mid-June

Amorpha fruticosa
Castanea pumila
Catalpa speciosa
Ceanothus pallidus rosea
Celastrus scandens
Colutea arborescens
Cornus amomum
" bretschneideri
" coreana
" kousa
" racemosa
Cytisus supinus
Deutzia scabra and varieties
Diospyros virginiana
Euonymus europaea
" fortunei vegeta
Gymnocladus dioica
Hydrangea bretschneideri
Ilex glabra
Kalmia angustifolia
" latifolia
Ligustrum obtusifolium
" " regelianum
" vulgare
Liriodendron tulipifera
Lonicera browni
" iberica
" japonica halliana
" periclymenum
Periploca sepium
Philadelphus coronarius
" cymosus varieties

Philadelphus inodorus
" grandiflorus
" laxus
" lemoinei and varieties
" maximus
" pubescens
" tomentosus
" virginalis and varieties
Rosa arvensis
" dahurica
" jacksoni
" micrantha
" multiflora cathayensis
" rubifolia
" rugosa kamtchatica
" " repens
Rubus allegheniensis
Sophora vicifolia
Spiraea henryi
Spiraea menziesi
" nipponica rotundifolia
" veitchi
Symphoricarpos racemosus laevigatus
Syringa amurensis
" " japonica
" pekinensis
Tilia platyphyllos
" tomentosa
Vaccinium stamineum
Viburnum acerifolium
" dilatatum hispidum
" erosum
" molle
" pubescens
Weigela "Congo"
Xolisma ligustrina
" mariana
Zenobia pulverulenta

Late June

Acanthopanax sieboldianus
" senticosus
Actinidia polygama
Amorpha glabra
Cornus macrophylla
Cotoneaster salicifolia
Cytisus albus
" supinus
Deutzia myriantha
Genista anglica
Halimodendron halodendron
Ilex erenata
Indigofera decora
" kirilowi
" potanini
Itea virginica
Lonicera henryi
Periploca graeca
Rhododendron arborescens
Rhododendron maximum
Rhus typhina
Rosa anemoniflora
Rosa carolina
" damascena
" multibracteata
Rubus odoratus
Sambucus canadensis
Schizophragma hydrangeoides
Sorbaria sorbifolia
Spiraea brachybotrys
" bumalda
" latifolia
" pyramidata
" rubra
" sylvestris
" tenissima
" tomentosa
" virginiana
" Watsoniana
Stewartia koreana
Tilia species
Tripterygium regeli
Weigela "Eva Rathke"
Yucca glauca

Early July

Buddleia japonica
Castanea species
Cytisus nigricans
Holodiscus discolor
Indigofera amblyantha
Maackia amurensis
Rhus glabra
Rosa setigera
Spiraea billiardi

Mid-July

Aesculus parviflora
Amorpha brachycarpa
" fruticosa
Berberis aggregata
Catalpa ovata
" speciosa
Ceanothus americanus
Clematis jackmani
Diervilla lonicera
Hydrangea arborescens grandiflora
" cinera
" paniculata praecox
" quercifolia
" serrata
Hypericum aureum
Hypericum kalmianum
Koelreuteria paniculata
Lespedeza bicolor
Lonicera sempervirens
Martensia erecta
Rhododendron viscosum
Securinega ramiflora
Sorbaria sorbifolia
Sphaeralcea remota
Spiraea alba
" albiflora
" douglasi
" magentae
Tamarix odessana
" pentandra
Yucca filamentosa

Late July

Albizzia julibrissin rosea
Aralia spinosa
Buddleia albiflora
Callicarpa species
Calluna vulgaris and varieties
Campsis radicans
Cephalanthus occidentalis
Clethra acuminata
" alnifolia
Hydrangea radiata
Hypericum prolificum
Indigofera pulchella
Ligustrum quihoui
Lonicera involucrata serotina
Nandina domestica
Oxydendrum arboreum
Sorbaria arborea
Spiraea bumalda "Anthony Waterer"

August

Abelia grandiflora
Buddleia davidi magnifica
Clematis virginiana
" vitalba
Evodia danielli
Hibiscus syriacus varieties
Hydrangea arborescens
" macrophylla
" paniculata
" " grandiflora
Hypericum dawsonianum
Lespedeza buergeri praecox
" cyrtobotrya
Lonicera heckrotti
Paulownia tomentosa
Polygonum auberti
Sophora japonica
ymphoricarpos vulgaris
Vitex agnus-castus
" negundo incisa

September

Clematis paniculata
Clerodendron trichotomum
Elsholtzia stauntoni
Franklinia altamaha

October

Hamamelis virginiana

DONALD WYMAN

ARNOLD ARBORETUM
HARVARD UNIVERSITY

BULLETIN
OF POPULAR INFORMATION

SERIES 4. VOL. VII DECEMBER 1, 1939 NUMBER 12

BREEDING NEW VARIETIES OF ORNAMENTAL CRABAPPLES AT THE ARNOLD ARBORETUM

DURING the past few years the Arboretum has started rather extensive experiments in the breeding of ornamental trees and shrubs. One of the objectives is the possibility of thus obtaining new plants which may be desirable from an ornamental standpoint. To perhaps attain this objective, a large number of seedlings must be grown from which to make selections. Since nursery space at the Arboretum is limited, we cannot carry through all of these seedlings to maturity and, hence, plan to "farm out" these plants to interested individuals who have space in which to grow them. The ornamental crabapples were selected because of their high ornamental value and the interesting genetic problems connected with their breeding. Approximately 2000 seedlings will be distributed next spring to individuals and institutions requesting them, and it is to acquaint those who may be interested with some of the facts concerning this work that this bulletin is issued.

