Contents

261 A Guide to Selecting a Strong and Healthy Young Tree
    NANCY M. PAGE

284 Cranberries — The Last One Hundred Years
    CHESTER E. CROSS

292 Willow Oak (Quercus phellos):
    A Fenway Jewel
    MARTHA DAHLEN

295 Arnoldia Reviews

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A Guide to Selecting a Strong and Healthy Young Tree

In the wild, the basic structural form of a tree is logically related to the various stresses of its lifelong growing conditions: stem, leafy branches and roots are molded to forms which will best suit the tree's performance in a particular landscape, whether to reach up high for a woodland's diminished sunlight, or to spread out wide into the abundant sunlight and space of an open field.

In a nursery, the basic structural form of a tree is artificially molded by a set of growing practices. Its strength and health and beauty are largely a product of the grower's sensitivity and expertise: how wide he makes his rows and spaces his plants, how frequently he root-prunes or transplants them, how sensitively he trains them, how they are stored and marketed. His techniques may produce a tree far more suited to be grown as a specimen in the average landscape than a tree one would be likely to find in the wild; or they may inadvertently produce a tree which is a structural failure.

The long-range significance of some growing techniques has not been well understood. For instance, research at the University of California at Davis in recent years has demonstrated that the natural capacity of young seedling trees to support themselves even in a high wind can be undermined by severely crowded conditions, or the drastic pruning and staking practiced by some growers. Modifications of the tree's canopy and trunk structure may create an individual which is actually unable to support itself upright when moved out into the landscape (6, 7). Similarly, modifications of a tree's root system through container line production may create permanent structural defects rarely found out in the wild.

Such deformities as these underscore why trees are such a particularly vulnerable form of merchandise; not primarily because they may not have survived poor handling or growing conditions (living things are remarkably adept at finding ways
A tree may be inadvertently modified by growing practices in such a way that it actually can no longer support itself upright, such as this young Tupelo.
to adjust to the most adverse conditions), but because their structural quality and vigor may have been critically diminished through the struggle to survive. And, unfortunately, this kind of damage is not always immediately perceptible.

It is of particular significance with trees, over smaller and shorter-lived plant material, because what initially may be considered a minor structural handicap may become a major structural flaw in time. As a tree matures, the sheer massiveness of its upright bulk generates enormous stresses on every part of its framework. To hold together, and meet the force of environmental stresses successfully, this framework must be strong and healthy.

The stem. According to research at the University of California at Davis, trunks tapering uniformly from base to tip can withstand greater stress from wind and vandals than trunks with little or no taper. While a tapered trunk tends to bend uniformly along its entire length, a trunk with little or no taper bends from the base and is more susceptible to deformation or breakage. Crowding or rigidly staking a tree tends to suppress the normal outward growth of its trunk and the normal trunk taper, while increasing its height (4, 5, 6, 7).

The relationship between the trunk diameter (or "caliper")* and height of a tree is one of the most visible indications of the environment it has come from and the quality of a grower's cultural practices. Trees grown in crowded rows bear the same features as woodland trees: trunks are tall and narrow, branching is concentrated up high towards the only available source of light with lower branches dead or dying from lack of light. Trees which have grown particularly fast from being over-watered and over-fertilized also tend to be taller and lankier than average, but branching is more widely and evenly distributed along the trunk. Those which have grown slowly due to poor soil conditions, girdling roots, or an extremely exposed site tend to have the form characteristic of dwarfed plants: branches and trunk are short and stout, branching is concentrated densely along the stem.

While caliper or height is usually the governing measurement for categorizing the size of a tree, the relationship between height and caliper is so greatly variable that referring to stock

* Caliper of trunk is measured 6 inches above ground level up to, and including, 4-inch caliper size; 12 inches above ground for larger sizes.
solely by one characteristic or the other gives an unreliable
description of the plant's actual size and age.

Accordingly, the American Association of Nurserymen has
developed standards useful for indicating a "normal" relationship
between key characteristics of several different types of
trees. For instance, shade trees are expected to have a rather
broad, but definite correlation between height and caliper.
Smaller growing trees are expected to have a correlation be-
tween number of branches and height, or among height, caliper
and number of branches (see Tables I-III).

The canopy. Branching is characteristic of a particular kind of
tree and a given site. But in almost all cases the growing tip of
a tree should be limited to one dominant ascending shoot (or
"leader"), because trees with multiple leaders lose their directed
upward growth. Double leaders are apt to have a narrow angle
of attachment to the trunk, and as branches form on one side
only of each leader and greater pressure is exerted on this weak
point of attachment, the tree may eventually split in two.

The proper height above ground of the first permanent
branches depends largely on personal taste, the type of tree,
and the landscape use it will be put to; and may vary from
only a few inches to many feet. But note that the height of a
branch will always stay fixed at exactly the same distance from
the ground (except for its thickening); in other words, branches
do not grow up as the trunk elongates.

There has been a tendency to train a young tree's branches
disproportionately high up for its size, particularly in the case
of street trees. If a high branching specimen is required, it
should be trained gradually. At least some temporary branches
should be left on the stem as these branches will both protect
and nourish the young trunk, contributing measurably to its
caliper growth and taper.

As a result of their findings at Davis, Richard W. Harris and
Andrew T. Leiser recommend that one-half or more of the
foliage or one-year-old wood be left on the lower two-thirds of
the trunk, and half or less on the upper third of the trunk.
Besides contributing to the proper growth of the trunk, this
distribution will center the wind load acting on a tree at a
mechanically desirable point at about two-thirds its total height
(6).

If the tree is old enough to have formed permanent branches,
their vertical and radial distribution up the trunk should be
carefully noted. The major scaffold branches of a tree are best
Overcrowding has produced extreme attenuation of form in 18 ft. tall, 1¾ in. caliper Honeylocusts growing a scant 2½ ft. apart in the row. Note concentration of canopy towards upper one-third of trunk, narrow stem girth in relation to height, dying lower branches. A height of about 10 to 12 ft. would be normal for the caliper of these trees.
distributed symmetrically up the trunk in a configuration that avoids competition for nutrients and light. At least 8 inches and preferably 1½ to 2 feet should be allowed vertically between major scaffold branches; many mature branches lie 4 to 12 feet apart vertically. As a tree matures, closely spaced branches may break more easily than those with wide spacing because close spacing encourages long thin branches to develop with little structural strength (4).

All permanent branches should be attached widely to the trunk, as narrow angles of attachment are weaker and are apt to split with increasing stress as the tree grows.

