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Spring 1992

arnoldia

The Magazine of the Arnold Arboretum

APR 2 0 1992

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GRAY HERBARIUM

APR 2 0 1992

arnoldia

Volume 52 Number 1 Spring 1992

Arnoldia (ISBN 004-2633, USPS 866-100) is published quarterly, in winter, spring, summer, and fall, by the Arnold Arboretum of Harvard University. Second-class postage paid at Boston, Massachusetts.

Subscriptions are $20.00 per calendar year domestic, $25.00 foreign, payable in advance. Single copies are $5.00. All remittances must be in U.S. dollars, by check drawn on a U.S. bank, or by international money order. Send orders, remittances, change-of-address notices, and all other subscription-related communications to: Circulation Manager, *Arnoldia*, The Arnold Arboretum, 125 Arborway, Jamaica Plain, MA 02130-3519.
Telephone (617) 524-1718.

Postmaster: Send address changes to:
Arnoldia, Circulation Manager
The Arnold Arboretum
125 Arborway
Jamaica Plain, MA 02130-3519

Peter Del Tredici, Editor
Judith Leet, Associate Editor

Arnoldia is set in Trump Mediaeval typeface and printed by the Office of the University Publisher, Harvard University.

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Front cover: The rapidly expanding bud of *Carya laciniosa*, the big shellbark hickory, growing at the Arnold Arboretum. Photograph by P. Del Tredici.

Inside front cover: The flowers of *Styrax obassia*. Photograph by Rácz and Debreczy.

Back cover: Greenhouse manager Tom Ward provides scale for the trunk of *Styrax japonicus*, AA #17334, raised from seed collected by C. S. Sargent in Japan in 1892. Photograph by P. Del Tredici.

Inside back cover: The flowers of *Styrax japonicus*, AA #17334. Photograph by P. Chvany.

The Snowbells of Korea

Paul Meyer

***Styrax japonicus* and *obassia* are small, spring-blooming trees that add a touch of elegance to any garden. Both species have gained in popularity in recent years.**

When horticulturists think of the origin of many oriental garden plants, Japan and China most frequently come to mind. Though overlooked until recent years, Korea is also home to an exceptionally rich temperate flora and contributes much to our American gardens. When the Korean climate is compared with that of the northeastern United States, strong similarities are evident, often more pronounced than similarities to the climates of most of Japan or China. When a species occurs across a wide geographical range that includes parts of China, Japan, and Korea, the Korean populations may be the most adaptable to the growing conditions of the northeastern United States.

Over the past fifteen years, a number of American institutions—the U. S. National Arboretum, the Holden Arboretum, the Arnold Arboretum, and the Morris Arboretum—have aggressively collected plants in Korea. I personally have participated in five trips to Korea in search of trees and shrubs well adapted to the growing conditions of the eastern United States.

During the course of these expeditions, I have become interested in the genus *Styrax*, the so-called snowbells, represented in Korea by two species, *Styrax japonicus* Siebold and Zuccarini and *Styrax obassia* Siebold and Zuccarini—both outstanding horticulturally as small flowering trees. Although familiar to American gardening connoisseurs for more than a hundred years, both species are little known beyond the circles of avid gardeners. These Korean snowbells are among the hardiest of some one hundred and twenty *Styrax* species. The genus, largely tropical and subtropical, occurs in East Asia, the West Indies, South and Central America, the Mediterranean region, and North America.

Styrax japonicus—Japanese Snowbell

Both the scientific epithet and common name of this species obscure the full breadth of its natural range. It is indeed native to Japan, where it was first collected by Western botanists, but it is also native to Korea, China, Taiwan, and the Philippines. Japanese snowbell is a small tree, seldom much taller than ten meters at maturity. When young, it can be narrow and upright, or multistemmed and spreading. At maturity it broadens to become a spreading, flat-topped tree. At the Morris Arboretum, a plant of unknown origin is at least seventy-seven years old, and measures 11 meters tall by 12 meters wide, with a trunk diameter of 48 centimeters measured at breast height. Another plant at the Arnold Arboretum (AA #17334), raised from seed C. S. Sargent collected in Japan in 1892, is still thriving, having reached a height of 10.8 meters, with a spread of 14.6 meters. Both trees branch relatively low to the ground, and their trunks have a distinctly sculptural quality. Bark on the trunk and older branches, dark

Close-up of the flowers of Styrax japonicus. *Photo by P. Del Tredici.*

charcoal in color, is relatively smooth and sinewy. The leaves are small, dark green and fine textured, and give the tree a refined appearance.

In late May, numerous pendulous flowers create horizontal layers of white beneath the already dense green foliage. When seen from above, the bell-shaped flowers are scarcely visible, but from below the effect is striking. The flowers are followed by pendant, oval, light-green fruits which, though interesting when examined closely, have little landscape merit. These fruits contain the poison *egosaponin*. When the fruit is crushed, its poison can stun fish if sprinkled on a pool of water. In the Orient, it is used as part of a traditional fish-gathering technique.

Widely distributed in south Korea, *Styrax japonicus* occurs in a variety of ecological niches from relatively well-drained lowlands to higher elevations. Most commonly found in the understory and edges of oak-pine woodlands, it grows in association with *Quercus dentata, Q. aliena, Pinus thunbergiana*, and *P. densiflora*.

During a 1984 United States National Arboretum expedition to Korea that I participated in, along with collectors Barry Yinger, Sylvester March, and Peter Bristol, an interesting, naturally occurring variant of *Styrax japonicus* was spotted. The plant was growing in dry, sandy soil just a short distance from the coast of the Yellow Sea, exposed to salt spray, periodic drought, and reflected heat. We noted that this collection had particularly large, glossy, leathery leaves, and speculated that plants adapted to these stressful natural conditions might be well adapted to analogous

The multistemmed trunk of Styrax japonicus *(AA #17334) raised from seed collected in Japan in 1892 by C. S. Sargent. Photo by P. Del Tredici.*

urban conditions. Six-year-old seedlings from this parent plant are now under evaluation in a relatively stressful site in the Morris Arboretum parking lot. They range between 2 and 2.3 meters tall and all are 3 centimeters in diameter. One seedling in particular, which shows the distinct leathery leaf characteristics of its parent, will be evaluated closely over the next few years for possible introduction.

Other young plants of *Styrax japonicus* of known Korean origin are growing throughout the Morris Arboretum. The oldest ones, ranging from 2 to 6 meters tall, are eleven years of age. Phenologically, these Korean collections bloom about one week earlier than other older plants in the collection of unknown natural origin. In years when a late frost occurs, this earlier blooming tendency might be a problem. Plants grown from seed are highly variable, some individuals growing upright with a strong central leader, while others are multistemmed and spreading.

J. C. Raulston of North Carolina State University Arboretum has promoted another interesting natural form of *Styrax japonicus.* Collected in 1986 on Souhuksan Island off the southwest coast of South Korea, this form is notable for its large flowers and exceptionally large, lustrous leaves, nearly twice the size of the typical species. The hardiness of this cultivar, which is of a more southern origin, is not yet established. A specimen of this clone at the Morris Arboretum continued to produce new growth late into the autumn in

The pendant fruits of Styrax japonicus. *Photo by Peter Del Tredici.*

1991, and may, therefore, be particularly susceptible to winter damage. Though promising for some regions, this clone requires further evaluation before it can be widely promoted, especially in the Northeast.

As one might expect with any widely distributed species, *Styrax japonicus* is quite variable. Prior to recent collections, most plants in cultivation in this country came from a few individuals introduced at the turn of the century and therefore represented only a narrow slice of the potential genetic diversity of the species. Newly introduced populations from Korea may, in time, result in improved winter hardiness, stress tolerance, disease resistance, overall form, and landscape characteristics, thus increasing the adaptability of this attractive landscape tree.

Styrax obassia—Fragrant Snowbell

Although grown in the U.S. since 1879, *Styrax obassia* is still rare. Like *Styrax japonicus*, it is a relatively small tree, usually under 10 meters. Its large, bold, heart-shaped leaves, measuring up to 20 centimeters across, create a strong textural element in the landscape. Racemes of fragrant white flowers open in mid-May in the Philadelphia area (in late May around Boston)—about a week before *Styrax japonicus*. In the autumn, the leaves turn a clear yellow before falling away to expose a smooth, sculpted, gray trunk. On the young

The flowers and foliage of Styrax obassia *growing in Harrisburg, Pennsylania. Photo by J. Horace McFarland, 1935. From the Archives of the Arnold Arboretum.*

branches, the brown bark peels off in long, narrow strips, often persisting for some time before falling away.

Like *Styrax japonicus*, *S. obassia* is a plant of open woodland understory or edges. It grows best in moist well-drained soil and is susceptible to drought, especially a newly established plant. In many ways the natural habitat and horticultural adaptability of both these species are similar to those of the native American flowering dogwood (*Cornus florida*).

In older literature, *Styrax obassia* is reported hardy only to Zone 6. This information was probably based on plants collected in warmer parts of its range in Japan and China. In South Korea, my colleagues and I have collected populations north of Seoul where winter temperatures drop to -35 degrees Centigrade. We're eager to test these populations in the hope that they will provide individuals with greater winter hardiness. At the Morris Arboretum, these new populations have performed well so far. One plant, grown from Korean seed collected in 1979, stands 5 meters tall and 2.2 meters wide. Nine plants from a 1981 expedition to Korea average 10 centimeters in diameter, 5.4 meters in height,

and 4 meters in width. It is common for young plants to grow more than a meter a year when well sited.

