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HOW TO ESTABLISH AN ARBORETUM OR BOTANICAL GARDEN

NUMEROUS requests are received from time to time by the principal arbore-
tums and botanical gardens of the country for information concerning how
to start an arboretum. Such inquiries clearly indicate that the arboretum idea is
definitely being considered in widely separated parts of the country.

Professor Charles Sprague Sargent, first director of the Arnold Arboretum, long
ago realized the need for arboreta or maintained plant collections strategically
located in the various climatic zones of North America. Many new arboreta
were established during his lifetime. Such institutions are not competitive but
cooperative, and today there is a great need for more of them.

Botanical gardens on the other hand, are much older in this country and abroad.
It is obvious that there is an ever growing desire on the part of the public to have
named collections of plants, both native and exotic, for observation as well as for
study and enjoyment in places where they can best be seen and appreciated.

An arboretum should be carefully planned, well financed, and competently
administered. This article is devoted to some of the ways and means of establish-
ing and maintaining a satisfactory arboretum or botanical garden, many of the
suggestions here offered resulting from observing the successful development of
various institutions in widely separated parts of the country.

Definition:—An arboretum or botanical garden, as considered in the following
discussion, is an ample area set aside for the growing and effective display of all
the different kinds of worthy ornamental trees, shrubs, vines and other plants
which can be grown in a given area, their maintenance, proper labeling, and
study. It does not necessarily have to include all the plants that can be grown
in a region, nor does it necessarily have to include formal beds or borders of
annuals and perennials.

An arboretum differs from a botanical garden in that the emphasis is placed on

the growing of woody plants in the arboretum, whereas in the botanical garden emphasis is not placed on the growing of any particular kind of plant, but all types are grown. Large rock gardens and expensively operated rose gardens are frequently found in an arboretum or botanical garden but these are not essential parts of either.

Both differ from a park in that in the former a serious effort has been made to plant an extensive collection of many kinds of labeled plants not only for the purpose of display but also for critical examination and scientific study. Many parks are planted without the labeling of any plants and with the use of only a small number of locally available plant species. Some parks, it is true, contain a certain number of labeled plants, as for example, the Boston Public Garden; Roger Williams Park in Providence, Rhode Island; Fairmont Park in Philadelphia; and others throughout the country, but no consistent effort is made in most of them to label and keep labeled all the different kinds of plants grown. Both a park and an arboretum or botanical garden can be used for recreational purposes; but the arboretum or botanical garden go beyond the park in that they become highly educational to many of their visitors, demonstrating by means of labeled specimens what good species are available for planting in a given area or can be grown indoors.

The purpose of any arboretum, be it large or small, is to grow (and to keep labeled) the best of the ornamental woody plants which will thrive in a given locality. Many other objectives may be considered, such as the actual introduction of new plants into cultivation, actual exploration of remote regions, the growing of all types of woody plants hardy in the area, scientific investigations of various kinds including plant breeding and hybridization, the maintenance of a large herbarium and library, and laboratories of various types—these may be legitimate functions of an arboretum, depending on the funds available, and the qualifications of the members of its staff.

Botanical gardens may have even wider functions for their aims are wider, including as they do representatives of the whole plant kingdom from the tropics to the Arctic, grown outside or under glass. However, small communities should not be deterred by these weighty and often expensive objectives for they may be omitted altogether where funds for the maintenance of such gardens are unavailable. If an arboretum effectively demonstrates "the best" of the woody plants hardy in its area, this alone will make it a most valuable asset in the community it serves. The botanical garden need not cover a large area. It can be effective on a few acres with a few display greenhouses and display a representative collection of plants from all over the world.

Charles Sprague Sargent used to say that in order to start an arboretum it was necessary to have a thousand acres of land with at least a million dollars endowment: yet he started an arboretum with only 125 acres of land and \$100,000 endowment, and in the early years of the Arnold Arboretum he had only one

third of the income of that modest endowment for annual expenditure. There is still the need for large arboretums placed in different regions representing different climatic conditions where all the woody plants hardy in an area may be grown and which are well endowed for scientific investigations. This is undoubtedly what Professor Sargent had in mind, for the Arnold Arboretum was, and is, that kind of an institution. But times are changing. With the extensive garden club movement and increased tendency away from urban dwelling, more and more people are becoming interested in the growing of plants.

