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46 BOOKS
The Great Catalpa Craze

Peter Del Tredici

Zealous promoters once made claims about the value of the hardy, or western, catalpa that far exceeded the tree’s true economic potential, obscuring its real worth

Horticulturists, who make it their business to pass judgments on plants, generally consider the catalpa tree a disaster. Although very beautiful, its large, heart-shaped leaves create a major litter problem when they fall. And during the growing season, their lovely, soft-green tints are generally masked by infestations of powdery mildew. The catalpa tree is among the last to leaf out in the spring, and in the autumn its foliage turns brown and shrivels in response to the first touch of frost.

The catalpa is sparsely branched; consequently, for six months of the year it presents a very stark, almost gawky, appearance. Its long pods, which provide the reason for the plant’s common name, the Indian bean tree, add a note of interest to the winter silhouette, but in the spring, when they fall, they provide the homeowner with yet another reason to curse the tree. To top off this bleak situation, catalpa wood is quite brittle, and small branches regularly break off during storms.

Without a doubt the flowers are the primary ornamental feature of the catalpa. They are produced in early summer and rival those of the common horse-chestnut (Aesculus hippocastanum) in showiness, being quite large, pure white, and lightly speckled with purple and yellow spots arranged in parallel bands. Unfortunately, this bloom period lasts only about a week or so, depending on the weather.

In short, the catalpa has too many black marks against it to win favor with modern horticulturists. Yet, this was not always the case. There was a time, in the late 1800s, when planting catalpa was the thing to do, and people up and down the East Coast, across the Great Plains, and as far as California were madly planting the tree everywhere. The movement to plant catalpa was a fad not dissimilar to the one of planting Paulownia in the middle Atlantic states today or Ailanthus in urban areas, from the early to mid-1800s.

While the active planting of catalpa has by and large ceased, the tree has managed to increase its range on its own, as spontaneous seedlings sprout up along highway embankments, roadsides, and stream banks throughout the East Coast. In some towns, spontaneous catalpa is so well established that one is tempted to look upon it as part of the native vegetation.

The Two Species

There are two distinct species involved in the parentage of these escaped catalpas. Both are native to the eastern United States and, while very similar, occupy nonoverlapping ranges in their wild state and have quite distinctive growth habits. The first, the southern catalpa, Catalpa bignonioides, occupied a rather limited range before the European settlement, growing along river banks from central Alabama and Mississippi to western Florida. Because of its showy flowers, catalpa was very quickly and widely planted throughout the south, so that even the early
botanists could not determine its original range with certainty.

The second species, the western, or hardy, catalpa, *Catalpa speciosa*, is geographically separated from its southern cousin, growing in a small area encompassing southern Indiana, Illinois, Missouri, western Kentucky and Tennessee, and northeastern Arkansas. This disjunct population of catalpa was not recognized as distinct until 1853, when Dr. John A. Warder of Cincinnati, Ohio, first described it. While it is difficult if not impossible to distinguish the two species in the herbarium, they are fairly easy to separate in the field. For one thing, *Catalpa speciosa* blooms in late May or early June in New England, a good two weeks before *Catalpa bignonioides* does. For another thing, *Catalpa speciosa* usually is a tall, narrow tree, upwards of 80 feet in height, with a straight trunk, while *Catalpa bignonioides* is considerably smaller, usually around 40 feet, with a contorted or low-branched trunk and a wide spreading crown.

In areas where the two species are planted together, there is often an overlap in the end of the *Catalpa speciosa* bloom and the start of the *Catalpa bignonioides* bloom. This raises the distinct possibility of hybridization, which, if it occurred, would give rise to trees intermediate between the parents in stature and in time of bloom. It is quite possible that some of the spontaneous plants one sees along the roadsides are of hybrid origin, in contrast to the cultivated plants, which are usually identifiable as one species or the other.

The question remains as to why and how these two species of catalpa came to be so widely planted that they became part of the spontaneous flora of the East. The answer eluded me for many years, until I consulted the fountainhead of information on trees, *The Silva of North America*, by Professor Charles Sprague Sargent. This many-volume work is special because it was produced at a time when botany, horticulture, and forestry were not seen as separate specialties; it contains, therefore, everything that was known about trees through 1894.

**Apostles for Catalpa**

According to Sargent, two men, E. E. Barney of Dayton, Ohio, and Robert Douglas of Waukegan, Illinois, became apostles for the western catalpa during the 1870s, the former writing and publishing a book about the virtues of *Catalpa speciosa*, while the latter was the principal contractor for the actual planting of catalpa on large tracts of prairie owned by various railroad companies. By his own reckoning, Douglas had planted over two and a half million seedlings throughout Kansas and Missouri in less than six years. Barney’s pamphlet of 1878, *Facts and Infor-
mation in Relation to the Catalpa Tree, offers a clear picture of the catalpa gospel of the day.

A railroad man, Barney saw the catalpa as solving the specific problem of obtaining railroad ties for the construction of new lines across the treeless Great Plains. Barney felt that catalpa wood was the ideal solution to this problem because it was extremely resistant to decay. Catalpa was further suited to the task since it grew incredibly fast and was not particular about what type of soil it required. Barney predicted that seedlings planted in good soil would produce four to eight ties each after twenty-five to thirty years of growth.

In addition, Barney advocated its use for poles, fence posts, and, because of its beautiful flowers, general civic beautification. He also stressed the fact that while there were two distinct varieties of catalpa, only the hardy, or western, variety grew fast enough and straight enough to have any economic potential. The southern variety, while it was equally beautiful in flower, was a much smaller, less straight tree that was useless for railroad ties or poles. In the second edition of his pamphlet, published in 1879, Barney included articles by both C.S. Sargent and J.A. Warder, which made it much more scientific than the earlier work.

Barney did much more than attempt to convince people to plant the tree; he actually offered them seeds of Catalpa speciosa: "I will send by mail, postage paid, to anyone wishing the seed, enough to plant one acre four feet each way (2500 seeds), and a copy of this pamphlet, upon receipt of fifty cents." There can be little doubt that this early, at-cost distribution of seed played a key role in helping Catalpa speciosa to get established throughout the country. Catalpa seeds have no dormancy requirements; they germinate immediately upon sowing. No doubt this ease of cultivation also contributed to its successful establishment.

An Experimental Planting

A year after the second edition of Barney's pamphlet appeared, the most famous planting of western catalpa was undertaken by Horatio Hollis Hunnewell, Charles Sprague Sargent's friend and relation. Hunnewell was first and foremost a businessman who served either as director or president of some thirty-four different railroads between 1852 and 1901. He was also deeply interested in plants. In 1880, at the age of sixty-five, he managed to merge these two interests by commissioning Robert Douglas to plant four hundred acres of Catalpa speciosa and one hundred acres of Ailanthus altissima on a tract of prairie near Farlington, Kansas. The trees were planted on four-foot centers, which gave a density of two thousand per acre. The seedlings grew very rapidly at first, reaching an average height of twenty-two feet, three inches in diameter after only nine years. This growth rate was sufficient to have the experiment hailed as a success by all those who saw it (and some who didn't), and led to the planting of many more plantations by other railroad companies.

Horatio Hollis Hunnewell (left) and Charles Sprague Sargent in Horticultural Hall, Boston Photograph from the Archives of the Arnold Arboretum.
Unfortunately, the growth rate of the trees in the Hunnewell plantation slowed down considerably after the first nine years as overcrowding became an inhibiting factor. When the trees were last measured in 1898, at eighteen years of age, the average height was only thirty feet and the average diameter slightly less than four inches. In other words, after showing an average height increase of 2.4 feet per year during the first nine years, the trees slumped to an average height increase of only 0.9 foot per year during the second nine years.

In 1902, William L. Hall, superintendent of tree planting for the U.S. Department of Agriculture's Bureau of Forestry, estimated the average value of the Hunnewell plantation to be about $400 per acre. When the trees were finally cut in 1905, the actual gross profit was near $500 per acre. Hall calculated the expense of establishing and maintaining the plantation at about $115 per acre. Subtracting this figure from the $500 gross leaves a net profit of $385 per acre after twenty-five years.

Interestingly, almost all of the harvested trees were made into fence posts, while a few of the tallest and straightest trees were made into telephone poles. According to A. E. Oman, writing in 1911, none of the plantation trees ever grew big enough to make railroad ties. On three other Kansas plantations that Oman looked at, totalling approximately one thousand acres, the story was repeated — plenty of fence posts, a few poles, and no railroad ties.

While fence posts were not exactly what had been envisioned when the catalpa plantations were set out, they did make a reasonable profit for their owners. Unfortunately, the twenty to twenty-five years that one had to wait for it was too long for most farmers (and businessmen) to wait. And so corn and wheat were planted instead of catalpa.

Once the initial publicity blitz for western catalpa was started by Barney, planting of the species seems to have attained a momentum all its own. The fact that the plantations produced fence posts rather than railroad ties after twenty-five years was not, of course, fully appreciated when the seedlings were set out.

**A Practical Experiment**

Even before the harsh economic realities of planting catalpa were fully appreciated by people, Hunnewell’s cousin, the indefatigable Charles Sprague Sargent, raised serious questions about the widespread assumption that catalpa timber made good railroad ties. In 1886, Sargent published the results of an experiment that had been set up eight years earlier to test the practicality and longevity of catalpa ties:

The Boston and Providence Railway Corporation began in 1878, at my suggestion, an experiment for the purpose of determining the value of different woods for cross ties. Fifty-two ties were laid on the 12th and 13th of December, under the direction of Mr. George F. Folsom, master carpenter of the corporation, who has had, from the beginning, the entire charge of the experiment, in the main outward track, at a point beginning 775 feet west of the Tremont Street crossing in Boston. The traffic at this point is very heavy, an average of sixty-five trains passing over this track daily. The following ties were laid:

- Nos. 1 to 3, American Larch.
- Nos. 4 to 12, White Oak.
- Nos. 13 to 18, European Larch.
- Nos. 19 to 24, Western Catalpa.
- Nos. 25 to 30, Ailanthus.
- Nos. 31 to 36, Black Spruce.
- Nos. 37 to 38, Southern Hard Pine.
- Nos. 39 to 40, White Elm.
- Nos. 41 to 46, Hemlock.
- Nos. 47 to 52, Canoe Birch.

The catalpa ties were furnished by the late E. E. Barney, of Dayton, Ohio, who for many years before his death was zealously engaged
in making known the value of the catalpa tree, and the remarkable durability of its wood.

Upon completion of the experiment, Sargent found that western catalpa had failed to live up to its press releases:

The behavior of the catalpa is one of the most interesting features in the experiment. . . . The catalpa is a soft, light wood, with a specific gravity of only 0.4165; and it has not shown its ability to resist the heavy and constant traffic of the Providence Railroad as well as white oak and other heavier and harder woods. The two catalpa ties taken from the track in October, 1885, that is, after four years and eight months' service, are perfectly sound except under the direct bearing of the rails. These had cut down into the wood to the depth of five-eighths of an inch, while the whole mass of wood under the rail is reduced nearly to pulp by the separation of the layers of annual growth and the breaking of the fibre. This disintegration has penetrated so deeply that if the ties, otherwise perfectly sound, were turned over, the wood which would then come under the rail would not have sufficient thickness to hold the spikes. The pressure, however, to which these ties have been subjected has been unusually severe, and there is nothing in the behavior of these catalpa ties to show that they would not, in a road with lighter traffic, have stood for a number of years, and resisted as well and probably better than ties made from any other equally soft and less durable wood.

Sargent concluded that white oak made the best ties of any of the species included in his experiment. He noted, however, that
The two Catalpa speciosa trees received as plants in 1886 from Robert Douglas of Waukegan, Illinois. The trees are now about fifty-five feet tall. Photograph by Peter Del Tredici.
American chestnut, which unfortunately was not tested, was to be preferred because it allowed the spikes to be removed more easily than did white oak, when the time came to move or change the rails.

Yet even this clear statement of the facts seems to have gone unheeded, as John P. Brown of Chicago, editor of Arboriculture, continued to advocate in his journal the planting of catalpa for railroad ties well into the 1900s. A very high percentage of the early numbers of Arboriculture were devoted exclusively to the “wonders” of hardy catalpa. Brown’s efforts, like Barney’s twenty years earlier, no doubt greatly stimulated the planting of the tree.