Dr. Michael Dirr of the University of Georgia has been testing the hardiness of a number of different individuals within this species in the laboratory. As one might predict, early results indicate that these northern populations show superior hardiness. In particular, one northern collection showed laboratory hardiness to at least -30 degrees Centigrade. Trees from this population are growing at the Morris Arboretum and the Arnold Arboretum, and seeds from these plants are now being distributed to interested nurseries for further evaluation.

Insect and Disease Problems

Styrax japonicus and *Styrax obassia* are rarely affected by most insect or disease problems. However, the Morris Arboretum, Brookside Gardens, and the Holden Arboretum report some problems in both species with ambrosia beetle (*Xylosandrus germanus*), an insect that bores into the wood, destroying the vascular tissue. Although it was previously thought to attack only plants under stress, recent observations at these three institutions indicate that ambrosia beetle can also attack young, vigorously growing plants. Though infested plants were often killed to the ground, they subsequently resprouted from the base; in other instances, only lateral branches were killed. At the Morris Arboretum, a group of ten plants of *Styrax japonicus* growing in full sun on a hot south-facing slope was severely infested with ambrosia beetle. Our observations suggest that both species grow best on a cool, moist, woodland edge, or in an open understory. Under these conditions, plants are less likely to be attacked by ambrosia beetle.

Propagation

Shelly Dillard, propagator at the Morris Arboretum, reports that seeds of *S. japonicus* and *S. obassia* are readily germinated after moist, warm stratification for 150 days, followed by moist, cold stratification. Some seeds, though, may not germinate until the second year. Plants of *Styrax japonicus* can also be grown easily from softwood cuttings. At the Morris Arboretum, cuttings taken in June are dipped for 10 seconds in a solution of 2000 ppm of indolebuteric acid (IBA) dissolved in propylene glycol. Cuttings are stuck in a 3 to 1 perlite/peat mix and misted approximately 6 seconds every 8 minutes. Some selected cultivars are also propagated by grafting.

The mature fruits of Styrax obassia *at the Arnold Arboretum. Photo by Peter Del Tredici.*

Cultivars

Until recently, virtually no cultivars of *Styrax* were available to American gardeners. In

the 1980s, however, Brookside Botanic Gardens introduced several cultivars of *Styrax japonicus* obtained by Barry Yinger from Japanese nurseries. Currently, no cultivars of *Styrax obassia* are available in the American nursery trade. The recent introduction of new germplasm of these two species into the U.S., however, will more than likely result in new cultivars over the next decade. The following cultivars are currently available in North America:

Styrax japonicus 'Carillon'

This cultivar was first received in the United States by Brookside Gardens from Shibamichi Nursery of Angyo, Japan, through the collections of Barry Yinger. Philip M. Normandy, Curator of Brookside Gardens, reports that their largest plant of this cultivar was planted outdoors in June, 1983, as a two-gallon plant. It now measures 1.4 meters tall by 1 meter wide and has a diameter at ground level of 3.8 centimeters. Whereas its flowers and foliage are typical of the species, its branches are weeping or pendulous. This cultivar can be trained to form a small tree by staking the leader until the desired height is reached. Its dense, mounded habit resembles that of cutleaf Japanese maple cultivars. Normandy reports some winter branch dieback, but the plant subsequently grows back vigorously. The cultivar name 'Carillon' was applied by Brookside Gardens, after determining that the Japanese name 'Shidare' was invalid.

Styrax japonicus 'Pink Chimes'

This cultivar was selected for its light pink flowers. The petals, pale at the top and darker at the base, tend not to fade. Branches of young plants are slightly pendulous, but become less so as the plant ages. This cultivar was introduced into cultivation in Japan about 1976 by the Shibamichi Kanjiru Nursery Company, of Angyo. It was brought originally to North America by the U.S. National Arboretum and then reintroduced in 1978 by Barry Yinger to Brookside Gardens. The largest plant at Brookside Gardens, received in April 1981, now measures 4.5 meters tall by 2.1 meters wide and is 8.9 centimeters in diameter at ground level. Normandy reports that it reliably produces an abundance of attractive pink flowers and is similar in other respects to the species. Both cultivars root readily from soft wood cuttings, although high losses can be expected during the first winter. The weeping trait comes partially true in plants grown from seed, indicating that this cultivar might be appropriately classified as forma *pendula*. At Brookside Gardens, ambrosia beetle has not been a problem on either of these clones so far.

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Paul W. Meyer, former Curator at the Morris Arboretum of the University of Pennsylvania, has recently been appointed its Director.

The Lady as Landscape Gardener: Beatrix Farrand at the Arnold Arboretum, Part 2

Jane Brown

"Your trust in my training is the greatest honor of my fifty years of active practice."

—Beatrix Farrand to Dr. Paul C. Mangelsdorf, May 15, 1946, on her appointment as Consultant Landscape Gardener to the Arboretum

Having launched the young Beatrix Jones on her career in the late 1890s, Professor Charles Sprague Sargent, her "Chief" as she called him, was a continuing benefactor in her progress. Beatrix and her mother, Mary Cadwalader Jones, invariably visited Holm Lea for the rhododendron parties each June, on their annual northward migration from New York to summer in Bar Harbor. (Beatrix, in her turn, most frequently used the hybrids connected with her friends, Mrs. C. S. Sargent, Ignatius Sargent, and Louisa Hunnewell in plantings for her clients.) The Professor never failed, it seemed, to give her a discreet good recommendation where he could, and even gave her Christmas presents of significance; in 1911 it was Wilhelm Miller's *What England Can Teach Us About Gardening*, in which Holm Lea was much praised, and where Beatrix found the corroboration for many of her own opinions.[1] The Sargents, loving her, were doubtless overjoyed, as were her other friends, by her happy marriage to the historian Max Farrand in December 1913, and though the pattern of her life changed, she worked as hard as ever, and still paid frequent visits to the Arnold Arboretum, with her notebook, to refresh her knowledge of plants for a new commission or situation. The relationship between Beatrix and her Professor was aptly illuminated by Mildred Bliss at the very start of the commission for Dumbarton Oaks: having put forward all her design ideas, Beatrix was keen to make a brave start and wrote to Mrs. Bliss, sending photographs of three cedars, which she could obtain from the Arboretum for $300 each for digging and packing. Mrs. Bliss replied promptly in favor of the cedars, noting that if "Mr. Sargent loves you enough to part with them," then go ahead.[2]

When Charles Sargent died, aged eighty-five and still working, in March 1927, Beatrix was about to embark on a major diversion from her life's pattern because of Max Farrand's appointment as Director of the Henry E. Huntington Library at San Marino, California. From then on the Farrands' lives were divided basically into winters in California and summers at Bar Harbor, though much of Beatrix's time was taken in long train journeys to keep her scattered commissions in Chicago, Long Island, Washington, D. C., and at Yale in order. She had little time for her old haunts, except for a brief call on Alice Sargent at Holm Lea to design a new trellis for the house walls.

Connections with the Arboretum were maintained through Susan Delano McKelvey[3] and Chief Propagator William Henry Judd.[4] It was to these two people that she turned for help when she agreed to her longest-distance

commission of all, to work for Leonard and Dorothy Elmhirst (the former Dorothy Whitney Straight) at Dartington Hall in Devon, England, in 1932. She needed to renew English contacts, so William Judd (who had been trained at Kew and was secretary to the Kew Gardeners of America) introduced her to Sir Arthur Hill, then Kew's director, and Mrs. McKelvey paved her way to the doyen of English plantsmen, W. J. Bean, who was working on the third and final volume of *Trees and Shrubs Hardy in the British Isles* (1933), following his retirement from the Royal Botanic Garden.

Reef Point

The contacts worked well and Beatrix was grateful. Susan McKelvey became a frequent visitor to the Farrands' Bar Harbor home, Reef Point, and she rarely arrived empty-handed. Many varieties of clematis and lonicera went from the Arboretum to Reef Point, where their progress in that northerly and sea-girt habitat was eagerly reported. William Judd went frequently to Reef Point, but just as often across the country to the Huntington gardens, where there were not only the exotic delights of the cactus garden, but also other visiting experts for entertainment. Beatrix greatly enjoyed putting her plant-expert friends together, introducing one to another, and leaving them to enjoy their private worlds: during the thirties Judd helped her to educate and entertain two head gardeners from Dartington Hall for whom she arranged grand tours, as well as John Murray from Yale Botanical Garden and various park superintendents from New Haven. The latter she felt were "much in need" of Judd's skill and help, and in general it seems clear that if she could have dispatched every head gardener and grounds superintendent (let alone a few of the architects!) that she encountered to the Arboretum for enlightenment and inspiration, her working life would have been a much smoother path.