A new conception of an arboretum is coming into being. This is very well expressed in the plantings of the Arthur Hoyt Scott Horticultural Foundation at Swarthmore College, Swarthmore, Pennsylvania. It is adaptable to communities smaller than Boston, Philadelphia, Chicago, New York, St. Louis or Seattle. It is feasible where funds are lacking to finance expensive scientific investigations, but where there is a definite need to grow and demonstrate to the public "the best" plants hardy in a particular area. It is readily seen that this idea is a flexible one for the actual size of the arboretum or botanical garden may vary considerably. The idea is based on the theory that the same old varieties of plants may be superseded by new and better varieties. There are new varieties of cars, of refrigerating devices, of clothes and women's hats, and there are new varieties of plants as well. In the display gardens the "old" varieties are grown side by side with the "new," both often being available to the plant-buying public. But with the best varieties only being displayed, interest and variety in private and municipal planting will be greatly stimulated. With this conception in mind, the committee responsible for planning an arboretum or botanical garden should be so constituted as to give the best advice possible for its usefulness and adaptation to the community.

Functions of an Arboretum or Botanical Garden:—The purposes of establishing a display garden should be carefully considered before the plan is publicly broached. Some of the more important functions of such a garden might be :

- 1) To grow only a few of "the best" plants hardy in the area in order that home owners may become acquainted with their names, their ornamental characteristics and the proper methods of culture.
- 2) To show a complete selection of all that is considered the best from an ornamental standpoint among the woody plants (if an arboretum, or among the perennials, annuals, bulbs as well, if a botanical garden) that it is possible to be grown in the area.
- 3) To serve as a means of introducing new plants into the area, regardless of the source from which they may come.
- 4) To disseminate knowledge of plants to the public. This would include in-

clude information on culture, pruning, fertilizing and possibly a continual study under local conditions of just what varieties are "the best" including cooperation with schools, garden clubs and other organizations.

- 5) To test the hardiness of untried varieties.
- 6) To provide a laboratory for students of botany, horticulture and nature study.
- 7) To increase the productivity, economic importance and beauty of an area, by intelligent and interesting planting, and by introducing plants not grown there before.
- 8) To provide recreational stimulus to the public by means of walks, drives and beautiful displays, flower shows, etc., and to stimulate the pleasure of learning to know new plants which might be adapted to planting on private property.

Each of these functions should be studied individually with view to the best interests of the community. One of the first decisions to be made is whether the present park system satisfies the needs and desires of the people or whether its scope should be enlarged. Would the people be interested in a garden of woody plants only, or should an expensive display greenhouse for showing material in the winter be included? It is important to consider that an arboretum will always be less expensive to operate even if it includes a large variety of woody plants. On the other hand there are some communities where plant displays in large conservatories fill a real need in the winter. If this is the local situation and funds are available, the construction of display greenhouses filled with exotics must be considered.

If the community is small, the effective functions of the display garden will be largely display. If the community is large and funds are available, the functions may also include scientific investigations, especially if there is an institution of higher learning with which the arboretum may be connected. How far this may be extended will depend upon the community, its nearness to other large institutions, the availability of funds, and on leaders in the municipality.

Methods of Establishing an Arboretum or Botanical Garden:—The first arboretums and botanical gardens started as *private gardens* when individuals became interested in assembling collections of plants. John Bartram has the credit of establishing the first large collection of trees and shrubs in this country when he established his garden in 1728 at Kingsessing on the banks of the Schuylkill River near Philadelphia. Since that time, many private collections have been established at one time or another but many of them have passed out of existence after the death of the original owners. Today there are a few private arboretums worthy of the name. Among them would be the one started by Mr. H. H. Hunnewell in Wellesley, Massachusetts, in 1852, and devoted mainly to conifer-

fers; and that of Mr. Stanley Rowe of Cincinnati, Ohio, which now contains 3000 different kinds of woody plants.