**Legitimate Uses for Catalpa**

All of this is not to say that the widespread planting of Catalpa speciosa was a mistake to be regretted. To the contrary, the plant contributes significantly to the beauty and diversity of the countryside, whether in flower or in leaf. Belonging to a family of plants that is primarily tropical, the Bignoniaceae, it adds an exotic appearance to eastern and midwestern roadsides. Two stately specimens of Catalpa speciosa at the Arnold Arboretum (2776-A and 2776-B) show just how spectacular the tree can be when grown as a specimen. They were received in 1886, exactly one hundred years ago, as plants from the “Johnny Appleseed” of hardy catalpa, Robert Douglas of Waukegan, Illinois. Towering above the lilac collection, they are both about fifty-five feet tall with very straight trunks thirty-two and thirty-five inches in diameter, respectively. Dripping with long pods against the winter sky, they make a particularly dramatic impression. Nearby is a specimen of Catalpa bignonioides (12926-A) planted in 1891, that is forty-three feet tall, with a broad crown and a short trunk twenty inches in diameter.

The hardy catalpa can be a superb landscape plant in the proper location. It is not a good shade or street tree because of all the litter it drops. But in a parkland situation, where the tree can develop as a specimen, its showy flowers, distinctive foliage, and unique growth habit can add considerable interest to the landscape. In addition, its tolerance of poor, sandy soils, as well as of soils that are periodically inundated with water, makes the tree ideal for planting in habitats that have been badly disturbed or where spring flooding is a problem.

Catalpa also does well in cities. In downtown London, for example, Catalpa bignonioides is widely planted and seems to grow quite well. When I asked an English horticulturist why this was so, given that I hadn’t seen it anywhere in the countryside, he replied that downtown London was the only place in England hot enough in summer for catalpa to grow. It’s an odd twist of fate that a tree considered a weed by many in the United States should be a pampered prize in England.

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Peter Del Tredici, assistant plant propagator for the Arnold Arboretum, writes often on horticultural subjects for *Arnoldia* and *Horticulture* magazines. Not long ago, Theophrastus published his book, *St George and the Pygmies*, a study of *Tsuga canadensis* 'Minuta'.

**A Word about the Cover Artist and Her Work**

*Arnoldia* is privileged to have for the cover of this issue an elegant watercolor painting of *Catalpa speciosa* by the distinguished botanical artist, Esther Heins of Marblehead, Massachusetts. Together with some sixty-seven other equally superb watercolors, this painting will be published during the spring of 1987 by Harry N. Abrams, Inc., of New York City under the title, *Flowering Trees and Shrubs*.

Educated at the Massachusetts College of Art and the School of Vision, Salzburg, Austria, Esther Heins studied painting with Ernest L. Major and Oskar Kokoshka. Her work has been displayed in many exhibitions, including three one-woman exhibitions. Paintings by her are part of the permanent collections of the Museum of Fine Arts, Boston, the Hunt Institute for Botanical Documentation, Pittsburgh, and the Boston Public Library. Previously, her work has been published by *Horticulture, Arnoldia, JAMA* (the journal of the American Medical Association), and the Hunt Institute, among others. *Arnoldia* is pleased again to share Mrs. Heins’s work with its readers.

**Corrections**

Because of an editor's error, the captions for *Daphne odora* 'Ringmaster' and *D. odora* 'Zuiko Nishiki' (*Arnoldia, Volume 45, Number 2, Spring 1985, page 14*) were transposed. *Arnoldia* regrets the error.

Through an oversight, Theodore R. Dudley's name was absent from the list of American members of the 1980 Sinoh-American Botanical Expedition given on page 13 of *Arnoldia, Volume 45, Number 4, Fall 1985*. Dr. Dudley, Research Botanist at the U. S. National Arboretum, who was especially interested in Chinese species of *Ilex* and *Viburnum* during the Expedition, informs *Arnoldia* that the painting printed on page 16 of that issue and attributed to "an unknown artist" was in fact done by Xin Ke-jiang of the Creation Group of the Bureau of Culture, En-shi Xian ("County"), Hubei province. *Arnoldia* thanks Dr. Dudley for having passed this information along.
Prunus maackii, the Friends’s Plant Dividend for 1986

Gregory J. Waters

Friends of the Arnold Arboretum receive the exceptionally cold-hardy Amur chokecherry as a benefit of membership

All members of the Friends of the Arnold Arboretum will be receiving ready-to-plant seedlings of Prunus maackii in late April or early May, as this year’s plant dividend. In mid-April, staff members and volunteers working in the Dana Greenhouses shipped the six- to twelve-inch seedlings by U.S. mail. Recipients who live farther north than Boston will be pleased to learn that the species is hardy to at least minus 35 degrees Fahrenheit. Unfortunately, Prunus maackii does not perform well south of Zone 6 owing to the stresses of summer heat.

The common name, Amur chokecherry, refers to the species’s native habitat along the Amur River in northeastern China (Manchuria) and southeastern Soviet Union. Prunus maackii is native to parts of Korea as well. The Flora of the U.S.S.R. states that Prunus maackii occurs in the “taiga, mixed forests, rare in conifer forests and even more rare in purely broad-leaved forests, often on mountain slopes, in illuminated sites, along streams, forest edges and clearings, and coarse rock taluses.”

Its history at the Arnold Arboretum goes back 108 years, to 1878, when the Arboretum was in its infancy. During the summer of that year, the Arboretum’s first director, Charles Sprague Sargent, and Asa Gray were actively consulting with Frederick Law Olmsted on the preliminary plans for incorporating the Arboretum into the City of Boston’s park system. That year, plants of Prunus maackii arrived from the botanic garden in St. Petersburg (now called Leningrad). This was the first recorded introduction of the species into the United States. Prunus maackii was not introduced into Britain until 1910.

Though the Amur chokecherry produces small racemes of white flowers (see the back cover of this issue of Arnoldia) and pea-size dark-purple fruit, the main ornamental attraction is its bark. Golden brown and glossy, it peels off in thin strips when mature. Lit by afternoon sun or seen against a backdrop of snow, the beautiful bark of Prunus maackii is an unforgettable sight.

Few Friends of the Arboretum can have missed the prominent pondside planting of the species adjacent to the new Bradley Rose...
Garden. These trees are descendants of seeds collected by the Russian botanist B. V. Skvortzov from a forest east of Harbin, Manchuria, on September 19, 1939. Skvortzov sent the seed to the United States Plant Introduction Station at Glenn Dale, Maryland, in January 1940, where they were assigned Plant Introduction Number 135617 and planted. In 1961, scion material from the Plant Introduction Station trees was sent to the Arnold Arboretum, where it was grafted onto Prunus serrulata rootstalk and given Accession Number 388-61. Vegetative cuttings from these grafted trees yielded the trees we have today. Because of their distinctive glossy bark, which can be viewed year round, they are among the most commented-upon trees in the Arboretum.

The Arboretum's records indicate that Prunus maackii can be propagated by seeds, cuttings, and grafts. (See Alfred J. Fordham's detailed article on the propagation of Prunus maackii below.) Perhaps the easiest method of propagation for the general gardener would be to take semi-hardwood stem cuttings in mid-July and to treat them with an 0.8 percent indolebutyric acid dip or with an equally strong powder. Placed in a rooting medium of equal parts of sand and perlite, and kept in the humid atmosphere of a mist bench or enclosed in a plastic bag, the cuttings should have roots within ten to twelve weeks. Seedlings should be kept cool until they are planted outdoors, preferably in mid-May. They should be planted in sites with moderate to full sun, in well drained soil. Young trees should be staked for the first two or three years so that their shallow roots can become firmly established.

Pruning and controlling insects and diseases should be easy with the Amur chokecherry. During the early years, structural pruning performed in late winter corrects the tree's naturally small branching angles and improves its overall shape. Proper care and maintenance keep insect and disease problems to a minimum.

Gregory J. Waters has worked as a horticulturist in Holland, England, and Pennsylvania, and at the Arnold Arboretum, where he has been an intern in both plant propagation and horticulture. Currently a graduate student in ornamental horticulture at Cornell University, he has previously written for Horticulture and American Nurseryman, as well as for Arnoldia
Notes and Quotes on the History and Origins of the Amur Chokecherry (*Prunus maackii*)

*Maackii, amurensis, ussuriensis*—these and certain other specific epithets, or variants of them, appear in the scientific names of many specimens in the Living Collections of the Arnold Arboretum. There is even a genus *Maackia*, the type species of which is *Maackia amurensis*. All are linked by a story that combines plant exploration with the international intrigue and politics of a century and a quarter ago, intrigue and politics that led to the discovery, and eventually to the cultivation, of *Prunus maackii*, the Amur chokecherry. How? Perhaps the comments made in *Horticulture* magazine in 1912 by the Midwestern horticulturist, E. O. Orpet, give us the best excuse to explore the issues surrounding the origins of *Prunus maackii*. Orpet wrote as follows:

### Prunus maackii

Surprises come to all of us who have eyes to see, and the other day when visiting Mr. William Constantine Egan at “Egandale,” his estate in Highland Park, Illinois, by invitation to see his “Russian May Day” trees in full bloom, it was a revelation indeed, and yet a puzzle to explain how it is that so good a thing, with all the help Mr. Egan has given it in the way of publicity, should be practically unknown in cultivation, certainly unlisted in catalogues, and given only scant notice in Bailey’s *Cyclopedia*.

The trees with Mr. Egan are rapid in growth, with perfect pendulous habit for a specimen or lawn tree, and they are in full bloom with the shad-bush, which most of us regard as the harbinger of the flowering trees. The whole tree was covered with the spikes of bloom, these being as large as and much more abundant than our *Prunus serotina*, and the sweet fragrance can be noticed many yards away. A very happy and instructive combination is obtained by the planting of *P. maackii, P. padus* and the native *P. serotina* in the same group, thus having the European, Russian, and American Bird Cherries, no two of which flower together. When asked as to seeds, Mr Egan said it was very hard to get as the birds carried them all off. There is compensation in this, however, for we noticed the young trees coming up spontaneously in the vicinity presumably from seed carried by birds.

It would appear from other cultivated trees of *P. maackii*, that it does not bloom for at least twelve years from seed; we find that this is so with specimens here in Lake Forest and in Lake Geneva, but after they do begin, it is a continual May Day feast, and we doubt not that in the future, when better known, *Prunus maackii* will figure in the landscape to a marked degree. The writer is free to confess personally that not in ten years has any tree or shrub made as great an impression at first sight, hence the present note.

The first week in November last, Mr. Dunbar pointed out in Highland Park, Rochester, N. Y., *Lonicera maackii* in fruit, bearing as profuse as we see it in *L. morrowii*, in August. There are few shrubs fruiting in November, and this had a very distinct decorative value. We have young plants now raised from a few seeds gathered at that time, but this again is a plant we do not find in catalogues; in other words it can’t be bought.

It appears that there was once a *Maackia amurensis*, now reduced to *Cladrastis*. The three plants under note are from Mandschura, and were described by Ruprecht. We are wondering who Maack was. Perhaps some one from the Arboretum can tell us.

In this particular year when we are all talking about hardiness or otherwise of all outdoor things, it is good to be able to report...
Prunus maackii
so favorably on a seemingly new tree, originally distributed by Prof. J. L. Budd of Ames, Iowa, and said to be the hardiest farthest north of all Chemes with a very marked horticultural value as a decorative tree.


**A Case of Misplaced Enthusiasm?**

Messrs. Orpet and Egan, among others, would have been chagrined to read the following information in an article by Charles Sprague Sargent that was published in *Garden and Forest* in 1888. Discussing a very-early-flowering variety of *Prunus padus* (like *Prunus maackii* a bird cherry from Manchuria), Sargent reported that a specimen in the Arboretum’s collections was raised from seed sent many years ago to the Arnold Arboretum from the St. Petersburg [Leningrad] garden as *Prunus Maackii*, a Manchurian Bird Cherry, with pubescent foliage and young branches, while those of this plant are quite glabrous and show no trace of the glandular dots which cover the under surface of the leaves of that species.

While they might have failed to see the by then decades-old *Garden and Forest* article, Orpet and Egan no doubt did see a much later one—which may also have been written by Sargent—in the *Bulletin of Popular Information* (now called *Arnoldia*), in 1917, though chances are they already knew the unhappy truth it revealed. In the later article, an anonymous author confesses, in describing a specimen of *Prunus padus var. commutata* in the Arboretum’s collections, that

The seed from which this plant was raised was sent from the Botanic Garden at Petrograd [Leningrad] in 1878, incorrectly as *Prunus Maackii*, under which name the young plants were distributed from the Arboretum, and as *Prunus Maackii* it is still cultivated and much esteemed in some Illinois gardens.