If a tree has lost its leader, undesirable whorls of branches shortly spaced apart may be formed. Branches lying directly over each other are considered undesirable because they must compete for nutrients and water, and the lower branch is shaded. Two or more vigorous branches at or near the same level of trunk are apt to suppress the leader and limbs growing above. Crossing branches, or branches growing vigorously upright in an otherwise horizontally branching tree will have to be removed to avoid interference.

Roots. A particularly vital mechanical and nutritional inter-relationship exists between the roots and aerial portions of a tree. But an imbalance between roots and canopy is not uncommon in greenhouse and container production when plants are subjected to an overly intense feeding and watering program which tends to encourage top growth over root growth, and produces a small root system incapable of supporting the canopy and trunk in a more demanding environment without commensurate maintenance (6).

An even more drastic disruption of the nutritional and mechanical balance between aerial parts and roots occurs each time a tree is transplanted. When roots are cut in transplanting not only the physical stability of the tree is affected, since the ratio of above to below ground parts is thrown off, but also its capacity to absorb enough water and minerals from the soil to maintain its disproportionately large aerial structure.

How severe this imbalance is depends on what proportion of the root system remains, how rapidly it can regenerate, and the type of environment in which it is planted. While the growth characteristics of root systems vary by species, and some kinds of trees are innately more difficult to move than others.

Right: The two balls in the foreground are “soft” or “homemade” balls, dug up bare root and simply wrapped loosely in burlap and soil afterwards; the root ball lying behind them has the characteristics of a “hard” ball, dug and carefully packaged in burlap to keep the entire ball of roots and soil intact. Root balls should never be left exposed like this to possible injury from heat and drought.
Above: During storage, containers should be as well mulched as root balls to prevent damage to root systems from temperature fluctuations and drought. Note well mulched stock stored to the right and left.
New roots have penetrated lower one-third of burlap on a Cut-leaf Beech apparently over-wintered above ground in a heavy mulch. The absence of new roots on the upper two-thirds of the ball is probably due to root injury from alternate freezing and thawing.

(such as Pawpaw, Hickory, Dove Tree, Walnut, Tupelo, Sassafras, White and Scarlet Oaks), growing practices can exercise a considerable effect on the ease of transplanting.

The development of a root system is influenced by the entire soil environment (soil texture, availability of water and nutrients, soil depth, and competition). A more compact root system is apt to be formed in deep organically rich soil than in sandy soil.

Root systems are also directly and positively modified by the nursery practice of root pruning: an important element of nursery training which should occur every few years as it tends to artificially consolidate a rangy system by encouraging side branching. Trees grown in the wild are particularly difficult
Poorly stored Hawthorns have lost most of their foliage by mid-summer. Burlap has completely disintegrated on the two root balls in the foreground, and the balls are crumbling apart. The other balls are wrapped in plastic which is tightly bound around the base of the trunks with wire — presumably to seal in the moisture and create a "carefree" maintenance system.
to transplant because their roots have never been shortened through pruning.

Trees are sold with their roots in containers, or balls of soil wrapped in burlap, or completely bare. Each method has its advantages and disadvantages. Bare root stock and containerized plants are much cheaper than field grown trees which have been carefully balled and burlapped. But trees moved bare root are affected most severely by transplanting since many small feeding roots are damaged when the soil is disturbed, and the root system is more vulnerable to mechanical and climatic damage while being stored and shipped. Normally only trees such as maples, ashes, and honeylocusts, which have demonstrated their relative speed of recovery, are sold bare root; and they are available only in small sizes, during the dormant periods of fall and early spring.

Containerized stock is affected least by the transplanting process; the entire root system can be easily transferred and few of even the small roots are apt to be lost in the process. Nevertheless, containerized stock is sometimes subject to critical root defects, and should be examined closely for damage (see section on Root damage).

Clearly, a tree moved with an intact ball of earth around its roots ("balled and burlapped" or "B&B") will retain more of its small feeding roots than a tree moved bare root, which is why trees reputed to be difficult to move are always transplanted B&B even in small sizes, or grown in containers. In addition, the buffer provided by the soil around the root system tends to protect roots of both containerized and B&B stock while being stored or shipped.

There are several techniques to balling and burlapping a tree's roots; but due to the increasing expense of handling stock, recent practices are tending to become more expedient and less expert. The best method produces a completely intact ball of earth and roots, which is packaged so expertly it is unlikely to shift or come apart during transport and replanting. In recent years nurseries have tended towards the "soft" or "homemade" ball for all but the largest or most difficult material. This alternative is really just a bare root tree wrapped in soil and burlap. Since the original ball of soil has not been retained intact, one might well question whether a homemade ball accomplishes much over the bare root method, aside from buffering the root system a bit from mechanical or climatic injury.
Signs of branch die-back from poor storage.
The major structural framework of this young Dogwood is poor. The kink in the trunk may be left from the point where a competing second leader has been removed later than desirable, as it has already substantially affected the form of both trunk and canopy. Under stress, the weak V-shaped joint where the leader divides into two main branches may split right down the middle.
Another Dogwood with a basic structural flaw. Instead of branching outward from the stem, one of the three major branches of this specimen is growing in against another and will have to be removed — leaving a large hole along one side of tree’s silhouette.
The American Association of Nurserymen also provides minimal standards governing the spread of roots in bare root nursery grown shade trees. For instance, a tree of 2 to 2½-inch caliper, approximately 12 to 14 feet high, would be expected to have a minimum root spread of about 28 inches (see Table V).

The amount of stress on roots to provide water for the above ground structure varies according to weather conditions and the relative dormancy of the plant. The hotter the weather and the more fully leaved out the plant, the more water normally passing through its system from roots to leaves. This is why plantsmen prefer to move field grown material in the cool damp periods of early spring and fall when deciduous stock is dormant; however, it is possible to move just about any kind of tree any time of the year if it is done expertly and with a large enough root ball.

To reduce the imbalance between above ground and below ground parts, a newly transplanted tree is usually pruned. If it has been moved bare root, the tree is normally pruned quite severely, with up to a third of its branches removed. While necessary if a tree has been moved roughly, this method of compensation has important disadvantages: the tree may lose several years’ past growth in a heavy pruning; pruning the canopy in turn reduces the tree’s capacity to produce and store food needed not only for sustenance but also for its new growth; and, of course, balancing the canopy to the roots will in no way diminish the dimensions of the trunk which will remain out of proportion to both of them. If greatly disproportionate, the trunk may even consume most of the food produced by the tree simply to sustain its bulk.