A *local community* can have an arboretum as a result of cooperative effort by various local organizations. The Berkshire Garden Center at Stockbridge, Massachusetts, is just such an example. Funds are raised by local committees of enthusiasts to produce and maintain the type of arboretum wanted by a majority of the community—in this case showing some of the better ornamental plants that can be used in planting home grounds in the area.

The *government operated arboretum* is exemplified by the Dominion Arboretum adjacent to the Experimental Farm in Ottawa, Canada. This is 73 years old and contains about 3300 species and varieties of woody plants. It is owned and operated by the Canadian government. Our own National Arboretum at Washington, D.C. has been developed by government funds. Even national government budgets are frequently the playthings of legislators, and the future of an arboretum under government jurisdiction, though safer than a private arboretum, may still suffer much from a fluctuating annual budget.

An arboretum is sometimes part of the *park department* of the city. Such is the case with Highland Park and Durand-Eastman Park in Rochester, New York. The 484 acres constituting Durand-Eastman Park were originally a gift to the city, made by Dr. Henry S. Durand and George Eastman, but maintenance operations are carried out exclusively by the city Park Department, support being from city taxes. The advantages are obvious, for the park personnel is usually well equipped to maintain a collection of trees and shrubs. However, disadvantages are often evident. In many a park department the annual budget is subject to devious manipulations by politicians who may have no interest in park plantings and in all too many cities in this country the park department budget is the first to suffer reductions when city expenditures are cut.

The best method of establishing an arboretum or botanical garden is to provide a properly safeguarded *restricted endowment*, the income from which may be used only for specified purposes. The endowment should be sufficiently large to provide a reasonably ample annual income, for only in this way can permanence be assured. It will be necessary for the Planning Committee to estimate the annual expenses in advance. Many arboretums today are being operated wholly or in part by income from endowments. The endowment is not sufficient in some instances to cover all expenses and additional funds are necessary from the tax budget or from private sources in order to make it possible to attain the ends desired. When the income from an endowment must be augmented by annual popular subscriptions or by annual grants from the city park department, many difficulties arise. This is, in general, a most unsatisfactory way of operating an arboretum, for projects started one year when funds may be ample may have to be curtailed or even discontinued in another year. Success is most assured when an ample endowment is possible.

Usually a board of directors is formed to oversee the administration of funds in privately endowed institutions. Such is the case with the Morton Arboretum at Lisle, near Chicago, and with Longwood Gardens at Kennett Square, Pa. Frequently it has been found advisable to associate the arboretum (with its endowment) with an institution of higher learning. Such is the case with the Arnold Arboretum (Harvard University), Arthur Hoyt Scott Foundation (Swarthmore College), Morris Arboretum (University of Pennsylvania), each one of which has its own endowment. The Arboretum of the University of Washington (Seattle) is connected with the University with most of its maintenance funds coming from state appropriations. This source is supplemented by membership fees, and an attempt is now being made to secure a restricted endowment.

The association with a university is ideal for it tends to add permanence to the arboretum; sound and intelligent advice on arboretum problems are always available from university staff members, and the arboretum can serve as an ideal out-of-doors laboratory to augment classroom instruction. It is also true that the facilities offered by an arboretum would be used more as a result of this association than might otherwise be the case.

When budgetary items are reasonably fixed from year to year, the work of an arboretum can proceed unhindered by extraneous circumstances. The main object in establishing an arboretum is to make it permanent, to provide for a permanently dependable source of income, and thus insure its usefulness to be continuously available to the greatest number of people. There is no better way to insure this than to provide an ample endowment at the beginning.

Selection of the Site:—Before the plan can be made, a site must be decided upon, and the size of the area to be developed should be determined in relation to the sources and amount of available funds. The site could well be a local spot of beauty, of historical significance, or an existing part of a park if suitable. It will take intelligent discussion and sound advice to decide on the site, for the general plan and the functions of the arboretum also must be considered simultaneously. Arrangements should be made for alternatives in case the amount of money originally hoped for is not eventually forthcoming. A very important factor is accessibility.