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Maackia amurensis var. buergen in the Arnold Arboretum. Left: habit, right: close-up of leaves and an inflorescence. Maackia is one of the many plant taxa named after Richard K. Maak. Photograph by Herbert W. Gleason From the Archives of the Arnold Arboretum.

The Arboretum’s records on the seeds sent from Leningrad seem to be lost. In 1915, however, it did receive “Seed” of *Prunus padus* var. *commutata* from none other than E. O. Orpet of Lake Forest, Illinois. No doubt there had been an interesting exchange of letters between him and Sargent in the three years since his piece on “Prunus maackii” had appeared in *Horticulture*. The Arnold Arboretum did receive three authentic plants of *Prunus maackii* from Leningrad in 1878, however, one of which survived until 1946, when it had to be removed because it was in poor condition.

Fortunately, the two taxa can easily be distinguished from each other. The following chart should help expose any specimens of *Prunus padus* var. *commutata* still masquerading as *Prunus maackii*:

<table>
<thead>
<tr>
<th>Most Likely</th>
<th>Time of Bloom</th>
<th>Length of Racemes</th>
<th>Flowers</th>
<th>Leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Prunus maackii</em></td>
<td>Mid- to late May, after leaves appear</td>
<td>2 to 3 inches</td>
<td>½ inch</td>
<td>Mudribs hairy beneath, glandular dots on lower surfaces</td>
</tr>
<tr>
<td><em>Prunus padus</em> var <em>commutata</em></td>
<td>Early May, before leaves appear</td>
<td>3 to 6 inches</td>
<td>½ inch</td>
<td>Hairless, no dots on lower surfaces</td>
</tr>
</tbody>
</table>

Richard Karlovich Maak

*The Great Soviet Encyclopaedia* states that Richard Karlovich Maak was “Born Aug. 23 (Sept. 9), 1825, in Arensburg, present-day Kingissepp, Estonian SSR; died Nov. 13 (25), 1886, in St. Petersburg.” He was, the *Encyclopaedia* continues, a “Russian naturalist and explorer of Siberia and the Far East.” (In English translation, the *Encyclopaedia* renders the surname “Maak,” not “Maack” as most other sources do.)

“In 1853, Maak took part in the expedition which first described the orography, geology, and population of the basin of the Viliui, Olekma, and Chona rivers” the great work continues. “He studied the valleys of the Amur (1855-56) and Ussuri (1859) rivers.” An account of Maak’s work in the Amur valley,

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*Puteshestvie na Amur, sovershennoe po rasporyazheniyu Sibirsogo otdela Rosskogo geograficheskogo obshcheskogo obshchestva v 1855 godu*, was published in St. Petersburg in 1859. The title is usually given in English as *Journey to Amur in 1855*. Here, at least in brief outline, is an answer to E. O. Orpet’s query.

Emil Bretshneider, the Russian biographer, tells us more. Maak, he says,

studied natural sciences at the St. Petersburg University, took his degree of Candidate, in 1849, and in 1852 was appointed Professor of Natural Sciences at the Gymnasium of Irkutsk. Subsequently he became Director of that Gymnasium, and from 1868 to 1879, he was Superintendent of all schools in Eastern Siberia. He died at St. Petersburg,
November 13, 1886.

Maak described his first expedition down the Amur and back in a book entitled: Journey on the Amur, in 1855 (in Russian), published in 1859, accompanied with an Atlas containing maps, views and drawings of plants.

The expedition left Irkutsk in April 1855, and proceeded by the ordinary way to Nerchinsk. Here, at the discharging of the Nercha into the Shilka, they found a great raft prepared for them, on which they embarked on the 5th of May. Albazin, May 26, stay till 31st.—On August 8, the expedition arrived at the post Marinsk, near the Kidzi Lake and remained there till August 14. Then back up the Amur River, reached Aigun October 11, spent a month there. On November 12, started on horse back, for the Amur was frozen, following the river valley. Ust Strelka, December 30, Irkutsk January 16, 1856.

As on this river journey frequent stops were made, sometimes for several days, Maak had a favourable opportunity for making botanical and zoological collections. The plants gathered by him in the Amur valley, in 1855, were determined and described by Maximowicz in his Primitiae Florae Amurensis.

The Amur River

The Amur River (Hei-lung Chiang in Chinese) is a river of eastern Asia that forms the present border between the Soviet Union and China (Manchuria, or Heilongjiang). Flowing generally southeastward, the Amur is nearly 1,800 miles in length. (Counting the Shilka-Onon system, the Amur would be 2,700 miles in length.) It did not always form the frontier between the two countries, however. Before 1858, when China ceded all lands north of the Amur and east of the Ussuri rivers to Russia by the Treaty of Aigun, the Chinese claimed both of its banks. Russians had first reached the Amur area in the Seventeenth Century, but by the Treaty of Nercinsk [1689] had yielded it to the Chinese. Russians began to colonize the area again in the Nineteenth Century. Richard Maak, the botanist, was part of that second wave.

Enter Perry McDonough Collins

Only a few months after Richard Maak explored the Amur River, an American, Perry McDonough Collins, having travelled the length of Russia eastward from Moscow, drifted down the Amur on a barge provided by Siberian officials, the first American to navigate the Amur from its source to its mouth. A businessman and promoter, Collins had managed to get himself appointed the official “American Commercial Agent to the Amoor River.” Attracted by the potentialities he saw for American trade in the Amur region, he went there to see for himself, and on behalf of the United States government. Like other Americans of the time, Collins was afflicted with “Russian fever.” Eventually, the era of good feeling between the United States and Russia would be capped by the sale of “Russian America” (Alaska) to the United States in 1867.

In an account of his travels, prepared for the United States Congress (A Voyage Down the Amoor, originally published in 1857, and reprinted by the University of Wisconsin Press in 1962 under the title, Siberian Journey: Down the Amur to the Pacific, 1856–1857), Collins captured a moment of change in czarist Russia’s eastward expansion and development of Siberia. Fresh from the developing frontier of his own country, Collins saw Russian activities in the Amur region through approving eyes. “Siberia is comparatively a free country,” he wrote.

There are no landed proprietors, no serfdom. The land belongs to the Crown, and is given to the settlements or villages in the country or to individuals in cities. Public sentiment and speech are quite free also; in fact, the reins of government seem to set lightly on her people. The people are hardy and robust, accustomed, like our own frontiersmen, to
a rough and active life, have the rifle and use it well, as the mountains of furs and skins seen in the cities and market-towns fully attest.

Collins described the mighty Amur in terms any American could have understood:

The river is truly a grand one, and since we passed the Zea, more and more resembling the Mississippi, and since we passed the Songahree, and now the Ousuree [Ussuri], in many places with its cut and crumbling shores, falling-in timber, and the muddiness of its waters, and its huge sandbars, the resemblance has become almost perfect.

From the Songahree the Amoor is certainly a more considerable river in breadth than the Mississippi below the mouth of the Ohio. The expanse of water, the numerous islands, and the many navigable chutes, some of them thirty miles in extent, must give it more breadth than the Mississippi. As for distance, above the Ousuree the river is divided into two parts, one—the right—usually navigated, into which falls the Ousuree, deep, and about the size of the Ohio; the other, broad and filled with islands, bars, and chutes, certainly as large as the Mississippi above Memphis, and looking very like it.

Charles Vevier, who edited the 1962 reprinting of Collins's book, summarized the political situation of the Amur region during the 1850s in the following clear terms: "Economic opportunity in this unknown region . . . was grasped in a Russian fist which now, after some two hundred years of negotiation, had unclenched, spreading its fingers over the Amur region, the Ussuri River area east to the Pacific coast, Northern China, Sakhalin, and Japan." There was at least one benign result of Russia's thrust into eastern Asia, a flood of plant material new to botany and horticulture. Richard Maak alone discovered forty-two new taxa in the Amur and Ussuri river valleys on the two expeditions he made to the region during the 1850s, the first in 1855, the second in 1859. The genus *Maackia* was among the new taxa, as was the species *Prunus maackii*. It was the year after Maak's first expedition to "Amur-land" that China, in the city of Aigun, relinquished all claim to territory north of the Amur and east of the Ussuri. Two years later (1860), Russia established the town of Vladivostok at the southeasternmost extremity of its newly secured territory.

**Professor Sargent & Son in Amur-land**

Forty-three years later, Professor Charles Sprague Sargent, the first director of the Arnold Arboretum—accompained by his son, A. Robeson Sargent, and the naturalist—writer, John Muir of California—travelled to the Amur region in search of plants. They left the United States on May 29, 1903, on a six-month around-the-world tour, arriving in Russia on August 1st and the Amur region a dozen days later. The journey went well for the most part until the travellers arrived in Manchuria and Siberia. There, they had to spend days at a time on hot, crowded trains, unable even to change their clothes. The food was abominable; at Harbin, Manchuria, Muir developed a severe case of food poisoning. These hardships, plus a profound difference of temperament between Muir and the elder Sargent that intensified during the trip, prompted Muir to strike out alone once the party had escaped Siberia and Manchuria. A newspaper interview with Robeson Sargent and private accounts of the trip by Muir follow.

**Prof. Sargent Garners Rare Specimens of Eastern Flora**

*His Recent Expedition to Russia, and Through Siberia, Will Be of Vast Benefit to Plant Collection at Arnold Arboretum*

Prof. Sargent, of the Arnold Arboretum, has just returned from a 6 mos.' tour of Russia and Siberia.
The journey was undertaken by Prof. Sargent for the purpose of securing an exhaustive collection of tree and plant specimens, and in this arduous task he was assisted by his son, A. R[obeson]. Sargent, the landscape architect.

More than 8000 bulbs, seeds and roots were the result of the expedition, and while it will require many months for development to reveal the exact value of the collection, the professor is sure that many rare specimens of eastern flora have been gathered and the success of this mission is a question beyond cavil.

The party left New York May 29, and entered the land of the czar Aug. 1.

Several weeks were devoted to the Crimea, where the younger Sargent was charmed with the landscape effects of the gardens attached to the imperial palace, pronouncing them surpassed only by the craft of the Italian landscape gardener.

"The most superb thing in nature that Russia had to offer," said he,

was the voluptuous floral display of Mt. Kasbek, a spur of the Caucasus range, where 10,000 ft above the sea level the luxurious profusion of wild flowers was astounding.
Every conceivable color was there to be found, and yet the blending was in such perfect harmony that it constituted a color scheme well worth cultivating in landscape gardening, and one scarcely creditable to accident alone.

My one ambition is to reproduce the effect in America.

We entered Siberia by way of the Chita branch of the railway and spent 28 nights upon the tram, during 10 of which we did not remove our clothing, owing to the miserable sleeping car accommodations.

In Russia every traveler takes his bed clothing with him, and through ignorance of this custom we found ourselves in a sorry plight. Often where bedding could not be hired, we were compelled to drive the streets all night.

I was impressed with the vast forests and broad steppes of Siberia, and as we sped over the Amur R., the original one of the country, we passed many trains filled with Russian convicts. They were crowded into small box cars, lighted with dim barred and grated windows.

At Harbin, in Manchuria, we found the Russian government was secretly mobilizing her troops, and everybody professed belief in the permanent occupancy of that country by the czar’s minions. Harbin is a new town and tenanted by soldiers and Russian officials exclusively. The most interesting town in Manchuria is Khabarovsk [i.e., Khabarovsk], a place of 5000 inhabitants and delightfully situated at the junction of the Amur and Usan rivers.

We expected to return from here to Harbin, where the Eastern China R. commences, but while en route thither a bridge went down with 40 passengers and we were compelled to retrace our steps.

Farming is quite primitive in Siberia and agricultural implements are most crude. Wooden plows are used and drawn by 12 yokes of oxen. I was pleased to see, however, that American implements of agriculture are being introduced into the country.

The soil is fertile and with proper cultivation would supply the world with wheat.

Vehicles with 2 wheels are employed exclusively, and the ox is ubiquitous as a draught beast.

We had ample opportunity to study the people, for the Russian trader usually reaches the depot several days in advance of the departure of his train, and there he sleeps and eats in the depot, carrying his food and bedding with him. They are all disgustedly dirty and wear shoes made of pelts and twisted twine. The beverage is invariably tea, which is drunk with block bread. The national intoxicant is voyanka, which is sold by the bottle, the law prohibiting its sale by the glass, and the purchaser gets gloriously drunk thereon. It seems to be made of pure alcohol.

The edifices are mostly block houses with thatched roofs.

Living is expensive, though railway fares are ridiculously cheap.

The better class of Russian women are the handsomest in the world, but the military officers do not present so fine an appearance as do those of the German and Austrian armies.