By the end of the 1930s (Beatrix was sixty-five in 1937), the Farrands' lives became more

Beatrix Farrand in her late sixties, c. 1937. Reprinted with permission from the Princeton University Library.

and more devoted to where they felt really at home, at Reef Point. They set up the Reef Point Gardens Corporation in 1939, with Mrs. McKelvey as a member, to carry forward their plans to turn their home and garden into an educational center for people interested in every kind of gardening. The prime objects were to demonstrate "what outdoor beauty can contribute to those who have the interest and perception that can be influenced by trees and flowers and open air composition."[5] To these ends they set about the reorganization of the garden and, most importantly, the naming and recording of the plants. It was soon revealed that, in several aspects of the garden, the educated but mainly instinctive acquisitions of the years had grown into interesting collections, especially for a garden in eastern Maine, of rhododendrons and azaleas, climb-

ing plants on the house, and single-flowered hybrid tea roses. Thrown back into the puzzles of identification and nomenclature, Beatrix naturally returned to the sure ground of her associations with the Arnold. Perhaps to smooth her path, she wrote to Dr. Alfred Rehder on 25 June 1940 in her characteristically modest vein: "You have doubtless forgotten an old acquaintance who used to see you when she was occasionally at the Arboretum with her " 'chief' Professor Sargent," but she wanted to thank him for his *Manual of Cultivated Trees and Shrubs*, which had given "so much aid to a working landscape gardener" over the years. The occasion was her receipt of a revised edition.[6] Dr. Rehder, of course, had not forgotten her but chided, "when Professor Sargent was still with us, you used to come much more frequently" and hoped she would return to the Arboretum soon.[7]

Beatrix took the opportunity, at least by letter, and tackled Chief Propagator Judd on the identification of her loniceras, which he did; they were both pleased with her *Lonicera tragophylla*, the Wilson introduction, with large butter-yellow heads of flowers, which had thrived since coming from the Arboretum. The naming process went on through Reef Point's clematis, some pears, apples, barberries and hemlocks, sempervivums and alpines. Soon a formal arrangement to pay Judd's expenses was made, and the Arboretum was also offered, in return, any cuttings that might be wanted, as long as specific instructions were sent as to how to take them and how to pack them. The rare *Decaisnea fargesii*, with remarkable metallic blue pods was offered, and a couple of little *Clematis tangutica obtusiuscula* were accepted.

The Arnold Connection

The record of plants sent from the Arnold to Reef Point is by no means complete, but there seemed to be two particularly successful Arnold "children." A docket dated May 12, 1924, lists the *Tripterygium regelii*, which Professor Sargent sent, telling Beatrix that Reef Point was most welcome to it as it was a "dud" plant. In "Climbing Plants in Eastern Maine"[8] she writes: "This species of the *Celastrus* family was planted on the southeast corner of the house, and started to grow with rampant cheerfulness. Its sweetly scented trusses of tiny flowers are often nearly three feet long, and in July the whole side of the house where it grows is as murmurous with bees as any English lime-tree walk." The other success story was the Japanese hydrangea-vine, *Schizophragma hydrangeoides*, sent from the Arnold on October 9, 1931: this grew marvelously up to the second-floor windows on the north corner of the garden house, only outdone in magnificence by two big *Hydrangea petiolaris*, which clambered to more than thirty feet.

In the early 1940s, Reef Point's garden flowered as its makers intended; both Farrands worked very hard for their project, our "little horticultural foundation," as Beatrix described it to William Judd in July 1942. "You may like to know," she continued, "that already at this early season we are sure that more than 300 people have visited the garden" and as she dictated the letter she could see more people wandering around.[9] Both Farrands were now entirely devoted to this dream project, but within a very short time Max Farrand's poor health marred their happiness. For his last year Beatrix worked doubly hard to achieve their plans for the education center and the library, and yet to keep the seriousness of his illness from him. When he died, in June 1945, just two days before her seventy-third birthday, she was both exhausted and stunned. The only thing she could do was to carry on, with now a kind of obsessive energy devoted to fulfilling Max's hopes and plans.

William Judd must have been a little perturbed to find a letter from her so soon, dictated the day after Max's death, at the moment the announcement appeared in the *Boston Herald*, asking him to identify her rhododendrons. Furthermore, she had already organized the cutting and packing of over sixty flower heads, and almost immediately these were tumbling out onto the laboratory

*Torch azaleas (*Rhododendron obtusum *var.* kaempferi*) growing on Bussey Hill in 1928. This picture accompanied Beatrix Farrand's article on the Arboretum that appeared in* Arnoldia *in 1946. Photo by J. Horace McFarland Co. From the Arnold Arboretum Archives.*

table. Judd, Dr. Rehder, and Donald Wyman dropped all they were doing, and prepared a list of names that was sent to her by return mail. She was not very satisfied; she queried many of their attributions, and sent another twenty-five blooms. In all they identified more than eighty specimens, mostly the species *calendulaceum*, *japonicum*, *myrtifolium*, and *arborescens*, with some Ghent and Fortunei hybrids, plus the cultivars 'Boule de Neige,' 'Bijou des Amateurs,' 'Louisa Hunnewell,' and 'Lady Armstrong.' Even so, she was forced to admit that Reef Point might need a real rhododendron expert, "so-called."

She knew that she was being ungracious, and "a nuisance to my friends" but it was her grief and desperation that made her so; fortunately, within a month she had resumed her appreciation of the "kind and helpful" William Judd and was hoping he would be her welcome guest later in the summer.

A Major Appointment

The following spring she was both surprised and delighted to be appointed as Consultant Landscape Gardener to the Arboretum. "Your trust in my training is the greatest honor of my fifty years of active practice," she wrote to

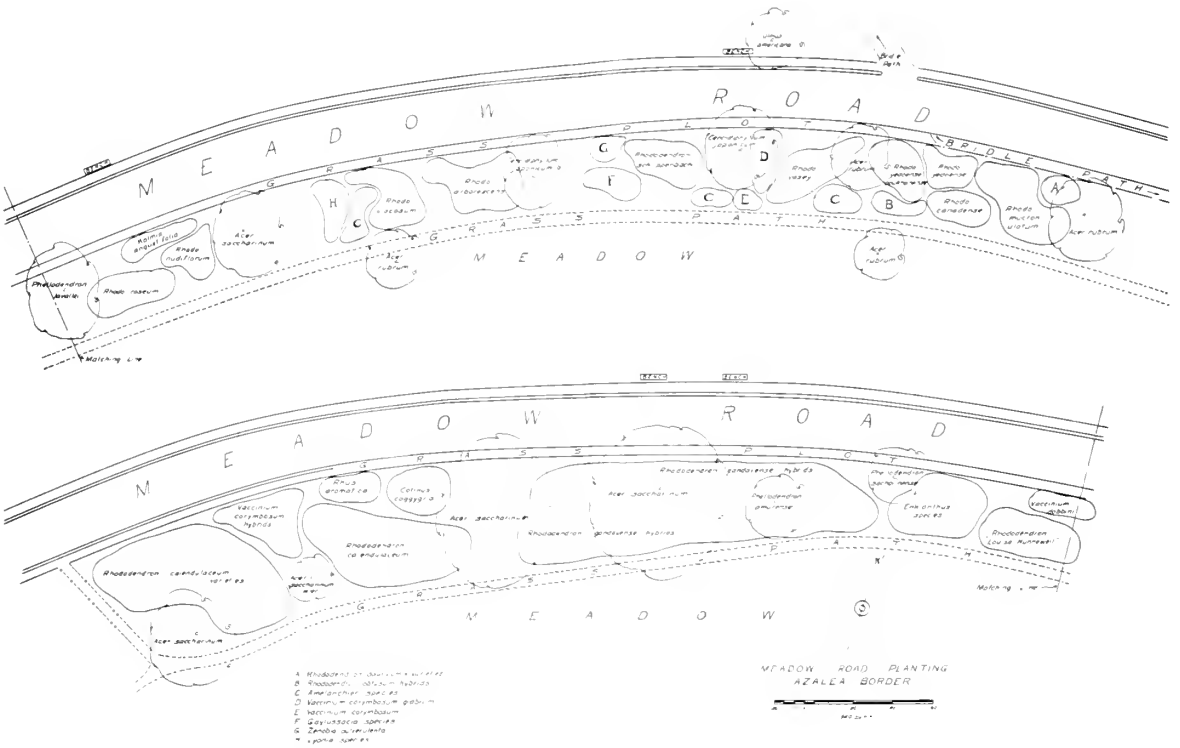
Dr. Paul C. Mangelsdorf.[10] She accepted "in great humility of spirit" and with the "hope" that her colleagues would not be disappointed; she looked forward to working with Judd and Dr. Wyman. However, it was not to be, for a few days later William Judd died of a heart attack. The *Arnoldia* of June 7, 1946, paid tribute to him, and in the same issue, Beatrix's appointment was announced.

There was a justice in that her last important commission was at the place where she had started her career, but it was perhaps surprising that an almost seventy-five-year-old lady should start striding around the Arboretum, measuring, taking notes, and asking pertinent questions. She brought in an assistant, Robert W. Patterson, an architect and landscape architect from Bar Harbor,[11] to do the strenuous work, but she also warned Dr. Mangelsdorf, "You will need patience and understanding of physical limitations of age which are most irksome to me, but which must be recognized."[12]

No such limitations seemed evident, for within two months of her appointment, that is, on 12 July 1946, she was writing to Dr. Mangelsdorf that Dr. Wyman, Patterson, and herself were in "hearty agreement on the main points." These points were no timid tinkerings, but recommendations for major revisions to the appearance of the Arboretum. "Project One" advocated a remodeling of the planting at the main entrance, around the Hunnewell building, and at the Forest Hills entrance; a long-term plan for Hemlock Hill; and a revision of the planting on Bussey Hill. "Project Two" envisaged the removal of duplicates, and aged and outworn plants throughout the collections, and "Project Three" was for the establishment of a 25- to 40-acre nursery outside the Arboretum.[13] Immediate approval was sought for these recommendations, but Peter's Hill, the marsh at the main entrance, and a planned watering system for the whole Arboretum also required urgent consideration. She felt in a certain "psychological fog" as to how to obtain decisions or actions, and hoped her report was not too much of a "tidal wave." Within a week Mangelsdorf had replied that Donald Wyman, who was Curator of the Living Collections, had all the authority required to make decisions about moving plants as necessary, which appeared a *carte blanche* to proceed. Donald Wyman, whom Beatrix had found "frosty" at first, had "thawed" considerably towards her, and they were getting on well, particularly when he visited her at Reef Point for discussions. The result was their list of twenty-three landscape problems needing immediate attention.