Who is to Plan:—Almost any enthusiastic temporary group may be responsible for initiating public interest in the new arboretum, but a planning committee responsible for preparing definite plans associated with a campaign for raising funds should be carefully selected. The planning committee could well include an experienced landscape architect; a representative from the park department who would know about future park plans; a banker; a person well versed in the values of real estate; prominent nurserymen; and representatives from prominent civic organizations who would represent the desire of the people to have an arbo-

return and the will to work for one. A representative from an active arboretum, similar in size to the one contemplated, might well be called in for consultation. Large committees move more slowly than small ones, but somehow all interests should either be represented or heard prior to the time the actual site is decided upon and the plan is completed.

Ways of Initiating Interest and Action:—It is a simple matter to propose the idea of an arboretum in any community lacking one. Except in strictly urban areas, most home owners are interested in planting their properties so as to make them beautiful and enjoyable for as much of the year as possible. In strictly urban areas the people always desire to get into the open for rest and relaxation. Consequently, people in general are receptive to the idea and do not begin to “hedge” until the time comes for asking for increased taxes or donations for endowment or for annual support.

Many community organizations are well equipped to assist in a campaign for an arboretum. The garden club movement is fortunately firmly imbedded in almost every community. Nature clubs, bird clubs, forestry associations, conservationist groups and other organizations by their very nature should be interested in the idea and their members afford an excellent basis for enthusiastic support. Schools, parent-teachers organizations, Rotary and Kiwanis Clubs, women’s organizations, church groups, town park departments, all should be thoroughly canvassed and their support enlisted.

Horticultural experts could give illustrated lectures to show the kinds of plants which might be grown. Local landscape architects could have a field day in discussing possibilities. Staff members from existing arboretums could come and show what has been done in other communities, and discuss frankly the possibilities of a local arboretum. Costs could be discussed by committees representing various organizations. When opinion becomes fairly crystallized, some group could offer a sum to be used for the preparation of a definite plan. This was done in Seattle with excellent results. It was felt by those in charge that a topographic map of the Seattle Arboretum site was necessary, showing the two-foot contour lines. Such a map was prepared by the State W.E.R.A. at a cost of \$5,465.00. Then the Garden Club of Seattle raised \$3,000.00 and under its auspices a plan was drawn by a prominent firm of landscape architects. By the time the plan drawing stage is reached, public opinion should be fairly well crystallized in the form of a planning committee or “Arboretum Committee” which would have the authority to work with the individuals drawing the plan.

It is always advisable to have a well conceived plan on paper, regardless of what the local situation may be. The man or men eventually to be in charge of an arboretum do not just begin to plant trees and shrubs. Roads must be constructed, paths provided for pedestrians, a certain amount of grading done, certain plants placed in situations where they will grow best, a propagating unit

intelligently placed, water pipes laid where they will do the most good, drainage provided for in certain instances—in short, a thousand and one things should be thought of before the actual planting is started. In some instances the soil of the arboretum site may be very poor, and arrangements must be made to grow cover crops on it for several years (this was done on the site of the National Arboretum in Washington), thus preparing the soil over a period of time before any trees or shrubs are planted. Water, in the form of a running brook or pond, can be used to excellent advantage if properly planned for, whereas without planning, such a feature might easily become a liability. Trained horticulturists experienced in arboretum objectives and various professional landscape architects are familiar with these phases of the project. Thus if carefully considered plans are prepared in advance, much money can be saved, and many disappointments avoided by doing the right thing at the right time in the right manner.

How to Plant:—The actual placing of the different groups of trees and shrubs should be done according to a carefully conceived plan in which the individual needs of the plants are harmonized with the requirement of good landscape design and in which the best interests of the public are also considered.

Some of the arboretums have been laid out so that the plantings follow a definite botanical sequence of families and genera. This is not necessary or essential in most arboretums. It is advisable to keep all the plants in a certain genus together if possible, and to so place the important genera that they are easily seen from roads and paths. All projected plantings should be critically considered from the standpoint of landscape design.