Aside from the novelty and pleasure which the trip afforded, I feel that the benefits which will thereby accrue to the study of trees and plants is of incalculable value.

—Boston Evening Record, December 29, 1903.

John Muir’s accounts consist of a letter to his wife, Louisa (“Louie”), which he wrote in Vladivostok, and hastily scribbled entries in his diary. These give a vivid and decidedly more candid picture of the unhappy conditions under which the party travelled than did the newspaper account. Both the letter and diary excerpts are presented below with only minor editing.

Letter

Vladivostok Aug. 19, 1903

Dear Louie After many short stops here & there we are at last on the Pacific having crossed the whole vast breadth of Asia, & now you don’t seem so dreadfully far. We arrived yesterday morning very tired having slept in our clothes the last 8 nights & the heat has been trying 80 to 90° in the cars. & miserable uneatable food at the stations most of the[m]. Here it is delightfully cool—but the food is very poor. I’m resting today while the Sargents are out botanizing. I suppose we will be here a few days longer. Then Sargent wants to [see] the Amour for a day or two, thence back to Harbin, thence to Muken & thence to Peking which will require 8 to 10 days more of rail riding of most wearisome sort, but with views of wonderful regions their rocks scenery flora people etc by way of compensation. I had made up my mind to leave the Sargents here
& go to Japan Shanghai, etc as I long for the cool sea. But Sargent advises very strongly against my going off alone & raises all sorts of objections, difficulty of arranging money matters etc. promises not to stay but a day or two in Pekin or hot, dusty Mukden [suggestive name] So I suppose I'll go on with him as far as Pekin or Shanghai—where I hope to hear from you once more. The whole trip has been exceedingly interesting far more so than anything I had read lead me to expect. And now dear wife & babes Heaven bless you. How glad I'll be to get home. Love to all. John Muir

Muir's diary is even more revealing than his letter.

Diary

Aug 12 . . . Mr Sargent & Son have decided to give up the voyage down the Amour on acct of missing todays boat, tho another sails in 4 or 5 days. Would go on alone but can't separate . . .

Aug 19. Sargents out botanizing while I read & work & rest. Would like to leave for Japan etc but Sargent wishes to go with him to point on the Amour & thence to Mukden Pekin & Shanghai. 2 weeks more of miserable rail travel in very enfeebled condition but I suppose I'll get thro somehow & I will see more of Manchuria.

Aug 20. In house all day resting.


Aug 28. 6 A.M. In broad flat mostly cultivated. At Harbin 7 a.m. Bar[ometer] 600 rainy Harbin is situated on river. Flat & muddy streets. When dry fill in ruts & sink-holes the story of sea of mud. Large Govermt buildings—intended for large town. like many others along the R.R. but Yankee enterprise sadly wanting or adventurous builders of homes. The whole country seems a Government camp. Drive to so-called garden restaurant 5 ms of the most horrible streets for holes basins pits ridges & peaks made chiefly of mud. Harbin on its large flat rain again and dark. Left Harbin at 2.30 for Mukden. Ran at 2.45 in rich rolling treeless prairie like country planted mostly to millet.

4:30 Bar 700. Same prairie sunflrs millet, melons etc. Still dark, rainy, extremely rich soils glacial mud silt reformed in slow water—few clumps of trees on horizon mud adobe houses thatch roofs mud corall walls, some corn.

6 P M universal rain Bar 850 Dripping Chinnamon herding cattle & horses here and there some with umbrellas. Nearly all cultivated or in pasture The country is flatter than 2 hrs ago. All looks like Illinois

29 aug. Bar 650, cldy. The same prairie & crops. All Chinese horses poor & sore. Groves & single trees here & there Willow poplar tilia [Tilba] or elm mostly not a stone to be seen Houses mud framework wood. The whole country beautiful in features of low swells & ravines with hulls dotted with trees in dist. seems to have been cultivated every inch of it time immemorial No wildflrs in it only weeds by waysides & in pastures rose colored polygonum the showiest. Chinese here keep hogs wh they herd. The largest ever saw have enormous ears look like baby elephants.

We are running back to [Kungchuhing]. 3 bridges said to be washed out ahead,—going back all the way to Harbin. Dont know how long may have to wait in that filthy place. Sargent seems pleased.

30 Aug. Still damp and cloudy & running wearily back thru millet fields to Karbin will probably get there this P.M. arrived at 10 a.m Stay here until 3 P M when we again go back 200 ms or so into first mtns to N of here to botanize. A day or so while waiting repairs on line to Port Arthur None knows when they will be completed.

Start at 3.40 PM rain hazy muggy weather. Bar 650 has stood so from when we turned
back. At 6 P.M Bar 800 Many on train going this way via Vladivostok to Pt. Arthur, wish we were but of course Sargent wont & he has me in his power

Arrive Aug. 31 at station in the mtns 1600 ft El at daybreak & in pouring rain, Crouch for a while back of brick wall then go to porch of restaurant where I lie on bench all day in terrible pain. indigestion after 3 mos of abominably cooked food. Start back to horrid Harbin at 4 or 5 P.M. Arrive Sep 1, at 6 AM. After dreadful night of pain. I told S. that we wld probably be compelled to go via Vladivostok & Japan after all thus passing 5 times ovr part of road on acct of the broken bridges. He never seemed to think of me sick or well or of my studies only of his own. until he feared I might die on his hands and thus bother him—He was planning another botanical trip to some point on the Sungari, going by Stmr & leaving me alone at some hotel or lodging house. But fortunately learned the R R might not be opened for a Mo & that a stmr wld leave Vladivostock on the 3d or 4th. So back N we went again this Eve Sept 1.

Sep 2. Still alive. Morphin to stupify pain & brandy to hold life.

Sep 3 arrived at old quarters in Vladivos—tok at 7 AM. after most painful days of all my experience in this. Learn the steamer sails at 3 PM. today. Robeson [Sargent] loses his passport, & cant buy ticket or leave country. After big fuss went to Am consul & under his direction got out papers enabling him to leave—got off at 6 P.M. & now hope to get well.

Ate a little supper & suffer no pain.

Sep 4 glorious to be free from pain. Arrive at San Won [Wonsan] beautiful harbor on Korean coast leave at night...

From Korea, the party went to Japan and thence to China. At Shanghai, Muir and the Sargents went their separate ways.

The Sargent—Muir Trip in Context

Manchuria and Siberia, separated by the Amur and Ussuri rivers, increasingly became the scene of international rivalries between the time Maak and Collins, on the one hand, and the Sargents and Muir, on the other, travelled there. They also became the scene of intense botanical collecting. Frank N. Meyer, for instance, was in Siberia and Manchuria in late 1906 and early 1907. He was there again in late 1912 and early 1913. On both occasions he passed through Harbin and Mukden. During the first of those trips Meyer also travelled in northern Korea. On August 21, 1903, he collected a pyramidal wild cherry with bright-green foliage that Alfred Rehder of the Arnold Arboretum much later named Prunus × meyeri in his honor. (Two days after Meyer made the collection, he recorded a killing frost.) Meyer reported seeing "Only two or three trees... during the whole trip through northern Korea and only two had a few seeds."

When he described Prunus × meyeri, Rehder had suggested that it might actually be a hybrid. "Prunus Meyeri seems in all its characters intermediate between P. Maackii Rupr. and P. Maximowiczii Rupr.,” he wrote in the Journal of the Arnold Arboretum in 1920, “and is probably a hybrid between these species, both of which grow in northern Korea and in the same regions, as specimens collected by Mr. [E. H.] Wilson on the Tumen–Yalu divide on two subsequent days show."

In 1928, the Russian botanist B. V. Skvortzov reported two forms of Prunus maackii, Prunus maackii forma rotunda and Prunus maackii forma oblonga, from northern Manchuria, in the Lingnam Science Journal. In 1939, from a forest near Hsiaoeling, Manchuria (a town on the Trans-Siberian Railroad through which the Sargents and John Muir must have passed several times in their wanderings), Skvortzov collected seeds of Prunus maackii, which he
sent to the U. S. Department of Agriculture and from which came the scions that produced the trees now growing in the Arnold Arboretum.

The Sargents and Muir travelled in Manchuria during a period of intense rivalry between Russia and Japan through which China was drawn to Russia (and Russia to China) in an alliance against Japan. As part of this process, Russia had begun to build the Trans-Siberian Railroad in 1891, to forge a link between Vladivostok and Russia proper; Russia was able to exact from China a concession that part of the line run through Manchuria in order to protect the Amur River frontier. The alliance between Russia and China was strengthened by Japan's victory over China in the Sino-Japanese War in 1895. Harbin (or Haerbin) owed its origin to the construction of the Manchurian section of the Trans-Siberian Railroad, the "Chinese Eastern Railway," over which the Sargents and Muir travelled. Before 1896, Harbin had been a minor fishing village and market town; thereafter, it became the construction center for the Chinese Eastern Railway. Another railroad (on which the Sargents and Muir also travelled) was built southward from Harbin to connect it with the Russian-developed city of Port Arthur (Lushun) on the Liaoatung Peninsula in southern Manchuria. Largely Russian-built, Harbin became a base for Russian military operations in Manchuria during the Russo-Japanese War of 1904–05, which broke out soon after the Sargents and Muir were in the area. After the Russian Revolution of 1917, Harbin became a haven for Russian refugees; for a time, it was the largest Russian city outside the Soviet Union. Most likely B. V. Skvortzov was one of those refugees.

### Summer Monsoons and *Prunus maackii*

The Sargent–Muir party chose a very poor time of year to travel in the Amur River region of Siberia and Manchuria, at least from John Muir's point of view. While they were there (mid-August through early September), the summer monsoon was at its height. On average, ten to sixty times more precipitation falls during the summer in the Amur region than during the winter. In the peak monsoon months of July, August, and September, 70 to 90 percent of a month's total may fall in only five or six days—up to 9.5 inches of it in a single day. A. A. Borisov, in *Climates of the U. S. S. R.*, reports that, "At Vladivostok 386 mm [15.3 inches] of precipitation, 65% of the annual total, fall from June to September, but only 28 mm [5%] fall in winter." Summer floods, some of them very destructive, are common. During the ripening and harvesting of grain crops, the excessive moisture affects the harvest adversely. Muir's "universal rain" seems an apt description. In the vicinity of Vladivostok, a coastal city, the summer monsoon usually lasts for four to four and one-half months, inland and northward for shorter periods of time. Contributing also to Muir's misery was the high humidity, which averages 88 percent during the summer. Winters, on the other hand, are sunny and dry in the Amur region; snow cover is thin and persists only in the northermost parts of the region. Autumns are warm and dry.

The climate of Harbin, which is only forty or so miles northwest of Xiaoling (Hsiaoling), the town where B. V. Skvortzov collected the seeds he sent to the U. S. Department of Agriculture in 1940, is similar to that of Winnipeg, Canada, as the following table shows:

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While Harbin and Winnipeg receive similar amounts of precipitation (577.4 mm [about 23 inches] and 516.9 mm [about 20 inches] per year, respectively), the precipitation is more evenly distributed from month to month in Winnipeg than it is in Harbin. Winnipeg receives eight times more snow than does Harbin in an average winter (50 inches versus 6.7 inches).

*Prunus maackii* does best in moist, well drained soil—perhaps reflecting the soaking summer conditions of its native range. And, while very cold-hardy, it seems to be less frost resistant than *Prunus padus*, another early-blooming species. Also, it may not take to transplanting as well as some other species of tree, at least under certain conditions.

**Acknowledgment**

The text of the John Muir letter and of the quotations from John Muir's journal are published with the permission of the Muir-Hanna Trust, Holt-Atherton Center for Western Studies, University of the Pacific, Stockton, California. Copyright © 1984 Muir-Hanna Trust.

**Sources**


Egan, William C. *Prunus maackii*. *Gardening*, Volume 6, Number 137, page 259 [May 15, 1898]. [Egan seems to be referring to *Prunus padus var. commutata*.]


Propagation of *Prunus maackii*

*Alfred J. Fordham*

The records of the Arnold Arboretum reveal that *Prunus maackii* is easily propagated by any one of four routine methods.

*Prunus maackii* can be propagated readily by seeds, cuttings, grafting, or budding. The records of the Arnold Arboretum show that early in 1961 we received fifteen scions of that species from the United States Plant Introduction Service, Glenn Dale, Maryland. At the time of year they arrived, grafting would have been the most appropriate method of propagating them. *Prunus avium*, commonly known as mazzard cherry, was listed as being a suitable rootstock for grafting *P. maackii* but was not available. We were able to get seedlings of *P. serrulata* (Oriental cherry), however; they proved to be excellent rootstocks.

