ARNOLD ARBORETUM
HARVARD UNIVERSITY

ARNOLDIA

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ILLUSTRATIONS

ARNOLDIA

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FOOD PLANTS IN THE ARNOLD ARBORETUM

In the general search that is being made under the stimulus of war conditions for food plants and for plants of economic value even as small an area as the Arnold Arboretum has something to contribute. For although the most important work of the Arboretum lies in other fields, various plants are found in the native flora and in the collections of trees and shrubs drawn from many parts of the world that have food value, and some of them are being used in a limited way for food purposes. The plants growing spontaneously in the Arboretum are of course those found generally in eastern Massachusetts and most of them over a large part of eastern North America. Most of the cultivated trees and shrubs are also grown or may be grown more or less generally in this region. Notes on the food plants of the Arboretum will, therefore, have a wider application than to the limits of the area itself.

Almost one hundred species of the larger fungi have been identified as occurring in the Arboretum and the number that might be found is no doubt much larger. The fungi differ so widely in appearance from flowering plants that many people scarcely think of associating them; and yet they form an important class in the vegetable kingdom. Some sorts found here are most undesirable, as they attack trees and other plants through injuries in the bark and wood, and promote decay. The more permanent vegetative parts of these plants are seldom seen, as they grow underground or are concealed under the bark or in the tissues of decaying wood. This subterranean growth, called the mycelium, is a mass of root-like or net-like fibers which at certain seasons and under favorable conditions of moisture and temperature sends up the familiar growths known as mushrooms, toadstools and puffballs, or the branching bracket-like forms often seen on decaying trees and logs. These are the fruiting parts of the plants on which the microscopic spores for the propagation of the species are borne, usually on the gills or pores.

The popular distinction made between mushrooms and toadstools and the idea that the former are edible and the latter poisonous has no basis in fact. The name toadstool obviously refers to the shape and to the fancied resemblance to a piano stool or similar bit of furniture. If applied consistently, it would include the mushroom of commerce and many of the edible native sorts. Unfortunately there are a few sorts of poisonous mushrooms, and one or two species are so toxic that serious illness or death may result from eating a small portion of them. For this reason, it is well to let all doubtful sorts alone. But it is not necessary for anyone with a little intelligence and enterprise to refrain from gathering and eating wild mushrooms, since the poisonous ones can easily be distinguished from the good ones by consulting one of the many popular illustrated papers or books on the subject or by receiving a little instruction from someone who knows mushrooms.

Only a few of the numerous sorts of edible mushrooms found in the Arboretum can be mentioned here. Some of them can be found from June until November. The supply varies greatly in different years, and they are most abundant in rainy seasons.

The field mushroom (*Agaricus campestris*) is sometimes abundant in meadows. It usually grows in open places where the grass is not too tall. This is a wild form of the common market mushroom. In similar places, or sometimes about trees that have been cultivated or fertilized is found the parasol mushroom (*Lepiota procera*) or its relative, the smooth lepiota (*L. naucina*). All of these are excellent to eat. The large puffballs (*Cyathus olla*, *Clavatia cyathiformis*, etc.) grow usually where the grass has been kept mowed or along paths or roadsides. Small forms grow in clusters about decaying stumps. All of the puffballs with the flesh white or pale colored while young are safe and good to eat. The oyster mushroom (*Pleurotus ostreatus*) is often found as a soft shelf-like growth on decaying logs after heavy rains. In the late fall large clusters of the honey mushroom (*Armillaria mellea*) and of the brick-top mushroom (*Hypholoma sublateritium*) come up about the bases of rotting stumps or spring up from the decaying roots where they are often well concealed by the grass. Both are of rather firm or tough texture, but many people esteem them. The shaggy mane and inky cap are gregarious mushrooms, often very abundant on ground fertilized with stable manure or on fertilizer heaps. They are very fragile but good, if taken soon after they come up. There are scores of other sorts that are edible and desirable, if found in sufficient quantity. Many of our citizens of foreign origin prize the wild mushrooms highly, and they may be seen searching for them when in season. Others, including members of the Arboretum staff, know their value too and do not overlook this sort of highly palatable food.

With the first days of spring the search for greens begins. The leaves of the common dandelion (*Taraxacum officinale*) are among the earliest to appear. They are extensively gathered and eaten and are sometimes sold on the market. Some people profess to like them in spite of the slightly bitter taste, and there is a

Pokeweed, fruiting top

PLATE I

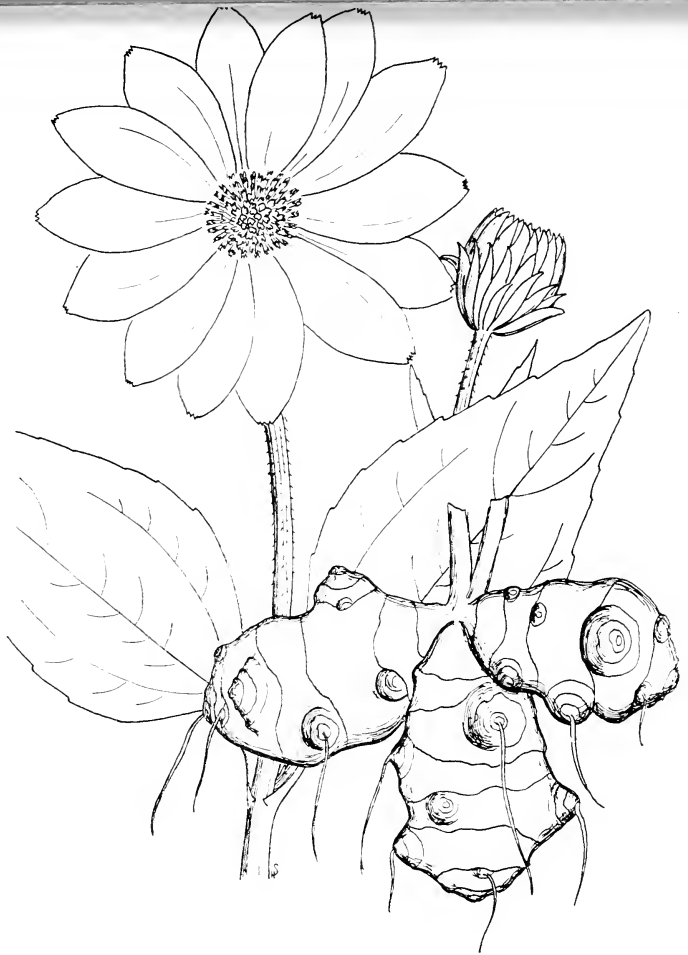
Pokeweed, young sprouts ready to gather

popular idea that they serve as a spring tonic as well as an addition to the bill of fare. They are rich in vitamins. The young sprouts of chicory (*Cichorium Intybus*), charlock (*Brassica arvensis*), yellow dock or curly-leaf dock (*Rumex crispus*), sow thistle (*Sonchus oleraceus*), wild lettuce (*Lactuca spp.*), and lambsquarters (*Chenopodium album*), are also gathered for greens. The last is a relative of the garden spinach and tastes somewhat like it. It is sometimes found in large patches on dumps or in waste ground.

The most desirable weed or wild plant for greens found in this area is the pokeweed or pokeberry (*Phytolacca americana*). This plant has become abundant in recent years in various parts of the Arboretum, growing on partially shaded banks or in waste or cultivated ground where the soil is rather fertile. It is a deep-rooted perennial, and late in the spring when the ground has become quite warm, it sends up clusters of sprouts from the base of the old stems. They are as tender as asparagas and can be used until they are four or five inches high and the leaves are about half grown. The plants grow to a height of five or six feet and in late summer they are rather attractive when loaded with the long pendulous racemes of purplish black fruit. Our pioneer ancestors made ink by soaking rusty nails in a decoction of pokeberry juice. Chicory also had another and a more important use. The fleshy roots after being dried were roasted and ground and used as a substitute for coffee or were mixed with coffee.

A number of other plants found in the Arboretum are sometimes used for greens or for salads, including fiddle-heads or the young sprouts of several ferns, purslane (*Portulaca oleracea*), sprouts of the common milkweed (*Asclepias syriaca*), peppergrass (*Lepidium virginicum*), and water cress (*Rorippa Nasturtium-aquaticum*). Water cress grows along brooks and ditches and is a tender and tasty salad plant, when grown in clean running water. In some years it is very abundant in the Arboretum.

Sassafras (*Sassafras albidum* var. *molle*) is probably the best-known spice plant of the North American flora. It grows over a large part of the eastern and central United States. In some sections it becomes a large tree, but in New England it is usually shrubby, spreading into thickets. It is a relative of the cinnamon tree, and the bark of the roots is highly aromatic. An oil distilled from that part of the plant is used for flavoring candies, root beer and other beverages, and in perfumery. In early colonial days sassafras became an important article of commerce and it sometimes formed the most valuable cargo of ships sailing from Cape Cod, Martha's Vineyard and Nantucket. The custom of drinking sassafras tea in spring is still very prevalent in many parts of the South and Middle-west, where it is regarded as a medicine as well as a beverage. Its reputed medicinal virtues are vague but very general and you are told that "It's good for what ails you." A thicket of native sassafras is growing near the top of Peters Hill in the Arboretum and it is planted elsewhere. The roots should be dug in early spring and tea can be made from them by steeping them in boiling water. The flavor is very



Jerusalem Artichoke, flowering tuber

PLATE II

Chicory

agreeable to most people. The aromatic wintergreen (*Gaultheria procumbens*) grows sparingly on Hemlock Hill. The leaves have been used for tea and they are the source of wintergreen oil used for flavoring confections.

Edible native fruits found in the Arboretum include blackberries, dewberries, raspberries, strawberries, blueberries, service berries and elderberries. Most of them are not produced in sufficient quantity to be of much importance. A species of blackberry has become established in the low meadow near the maple collection and elsewhere that produces large quantities of fruit of a good quality. The seeds were probably brought in by birds from cultivated plants, as it appears to be a selected variety of the native high-bush blackberry. Two sorts of low blueberries (*Vaccinium augustifolium* and *V. vacillans*) grow abundantly in open woods and on rocky ground in several parts of the Arboretum. The quantity of fruit produced is not large, but children and older visitors can often be seen gathering the berries in season. Elderberries (*Sambucus canadensis*) grow spontaneously in the low meadows, and they are sometimes used for jellies or for other purposes as well as for making wine.

Many fruit-bearing trees and shrubs of exotic origin, as well as most of the native sorts, are cultivated in the Arboretum. None of them are selected primarily for their fruit and no attempt is made to grow commercial pomological varieties. But most of them produce fruit in considerable quantity, and some of it has food value. Gooseberries, currants, barberries, apples, pears, quinces, apricots, cherries, plums and grapes are found in great variety. There is a large collection of Juneberries and shad bushes (*Amelanchier spp.*). The fruit of all sorts is edible and it is often abundant. No use is made of it here, but in some sections the plants are cultivated for their fruit.

The American plums often bear very heavy crops of fruit. Beach plum (*Prunus maritima*) jelly is well known in New England, and the fruit of several other species is equally good. Among the best sorts in quality of fruit are *Prunus americana*, *P. lanata*, *P. hortulana* and *P. Munsoniana*. Most of the Japanese cherries are grown exclusively for their flowers, but a few sorts produce small but edible fruit. The Chinese crab-apples are also grown mainly for their flowers, but nearly all of them bear heavy crops of fruit, and in some species it is so handsome and brightly colored that the trees are almost as attractive in autumn as in the flowering season. The fruit of a number of species is excellent for the making of jelly and marmalade.

The butternut (*Juglans cinerea*) and three or four species of hickory, as well as the hazelnut (*Corylus americana*) are native in the Arboretum. The chestnut (*Castanea dentata*) formerly grew in the woods until destroyed by the blight. Sprouts still come up from old stumps on Peters Hill. In the planted groups are found additional species of walnuts, hickories, chestnuts, filberts and hazelnuts. The black walnut (*Juglans nigra*), the shagbark hickory (*Carya ovata*), the kingnut (*C. laciniosa*) and the chinquapin (*Castanea pumila*) are often heavily loaded

with nuts. Usually the gray squirrels get most of the nuts even before they ripen, but in good seasons boys and other visitors compete with them for the remainder of the crop.

In the low meadow near the maple collection there is a large patch of the sunflower, *Helianthus tuberosa*. The fleshy tuberous roots of this plant, known as Jerusalem artichokes, are esteemed as a vegetable by many people. They grow in great quantities a few inches below the surface and are best dug in late fall after the plants have begun to wither, and early in the spring before the new growth appears. In 1943 these were sold in the Boston markets for as high as 25 cents per pound, and in one large patch there are literally hundreds of pounds available to anyone who may wish them.

In more indirect ways the Arboretum also contributes to the program of food conservation. One of them is in the feeding of birds and in the fact that the Arboretum is a bird sanctuary. Seeds and fruit of many plants furnish food for the birds, and they are among the best friends of the farmers and gardeners in their fight against destructive insect enemies.

Ernest J. Palmer

Cuts in this bulletin are reproduced from the original drawings appearing in **EDIBLE WILD PLANTS OF EASTERN NORTH AMERICA** by Merritt Lyndon Fernald and Alfred Charles Kinsey, pp. 422, 124 fig., 25 plates. Idlewild Press, Cornwall-on-Hudson, New York. The Gray Herbarium of Harvard University recently announced this important publication. More than one thousand species of edible flowering plants and the more important edible ferns, mushrooms, seaweeds and lichens which grow wild in North America north of Florida and east of the Great Plains are considered in this book. One hundred and twenty-five line drawings and twenty-five half tone plates aid materially in the identification of these edible plants and additional notes are given concerning their identification. Recipes for cooking and preserving the different types of vegetables and fruits are given.

This is the most comprehensive and authoritative treatment of our edible wild plants ever prepared. It may be obtained either from the Idlewild Press, Cornwall-on-Hudson, New York, or from the Gray Herbarium, Harvard University, Garden Street, Cambridge 38, Massachusetts. The price, post paid, is $3.00.

DONALD WYMAN

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SHORT GUIDE TO CARE OF THE GARDEN DURING WAR TIME

Pruning

Many people will have to do their own pruning this year. For some this may be the first time they have ever attempted it themselves. Pruning is not difficult once the general fundamentals are understood, and it may be well to devote this issue of Arnoldia to the general rules for pruning trees and shrubs which are commonly found on the home grounds, as a "refresher," especially for those who are not experienced or who have never attempted to do their own pruning.

Reasons for pruning

1. To cut down water loss at time of transplanting. Since many roots are unavoidably cut off or injured in the transplanting operation, a certain number of the branches must be removed to make up for this loss. If such pruning is not done at transplanting time, a larger number of leaves will be produced than can be properly supplied with water by the roots. As a result, the branches or even the whole plant may die and in any case the plant will be weakened. If proper pruning is done at the time of transplanting, thus permitting time for the formation of new roots to support the new foliage, the new growth will make a vigorous start. This is one of the most difficult points for the amateur to understand, but it is vitally essential. Naturally one always dislikes to cut off what appear to be normal branches. Clearly, if nurserymen would prune their plants before they sell them, far better results would be obtained by the average gardener.

2. To cut out dead, diseased or scale-infested limbs.

3. To remedy structural defects and other faults such as unnatural growth. Sometimes a branch takes the lead in vigorous growth and must be restrained for the general good of the others. Frequently a bad crotch forms, that is, two branches of apparently equal vigor form at the same height on the trunk but on

opposite sides of the tree. Splitting of the trunk at this place may result later, especially in fruit trees which bear heavy crops, hence it is always advisable to prune one branch back, or in certain cases to remove it altogether.

4. To increase density of windbreaks, screens and hedges. Usually this is a mere clipping operation to force the growth of many small branchlets.

5. For utility purposes. Often a branch obstructs a view, hits the house during windy weather, partly blocks a driveway, or unnecessarily bars the path of electric light wires. Such branches should be removed, if possible. In this connection it should be remembered that there is much more space available for service wires through the wide arching limbs of an American elm or the wide spreading branches of a white oak than there is through the rather dense branching system of a Norway maple. Hence, when a tree must be planted where it may interfere with service wires, it is advisable to select a tree with an open branching system, rather than one like the Norway maple, which is dense in habit.

6. To promote flowering and fruiting of certain specialized plants. It is here emphasized that all pruning is a dwarfing process. Vigorous young shoots may develop after a large limb has been removed, but careful experiments have proved that, other conditions being equal, the plant which is pruned grows less (usually measured in total amount of leaf area) than the plant which is unpruned. The leaves of the plant are the food manufacturing organs. Water and mineral nutrients taken in by the roots, associated with sunlight, heat and carbon dioxide from the air, are the raw materials from which the leaves manufacture foods, through the action of chlorophyll. Any pruning would decrease the total leaf area of the tree, and this decreases the total amount of food manufactured. Therefore, total growth would be decreased also. This is a very important fact to keep in mind whenever pruning is contemplated.

Time for pruning

Pruning can be done now, for tests made in the northeastern United States show that wounds heal quicker when made between February 1 and May 1, than when made at any other time of year. If a plant, like early flowering forsythia or the flowering dogwood, is to be pruned for some justifiable reason, pruning might best be put off until after the flowering, so that one will obtain the full benefit from the flower buds now on the plants. If flowering this year is not a factor, prune at once. On the other hand, for plants which flower on the current year's growth like the rose of sharon, the time to prune is now. A few trees, among which are the birches and the yellowwood, are best pruned in the summer, for they "bleed" profusely when pruned early in the year.

Wound dressing

Various types of commercial wound paints are on the market, and those made from asphaltum are satisfactory. Wounds over two inches in diameter should al-

ways be painted. Wounds less than two inches in diameter may be left untreated, but it is always safer to paint all wounds. Orange shellac has been used as a paint but it is difficult to obtain now and the color is objectionable. White and red lead paints are also objectionable in color and are slightly injurious to the cambium, but they do form effective wound dressings. If neither asphaltum paint nor orange shellac can be used, then these paints may be used. Wounds may be repainted annually if necessary.