Azaleas and rhododendrons, if used, should be given a situation with acid soil where they have some protection from winter winds. Lilacs should be so placed that people can easily walk among them and observe them closely as well as from a distance. A collection of hickory or walnut trees, for instance, might be placed in an out-of-the-way spot, where they can be seen from a distance. Colorful displays that have particular seasonal interest should be easily accessible and where they can be seen from many vantage points. Some plants like wet soils, some do better in dry soils. Each group should be placed where it will grow best.

Special attention should be given to displays of seasonal interest. Lilacs, for instance, are of interest only in the spring and might well be grown near the viburnum collection, which is of interest chiefly in the fall. The oriental crab apples, on the other hand, have seasonal interest both spring and fall and hence might be in a spot by themselves. Certain azaleas and the flowering dogwood bloom at the same time and might be planted adjacent to one another. A bank of red roses that will bloom in late June might be planted near the collection of mock oranges to give it additional color interest when its white flowers appear. Evergreen trees are frequently kept by themselves, but intelligent planting would call for the placing of a few deciduous trees in such a collection, especially

those which color vividly in the fall, to lend color and variety. And in or near plantings of deciduous trees it is usually desirable to place a certain number of selected evergreens.

It may be advisable from a maintenance standpoint to grow many shrub groups together in long beds with grass walks between them. Planted in this manner the shrubs are easily observed closely. A large number can be studied with comparatively little effort, and direct comparisons made. Roses, and representatives of such genera as *Weigela*, *Spiraea*, *Deutzia*, *Philadelphus*, *Chaenomeles*, and several other genera come in this group that can be so treated. Such a collection, though of little landscape interest, has a great deal of interest to the public at all times of year. The "shrub collection" at the Arnold Arboretum contains 800 different kinds of shrubs in parallel beds. It might well be one of the features in any arboretum, placed easily accessible to the main entrance, where people with little time can spend it to best advantage. It is also a most economical method of growing such a large number of shrubs, for machine cultivation can be easily practiced.

What to Plant:—What constitutes "the best" and who is competent to judge which are "the best" is always a debatable question. There are in existence several large collections of woody plants in this country and attempts are continually being made to make reliable lists of "the best" ornamentals in each group (genus or species). Such available lists could be utilized at the start. Let me explain more fully how this might be done, using the collections at the Arnold Arboretum as an example.

At the present time there are approximately 6000 different species and horticultural varieties of woody plants being grown in the Arnold Arboretum. Certain groups are larger than others. Thus in these collections there are 96 viburnums, 107 mock oranges, 159 maples, 270 crab apples, and 574 lilacs. Taking the lilacs for closer scrutiny, there are approximately 400 varieties of *Syringa vulgaris* alone, of which 32 have white flowers! Certainly all do not have outstanding ornamental value. In fact, it is extremely difficult to tell some of the varieties from others. It would be difficult to locate nursery sources for all, and certainly many have been discarded by commercial growers as being unsatisfactory. This large collection of lilacs has its place as a laboratory for scientific study (Mrs. Susan D. McKelvey did much of the work for her monograph on lilacs in this collection) but many of the varieties could be eliminated if scientific study were not one of the functions of this arboretum. The collections would be much more ornamental if the number of varieties were reduced, for then massed plantings of a single lilac variety could be made in space now occupied by twenty different varieties, for the ornamental effect of a massed planting is always greater, especially to the casual observer.

In a small arboretum, a collection of 50 or even 25 varieties of lilacs might be

satisfactory—only those being selected for planting which are considered to be the most ornamental and representative of the entire group. Just as many plants could be used as in our large collection if space were available, but far fewer varieties. The same principle could be used in selecting “the best” in the other groups of plants. The advice of local plantsmen will prove invaluable at the start when considering such points.

The Number of Plants:—The number of plants selected at the beginning will vary with the part of the country in which the arboretum is located, with its size, financial resources, and its propagating facilities. A few examples will illustrate this point. In making a preliminary report of proposed plantings for the Cornell University Arboretum, now called “Cornell Plantations,” there were approximately 2,000 species and varieties of woody plants listed as worthy of trial at the beginning. The Arthur Hoyt Scott Foundation of Swarthmore College listed approximately 2,800 species and varieties of woody plants that were being grown there in 1942. The 6,000 species and varieties now growing in the Arnold Arboretum might be reduced as much as one half or even more if only the most ornamental were to be selected. These figures are, of course, very general but they give some idea of the number of plants worthy for first consideration. The American Association of Botanical Gardens and Arboretums has published three inclusive studies, one on lilacs, one on crab apples, and a third on maples, showing the tremendous number of varieties being grown in this country and offering suggestions for short lists of the best. Such lists should be consulted. The smaller the arboretum, the fewer the number of specimens of any one variety which should be grown.