Root damage. Growing practices can be responsible for a series of root deformities which may seriously handicap a tree for life, or even cause its death if left uncorrected (6). Kinked, twisted or circling roots are most commonly found in containerized stock, but also may be observed out in the field if the stock has been raised in containers at some point. These root defects are easily corrected by pruning while the roots are young; but as a tree matures, one may do as much damage by attempting to correct them as by leaving the tree alone.

Improper storage of tree stock also may be responsible for
extensive damage to the root system. When roots are raised out of the ground, whether balled and burlapped, containerized or bare root, they become extremely vulnerable to temperature fluctuations, drought, and mechanical injury. Roots on stock stored out of the ground in cold weather may be entirely or partially killed by alternate freezing and thawing. In storage the entire root system should be kept well covered with a thick layer of mulch, and watered regularly.
Two Silver Maples toppled over by the wind. These are actually balled and burlapped trees which were replanted in containers to keep the root systems intact during prolonged storage. When replanted, burlap should have been pulled back from the upper one-third of the ball.

The American Association of Nurserymen provides standards for the relationship between tree caliper and a minimal ball diameter (in the case of shade trees) and between tree height and a minimal ball diameter (in the case of smaller growing trees). For instance, shade trees of approximately 2 to 2½-inch caliper are expected to have a minimal ball diameter of about 2 feet; smaller types of trees of about 6 to 7 feet would be expected to have a minimal ball diameter of about 1½ feet (see Table IV). The American Association of Nurserymen figures are applicable only to stock which has been grown under favorable conditions and which has been properly root pruned. Plants with a coarse or widespreading root system, or those moved out of season, would require a larger ball.
Defective bark on a Dogwood.
A confused whorl of branches with no dominant growing point characterizes the growth response of a tree which has lost its main leader. The Norway Maple on the right, the same age and caliper as that on the left, but with an intact single leader, is a foot or so taller and has the directed upward growth we associate with most shade trees. Note also the vertical distribution of the canopy on these two trees: both have been trained higher than desirable for their present height, with the canopy concentrated along the upper one-third to one-fourth of the trunk. This is not atypical of most shade trees available in the trade, but for the sake of structural strength and nourishment of the trunk it would be preferable to raise the crown more gradually.

A group of young Norway Maples with branching occurring in undesirable whorls. This is a common growth response when the main leader has been pinched back to induce branching.
Indications of health and vigor. A specimen’s vigor is indicated by the plumpness of its buds; the size, color and shape of its leaves; the length of last year’s growth, as indicated by the length between terminal bud scars; and the rate of callousing over small wounds.

Any signs of branch die-back, or leaf-fall and discoloration should be taken as ample indication of poor health and vigor. Bark should be light and smooth; bark and leaves should be free from all signs of pests and diseases. Young roots should be light colored.

A reputable nursery guarantees its stock for at least one full growing season after transplanting; preferably, it is guaranteed for a complete year. Prospective purchasers would be wise to check the extent of this responsibility in addition to the visible indications of strong and healthy stock.

NANCY M. PAGE

(All photos by the author.)

Table I.
Height relationship to caliper for shade trees.
(From American Standard for Nursery Stock. 1973)

<table>
<thead>
<tr>
<th>Caliper</th>
<th>Average Height Range</th>
<th>Maximum Heights</th>
</tr>
</thead>
<tbody>
<tr>
<td>½ to ¾ in.</td>
<td>5 to 6 ft.</td>
<td>8 ft.</td>
</tr>
<tr>
<td>¾ to 1 in.</td>
<td>6 to 8 ft.</td>
<td>10 ft.</td>
</tr>
<tr>
<td>1 to 1¼ in.</td>
<td>8 to 10 ft.</td>
<td>11 ft.</td>
</tr>
<tr>
<td>1¼ to 1½ in.</td>
<td>8 to 10 ft.</td>
<td>12 ft.</td>
</tr>
<tr>
<td>1½ to 1¾ in.</td>
<td>10 to 12 ft.</td>
<td>14 ft.</td>
</tr>
<tr>
<td>1¾ to 2 in.</td>
<td>10 to 12 ft.</td>
<td>14 ft.</td>
</tr>
<tr>
<td>2 to 2½ in.</td>
<td>12 to 14 ft.</td>
<td>16 ft.</td>
</tr>
<tr>
<td>2½ to 3 in.</td>
<td>12 to 14 ft.</td>
<td>16 ft.</td>
</tr>
<tr>
<td>3 to 3½ in.</td>
<td>14 to 16 ft.</td>
<td>18 ft.</td>
</tr>
<tr>
<td>3½ to 4 in.</td>
<td>14 to 16 ft.</td>
<td>18 ft.</td>
</tr>
<tr>
<td>4 to 5 in.</td>
<td>16 to 18 ft.</td>
<td>22 ft.</td>
</tr>
<tr>
<td>5 to 6 in.</td>
<td>18 ft. and up</td>
<td>26 ft.</td>
</tr>
</tbody>
</table>

Examples of trees in this category:

- Acer rubrum, A. saccharinum
- Betula spp.
- Fraxinus americana, F. pennsylvanica
- Ginkgo biloba
- Gleditsia triacanthos
- Liriodendron tulipifera
- Platanus spp.
- Populus spp.
- Quercus rubra, Q. macrocarpa, Q. phellos,
- Q. palustris
- Salix spp.
Tilia americana
Ulmus americana

While shade trees of slower growth may not attain the height-caliper relationship indicated above, their heights should not be less than two-thirds the height relationship given above.

Examples of trees in this category:
- Aesculus spp.
- Celtis spp.
- Cladrastis lutea
- Fagus sylvatica
- Koelreuteria paniculata
- Laburnum anagyroides
- Liquidambar Styraciflua
- Nyssa sylvatica
- Quercus alba
- Sorbus spp.
- Tilia cordata, T. euchlora

Table II.

Height relationship to caliper and branching for small upright trees.
(From American Standard for Nursery Stock. 1973)

<table>
<thead>
<tr>
<th>Height</th>
<th>Caliper</th>
<th>Branches</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 to 3 ft.</td>
<td>5/16 in. caliper, 3 or more branches</td>
<td></td>
</tr>
<tr>
<td>3 to 4 ft.</td>
<td>7/16 in. caliper, 4 or more branches</td>
<td></td>
</tr>
<tr>
<td>4 to 5 ft.</td>
<td>9/16 in. caliper, 5 or more branches</td>
<td></td>
</tr>
<tr>
<td>5 to 6 ft.</td>
<td>11/16 in. caliper, 6 or more branches</td>
<td></td>
</tr>
<tr>
<td>6 to 8 ft.</td>
<td>7/8 in. caliper, 7 or more branches</td>
<td></td>
</tr>
</tbody>
</table>

Examples of trees in this category:
- Crataegus spp.
- Halesia spp.
- Malus spp.
- Prunus cerasifera 'Thundercloud'
- Prunus serrulata, P. subhirtella
- Styrax
- Syringa amurensis japonica

Table III.