Methods of Pruning

Fruit Trees

Obviously the method of pruning varies with the type of plant. Apple trees, for instance, are an example of fruit trees. There should be a fairly prominent central leader and great care should be taken so that there are no bad crotches; i.e., branches of equal size and vigor originating at the same height on the trunk but on opposite sides. On old trees, there is a tendency for the formation of "water sprouts"—vigorous young shoots originating from the older branches. These are often profuse and much too vigorous, acting as a drain on the tree and most of them should be removed. Then, too, air and light should be allowed in the center of the tree to allow the fruits to develop properly, and this frequently necessitates the removal of many small limbs in the center of the tree. Too many flowers and fruits on an apple tree are undesirable because the fruits will remain small and frequently too many will fall before maturity. The ideal is to obtain a tree with sturdy, well-spaced branches, strong enough to carry a heavy crop of fruits without breaking, and with sufficient light and air available in the center of the trees so that fruits will be produced there as well as at the ends of the branches. If fruits are produced only at the tips of the branches, too much weight occurs at the ends and breakage may occur.

Grapes

There are several methods of pruning grapes, but one popular method is sufficient for this article. This is known as the four-arm Kniffin system. Presupposing the grape vine is to be grown on wires, posts are erected 8 to 10 feet apart, and two heavy wires strung between them, one at $2\frac{1}{2}$ feet from the ground, the top wire about 5 feet from the ground. The first year the grape is planted, it is allowed to grow at will. The next year the strongest leader is selected and tied to the top wire perpendicularly. The idea now is to obtain four main branches which will grow from either side of the main leader on the two wires. The third spring, select these four branches, tie them carefully to the wires, cut them back to about 8 to 12 buds (this depends on the variety and the vigor of the plant). All other branches can be cut off except a short branch bearing a few buds near where each main branch joins the central leader; for these short branches are to grow into the long branches which will bear the fruit the following year. In

the grape, fruit is borne only on one-year-old wood. After the four branches have fruited, they should be removed in the spring, thus permitting the four new one-year-old branches which have been growing during the past season to be used as the fruit bearing branches during the current year.

Raspberries

Raspberries are usually pruned immediately after they are through fruiting for the simple reason that once a cane has fruited, it does not fruit again and usually dies. Hence, as soon as the canes have fruited, cut them out and leave only the new suckers which have come up during the current growing season. Experienced growers know that the best way to produce raspberries is to limit the height of the canes to about $4\frac{1}{2}$ or 5 feet and grow them in a row about two feet wide between a few strands of wire which will help hold them upright.

Blackberries

Blackberries are slightly different in that their fruits are not borne on the main cane as is the case in raspberries, but on lateral branches. These laterals should be pruned back somewhat, but the amount of pruning depends on the variety. With the Eldorado, the best variety for Massachusetts, laterals should be left 18 to 24 inches long since most of the flower buds are produced at the ends of these laterals.

Blueberries

Severe pruning in the dormant season is of the utmost importance with blueberries in order to produce a good crop of large fruits. A few of the older main branches are cut back or removed each year in order to insure an ample supply of vigorous growing young wood. The slender weak growth throughout the plant should be removed annually. Those branches which are allowed to remain should be cut back to 3 or 4 flower buds. However, varieties differ in the amount of cutting back required. Cabot, for instance, should be cut back more heavily than Rubel.

Vines in general

Ornamental vines, like bittersweet, clematis, honeysuckle, bower actinidia and the like, need little pruning except the regular removal of any dead wood. Wisteria, on the other hand, frequently requires heavy pruning in order to induce it to flower well. This pruning is frequently done during the period (usually June) when the shoots are elongating, the idea being to cut them back continually so that food will be available for the formation of flower buds and will not all go into vegetative growth. If a wisteria vine blooms satisfactorily without any pruning, it might be left alone, but if few flowers are produced, then a continual pinching back or cutting back of the elongating young shoots is very much in order, and will probably result in profuse flowering the following year. Also, pruning or cutting back some of the roots of a non-flowering wisteria may aid it in producing flowers the following season.

Young deciduous hedges should be pruned heavily when planted (many to the ground) in order to make the hedge more dense at the base. After this initial pruning the plants should grow unmolested the first season in order to grow vigorously and develop a strong root system. Another heavy pruning may be necessary the second season, after which frequent trimming, to promote denseness, is desirable until the hedge reaches maturity.

Mature deciduous hedges need to be trimmed but once a year, except a few of the most vigorous ones such as California privet, osage-orange, or honey locust. This may be done at any time of the year but probably for best results the hedge should be trimmed just after the first growth has stopped in the late spring or the early summer; if trimmed at this time the hedge will have a fairly even, uniform appearance for the rest of the year. The plants may grow some after this trimming, but not enough to spoil the uniformity of the hedge, unless they are the unusually vigorous types above mentioned. If the pruning is delayed too late in the summer, new growth may result which will not have sufficient time to mature properly before freezing weather.

On the other hand, if trimming is done in the fall or very early spring, the hedge will remain even for a short time only, for when growth starts in the spring it will have a decidedly uneven appearance for the rest of the year. A little careful observation and practice will give the home owner a better knowledge of when he may trim his particular hedge under his particular conditions and get the best effect for the longest period of time.

Since evergreen hedges are slower in their growth, they do not need to be pruned so much nor so early as deciduous hedges. However, each year's growth can be made much more dense by one or two trimmings early during the growing period.

The amount of growth to be removed depends on the present size of the hedge and on the permanent size desired. If it is to grow no larger, only about one inch of the current year's growth should be left after trimming. In fact, it may be necessary to cut back to three- or four-year-old wood at intervals in order to keep the plants within bounds, but only a very little of such trimming should be done at first in order to determine whether or not this method is feasible for the type of hedge being grown.

If a hedge has a considerable amount of growth to make before it reaches the proper size, then more of the current season's growth can be left on. Sometimes several clippings can be given a young hedge during the growing season, simply to remove a small amount of the terminal growth and so promote the branching of side shoots.

The general shape should be wide at the base and narrower at the top. Styles differ. Some like a rounded hedge while others prefer one more or less triangular with only a very narrow flat surface at the top. The hedge with the rounded

top tends to shed the snow much better than the one with a flat top, and this is important in sections where the snowfall is heavy, particularly if the plant used is weak-wooded.

The following points about trimming hedges cannot be over emphasized.

1. Always trim so that the base of the hedge is wider than the top.

2. Do not be in a hurry to force growth in height at the expense of denseness and width.

3. In an old deciduous hedge that is scraggly and open at the base, it will usually pay to cut the plants to within a few inches of the ground now and let the new growth develop again from the base, rather than attempt to correct the growth in other ways.

Lawns

Actually, the cutting of grass on the lawn is a pruning operation. This year especially, when little or no fertilizer is available for use on the lawns, it is essential to let the grass remain on the lawn after cutting. Do not rake it off. Grass should be cut so that what remains is about $1\frac{1}{2}$ inches high, and it should be cut frequently enough, so that the clippings will dry up in a day or two. If the grass is too thick or too long, the clippings will mat and may injure or even kill the living grass underneath. This may be avoided by mowing the lawn frequently enough so that the clippings will not mat down, but will quickly dry up. The amount of rain, kind of soil, fertilizer, and the amount of moisture in the soil, all govern the speed with which the grass grows and each person will have to decide for himself exactly how frequently the mowing of his own lawn should be done. Clipping must be done more frequently in the late spring than in the summer. The accumulation of dried clippings over the course of one year not only acts as a mulch to the grass roots, but eventually adds considerable fertilizer to the soil in the form of much-needed nitrogen.

SPRAY PROGRAM IN THE HOME GARDEN

Woody Plants

Scale insects	Miscible oil	1-15	Feb. 15 to early April Applied when temperature remains 40° F. and above until oil dries
Euonymus scale	Miscible oil	1-15	Feb. 15 to early April (If applied to an evergreen species, defoliation may occur)
	" "	1-50	In the summer
Pine leaf scale	Miscible oil	1-30	Early April
Spruce gall aphis	Miscible oil	1-30	Early April
Larch case bearer **Spring canker worm** **Willow leaf beetle**	Arsenate of lead Calcium caseinate Water	2 lbs. 1 lb. 50 gal.	As soon in spring as young appear

NOTE:—For the willow leaf beetle the spray should be applied to the undersurface of the leaves in early June.

Elm leaf beetle and Japanese beetle	Arsenate of lead Calcium caseinate Water	3 lbs. 1 lb. 50 gal.	Early June for the Elm leaf beetle and early July for the Japanese beetle

NOTE:—If the Japanese beetles are profuse on garden produce or fruits, spray with Rotenone, 3 lbs. in 50 gal. water.

Lace wing fly of Rhododendrons	Sunoco oil	1-70	As the insects appear in spring
		1-60	In summer on a cloudy day when temperature is not over 80° F.
Red spider on evergreens	Sunoco oil	1-100	Applied in summer as a fine mist on a cloudy day when temperature is not above 80° F.

Roses

Rose bugs	Arsenate of lead Molasses Water	4 lbs. 1 gal. 50 gal.	Apply when beetles first appear and at intervals of one week if infestation is severe

Black spot of Roses	Finely ground sulfur dust lead arsenate	9 parts 1 part	Applied weekly, preferably before a rain rather than after it

NOTE:—Some commercial dusts are available that are dyed green and are not so conspicuous as pure sulfur dust.

Grapes

Bordeaux Mixture (4-4-50)

NOTE:—Usually four sprays will suffice if applied at the proper time:—

1. When new growth is $\frac{1}{2}$–1″ long
2. When new growth is 4–6″ long
3. As soon as blossoms fall
4. Just before berries touch in the clusters

Apples

Dwarf apples are ideally suited for the home garden especially because they make insect and disease control very simple. Though there are many insects and diseases infesting apples, usually the following dust applied every week or ten days until mid-July or early August will prove a satisfactory control, especially on dwarf apple trees.

Fine sulfur dust	8 parts
Arsenate of lead	2 parts

Vegetables

Cutworms	Heavy paper or cardboard collar around young plants, 2″ below ground and 4″ above		during late May and June
Cabbage maggots	6″ square of heavy roofing paper on surface of soil over plant roots		in May and June
Cabbage worms	Rotenone dust		Weekly from time worms first appear
Mexican bean beetle	Rotenone or Pyrethrum dust		apply to undersurface of leaves every week or ten days
Striped cucumber beetle	Calcium arsenate talc (or dust with Rotenone)	1 part 9 parts	weekly from time beetles first appear
Potato bugs and Potato blight	Bordeaux Mixture Arsenate of lead	9 parts 1 part	dusted on from 2-6 times from time plants are 6-8″ high, or as needed

DONALD WYMAN

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RHODODENDRON WINTER INJURY

RHODODENDRONS have been seriously injured during the past winter. In fact, a cursory investigation seems to indicate that the injury will be as widespread as it was after the winter of 1940–41. Injury has been noted in Philadelphia, northern New Jersey, New York and Boston, undoubtedly indicating that rhododendrons growing in a wide area have suffered. As many home owners will be disappointed with their plants this spring, and because of this widespread injury, this issue of Arnoldia is devoted to a discussion of some of the factors that might have been the cause. (For notes on the injury occurring three years ago, see Arnoldia vol. 1, 33–36, April 29, 1941.)

The injury became evident in the Arboretum about two or three weeks ago. Prior to that time, the plants were apparently in good condition, though it is admitted that we did not make minute examinations. The greater number of the evergreen rhododendrons are growing at the base of Hemlock Hill. This spot is frequently very cold and very windy at times during the winter, and wind has caused freakish injuries to rhododendrons and other plants as well.

The injuries this spring are varied. A branch here and there may have been killed on a plant while the remaining branches are in a healthy condition. Sometimes only a few leaves are injured; sometimes half the plant is killed. Several large plants in the collection, plants which have been growing there for ten or fifteen years, are completely killed, while their immediate neighbors are apparently unscathed. Of course there are many varieties of rhododendrons growing in the Arboretum with varying degrees of exposure. Most of the plants are mulched well with oak leaves, and those with the worst exposure were protected from winter winds by pine boughs, set and tied in place during December and removed the first week in April.

How did the damage occur?

Obviously, the temperature records should be consulted first to determine

whether the injury was caused by low temperatures. This was not the cause of injury in the Arboretum last winter for several reasons.

Records of maximum and minimum temperatures are recorded daily at our greenhouses. Only once did the temperature drop below zero (December 24) when it was -1° F. and only five times did it drop below ten degrees above zero. From the standpoint of winter cold, this was a mild winter, and accurately kept temperature figures are not the only criterion. Plants themselves tell the temperature story. For instance, the flower buds of *Viburnum fragrans* are very much in evidence all winter long. These are frequently injured by low temperatures. However, *Viburnum fragrans* in the Arboretum is in full bloom now with hundreds of beautiful pink flowers, not one of which shows any winter injury. In fact, the flowers of this plant have not looked so well for many years.

Corylopsis flower buds are frequently injured by cold winters, but none were affected in the past winter. Forsythia flower buds also are frequently injured by low temperatures, but these are in splendid condition and soon will begin to open in all their golden splendor. The flowers of our cherished native dogwood, *Cornus florida*, are not injured, and, incidentally, the trees throughout this area are loaded with flower buds giving promise of a gorgeous display in May. It may be remembered that the previous winter (1942–43) was a severe one with respect to many woody plants and that in many cases the outer bracts of the dogwood "flower" bud were injured to such an extent that when the "flower" was fully open, only two bracts were a normal white, the other two were grayish and stunted or else had dropped off altogether by flowering time. Such is not the case this year and it is safe to predict that dogwoods will produce in another month one of the best flowering displays in years.

And as a final example (there are many more which could be mentioned), the flower buds of the rhododendrons themselves are in splendid condition, except on those branches or plants that have been completely killed. In severe winters, the flower buds show considerable injury at this time, but such is not the case, at least in the Arboretum collection. Of course, these plants will not bloom for six weeks, and complications in the injured water systems of the plants may arise which might cause some of the flower buds to die before they open, but now, the majority of the plants that are uninjured are well covered with perfectly normal well filled flower buds. These plants, too, will produce a splendid display of flowers this season.

Consequently, from the temperature records taken in the Arboretum and from the fact that other plants with tender flower buds were uninjured, low temperatures alone were not responsible for the peculiar and disappointing type of winter injury which is so evident on rhododendrons.

High winds

High winds are frequently the cause of winter injury, and often a contributing cause. This was not the case in the Arboretum last winter. One has only to in-

spect the plants in the collections to be convinced. Here it would be quickly evident that injured branches are not those that are most exposed. On the contrary, the injured branch as evidenced in our collection may be the branch most protected from *sun and wind*! Entire plants *in the center* of the collection have been killed, whereas those on the outside of the collection, those most exposed, have not been injured. Hence it is not possible to blame the injury to high winds. This fact is borne out by an examination of the official weather bureau reports for the months in question (November '43 to March '44) which show that the wind velocities for each of these months has been about normal.

It may be remembered that in March of 1941 there were several days when there were comparatively high temperatures, some slight wind, full sunshine and rather remarkably low humidities, factors which combined to make a condition most unfavorable to rhododendrons at that time of year. No such correlation of temperature, humidity and sunshine existed during this past winter; consequently, with these factors in mind, it would seem logical that injury was not caused by high winds or a combination of low humidity and high temperature.

Rainfall

If there is any one factor which can be singled out as being responsible for the injury, it might well be the rainfall, or better, the rainfall and the snowfall. In the first place, there was practically no protecting blanket of snow on the ground all winter. The one major snow storm occurred March 20, a ten-inch fall which did no good as a ground cover for it melted in a few days.

In Boston the annual rainfall amounts to about 40 inches each year. By the end of December, 1943, there was an 8 inch deficit in this expected amount. November and December are actually the critical months for it is during these months that the ground freezes. Once this occurs, the ground water becomes unavailable to plants. If the soil freezes at a time when the plants themselves have not had sufficient water, injury may occur. Especially is this true of broad-leaved evergreens for their stomates are continually exposed to the atmosphere and must give up water on warm or windy days, *even though the ground remains frozen.* Injury occurs when no more "stored" water is available from plant parts above the ground, and with the ground frozen, the plant gives up water essential to the life of the plant cells.

During November and December of 1943 there was a rainfall of only 3.15 inches —less than half the normal amount for those two months. By November there was already a 5 inch deficit in the rainfall. Hence the rhododendrons went into the winter (after the soil had frozen) in a very dry condition. With practically no snow cover, and evaporation of water from the soil surface throughout the winter, the situation was aggravated. With the first occurrence of high temperatures in March, increased evaporation occurred from the leaves but water could not be taken up from the soil, hence injury occurred. It is extremely difficult to explain the unequal injury of these plants; i.e., why only a branch was killed

here and there on one plant. It is likely that unequal absorption of water by various plant parts, unequal root distribution, and unequal freezing and thawing of the soil are all related to the problem.

It is interesting to note that very few plants other than rhododendrons have been injured here this past winter.

Care of injured rhododendrons

Now that the injury is evident, what steps should be taken to help the rhododendrons back to good growth? All dead wood should be cut out, the plants given plenty of water and the tops sprayed with water occasionally (except in bright sunshine when the temperature is high). Everything should be done to aid the plant into vigorous growth early in the season. The only thing which might have prevented injury to rhododendrons this past winter (presupposing normal cultural methods were followed) would have been a thorough watering of the plants throughout late October and November, or during the several week period prior to the time the ground froze.