The first places to investigate as possible sources for plant materials would be the local nurseries. Nurseries at a distance may be able to supply many varieties unavailable locally. It will, of course, be found that some species are unobtainable from commercial sources. Then it is necessary to provide for a propagating unit and grow wanted varieties from cuttings or by grafting, where the propagating material is supplied by other arboretums, private individuals, or in some instances where seed is collected in native habitats primarily for this purpose. The smaller the plants when purchased, the lower the initial expenditure. The larger the plants at the start, the more quickly an initial display can be made for the public to enjoy. The factors here involved are obviously important ones and should be carefully weighed by the local planning committee.

The Amount of Space Required:—This, too, varies with the arboretum, its size, funds available for maintenance, and its functions in the community. Should much space be given over to massed plantings of single varieties? Massed plantings of azaleas, lilacs and crab apples are most ornamental and can be extremely effective, whereas massed plantings of maple trees, for instance, take up much

more space and have little ornamental effect. The enforcing of a rigid rule that no more than two or three plants of any one variety can be planted might be enough to defeat the purposes of an arboretum in the eyes of the public. The Arnold Arboretum proper covers an area of 265 acres, yet there is little room for additional planting, even though nearly half the present area is woodland. This wooded area is considered absolutely essential in setting off the man-made plantings to good advantage, and to serve as an added source of beauty and interest to visitors. Viburnums alone take 30,000 square feet (190 plants), elms take up about $5\frac{1}{2}$ acres (170 trees), while the lindens are given 3 acres for 58 trees. Three and a half acres constitute what is known as the shrub collection—long beds of miscellaneous shrubs with grass walks between, in which about 800 different species and varieties are grown. Almost a third of this is taken by the grass walks. Such a shrub collection affords an excellent means of teaching the public a great deal in a small area, but affords no opportunity for gorgeous displays of massed plant materials.

Another way of approaching a decision on the amount of space necessary would be to take the figure of 2,000 species and varieties as a starting point (the number suggested as the starting point for consideration by Cornell Plantations). If two plants of each of these were planted in long nursery rows, the distance between plants averaging 20 feet, they would take about 37 acres. Would such a planting in nursery rows have aesthetic value and be of interest to the public? Of course not! On the other hand, the proverbial "thousand acres" might prove too much for practical purposes. Here is another opportunity for intelligent planning by the Arboretum Committee, and an opportunity where practical plantsmen and landscape architects can lend invaluable assistance.

Costs:—The maintenance of plants in an arboretum need not be expensive. Spraying, pruning, planting, should not be curtailed in any one year. If spraying and pruning be omitted two or more successive years because of lack of funds, the plantings quickly show neglect and it may take several years to bring some of the plants back into vigorous growth. A fluctuating budget does not allow for intelligent annual operation, one of the best arguments against trying to operate too extensively on the basis of funds solicited annually.

The actual amount of money necessary to operate a small arboretum varies with the size of the arboretum, the labor situation, equipment, the objectives and the extent of its formal plantings. A good park administrator who knows park maintenance costs in the locality where an arboretum is to be established can give excellent advice regarding such costs. However, certain things are known. Lilacs, crab apples, quinces, and many other groups are very susceptible to infestations of scale and should be treated annually with a dormant spray to control this pest. They need a certain amount of renewal pruning every few years, without which periodic care they will very quickly turn into unattractive specimens which have

little ornamental value. No collections of these particular kinds of plants should be contemplated unless they can be cared for properly each year.