It is desirable from our standpoint that plantings be made in regions reasonably convenient to Boston so that at the proper season we may have the privilege of examining the growing stock. They will, of course, all represent unnamed seedlings, but it is expected that some of them will present features of special horticultural interest and it may later be desirable to perpetuate some of these by asexual propagation methods.

As a rule the breeding of new varieties of plants is done by artificial cross pollination, but in the case of apples and cherries the plants are largely self-sterile so that under proper conditions hybrids are produced naturally. It has long been known that apples are partially or completely self-sterile and must be cross pollinated to produce fruit and

set seeds. Trees of a clonal variety are inter-sterile so that in commercial orchards different varieties must be planted together to insure proper pollination. The cross pollination is effected largely by bees, and in many of the large western orchards hives of bees are distributed through the orchards at blooming time. In New England the bumble bees play an important part in orchard pollination.

The species of ornamental crabapples also are self-sterile and must be cross pollinated in order to produce seeds. In the Arnold Arboretum these species and varieties are represented by single specimens as a rule so that the seed produced by a single tree is the result of pollination by the other trees in the vicinity. Consequently, the seedlings produced by such a collection of species must be hybrids. There is some limitation on crossing because the flowering periods of the Asiatic and American species do not overlap and as a consequence crossing is restricted to species within these two groups growing in the Arnold Arboretum.

Seeds from species of crabapples were collected in the fall of 1938 and were planted in flats. Young plants were grown in the greenhouse until they could be set out in the nursery plots in May. Most of these seedlings are now from 2 to 4 feet tall and can be transplanted next spring.

There are over 3,000 trees in the nursery representing the progeny of 50 species and varieties. As expected most of the seedlings from any species vary greatly in growth habit, leaf shape, and color, indicating that they are of hybrid origin. Some of the parental trees were known to be of hybrid origin so that their progeny should vary even if pollination were limited to a single male parent.

Among these crabapple species two produce only the parental types. These species, Malus hupehensis (theifera) and M. toringoides, are parthenogenetic and produce seed asexually without pollination. These species fortunately are among the best of the flowering crabs, and can be reproduced by seed regardless of their association with other species. A few of the other species show little segregation, but most of them produce seedlings which are extremely variable.

Among the seedlings from the Arboretum collections there are many dwarfs, a few prostrate or weeping types, and many variations in leaf shapes and colors. Some have dark purple foliage all summer long while others have color only in the fall. A few are very large and vigorous and may have possibilities as root stocks for orchard trees.

It is hoped that many of the new combinations of species will produce varieties of horticultural value. Types with attractive flowers,

PLATE X

Seedling Crabapples at the Arnold Arboretum After Their First Year of Growth.

These are the seedlings, 2 to 4 feet tall, which will be distributed in the spring of 1940.

ornamental fruits and graceful growth habits will be selected as the trees mature. The Arboretum now has several acres of nursery space where many crabapple, lilacs, cherry, and rose seedlings will be grown to the flowering stage.

There will be a considerable number of crabapple trees which we cannot handle at the Arboretum and we hope that about 2,000 of these seedlings can be placed on private grounds or estates. We plan to distribute our surplus stock next spring to individuals who will care for the young plants. If any particular orphan tree should prove to be of exceptional value, the Arboretum reserves the right to obtain propagating stock from it so that the variety can be more widely distributed.

The surplus apple seedlings will be distributed in the spring of 1940. Most of them should be of ornamental value and some should be new and unusual types. Those interested in growing some of these hybrids should send their request to Dr. Donald Wyman, at the Arboretum, and indicate the number of seedlings desired. Because of the hybrid nature of these seedlings, as explained above, the color of flowers and fruit cannot be foretold. The plants will be delivered simply as crabapple seedlings. However, since all have been grown from seed collected in the Arboretum where the best ornamental species are grown, a large number should be of distinct ornamental value. It is understood that, in most cases, the prospective grower will obtain the young trees at the Bussey Institution greenhouse at a time to be indicated later, and see that the trees are properly planted and cared for.

George W. Skirm

CONDITIONS UNDER WHICH CRABAPPLE SEEDLINGS MAY BE OBTAINED

1. Each seedling must be carefully planted and given normal care thereafter. They become the property of the person or institution obtaining them.