Donald Wyman

ARNOLDIA

A continuation of the
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of the Arnold Arboretum, Harvard University

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SPRING DISPLAYS IN THE ARNOLD ARBORETUM, 1944

THIS year, like last, time and gasoline are at a premium. Persons who are interested in the beautiful collections at the Arboretum would undoubtedly appreciate some information about the time when these displays are expected to be at their peak. The following ten groups of plants have been selected merely because they constitute some of the more conspicuous flowering collections during the spring months. Dates given can only be approximate but are corrected for this year, a year which has been marked for its cold weather up to this time, as evidenced by many of the plants flowering a week or two later than they normally do.

Magnolias

The magnolia collection, situated around the administration building by the Jamaica Plain gate, is coming into flower now. There are 18 species and 26 varieties of these in the Arboretum, the first in flower always being *Magnolia stellata*, shortly followed by *M. Kobus* and *M. denudata*. Then come the colorful *M. Soulangeana* varieties, most of which should be in bloom during the first week in May. This collection is not marked for large numbers of trees but rather is of interest for its individual specimens.

Forsythias

Every one who has visited the arboretum during the latter part of April will remember the impressive bank planting of forsythias at the base of the lilac collection opposite the ponds. Contrary to popular belief there is not just one "forsythia," but in the collection at the Arboretum 6 species and 15 varieties are represented. *Forsythia intermedia spectabilis* has the largest, deepest yellow colored flowers of the varieties yet named, while *F. intermedia primulina* is very lovely because of its pale primrose yellow flowers. Since *F. ovata* started to bloom April 20 and the other forsythias are now in full flower and will be colorful for another week or two, it is seen that these plants can fill a corner in the garden with bright spring cheer for several weeks.

Oriental cherries

Many of these interesting small trees were first introduced into this country by the Arnold Arboretum. However, the trying climate of New England has not been kind to many of the double flowered varieties. The single flowered species, like *Prunus Sargenti*, *P. subhirtella*, *P. triloba*, *P. tomentosa* and others will be in full bloom the first week of May. *Prunus subhirtella autumnalis* particularly is worth observing because its flowers are semi-double. It can be termed the first of the double flowering cherries to bloom, a splendid tree being situated immediately within the Forest Hills entrance.

The double flowered cherries bloom a week to ten days after the single flowering forms, and can be expected in flower during the week of May 15. The collection of these on Bussey Hill has been hard hit by severe winters, but there are a few, here and elsewhere in the Arboretum that are well worth inspection. One of the hardiest of all is the variety "Kwanzan."

Crab apples

Much has been written in these pages during the past few years in praise of the oriental crab apples as ornamental plants. They will start to bloom within a few days but the peak of their bloom will not come until the week of May 15. Some excellent old specimens are planted adjacent to the Forest Hills entrance. Others can be found on Bussey Hill. The largest collection is planted around the base of Peter's Hill on the further side of Bussey Street. All in all, there are nearly 200 species and varieties of the genus Malus growing in the collections, many of which make admirable ornamentals. Their vividly colored fragrant flowers are always followed by myriads of bright colored fruits in the fall. Most of the varieties being grown in the Arboretum are available from some nursery in the United States. If there are some that you would like to have in your garden and you cannot find them in the available nursery catalogues, write to the Arboretum and it may be that sources can be located. The delicate pink and white blossoms of *Malus floribunda*, the purplish red flowers of *M. purpurea* and its several varieties and the carmine flowers of *M. atrosanguinea* are all outstanding and should be compared, one with the other, in order to select the "best" species or variety for one's own garden.

Azaleas

The parade of the azalea blossoms has already begun. *Rhododendron mucronulatum* (to all intents and purposes considered an azalea) started to bloom last week, and by May 15 a wealth of azaleas should be on colorful display. The pinkshell azalea is ideally planted beside Meadow Road and also at the edge of one of the ponds, where its delicate pink flowers are always mirrored in the water beneath the tall growing oaks. The torch azalea from Japan should also be at its height of bloom at this time. There are hundreds of these in the woods of the Arboretum but perhaps the best display of all is beneath the century old pines on Bussey Hill. The royal azalea, the one with the largest flowers, is also in

bloom at mid May, followed by some of the natives in late May and the gorgeous orange *R. calendulaceum* in early June. Many hybrids also bloom in late May and early June, especially the popular Ghent azaleas, so many of them that it is certainly worth a trip to the Arboretum to compare the varieties at their height of color. The largest collection of hybrids is on the southern slope of Bussey Hill facing Hemlock Hill.

Dogwoods

Whenever dogwood is mentioned, one immediately thinks of the flowering dogwood, *Cornus florida*, a native, widely distributed over the eastern United States. This tree is frequently seen in the Arboretum and this year its presentation of blossoms should be one of the best in years, for the plants are covered with fat flower buds that are merely awaiting warm weather to start opening. The week of May 15 should see these trees come into the glory of full bloom and they will remain at their best until lilac time. Among the many interesting plants growing in the Arboretum are a double flowered dogwood and a variety with pendulous branches.

There are approximately 65 different kinds of dogwoods growing in the Arboretum, many of them being in the collections near the lindens along Meadow Road. Most of these of course are the shrubby types. *Cornus mas* and *C. officinalis* started to bloom last week. Although the big display of the dogwood clan is with *Cornus florida*, many of the shrubby sorts that follow have interest and certainly *C. kousa* and its variety *chinensis* are well worth seeing when they bloom in June.

Lilacs

There are approximately 550 lilacs growing in the collections and the nurseries in the Arboretum! To many it proves confusing to walk through the long lines of bushes when they are at the height of their flowering period (about the week of May 22 this year) for there are so many varieties that look alike! Yet there is always the possibility of spotting a variety that has just the right color for one's own garden. It is indeed difficult to distinguish some of the varieties apart because of their similarity. That is why the Arboretum has listed some varieties as "the best" in order to point out some that are outstanding and at the same time are available from nursery sources.

Of this large group 30 are lilac species. Most of the others are varieties of *Syringa vulgaris* but it should be pointed out that each year now, we are expecting more and more bloom (in early June) from the hybrids and varieties of *S. Prestoniae* which are planted at the upper end of the main collection towards the *Euonymus* group. These lilacs do not have the fragrance of the *S. vulgaris* varieties but they have vigor, hardiness and bloom a week or two after most of the *S. vulgaris* varieties are past.

Rhododendrons

The main collection, planted at the base of Hemlock Hill beside a meandering

stream, should prove very colorful this year, even though many plants have been seriously injured during the past winter. The rhododendrons, like many other plants, are at their best in alternate years. They seem to be well covered with flower buds at this time, and, if no complications arise from the buffeting many of them underwent last winter, a splendid display should be in store for those who care to walk over to see them during the first week in June.

Mockoranges

The main mockorange collection is across the road from the lilacs, near the Forest Hills entrance, with some planted in the shrub collection. Together they number at least 110 different species and varieties, all of which should bloom during a two or three week period starting about the first week in June, with the peak of the bloom being the week end of June 17. These dense shrubs vary in size from dwarfs about a foot high, to massive shrubs 15 feet high. Some, like the hybrid *Philadelphus virginalis* varieties have very fragrant blossoms, while others like the mound-like, dense, single flowered *P. splendens* have very little fragrance. The flowers of all are white, the fruits have no ornamental value and none of the species have any autumn coloring in the fall. Consequently, the only time to enjoy these plants is when they are in flower. Since last winter was a comparatively mild one as far as temperatures were concerned, many of the slightly tender hybrid varieties are probably uninjured and should be well covered with flowers during mid-June.

Roses

Those who have visited the Arboretum know that there is no formal rose garden as such. However, there are well over a hundred species and botanical varieties of roses growing in the shrub collection adjacent to the Forest Hills entrance. These begin to flower in late May with *Rose Ecae*, *R. primula* and *R. Hugonis* leading the display that reaches its height during the third week of June. Many of the old-fashioned roses are growing in this interesting collection, including some of the moss roses, the Lancaster and York rose, the old cabbage rose or rose of a hundred petals and several varieties of the Scotch rose, the rose which is native over a wider area of the earth's surface than any other rose.

These then are some of the most prominent displays of flowers to be anticipated in the Arboretum this spring. The Arboretum is easily reached by automobile, being situated at the junction of Centre Street and the Arborway in Jamaica Plain. Routes 1, 3, 28, 38, and 138 go right past it. Or it may be reached by taking the Arborway car at Park Street and getting off at the Arborway. Or, it may be quickly reached by taking the Forest Hills subway, getting off at Forest Hills and walking one block along the Arborway to the entrance gate. Easily accessible, with a major proportion of these displays within a short walk of the Forest Hills gate, there is always the opportunity to see gorgeous flowering displays during May and June with little expenditure of time and effort.

DONALD WYMAN

ARNOLDIA

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HOW TO SPEND AN HOUR IN THE ARNOLD ARBORETUM

MANY visitors to the Arboretum express a desire to see all parts of the 265 acres, but apologetically remark that their time is limited—they only have "an hour." To one who is familiar with the many thousands of different kinds of trees and shrubs growing on these 265 acres, it is manifest that little more than a hasty trip through the grounds can be accomplished in an hour. If, however, the hour is spent in leisurely strolling up and down the walks through the shrub collection, immediately adjacent to the Forest Hills gate, over a thousand different kinds of shrubs (and vines) can be closely observed and many notes can be made concerning the ornamental qualities of the most interesting of these.

First, one might walk between the two rows of vines, each containing about 60 different kinds of vines. Some, like the *Ampelopsis* species are noted for their interesting foliage and a few for their bright fruits. Others, like the trumpet-creepers, are valued for their conspicuous flowers in early summer. Of particular interest should be the five-leaved Akebia (*Akebia quinata*) which is one of the best twining vines available because of its excellent almost semi-evergreen foliage. Several species of bittersweet (*Celastrus*) are growing near the *Akebia*, and it is easy to note the distinguishing characteristics between the native American bittersweet (*C. scandens*) and the oriental bittersweet (*C. orbiculata*). One other bittersweet might be noted here too. It is not available in the trade but it should be, for it has small thorns, grows in a dense mass, and thus makes a formidable barrier plant. This is *C. flagellaris*, a splendid little vine and well worth planting for barrier purposes.

Then one could easily spend much time examining the long rows of shrubs, many of which are commonly grown in nurseries and hence are available to every home owner. Most of the shrubs in this collection have been permitted to grow with a minimum amount of pruning, so that the true habit could be properly attained. In some cases, crowding has unavoidably modified the habit and certain

allowances, therefore, must be made, but on the whole most of these plants have been allowed to develop more or less as they would in nature.

The barberries occupy most of the row next to the vines. It should be kept in mind that many barberries carry the destructive wheat rust, and legislation is in force against planting them in many areas. All varieties of *Berberis Thunbergii* are fairly immune to this disease, and so *B. Thunbergii minor* deserves special attention because of its diminutive leaves, flowers and fruits. *Berberis koreana*, too, is nearly immune and is fast replacing many of the more susceptible species, hence it too, should be observed closely. In the fall its brilliant red foliage and scarlet fruits make it truly desirable.

The tall, aristocratic pearl bushes (*Exochorda* sp.) might be inspected. Here is clear evidence that the species common in the trade (*E. racemosa*) is not the hardiest, in fact it is the least hardy! *Exochorda Giraldii Wilsonii* is probably the best, particularly because of its larger flower clusters, and again because it is certainly hardier than the common *E. racemosa*.

Most of the spireas can be passed over quickly since their similarity in flower is frequently confusing to the amateur. The vigorous growing ninebarks (*Physocarpus* species) clearly show their vigorous habit of growth and demonstrate the fact that when they are planted they should be allowed plenty of room for expansion.

The rose species occupy the better part of two full rows the length of the entire collection. These might be called the wild roses of the world. Some are hybrids, many are familiar "old fashioned" roses like the cabbage rose (*Rosa centifolia*) and the Austrian copper rose. The rose with the smallest flower (*R. Watsoniana*) is of interest for this fact and also because of its finely cut foliage. Many of these roses bear close scrutiny—*R. Helenae* for its delicate flowers, *R. Roxburghii hirtula* for its very large flowers and interesting bark, unique among roses, and many others which will bloom during the month of June.

The quinces were particularly beautiful during mid-May. The comparatively mild winter did not injure the flower buds and hence an excellent opportunity was presented to compare them in flower. It should be pointed out that the hybrid *Chaenomeles cathayensis* is not hardy. *Chaenomeles lagenaria* "*kermesina semiplena*" is apparently the largest growing of all, while *Chaenomeles japonica* and its varieties are the lowest, being less than three feet tall.

Various mock oranges and deutzias are about to come into bloom now and interesting notes might well be made concerning them as well as the hydrangeas, weigelas and privets. Though several species of these are commonly seen in gardens, other less well-known ones grow here in these rows, making comparisons a most interesting way of spending a short time in the Arboretum. This shrub collection is one of the very few places in this country where so many different kinds of woody plants can be seen and closely examined in such a small area. An hour spent here is well worth while to both amateur gardeners and professional plantsmen.

The mid-May frosts

The vagaries of the weather have not left the trees and shrubs of the Boston area untouched this year. Mention has already been made of injury to rhododendrons (in Arnoldia, vol. 4, No. 4, 1944). On the nights of May 18, 19 and 20 parts of Boston and its suburbs experienced killing frosts. This was true in many other parts of the country as well. Damage done to crops has been considerable and some ornamental plants were injured. As an example, this spring a planting of 42 varieties of Ghent hybrid azaleas was made on the James B. Case estate in Weston, now the property of the Arnold Arboretum. The frost on the night of the 18th killed all of the flowers and the leaves of all the varieties, a very disappointing loss since these plants were just coming into bloom for the first time. Now no records of flower size and color can be made until next year, and these data were needed for use in a proposed selection and propagation program.

The highbush blueberries in the Arboretum were uninjured, but in low lying areas of Boston's suburbs a very heavy crop of flowers was completely killed—sad news to many a housewife who was depending on some of the fruits for canning this summer.

The young shoots of many oak trees were either partly or entirely killed, depending on the situation in which the trees were growing. Such a freeze occurred about six years ago when many oak trees were injured. The unseasonably warm weather during the first part of May developed the foliage with a rush, so that when the freeze came, the young growth of many plants was entirely too tender to withstand it. Young shoots of sycamores, sumac and hickory trees were also killed in the western part of the state and many oak woods appear brown when viewed from the train window because of the killing.

Cladrastis lutea, for instance, was badly injured. One tree in my garden—approximately fifteen feet tall—had all its leaves killed. New leaves and shoots will grow on this tree, but it is of interest to note that the leaves and young shoots of *Fagus grandifolia*, *Fagus sylvatica*, *Acer saccharum* and *Acer mandshuricum* growing in the same place were not injured. Lilacs, *Rosa primula* and *R. rugosa* were not injured in the same situation where the young shoots of hybrid tea roses were killed back to the ground, although it is understood that there was killing of lilac foliage in some of the other suburbs.

The young shoots of many *Taxus* species and varieties are about an inch long at this time of year. These shoots were all killed in certain sections of the Boston suburbs, whereas the young shoots of pine and spruce were not injured. This, of course, means only that in these certain locations the young shoots of *Taxus* are the first to be killed. I do not have a record of the exact temperatures, but, at Weston, there was an eighth of an inch of ice on small pools the morning following the first freeze.

Fern fronds, young grape shoots, and even some clover leaves and shoots of

poison ivy were killed. Such injuries are not serious as the plants affected all have strongly recuperative properties, but it is interesting to note that even native plants were totally unprepared for such a drop in the temperature.

Plants in the Arboretum did not suffer very much. Few of the hundreds of azaleas in full bloom were injured. Flowers of *Malus ioensis plena* were just opening and the outer petals of these were turned brown. The lilacs suffered no injury. If they had, it would have been disastrous indeed for it is estimated that perhaps between 30,000 and 45,000 people visited the Arboretum to see them on Lilac Sunday, May 21, just after the frosts.

The cold spring kept many of the early blooming shrubs in check until the first of May. Then there was a procession of unseasonably warm days with high temperatures and strong sunshine. The flowering season was about two weeks behind by the end of April and even forsythias did not reach full bloom until shortly after May first. Then with the warm weather, many plants burst quickly into bloom so that by mid-May plants were blooming very near to the accustomed time when they are normally expected. The sudden frosts, after two weeks of unusually warm weather, came at a time when the young growths of many plants were too tender to withstand low temperatures. The differences in the way the same varieties were affected in different locations is, of course, accounted for by differences in elevation, air drainage, and the vagaries of low temperatures and wind currents in general.

DONALD WYMAN

Notes

E. D. Merrill, Director of the Arnold Arboretum was elected a member of the council of the American Philosophical Society for a term of three years at the annual meeting of the Society in April. He was also selected by the Executive Committee of the National Academy of Sciences to represent that Society on the Board of the National Parks Association, succeeding the late Dr. J. McKeen Cattell.

Arnold Arboretum staff members, Dr. H. M. Raup, Assistant Professor of Plant Ecology, and Dr. A. C. Smith, Curator of the Herbarium, were both honored by being elected to membership in the American Academy of Arts and Sciences at its annual meeting in May.

ARNOLDIA

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EMERGENCY FOOD MANUALS

AS everybody at all familiar with world events realizes the present global war is in many respects very different from the first world war. Not only are many operations prosecuted along lines totally different from those which characterized the period between 1914 and 1918, but sources of special information have been developed in a wide variety of fields. Relatively speaking, the last great war was a world war in name, but in the present conflict actual combat involves not only the oceans of the world, but also the continents of Europe, Asia, Africa and the islands of the Pacific. In this second conflict botanists trained and experienced in widely diversified fields are contributing materially to the solution of various complex problems. The emergency food manuals are a small but distinctly important contribution from the fields of systematic and economic botany.