As an example of the cost for maintaining one group of plants, there are approximately 700 lilac plants in the collection at the Arnold Arboretum. Spraying these with a dormant oil spray takes two men about a half day, and about 600 gallons of spray mixture. Three good pruners spend an average of two weeks in this collection each year, keeping it in excellent condition. The cutting off of flower clusters is a time-consuming operation but should be done for the benefit of the next season's display. Although we cannot do this completely every year, if done properly (as it should be) it would take four men at least two weeks. This will give some idea of how to approach the problem of prospective costs in each of the large collections contemplated.

Viburnums need practically no spraying and very little annual pruning. Elms must be sprayed in this area for elm leaf beetle and the bark beetle. Canker worm, gypsy moth, willow leaf beetle, Japanese beetle—all attack many kinds of plants and must be controlled in various parts of the country. In 1959, 400 man hours were spent in spraying the various collections in the Arnold Arboretum for specific insect and disease control.

Pruning, also cannot be definitely estimated. Young plants, pruned properly at transplanting time, may require no pruning for several years. On the other hand, in an established arboretum with many kinds of mature trees, a wind, snow or ice storm may cause immense damage. The hurricane of 1938 cost the Arnold Arboretum in pruning and the removal of fallen or badly damaged trees and shrubs about \$6,500 above the budget provided. This did not include the irreparable loss of old established specimens. During a recent winter, one fourteen-inch snowstorm with very heavy snow broke so many branches that it took approximately seventy-five man-days to repair this damage alone.

Labor:—This item is the most expensive in any park or arboretum. It can be controlled somewhat by the amount of grass cutting and leaf raking which is done. In some parks all grass areas are carefully cut with a lawn mower once a week. This is a very expensive operation. In the arboretum or botanical garden certain areas are given over to the growth of deciduous trees and conifers the grass need only be cut but a few times each season, providing a few walks are open through these collections. In the shrub collection, which many people visit at all seasons of the year, the walks should be closely cut, as well as certain small areas along the main walks and near main entrance gates. Grass cutting is an essential annual operation to reduce the fire menace and must be provided for. Tractor-drawn rotary mowers are ideal for keeping grass under control at minimum expense.

Hoing by hand takes considerable time. The cost of this operation can be reduced by the use of mechanical equipment in the larger beds, and may be reduced

still further by the use of some of the new weed killers now available. The Arnold Arboretum employs nine laborers with occasional additions during spring and summer, a superintendent with his assistant, for the maintenance of the growing collections, as well as a propagator, his assistant, and a man in charge of labeling and mapping. These are not maximum requirements, probably might be termed the minimum labor requirements for an arboretum the size and age of the Arnold Arboretum. The National Arboretum with 450 acres has 32 men on the grounds crew. The Arthur Hoyt Scott Horticultural Foundation with an area of about 300 acres has seven on the grounds crew.

Equipment:—The more standardized mechanical equipment that can be utilized to good advantage, the less will be the expenditures for labor. Minimum equipment for a 200–300 acre arboretum might be:

Tractor (with rotary mower, plow, harrow, etc.)

Sprayer with tank capacity of at least 300 gallons

At least one ton and a half truck

2 power lawn mowers

2 heavy duty rotary mowers

Rototiller or small motorized cultivator

Gasoline chain saw

The best available hand saws, pruners, pole saws, etc., for the type of work contemplated

Propagation:—Every arboretum large or small should have its own propagating unit. Since many of the plants grown will be rare, they will not be available from commercial sources as plants, hence the arboretum will have to propagate many species from seeds, cuttings, or grafts. There are decided advantages in having a nursery well stocked with materials, for plants so grown are easier to dig and move. They should be correctly named, for if they are allowed to grow to sufficient size in the nursery, they can be properly identified before being transplanted. Larger specimens can be handled this way than would be advisable with purchased specimens.

The actual size of the greenhouse will depend on the location of the arboretum, its size, and the amount of material to be propagated. At the beginning a great deal of propagating will be needed to provide material for contemplated plantings. Many of the older arboretums are concerned merely with replacements and material which is new to the collections.

It is amazing what a large amount of material can be propagated and grown to planting size in a well organized space. The Arnold Arboretum has been operating for 35 years with only two greenhouses 50'x18'. A recent reassessment of its space needs showed that though it needed an additional greenhouse for experimental use, it still could carry on with normal propagation procedures with

only two houses. Many a smaller arboretum has considerably less greenhouse space, and a few have more.