Height relationship to branching for small spreading trees.
(From American Standard for Nursery Stock. 1973)

<table>
<thead>
<tr>
<th>Height</th>
<th>Branches</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-3 ft.</td>
<td>4 or more branches</td>
</tr>
<tr>
<td>3-4 ft.</td>
<td>5 or more branches</td>
</tr>
<tr>
<td>4-5 ft.</td>
<td>7 or more branches</td>
</tr>
<tr>
<td>5-6 ft.</td>
<td>8 or more branches</td>
</tr>
<tr>
<td>6-8 ft.</td>
<td>8 or more branches</td>
</tr>
</tbody>
</table>

Examples of trees in this category:
- Acer palmatum, A. griseum
- Cornus spp.
- Lagerstromia indica
- Magnolia soulangeana, M. stellata
- Malus sargentii
- Viburnum prunifolium
Table IV.
Relationship between ball size and height or caliper.
(From American Standard for Nursery Stock. 1973)

<table>
<thead>
<tr>
<th>Shade Trees</th>
<th>Trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types 1 and 2 *</td>
<td>Types 3 and 4 **</td>
</tr>
<tr>
<td>Caliper Inches</td>
<td>Minimum Diameter Ball Inches</td>
</tr>
<tr>
<td>½-¾</td>
<td>12</td>
</tr>
<tr>
<td>¾-1</td>
<td>14</td>
</tr>
<tr>
<td>1-1½</td>
<td>16</td>
</tr>
<tr>
<td>1½-1¾</td>
<td>18</td>
</tr>
<tr>
<td>1¾-2</td>
<td>20</td>
</tr>
<tr>
<td>2-2½</td>
<td>22</td>
</tr>
<tr>
<td>2½-3</td>
<td>24</td>
</tr>
<tr>
<td>3-3½</td>
<td>28</td>
</tr>
<tr>
<td>3½-4</td>
<td>32</td>
</tr>
<tr>
<td>4-4½</td>
<td>38</td>
</tr>
</tbody>
</table>

* Standard and slow growing shade trees. ** Small upright and small spreading trees.

Table V.
Relationships among root spread, caliper, and height of bare root nursery grown stock.
(From American Standard for Nursery Stock. 1973)

<table>
<thead>
<tr>
<th>Caliper</th>
<th>Average Height Range</th>
<th>Minimum Root Spread</th>
</tr>
</thead>
<tbody>
<tr>
<td>½ to ¾ in.</td>
<td>5 to 6 ft.</td>
<td>12 in.</td>
</tr>
<tr>
<td>¾ to 1 in.</td>
<td>6 to 8 ft.</td>
<td>16 in.</td>
</tr>
<tr>
<td>1 to 1½ in.</td>
<td>8 to 10 ft.</td>
<td>18 in.</td>
</tr>
<tr>
<td>1½ to 1¾ in.</td>
<td>8 to 10 ft.</td>
<td>20 in.</td>
</tr>
<tr>
<td>1¾ to 2 in.</td>
<td>10 to 12 ft.</td>
<td>22 in.</td>
</tr>
<tr>
<td>2 to 2½ in.</td>
<td>10 to 12 ft.</td>
<td>24 in.</td>
</tr>
<tr>
<td>2½ to 3 in.</td>
<td>12 to 14 ft.</td>
<td>28 in.</td>
</tr>
<tr>
<td>3 to 3½ in.</td>
<td>14 to 16 ft.</td>
<td>32 in.</td>
</tr>
</tbody>
</table>

(Tables I through V are reprinted with permission of the American Association of Nurserymen, Inc.)
Literature Cited


Cranberries —
The Last One Hundred Years


(The following article is excerpted from a talk presented at the Arnold Arboretum during the January 1972 meeting of the Northeastern Section of the American Society for Horticultural Science. Ed.)

It is difficult for us to picture the state of the cranberry industry one hundred years ago. Observing my loss of hair and the graying of what is left I sometimes think I should be able to tell you from personal recollection what it was like. We know, however, that berries were hand-picked by fingers, that foremen saw to it that each picker harvested every berry in his allotted patch and that these were all shipped in wooden barrels of 100 lbs. (or 100 quarts) each. Horse and cart took them to rail terminals where they were stacked four high in the freight car. There was no market for processed cranberries so all were shipped dry except for some packed in water-filled barrels for
steamship transport to the west coast and overseas. I can still remember seeing the last of the hand-picking gangs in the early 1930's; about 160 men, women and children in a long, irregular line across the bog picking into 6-qt. pails and most talking continuously.

Statistics are hard to find for this industry a century ago. Farm operations in general and cranberry production in particular required much hard labor for long hours by many people, all of which may well account for the paucity of records. I think it is perhaps true that my audience may not want a long string of statistics so I will try to review some of the more significant events.

It was just a hundred years ago in 1872 when the Wisconsin cranberry crop exceeded that of Massachusetts for the last time. My source of data refers to the Wisconsin crop as from "the West". It was in 1894 that New Jersey's crop beat that of Massachusetts for the last time. It was not until 1924 that Pacific Coast production reached proportions that merited recording. Since 1949 the records of production in Washington and Oregon are reported separately. It is undoubtedly a blessing that cranberry production appears impractical in California. So five states are, and have been, important in this industry and it is probably significant with respect to Black Monday, November 9, 1959, when the notorious "cancer scare" broke, that the industry could count on support from only 10 of 100 senators. I will say more on this later.

In 1907 cooperative license #1 was granted to the American Cranberry Exchange with the Eatmor brand name. Much as I abhor such a name, this established a trend toward cooperative marketing in cranberries, a trend that has persisted to the present to the great benefit of both cranberry growers and consumers. In 1909 the Cranberry Experiment Station was founded with Dr. H. J. Franklin providing the talent and industry as both chief and Indian. Originally he slept at the Station, the better to work long hours seven days a week. He came to be known as "Mr. Cranberry" and I can vouch he was a most difficult person to follow as head of the Station. Two significant events date from 1913. The first can of Ocean Spray cranberry sauce was produced in that year, and Chester E. Cross was born! The Ocean Spray name began under Marcus L. Urann and was the trade name of his company, the United Cape Cod Cranberry Company. By combining the canning interests of this and others, the canning cooperative, "Cranberry Canners, Inc.", was founded in 1930. Thus the industry came to have
two large cooperatives, one for fresh fruit and one for processing, and while many efforts were made to keep these functioning amicably, there existed great rivalry. Cranberry Canners, Inc. became the National Cranberry Association in the mid-1940's to undertake the cooperative marketing of both fresh and processed cranberries. In the 1950's the National Cranberry Association bought the New England affiliate of the American Cranberry Exchange, and under the new name of Ocean Spray Cranberries, Inc. now markets about 85% of the total U.S. crop.