In the early part of the century when I commenced botanical work in the Philippines I soon realized, from field experience, that it was incumbent upon me to accumulate as much knowledge as possible regarding the edible qualities of various jungle plants. In my first year I had the experience of having been marooned for more than a week with no other available food than rice; and boiled rice three times a day with nothing to diversify it, is not only monotonous but is also distinctly not a satisfying diet from any angle. At that time I knew practically nothing about what one could find to eat in the vast tropical forests of the Philippines. Little did I realize that forty years later my services would be drafted to compile the data regarding jungle foods for the benefit of the men in our various services who were called upon to operate in the islands of the Pacific. Several years after the boiled rice experience when three of us were marooned by heavy rains in central Mindoro, entirely out of food and no avenue of escape open to us as long as the rain continued, one of my companions observed, when on Thanksgiving Day 1906 we dined on two broiled wood rats each, supplemented by boiled fern tips, "Cheer up, you couldn't buy a meal like this at Delmonico's." This

is, however, no place to enlarge upon the subject of what I have eaten and why, for the list would indeed be a strange one.

It is clear to anyone familiar with the tropics, and who has even a limited knowledge of the plants, parts of some of which may be eaten with entire safety, that there is no need of anyone starving to death in the midst of relative plenty. True, an army could not possibly subsist on what might be found in the jungles, but individuals and small groups of men can find much that may be eaten provided they know what to select. Dr. H. Lam mentions in his most interesting account of his trip up the Mamberamo River to the summit of the Central Snow Range (Mount Wilhelmina) in 1920 that his party met at the Meervlakte two Chinese bird hunters accompanied by nineteen native Papuans, who had travelled inland from the coast to the Idenburg River and thence down the Mamberamo. For a period of seventy days they had subsisted wholly on such plant and animal food as they could secure in the New Guinea forests, proof, if proof be needed, that it is possible to live on the country even in uninhabited areas such as this one in New Guinea.

Naturally, widely scattered and very rare or local species should not be considered in any popular booklet on edible plants, hence a prime necessity, if anything really useful is to be prepared, is a wide field experience on the part of the compiler. He must in the first place know the tropics from personal experience, and in the second place he must know what plants and plant parts may be eaten, either crude or processed—and some plant parts must be processed before they can be eaten in order to eliminate certain poisonous principles. But what is of even greater importance than this is a knowledge of what are the common and widely distributed species. It would be utterly valueless were a species to be included that is so rare or so local that no one could possibly expect to find enough to satisfy, in part, the hunger of even one man.

The first emergency booklet prepared was a small one compiled by Captain A. B. Godshall and published in Panama in 1942, entitled "Edible, Poisonous and Medicinal Fruits of Central America," illustrated by 42 excellent line drawings. Immediately the idea appealed to others and within a very short time after this booklet appeared no less than twenty-one different individuals or agencies, representing various branches of the service, commenced to play with the idea of preparing something for the benefit of our service men who might become separated from their commands and who might have to live for a time on what they could find in the tropical jungles. There was no coordination of these endeavors, and too frequently individuals with no knowledge of the subject and with no tropical experience were assigned to the task of compiling data. Because of this confusion a meeting of representatives of the various services was arranged under the auspices of the National Research Council in Washington in September, 1942. The result of this conference was to enlist my services to prepare the copy for a booklet appertaining to the Pacific islands, while to Mr. Paul C. Standley and

Mountain Sorrel (*Oxyria digyna*)

Cowslip (*Caltha palustris*)

PLATE III

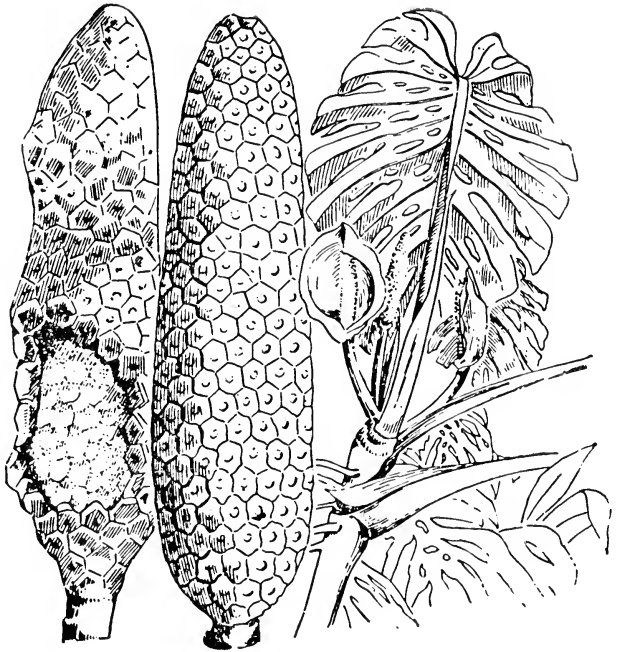
Reproduced from Standley, Paul C. "Edible Plants of the Arctic Regions" 1944, by courtesy of the author and the Bureau of Medicine and Surgery, Navy Department

Dr. B. E. Dahlgren of the Field Museum of Natural History, Chicago, were assigned the arctic and subarctic regions (including Alaska) and tropical America.

Immediately on my return to Boston from this conference I commenced to compile the data that were available to me, and the result was the completion of the copy and the illustrations late in December, 1942. The booklet of 149 pages with 113 illustrations was issued in a large edition on April 15, 1943. This is Technical Manual 10–420, entitled "Emergency Food Plants and Poisonous Plants of the Islands of the Pacific," issued by the War Department for wide distribution to service men.* It is non-technical, without descriptions, the illustrations taking the place of descriptions, and includes the majority of the common and widely distributed jungle plants that may be used as food, even including some that, unless the seeds or the tubers are properly processed, are actually poisonous if eaten raw. It covers in general certain natural groups such as the palms, ferns, grasses and aroids, followed by a consideration of those species in various unrelated families that produce edible tubers, those plants parts of which may be freely eaten as greens, edible fruits, edible seeds, a brief consideration of poisonous plants that it is desirable to avoid, and finally a consideration of the more common species parts of which, when macerated and thrown into pools or slow streams, will suffocate or poison fish. The area covered is all of the islands of the tropical Pacific, Papuasia, the Philippines, and all of the Malay Archipelago; and for all practical purposes it also covers British Malaya, Indo-China, Siam, Burma, and southern and eastern India. All in all some 128 different edible plants or plant parts are illustrated and others are discussed or mentioned. Some of these species will be found on every island of the entire tropical Pacific region that is high enough to support any vegetation.

A more finished product in this field is the "Edible and Poisonous Plants of the Caribbean Region" by B. E. Dahlgren and Paul C. Standley of the Chicago Museum of Matural History, in somewhat larger format than TM 10–420, mentioned above. This is a booklet of 102 pages with 72 illustration, published by the Bureau of Medicine and Surgery of the Navy Department in 1944, and the equally authoritative "Edible Plants of the Arctic Region" by Paul C. Standley, a booklet of 49 pages with 27 illustrations, issued in 1943. The former is available to the public through the Superintendent of Documents, Government Printing Office, Washington, D.C. at 20 cents per copy. These, then, are some of the contributions of American botanists who are familiar with their fields and also, on the basis of extensive field work, familiar with the tropics. Little can be said in favor of the botanical parts of "Jungle Desert Arctic Emergencies" and "Jungle and Desert Emergencies" issued under the auspices of the Army Air Forces in

*This is available to anyone interested in securing a copy through the Superintendent of Documents, Government Printing Office, Washington, D. C., the price being fifteen cents *in coin* (not stamps) per copy.



Piñanona (*Monstera deliciosa*)

Chayote (*Sechium edule*)

PLATE IV

Reproduced from Dahlgren, B. E. and Standley, Paul C. "Edible and Poisonous Plants of the Caribbean Region" 1944. by courtesy of the authors and the Bureau of Medicine and Surgery, Navy Department

1944, for the simple reason that too much of the relatively small amount of data about plants included in them verges on botanical misinformation, rather than on real facts.

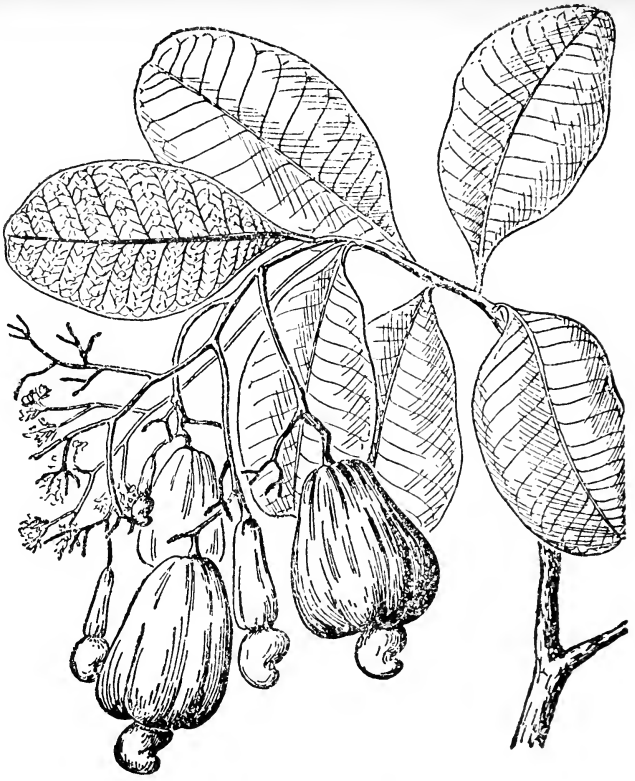
But the United States Government is not the only one that has tapped this special botanical reservoir of information for the benefit of its service men operating in strange lands. About the middle of 1943 there was issued in Australia a booklet entitled "Friendly Fruits and Vegetables" compiled for the use of Australian service men operating in the Southwest Pacific area. This consists of 71 pages with 37 figures. In August, 1943, there was issued under the auspices of the Auckland Institute and Museum, Auckland, New Zealand, "Food is Where You Find It. A Guide to Emergency Foods of the Western Pacific." This is a 72 page booklet with illustrations of nearly fifty plant species as well as pictures of certain fishes that are poisonous if eaten, and others that inflict severe wounds (including also the poisonous sea snakes and cone shells), as well as other fishes and marine forms that may be eaten with safety. These two antipodean contributions include much the same plant species as those discussed in Technical Manual 10–420. To be mentioned in this category are two booklets issued in Honolulu for the needs of our service men in the Pacific area, one by K. P. Emory, published by the Bishop Museum entitled "South Sea Lore," and one compiled and published by the United States Army, entitled "Castaway's Baedeker to the South Seas." Both of these contain some information regarding edible and otherwise useful Polynesian plants. The former is a booklet of 75 pages and the latter one of 63 pages, and both are illustrated.

Nearer home, and a mine of information regarding the edible qualities of our own species is the Fernald-Kinsey "Edible Wild Plants of Eastern North America," pp. i–xiv. 1–452. fig. 1–129. pl. 1–25. 1943. This was prepared at the Gray Herbarium of Harvard University, and is by far the most complete and most authoritative treatment of our native edible plants that has been issued. It covers the area from the Maritime Provinces to Minnesota southward to eastern Oklahoma and northern Florida. It is available from the Idlewild Press, Cornwall-on-Hudson, N.Y., price $3.00. (See ARNOLDIA, **4**: 8. 1944.)

The published information regarding potential jungle food plants is tremendously scattered in periodical literature, covering the fields of botany, horticulture and agriculture, as well as in various standard botanical treatises. Several of the particularly valuable reference works in the field of economic plants appertaining especially to the Malayan region and hence also to Polynesia, Micronesia, the entire Southwestern Pacific region and all of southern Asia are: **Ochse, J. J. & Bakhuizen van den Brink, R. C.** "Fruits and Fruticulture in the Dutch East Indies" i–x. 1–180, *pl. 1–57* (in color). 1931. (This is an English edition of their "Vruchten en vruchtenteelt in Nederlandsch-Oost-Indië"); their "Vegetables of the Dutch East Indies (Edible Tubers, Bulbs, Rhizomes, and Spices Included). Survey of the Indigenous and Foreign Plants Serving as Pot-herbs and Side

Pungapung (*Amorphophallus campanulatus*)

PLATE V



Cashew (*Anacardium occidentale*)

Reproduced from Merrill, E. D. "Emergency Food Plants and Poisonous Plants of the Islands of the Pacific" 1943, by courtesy of the author and the Quartermaster's Office, War Department

Dishes." i–xxxvi. 1–1006, illus. 1931. (This is an English edition of their "Indische groenten"); **Heyne, K. K.** "Die nuttige planten van Nederlandsch-Indië —." **1:** 1–250. i–xxviii. 1916 (re-issue 1–570. i–lxxx. 1922), **2:** 1–349, i–xxxix. 1916, **3:** 1–402, i–xlviii. 1917, **4:** 1–254. i–xxxvi. 1917; ed. 2, 1 vol. in 3, p.p. 1–1662. i–ccxli. 1927; and Burkill, I. H. "Dictionary of the Economic Products of the Malay Peninsula," 2 vols. pp. i–xi. 1–2402. 1935.

Thus certain information, not previously available in any single volume, some of it based on actual experience and observation on the part of individual authors, some compiled from widely scattered publications, has been assembled. In the compact form of the booklets briefly discussed above, these data have now been made widely available for all who may be interested in acquiring information which, on occasion, may be vitally important. This of course applies especially to individuals lost in the jungles of the tropics, cut off from their food supply and thus those whose lives are dependent on their own efforts.

E. D. Merrill

Notes

Dr. H. M. Raup, of the Arboretum staff, left Boston on May 31, with his party of seven, to continue the botanical survey of the Alaska Military Highway. Last year his party covered that part of the road from its southern terminus to Whitehorse. This year the group, which consists of Dr. and Mrs. H. M. Raup and their two sons, Karl and David, Dr. S. K. Harris of Boston University, Dr. John H. H. Sticht, glacial geologist, and Mr. Frederick Johnston of Andover Academy, archaeologist and anthropologist, will cover the region from Whitehorse to the Alaskan terminus of the road. The botanical field work will be done by Messrs. Raup and Harris and Mrs. Raup. This trip has been made possible by special grants received from the Milton Fund of Harvard University, the American Philosophical Society, the National Academy of Sciences, the Society of Sigma Xi, the American Geological Society and the Peabody Foundation. This year, as last, the party will operate in the field, not only with the permission of the military authorities, but transportation on the road and commissary privileges have been granted by these authorities without which it would be impossible to operate. This will be Dr. Raup's tenth season in botanical field work in the northern parts of North America. The party will return about the middle of September.

ARNOLDIA

A continuation of the
BULLETIN OF POPULAR INFORMATION
of the Arnold Arboretum, Harvard University

VOLUME 4 | OCTOBER 13, 1944 | NUMBER 8

AUTUMN COLOR

ALL indications point to a splendid display of autumn color this fall. There has been plenty of sunshine during September and rainfall has not been excessive. The few days prior to the hurricane of September 14 were about the last during which there was an appreciable amount of rain in Boston. The nights during the first week of October have been very cool, with light frosts in low spots in the Boston suburbs. All these indications thus point to the combination of conditions that should produce a fine display of color during the next few weeks. In order that Arnoldia subscribers will be better able to interpret what they may see during this period, the following notes on autumn color are presented, these data being in part publication of an earlier number of the Bulletin of Popular Information (Series 4, Vol. IV, November, 1936).

The eastern United States is fortunately located in one of the few regions of the world where brilliant autumn coloration of foliage prevails. There is only one small region in the southern hemisphere, and that in South America. In the northern hemisphere, there is a large region in eastern Asia, including central and northern Japan, and a small region in the southwestern part of Europe. In North America, the region characterized by brilliant autumn foliage extends from the Gulf of St. Lawrence to Florida and westward to the Great Plains, areas which are blessed with extensive deciduous forests and considerable rainfall. Here the general climatic conditions are often just what is needed to produce that lovely phenomenon of nature—the autumn coloration of deciduous foliage.

In North America the most brilliant displays of autumn color are of course in southeastern Canada, the northeastern United States and in certain other areas at higher altitudes. The further south one goes, the less brilliant is the display of autumn color, particularly in areas along the seacoast. In the higher altitudes of the South, such as the Blue Ridge Mountains, the color is usually just as brilliant as in the northeastern United States.

It should be pointed out that it is chiefly in areas of predominantly deciduous forests that autumn color displays are best, and such forested areas occur only in two general regions in the world. Plants growing in deciduous forests in tropical regions usually drop their leaves towards the end of the dry season. Since these leaves usually dry up before they fall (because of lack of water), they do not develop brilliant colors but usually turn brown and then fall off. In the case of plants growing in deciduous forests in temperate regions—especially in areas with ample rainfall equally distributed throughout the year—the leaves fall at the approach of cold weather, and because the plants have been well supplied with water, leaves of many trees do change color before they fall. This gorgeous phenomenon is what focuses our attention on the woods and forests at this time each year.

In some years, the autumn color is much more pronounced than in others. There are always plants, the foliage of which turns yellow in the fall, but it is the brilliant reds and gorgeous scarlets which, in combination with the yellows, make autumn color of outstanding beauty. It is chiefly the reds and scarlets which are intensified by the right climatic conditions.

Leaves are green because they contain a complex material called chlorophyll. This is essential to the growth of all plants, except the saprophytes and a few parasites, for it is through the action of chlorophyll that the plant can manufacture the food it requires from crude chemicals in the presence of light and heat. Chlorophyll is a highly complex chemical material, being continually manufactured in the leaf and at the same time being continually broken down. Ordinarily, the rate of its breakdown about equals the rate of its manufacture. In the fall, the rate of chlorophyll manufacture is gradually reduced, although the rate of its decomposition is maintained. The exact cause for this phenomenon is not fully understood, but the accumulation of waste products in the leaf may be the principal cause.

Why leaves are yellow

A certain stage is reached where there is little if any chlorophyll manufactured. Most of the chlorophyll already made eventually is destroyed. This is the reason why leaves are yellow, for the two yellow pigments usually present, carotin and xanthophyll, are continually masked by the chlorophyll. When most of the chlorophyll is destroyed, these pigments become apparent. These same coloring materials are present in large quantities in egg yolk, carrots, and in some yellow flowers.