Surveys, plans, and discussions had taken half of her first year as consultant. *Arnoldia* of November 1, 1946, printed her draft paper on her approach to the design problems, which was a classic summation of landscape variabilities: time, soil depletion, a deterioration of soil quality in some places, new plant introductions, visitor problems, changes in taste, and particularly the devastating hurricane of September 21, 1938, had all taken their toll on Olmsted's original design for Sargent's conception. It seemed clear that one of the reasons for Beatrix Farrand's appointment as consultant was just that she was one of the few people around who could actually remember what Sargent said he was trying to do, and certainly her loyalty to the Professor was unshakable. She concluded, "Old friends of the Arboretum may feel aggrieved in seeing some of the plantations altered, but they will be less distressed when they realize that these very alterations are in the truest sense of the word restorations, as they are intended to restore the design to the original conception of the great botanist and artist who was its first director."[14]

She must have been busy with frequent visits to the Arnold for two and a half years, though no drawings or correspondence of work in progress appears to have survived. Her first descriptive report of the work she had supervised appeared in *Arnoldia* of April 15, 1949.[15] This elegant piece, "The Azalea Border," is a gem of landscape writing, beautifully balanced in its treatment of the botan-



Beatrix Farrand's plan for the azalea border along Meadow Road. From the Arnold Arboretum Archives.

ical and visual aspects of planting design. The accompanying plan was deceptively simple, for she and her colleagues at the Arboretum had achieved far more than just a "border." The land opposite the Hunnewell building, between Meadow Road and the marsh, had been cleared as a home for the family Ericaceae, a family of "distinction and elegance . . . from the flat and fragrant mats of mayflower to the tall rhododendrons and sourwoods."[16] Loads of peat had been imported and great care taken to place lovers of the damp places just where they could keep wet feet, but the design priorities had also been carefully interwoven with the planting: "Immediately inside the entrance the quiet open view over the marsh is maintained by low ground-hugging shrubs like bearberry, low blueberry and pachistima, ending in a higher mass after the first vista has been enjoyed."[17] Then came the early-flowering deciduous rhododendrons ("the crinkled petals of *mucronulatum*, when they first appear, look as though they had been ill packed during the winter in a small valise"), keeping the lavender and purply shades separated from the pinks by "islands and tufts of shadbush, Labrador tea and leatherleaf with huckleberries and tall blueberries. The rhododendrons progressed through American natives and Chinese *schlippenbachiis* with *Enkianthus* and "good *Phellodendrons*" as well as old sumacs, to separate species from hybrids and pinks from oranges and scarlets. Once these had all settled, "further little tufts and wisps of the smaller Ericaceae will be tucked into the bays and hollows" and the grass path on the marsh side would be made.[18]

In the autumn of 1949,[19] Beatrix explained her designs for Peter's Hill, where Professor

A view of Meadow Road on 27 May 1950, with pinkshell azaleas and a flowering dogwood in bloom. From the Archives of the Arnold Arboretum.

Sargent's thorns had become a thicket and a fire hazard. Her plan showed how beautifully the plantations of *Crataegus* and *Malus*, the walks, and open glades would flow with the grain of the hill form, while the grove of native oaks and some old conifers on the west slopes were carefully saved. The very top of the hill, a typical New England knoll, was to be kept open for its view of Boston "with radiating vistas."

The Final Years

By the time her piece on Peter's Hill appeared, Beatrix was well into her fourth year as the Arboretum's consultant (at a maximum of $2,000 a year, though what she actually charged is not known). She had given of her best and very considerable skills, but she was still keen to do more: "It looks as though our next big job were the rearrangement of the shrubs in the present shrub collecting area," she wrote to Dr. Karl Sax, the new Director, on November 9, 1949.[20] She was full of plans for herself and Donald Wyman to work on this area through the winter, and she was to come at the end of the month and discuss it all with them. Her plan was prepared but never carried out, and her correspondence ceases. What happened is not entirely clear: perhaps Donald Wyman, boosted by the publication of *Shrubs and Vines for American Gardens* in 1949 and *Trees for American Gardens* in 1951, felt he should be able to arrange his own collections, or perhaps Dr. Sax was over-

whelmed by the mounting controversy over moving the library, herbarium, and some of the Arboretum's staff to the new building in Cambridge. Another clue might lie in the constant reassurances and provisos with which she had had to package every move so far, in deference to the "old friends" of the Arnold who wanted nothing changed.[21] Troubled times were ahead for the Arboretum, but it seems sad that its distinguished landscape consultant was the first casualty.

And after all, Beatrix Farrand was eighty in 1952. She had to face the bitter truth that her beloved Reef Point Gardens, the "little horticultural institution" she had set up with her husband, could not be maintained. In 1955 she took steps to dismantle everything they had created, even the home which she had known since she was ten years old. That element of desperation, so evident in her actions immediately after Max Farrand's death, reasserted itself in her final acts. She disposed of her plants, destroyed her house and garden, and gave her life's working drawings (together with those of Gertrude Jekyll), her collection of prints and library of 2,700 books (including many rare herbals, floras, and gardening books) to the Department of Landscape Architecture at the University of California's Berkeley campus. There are rational reasons for this course of events, but questions persist: if Beatrix Farrand's appointment as the Arnold's landscape consultant had not ended so ignominiously, would it not have been perfectly natural for the Arnold to have had her collections? And if the Arnold and Harvard had not been so embroiled in the controversy over the Jamaica Plain library and herbarium, should they not have been duty bound to conserve her legacy in its natural habitat? For the saddest thing was that in sending her legacy to California she had to flout the abiding rule of her landscape life—that of the fitness of any work for its setting. It was the rule that Charles Sprague Sargent had taught her.

Now, on the 120th anniversary of her birth, Beatrix Farrand's name is perpetuated at the Arnold Arboretum by some splendid specimens of "her" *Forsythia*,[22] a tetraploid hybrid from 'Arnold Giant' raised in 1944, with magnificently rich, deep-yellow flowers, and—perhaps "an upright and vigorous" growth habit.

Acknowledgments

I am particularly grateful to Sheila Connor, Librarian of the Arnold Arboretum, for help with this part of my research on Beatrix Farrand.

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12. Farrand to Mangelsdorf, 15 May 1946, Arnold Arboretum Archives.
13. Farrand to Mangelsdorf, 12 July 1946, Arnold Arboretum Archives. The nursery was part of the use proposed for the Case Estates, which had been given to the Arboretum in 1942.
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16. Ibid., p. 6.
17. Ibid.
18. Ibid., p. 7.
19. *Arnoldia* 9(9): 38-43, 1949.
20. Beatrix Farrand to Karl Sax, 9 November 1949, Arnold Arboretum Archives.

[21] Beatrix had always conscientiously dealt with the "old friends" of the Arboretum who were shocked at her changes. In 1947, Dr. Sax asked her what she thought about the idea of forming a Friends' Association—she agreed and sent names of subscribers, adding, "What do you hope people will subscribe, $10, $100, or $1,000 a year?" Farrand to Sax, 20 August 1947, Arnold Arboretum Archives.

[22] The specimens of *Forsythia* 'Beatrix Farrand' were located and identified for me one fine afternoon in 1991 by Michael Dirr, author of *Manual of Woody Landscape Plants* (Champaign, Ill.: Stipes).

Jane Brown is a well-known writer on the history of landscape gardening. The information in this article is based on her forthcoming book on Beatrix Farrand's life and work, scheduled to be published by Viking in the spring of 1993.

The "Hope of Spring" Magnolia Finally Flowers in Boston

Stephen A. Spongberg and Peter Del Tredici

After a difficult start, *Magnolia biondii* from China flowered in the Arboretum for the first time in March of 1991.

The spring and early summer of 1991 at the Arnold Arboretum were extraordinary with regard to the heavy flowering of many of the trees and shrubs within the Arboretum's collections. Nor was this phenomenon restricted to the confines of the Arboretum, for across the Northeast crabapples, flowering dogwoods, and other ornamental trees and shrubs produced an abundance of bloom that marked the season as outstanding. The relatively mild winter of 1990-1991 and the abundant rainfall that fell during the summer of 1990 combined to make the spring of 1991 an exceptionally floriferous one.

Not only was there an abundance of bloom, but many of the newer accessions at the Arboretum, some of which have been considered only marginally hardy in our location, also flowered for the first time. Included in this group were two species of *Sinojackia* (*S. rehderiana* and *S. xylocarpa*), rare members of the *Styrax* family from China, *Liquidambar acaylcina*, a recently described species of sweetgum, also from China, and *Fortunearia sinensis*, a little-known genus in the witch hazel family named to honor the well-known nineteenth-century plant hunter, Robert Fortune. Several members of the magnolia family also flowered for the first time, including a hybrid tulip tree that combines the American and Chinese species (*Liriodendron chinensis* x *L. tulipifera*), *Magnolia officinalis* var. *biloba*, and *Magnolia biondii*. While we were eager to examine each of these in turn, and to document their flowering with voucher herbarium specimens and photographs, the first flowering of the last-named magnolia presented us with the opportunity to examine the flowers of this species and to fix its position in the classification of the genus *Magnolia*.