To preserve the scions until we needed them, we placed them in a sealed polyethylene bag and stored them at 40 degrees Fahrenheit in a refrigerator. When it is handled in this way, woody-plant propagating material remains viable for many months. It should be inspected occasionally, however, to make certain it is not too wet or too dry, for either condition can cause it to deteriorate.

**Whip-and-Tongue Grafting with Whole Rootstocks**

As the name implies, a whole rootstock is the entire root system of a seedling. In autumn, before the ground freezes, seedlings are dug and placed in a deep frame, refrigerator, or cold-storage unit that is cold enough to keep them dormant, yet warm enough to prevent them from freezing, so that they will be available when they are needed.

In preparation for grafting, roots of the rootstocks were washed and trimmed to a uniform size. To accomplish grafting, the top of the seedling was removed, leaving about two inches of stem above the root system. Scions were about four inches long and contained three or four buds.

The stock and scion were joined by a whip-and-tongue grafting technique, making certain the cambial layers of each had as much contact as possible. The two components were then bound with rubber budding strips, which held them together with relentless tension.

**Care after Grafting.** When completed on March 29th, the grafts were placed in a medium of damp peatmoss on a greenhouse bench, making certain that the unions were well covered with peatmoss. Bottom heat of 70 degrees Fahrenheit was provided. This relatively high level of bottom heat leads to rapid callusing and growth.

By May 26th all grafts had succeeded, and the plants were in excellent growth. They next were transferred to one-gallon cans and placed on a greenhouse bench where they could be forced, to provide cutting wood for further propagation.

**Propagation by Cuttings**

By June 22nd, the growth had developed to a stage where it was ready to provide softwood cuttings. Twenty-six cuttings were taken, treated with a root-inducing substance containing eight milligrams of indolebutyric acid in a gram of talc. The cuttings were then placed under intermittent mist. By July 14th, twenty-one of them had developed excellent root systems and were potted. In the Boston
area, softwood cuttings taken during about the third week of June and placed under mist should root in high percentages. Hardwood cuttings do not root.

**Propagation by Seeds**

The natural dispersal of cherry seeds is largely accomplished by birds. As fruits of *Prunus maackii* ripen, they soften, becoming shiny black and attractive to birds. Since birds have no teeth, they gulp their food; therefore, the hard-coated seeds pass unharmed through their digestive systems and are scattered about the countryside in droppings. *Prunus maackii* fruits ripen around July 1st and must be watched carefully and collected before birds can get to them.

Nursery practice when dealing with *Prunus maackii* follows the chain of events as they occur in nature: the fruits are collected, their pulps removed, and the cleaned seeds then sown out-of-doors in prepared beds, where they are protected from rodents. The seeds of *Prunus maackii*, like those of many Temperate Zone woody plants, have dormancies—protective “barriers” that prevent them from germinating at times that would be unfavorable to the survival of the resulting seedlings. When the seeds are collected, cleaned, and sown without delay, seasonal changes overcome the barriers and germination occurs in spring.

An alternative, and simple, method of overcoming dormancy is to provide artificial “seasons.” A polyethylene bag makes an ideal container for this purpose. The seeds are combined with a dampened medium of sand, peat moss, or such. The volume of the medium should not be more than three to four times that of the seeds. Keeping the bulk small is important, for at sowing time the entire content of the bag is sown. Twisting the top of the bag and binding it with a rubber band makes it vapor-proof for the full pretreatment period.

Propagating *Prunus maackii* by seed requires two stages, warm stratification and refrigeration. Warm stratification is provided by placing the container in a warm location, such as a windowsill, for four months. Full sun should be avoided as it could result in overheating. The container is then moved to a 40 degree Fahrenheit refrigerator for three months. Thus prepared, the seeds should germinate rapidly.

**Propagation by Budding**

Budding is an inexpensive way to propagate *Prunus maackii*, requiring neither the facilities nor skill, nor the meticulous aftercare, that grafting does. It is economical of propagating material, since only one bud is needed to produce a propagant.

To prepare for budding, line seedlings out in spring, spacing them about four inches apart in rows about twenty inches apart. They are ready for budding in the summer of their second growing season, when buds are inserted. The buds remain inserted until the next spring, when, before growth commences, the stocks are cut off just above the buds.

Alfred J Fordham was affiliated with the Arnold Arboretum for forty-eight years, retiring in 1977 as research horticulturist. A member of many professional societies, he has received numerous awards for his research on plant propagation.
Japanese Honeysuckle: From “One of the best” to Ruthless Pest

Richard A. Hardt

Slow to escape from cultivation when introduced, Japanese honeysuckle has become an aggressive and tenacious weed that should be used only with great caution

Lonicera japonica—flowers white changing to yellow, deliciously fragrant, borne in great profusion in the summer and occasionally in autumn. Grand for trellises and ground cover. One of the best.

—Biltmore Nursery Catalog, Biltmore, North Carolina (1912), page 99.

Lonicera japonica . . . a pernicious and dangerous weed, often overwhelming and strangling the native flora.


[A] network of tangled cords that covers the ground wherever this ruthless invader gets a foothold.

—“The Japanese honeysuckle in the eastern United States,” by E. F. Andrews, Torreya, Volume 19, Number 3 (March 1919), page 39.

I was born and raised in the southern Piedmont of Maryland, where Japanese honeysuckle (Lonicera japonica Thunb.) is ubiquitous. At an early age I despised it for smothering my woodland clearings and have killed countless of its vines with a determined hatred. Yet I have always been delighted by the smell of its flowers on summer evenings and the taste of its nectar licked off a pulled stamen.

Introduced into the United States in 1806 as an ornamental, Lonicera japonica escaped from cultivation and eventually became naturalized throughout the eastern part of the country, where it is now an important component of the flora as far north as Massachusetts, Connecticut, southern New York, and Ohio. In the northern part of its range it is not the vigorous pest it is elsewhere because its early growth is killed by late spring frosts. Long Island and Cape Cod, where it is locally dominant, seem to be its northern limits as a pest. It is a serious pest as far west as Indiana and southern Illinois, however, becoming rarer westward and disappearing altogether in central Kansas. Japanese honeysuckle ranges southward to central Florida, being absent from the subtropical part of that state.

The commonly planted (and escaped) plant is Lonicera japonica ‘Halliana’, Hall’s honeysuckle. Introduced by George Hall to Par-
sons's Nursery of Flushing, New York, in 1862, it differs from the species only in its more vigorous growth. In the eighth edition of *Gray's Manual of Botany*, Merritt Lyndon Fernald does not recognize it as a legitimate botanical variety. A common item in turn-of-the-century nursery catalogs, Hall’s honeysuckle is still very much available in the trade.

**Slow To Escape from Cultivation**

It is difficult to pinpoint when *Lonicera japonica* began to escape from cultivation, but it apparently did so in the 1890s, becoming naturalized over most of its present range within thirty years. It may have escaped before 1890, however, but was uncommon and not recognized when encountered. Alvan Chapman did not list it in his *Flora of the Southern United States* (1884), nor did Asa Gray in the sixth edition of his *Manual of Botany* (1889). Nathaniel Lord Britton and Addison Brown gave the first evidence for its escape, in 1898, reporting *Lonicera japonica* as freely escaped from southern New York and Pennsylvania to North Carolina and West Virginia in their *Illustrated Flora of the Northern United States and Canada* (1896–1898). By 1903, it was reported from Florida and, in 1918, from Texas.

Why did it take more than eighty years for Japanese honeysuckle to escape?

Birds disseminate its seeds. Perhaps it took them some time to recognize honeysuckle berries as a source of food. The birds may even have had to develop a taste for the berries. Even today, when the berries are widely and dependably available, birds eat them sparingly.

On the other hand, Japanese honeysuckle may have spread slowly because there was little suitable habitat for it until the latter part of the Nineteenth Century. Cultivated land is not suitable for honeysuckle, and most mesic sites were under the plow in the early part of the century. After the Civil War, many farmers in the East abandoned their land. Abandoned fields, as they pass into the shrub stages of ecological succession, are ideal habitat for Japanese honeysuckle. A combination of these factors, and others, may best explain the long delay between the date of the species’s introduction and the first reports of its escape.

A ban on honeysuckle at an early stage, coupled with a campaign to eradicate it, might have kept it within bounds, though there seems to be no precedent for success with this sort of effort. In any event, it is now too late to do anything about it. Japanese honeysuckle is a naturalized member of our flora.

![Flowers of Lonicera japonica. Photograph by Albert W. Bussewitz.](image)
A “most pernicious and dangerous weed”

Regardless of when it did, in fact, escape, Japanese honeysuckle quickly exhibited its darker side. By 1919, it had locally become a pest. E. F. Andrews, writing in the March 1919 issue of *Torreya*, reported that “it is no uncommon thing to see acres upon acres ... buried under the rank growth of this aggressive invader.” Government documents tell the same story: *The Eradication of Wild Honeysuckle*, by L. W. Kephart [1939]; *Honeysuckle Is a Serious Problem*, by T. C. Nelson [1953]; and the ominously titled, *Honeysuckle or Trees?*, by E. V. Brender and C. S. Hodges [1957]. Animosity towards Japanese honeysuckle apparently developed rapidly. The usually dry and objective *Gray's Manual of Botany* (eighth edition), describes it as

> a most pernicious and dangerous weed, overwhelming and strangling the native flora and most difficult to eradicate, extensively planted and encouraged by those who do not value the rapidly destroyed indigenous vegetation... (Unfortunately natzd. from Asia).

Meanwhile, U. S. Department of Agriculture publications were recommending its use and suggesting planting methods. Nursery catalogs contained glowing accounts of it. But perhaps the most disturbing note came from Ernest H. Wilson’s classic, *Aristocrats of the Garden* [page 67]:

> Hall’s semi-evergreen Japan Honeysuckle (*Lonicera japonica, var. Halliana*) needs no comment...

On the contrary, “Japan Honeysuckle” requires considerable comment, discussion, and consideration.

Why is Japanese honeysuckle so vigorous and aggressive in the eastern United States? Let us consider these traits separately, defining “vigor” as a high growth rate and “aggression” as domination of other plants by direct competition. (Honeysuckle’s aggression is, of course, dependent upon its vigor. Only a vigorous plant can be aggressive. But other botanical characteristics besides vigor make honeysuckle troublesome.)

Honeysuckle’s growth rates are indeed high. One researcher has reported fifteen meters of growth on one plant in a single year. Such extensive vegetative growth is supported by an appropriately extensive root system. On an established Japanese honeysuckle plant, the roots may reach three meters across and one meter deep.

Honeysuckle is semi-evergreen, losing its leaves only in cold winters. It produces new leaves very early in the spring. As a result, it
can begin active photosynthesis before competing trees and shrubs. Also, evergreen leaves can take advantage of warm, sunny winter days. The entire plant can make as much as two months of growth before most deciduous plants begin to grow. In Maryland, honeysuckle usually leafs out by March 15th, while the predominantly oak forests are leafless until May.

Another element of Japanese honeysuckle's aggression is its ability to reproduce rapidly by both vegetative and sexual means. The lateral branches that spread along the ground, root at the nodes in moist soil. Once this happens, the rooted branch is a new plant in a colony, able to survive if the original root crown is damaged or the branch cut. When a vigorous honeysuckle vine is cut, the root crown will respond with rapid resprouting. Lateral roots also can sprout, creating individuals independent of the original plant.

Ecological Relationships

The Japanese honeysuckle's fruit is a firm, black berry with few seeds. Birds disperse the seeds, eating the berry and excreting the seeds. There is an ecologically self-reinforcing aspect to this manner of seed distribution: the bird ingests the berry and flies some distance before excreting the seeds. Chances are that the bird will deposit the seeds in an environment similar to that in which it found the berry, increasing the probability that the resulting seedlings will succeed. The consumers of honeysuckle berries—bluebirds, purple finches, white-throated sparrows, juncoes, robins, bobwhite quails—are birds of brushy areas, thickets, and forest openings. Birds of forest openings usually fly directly from one opening to another. Thus, while roosting, a bird will deposit seeds at the base of a tree that, if all goes well for one seed, will be climbed by a new honeysuckle vine.

Honeysuckle seedlings must have open conditions to succeed. Its small seeds contain little stored food and seedlings must begin photosynthesis soon after germinating. Dense grasslands are poor habitats for honeysuckle, however, because the honeysuckle vine cannot climb the grass blades to reach the full sunlight. If the seeds were to be deposited in a mature forest or in a grassland, the new honeysuckle vine would not be able to complete with its neighbors.