When green plants are taken into dark places, such as a cellar, the leaves often turn yellow. Also, young shoots appearing for the first time under the dark conditions of the cellar are usually yellow. This is explained by the fact that chlorophyll is manufactured only in the presence of light. When light is absent, plants are unable to manufacture new chlorophyll and the yellow pigments become predominant as soon as all the previously manufactured chlorophyll has been destroyed.

The gradual cessation of chlorophyll manufacture and the final breakdown of all that previously made, completes the first stage in autumn coloration. This is the reason for certain plants becoming yellow. There are some plants, like some magnolias for instance, the leaves of which do not turn yellow, but change from green directly to brown. For some reason, the breakdown of the chlorophyll does not start soon enough or is not complete enough to result in the appearance of the yellow pigments. The yellow color does appear in the foliage of many other plants regardless of the weather conditions. There is an interesting high degree of individuality in certain species. Red maple, for instance, usually turns a good red in the fall, but certain individuals may color yellow. The same can be said of sugar maples and several other plants. This is a most interesting physiological problem worthy of considerable investigation.

Why leaves are red

The gorgeous beauty of most autumn color combinations results from the brilliant reds and scarlets, together with the yellows. The sassafras, some of the maples, oaks, sumacs, sourwood, tupelo, and other plants are particularly outstanding for their brilliant red autumn color. These plants are most interesting in that the brilliance of their color apparently varies from year to year. The red in their leaves is caused by a third pigment called anthocyanin, which results in some way from the accumulation of sugars and tannins in the leaf. In some of the maples valued for their sugar production, it is probably the sugars which cause this red color. The oaks, however, being rich in tannins probably owe their high autumn coloration to the presence of these.

There are two factors necessary in the production of red autumn color. The first is light. There must be warm, bright, sunny days in the fall, during which time the leaves naturally manufacture a great deal of sugar. Secondly, such days must be followed by cool nights, during which the temperature is below 45° F. Plant physiologists have shown definitely that, under such conditions, there is little or no translocation of sugars and other materials from the leaf to other parts of the plant. In other words, when cool nights occur, following warm, bright, sunny days, sugars and other materials are "trapped" in the leaves. The accumulation of these products results in the manufacture of the red anthocyanin.

The combination of these factors is well understood when one observes a certain tree that may be red only on that side exposed to the sun. Other leaves not directly in the sun's rays may be green or yellow. Leaves exposed to the sun have been able to manufacture more sugars, which when accumulated and "trapped" in the leaves by cold night temperatures may result in the red color. It is interesting to note that trees and shrubs growing in swamps and other low places are often among the first to color in the fall, simply because it is in such places that cold air first settles on still nights.

With these points in mind, it can be easily seen why there is so much divergence of opinion about autumn color. When plants are located so that they re-

ceive full sunlight, especially in the late afternoons during the early fall, they should be expected to show pronounced color if the weather conditions have been favorable. On the other hand, if a plant grows in the shade where it receives no direct sunlight, it cannot be expected to have marked autumn color.

One species in the Arboretum annually demonstrates this point. There is a splendid plant of *Fothergilla monticola* in the shrub collection of the Arboretum. This plant is exposed to full sunlight, while the shrub collection is in the lowest spot in the Arboretum, so one would normally expect plants there to color if any did. In years when the climatic conditions have favored autumn color formation, this particular plant of *Fothergilla monticola* is gorgeously colored red and yellow **—on the western side.** On the eastern side, where the foliage is shaded from the late afternoon sun, the foliage is merely colored yellowish and does not show the brilliant contrasts of red and yellow. Fortunately all plants do not show such great variation in autumn color when one side is compared with another, but it is a fact, that the western side usually has the deepest colored foliage when there has been plenty of sunshine. This point should be kept in mind in planting, locations and plants being selected that would show to best advantage during the period of autumn color.

Dull autumn coloration

A warm, cloudy fall, sometimes with much rain, will restrict the formation of bright colors in the foliage. With insufficient sunlight, the sugar production is greatly reduced, and with warm nights, what little sugar has been manufactured in the leaves can be readily transported to the trunk and roots where it has no effect on the color of the foliage.

The leaves of many evergreens change color in autumn. Some of the junipers and arborvitaes are listed in the following groups. Some pines may turn yellow, but usually such color lasts only for a short time, the leaves quickly turning brown. This is particularly true of those evergreen leaves which are normally shed each year, and although the autumn color may not be conspicuous in many evergreen plants, nevertheless it is evident on close examination.

All leaves eventually turn brown. This is not an autumn color, but is merely the result of the death, and in some cases the decay of the plant tissue. Sometimes, the leaves turn brown while they still remain on the tree, as in the American beech and in some of the oaks. In other cases, like the sugar maple and the spicebush, the leaves drop from the plants while they are still brightly colored and turn brown afterwards.

Autumn color is then a physiological phenomenon which is very complex. There are plants the leaves of which will always turn yellow regardless of current climatic conditions, but many of the plants with red fall foliage will be striking in appearance only when warm, sunshiny days prevail, followed by nights with temperatures below 45° F. The sugar formation in the leaf, the amount of sunshine

received by the plants, and the temperature of the air are three variable factors which to a large degree control autumn coloration.

Woody Plants with Autumn Color

The following plants are listed according to their most conspicuous autumn color. As has been explained above, these may change from year to year, depending on climatic conditions. For instance, some years *Cladrastis lutea* will be yellow, other years the same trees will be purplish. The degree of color may also depend on soil conditions, it being a well-known fact that pin oaks, for instance, which have received heavy applications of nitrogenous fertilizers, will have a much deeper red color than those grown on poor soils without such fertilizers. With these qualifications in mind, the following lists are offered. Plants with an asterisk (*) usually show conspicuous autumn color.

Autumn Color - Red

*Acer Ginnala
japonicum
mandshuricum
palmatum
platanoides Schwedleri
* rubrum – red and yellow
* Schlesingeri – very early red
* saccharum – red and yellow
triflorum
Aronia arbutifolia
melanocarpa
prunifolia
*Berberis, many species
Carpinus caroliniana
*Cornus alba
* florida
kousa
mas
stolonifera
*Cotinus americanus
* Coggygria
Cotoneaster divaricata
*Crataegus Phaenopyrum
*Enkianthus campanulatus
* perulatus
*Euonymus alata
atropurpurea
europaea
obovata
* sachalinensis
sanguinea
*Fothergilla species – red and yellow
Franklinia alatamaha – red and yellow
*Liquidambar Styraciflua – red and yellow
Malus Dawsoniana – red and yellow
Nemopanthus mucronatus
*Nyssa sylvatica
*Oxydendrum arboreum
*Parthenocissus quinquefolia
* tricuspidata
Photinia villosa
Prunus mandshurica
Maximowiczii
nipponica
* Sargentii
*Pyrus communis
* pyrifolia
* ussuriensis
*Quercus borealis maxima
* coccinea
* palustris
* velutina
Rhododendron calendulaceum
Schlippenbachii

*Rhododendron Vaseyi
*Rhus aromatica
* copallina – shining red
* glabra
* radicans – red and yellow
* typhina
verniciflua
Ribes aureum
hirtellum
odoratum
*Rosa rugosa – red and yellow
setigera
* virginiana – red and yellow
*Sassafras albidum – red, yellow to orange
*Spiraea prunifolia – glossy red
Syringa oblata dilatata
*Vaccinium species
*Viburnum dentatum
* Lantana – deep red
* prunifolium
* tomentosum – velvety, dull red

Autumn Color - Reddish to reddish purple

Cornus Amomum
* racemosa
Forsythia viridissima
*Fraxinus americana
*Gaultheria procumbens
*Gaylusaccia brachycera
Ilex decidua
*Juniperus horizontalis plumosa
virginiana
*Leucothoe Catesbaei
Ligustrum obtusifolium Regelianum
*Mahonia Aquifolium
* repens
Malus baccata
purpurea Eleyi
* sublobata
Myrica pensylvanica – bronze
*Pachistima Canbyi
Physocarpus monogynus
Prunus allegheniensis Daviesi
armeniaca "Mikado"
canescens
cyclamina
serrulata spontanea
*Quercus alba
Rhododendron obtusum Kaempferi
roseum
Rubus hispidus
Symphoricarpos Chenaultii
*Thuja occidentalis ericoides – purple
plicata – bronze
*Viburnum acerifolium
Carlesii
* dilatatum
* Lentago
molle
Rafinesquianum affine
Vitis Coignetiae

Autumn Color - Yellow

*Acer pensylvanicum
* platanoides
rufinerve
saccharinum
Actinidia arguta
*Amelanchier species – yellow to red
*Assimina triloba
*Betula species
*Celastrus species
Cercidiphyllum japonicum
*Cercis canadensis
*Cladrastis lutea – yellow to purplish
*Clethra acuminata
* alnifolia
Diospyros virginiana
Dirca palustris

*Ginkgo biloba
*Hamamelis mollis
* vernalis
* virginiana
Hypericum species
Kalopanax pictus
Kerria japonica
*Larix decidua
* laricina
*Lindera Benzoin
*Liriodendron Tulipifera
Maclura pomifera
Malus Halliana spontanea – yellow and purple
Ostrya virginiana
Parrotia persica – yellow to orange
*Phellodendron amurense
Physocarpus opulifolius
Populus alba
grandidentata
nigra italica
tremuloides
Poncirus trifoliata
Prinsepia sinensis
*Pseudolarix Kaempferi
*Sorbus americana
* aucuparia
Ulmus americana
Zelkova serrata

Autumn Color - Yellowish to Bronze

Aesculus parviflora – yellow brown
*Carya species – yellow to brown
*Castanea dentata – yellow to brown
mollisima – yellow to brown
Dirca palustris
*Fagus grandifolia
* sylvatica
Gymnocladus dioica
*Magnolia stellata – yellow brown
Malus ioensis plena – yellow brown
*Quercus imbricaria

No autumn color

Ailanthus altissima
Akebia quinata
Baccharis halimifolia
Clematis, many species
Daphne Mezereum
Davidia involucrata
Elaeagnus angustifolia
Euonymus Bungeana semipersistens
Hibiscus syriacus
Ligustrum vulgare
Lonicera fragrantissima
syringantha
thibetica
Lycium halimifolium
Polygonum Auberti
Potentilla species
Prunus Persica
Robinia Pseudoacacia
Salix blanda
pentandra
Sophora japonica
Vitex Negundo

Note:—Since this number of Arnoldia deals with foliage colors for a short period in the fall only, attention should be called to other recent issues which treat of foliage colors at other times throughout the year.

Winter Foliage Color of Narrow-leaved Evergreens. Arnoldia, Volume 3, No. 3, May, 1943.

Broad-leaved Evergreens with Green Foliage Throughout the Winter. Arnoldia, Volume 3, No. 4, May, 1943.

Foliage Colors of Woody Plants April to September. Arnoldia, Volume 2, Nos. 11 to 12, December, 1942.

Autumn blooming shrubs

The display of color in the fall not only consists of colored foliage and bright colored fruits, but also includes the flowers of a few late blooming shrubs and vines. The sweet autumn clematis (*Clematis paniculata*) and the fleecevine (*Polygonum Auberti*) are two vines whose white flowers have considerable merit in the fall.

Elsholtzia Stauntoni is a fall flowering shrub from China which grows about four feet tall and has many spikes of small lilac colored flowers. It was first introduced into this country in 1905, and although it has not found its way into many gardens, it is listed by several nurseries.

Franklinia alatamaha in the Arnold Arboretum begins to bloom about the first of September and continues until frost kills flower buds and leaves. The plants this year do not have many of their pure white, waxy flowers, due in large measure to the serious set-back the plants received in the prolonged drought this summer. Usually at this time they are covered with flowers. Though this native American plant is usually grown in the south as a tree, it is grown in the Arnold Arboretum as a shrub, with many branches from the base of the plant. When grown in this manner, winter killing is not nearly as severe as it is when the plant is grown as a tree, and, also, soil can be mounded around the base of the plant to aid in winter protection.

There are several members of the *Lespedeza* clan which are in bloom now. One of the most conspicuous this year is *Lespedeza japonica*, almost impossible to find in nursery catalogues, but a handsome, free-flowering shrub nevertheless, with its pure white flowers borne on conspicuous terminal spikes. Our plant is about four feet tall. *Lespedeza Thunbergii* is also in full bloom, with pink flowers. It is only about three feet tall, and the flowers are not as conspicuous as those of *L. japonica*. The native witch-hazel (*Hamamelis virginiana*) is starting to bloom now, usually an indication that most shrubs have ceased flowering for the year. However, the unseasonably warm weather (it was 86° the other day) not only brought it into bloom ahead of schedule, but the flowers of many spring blooming shrubs (*Spiraeas*, *Chaenomeles*, etc.) are starting to appear here and there in the plantings also. The "advantages" of New England weather this year have been forcibly emphasized by a late spring freeze, a long summer drought, an earthquake, a hurricane, and now a real Indian summer; to say nothing of a mosquito menace in mid October!

Donald Wyman

ARNOLDIA

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BULLETIN OF POPULAR INFORMATION
of the Arnold Arboretum, Harvard University

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AVAILABLE RAPID GROWING VINES FOR THE UNITED STATES

VINES play a very essential part in any garden, and rapid growing vines are frequently desired for some particular purpose which no other plant material will fulfill. Sometimes they are needed only temporarily; other times they are needed permanently. Rapid growing vines are not always the most ornamental, but, since their number is rather large, some of the best will be found among them. Nor are the most ornamental vines always the easiest to obtain. Rapid growing vines that are easily obtainable are very much of interest and are in demand throughout the country. Consequently, this number of Arnoldia deals with those rapid growing vines, easily obtainable, that are recommended in different areas of the United States. They may not all be of prime ornamental value when compared with some of the rarer ones, but their rapid habit of growth makes them of considerable value for certain screening purposes.

The information in this issue of Arnoldia is taken from a report prepared a short time ago when there was a great deal of interest in the camouflaging of various installations in this country, both public and private. Various horticulturists* in widely separated parts of the country contributed information on the

* Edgar Anderson, Missouri Botanical Garden, St. Louis, Missouri
W. H. Friend, Texas Agricultural Experiment Station, Weslaco, Texas
Norvell Gillespie, O.C.D., San Francisco, California
John Hanley, University of Washington Arboretum, Seattle, Washington
A. C. Jordahn, The Coconut Grove Palmetum, Coconut Grove, Florida
E. L Kammerer, Morton Arboretum, Lisle, Illinois
H. E. McMinn, Mills College, Oakland, California
H. B. Parks, Texas Agricultural Experiment Station, San Antonio, Texas
H. W. Shepard, School of Landscape Architecture, University of California, Berkeley, California
Maunsell Van Rensselaer, Santa Barbara Botanic Garden, Santa Barbara, California
Eric Walther, Golden Gate Park, San Francisco, California
Donald Wyman, Arnold Arboretum, Jamaica Plain, Massachusetts

vines in their respective areas, and this aided materially in the selection of the final lists of plants. It must be understood that all of the vigorous and fast growing vines do not appear in the following lists, merely because some are very difficult to find in nurseries and are of more or less restricted occurrence in nature.

Areas

For purposes of selecting the right vines for the right areas, the United States has been divided into eleven *general* areas, and vines are listed and recommended for each area. Naturally, these areas will overlap considerably. It is readily understood that there are many places within a certain area, where, because of altitude, soil conditions, or some climatic factor, recommended vines may not thrive. For instance, Area No. 1—the Eastern United States—bounded by the Atlantic Ocean, Canada, the Mississippi River, and a line across southern Mississippi, Alabama, and Georgia—covers a great territory with widely varying climatic conditions. Vines that would not grow in the vicinity of Mt. Washington in New England would flourish in the comparatively mild climate of the James River in Virginia. With these points in mind, the recommended areas for growing these vines should be taken with considerable reserve. The most vigorous and most hardy vines only have been selected. All can be used for screening purposes. Vines for growing within specific localities should be selected after first obtaining available information concerning plant growth and hardiness in the specific locality under consideration.

1. Eastern and Northeastern United States—In general all that part of the United States east of the Mississippi River and between lower Georgia, Alabama, Mississippi and Canada.

2. North Central United States—The entire area in Wisconsin, Ohio, Indiana, the Chicago area, and possibly west of the Mississippi into Iowa. (Areas 1, 2 and 3 overlap somewhat, but much of the recommended plant material is identical.)

3. Central United States—Including a wide area around Missouri, Arkansas, Oklahoma. In general, this area has summers that are more hot and dry than in the eastern United States.

4. The Great Plains Area—Including a wide area around Minnesota, Nebraska, North and South Dakota, Kansas, Montana, Wyoming. However, in northern Montana, Wyoming, and North Dakota, temperatures go extremely low in the winter and some of these vines may not survive in the areas with extreme winter cold.

5. Northwest Pacific Coast—Between San Francisco and Seattle. Many of the vines can be used considerably farther inland than the coastal area.

6. San Francisco Area—This is intermediate between Areas 5 and 7. Many of the vines recommended for growing in both these areas will grow in the vicinity of San Francisco, some, however, needing special care.

7. Southern California—This does not include the hot, arid areas.

8. Semi-arid area of Southwest Texas

9. Coastal Area of Southern and Southwestern United States—This includes part of Texas and a general area across all the Gulf states through Florida but does not include the subtropical areas of Texas and Florida.

10. Extreme Southern Texas and Southern Florida—Subtropical areas only. There is a small area, south of Corpus Christi, which can be considered as subtropical, together with the southern part of Florida.

11. Extreme southern part of Florida—Many of the vines listed in area 10 can be grown throughout southern Florida but there is an area from Stuart south around the coast to Ft. Myers, where truly tropical vines can be grown.