A pit house is essential in the North to aid in wintering over young stock and propagation materials. In the South, lath houses are essential, the number depending on the size of the whole arboretum undertaking. In the Arnold Arboretum we have found that saran cloth shade houses are ideally suited for growing ericaceous and other broad leaved evergreens during the hot summer months. We have five houses varying in size, approximately 100'x30'. Frames are also essential for wintering young plants. Nursery space will vary but the young arboretum which is doing a lot of plant propagation will need several acres at least.

It goes without saying that an experienced plant propagator must be employed. Sometimes he can work alone, sometimes he may need assistance, but in order to keep accurate records and to produce good plants, he should be thoroughly trained and experienced. If he is of this type, he will know the approximate size of the nursery and plant bed space needed, as well as the type of greenhouse space required.

Labeling and Mapping:—A most essential function of an arboretum is to keep the plants properly labeled. In order to maintain correct labeling it is essential that the plantings be accurately mapped. An active young man who is really interested in this work—and it takes a great deal of walking!—should be able to keep maps and labels up-to-date, providing he has some seasonal assistance. In the winter some of the labor force could paint and even print labels. In the summer, one or two high school boys might be hired to help with the mapping if this were necessary. Mapping with the alidade and tape is sufficiently accurate. We have found that maps approximately 2'x2½' on a scale of 1"=20' are practicable, but a few enlargements are necessary on a scale of 1"=10'. It took nearly a year for two men to map all the plants in the 265 acres in the Arnold Arboretum, but once accomplished, the maps are easily kept up-to-date with a minimum expenditure of time.

If plants are not accurately and clearly labeled, the arboretum loses its educational function completely. Labels will disappear, often being appropriated by certain types of visitors, and others will become defaced. Thus a careful mapping of a collection makes relabeling of individual plants simple and accurate, for the critical and sometimes time-consuming matter of reidentification is eliminated. A display label should be clearly visible on every plant except in instances where a large number of a single variety are used in mass planting. On the label, as a minimum, should appear the common name, the scientific name, and the geographic origin of the species.

In the Arnold Arboretum we have a small record label made of embossed zinc tape which is attached to every plant when it is planted in the collections. This remains on the plant indefinitely, and contains the accession number of the plant,

its scientific name, the origin of the plant, and the date of its accession. These cost about five cents per label just for the materials. A large wooden or metal display label is attached to each plant that is large enough to carry one. These cost about twenty to thirty cents per label for the materials (not including the labor of printing) and will remain on the plant in good condition about five years. Certainly a plant worth placing in an arboretum is worth two labels at a cost of thirty-five cents.

Educational Costs:—If a community is large enough, the director or superintendent of the arboretum might be a man who could direct the work in the arboretum and at the same time give lectures to local groups concerning the plant materials in the arboretum and their proper use. He could write articles for local publication, conduct groups through the arboretum, and work with local groups for the general education of the public in better appreciation of the plants and their maintenance. The services of such a man are almost a “must” for the arboretum or botanical garden since a certain amount of educational publicity contributes materially toward a better utilization and appreciation of the arboretum by the residents of a community.

It would serve no purpose to give the actual operating expenses of any arboretum, since methods vary, functions of the arboretum vary, and wages vary. Each expense item should be understood before studying actual maintenance costs. The figures and facts given, however, should serve to help with the general plans of any Arboretum Committee. They should be interpreted by men familiar with maintenance work who at the same time are familiar with the proposed functions of the arboretum under consideration.

For those who are interested in knowing where American arboretums and botanical gardens are, “The Arboretums and Botanical Gardens of North America” is a seventy page booklet published by the Arnold Arboretum, Jamaica Plain, Mass., in 1959. It is available for \$1.50 postpaid. One hundred and nine arboretums are described so that with this as a reference, those wishing to start an arboretum could contact any of these that might have policies and a size similar to that wanted by the organizational group. Such institutions are always glad and willing to help with information and suggestions when a new garden is contemplated.

DONALD WYMAN