Early History of the Species

Magnolia biondii was first described by the Italian botanist Renato Pampanini in 1910 based on specimens collected in Hubei Province in central China in 1906 by the Italian missionary and naturalist, P. C. Silvestri. The plant was next collected in 1907, also in Hubei Province, by E. H. Wilson, who was traveling in China on his first expedition sponsored by the Arnold Arboretum. Wilson's specimens, one of which was in fruit, were studied by Arboretum taxonomist Alfred Rehder, and the two men named another new species, *M. aulacosperma*, based on Wilson's collections. This new species was described and published in *Plantae Wilsonianae* in 1913, with the added note that it formed "a shapely tree with many rather slender and spreading branches and wealth of leaves."

However, the late James E. Dandy of the British Museum, a noted English authority on the genus, determined that Rehder and Wil-

NEWS

from the Arnold Arboretum

Why Renovate?

Robert Cook, Director

Given that a major renovation of our main administration building, the Hunnewell Visitor Center, will be both highly disruptive and rather expensive, why are we doing it?

First, and foremost, we **must** renovate to keep the building legally functioning. The herbarium wing has major structural problems that will require steel reinforcements to the floors, and this work alone will trigger a number of regulatory requirements for other parts of the facility. The plumbing and electrical systems need to be significantly upgraded. We must strengthen our fire prevention systems with smoke and heat detectors, alarms, and a sprinkler system. The passage of the Americans with Disabilities Act, which became law earlier this year, requires that all aspects of the building need to be modified in order to accommodate individuals who may have physical handicaps. To do this we will add an elevator tower to the west side of the building, along with an interior fire stairwell. We will also be designing a new entrance that will permit wheelchairs to approach our front door with ease.

Beyond regulatory requirements, we must achieve a standard of everyday operation appropriate to the Arnold Arboretum. We have an obligation to establish conditions of climate control that will prevent the continuing deterioration of our valuable library holdings. Similarly, it is not acceptable to ask staff members to work with stifling heat each summer and space heaters in winter. Finally, the public should not be greeted with inadequate bathroom facilities when they come to visit the Arnold Arboretum. Our renovation plans will address all of these issues.

There is, however, a third justification. This renovation, along with our master plan being developed by the landscape consulting firm of Sasaki Associates, will permit us to renew our commitment to public education in a profound way. Our current classroom in the building will be enlarged to accommodate more individuals for our continuing adult education program and other major lectures. We will also be creating a significant interpretive exhibit, currently under planning with a grant from the National Endowment for the Humanities, that will provide individuals with a greatly enhanced

(continued on next page)

educational experience focused on our historic Olmsted landscape and the scientific mission of the Arboretum. The centerpiece of this exhibit will be a large-scale model of the Arboretum which, in conjunction with new brochures and signage on the grounds, will allow visitors to choose from a menu of potential interactions with the plants in our magnificent landscape.

At the end of the day, therefore, I see the renovation as a major occasion for revitalizing our commitment to public education and visitor enjoyment of the Arboretum. At the same time we will be establishing a standard of operation consistent with our dedication to quality in all that we do.

Bob Cook

Arboretum Programs During the Renovation

Richard Schulhof
Assistant Director for External Relations

For over a century the Hunnewell Center's elegant, red-bricked facade has beckoned visitors through the Arboretum's main gate to the splendors of the landscape. Indeed, the past decade has brought even greater public use, as the Hunnewell Center has served as the primary site for growing education programs and as an increasingly popular meeting and resting place for Arboretum visitors. While the building is about to undergo extensive renovation, plans are currently underway to ensure the continuity of our education programs, and, looking further into the future, to maintain the Arnold Arboretum's high standards in education and public service.

Since the early 1890s when Professor Charles Sargent first arranged a program of public lectures, the Arnold Arboretum has been known as a center for the study of botany and horticulture. Evolving from modest beginnings—26 students in 1891—Arboretum education programs have grown into a nationally recognized program serving over 7,000 students annually.

As the pending temporary closure of the Hunnewell Center has prompted many of our friends and supporters to inquire about the future of the educational offerings which depend on this facility, we wish to share our plans for these programs.

Adult Education

Due to construction, the Hunnewell Center will be closed to the public from September of this year through the fall of 1993. Although course offerings must be reduced by 25% due to the temporary closure of the Hunnewell lecture hall, classes will continue year-round in the classroom facility at the Dana Greenhouse and during the spring, summer and fall months at the Case Estates in Weston. Looking beyond the renovation, we plan to offer roughly 400 class meetings a year, the program size represented by our current spring/summer catalogue.

As for the content of the program, we plan to take fuller advantage of the living collections in Jamaica Plain with a stronger focus on the biology and horticulture of woody plants. While courses in landscape history, design and herbaceous materials will continue to be offered, it is our aim to more fully address the Arboretum's traditional strengths in botany and arboriculture.

The Children's Program

As with the adult education program, the renovation will necessitate a reduction in the activities of our Children's Program. During construction, classes will be staged out of a tent in an area below the Dana Greenhouse, while guide training will take place in the Greenhouse classroom facility. Although a smaller number of children can be accommodated via this arrangement, it will allow us to maintain the program until the reopening of the Hunnewell Center. At that time, programs for children will return to their current level.

Future plans for the Children's Program promise a greater commitment to improving the quality of science education in Boston area classrooms. Beginning this year, we have made our Field Studies Experiences program available in several Boston schoolyards. In addition, we plan to further develop our teacher's training program, LEAP. With the help of a generous grant from the Jessie B. Cox Charitable Trust, teachers from Boston area schools will come to the Arboretum for training in this nationally recognized curriculum.

Visitor Services

Under the umbrella of Visitor Services we include weekend tours and the Bookstore. Sunday tours will continue during May, June, September, and October of the renovation year, while the Bookstore will close, along with the rest of the Visitor Center, on September 8, 1992.

When the Hunnewell Center reopens in 1993, we look forward to offering a higher level of visitor information and services. Thanks to support provided by the Massachusetts Foundation for the Humanities and the National Endowment for the Humanities, the future Hunnewell Center promises new interpretive exhibits that tell the story of the collections and landscape, improved visitor orientation, and an information center that will offer books, pamphlets, and other materials specific to the Arboretum's world-renowned living collections.

In the coming year we ask your patience as we prepare the Hunnewell Visitor Center for another century of service. Further, we invite any comments or questions you may have concerning either the renovation or our plans for the future. We look forward to hearing from you.

Arnold Arboretum Public Meeting

The Arnold Arboretum has contracted Sasaki Associates, Inc., landscape and planning consultants from Watertown, Massachusetts, to create a master plan for our landscape in Jamaica Plain. Funded with grants from the Institute of Museum Services, the National Endowment for the Arts, and the Stratford Foundation, the master plan will develop recommendations and long-range guidelines concerning the upgrading of visitor services, the enhancement of our entrances, walls, and other perimeter elements, and the management of lands peripheral to the historic Olmsted/Sargent landscape.

As part of the planning process, the Arboretum will hold a series of three public meetings. Please join us on **Wednesday, April 22 at 7:00 p.m.** in the auditorium of the State Laboratories Building located on South Street (a short walk from the Forest Hills Subway Station) to meet the Sasaki team and discuss the master planning process. Parking is available. For more information, please call 524-1718.

Announcing a Spring Cleaning Sale

The Arnold Arboretum Bookstore pre-renovation

Weeding-Out Sale

Opens to the public on May 1st, but you can be an
Early Bird and get the Best Worms during

Members only Week

Monday, 20 April to Sunday, 26 April, 1992

And get a special 20% pruned off all non-sale items!

Open Daily, 10:00 a.m. until 4:00 p.m.

Don't forget to bring you membership card or renewal acknowledgement letter.

Phone orders accepted during sale days only!

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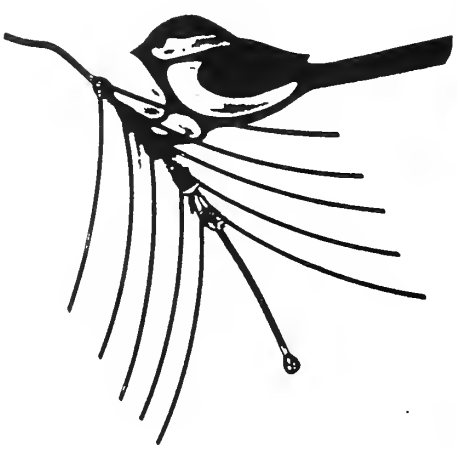

National Park Service at the Arboretum

The National Park Service has recently joined in partnership with the Arnold Arboretum to expand interpretive services available to Arboretum visitors this spring. Park Rangers from the Frederick Law Olmsted National Historic Site in Brookline will introduce Arboretum history and design in a program of weekend walking tours covering various portions of the landscape.

We welcome you to join Park Rangers Alan Banks and Christopher Lamond on Saturdays and Sundays from April 18 through June 21 for special walking tours at 10:30 a.m. and 2:30 p.m. Each no-fee tour will leave from the Park Service Staging Area near Forest Hills Gate to the Arboretum. Rangers will also be stationed at this location weekends from 10:00 a.m. to 4:30 p.m. to supply information and handouts.