VINES FOR EASTERN AND NORTHEASTERN UNITED STATES

(Area 1)

Clinging to stone or wood by rootlets

Campsis radicans
Hedera Helix
Parthenocissus quinquefolia
Parthenocissus tricuspidata

Climbing by tendrils or twisting leaf stalks (These will cling to any material similar to chicken wire.)

Ampelopsis aconitifolia
Ampelopsis brevipedunculata Maximowiczii
Clematis paniculata
Clematis virginiana
Clematis Vitalba
Clematis Viticella
Smilax hispida
Vitis aestivalis
Vitis argentifolia
Vitis Coignetiae
Vitis Labrusca
Vitis vulpina

Twining (For twining about wires and supports of various kinds and shapes)

Actinidia arguta
Akebia quinata
Celastrus orbiculata
Celastrus scandens
Lonicera japonica Halliana
Lonicera sempervirens
Menispermum canadense
Polygonum Auberti
Pueraria Thunbergiana
Wisteria floribunda
Wisteria sinensis

Used as ground covers

Akebia quinata
Celastrus orbiculata
Celastrus scandens
Lonicera japonica Halliana
Parthenocissus quinquefolia
Pueraria Thunbergiana

Retaining leaves late in fall to early winter

Akebia quinata
Clematis paniculata
Clematis virginiana
Clematis Vitalba
Clematis Viticella
Lonicera japonica Halliana
Smilax hispida

Most ornamental

Campsis radicans—red flowers
Celastrus sp. —yellow and orange fruit

Clematis sp.—white flowers
Lonicera sp.—yellow or reddish flowers
Polygonum Auberti—white flowers
Wisteria sp.—white to purple flowers

Note: Three vines, namely *Lonicera japonica Halliana*, *Polygonum Auberti* and *Hedera Helix* will grow well in Boston but are frequently injured by severely cold winters. Consequently, they might best be used south of New York. A third, probably the fastest growing of all vines, *Pueraria Thunbergiana* should not be considered thoroughly hardy north of Philadelphia.

VINES FOR THE NORTH CENTRAL UNITED STATES

(Area 2)

Clinging to stone or wood by rootlets
Campsis radicans
Parthenocissus quinquefolia
Parthenocissus tricuspidata

Climbing by tendrils or twisting leaf stalks (These will cling to any material similar to chicken wire)
Ampelopsis aconitifolia
Ampelopsis brevipedunculata Maximowiczii
Clematis paniculata
Clematis virginiana
Smilax hispida
Vitis aestivalis
Vitis Coignetiae
Vitis Labrusca
Vitis vulpina

Twining (For twining about wires and supports of various kinds and shapes)
Aristolochia durior
Celastrus orbiculata
Celastrus scandens
Lonicera japonica Halliana
Lonicera sempervirens
Menispermum canadense
Polygonum Auberti
Wisteria floribunda
Wisteria sinensis

Used as ground covers
Akebia quinata
Celastrus orbiculata
Celastrus scandens
Lonicera japonica Halliana
Parthenocissus quinquefolia

Most ornamental
Campsis radicans—red flowers
Celastrus sp.—yellow to orange fruits
Clematis sp.—white flowers
Lonicera sp.—yellow or reddish flowers
Polygonum Auberti—white flowers
Wisteria sp.—white to purple flowers

Note: There are no evergreen vines for this area, unless *Euonymus* species might be considered. These are comparatively slow in growth and susceptible to scale.

VINES FOR THE CENTRAL UNITED STATES

(Area 3)

Clinging to stone or wood by rootlets
Campsis radicans
Parthenocissus quinquefolia

Climbing by tendrils or twisting leaf stalks (These will cling to any material similar to chicken wire)

Ampelopsis arborea
Clematis paniculata
Clematis virginiana
Smilax hispida
Vitis sp.

Twining (For twining about wires and supports of various kinds and shapes)

Aristolochia durior
Celastrus orbiculata
Celastrus scandens
Lonicera japonica Halliana
Lonicera sempervirens
Polygonum Auberti
Pueraria Thunbergiana
Wisteria floribunda
Wisteria sinensis

Used as ground covers

Celastrus orbiculata
Celastrus scandens
Lonicera japonica Halliana
Parthenocissus quinquefolia
Pueraria Thunbergiana

Evergreen vines

none

Most ornamental

Campsis radicans—red flowers
Celastrus sp.—yellow to orange fruit
Clematis sp.—white flowers
Lonicera sp.—yellow to reddish flowers
Polygonum Auberti—white flowers
Wisteria sp.—white to purple flowers

Note: This area is considerably more hot and dry in the summer than many areas in the eastern United States, consequently the choice of material is more limited.

VINES FOR THE GREAT PLAINS AREA

(Area 4)

Clinging to stone or wood by rootlets

Parthenocissus quinquefolia

Climbing by tendrils or twisting leaf stalks (These will cling to any material similar to chicken wire)

Clematis paniculata
Clematis virginiana
Smilax hispida
Vitis amurensis
Vitis Labrusca
Vitis vulpina

Twining (For twining about wires and supports of various kinds and shapes)

Aristolochia durior
Celastrus orbiculata
Celastrus scandens
Lonicera sempervirens

Used as ground covers

Celastrus orbiculata
Celastrus scandens
Parthenocissus quinquefolia

Evergreen vines

none

Hardiest for this area

Celastrus scandens
Parthenocissus quinquefolia

Most ornamental

Celastrus sp.—yellow and orange fruit
Clematis sp.—white flowers

Note: The climatic conditions in this huge area vary greatly. In some unusually dry and cold areas, none of these vines may grow. In others where moisture is not too limited but where winter temperatures are extremely low, only *Ce-*

lastrus scandens and *Parthenocissus quinquefolia* may grow. The more moisture and more moderate the winter temperatures, the more vines on this list may succeed. All have been successfully grown in Minnesota; in North Platte, Nebraska; and in Brookings, South Dakota.

VINES FOR THE NORTHWEST PACIFIC COAST

(Area 5)

Clinging to stone or wood by rootlets

Hedera Helix
Parthenocissus quinquefolia
Parthenocissus tricuspidata

Climbing by tendrils or twisting leaf stalks (These will cling to any material similar to chicken wire)

Ampelopsis aconitifolia
Ampelopsis brevipedunculata Maximowiczii
Clematis montana
Clematis paniculata
Clematis virginiana
Clematis Vitalba
Clematis Viticella
Smilax hispida
Vitis aestivalis
Vitis argentifolia
Vitis Coignetiae
Vitis Labrusca
Vitis vulpina

Twining (For twining about wires and supports of various kinds and shapes)

Actinidia arguta
Akebia quinata
Celastrus orbiculata
Celastrus scandens
Lonicera etrusca superba
Lonicera japonica Halliana
Lonicera sempervirens
Menispermum canadense
Polygonum Auberti
Pueraria Thunbergiana
Wisteria floribunda
Wisteria sinensis

Used as ground covers

Akebia quinata
Celastrus orbiculata
Celastrus scandens
Hedera Helix
Lonicera japonica Halliana
Parthenocissus quinquefolia
Pueraria Thunbergiana

Retaining leaves late in fall to early winter

Akebia quinata
Clematis montana
Clematis paniculata
Clematis virginiana
Clematis Vitalba
Clematis Viticella
Hedera Helix (evergreen)
Lonicera japonica Halliana
Smilax hispida

Most ornamental

Celastrus sp.—yellow and orange fruits
Clematis sp.—white flowers
Lonicera sp.—yellow to reddish flowers
Polygonum Auberti—white flowers
Wisteria sp.—white to purple flowers

Note: Most of the vines in this list can be grown from San Francisco to Seattle. The list is practically identical with that for the eastern United States. However, the climate along the northwest Pacific Coast is considerably milder than

that of New England—more on a par with that of the Carolinas. Consequently, these vines should grow more luxuriantly.

FROST RESISTANT IN SAN FRANCISCO AREA

(Area 6)

Clinging to stone or wood by rootlets

Hedera Helix
Parthenocissus quinquefolia
Parthenocissus tricuspidata

Climbing by tendrils or twisting leaf stalks (These will cling to any material similar to chicken wire)

Cissus striata
Clematis montana
Clematis paniculata
Clematis Vitalba
Phaedranthus buccinatorius

Twining (For twining about wires and supports of various kinds and shapes)

Actinidia chinensis
Akebia quinata
Celastrus orbiculata
Celastrus scandens
Lonicera japonica Halliana
Lonicera sempervirens
Mandevilla suaveolens
Muehlenbeckia complexa
Polygonum Auberti
Pueraria Thunbergiana

Used as ground covers

Akebia quinata
Celastrus orbiculata
Celastrus scandens
Hedera Helix
Lonicera japonica Halliana
Muehlenbeckia complexa
Parthenocissus quinquefolia
Pueraria Thunbergiana

Evergreen foliage

Hedera Helix
Lonicera japonica Halliana
Mandevilla suaveolens
Muehlenbeckia complexa
Phaedranthus buccinatorius

Most ornamental

Celastrus sp.—yellow and orange fruit
Clematis sp.—flowers
Lonicera sp.—yellow to reddish flowers
Phaedranthus buccinatorius—showy red to purplish flowers

Note: During the rainless summers, all plantings require frequent watering without which they are certain to fail. Their annual growth is directly proportional to the amount of summer irrigation.

SOUTHERN CALIFORNIA

(Area 7)

Clinging to stone or wood by rootlets

Campsis grandiflora
Ficus pumila
Hedera Helix
Parthenocissus quinquefolia
Parthenocissus tricuspidata

Climbing by tendrils or twisting leaf stalks (These will cling to any material similar to chicken wire)

Ampelopsis arborea
Bignonia capreolata
Boussingaultia baselloides

Cissus capensis
Cobaea scandens
Distictis lactiflora
Doxantha Unguis-cati
Pandorea pandorana
Passiflora sp.
Phaedranthus buccinatorius
Pithecoctenium echinatum
Pyrostegia ignea
Vitis californica
Vitis Girdiana

Twining (For twining about wires and supports of various kinds and shapes)
Bougainvillea glabra
Bougainvillea spectabilis
Dolichos lignosus
Ipomoea sp.
Lonicera etrusca superba
Lonicera japonica Halliana
Lonicera sempervirens
Muehlenbeckia complexa
Senecio mikanioides
Solanum jasminoides
Solanum Rantonnetti
Wisteria floribunda

Used as ground covers
Ampelopsis arborea
Hedera Helix
Lonicera japonica Halliana
Muehlenbeckia complexa

Evergreen vines
Bougainvillea glabra
Bougainvillea spectabilis
Cissus capensis
Cobaea scandens
Distictis lactiflora
Dolichos lignosus
Doxantha Unguis-cati
Ficus pumila
Hedera Helix
Lonicera japonica Halliana
Muehlenbeckia complexa
Pandorea pandorana
Passiflora sp.
Phaedranthus buccinatorius
Pyrostegia ignea
Solanum jasminoides
Senecio mikanioides
Tecomaria capensis

Most ornamental
Bignonia capreolata—yellow-red flowers
Bougainvillea sp.—magenta fruit bracts
Boussingaultia baselloides—fragrant white flowers
Campsis grandiflora—scarlet flowers
Distictis lactiflora—purple to white flowers
Ficus pumila—fine foliage
Ipomoea sp.—showy flowers
Lonicera sp.—fragrant flowers
Passiflora sp.—showy flowers
Phaedranthus buccinatorius—red flowers
Pyrostegia ignea—orange flowers
Wisteria floribunda—white to purple flowers

Note: There are many vines grown in Southern California. These are only a very few of the most common. Some are grown as perennials which in the north might be treated as annuals. Also, some of the vines grown farther north certainly would grow here. However, during rainless summers all plantings require frequent watering without which they are certain to fail. Their annual growth is directly proportional to the amount of this summer irrigation.

It should be noted in this connection that the following vines are drought resistant:

Bougainvillea spectabilis
Ficus pumila
Pithecoctenium echinatum
Tecomaria capensis
Vitis Girdiana
Rubus vitifolius needs moisture

SOUTHWEST TEXAS - SEMI-ARID AREA
(Area 8)

Clinging to stone or wood by rootlets
Campsis radicans
Ficus pumila
Operculina dissecta
Parthenocissus quinquefolia

Climbing by tendrils or twisted leaf stalks (These will cling to any material similar to chicken wire)
Ampelopsis arborea
Boussingaultia baselloides
Cissus incisa
Clematis crispa
Clematis Drummondii
Clematis Pitcheri
Clematis texensis
Parthenocissus heptaphylla
Parthenocissus quinquefolia
Vitis candicans

Twining (For twining about wires and supports of various kinds and shapes)
Lonicera sempervirens
Polygonum Auberti
Pueraria Thunbergiana
Serjania brachycarpa
Thunbergia alata

Used as ground covers
Ampelopsis arborea
Clematis Drummondii
Pueraria Thunbergiana
Serjania brachycarpa
Thunbergia alata

Most ornamental
Boussingaultia baselloides—fragrant white flowers
Campsis radicans—red flowers
Clematis sp.—flowers
Ficus pumila—fine foliage
Lonicera sempervirens—red and yellow flowers
Polygonum Auberti—white flowers
Thunbergia alata—white to purplish flowers

Note: Because of the large area and numerous climatic conditions in Texas, lists of vines are offered for three areas. Seventeen of these vines are grown in all three areas.

COASTAL AREA OF SOUTHERN AND SOUTHEASTERN UNITED STATES (EXCLUSIVE OF SUBTROPICAL AREAS OF TEXAS AND FLORIDA)
(Area 9)

Clinging to stone or wood by rootlets
Campsis grandiflora
Campsis radicans
Ficus pumila
Hedera Helix
Operculina dissecta
Parthenocissus quinquefolia
Parthenocissus tricuspidata

Climbing by tendrils or twisted leaf stalks (These will cling to any material similar to chicken wire)

Ampelopsis arborea
Anredera vesicaria
Bignonia capreolata
Boussingaultia baselloides
Cissus incisa
Clematis crispa
Clematis Drummondii
Clematis paniculata
Clematis Pitcheri
Clematis texensis
Parthenocissus heptaphylla
Smilax hispida
Vitis candicans

Twining (For training about wires and supports of various kinds and shapes)

Actinidia chinensis
Akebia quinata
Aristolochia durior
Ipomoea cairica
Lonicera japonica Halliana
Lonicera sempervirens
Phaseolus Caracalla
Polygonum Auberti
Pueraria Thunbergiana
Serjania brachycarpa
Wisteria floribunda
Wisteria sinensis

Used as ground covers

Ampelopsis arborea
Clematis Drummondii
Pueraria Thunbergiana
Serjania brachycarpa

Evergreen (E) and semi-evergreen (S) vines

Ampelopsis arborea (S)
Cissus incisa (S)
Clematis crispa (S)
Clematis Drummondii (S)
Clematis Pitcheri (S)
Clematis texensis (S)
Ficus pumila (E)
Hedera Helix (E)
Ipomoea cairica (E)
Lonicera japonica Halliana (E)
Lonicera sempervirens (E)
Operculina dissecta (S)
Phaseolus Caracalla (E)
Serjania brachycarpa (S)

Most ornamental

Bignonia capreolata—yellow red flowers
Bougainvillea sp.—magenta fruit bracts
Boussingaultia baselloides—fragrant white flowers
Campsis sp.—red flowers
Clematis sp.—flowers
Ficus pumila—fine foliage
Ipomoea cairica—pink flowers
Polygonum Auberti—white flowers
Wisteria sp.—white to purple flowers

Note: There are several vines ideally suited for growing on and along the Gulf Coast beaches. They would include:

Brunnichia cirrhosa (native of Gulf Coast)
Cardiospermum sp.
Cocculus carolinus (native of Texas)
Ipomoea Pes-capre (native of Gulf Coast)
Tetrastigma Harmandii

It is also of interest to note that *Ampelopsis arborea* will cover more square feet in less time than any other vine in most parts of Texas.

EXTREME SOUTHERN TEXAS AND SOUTHERN FLORIDA (SUBTROPICAL AREAS - EXCLUSIVE OF THE SOUTHERN END OF FLORIDA)

(Area 10)

Clinging to stone or wood by rootlets

Campsis grandiflora
Campsis radicans
Ficus pumila
Operculina dissecta
Parthenocissus quinquefolia

Climbing by tendrils or twisted leaf stalks (These will cling to any material similar to chicken wire)

Ampelopsis arborea
Anredera vesicaria
Antigonon leptopus
Boussingaultia baselloides
Cissus incisa
Clematis crispa
Clematis Drummondii
Clematis paniculata
Clematis Pitcheri
Clematis texensis
Cobaea scandens
Doxantha Unguis-cati
Parthenocissus heptaphylla
Passiflora sp.
Pyrostegia ignea
Tetrastigma Harmandii
Vitis candicans

Twining (For twining about wires and supports of various kinds and shapes)

Bougainvillea glabra
Bougainvillea spectabilis
Cryptostegia grandiflora
Cryptostegia madagascariensis
Ipomoea cairica
Lonicera sempervirens
Muehlenbeckia complexa
Phaseolus Caracalla
Polygonum Auberti
Pueraria Thunbergiana
Serjania brachycarpa
Thunbergia alata
Wisteria japonica

Used as ground covers

Ampelopsis arborea
Clematis Drummondii
Muehlenbeckia complexa
Pueraria Thunbergiana
Serjania brachycarpa
Thunbergia alata

Evergreen (E) or Semi-evergreen (S)

Ampelopsis arborea (S)
Antigonon leptopus (E)
Cissus incisa (S)
Clematis crispa (E)
Clematis Drummondii (E)
Clematis paniculata (E)
Clematis Pitcheri (E)
Clematis texensis (E)
Cobaea scandens (E)
Cryptostegia grandiflora (E)
Cryptostegia madagascariensis (E)
Doxantha Unguis-cati (E)
Ficus pumila (E)
Ipomoea cairica (E)
Lonicera sempervirens (E)
Muehlenbeckia complexa (E)
Operculina dissecta (E)
Passiflora sp. (E)
Phaseolus Caracalla (E)
Pyrostegia ignea (E)
Serjania brachycarpa (S)
Thunbergia alata (E)
Wisteria japonica (E)

Most ornamental

Antigonon leptopus—pink flowers
Bougainvillea sp.—magenta fruit bracts

Boussingaultia baselloides—fragrant white flowers
Campsis sp.—red flowers
Clematis sp.—flowers
Cryptostegia sp.—flowers
Ipomoea cairica—pink flowers
Passiflora sp.—showy flowers
Polygonum Auberti—white flowers
Pyrostegia ignea—orange flowers
Wisteria japonica—white flowers

EXTREME SOUTHERN PART OF FLORIDA

(From Stuart south around the coast to Ft. Myers)

(Area 11)

Clinging to stone or wood by rootlets

Ficus pumila
Monstera deliciosa
Philodendron sp.
Scindapsus aureus
Syngonium sp.