Honeysuckle occupies a special position in eastern landscapes not occupied by native vines. Its twining habit is well suited for climbing shrubs and saplings, a different "strategy" from those of native vines. Grapes [Vitis spp.] climb by tendrils, which are effective for holding onto tree branches, while Virginia-creeper [Parthenocissus quinquefolia] climbs by adhesive discs on tendrils, which allow it to climb tree trunks that would be too large to twine around. Poison-ivy [Rhus radicans] climbs in the same manner as Virginia-creeper, but does so with modified aerial roots.

These vines have climbing strategies well suited for forest environments: they are adapted for climbing the branches and trunks of mature trees. Bittersweet [Celastrus scandens] is more like honeysuckle in that it, too, climbs by twining, but it does so much more "lazily" than honeysuckle, making fewer circuits per length of stem than the honeysuckle. As a result, bittersweet cannot support as much weight and does not climb as high as honeysuckle does. Nor can it produce a dense, sunlight-blocking canopy above a sapling, since it does not hold tightly enough to support the weight.

Honeysuckle can climb any object that is thin enough. It cannot twine around mature tree trunks, but it wraps itself around saplings with ease. It grows up and past a sapling, blocking the sunlight to its host. Deprived of light, the sapling dies, and the weight of the vine causes the dead stem to collapse, leaving
only a hummock of honeysuckle. Its twining is equally effective on shrubs. In mature forests, honeysuckle may twine upon other vines such as grape, Virginia creeper, and poison-ivy, that have successfully climbed mature trees.

Forest openings contain herbs, shrubs, and saplings, many of which are attractive to both man and wildlife. Vigorous growths of honeysuckle can smother them, replacing a diverse flora with a monotonous one. In the Piedmont of Maryland, flowering dogwood (Cornus florida), black cherry (Prunus serotina), tulip-poplar (Liriodendron tulipifera), and brambles (Rubus spp.) are very common constituents of forest openings and edges and have much higher wildlife value than honeysuckle.

All of the regions in which Japanese honeysuckle has become naturalized were once forested. Honeysuckle can block the return of forest to landscapes that originally were forested, producing what ecologists call a disclimax or disturbance climax. Plant succession can be “frozen” at the honeysuckle disclimax.

### Costs and Benefits

In human terms, Japanese honeysuckle has both costs and benefits. The costs are due to its vigor, aggressiveness, rapid dispersal, and tenacity. A pest in forest management because of its impact on forest regeneration, honeysuckle prevents both the natural and artificial regeneration of forest lands.

Professionals tend to see only one side of the plant—either its virtues or its vices. Nurserymen and landscapers cultivate and plant it, foresters try to eradicate it. Landscaping professionals must understand the character and potential problems of this plant before using it. Planted in the right situation it does no harm, but very few situations are right. Under most conditions, honeysuckle will have a damaging and uncontrollable impact on its environment. It should be used only after careful and thorough consideration.

In the South, foresters generally practice even-age management on pines (i.e., cutting and restocking large, continuous blocks of forest at the same time), which opens an area to direct sunlight and reduces competition for moisture, allowing honeysuckle to take over and making effective restocking with trees impossible. If honeysuckle is not present, the trees may have a chance to become sufficiently established to shade the ground, making the site less attractive to honeysuckle. However, if honeysuckle is present in a forest stand when the trees are cut, the honeysuckle may grow rapidly, preventing the return of the forest. Often, foresters will not cut certain forests for fear that honeysuckle will take over.

While a luxuriant growth of honeysuckle in a woodland is visually unpleasant, a tended and pruned vine of honeysuckle clothing an arbor or fence can be very attractive. The sweetly fragrant flowers open pure white and fade to a soft yellow. In full sun, with regular pruning, honeysuckle is far more floriferous than in the woodlands, where most honeysuckle vines are devoid of flowers. It is very easy to transplant and is a vigorous and carefree flowerer. This, of course, is one of the reasons it is such a pest outside of the garden.

Honeysuckle can provide a dense mat of vines that will climb over banks and thus is useful for stabilizing roadbanks, controlling erosion, and revegetating terrain. Rooted cuttings grow readily and quickly produce a cover, completely arresting soil erosion. The same qualities that make it a pest under one set of circumstances make it a valued plant under another set of circumstances.

Honeysuckle’s value to wildlife must be carefully evaluated since it suppresses many of the plants that have the highest food value to wildlife. It holds its berries through the
winter, usually well above the ground, providing a dependable food source during a critical period. Songbirds and gamebirds do eat small quantities of its berries. Deer eat its leaves. The tangled vines do provide superlative cover for birds, mice, and, particularly, cottontail rabbits. Honeysuckle has been suggested for use as a managed source of nutritious browse in the heavily manipulated southern pine plantations.

Japanese honeysuckle can also strongly affect historic sites. One survey of historic sites around Washington, D.C., noted that honeysuckle had damaged wooden and masonry structures, forcing apart stonewalls and producing dry rot in wooden walls. More importantly, it may produce an uncontrollable, historically inappropriate landscape. The study found that along the Potomac Canal in Washington, D.C., honeysuckle was threatening “visitors’ understanding and appreciation of the site.”

**Design Considerations**

A luxuriant growth of Japanese honeysuckle is aesthetically objectionable for three reasons: it lacks discernible form, it creates no line, and it suppresses aesthetically pleasing vegetation. “Form” can be defined as the three-dimensional mass of an object. Japanese honeysuckle is loose and rangy, forming hummocks over strangled saplings and reaching in all directions. It is impossible to perceive limits to its mass; it is amorphous. Its growth creates no visual points, no visual line (for a line is a series of points). The most commonly perceived visual line of a plant lies along its stem, from the root collar to the leaves. A dense growth of honeysuckle hides its source, presenting a façade of leaves or tangled vine stem. It can establish no “rhythm” without points, no pattern without lines. If a growth of honeysuckle were translated into sound, it would be noise. As noise disrupts music, honeysuckle disrupts an aesthetically pleasing landscape. Instead of a thicket or young forest, it produces a tangle of amorphous vegetation. Forest openings and edges usually are characterized by a richness of plant elements and structures, but Japanese honeysuckle succeeds in creating a landscape of only one element.

On balance the costs of Japanese honeysuckle outweigh the benefits. Other, less invasive plants can be used to control erosion and as ornamental vines. Of course, it would be impossible to make Japanese honeysuckle disappear; it is a permanent part of our flora. It can only be controlled.

**Controlling Honeysuckle**

A number of measures are used routinely to control weeds: chemicals, mechanical cultivation, hand labor, fire, biological control, and competition. Chemicals have been developed to kill honeysuckle. They usually kill broad-leaf plants on contact without affecting conifers. In southern pine plantations, these chemicals may be the most effective control measure. Unfortunately, honeysuckle is also present in hardwood areas, in which the chemicals would also kill desired saplings and shrubs.

Mechanical cultivation eliminates Japanese honeysuckle. As a result, the species is absent from cultivated cropland. In woods and thickets, mechanical cultivation is not possible because it kills the trees and shrubs you want. Hand labor would eliminate the honeysuckle without destroying the trees and shrubs, but its high cost makes this method completely impractical.

Fire often is used to control weeds in southern pine plantations and can also be used to control honeysuckle in pine forests, though the vine is likely to resprout from the roots. A light fire does not kill the pine trees but does kill seedlings, shrubs, and most hardwood trees. Therefore, fire can be used before planting, to clear out honeysuckle and
give seedlings a slight headstart.

Biological control—the deliberate use of a disease or animal to control a weed—has been used successfully on several invasive exotics. In Australia, the prickly-pear cactus has been controlled by an introduced moth (Cactoblastis cactorum) that feeds on the cactus. St. Johnswort (Hypericum perforatum), a weed of rangelands in the western United States, has been controlled by two introduced beetles. Unfortunately, there appear to be no disease-producing organisms that have any serious effect on Japanese honeysuckle in the United States, nor are there any insects in the United States that do anything more than nibble its leaves occasionally. This freedom from diseases and insects is a major reason for honeysuckle’s high vigor. Nonetheless, biological control represents the best potential for controlling Japanese honeysuckle and is deserving of research.

Ecological competition is a natural phenomenon. Competition for light by trees reduces the vigor of honeysuckle. When its vigor is sufficiently reduced, it is no longer a pest. It is a lion without teeth. Unfortunately, human activity usually leads to the removal of trees, eliminating the competition for light.
Because it is such a problem, ought it not to be illegal to plant Japanese honeysuckle? Indeed, it is highly inadvisable to plant the species near woodlands if it cannot be controlled, but in the garden, tended and pruned around an arbor, it does no harm. There is already so much wild honeysuckle that garden plants could not significantly affect the overall seed supply.

Japanese honeysuckle has some virtues and many vices. When I was a child in the woods of Maryland, it was rope and string, perfume and ambrosia to me. Though I have spent many a day ripping it out of the earth with my bare hands, I have never wished that Japanese honeysuckle had never been.

Richard A. Hardt is a student in the Graduate School of Design, Harvard University. During the summer of 1985, he was a horticultural intern with the Arnold Arboretum.
Botanical Gold: Exploring the Treasures of the Harvard University Herbaria

Caroline J. Swartz

Faculty and staff of the combined Harvard herbaria invite Friends of the Arnold Arboretum and other special guests to an open house in May

On Thursday, May 8, 1986, from 5:30 to 8:30 p.m., the combined Harvard University Herbaria (HUH) will offer a unique opportunity to visit behind the scenes of one of the world’s richest botanical resources. Friends of the Arnold Arboretum, Friends of the Farlow Herbarium, members of the New England Botanical Club, and members of the Harvard community are cordially invited to come and talk with Herbaria faculty and staff members about their research, botanical exploration, and particular areas of study. Guests will have a special opportunity to examine specimens of plants collected by botanists between the late 1700s and the present and to see records of historic plant expeditions that date from the opening of the American West and the United States’s first ventures into world exploration, to recent expeditions to all parts of the globe. This special evening will provide an opportunity to see why these rich collections are so important to researchers around the world in the identification, classification, and study of the evolution and distribution of plants.

The Combined Herbaria

The HUH building houses the combined Arnold Arboretum—Gray herbaria and libraries, the Farlow Herbarium and Library of Cryptogamic Botany, the Oakes Ames Orchid Herbarium and Library, the Economic Botany Herbarium and Library, and the New England Botanical Club Herbarium and Library. Associated with these collections are rich archival materials documenting the work of past researchers and the history of the collections. With over 4.5 million specimens of plants, the Harvard Herbaria comprise the fifth-largest such collection in the world and the largest university-associated collection of its kind anywhere; their associated libraries contain 224,000 items, constituting one of the world’s leading resources for systematic botany. Together, the specimens, books, and historical documents form the foundation of modern botanical research and hold a wealth of information about the whole history of botany. The accompanying article gives details on the various herbaria’s and libraries’s holdings.

The rich accumulation of material, particularly the herbarium sheets of pressed and dried plant specimens, document a significant portion of the world’s roughly 400,000 kinds of plants and fungi. These collections were begun in 1842 by Asa Gray, the first Fisher Professor of Natural History at Harvard University. In the mid- to late 1800s, Gray received specimens from many government- and privately-sponsored expeditions to little-known parts of the expanding West, and to many other parts of the world. He described and identified these plants, accumulating a large number of specimens, now of great scientific and historical interest. Gray’s personal herbarium, containing over 200,000 plant specimens, and his collections of botanical texts were bequeathed to Harvard; they form the basis of the herbaria’s rich collections.
Connected to the HUH building is the Farlow Reference Library and Herbarium of Cryptogamic Botany. William Gilson Farlow, a one-time assistant to Gray and first professor of cryptogamic botany (the study of lower plants) in North America, appointed in 1874, endowed his personal collections at his death in 1919. His collections contained mosses, fungi, lichens, and algae.

The Arnold Arboretum, established in 1872 by its first director, Charles Sprague Sargent, supports a substantial herbarium in addition to its Living Collections. Sargent donated his personal plant collection and library to the Arboretum, but during his years as its director he made every effort to support field expeditions, primarily to eastern Asia, where such collectors as E. H. Wilson were strongly encouraged to collect herbarium specimens in addition to living plants and seeds. Sargent’s training under Gray helped him to understand the great value an herbarium would have in the Arboretum’s pursuit of botanical knowledge.