2. Arboretum staff members will have the privilege of inspecting these seedlings occasionally from time to time.

3. The Arboretum reserves the right to take propagating material from any tree which proves to be of exceptional value.

4. The plants will be prepared for shipment by the Arboretum but recipients are expected to make arrangements for their delivery from the Bussey Institution greenhouse, South Street, Jamaica Plain, at a time to be indicated later.

5. Because of the hybrid origin of these trees, color of flower, fruit, etc., cannot be foretold; consequently they will be distributed simply as unnamed seedlings, originating in the Arnold Arboretum.

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BOTANICAL EXPLORATION OF THE MACKENZIE MOUNTAINS

BOTANICALLY unexplored mountain ranges are no longer common in North America. A host of expeditions and local collectors, from the days of Kalm, Michaux, Douglas and Nuttall to recent times, have seen to that. The Mackenzie Mountains of northwestern Canada have remained a challenge, not only to botanists but to geographers and geologists as well, during the long period of more active exploration around them. They are remote both by distance and accessibility, hidden away in the vast wilderness of Yukon and western Mackenzie, and drained only by broken, unnavigable streams. A few hardy trappers and prospectors, and a few Indians who are among the least civilized on the continent, are the only inhabitants. But the development of air transport in recent years has altered all our prospects for biological exploration. Even the most inaccessible regions now become available for study by naturalists in various fields.

The Arnold Arboretum as part of its general program of field work sponsored a collecting expedition to the Mackenzie Mountains during the past summer. The main objectives were to make collections representing the flora of a part of this unknown region, and a study of the local types of vegetation. The net results will be a contribution to the broader problems of boreal phytogeography, for the summer's work will throw light on one of the largest blank spots in our plant maps of the northern part of the continent. The field work was in charge of the writer, who, with his wife, had been engaged in the botanical investigation of the Mackenzie basin for several years; and was financed in part by grants from the Milton Fund of Harvard University, the American Academy of Arts and Sciences, and the National Academy of Science. The National Museum of Canada made generous loans of field equipment. Mr. James H. Soper, of Hamilton, Ontario, served as field assistant. Since it was especially desirable to reach the mountains for spring collecting (mid-June), and since the Mackenzie system at Great Slave Lake is not commonly open to navigation so early in the season, plans for the whole trip had to be made a year ahead of time.

PLATE XI

Granite and shale mountains around the western end of Brintnell Lake. T
expedition's camp is on the shore near the right hand margin of the pictu

Timber line is from 1200 to 1400 feet above the level of the lake, and the effects of snow-slides may be seen in the spruce and birch forests on the steep slopes.

Most of the food supplies, collecting outfit, and heavier camping equipment were packed and shipped to the Hudson's Bay Company at Fort Simpson in the summer 1938. The party left Boston May 20, 1939, and reached Simpson on June 8th, using a Mackenzie Air Service plane for the last and ordinarily most time-consuming stage of the journey—north from Fort Smith. A week at Simpson gave time to sort and repack supplies, and to collect the local spring flora along the Mackenzie River.

On the 16th a chartered plane earried us to Brintnell Lake, a small body of water at an altitude of 2600 feet in the Snyder Range, approximately 200 miles west of Fort Simpson. This range lies in the heart of the Mackenzie Mountain system, and is composed of rugged granite and shale mountains, some of which reach elevations 9000 feet or more above the sea.

It would be difficult to conceive of a more completely primeval country than this. Two years ago a surveying party sponsored by Mr. Harry Snyder of Montreal (for whom the mountains were named) camped there for a few weeks; and trappers spent a winter on the lake a few years ago. Aside from these few visitors the lake and its surrounding mountains seem never to have been inhabited by human beings. No evidence of Indian occupation could be found. Overland travel proved extremely difficult due to the steep slopes and the complete absence of man-made trails.

The flora is a small one in number of species, and strongly Arctic in character. Never-the-less a remarkably rich forest of spruce grows on the lower slopes of the mountains. The timber line is from 1200 to 1400 feet above the lake, with colorful alpine meadow and crevice vegetation above. The steeper slopes everywhere are made difficult for plant growth by the prevalence of hazardous slide-rock; and on the steep southward-facing surfaces the vegetation is subject to great damage by periodic spring snow-slides. Collecting and field studies of local distribution problems engaged our attention until another plane came for us on the 20th of August. A sectional canoe made possible short trips about the lake, but otherwise we went on foot to the surrounding country. No two mountain slopes had the same flora, so that the collecting did not become monotonous in spite of our confinement to one region.

After a stay of three weeks in Fort Simpson we travelled southward up the Mackenzie, Slave and Athabaska Rivers by slow stages, and finally reached home on the 28th of September. The summer's collecting netted some 15,000 herbarium specimens, over two thirds of which are of flowering plants and ferns, and the remainder lichens, mosses and fungi. Most of the material came from Brintnell Lake and Simpson, although some very interesting plants, especially willows, were gathered along the rivers as we travelled northward in the spring. The collections will be studied at the Arboretum and the duplicates distributed from it in exchange with herbaria throughout the world.

Hugh M. Raup

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

These Bulletins will be discontinued until spring of next year.

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