The cranberry industry's growth in acreage shows a steady increase in Wisconsin, Washington and Oregon, reaching currently to 7,000, 1,250, and 875 acres respectively. In New Jersey the century began with 9,000 acres, increased slowly until after World War I when the false blossom disease struck. From the 1920's to the 1950's many of New Jersey's cranberry bogs were converted to high bush blueberry culture, the cranberry acreage declining to 2,500 acres in 1958. With control of the false blossom disease and a conversion to flood harvesting, New Jersey's acreage is now up to 3,800. In Massachusetts the cranberry bog acreage started this century at 11,300 and now has the same total! It rose to 15,000 in the late 1940's but, as competition increased, marginal bogs (chiefly those with limited water supplies) were abandoned.

It will probably surprise you to know that here "in the land of the free and the home of the brave" the cranberry industry is unlikely to have any further wide fluctuations in acreage. Under a federal marketing order dated August 1, 1968, no cranberries may be sold from new plantings made after the effective date. A similar regulation has been adopted in the chief cranberry-producing provinces in Canada. The present surplus of cranberries was clearly foreseen in 1967, and the national referendum showed nearly unanimous support for the order.

The cranberry industry, therefore, resembles other branches of American agriculture in showing great increases in production efficiency. The success of food production in the U.S.A. may prove to be its bane, for the producer has now become a scattered minority. A newspaper article of last summer projected the present decline of farmers and farm workers (the decade of the 1960's showed a decline of 1.2 million farmers and a decline of 2.8 million farm workers) to the year 1986 when farmers would number near zero. It suggested that the U.S. Department of Agriculture is no longer needed, and the
few remaining farmers could be transferred to the U.S. Department of the Interior where they could be placed on the Endangered Species List and be protected accordingly!

When Dr. Franklin founded the Cranberry Experiment Station in 1909 the average production per acre was 20 bbls. When he retired in 1952 productivity had doubled to average 40 bbls. per acre. The 1970 and 1971 Massachusetts cranberry crops averaged over 90 bbls. per acre, and this State's crop is just under half of total U.S. production. Combining these data with the acreage figures which show 11,300 acres in both 1900 and 1971, the efficiency of Massachusetts cranberry production becomes clear. In my opinion, three cultural improvements are primarily responsible for the increasing production per acre: frost injury prevention, improved harvest technology, and modern control of insect pests.

On September 10-11, 1917, an estimated 50% of the Massachusetts cranberry crop was frozen on the vines just prior to harvest. The very next spring on the night of June 20-21, 1918, an estimated 55% of the coming crop was destroyed. The terrible frost of May 18-19, 1944, came shortly after the widespread winter-killing of the previous winter. Together they reduced the crop about 65% to 159,000 bbls., less than average production back in 1900. On the night of Memorial Day, 1961, a sudden hard frost reduced the crop by one-third, and in that year the Wisconsin crop came within 10,000 bbls. of equalling that of Massachusetts. While these are just the greater frosts, lesser ones occur almost every year. Clearly, such losses cannot be absorbed in a highly-competitive, narrow-profit business.

A frost warning system was developed by the Cranberry Experiment Station in cooperation with the U.S. Weather Bureau, which computes twice daily the minimum expected temperature (accuracy 1°-3°F.) and issues a warning by telephone to subscribing growers, and as a public service by radio. With heavy capital outlay growers have supplemented or replaced the slow and sometimes wasteful method of flood frost protection with solid-set, low-gallonage sprinkler systems. These are fully protective about four minutes after starting and continue to protect buds and berries as long as they continue to operate, even though ice forms and coats the vines when ambient temperatures fall below 27°F. Buds, flowers and small green berries are known to tolerate 29.5°F., while under continuous sprinkling at 50 gallons per acre per minute the temperature of plant tissues remains at 30.5°F. or higher. Over 7,000 of Massachusetts' 11,000 acres of cranberries are pro-
tected in this way, using only about 10% of the water required by frost flooding. Cranberry growers here and in other states have impounded vast quantities of fresh water and therefore may be thought of as effective, eager conservationists.

The time-honored method of picking cranberries with the fingers had to be abandoned when the picker could not pick enough berries to equal the value of his time. The wooden or metal-toothed scoop replaced hand-picking in the 1930's, 40's and 50's. It was hard work for knees and back, it was hard on the cranberry vines (some broke off, and the roots of many were pulled up), and some 20 to 35% of the berries was dropped and lost down among the vines. After-harvest flooding retrieved some lost berries as “floats”, but costs of clean-up were considerable and the value of such fruit was limited. Right after World War II, and after many unsuccessful attempts, two dry-harvest machines were introduced which late in the 1950's and in the early 1960's came to harvest over 90% of the State's crop. Mechanical damage to the vines was less and the pulling of root systems was almost eliminated by these machines. The efficiency of harvest improved also, so that only 5-20% of the berries was lost. Finally in the late 60's flood harvesting came to Massachusetts and it is certain that this mode of picking, though used on only one-third of the State's bogs, is largely responsible for the two successive record crops of 1970 and 1971. The first national million-barrel crop was raised in 1953, while the first state to raise such a crop is Massachusetts with its 1971 crop of 1,058,000 barrels. It would appear to be appropriate timing that the Massachusetts cranberry industry should produce its first million-barrel crop as the Arnold Arboretum celebrates its centennial year.