To this day, botanists at the Harvard University Herbaria still travel to distant lands to carry out fieldwork and bring back thousands of plants specimens and seeds for the herbaria and for the Living Collections of the Arboretum. It is through the integrated use of the herbarium, library, and Living Collections that botanical knowledge will continue to be advanced. Says Peter Stevens, Professor of Biology and Curator of the combined Arnold–Gray Herbaria, “By studying all the species in one family, how they are classified, how they relate to one another, or, in some cases, do not relate to one another, one begins to understand that correct classification is the basis for all sound evolutionary ideas.” Only in the herbarium can one study simultaneously all the species of a family, or of a genus.

The Oakes Ames Orchid Herbarium is the world’s largest herbarium devoted to a single plant family. As with so many of the other collections of the HUH, the orchid herbarium owes its existence to the early efforts of a single person, in this case, Professor Oakes Ames.

An Invitation To Attend

Come visit us, then, and follow an “explorer’s map” through the HUH building. On display will be records from the early days of botanical exploration in the American West and in other parts of the world; specimens prepared by Henry David Thoreau in his treks around New England; herbarium specimens collected by Ernest (“Chinese”) Wilson and Joseph Rock in remote areas of China; early accounts and checks signed by Asa Gray; and material relating to more recent botanical expeditions to distant parts of the earth. Staff members will reveal how plant specimens are prepared, from the time they are collected in the field, through the mounting process, up to the time they are added to the collection and made available for scientific research.

Herbaria staff members, faculty, and graduate students will be on hand to describe the plants and documents on display and to convey through slide shows, photographs, and exhibits the kinds of research that are based on these collections. We encourage you to take advantage of this unique behind-the-scenes opportunity to visit one of the world’s richest botanical treasures and to learn about another aspect of botany at Harvard University.

Discover what plants are used for food and medicine in other parts of the world. Learn how plants make food, through demonstrations of photosynthesis. Explore the fascinating beauty and biological importance of fern spores through fantastic photographs taken with the scanning electron microscope. Gather insights on the difficulties that explorers faced in the early American West, and on some of the difficulties they faced in dealing with a famous Harvard professor!
Hosts for the Evening

The following are some of the staff members who will be present during the open house, and their areas of interest and expertise:


- **Peter S. Ashton**, Professor and Director of the Arnold Arboretum: tropical forests of southeast Asia.


- **Allan J. Bornstein**, Postdoctoral Herbarium Intern: the Piperaceae (pepper family).


- **Michael A. Canoso**, Manager of the Systematic Collections, and **Walter T. Kittredge**, Curatorial Assistant: organization, function, and workings of a major research herbarium.

- **Zepur Elmayan** and **Edith Hollender**, Preparators: mounting of herbarium specimens.

- **Leslie A. Garay**, Curator of the Oakes Ames Orchid Herbarium, and **Herman R. Sweet**, Research Associate: orchids of the world.

- **Ida Hay**, Curatorial Associate, and **Emily**

Two herbarium sheets from the Herbarium of the Arnold Arboretum. The sheet on the left is a specimen of Cornus kousa, a dogwood native to Japan and Korea, that on the right a specimen of a related species, Cornus flonda, the flowering dogwood of eastern North America. Visitors at the Herbaria open house on May 8th will be able to discuss such interesting similarities between the eastern Asian and eastern North American floras with faculty and staff, as well as other botanical topics. Photograph by Joseph Wrin. Courtesy of The Harvard University Gazette.
W. Wood, Curatorial Assistant: pressing and drying herbarium specimens in the field.

☐ Richard A. Howard, Professor and former Director of the Arnold Arboretum: West Indian floras and exploration in the Caribbean.

☐ Hsiu-Ying Hu, Botanist: food and medicinal plants of China.

☐ Geraldine C. Kaye, Librarian: fungi and other cryptogams in the Farlow Herbarium.

☐ David C. Michener, Research Taxonomist and Curatorial Administrator: the Wood Laboratory; sectioning wood for microscopic study.

☐ Donald H. Pfister, Professor, Curator of the Farlow Library and Herbarium, and Director of the Harvard University Herbaria: Discomycetes, early mycological literature.

☐ Bernice G. Schubert, Lecturer and Curator: Dioscorea (the yam) and Desmodium (beggar's ticks, legume family).

☐ Elizabeth A. Shaw, Bibliographer and Research Taxonomist: botanical exploration in the early American West.

☐ Otto T. Solbrig, Mangelsdorf Professor of Natural Science and past Director of the Gray Herbarium: photosynthesis.


☐ Peter F. Stevens, Professor and Curator, and Barbara A. Callahan, Librarian: the development of systematic botany as displayed through botanical illustrations.

☐ Rolla M. Tryon, Jr., Professor and Curator, and Alice F. Tryon, Associate Curator: the world of ferns and fern spores, scanning electron micrographs.

☐ Carroll E. Wood, Jr., Professor and Curator, and Ihsan A. Al-Shehbaz, Research Associate: the flora of the southeastern United States.

To Attend

Friends of the Arboretum will find free parking in the Andover lot, which is located behind the HUH building. They should enter from Oxford Street. (See the accompanying map.)

Complimentary hors d'oeuvres will be served.

Caroline J. Swartz is membership coordinator of the Friends of the Arnold Arboretum. A graduate of Connecticut College, she has a special interest in Chinese language and culture.
"HUH": Systematic Botany at Harvard

Harvard's diverse herbaria and their associated libraries make up one of the world's greatest centers for research in systematic botany.

The rich and diverse botanical collections housed in the Harvard University Herbaria building at 22 Divinity Avenue and in the adjacent Farlow Herbarium are world-renowned. Botanists working at the cutting edge of plant systematics converge from around the world to consult specimens of vascular plants, mosses, liverworts, algae, fungi, and lichens maintained in Harvard's half-dozen specialized herbaria. Designated "HUH" among systematic botanists at Harvard, the combined Harvard University Herbaria consist of the Herbarium of the Arnold Arboretum (designated "A"), the Oakes Ames Orchid Herbarium ("AMES"), the Economic Herbarium of Oakes Ames ("ECON"), the Gray Herbarium ("GH"), the Farlow Herbarium of Cryptogamic Botany ("FH") (actually housed in an adjacent, connected building), the Gray Herbarium ("GH"), and the Herbarium of the New England Botanical Club ("NEBC").

The Libraries. Comparable in depth and comprehensiveness to the collections of the Royal Botanic Gardens, Kew, and the Komarov Botanical Institute, Leningrad, the combined libraries of the Arnold Arboretum, the Gray Herbarium, the Farlow Herbarium, the Economic Botany Herbarium, and the Oakes Ames Orchid Herbarium are particularly rich in early botanical literature. These collections greatly facilitate research in systematic and evolutionary botany. All have grown from the research collections of their founder-scientists. This fact is easily sensed when one uses a volume that was originally owned and annotated by Charles Sprague Sargent, Oakes Ames, William Gilson Farlow, or Asa Gray.

The Arnold Arboretum's library now has over 90,000 books and pamphlets and some 11,000 microforms, the Gray library over 62,000 books and pamphlets and an archive collection of many thousands of items. Together, the archives of the two institutions are basic source material critical to the study of the development of evolutionary philosophy and the plant sciences in North America.

The Arnold Arboretum Herbarium (A). The Arnold Arboretum Herbarium was established by Charles Sprague Sargent in 1879, when he resigned his directorship of the Harvard Botanic Garden in order to devote full time to the Arboretum. It contains important collections from all over the globe and complements the Gray Herbarium (see below), inasmuch as it is especially rich in materials from eastern Asia, particularly China, the Philippines, western Malesia, and Papuasia. The large and important contributions of E. H. Wilson, J. F. Rock, G. Forest,
and the New Guinea collections of L. J. Brass are prominent among the Arboretum's 1,154,000 specimens housed in Cambridge. Its herbarium of cultivated plants in Jamaica Plain ("AAH") includes over 174,200 sheets and is the largest collection of its kind in the world.

To supplement its herbarium collections, the Arboretum maintains an extensive vouched wood collection of some 30,000 specimens and 45,000 prepared microscope slides of wood, pollen, seeds, etc., and an important fruit and seed collection.

The Orchid Herbarium of Oakes Ames (AMES). The Orchid Herbarium of Oakes Ames was founded in 1899 by Professor Oakes Ames, the Harvard Botanical Museum's second director. It is the largest herbarium in the world devoted to a single family. Originally a private institution, it was intended to be a working tool to facilitate the identification of orchid species and the preparation of orchid floras. In developing his herbarium, Ames emphasized from the very beginning the accumulation of scientific information in every conceivable manner, rather than solely the storing of dried specimens. Consequently, the collection of nearly 130,000 sheets is very rich not only in type specimens, but also in records and transcripts of holotypes from institutions located throughout the world. There are also a spirit collection of 3,000 plants and flowers and 25,000 slides of dissected orchid flowers. Its specimens, drawings of floral details, color plates, paintings, and descriptions make AMES a unique and indispensable tool in taxonomy. In 1939, Ames formally presented his Orchid Herbarium, together with his orchid library, which now consists of 5,000 books and pamphlets, to the Botanical Museum. In 1957, all of the orchid specimens of the Gray Herbarium and of the Arnold Arboretum's herbarium were integrated with those of AMES for an indefinite duration.

Housed in the Herbaria building, AMES contains some 10,000 type specimens or type collections of species. One of its unique holdings is a set of life-size drawings of types, together with drawings of floral details of types of orchids described by Rudolf Schlechter, which were prepared under his personal supervision. The actual type specimens from which these were made were destroyed in Berlin during World War II. AMES is exceptionally complete in material from the Philippines, Malesia, Mexico, Central America, South America, and China.

The Economic Herbarium (ECON). The Economic Herbarium of Oakes Ames, housed until recently in the Botanical Museum, consists of 45,000 specimens of economically important plants, especially from South America, and includes extensive collections of such genera as Zea (maize), Hevea (rubber), and Cinchona (quinine).

The Farlow Library and Herbarium (FH). The Farlow Reference Library and Herbarium of Cryptogamic Botany is housed in the former Divinity School Library, built in 1886; it is connected to the HUH building on the west and the Biological Laboratories on the east. Stemming from the extensive herbarium and library of William Gilson Farlow, who joined the Harvard faculty in 1874 and endowed the collections at his death in 1919, the herbarium now includes 1,125,000 accessions of bryophytes, fungi, lichens, and algae; the library has holdings of over 60,000 items. Included within the collections are the M. A. Curtis collection of fungi and William Starling Sullivant's herbarium of mosses, both of which Farlow brought to Harvard. The nearly quarter of a million specimens of types and authentic specimens in FH indicate the richness and importance of the collection for systematic and evolutionary studies.

The Gray Herbarium (GH). The collections of the Gray Herbarium date from 1842, when Asa Gray was appointed Director of the Harvard Botanic Garden and Fisher Pro-
Two preserved specimens of marine algae from the Farlow Herbarium. On the left is Padina pavonica, a brown alga that lives in warm marine waters worldwide. On the right is Heterosiphonia coccinea, a yellow-green, or yellow-golden, marine alga. These are only two of the one and a quarter million specimens of mosses, algae, fungi, and lichens in the Farlow's world-renowned collections. Courtesy Farlow Library and Herbarium.

Professor of Natural History. Although systematic botanical studies were initiated in 1807, when the Botanic Garden was established by W. D. Peck, the Herbarium was established by Asa Gray and grew steadily because of his research and that of his colleagues and successors. Today, the Gray Herbarium numbers 1,823,300 specimens. The collections of the early explorers are prominent. Worldwide in scope, GH is especially rich in North American materials and includes early collections from western North America and Mexico and the types and collections of Gray, Sereno Watson, B. L. Robinson, and M. L. Fernald.

Herbarium of the New England Botanical Club (NEBC). The 250,000 specimens in the Herbarium of the New England Botanical Club were collected totally within New England by knowledgeable amateurs, Harvard professors, and others. Serving to document the flora of the region, its specimens are also a rich resource for research on rare and endangered species. In concentrating on such a small area, NEBC makes it possible to study genetic variability from one population of a species to another.

The Botanical Museum

Although officially founded in 1888 when the University named Professor George Lincoln Goodale its first director, the collections of the Botanical Museum dated from 1858, when Asa Gray began to assemble a collection of "vegetable products, etc." that were augmented by plant materials of economic importance sent to him by his friend, William Jackson Hooker. The Economic Herbarium (ECON) is now housed in the HUH building (see above). The Botanical Museum's library has a notable collection of some 32,000 titles that has grown largely from the research collections of Oakes Ames and George Lincoln Goodale.
The ingenious application of acoustic devices enables botanists to study the water economy of woody plants.