Blooming for the very first time at the Arnold Arboretum, the delicate, creamy-white flowers of Magnolia biondii *(AA #1216-77-B) were photographed on 29 March 1991. Photo by Rácz and Debreczy.*

son's *Magnolia aulacosperma* was the same species collected by Silvestri and originally named by Pampanini in 1910. As a consequence of his earlier description, Pampanini's name, *M. biondii*, is the correct one for this central and northern Chinese species, which is now known to occur in eastern Sichuan, Honan, and Shensi provinces, as well as in western Hubei, where it was first encountered by both Silvestri and Wilson. Nowhere a common tree and apparently occurring only as widely scattered individual specimens, it has the northernmost distribution of any Chinese magnolia with the exception of *M. sieboldii*, a species that occurs in eastern and northern China and also in Japan and Korea. Its Chinese common name, *wan chun hwa*, means "hope for spring flower," and refers to its early flowering in late winter to early spring (Ting, 1977).

Silvestri's collection consisted of flowering specimens, and although Wilson procured sufficient fruits so that seeds were processed at the Arnold Arboretum greenhouses, neither man successfully introduced the species into cultivation in western gardens. Rehder (1927, 1940) nonetheless listed its year of introduction as 1908, but the seeds entrusted to Jackson Dawson at the Arboretum greenhouses either failed to germinate or the young plants failed to grow in the Arboretum nurseries, and there is no record of the plants having been added to the Arboretum's collections. In this regard, sometime before 1927 Wilson wrote to J. G. Millais, another noted English authority on the genus, "It is the only Magnolia I found in China which I failed to introduce into gardens" (Millais, 1927, p.85).

Following Wilson's failure, the introduction of *Magnolia biondii* into cultivation in Europe and North America became clouded by speculation, inasmuch as unsubstantiated rumors of its existence in the nursery trade in England and its inclusion in collections in Canada, the United States, and Germany were occasionally reported (Savage, 1974; Kehr, 1986). Apparently, these erroneous reports were based on the confusion of *Magnolia cylindrica*, a similar Chinese species, with *M. biondii*.

First Successful Introduction

To our knowledge, *Magnolia biondii* was first successfully introduced into cultivation in North America by Professor Y. C. Ting of Boston College in 1977 when he traveled to Honan Province to visit his homeland and relatives (Ting, 1977). Professor Ting had been encouraged to obtain seeds of this elusive *Magnolia* by members of the American Magnolia Society, and on returning home to Boston after a successful trip—a similar journey the previous year had been curtailed by a severe earthquake—he kindly gave half the seeds he had obtained to members of that Society and half to the Arnold Arboretum. These seeds, accessioned as #1216-77, germinated in the Arboretum greenhouses in the spring of 1978, and twenty-seven seedlings resulted. Cuttings taken from these plants were rooted in the summer of 1981 and distributed to members of the American Magnolia Society in the spring of 1982 (Del Tredici and Alexander, 1981).

The plant that flowered for the first time in the spring of 1991 was one of the original seedlings from lot #1216-77. It now stands nearly four meters tall and three meters wide. While it has a central leader at this point, there are also several secondary trunks that will probably become codominant, suggesting that this particular individual will eventually become a multistemmed tree. We cannot say whether this condition is due to the genetics of the species or to the fact that this specimen was somewhat stunted in its development by virtue of being grown in a container until 1984, when it was finally planted in the magnolia collection adjacent to the Hunnewell building.

Taxonomy

Based on Pampanini's original description, *Magnolia biondii* has been thought to belong to the Buergeria section of the genus *Magno-*

Magnolia biondii *in bloom on 29 March 1991. The plant is just over four meters (ten feet) tall and looks as if it will become multistemmed over time. Photo by Rácz and Debreczy.*

lia, a group of five species restricted to eastern Asia characterized by the precocious appearance of the flowers in spring before the foliage and by an outer whorl of three very small, often early-deciduous, sepal-like tepals. However, the lack of flowering specimens of *M. biondii* in western herbaria (other than Silvestri's in the herbarium in Florence, Italy) has left the question of sectional placement tentative. While most magnolia enthusiasts have accepted Pampanini's description as correct, uncertainty has remained, especially on the part of those who prefer to see evidence firsthand. This uncertainty was compounded when August Kehr reported that scion material of *M. biondii* that he had received from the Magnolia Society distribution had flowered in his North Carolina garden in the spring of 1986, undoubtedly the first time the species produced flowers outside of its native China. It turns out that Kehr had grafted the scion onto a mature specimen of *M. kobus*, and that he could not detect the expected outer whorl of small sepal-like tepals on the flowers produced by the grafted branch (Kehr, 1986).

As a consequence, it was with great interest that we inspected the morphology of the flowers produced by the Arnold Arboretum plant for the first time on March 27, 1991. Suffice it to say that these flowers corresponded to the requirements for placement of *Magnolia biondii* in section Buergeria: a whorl of three, linear, greenish-white tepals, each measuring about 10 millimeters in length by about 4 millimeters in width, comprises the outermost whorl of tepals. By contrast, the tepals of the inner two whorls (each consisting of three tepals) measure 50 millimeters in length and 25 millimeters in width, and these obovate to spatulate tepals are white with the bases tinged purplish. The small tepals of the outer whorl, however, were seen to fall from many flowers along with the protective bud scales as the flowers opened, and unless only partially opened flowers are inspected, the small tepals may not be found.

A view of the stamens and gynoecium of Magnolia biondii. *Photo by Peter Del Tredici.*

Occasionally, the three small tepals do persist after the wooly bud scales have fallen, but rarely do they persist for more than a day or two. This fact easily explains Dr. Kehr's observations of the flowers produced in his garden in the spring of 1986.

Other characteristics of species of section Buergeria (particularly *Magnolia salicifolia*, the so-called anise-leaved or willow-leaved magnolia) are shared by the Arnold Arboretum plant of *M. biondii* and combine to confirm its sectional placement. These features include the yellowish-green coloration of the young twigs and a pronounced lemony or anise-like odor emitted when the fresh twigs are broken or otherwise bruised. Now that a flowering specimen of *M. biondii* is growing in the Arnold Arboretum, comparisons between it and the other members of section Buergeria, which include the above-named *M. salicifolia* from Japan, *M. kobus* and *M. stellata* also from Japan, as well as a second Chinese species, *M. cylindrica*, can be easily facilitated in our collections. As of this writ-

ing, the Arboretum plant of *M. biondii* has numerous large flower buds, which promise that the plant will flower again in the spring of 1992. The fact that its flowers opened very early in the spring of 1991 (March 27) suggests that the species is a prime candidate for damage from late frosts. By coincidence, *M. biondii* opened its flowers on exactly the same date as another early-blooming magnolia recently introduced from China, *M. zenii* (Del Tredici and Spongberg, 1989). Whether this curious synchrony will occur again this year remains to be seen.

In order to determine the limits of hardiness of *Magnolia biondii*, as well as to learn more about the length of time necessary for the species to reach sexual maturity, the authors would like to hear from anyone who received one of the distribution cuttings in 1982.

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Stephen Spongberg is Horticultural Taxonomist at the Arboretum; Peter Del Tredici is editor of *Arnoldia*.

Groundcovers for the Garden Designer

Gary L. Koller

An eclectic selection of unusual plants for innovative gardeners.

With one foot firmly planted in the living collections of the Arnold Arboretum and the other in the Landscape Architecture Department of the Harvard Graduate School of Design, I look at plants for novel uses that may not be fully appreciated by the gardening public. I have long believed that the cohesiveness of a well-crafted garden relies heavily on the successful application of groundcovers. These plants can be used as a "substrate" through which other plants emerge, and which knits the planting into a composition that is visually and spatially pleasing. Given time and the appropriate conditions for growth, groundcovers potentially can reduce the maintenance requirements of the total landscape.

Having the opportunity to visit many plant collections as well as developed gardens, I have come across a number of plants that appear to have all the qualities of a successful groundcover, but are seldom cultivated as such. What are those qualities, you might well ask? Most good groundcovers are little more than very successful weeds controlled and put to good use. The plants not only must maintain themselves in the spot where they are planted but also must be able to spread outward and colonize an ever-expanding area. With many good groundcovers, the primary concern is not to encourage their growth, but rather to contain them by installing restraining devices at the perimeter of the space allowed them.

A good groundcover should be rather low and dense enough to suppress the intrusion of most volunteer weeds, and tough enough to survive neglect, poor soils, and extremes of drought and cold. Groundcovers should maintain their foliage in good condition all summer long and not die back prematurely, leaving a patch of bare earth where late sum-

Epimedium pinnatum *var.* colchicum *in bloom. From the Arnold Arboretum Archives.*

Artemisia stellerana *'Silver Brocade' in bloom. Photo by Gary Koller.*

mer weeds can move in. While a groundcover can be either woody or herbaceous, the focus in this article will be on less familiar herbaceous species that deserve greater recognition and testing. As you read about the following plants, bear in mind that each one has strengths that can be used to advantage in garden-making as well as weaknesses to be suppressed.

What follows is a selection of plants that I am still learning about and that seem to have a bright future as groundcovers for our gardens. I hope that one or more of them may be unfamiliar to you, and that I may entice you into acquiring them for testing under your own growing conditions and maintenance regime. My comments are offered here in the spirit of challenge—to encourage you not only to keep an eye out for plants with unusual variations but also to experiment with nontraditional uses of these plants. I welcome hearing from any readers who might know of similar plants that deserve wider recognition.

Anemone canadensis

The rapid growth habit of *Anemone canadensis* leads some gardeners to dub it as "invasive," and I have been cautioned against deploying it in the landscape. However, it is precisely this trait that enables the plant to make a tight, dense cover and to persist in difficult locations. While it may not be a plant for the mixed perennial border, it could be used very appropriately in challenging areas: beneath trees and shrubs, or in locations where it can be contained by barriers that restrict its spread.