Climbing by tendrils or twisted leaf stalks (These will cling to any material similar to chicken wire)

Antigonon leptopus
Antigonon macrocarpum
Arrabidaea magnifica
Clematis paniculata
Clytostoma callistegioides
Cydista aequinoctialis
Doxantha Unguis-cati
Passiflora coerulea
Passiflora quadrangularis
Pithecoctenium echinatum
Porana paniculata
Pyrostegia ignea

Twining (For twining about wires and supports of various kinds and shapes)

Allamanda cathartica Hendersonii
Allamanda cathartica Williamsii
Allamanda violacea
Argyreia nervosa
Aristolochia brasiliensis
Aristolochia grandiflora Sturtevantii
Bougainvillea glabra
Bougainvillea glabra Sanderiana
Bougainvillea spectabilis (and vars.)
Clerodendron Thompsonae
Cryptostegia grandiflora
Cryptostegia madagascariensis
Ipomoea Horsfalliae Briggsii
Jacquemontia pentantha
Pereskia aculeata
Petrea volubilis
Podranea Ricasoliana
Quisqualis indica
Stephanotis floribunda
Thunbergia alata
Thunbergia grandiflora
Trachelospermum jasminoides

Evergreen

Antigonon sp.
Clematis paniculata
Clerodendron Thompsonae
Clytostoma callistegioides
Cryptostegia grandiflora
Cryptostegia madagascariensis
Cydista aequinoctialis
Doxantha Unguis-cati
Ficus pumila
Monstera deliciosa
Passiflora coerulea
Passiflora quadrangularis
Pereskia aculeata
Petrea volubilis
Pithecoctenium echinatum
Pyrostegia ignea
Stephanotis floribunda
Thunbergia alata
Thunbergia grandiflora
Trachelospermum jasminoides

Most ornamental

Allamanda sp.—large, conspicuous yellow to rose-colored flowers

Bougainvillea sp.—brilliantly colored flowers, many vars. : vigorous habit

Cydista aequinoctialis—showy white or purplish flowers

Ipomoea sp.—large flowers

Petraea volubilis—violet colored flowers in early spring

Podranea Ricasoliana—panicles of pale pink to red flowers

Porana paniculata—pure white flowers in early fall

Quisqualis indica—white to red, fragrant flowers

Thunbergia grandiflora—large blue or white flowers

ANNUAL VINES

No attempt has been made to list all the annual vines, of which there are many good types for each area. A few suggestions, but by no means an exhaustive selection, would be:—

	Common Name	Area for which recommended
Calonyction aculeatum	Large Moon Flower	8,9,10
Cardiospermum sp.	Baloon Vines	Gulf Coast
Cobaea scandens	Cup and Saucer Vine	6
Convolvulus sp.	Bindweed	2,5,7
Cucumis sp.	Melons	1,2,3,5,6,7,8,9,10
Cucurbita sp.	Gourds	1,2,3,5,6,7,8,9,10
Dioscorea bulbifera	Air Potato Vine	9,10
Echinocystis lobata	Wild Cucumber	Gulf Coast
Echinocystis oregana	Oregon Man-root	5
Humulus sp.	Hop	1,2,5,6,7
Ipomoea sp.	Morning Glories	1,2,3,5,6,7
Lagenaria sp.	Gourds	1,2,3,5,6,7,8,9,10
Lathyrus sp.	Peas	5,6
Passiflora sp.	Passion Flowers	6,9,10
Phaseolus sp.	Beans	1,2,3,5,6,7,8,9,10
Quamoclit sp.	Star Glory Vines	7
Rhynchosia minima		Miles of Gulf Coast
Thunbergia sp.	Black Eyed Susan Vine	9
Tropaeolum sp.	Nasturtiums	5,6,7

	Areas for which recommended	Shoot Elongation During 1942	Open or Dense	How Climbing	Available	How propagated
Actinidia arguta Bower Actinidia	1,5	15-20′	D	Twining	most nurseries	seed and softwood cuttings
Actinidia chinensis Yangtao Actinidia	6,9	15-20′	D	Twining	a few western nurseries	softwood cuttings
Akebia quinata Fiveleaf Akebia	1,5,6,9	3-5′	D	Twining	most nurseries	seed, root cuttings and division
Allamanda cathartica Hendersonii Henderson Allamanda	11		D	Twining	southern Florida nurseries	cuttings, both old and new wood
Allamanda cathartica Williamsii Williams Allamanda	11		D	Twining	southern Florida nurseries	cuttings, both old and new wood
Allamanda violacea Purple Allamanda	11		O	Twining	southern Florida nurseries	cuttings, both old and new wood
Ampelopsis aconitifolia Monkshood Vine	1,2,5	12-15′	O	Tendrils	some nurseries	seed, hard and softwood cuttings
Ampelopsis arborea Pepper Vine	3,7,8,9,10		D	Tendrils	nurseries in Texas native in Texas	seed, cuttings
Ampelopsis brevipedunculata Maximowiczii Porcelain Ampelopsis	1,2,5	15-20′	O	Tendrils	a few nurseries	seed, hard and softwood cuttings
Anredera vesicaria Texas Madeira	9,10		O	Tendrils	native in Texas	seed
Antigonon leptopus Confederate Vine	10	25′	D	Tendrils	nurseries in Texas	seeds and cuttings
Antigonon macrocarpum	11		D	Tendrils	a few southern Florida nurseries	seeds and cuttings
Argyreia nervosa	11		D	Twining	a few southern Florida nurseries	seeds and cuttings
Aristolochia brasiliensis Brazil Dutchman's Pipe	11		D	Twining	a few southern Florida nurseries	cuttings, layers, seeds
Aristolochia durior Dutchman's Pipe	3,4,9	4-6′	D	Twining	most nurseries native Eastern U.S.	cuttings

Aristolochia grandiflora Sturtevantii Longtail Pelican, Dutchman's Pipe	11		D	Twining	a few southern Florida nurseries	cuttings, layers, seeds
Arrabidaea magnifica Funnelvine	11		D	Tendrils	a few southern Florida nurseries	seeds
Bignonia capreolata Cross Vine	5,6,7,9,10		D	Tendrils	most southern nurseries	cuttings, layering
Bougainvillea glabra Lesser Bougainvillea	7,10,11	4-8′	O	Twining	most southern nurseries	cuttings
Bougainvillea glabra Sanderiana Paper Flower	11		D	Twining	southern Florida nurseries	cuttings
Bougainvillea spectabilis Brazil Bougainvillea	7,10,11	6-9′	O	Twining	most southern nurseries	cuttings from half ripe wood
Boussingaultia baselloides Madeira Vine	7,8,9,10	4-6′	D	Tendrils	a few nurseries native of Texas	softwood cuttings
Campsis grandiflora Chinese Trumpet Vine	7,9,10		D	Rootlets	southern nurseries	seed, layering, cuttings
Campsis radicans Trumpet Vine	1,2,3, 8,9,10	11′	O	Rootlets	most nurseries native, southern U.S.	seed, layering
Celastrus orbiculata Oriental Bittersweet	1,2,3, 4,5,6	14′	D	Twining	most nurseries	seed, hard and soft-wood cuttings
Celastrus scandens American Bittersweet	1,2,3, 4,5,6	10′	D	Twining	most nurseries and native, eastern U.S.	seed, hard and soft-wood cuttings
Cissus capensis Evergreen Treebine	7	5-8′	O	Tendrils	southern California nurseries	cuttings
Cissus incisa Ivy Treebine	8,9,10		O	Tendrils	Texas nurseries native of Texas	seed
Cissus striata Grape Ivy	6	4-8′	D	Tendrils	a very few sub-tropical nurseries	cuttings
Clematis crispa Curly Clematis	8,9,10		D	Tendrils	nurseries	seed

	Areas for which recommended	Shoot Elongation During 1942	Open or Dense	How Climbing	Available	How propagated
Clematis Drummondii Old Man's Beard	8,9,10		D	Tendrils	native of Texas	seed
Clematis montana Anemone Clematis	5,6	6-10′	D	Tendrils	most nurseries	softwood cuttings
Clematis paniculata Sweet Autumn Clematis	1,2,3,4,5,6,9,10,11	15′	D	Tendrils	most nurseries	seed and softwood cuttings
Clematis Pitcheri Pitcher Clematis	8,9,10		D	Tendrils	most nurseries	seed and softwood cuttings
Clematis texensis Scarlet Clematis	8,9,10	6-10′	D	Tendrils	most nurseries	seed and softwood cuttings
Clematis virginiana Virgins-bower	1,2,3,4,5	20′	D	Tendrils	many nurseries and native of eastern U.S.	seed and softwood cuttings
Clematis Vitalba Travelers-joy	1,5,6	18-20′	D	Tendrils	a few nurseries	seed and softwood cuttings
Clematis Viticella Italian Clematis	1,5	18-20′	D	Tendrils	a few nurseries	seed and softwood cuttings
Clerodendron Thompsonae Bleeding Heart Glory Bower	11		D	Twining	southern Florida nurseries	cuttings of half-ripened wood; seed
Clytostoma callistegioides Painted Trumpet	11		D	Tendrils	southern Florida nurseries	cuttings
Cobaea scandens Cup and Saucer Vine	7,10	6-10′	D	Tendrils	most California and southern nurseries	seeds
Cryptostegia grandiflora Palay Rubbervine	10,11		D	Twining	Texas nurseries	cuttings
Cryptostegia madagascariensis Madagascar Rubbervine	10,11		D	Twining	Texas nurseries	cuttings
Cydista aequinoctialis Garlic Vine	11		D	Tendrils	a few southern Florida nurseries	cuttings
Distictis lactiflora Vanilla Distictis	7	25′	O	Tendrils	a very few southern California nurseries	seeds and cuttings

Dolichos lignosus Australian Pea	7	6-12′	D	Twining	most California nurseries	seed, softwood cuttings
Doxantha Unguis-cati Cat-claw Vine	7,10,11	20′	O to D	Tendrils	California and southern nurseries	seed
Ficus pumila Climbing Fig	7,8,9, 10,11	7′	D	Rootlets	California and southern nurseries	cuttings
Hedera Helix English Ivy	1,5,6,7,9	4-8′	D	Rootlets	most nurseries	cuttings
Ipomoea cairica Mexican Lavender Morning Glory	9,10		D	Twining	native of Texas	layering, seed
Ipomoea Horsfalliae Briggsii Magenta Horsfall Morning Glory	11		O	Twining	southern Florida nurseries	cuttings
Jacquemontia pentantha	11		O	Twining	southern Florida nurseries	cuttings
Lonicera etrusca superba Cream Honeysuckle	5,7		D	Twining	some Pacific Coast nurseries	cuttings
Lonicera japonica Halliana Hall's Honeysuckle	1,2,3,5 7,9	18-20′	D	Twining	all nurseries and in many places in U.S. escaped cultivation	hard and softwood cuttings
Lonicera sempervirens Trumpet Honeysuckle	1,2,3,4,5,6, 7,8,9,10	10-15′	D	Twining	native of eastern U.S., most nurseries	cuttings
Mandevilla suaveolens Chilean Jasmine	6	4-6′	D	Twining	most southern nurseries	softwood cuttings and seeds
Menispermum canadense Common Moonseed	1,2,5	6-10′	O	Twining	some nurseries, native of eastern U.S.	division, seed and root cuttings
Monstera deliciosa Ceriman	11		D	Rootlets	a few southern Florida nurseries	cuttings, seeds
Muehlenbeckia complexa Wire Vine	6,7,10	5-10′	D	Twining	most southern nurseries	softwood cuttings

	Areas for which recommended	Shoot Elongation During 1942	Open or Dense	How Climbing	Available	How propagated
Operculina dissecta Alamo Vine	8,9,10		D	Rootlets	native of Texas	seed
Pandorea pandorana Wonga Vine	7	15′	D	Tendrils	a few southern California nurseries	seed and cuttings
Parthenocissus heptaphylla Sevenleaf Creeper	8,9,10		O	Tendrils	nurseries native of southern U.S.	seed
Parthenocissus quinquefolia Virginia Creeper	1,2,3,4,5,6, 7,8,9,10	6-10′	O	Rootlets, Tendrils	most nurseries and native of eastern U.S.	seed, hard and soft-wood cuttings
Parthenocissus tricuspidata Boston Ivy	1,2,5,6, 7,9	6-10′	D	Rootlets	all nurseries	seed, hard and soft-wood cuttings
Passiflora sp. Passion Flower	7,10,11	6-15′	D	Tendrils	southern California nurseries	cuttings and seeds
Pereskia aculeata Barbados Gooseberry	11		O	Twining	southern Florida nurseries	cuttings
Petrea volubilis Queen's Wreath	11		D	Twining	southern Florida nurseries	cuttings, seed
Phaedranthus buccinatorius Bloodtrumpet Vine	6,7	5-12′	D	Tendrils Rootlets	most southern nurseries	softwood cuttings
Phaseolus Caracalla Snail Flower	9,10		D	Twining	southern nurseries	layering
Philodendron sp. Philodendron	11		D	Rootlets	a few southern Florida nurseries	division of stems
Pithecoctenium echinatum Mexican Monkeycomb	7,11		D	Tendrils	southern Florida and California nurseries	cuttings
Podranea Ricasoliana	11	15-20′	O	Twining	a few southern Florida nurseries	cuttings
Polygonum Auberti Chinese Fleece Vine	1,2,3,5, 6,8,9,10	10-15′	D	Twining	most nurseries	seed and cuttings
Porana paniculata Snow Creeper	11		O	Twining	southern Florida nurseries	seed

Pueraria Thunbergiana Kudzu Vine	1,3,5,6, 8,9,10	30-50	O	Twining	most nurseries	seed, hard and soft-wood cuttings
Pyrostegia ignea	7,10,11	20′	D	Tendrils	subtropical nurseries	cuttings
Quisqualis indica Rangoon Creeper	11		D	Twining	southern Florida nurseries	softwood cuttings
Scindapsus aureus Solomon Islands Ivy-Arum	11		D	Rootlets	southern Florida nurseries	division of stems
Senecio mikanioides Ivy Groundsel	7	5-8′	D	Twining	a few southern California nurseries	cuttings
Serjania brachycarpa	8,9,10		O to D	Twining	native of Texas	seed
Smilax hispida Bristly Greenbrier	1,2,3,4, 5,9	15-20′	O	Tendrils	some nurseries and native of eastern U.S.	root cuttings and division
Solanum jasminoides Jasmine Nightshade	7	15′	D	Twining	most California nurseries	seeds, cuttings of half ripe wood
Stephanotis floribunda Madagascar Jasmine	11		D	Twining	southern Florida nurseries	cuttings of half ripened wood
Syngonium sp.	11		D	Rootlets	a few southern Florida nurseries	cuttings
Tetrastigma Harmandii Ayo	10		D	Tendrils	a few southern nurseries	seed
Thunbergia alata Black Eyed Susan Vine	8,10,11		D to O	Twining	southern nurseries	seed
Thunbergia grandiflora Bengal Clock Vine	11		D	Twining	southern Florida nurseries	cuttings, layers, seed
Trachelospermum jasminoides Chinese Star Jasmine	11		D	Twining	southern Florida nurseries	cuttings of half ripened wood
Vitis aestivalis Summer Grape	1,2,3,5	30′	O	Tendrils	native of eastern U.S. (N.Y. to Fla., Mo., Miss.)	hardwood cuttings
Vitis amurensis Amur Grape	3,4		D	Tendrils	a few mid-western nurseries	hardwood cuttings

	Areas for which recommended	Shoot Elongation During 1942	Open or Dense	How Climbing	Available	How propagated
Vitis argentifolia Blueleaf Grape	1,3,5	30′	O	Tendrils	native of eastern U.S. (N.E. to Ill. N.C. and Tenn.)	hardwood cuttings
Vitis californica California Grape	7	30′	D	Tendrils	native of California	cuttings and layering
Vitis candicans Mustang Grape	8,9,10	30′	D	Tendrils	southern nurseries	seed
Vitis Coignetiae Glory Vine	1,2,3,5	40′	D	Tendrils	some nurseries	hardwood cuttings
Vitis Girdiana Valley Grape	7	25′	O	Tendrils	southern nurseries	cuttings and layering
Vitis Labrusca Fox Grape	1,2,3,4,5	20′	D	Tendrils	most nurseries	cuttings and layering
Vitis vulpina Frost Grape	1,2,3,4	25′	D	Tendrils	most nurseries	cuttings and layering
Wisteria floribunda Japanese Wisteria	1,2,3, 5,7,9	5-7′	O	Twining	some nurseries	seed
Wisteria japonica Evergreen Wisteria	10		D	Twining	a few southern nurseries	seed
Wisteria sinensis Chinese Wisteria	1,2,3,5,9	5-7′	O	Twining	all nurseries	seed

Note: The majority of these vines will grow 20 ft. or more ultimately. The actual elongation of some, especially those growing in the Arnold Arboretum, was measured for one year's growth only, and noted in the second column. The total elongation at maturity varies greatly with climate, moisture and soil. For instance, *Celastrus scandens* in California may grow 100 ft. long in several years' time, whereas on poor soil in New England it may only grow 25 ft. Also, if grown on the ground, it will not grow to the extent it will if growing upward around a support.