Finally, the control of insect pests must take its place in the forefront of the causes of high productivity. The Cranberry Experiment Station was originally founded by an entomologist to find ways of curtailing devastating losses due to insect depredation. As long ago as 1859, B. Eastwood published his book *The Cranberry and its Culture* in which it is clear that two kinds of “worms” cause extensive damage; one to the vines, the other to the fruit. In the effort to find controls for these and a dozen other insect pests, cultural methods like flooding and winter exposure were first thoroughly explored. By 1933 the following insecticides were in regular use: lead arsenate, Paris green, nicotine sulfate, sodium cyanide and pyrethrum. None of these is now used, but I can recall the smelly, hazardous job of dissolving 7 oz. of sodium cyanide in 100 gallons of water and
Above: Cranberry bog.
Below: Vaccinium macrocarpon in flower.
Photos: M. Gilmore
applying one gallon of solution to each square foot of cranberry bog in the effort to control root grubs, grape anomal and white grub. Here was a dangerous insecticide, men wading around in it with rubber boots and breathing fumes for the 9-hour work day, but I never heard of a casualty. Ground-rig dusters and aircraft made their appearance with the newer organic insecticides. Dragging hoses and the tramp of the booted feet of the spray gang caused much mechanical damage to the vines, so it was not long before helicopters and planes took over pesticide distribution, and refinements in their technique and a conversion to concentrate spraying has made for very efficient control. In the 1960's the installation of sprinklers has led to precision insecticide distribution through these devices, at the same time permitting treatment at dusk when birds and bees are no longer on the bog. The careful grower loses very little to insect pests today and he can do this with only three to five insecticide sprays * a year.

To read from the above you might gather all is well in the cranberry industry with its record crops, its control of pests, its mechanical harvesting, and even its sprinkler weather controls. Such is not the case, and our problems date back to 1959 and the amino-triazole cancer scare. With the nation's newspapers warning people of the hazards of residues on cranberries, the market died. It made no difference that we had a registered and approved use for the weedkiller that would leave no residue on the fruit, it made no difference that we had a fine educational program to instruct growers in the herbicide's proper use. Headlines across the country proclaimed the hazard. Very few Americans know the sequel. By agreement between the White House, growers organizations, U.S.D.A., and U.S.D.H.E.W., the growers, at their own expense but under supervision of H.E.W., tested systematically the unsaleable 1959 cranberry crop; when proved to be free of residue, it was allowed to be dumped and the grower was paid 8.1 cents per pound for his clean fruit. This was the estimated cost of production, and it cost the

* Unlike some commodities, cranberries in Massachusetts are treated only after insect infestations are discovered and quantitated. A prebloom treatment with Diazinon, Carbaryl or Parathion may be needed to control fireworms, cutworms, Sparganothis fruitworm, gypsy moth, tipworm, green spanworm or red mites. Repeated treatments with the same insecticides may be needed in late bloom or post-bloom to control the cranberry fruitworm, second brood fireworms, girdler larvae and weevils. An after-harvest treatment with Dieldrin may be needed once in five years (with drainage flumes closed) to control any of three species of root-eating grubs.
U.S.D.A. nearly $10,000,000 to pay for the residue-free berries that had to be destroyed. It was not until 1963 that a whole crop could be sold again. The industry was accused in the headlines; the efforts at amelioration were relegated to the back pages.

The cranberry crisis occurred three years before the publication of *Silent Spring*, described by Dr. Norman Borlaug as "half-science-half-fiction". Since then environmentalists have been attacking insecticides, and particularly DDT, with misused facts and many fancies. It has been many years since the cranberry industry has made use of DDT, but I was living and working on Cape Cod when the whole Cape was sprayed with DDT in 1949 and the whole of Plymouth County in 1950 for the control of the gypsy moth. I know that the gypsy moth was removed from our list of cranberry insect pests soon after this and that no cranberry bog in either county had to be sprayed for gypsy moth caterpillars for over twelve years. In fact, it was not until 1966 that the gypsy moth again appears on the cranberry insect control chart, and an extension education meeting was called to show the growers what the insect was and what it looked like. Perhaps you can imagine my disgust when I read in the May–June 1971 issue of the Massachusetts Audubon Newsletter in the unsigned article, "Man vs. Gypsy Moth", "... The knockout punch that man counted on was DDT — but it failed. In fact, biologists now say, it actually spread the gypsy moth, making it more annoying". This is pure rubbish, like so much of the environmentalist propaganda.

It is literally true that millions of people are alive today because of DDT, and the U.N. World Health Organization feels it cannot continue its programs for world health improvement without DDT. The U.N. Food and Agriculture Organization feels that tens of millions of the world’s people would die of starvation if we had a world ban of DDT. The outcry of the environmentalists has been so loud that it is now doubtful if we could get approval and registration of short-lived alternatives to the chlorinated hydrocarbon insecticides. The food production enterprise in U.S.A. is sorely beset by the very people who know the least about it and who at each mealtime take it all for granted.

Chester E. Cross
Professor of Botany and
Head, Cranberry Experiment Station
University of Massachusetts,
East Wareham
Willow Oak (Quercus phellos):
A Fenway Jewel

One of the living jewels which studs Boston's "Emerald Necklace" of park systems is a stately specimen of Quercus phellos, the Willow Oak. The tree is growing in the Fens near Boylston St., with the Fenway on one side and a steep bank leading to a shelter and the distant river on the other. Sturdy and majestic, the tree stands nearly 60 feet tall with a branch spread equal to its height. Its growth habit represents the best of both the willows and the oaks because its narrow, graceful leaves have a fine, willowlike texture, while its symmetrical rounded crown and dense branching habit give it the nobility of an oak. The 34-inch diameter and mature habit of this specimen imply an age of at least 80 years, so it seems likely this tree was
among the original plantings directed by Olmsted when he designed the "Emerald Necklace" in the 1880's.

*Quercus phellos* is a native North American species, common further south but rare in Massachusetts. It is distributed on the Atlantic coast from New York to Florida, along the Gulf Coast, and north on low sites into Missouri, Kentucky, and Tennessee. Nevertheless, it is hardy as far north as southern New Hampshire. The species generally prefers moist sites such as swamp borders, but will grow under dryer conditions.

The Willow Oak resembles the Pin Oak in a number of ways, and in fact is as widely planted in the south as Pin and Red Oaks are in the north. The tree grows rapidly, suffers from few pests, and has a shallow root system which makes it easy to transplant. The handsome, fine-textured form it develops is often characterized by slender drooping side branches, much like the Pin Oak. If planted more widely, the Willow Oak could provide desirable and interesting variety to the abundance of Pin and Red Oaks now in Boston; the Fenway tree stands as a living testament to the virtues of the species.

**Martha Dahlen**

(The author, a summer trainee at the Arnold Arboretum, is a student in horticulture at Purdue University.)