I can envision this plant being used to good advantage in parking islands, between sidewalks and buildings, and in urban parks to fill in empty spaces that invite weeds. The small white flowers in early summer persist for several weeks and are charming if not spectacular. The attractively lobed foliage remains green and in good condition all summer long. This anemone might be improved by the selection of compact forms with darker green

foliage and a longer flowering period. There is also the possibility of hybridizing *Anemone canadensis* with other anemones to extend the floral color range, the season of bloom, or the spreading tendency. *A. canadensis* is often compared to *A. sylvestris*, a plant that blooms several weeks earlier, but one I find a weak grower under those conditions where *A. canadensis* thrives.

Artemisia stellerana 'Silver Brocade'

Parched, sunny growing conditions present a challenge in many areas of the country. *Artemisia stellerana* is one of those plants that loves to bake in the sun and that naturally inhabits sand dunes and poor soils. A native of Asia, it has naturalized itself on beaches from Quebec to Virginia where it holds and stabilizes the shifting sand. The cultivar 'Silver Brocade', a recent introduction of the University of British Columbia Botanical Garden, was selected for rich gray foliage, a more finely cut leaf, and a lower, more compact growth habit. In the landscape, it can look beautiful edging a bluestone path where it has the opportunity to spread out and soften the hard lines, while at the same time echoing the blue-gray color of the stone itself. In coastal New England, this plant is one of the best choices for the harsh environmental assaults encountered by the dunes along the ocean.

Asarum canadense

Few plants tolerate drought and moderate shade as well as the Canadian ginger. It grows naturally in the understory of woods in Ohio, Kansas, and Missouri where it forms diffuse, but widespread colonies. In cultivation and with some level of attention, it stays dense and displays a beautiful moderate green foliage all summer long. It combines naturally with ferns and other woodland plants. In the future, this plant could be improved by some selection for more vigor and darker colored foliage.

James Waddick of Kansas City, Missouri, recently took me to see a wild population with pale yellow variegation in the leaves. There is some question whether this is a natural variation or a population with a virus. If, however, some types are discovered with good stable variegations, they would be a definite plus for the shade garden. Horticulture can be enriched by observant individuals combing wild plant populations for individuals with superior traits for garden use. Once found, the plant needs to be propagated and evaluated under different environmental conditions. If the plant maintains its unique characteristic and is garden worthy, it can then be publicized and distributed.

Campanula takesimana

This campanula is familiar to only a few dedicated perennial gardeners, who mostly use it in the mixed border. Spreading at a deliberate pace, it forms sizable colonies over time, and because of this tendency, it seems well adapted to use as a groundcover. The leaves are roughly heart-shaped with attractive, scalloped edges. The flowers are produced in large terminal panicles, which rise out of the basal cluster of leaves to a height of 30 to 60 centimeters (12 to 24 inches). Because of the number, weight, and size of the individual flowers, the inflorescence has a tendency to arch over. Individually the flowers are tube-shaped, and range from a pale, pink-beige to ivory, with chocolate or bronze markings on the inside of the blossom. If flowering stems are cut back as the blooms fade, the plant is capable of flowering two or three times a summer. This tendency to rebloom varies directly with the amount of light available. Repeat flowering also appears to be dependent on soil moisture, for in extremely dry seasons I have observed that these plants flower less frequently. In any case, I have found that the foliage itself is quite drought-resistant.

Carex siderostricta 'Variegata'

In northern landscapes (Zones 5 and 6), *Carex siderostricta* 'Variegata' has the potential to be used much as *Liriope muscari* 'Variegata' is in the south—except that its greater cold

The foliage of Campanula takesimana. *Photo by Gary Koller.*

hardiness is accompanied by a deciduous habit. *Carex siderostricta* 'Variegata' forms broad clumps of cream-colored variegated foliage, which stand 20 to 30 centimeters tall (8 to 12 inches). It thrives in light shade and soils that vary from dry to moist. In extremely dry locations, I have noticed the white markings of the leaves will assume a tired, brownish cast by late summer. This species mixes well with hosta, astilbe, and ajuga, forming tapestries of foliage texture and color.

Epimediums

Few plants are as tough, dependable, and persistent in shaded landscapes as the various species and cultivars of *Epimedium*. These plants could be made more useful by the introduction of variegated types, which presently exist in Japan and perhaps elsewhere. Barry Yinger, a noted collector of Japanese plants, tells me that, while there are several mediocre forms in terms of degree of variegation, a spectacular form is available from Watanabe Nursery.

While I am not aware that they exist yet, would it not be desirable to select epimediums for unusual leaf types, for richer, more saturated, autumn foliage colors persisting into wintertime, or for foliage marbled with contrasting colors of green? We need to seek out new forms actively and introduce them to the gardens of America. I'll be the first in line to purchase them.

Liriope muscari

Southern gardens are rich in many forms of lily turf, which allow for numerous creative applications of this attractive groundcover. In

The growth habit of Carex siderostricta *'Variegata'. Photo by Gary Koller.*

the north we have no reliable cold-hardy forms, although I have heard of rock gardeners growing this species farther north than it should be expected to grow. Have they hit upon some secret treasure? Think of the market potential if a selection could be made that would extend *Liriope muscari* by another hardiness zone, making it reliable for the urban areas such as Boston, Montreal, and Chicago. It seems that a nursery with a pioneering spirit could make a greater market impact by selecting a more cold-tolerant form rather than yet another cultivar of questionable distinctiveness.

Petasites japonicus 'Variegata'

Earlier in this century, *Petasites* was the signature plant of the landscape architect Fletcher Steele, who found a place for it in each of his garden compositions. One can still find the plant thriving in the garden at Naumkeag in Stockbridge, Massachusetts. Steele realized that plants with huge leaves and great stature could provide visual excitement and spatial illusion for smaller landscape spaces.

At maturity, *Petasites* can stand over a meter tall (3 to 4 feet), reaching the limit in height of what is considered acceptable as a groundcover. What makes *Petasites japonicus* 'Variegata' a desirable addition to garden design is that the early-season leaves are richly marked with cream-colored blotches, which appear different from leaf to leaf. These foliage markings are most intense in spring, and as summer advances, they become somewhat muted. In conditions of adequate soil moisture and light shade, the plant thrives and spreads vigorously. It is particularly useful as a design element to bring boldly textured, cream-colored leaves into shaded locations. Here they provide a color accent all summer long. This is a plant large enough to be planted along the edge of lakes and rivers where the size and scale will not be dwarfed by the expanse of the countryside, and it is equally at home in the small garden when sited appropriately.

At present only a lucky few have this plant in New England, but in time the plant should become a common component of our gardens, especially gardens with an area that is moist and lightly shaded. I first heard of it through Wayne Winterrod of Reedsboro, Vermont. When he learned that I was making a trip to the Pacific Northwest, he assigned me the task of bringing back a division for him. Upon inquiry, I located what probably is the original colony introduced into North America, growing in the Asian Garden at the University of British Columbia Botanical Garden, Vancouver. Dr. Gerald Straley, Curator of Collections, showed me the colony and gave me permission to gather divisions to bring back to Boston. The plant was originally introduced to the University of British Columbia Botanical Garden by its then Director, Dr. Roy Taylor, who found it growing in a field near an airport in Japan. He collected divisions to bring back to Canada, and from there it is now finding its way across North America.

Back in Boston some months later, I spoke with Paul Aden of Long Island, who for many years has collected rare variegated plants. I thought I had a new plant for him, but he informed me that he had a "whole field of it." He could not understand why no one grew or used it as a landscape plant. The answer is, of course, that no one can grow a plant if it's not distributed.

Pleioblastus viridistriata (= Arundinaria viridistriata)

I have a weakness for plants with foliage in shades of yellow to gold. As a result, I have long admired and grown *Pleioblastus viridistriata*, a yellow variegated bamboo that stands 60 to 120 centimeters (2 to 4 feet) tall. In sunny exposures the new foliage emerges with an irregular pattern of golden-yellow stripes alternating with green; in shade, however, the

The foliage of Pleioblastus viridistriata. *Reprinted from* The Horticultural Bamboo Species in Japan *by H. Okamura, 1986.*

variegation is muted and appears light greenish-yellow. In full sun the golden-yellow color is retained all summer long and into the fall or winter, when severe cold causes the foliage to turn beige. I find the foliage most attractive in the autumn landscape, for it blends well with other autumn foliage colors and generally looks attractive until Christmas or beyond.

The colony in my yard is underplanted with minor spring bulbs—*Crocus chrysanthus, Crocus tomasinianus, Galanthus nivalis,* and *Eranthis hyemalis.* I find I must cut the bamboo back at the end of winter so that the bulbs will have head space to grow and to be seen well as they flower. As the bulb foliage begins to ripen off, the bamboo begins its new growth. This bamboo is a strong, vigorous grower and, once established, can run outwards 1.6 meters (5 feet) or more each season; therefore, permanent and strong containment is essential. *Pleioblastus viridistriata* is tolerant of considerable abuse, and I have found it a particularly suitable choice for raised beds in urban parks and for islands along city and suburban streets. Here the golden foliage provides the illusion of abundant color all summer long and works, from a color standpoint, somewhat like a planting of marigolds—with the advantage of coming back each season.

In the Vermont garden of Wayne Winterrod and Joe Eck, this bamboo occurs in a mixed planting with the white-stemmed raspberries (*Rubus lasiostylus* var. *hubeiensis*). Cornelia McMurtirie, a local landscape designer, showed me photographs of one of her designs where the client was attempting to create a strong tropical landscape effect. In the design, she combined the *Pleioblastus* with *Yucca filamentosa* and rhubarb to create a bold, nontraditional effect.