DONALD WYMAN

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EXPEDITIONS TO THE ALASKA MILITARY HIGHWAY 1943-1944

THE Alaska Highway, for many years an apparently unattainable dream of American travellers and vacationists, has suddenly, under the necessity of war, become an actuality. It is not yet open to the general public, but presumably it will become so after the war. Public interest in the building of the road, and pride in its accomplishment are taking form in hopeful plans—millions of them—for automobile trips to northern British Columbia, Yukon or Alaska. Perhaps few people have realized, however, that the road opens to naturalists some of the most inaccessible areas of northwestern America—vast stretches of wilderness situated between the Mackenzie and Yukon River basins, and in southwestern Yukon and adjacent Alaska. The opening has taken place rapidly, rather than by slow stages, so that nearly all of the new highway is through a relatively unmodified and unspoiled wilderness. Before the building of the road the only inhabitants were a few scattered Indians, and an occasional trapper or trader. Only a few hardy prospectors and geological surveyors, and still fewer students of plants and animals, had made hurried and expensive trips into the more remote districts. The solutions for a whole series of problems having to do with the systematic relationship and geographic distribution of the fauna and flora, the structure and development of biotic communities, and the migrations of plants and animals, including prehistoric man, have awaited an examination of these regions.

In addition to the more purely scientific attractions of the highway, it presents also some unique opportunities in applied biology. One of the greatest problems in modern studies of land utilization and the reasonable conservation of our natural biological resources is the difficulty of estimating long-term natural potentialities in the land. One of the best clues to a solution of this problem, and very often the only one, is in the kind and distribution of native vegetation and animal life under the conditions that obtained before the coming of white men. Those who have tried to gather such information for regions that have long been

under settlement are keenly aware of the unsatisfactory nature of the scattered material that has to be sifted laboriously out of early records. Most such records were made by persons whose knowledge of natural history was extremely sketchy, and who could not dream of modern ideas and methods. The new road therefore offers an extraordinary opportunity to describe a vast new region in terms that should be of use in setting up a rational program of biological exploitation.

The Arnold Arboretum, in collaboration with certain other institutions, sponsored two expeditions to the Alaska Highway in the summer seasons of 1943 and 1944. In 1943 approximately the southern two-thirds of the road were covered, between Dawson Creek, B.C., and Whitehorse, Yukon, while the journey of 1944 extended the survey from Whitehorse to the Alaska terminus at Fairbanks. The field party of 1943 included, in addition to the writer, Dr. Charles S. Denny, who was then at Wesleyan University in Connecticut, but who is now with the U.S. Geological Survey at Washington, Dr. Donovan S. Correll, then of the Botanical Museum at Harvard, Mrs. Lucy G. Raup, and Karl and David Raup. Dr. Correll collected mosses and served as assistant in handling the vascular plants, while Mrs. Raup collected the lichens. Dr. Denny is a geologist whose primary purpose was a survey of the glacial features of the region. In 1944 Mrs. Raup continued the lichen collections and served as general assistant in all of the botanical work, as did also the two boys, Karl and David. Dr. Denny's geological investigations were ably carried forward by Mr. John H. H. Sticht of the Department of Geology and Geography at Harvard. A highly interesting and diverting phase was added to the work during the second season by Mr. Frederick Johnson, an archaeologist and anthropologist of the Robert S. Peabody Foundation for American Archaeology at Andover, Massachusetts. Dr. Stuart K. Harris of Boston University served as cook to the expedition of 1944. At the same time he collected birds and small mammals and occasionally assisted with the plant collecting.

The two trips were financed by generous grants from several sources. In addition to the Arboretum's contributions, the botanical work was supported by grants from the Milton Fund at Harvard, the American Philosophical Society, the American Academy of Arts and Sciences, the National Academy of Science, and the Society of the Sigma Xi. In both seasons the geological work was supported financially by the Geological Society of America, and the expenses of Mr. Johnson's archaeological studies were paid for by the Peabody Foundation. Invaluable assistance was given by the Department of Mines and Resources in Canada, principally through the loan of field equipment.

Even with adequate financial assistance, the expeditions would not have been possible at all had it not been for the all-important transportation facilities that were supplied by the Northwest Service Command of the United States Army. Arrangements for this were made through the Joint Economic Committees of Canada and the United States, an organization that was formed in June, 1941, in part for the purpose of gathering and correlating information on the natural

resources of western Canada and Alaska. In fact our two expeditions were originally suggested by representatives of the Joint Economic Committee, and were carried out under the combined auspices of the Committees and the Arnold Arboretum. The Army command supplied the field parties with all necessary transportation on the highway, and made it possible to purchase subsistence supplies from the Army depots. It would be difficult to express too great an appreciation of the efficiency and good will with which the officers and men of the Army carried out their part in the program.

With the exception of the means of transport the parties were quite independent so far as living facilities were concerned. There are no regular stopping places for unattached civilians along the road, so that a complete set of camping gear had to be carried. Only on rare occasions was it possible to find bunk space in barracks or in abandoned construction camps. During the period of active construction excellent meals could be had at the civilian labor camps, but later this became nearly impossible.

The Alaska Highway can be reached from the outside world by four routes. The easiest is by way of Edmonton, Alberta. From here there is both a railway and an automobile road to Dawson Creek, B.C., which is the southern terminus of the highway. A second route is by way of Skagway, Alaska, which is reached by boat from Seattle, Vancouver, or Prince Rupert. A narrow-guage railway, the "White Pass and Yukon," leads from Skagway to Whitehorse and so to the highway which passes westward through the latter place. The third route is by boat to Anchorage, Alaska, and thence by the Alaska Railway to Fairbanks. The fourth is by boat to Valdez and then by the Richardson Highway to Big Delta, a place on the new highway about 100 miles east of Fairbanks. There is now an alternative to this last route, by a new road leading from Gulkana to Slana and finally to Tok, which is on the main highway in the upper Tanana Valley.

In 1943 our party left Dawson Creek on June 8th and made its first base camp at the Beatton River, about 150 miles north of Dawson Creek. There it remained until July 4th. The Beatton River crossing is in the outer foothills of the Rockies, at an altitude of about 3200 feet. Many shrubs and trees were just breaking their winter buds there in the second week of June, and frosts were not uncommon at night. The next base camp was at Summit Pass, where the highway runs westward through the front range of the Rocky Mountains. The altitude in the pass is about 4200 feet above sea-level, and within about 300 feet of the mountain timberline. The situation proved exceedingly favorable for alpine collecting, and we stayed there from the 7th to the 28th of July.

The next camp, from July 30th to August 7th was at Watson Lake, in the plain of the upper Liard valley. A few collections were made enroute there from Summit Pass, notably at a hot spring near the lower crossing of the Liard River. Whitehorse was reached on August 9th, but the party stayed there only long enough to replenish supplies, and left on the afternoon of the 10th for the return

trip. The last camp of the season at which large collections were made was at a point between Little Atlin and Teslin Lakes, where the road passes between two precipitous mountains. By August 21st, when the expedition left this place, the season was well advanced, with hard frosts occurring frequently. The time between August 21st and Sept. 5th was given to a rather leisurely trip back to Dawson Creek, with frequent stops for pictures, notes, and miscellaneous collections.

The 1944 expedition left Boston on May 31st and went directly to Whitehorse by way of Vancouver and Skagway. After transportation and supplies had been arranged for at Whitehorse, the first base camp of the season was made at Pine Creek, about 100 miles to the west. This is in the valley of the Alsek River, close up to the northern base of the Coast Range. About 2½ weeks were spent here, from June 14th to 30th, and then a new camp was set up near the eastern end of Kluane Lake. Kluane Lake proved to be quite rich in archaeological and geological as well as botanical interest, and was used as a center of operations until July 26th. From there we drove directly to Fairbanks, where we remained from July 28th to August 1st. A base camp was then established in the Tanana Valley about 180 miles east of Fairbanks, and collections were made from neighboring valleys, hills, and mountains. August 16th and 17th were spent travelling again, this time back to Burwash Landing which is near the western end of Kluane Lake. About a week was devoted here to the last serious collecting of the season. Frosts had already come, and most plants had matured and lost their seed. Three days were used for a fine trip by boat to the north shore of the lake and to the head of a long northern arm that reaches some 20 miles back into the mountains.

Two or three days were devoted to fall collecting and a search for Indian artifacts at Pine Creek, the scene of the first camp of the season. On returning to Whitehorse, we did not retrace our route back to the United States by way of Skagway and the coast, but continued on down the highway to Dawson Creek. This was a leisurely trip similar to that of the fall of 1943, with frequent though brief stops along the way. The weather was fine, and the frosts had brought out the autumn color in all its glory. Days or parts of days were spent at Teslin Lake, Watson Lake, Muncho Lake, and Summit Pass. A camp of several days was made at the Buckinghorse River, and, finally, three days at Dawson Creek saw the party packed and ready for home.

The road itself is remarkably good. It is of ample width and well-graded, with a gravel surface. The original track had some bad hills and turns, but with local straightening and rerouting most of these have been eliminated. The distance from Dawson Creek to Fairbanks is about 1600 miles.

In terms of landscape the region of the highway can be divided roughly into eight districts. At the southern end it begins in the agricultural country of the upper Peace River, where broad expanses of gently rolling arable land, at an al-

PLATE VI. Rocky Mountains in Summit Pass. View southwest among glacial moraines, to valley of Macdonald Creek. White spruce and lodgepole pine in foreground (Photo. D. S. Correll, courtesy of the *Geographical Review*).

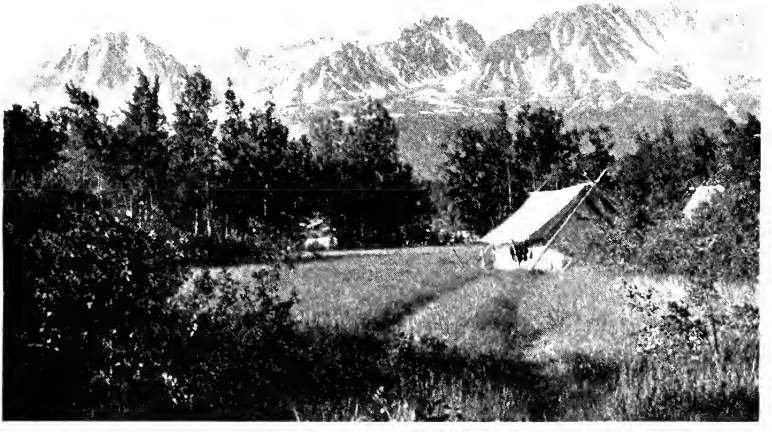

PLATE VII. Natural prairie in valley of Pine Creek, about 100 miles west of Whitehorse. View southward across the Alsek valley to the Dezadeash Mountains.

titude of about 2000 feet, are separated by remnants of ancient plateaus that rise a thousand feet or so higher. Northward from Ft. St. John the road soon leaves this country and rises to the higher plateaus and outer foothills of the Rockies. It remains at elevations ranging from 3000 to 4000 feet for about a hundred miles, then descends gradually to the Muskwa River at Nelson. There are some fine views westward in this area, for the road follows in many places the western rim of a high escarpment from which one looks across a broad valley to the high peaks of the mountains.

Summit Pass is about 100 miles west of Nelson. It is reached by way of the north fork of the Tetsa River which rises in the Pass. Scenically this is one of the more striking areas along the highway. Towering limestone mountains whose summits reach to about 7000 feet above sea level stand on either side, with still higher peaks a short distance back. Two small lakes in the pass add greatly to its charm. The Tetsa valley and the pass mark the beginning of the third topographic district. It is ruggedly mountainous and extends northwestward about 120 miles to the lower crossing of the Liard River. The scenery is beautiful throughout most of this stretch, particularly in the Toad and Trout River valleys. Muncho Lake, at the head of the Trout River, is especially attractive.

The fourth district is the broad upper basin of the Liard River, traversed by the road from the lower crossing which is near the mouth of the Trout to beyond Watson Lake and the upper crossing. The surface of the Liard Plain is for the most part gently rolling, with the mountains visible from the road only in the distance or not visible at all. It is continuously forested, and after the breath-taking scenery of the Rockies is apt to be monotonous to the traveller. Watson Lake, however, is a delightful place in spite of the low relief of the surrounding country. Other points of interest are the hot spring near the lower crossing, and Lower Post, an old trading establishment along the Liard near the mouth of the Dease River.

After leaving the Liard plain the road winds westward up the valley of the Rancheria River to the continental divide in the Stikene Mountains. These mountains are not so rugged as the Rockies, and differ markedly in form because they are of igneous rocks. The divide itself is not a spectacular pass, but rather a broad upland marked by muskegs, lakes, and rather low mountain summits. The road descends the western slopes by way of the Swift River valley.

The sixth topographic district is the great lake country of the upper Yukon basin. Teslin Lake is the first large body of water met with as one goes from east to west. This is a narrow lake some 90 miles long, surrounded by low mountains in the northern part. The highway follows its northeastern shore for about 40 miles, then turns westward across the Teslin River. From here on there is a succession of lakes – Squanga, Little Atlin, Marsh—to within a few miles of Whitehorse. Whitehorse is on the Lewes River, at the head of navigation on the Yukon system. West of this place the route leads across a plateau country to the Alsek

River valley. Beginning about 50 miles west of the town, semi-open prairie country appears, with lofty snow-covered peaks in the background. The only large body of water encountered beyond Whitehorse is Kluane Lake, situated in the mountains about 50 miles beyond the Alsek. The whole region of the Dezadeash valley and Kluane Lake is perhaps the most charming section traversed by the entire highway. It has greater variety in color, form, and vegetation than any other district. The prairies and alpine meadows are veritable gardens, set in the most picturesque mountain landscape imaginable.

Beyond Kluane Lake the road crosses a series of large streams that issue from the high ranges to the south and finally find their way into the Yukon. These are the Duke, Donjek and White Rivers, all with deep valleys and broad gravel beds. West of the White the route leads through a wide region of lakes and muskegs to the Alaska border and the upper Tanana valley. Scenically this section is rather uninspiring, but it has great topographic significance because in it the transition is made from a glaciated to an unglaciated region. The surface becomes more subdued in relief, and the hills have long rounded slopes with V-shaped valleys between them. The upland valleys are broad, with gentle, even slopes to the lakes or streams that occupy them. The whole surface is a "mature" one, developed by a long period of erosion and solifluction (movement of soils under the influence of frost) without the effects of glacial scouring or deposit.

The last notable topographic division is the Tanana valley itself, which the road follows all the way to Fairbanks. It is a broad valley, bounded on the north by the unglaciated Yukon Plateau, and on the south by the mountains of the Nutzotin and Alaska Ranges. These mountains, with one exception, appear only in the distance on the southern horizon. The exception is between Tok and the Robertson River, where the route leads up to the base of the slopes. Southern tributaries to the Tanana, rising in the mountains, carry enormous quantities of gravel which they have deposited in huge fans in the main valley, pushing the river over to the north side. The highway, on the south side, traverses one after another of these great fans, whose even surfaces and ample road materials have made possible long straight stretches, often 20 miles or more in length.

The scientific results of the two expeditions are somewhat varied, but their general significance is greatly enlarged, we believe, from having been gathered in an active field collaboration among botanists, glacial geologists, and an anthropologist. The first of the basic objectives was a description of the natural flora and its distribution along the highway. To this end some 4100 field numbers of plants were collected, involving approximately 25,000 specimens. Accompanying descriptive matter includes an account of forest types seen along the road, most of it in mile-by-mile notes. This is correlated with similar records of the principal soil types and topographic features. More detailed studies of local distribution and soils were made in the neighborhood of base camps, with special reference to the influence of soil frost upon the development of topography and vegetation.

Particular attention was given to the interpretation of aerial photographs in those parts of the area for which they were available. The geologists set out to describe the glacial phenomena of the country along the highway, with a view to fitting them into the general pattern of Pleistocene and post-Pleistocene events, or to setting up a new pattern if this should prove necessary in the light of new material. Topographic phenomena related to soil frost were given special attention, for they loom large in this subarctic wilderness. The anthropologist found his primary interest in a search for evidence of prehistoric man — this to be related on one hand to the early history of man in America, and on the other to the present distribution and living habits of the Indian tribes of the region.

An integral part of all these scientific aims and results was a search for ways in which the vast wilderness opened by the highway can be put to use by modern Americans. Even if the road is no more than barely maintained to service the great modern airports that have been established along it, a great many people will have to live either in camps by the road or at the airports themselves. What portion of their necessary food, shelter and materials of abode can these people find in the country? And are there any native resources that can be exported profitably? In addition to beginning a general biological description, our two expeditions have looked for evidence of agricultural potentialities, and have attempted to evaluate forest resources. Notes on the latter take the form not only of descriptions of existing timber, but also of attempts to unravel the history of the present stands and to predict the course of future development. In these practical aspects, the work of our expeditions supplements that carried on at the same time by the Geological Survey of Canada in the field of mineral resources, and by the Canadian Department of Agriculture in its survey of soils. Not since the early days of pioneering and railroad building in the West has so huge a territory been made available for exploitation in so short a time. The primary ideas on what could be done in the way of biological exploitation rested then, and must rest now, on a clear understanding of the natural biological resources of the country.

Hugh M. Raup

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Illustrations are in **bold face** type

These bulletins will be discontinued until Spring of next year. Subscription renewals for 1945 are now due, price $1.00 per year. Checks should be made payable to Harvard University, Arnold Arboretum, Jamaica Plain 30, Mass.