A beautifully produced book with numerous photographs, diagnostic line drawings, and colored plates, Eric Walther's monograph of the crassulaceous genus *Echeveria* represents the work of over 30 years, during which most of his energies were devoted to the development of the Strybing Arboretum and Botanical Garden in San Francisco's Golden Gate Park. At the
time of Walther's death in 1959, the manuscript of his monograph remained unfinished, but he had arranged with the California Academy of Sciences for his estate to be used to publish the work. Subsequently, the manuscript was edited and prepared for publication by John Thomas Howell with helpful collaboration from Elizabeth McClintock and Reid Moran, the latter a noted specialist in succulent plants.

Although by far the greater portion of the book is devoted to descriptions and keys to 143 species arranged in 14 sections, the introductory portion covers the botanical history, morphology, natural occurrence, and systematic position of the genus. In addition, cultural notes and sections devoted to hybrids and species in cultivation are included. As with most succulents, herbarium specimens of *Echeveria* are difficult to prepare, and diagnostic species characters are often obscured in pressed specimens. It is important to note in this connection that Walther's descriptions were largely based on living materials. Employing the type method of taxonomy, he revisited the type localities of numerous Mexican species to study the plants in nature and to supplement his studies of important herbarium collections.

Certainly most readers of this notice will be familiar with at least a few species of *Echeveria* in cultivation, both as houseplants and as striking ornamentals in warm temperate gardens. For persons wishing to know the identity of their plants, as well as botanists and horticulturalists anxious for more detailed information concerning the species of the genus, Walther's monograph will serve as the standard reference for years to come. It is a pleasure to see a genus of succulent plants (a group that as a general rule is dominated by amaturish coverage in the literature) monographed in a professional manner.

Stephen A. Sponberg

The Naturalists' Directory is an institution of impeccable ancestry and dubious prospects. The current edition lists "more than 3,000 individuals". The edition of 1895 lists 5747. This is not a reflection of decline in the number of naturalists, but rather a decline in the comprehensiveness of the Directory. There is a need for a comprehensive, national and/or worldwide listing of naturalists.

Most of the natural history specialist societies publish lists of members; some of them indicate the specialties of their members, some indicate current research projects of the individual members. There are fairly up-to-date, fairly comprehensive lists of arboreta and botanical gardens both national as well as international. One presumes that comparable lists are available for zoology and geology. If, as alleged, this is a compilation of materials, it is very poorly done.

To be sure, for one who has nothing else, it is better than nothing. However, a publication in its 41st edition ought to do better than this.

GORDON P. DeWOLF


John Harvey has written a fascinating book about the early trade in seeds, roots and plants, primarily in England from the Middle Ages until about 1800. It is of importance for American gardeners because such plants were available for American gardens, and tell us something of the way our ancestors gardened.

About one-third of the book is occupied by description text; the balance by reprints of various gardens and dealers' lists ranging from c. 1500–1833.

The one serious criticism one may make about the book is the size of the type. It is too small to be read with comfort by middle-aged eyes.

GORDON P. DeWOLF

This volume, subtitled "A pilot study", is a remarkable documentation of a theory. Holdridge proposed a model for the classification of the world's vegetation into 100 Life Zones arranged on the basis of latitudinal regions, altitudinal regions, and humidity provinces. The system has been applied in some tropical American countries and forms the basis of ecological vegetation maps of El Salvador, Guatemala, Panama, Honduras and Haiti. The present study is a detailed account of the vegetation of 46 selected forest sites in Costa Rica, culminating in an ecological map, with an appendix presenting data from seven areas in Thailand. It is remarkable that these data were assembled in about two years even with hard work.

Holdridge's system is complicated, but this volume presents the first detailed discussion of the factors he considers important. The sites selected were studied by means of several types of aerial photographs, and supported by on-the-ground transects of the vegetation and a great deal of climatological data, as well as soil chemical and physical data. The presentation of facts is remarkably clear. For each area there are stereopair photographs, some in color; standard profiles of the vegetation, also interpreted as idealized profiles; soil profile diagrams; crown cover photographs for vertical visibility, and these compared with MEGA vegetation diagrams of the Dansereau school. The best explanation available of the MEGA vegetation symbolization forms Appendix III. The only discordant element in an extremely handsome layout is the computer print-out reproduction of the species encountered in the Costa Rica study areas. The presence or absence matrix of sample tree species by life zones, which accompanies the listing, is also followed by a listing of life zones indicating the dominant taxa within each zone.

The authors asked three questions: "Does the use of the Holdridge system contribute to the organization and understanding of field data and thus lead to increased predictability? Is it broadly applicable? Is it usable in practice?" They conclude the answer is "yes", but they have demonstrated the difficulty of gathering the data desired as well as the value of
their data for comparative purposes. They admit there remains a problem of developing a predictive system which will produce reliable information on under-canopy features from aerial observations. The man observing within the forest is still needed.

RICHARD A. HOWARD


The publisher's blurb describes Mrs. Condon's instructions as "simple". Lucid they are; simple they are not. The author narrates in assiduous detail her method of preserving fresh flowers, using Great Salt Lake sand. Other equipment is described and pictured. Sources for supplies are given when required. Absolutely fresh flowers are essential, negating the preservation of a bridal bouquet. A large, dry working area is necessary and the patience of Job would be helpful. Mrs. Condon suggests that a course in flower arranging is advisable. She covers every vegetative subject which can be preserved by her method and even recommends its use by students of botany. A teachers' manual, special treatment for special flowers, and answers to frequently asked questions offer still more information. The book is well-indexed.

If one feels intensely about flowers going through the cycle of life, assisting other forms of life in the process, seeding, and returning to the earth which nourished them, then this book is not for him. However, in 1972 it was in its fourth printing indicating a strong desire by many to preserve flowers.

MILDRED PELKUS

The fact that The Compleat Naturalist is a biography of Linnaeus should be enough to recommend the book; in addition it is so handsomely illustrated (32 color plates and numerous half-tones) that it is as much a joy to look at as it is to read.

William Stearn's contribution, "Linnaean Classification, Nomenclature, and Method", makes this definitive work more definitive, if that is possible, and provides a simple, clear explanation of Linnaeus' contributions to science.

The account of Linnaeus' life makes interesting reading for the most part. No man's life is continually compelling, and some parts of the book are less compelling than others; but that is no fault of the author. Often the serendipitous information is
as interesting as the main line of the biography. There is a fascinating picture of university life at Upsalla during the 18th century, for example, which makes you wonder how anyone survived an education. Blunt’s account of life among the intelligensia of Europe, with their “curio cabinets” filled with treasures brought from around the world, also is interesting.