Martin H. Zimmermann, the late Charles Bullard Professor at Harvard University and Director of the Harvard Forest from 1970 to 1984, was a recognized expert on the water economy of plants, especially trees. Among his many contributions to science was the introduction of the term hydraulic architecture, a term that describes the way in which plants use their structures to regulate water flow. In fact, a major goal of Professor Zimmermann’s research involved detailed descriptions of hydraulic architecture in plants, a task he approached with ingenuity, often using techniques he had developed himself.

As so often happens in scientific research, one of the best ways of understanding a process is to study what happens when it is disrupted. For example, if one is interested in how water moves through a plant, one can ask what happens when water is no longer supplied. The immediate consequence, of course, is that the overall water content of the plant begins to decrease as a result of continued evaporation (transpiration) from leaves in the absence of a corresponding uptake of water by its roots. As further drying occurs, the pores (stomates) on leaves usually close, thus minimizing additional water loss. Then the stem begins to contract under the tension caused by the evaporation of water from within it. Eventually, dehydration of the stem results in cavitation within individual vessels (water-conducting “pipelines”) of the xylem as air bubbles replace water. At this stage, flow within the plant ceases because cavitated vessels can no longer transport water. Some plants, in fact, are damaged beyond recovery by cavitation since they are incapable of refilling air-plugged xylem even when water again becomes plentiful.

Sabotage by Bubbles of Air

According to a widely held theory, elaborated in large part by Martin Zimmermann, cavitation is initiated when a tiny bubble of air penetrates a water-containing xylem vessel from an adjacent, dry vessel element—a process known as air seeding. Negative hydrostatic pressure within the vessel then causes the bubble to expand quickly and fill the contents of the cell. While the air-seeding hypothesis has not been proven conclusively, it is generally considered to be the best current explanation for cavitation. At the very least, Zimmermann’s theory focuses interest on this important phenomenon and stimulates research that could lead to new technology. If cavitation can be better understood, perhaps it can be avoided by breeding plants...
with more effective mechanisms for preventing it. Or, improved procedures might be developed to reverse cavitation once it has occurred.

If the crucial event that sparks cavitation actually is the appearance of an air bubble, the obvious strategy for stopping cavitation is to prevent air from moving between cells. In plants suffering a moderate degree of water stress, this normally is accomplished by the cellulosic cell walls between adjacent elements. An illustration of the principle involved can be obtained by trying to plunge a fresh tea bag directly into hot water. The low permeability of the wet, cellulosic paper causes the tea bag initially to float on the surface of the water until air has diffused out of the bag. The same phenomenon is exploited in life-saving when a shirt or pillow case is used to improvise an emergency flotation device. In these cases, wet fabric impedes the diffusion of the entrapped air.
The relative permeability to air, of a plant cell wall or of any other wet barrier for that matter, can be calculated from physical laws based on the size of the pores it contains: the smaller the pore size, the greater the pressure difference required to push air through it. Given an average pore diameter of about 0.2 micrometer (approximately one ten millionth of an inch) in plant cell walls, the pressure differential necessary for air to move from one cell to another is about 10 to 1. In other words, one can expect air seeding to occur in trees as soon as vessel tensions reach values of minus 10 atmospheres and less.

Acoustic Emission: The Sound of Cavitation

Using microscopic techniques coupled with cinematography, Ann M. Lewis [a student at the Harvard Forest] has determined that the lapse of time from the first appearance of an air bubble in a vessel until the end of the cavitation event is less than 1/124 second. The rapidity of this process probably accounts for one of the most important aspects of cavitation—namely, the production of a weak but detectable noise as vessel walls vibrate in response to the air bubble's explosive expansion.

Studies of the "acoustic emissions" (AEs) accompanying cavitations have recently become an especially active area for scientific investigation. At the University of Toronto in Canada, for example, Professor Melvin Tyree has adapted the sensitive acoustic devices used in mechanical engineering to the study of AEs in white cedar (Thuja occidentalis) and hemlock (Tsuga canadensis) trees. Tyree clamps a noise detector onto the stem of a tree and then monitors AEs as the tree becomes more and more dehydrated. Each signal the detector picks up is processed with the aid of a computer, which analyzes harmonic frequency, duration, and intensity. By doing this, Tyree can exclude interfering signals caused by extraneous (i.e., noncavitation) noises.

This sophisticated instrumentation has already made it possible to prove that individual AEs correspond to single cavitations occurring in the wood of trees; thus, a small (4-mm-diameter, 10-mm-length) block of hemlock wood, for example, contains about one million tracheids (tracheids, rather than vessel elements, are the water-conducting cells of gymnosperms) and produces approximately that number of AEs upon complete dehydration. The technology also makes it possible to measure the potential of different water-transporting systems to recover from cavitation. This can be accomplished by

*A scanning electron microscope picture, highly magnified, of poplar (Populus grandidentata) wood showing the three-dimensional structure of xylem tissue and individual vessels (the large columnar cells with conspicuous pores on their lateral walls) making up the water-transporting system. Courtesy of Springer-Verlag.*
monitoring AEs during the dehydration of a wood sample, then rewetting the sample to its maximum extent and determining the total number of AEs obtained during a second dehydration treatment. Presumably, the difference in AE totals is the number of cells that cavitated beyond recovery during the initial dehydration. Alternatively, AE technology can be used to determine the types of cells that are most prone to cavitation, inasmuch as the harmonic frequency of an AE is apparently related to a cell's dimensions. Evidence to date confirms Zimmermann's theory that large vessels, and thus "ring-porous" trees such as oaks and elms, are more likely to cavitate than small vessels, and thus "diffuse-porous" trees such as maples.

Practical Applications

Of course, the greatest value of listening to thirsty plants ultimately will be improved understanding of water flow and the mechanisms by which plants prevent damage associated with dehydration. When one considers that water utilization is one of the major factors determining plant growth and survival as well as plant distribution in the environment, it is easy to appreciate how even small advances in scientific knowledge about the water economy of plants can have profound practical consequences.

Martin Zimmermann's book Xylem Structure and the Ascent of Sap was dedicated to the memory of Godfrey Lowell Cabot, who in 1937 established the Maria Moors Cabot Foundation for Botanical Research at Harvard University. In the dedication of the book, Professor Zimmermann describes his first meeting with Cabot in the mid-1950s, an occasion that he took advantage of to explain his latest scientific findings in great detail:

When I had finished, he surprised me with the sudden question, "How can you improve the growth of trees?" This caught me completely unprepared, because I had never thought about practical applications. After what seemed to me a rather painful silence I ventured that it would be useful to learn more about how trees function and grow. He seemed to be quite satisfied with this answer. Little did I guess that trees would be holding me under their spell for so many years!

M H Zimmermann's diagram of the stages involved in cavitation by air seeding. Each panel indicates the status of an air-filled vessel or tracheid (outside) and an adjacent vessel or tracheid (inside) undergoing cavitation. A through C show the effect of progressively negative xylem pressures in causing air movement through a small pore in the cell wall. In D, an air bubble has appeared within the water-containing cell, while E and F indicate the explosive expansion of this bubble that results in cavitation and, significantly, in the acoustic emission. Courtesy of Springer-Verlag.

John W. Einset, associate professor of biology in Harvard University, directs the Arnold Arboretum's Laboratory of Comparative Physiology. In May, he will teach "Tissue-Culture Propagation Methods: An Introduction to a New Branch of Plant Science," a special class limited to Friends of the Arnold Arboretum.
BOOKS


*How To Attract Butterflies to Your Garden*, by Nick Rossi. Saddle River, New Jersey: The Butterfly Garden, undated. 16 pages. $14.95 (paper). [Part of the “Home Garden Butterfly Kit,” which includes also ten packets of seeds.]


DAVID C. MICHENER

For over fifteen years I have been striving to turn a wooded city lot into a haven for butterflies, birds, and salamanders. Fifty dump-truck loads of wood chips, untold bags of leaves, numerous rotting logs, and a rerouting of the storm drains have delighted the salamanders, extirpated whatever remained of the rear lawn, and started the final phase of controlling the already successful “butterfly meadow.” I confess that I didn’t know a thing about butterflies before starting; everything I learned I learned by making mistakes. But there is an easier way. If you are interested in butterfly gardening, preferably without making the kinds of mistakes I did and without needing fifty loads of wood chips, you might consider reading a book. There are three possibilities that I know of, and a fourth on its way.

The trick to successful butterfly gardening, it seems, is to realize that (1) butterflies come from caterpillars, (2) most caterpillars are quite particular about what species of plants they will feed upon, and (3) female butterflies will seek out the right species of plants on which to lay their eggs, ensuring thereby that the caterpillars will have food. Good butterfly gardens provide sacrificial food plants for the caterpillars as well as flowering plants for the adults. *How To Attract Butterflies to Your Garden*, by Nick Rossi, does not address this central issue. Instead, $14.95 gets you ten packets of seeds (an $8.90 value at my local hardware store) and a sixteen-page booklet that is long on enthusiasm for butterflies but short on information about plants and gardening. The three sections on attracting adult butterflies account for only thirty-three lines of text. I recommend that you buy your own seeds after spending $8.95 on Mathew Tekulsky’s *The Butterfly Garden*. Here is a straightforward and well organized introductory book. It has already helped me understand what makes a garden “work” from the perspective of a butterfly.

Tekulsky’s fourth chapter, “Getting Started,” cuts to the core of the issue—the need to get the butterfly’s entire life cycle to occur in your garden. Subsequent chapters, on larval food plants and nectar sources, and the various appendixes form the “gardening” core of the book. Here are lists of plants to use, notes on how to attract the fifty most-common species of butterfly in North America, nursery and seed sources of the plants, and the addresses of both butterfly-fancier and gardening organizations.
Since *The Butterfly Garden* is intended for use by gardeners throughout continental North America, much of the region-specific information has to be extracted from the text and appendixes; but the information is there. I found the author’s familiarity with Californian butterflies and plants helpful in illustrating several points, though the specifics were not always germane to butterfly gardening in New England. Chapters on butterfly biology, the rearing of butterflies, and conservation round the book out. If you are thinking about attracting butterflies to your garden, start with this book and then use your imagination.

Compulsive butterfly gardeners (*mea culpa*) will pay the small ransom needed to purchase *Butterflies East of the Great Plains*, whereas others may prefer to wine and dine their local librarians until the book is purchased. *Butterflies East of the Great Plains* is a stunning tour de force and is destined to be the classic reference for decades to come. Every species of butterfly known to occur or to stray into the eastern United States is presented. (Canada is excluded.) The text is accentuated by 324 color photographs of the butterflies in nature. For every butterfly species, the etymology of the Latin name, the geographic range (usually shown through exquisite maps), the habitat, the life history, and the adult and larval food plants are presented and discussed. The last subjects are a gold mine for butterfly gardeners. Enjoyable hours can be spent scanning the maps for your home area and then reading the text to find out what plants you will need to attract the flying lovelies. If the illustrations make you realize that you simply cannot live without pipe vine swallowtails gracing your yard, the text will inform you that you must have *Aristolochia* in the garden, while the range maps tell you whether the species lives in your area. If the plant material is sometimes unfamiliar to you (both Latin and common names are provided), use any good garden dictionary to find out about the plants.

*Butterflies East of the Great Plains* is the only tome I know of that provides the essential information on the butterflies of a given area, listing their critical food and nectar plants. If I have any qualms about recommending this book to the reader, it is that the binding may not be up to the long-term use the book will receive.

All three of the titles reviewed here will be available for inspection at the “Sky Gardening” symposium scheduled for May 31st. Among the attractions of the symposium will be an annotated list of the butterflies native to eastern Massachusetts and their larvae’s food plants. The complete program for the symposium is given on page 48.
Saturday, May 31, 1986
8:30 am - 3:00 pm

Sky Gardening

Birds, Butterflies and the Horticultural Habitat

Program

8:30 - 9:00  Registration
9:00 - 9:10  Welcome and Introduction.
            Nan Sinton & David Michener
            Jo Brewer
            David Winter
10:15 - 10:55 Birds on the Blossom:
            attracting birds with plants.
            Al Bussewitz
10:55 - 11:10 Coffee Break
11:10 - 11:50 The Horticultural Habitat.
            Michael Dathe
11:50 - 12:30 Food Plants for our Region:
            caterpillar cuisine and berries
            for birds.
            David Michener
12:30 - 12:45 Summary
            David Michener
12:45 - 1:30  Box lunch with the speakers.
1:30 - 3:00  Observational Walks.

The Observational Walks of plant material in the Arboretum will follow unpaved paths and will climb a hill — come comfortably dressed for the weather.