The biography of Linnaeus is a gold mine of botanical trivia, such as the story of Linnaea borealis, the only plant that bears Linnaeus’ name. He described it as “lowly, insignificant, disregarded, flowering but for a brief space — from Linnaeus who resembles it.”

DONALD M. VINING

Linnaeus’ drawing of a cranefly. From The Compleat Naturalist.

The flowering of the 'Picturesque' or English landscape garden may be attributed primarily to 'Capability' Brown and Humphrey Repton. Mr. Hyams details the life of each artist tracing the evolution and refinement of his talent and the influence of the society in which he flourished.

Lancelot (Capability) Brown, following in the footsteps of William Kent, was the greatest exponent of this essentially new approach to planning and planting. The presentation of his life and work is used as a vehicle for the author's questionable theories concerning English gardening. Information must be sparse on the design and execution of Mr. Brown's landscapes, for the text becomes overinvolved with names and places; thus it fails to really capture either the character or the mind behind the genius who was to influence the course of landscaping and ultimately produce a master such as F. L. Olmstead.

Humphrey Repton, on the other hand, published several books on his work and, luckily for us, all of Mr. Repton's clients were presented with 'Red Books' which contained plans, paintings and sketches, and detailed explanations of all proposed work. Mr. Hyams takes advantage of this information and not only gives us a fairly comprehensive view of the Reptonian landscape, but introduces us to a fascinating and complex artist who characterizes the society of the late 1700's and early 1800's. Unfortunately the book does not provide us with adequate illustrations or plans, but there is a list of the surviving works of each man so one may view the artistry first hand.

**JACK LINK**

This is an English book which has experienced a relatively painless transition to the United States. The bulk of the book is made up of an alphabetical listing of genera of plants in cultivation and their species, with translations of the Latin words. It will fulfill the author’s purpose: “An excursion into the mysteries of botanical names; and, I hope, an answer to your friends who fix you with a glassy eye and ask, ‘What’s that in English?’”

GORDON P. DEWOLF


Dr. Dahlgren, in 1936, brought together in one index taxonomic and nomenclatural information on all species of New World palms. Since that time a Palm Society has been organized, with its publication Principes; several important books on palms have appeared, including an annotated checklist of cultivated palms, and many smaller monographic studies. Glassman’s revision brings all sources together again by supplying an alphabetical list of names of New World palms. Accepted names and synonyms are indicated, along with basic bibliographic citations and designations of type specimens, and references to published treatments. A supporting bibliography cites papers into 1971. Appendices offer a geographical list of taxa by country, an enumeration of the genera, and the respective number of species.

This is an excellent reference volume for curators or collectors, and belongs in all botanical libraries.

RICHARD A. HOWARD

A coffee table book or micologists and others interested in mushrooms. The book consists mainly of 160 beautiful full-page color drawings of mushrooms. It might be useful for identification if you can get the mushrooms to the coffee table before they have discolored.

DONALD M. VINING
Your City Garden. Jack Kramer. New York: Charles Scribner’s Sons. 1972. 120 pages, illustrated. $3.95 paperback.


What these three books have in common is the word “garden” at the end of a three-word title in which the second word is an adjective indicating the place where the garden involved may be found. Throughout this review I shall refer to the books by the distinguishing adjective.

I question the whole premise of City. It is a landscape architect’s view of urban gardening — given world enough (and money enough) and time, you can manage to ignore the city entirely. The book is really about small gardens and the author assumes that city dwellers will be the most interested parties. Also, whichever city Mr. Kramer has in mind, it is not a city in the sense of urban Boston or New York where even dandelions have a hard time; he has a gentle city in mind, like Atlanta or Seattle, where gardening is not a struggle with a hostile land. Perhaps the title should have been Small Gardens in Seattle.

Country is a book to read straight through like a novel. It is Ms. Nuese’s affair with gardening. There is a great deal of really good information tucked in among the honeyed phrases and, truthfully, a deal of good wit too.

Southern is the kind of book that sits on my shelves and induces guilt. It is organized on the “what-to-do-in-the-garden-on-May 6th” principle and as long as it is in the house, you will feel that there is something to do in the garden that you are not doing — which is always the case anyway, so you don’t need a carping book. (Country is also arranged by months but you don’t have to do anything about it.) That business aside, Southern is a pretty standard type garden book with lots of good lists of things to plant.

DONALD M. Vining
John Banister has been one of the legendary figures of American botany. He was an English clergyman, sent to Virginia to study and collect objects of natural history for Henry Crompton, Bishop of London. He arrived in America in 1678. He died after a shooting accident in May of 1692. In the interim he supplied his correspondents in England with natural history material, much of which was utilized by them without acknowledgement.

The Ewans have provided us with an eminently readable book. They tell us as much about Banister as they could find — and a very great deal about his contemporaries and correspon-
dents. Indeed this book is a veritable mine of information about 17th century English botanists. Annotated transcripts are provided of Banister's catalogs of plants, insects and arachnids, mollusca, fossils, and stones and "Mr. Banister's papers". Finally, 69 of his drawings are reproduced.

This book can be enthusiastically recommended to anyone interested in the history of biology in America.

GORDON P. DEWOLF

Gonolobus obliquus. From John Banister and His Natural History of Virginia 1678–1692.

Although this little book is in German, its value is such that it should be brought to the attention of American readers. In the first place this book deals primarily with plants in cultivation. Its features include (1) a sketch of the systematic classification of the plant kingdom, (2) a list of the cultivated families of cultivated plants with a list of the genera included in each, (3) an alphabetical list of genera and species with directions for cultivation indicated by a series of conventional signs (a technique widely used in the last century), (4) a list of the abbreviated name of authors of plant names with their full names, dates, and brief biographical information, (5) a brief bibliography that indicates the outstanding current horticultural literature.

It is a book to stand on your desk beside the dictionary, for it will receive an equal amount of use.

GORDON P. DEWOLF


It is difficult to become enthusiastic about this book — but also difficult to condemn it. Its main strength lies in some very nice line drawings by Michael Valdez. There are many photographs which tend to be “arty” and not very diagnostic and the text is distinctly lightweight.

In fact, one could probably get all of the information here from a good one-volume horticultural encyclopedia.

This is a fairly good magazine article that has been blown up with photographs and wide margins to make a small book. In all fairness the price is not excessive.

GORDON P. DEWOLF

Trifolium pratense. Photo: P. Bruns
Method of maintaining fields at the turn of the century in the Arnold Arboretum. Drawing from historical photographs by P. Bruns.
ARNOLDIA is a publication of the Arnold Arboretum of Harvard University, Jamaica Plain, Massachusetts, U.S.A.