A planting at Haskell's Nursery in New Bedford combines the bamboo with a gold-variegated form of *Acer negundo* so that the gold color is visually pulled from ground level to a height of 8 to 10 meters (25 or 30 feet). In my own designs, I have combined the bamboo with *Chamaecyparis obtusa* 'Cripsii', a gold-leaf form of this Japanese conifer, which worked as a gigantic echo of the yellow color. All of the above plantings create a strong and consistent color effect lasting several months.

Rubus calycinoides 'Emerald Carpet'

Taiwan creeping raspberry is a plant suitable only for the warmest sections of New England—Cape Cod, Martha's Vineyard, and Block Island. The wild species occurs at high elevations in Taiwan and, while its hardiness

The winter aspect of Sasa veitchii, *growing on a mound in Japan. Reprinted from* The Horticultural Bamboo Species in Japan *by H. Okamura, 1986.*

is not fully documented, it is thought to be hardy to USDA Zone 7.

Rubus calycinoides is a plant that hugs the ground while it spreads outward, forming a solid mat of foliage. Evergreen in mild locations and semi-evergreen to deciduous at the northern fringe of its range, this plant tolerates exposures ranging from full sun to moderate shade, but in northern locations some protection from the winter sun and wind may mean the difference between success and failure. It will also probably benefit from being placed in a location with excellent soil and air drainage.

The foliage is bright green, with three- to five-lobed leaves of an unusual crinkly texture. The visual quality of the leaf surface is distinctive and adapts well to tapestry plantings, which bring unusual combinations of height and texture together. The autumn foliage may turn a coppery color. Neither flowers nor fruit on this plant is a significant ornamental attribute.

Rubus calycinoides 'Emerald Carpet' was propagated from seed collected for the University of British Columbia Botanical Garden by Dr. Richard J. Pearson at Ho Huan Shan, Taiwan (elevation 2900 meters), in 1978. First introduced to the horticultural trade in 1985, it is just now becoming available in New England. Bruce McDonald, Director of the University of British Columbia Botanical Garden, suggests that this plant is well suited to small townhouse gardens as a low groundcover for shaded or semi-shaded areas.

Sasa veitchii

One of the most important and frequently used species of bamboo for Japanese garden design is *kuma-zasa.* In the United States it

Shibataea kumasaca *in a landscape setting in an American garden. Photo by Gary Koller.*

has proven to be root hardy to -31 degrees Centigrade (-25 degrees F), and it is reliably hardy in the Boston area. The plant, standing 60 to 150 centimeters tall (2 to 5 feet), has a relatively wide leaf blade that is a moderate green color all summer. The arrival of shorter and cooler days in the autumn causes the margin of each leaf to turn beige or straw color in a band roughly 0.6 to 1.2 centimeters wide. It is at this time that the plant is most visually distinctive, for the leaf color variation is a striking part of the autumn landscape. In areas where winter temperatures and winds are not so severe, the leaf remains evergreen; with more exposure, the entire leaf becomes desiccated and fades to beige.

Unable to thrive in full sun, *Sasa veitchii* requires light shade. It is an ideal groundcover under mass plantings of large trees and shrubs and for stabilizing steep, wooded slopes in cultivated locations. The soil must be well drained for it is intolerant of wet and poorly drained locations. While it does spread outward, I have found it to be less aggressive than most of the other stoloniferous bamboo species.

Shibataea kumasaca

A bamboo of small stature with a distinctively erect habit and lustrous, dark green foliage, *Shibataea kumasaca* can range in height from 1 to 1.6 meters (3 to 5 feet). Long-established plantings observed by this author have produced colonies so uniform in height that they resemble the top of a table. A fine example of mature growth can be seen at the Biltmore Estate in Asheville, North Carolina, where a huge colony grows near the edge of the driveway leading to the main house. In locations with a winter climate similar to

Boston, the plant requires shade in order to remain evergreen. The winter sun can beat and tatter the foliage, and recovery takes until mid-July when new growth masks the damage.

Uvularia grandiflora

This plant is native to woods and thickets from southwest Quebec to North Dakota, and in the south, ranges from Georgia to Oklahoma. In the wild, it inhabits calcareous soils, but I have seen it cultivated in more acidic conditions. In garden use, one normally sees it as an individual mixed among other woodland species; it is displayed in this manner at the Gardner Museum, Boston, where a large plant emerges through a simple groundcover of *Hedera helix*. Groundcover-style mass plantings can be seen in the native plant section of the Landscape Arboretum at the University of Minnesota and at the Calgary Zoo in Alberta, Canada. In both of these locations, plants are situated in what appear to be dry sites, with considerable tree shading.

Uvularia grandiflora produces rich, dark green leaves that, when full grown, can reach heights of 30 to 100 centimeters (1 to 3 feet). Its yellow flowers are small, nodding, and delicately showy, for they appear before any significant leaf expansion each spring. Individual plants expand slowly to form a robust clump that is generally circular in shape. To achieve a solid continuous cover, some attention must be given to spacing and placement, or else the colony appears as scattered circles of foliage. Once established, plantings seem to be persistent, dependable, and attractive throughout the entire summer.

Uvularia sessilifolia 'Variegata'

This quietly variegated plant bears creamy white stripes on each leaf and is similar in size, habit, and spreading qualities to *Disporum sessile* 'Variegatum'. It naturally inhabits dry to moist woodland sites and forms colonies that range from dense to diffuse in character. Blossoms are small pale yellow, nodding bells. The plant has thin, wiry stems,

Uvularia grandiflora, *the bellwort, native to eastern North America. Photo by Gary Koller.*

and its colonies spread outward. *Uvularia sessilifolia* 'Variegata' looks beautiful when woven through *Vinca minor*, drifted through colonies of European ginger, or rising out of masses of bronze and purple-leafed *Ajuga reptans*. The only problem I have ever noticed is that the variegated leaf sections sometimes turn yellow or brown when the plant is excessively dry or located in too much sun.

Vancouveria hexandra

This *Epimedium* relative, native to the Pacific Northwest, provides a low, tightly knit mass of thin-textured, light-green leaves, which stand 15 to 45 centimeters tall (6 to 18 inches), with height depending on the clone and the conditions of the site. Small individual leaflets are positioned in such a way as to give

the total plant a very delicate visual effect, not unlike that presented by ferns. The flowers are also small and rather insignificant but at their finest contribute to the delicate veiled effect.

While *Vancouveria* will never be regarded as a great flowering plant, the color and texture of the foliage make it useful when weaving foliage tapestries into the landscape. It can be successfully interplanted with hellebores, which rise above it with bold dark-green foliage; with hosta cultivars selected to mimic the same foliage color; with trilliums, which poke up through the foliage of the *Vancouveria* and appear to float across a cloud of delicate leaves; and with many ferns, which provide contrasts in height, color, and texture. From a cultural standpoint, it requires little more than some shelter from the sun and a moisture-retaining, well-drained soil. Established plants need little attention and can remain undisturbed for many years. In the West, the plant bears the charming common name redwood-ivy.

Gary Koller is Senior Horticulturist at the Arnold Arboretum and teaches a course on Plants as Elements of Design at the Harvard Graduate School of Design.

BOOKS

Neil Jorgensen

Second Nature by Michael Pollan. Atlantic Monthly Press, 1991. 320 pages. Hardcover. $19.95.

This book has received acclaim from every reviewer that I have read. I must dissent. As an autobiography, it is splendid; as a local history, it is vivid; as a dissertation on nineteenth-century *Naturphilosophie*, I guess it is a good place to begin. But as a book about nature and gardening, *Second Nature* is almost worthless.

Michael Pollan is an uncommonly good writer. Though many people have learned to write clearly and succinctly, only a few can paint with words like Pollan. His writing makes the reader feel like a hungry guest at a gourmet dinner, on the one hand wanting to wolf the insights but at the same time wanting to savor the metaphors.

In his first chapter, "Two Gardens," Pollan's autobiographical account of his early gardening days reminded me of Russell Baker's wonderful *Growing Up*. Pollan tells us about his gardening mentor, a grandfather who, upon semiretirement, developed a vegetable garden that single-handedly could have supported a farm stand. How the crafty old businessman would disarm his negotiating opponents with bushels of fresh produce is the stuff of dramatic comedy. And the scene of his non-gardening father in his underwear—his usual leisure outfit—tinkering with a permanently defective sprinkler system made me laugh out loud. I wish that this part of the book had never ended.

But, alas, end it did. And when Pollan turned his attention from autobiography to gardening—actual dirt gardening—my delight in the book turned to disappointment.

It takes years to become a good naturalist; it takes even more years to become a good gardener. Unfortunately, Pollan has not yet served his time. It shows all through the book. His many references suggest that he has read widely on gardens and gardeners, but reading about gardens is not the same as doing gardens. Pollan just plain lacks first-hand experience. The gardening discussions are so naive and simple-minded that they killed whatever enthusiasm I might have otherwise had for the book. Shall I weed my garden? Shall I build a fence around my vegetable garden to keep the woodchuck out? Shall I plant a willow in the meadow? Oh, come on.

Pollan gets into even bigger trouble when he tries to give us practical gardening Advice. For one of the many examples, read the following:

> Watch the way [an experienced gardener] handles seedlings. Compared to the novice who treats his young plants gingerly, the experienced gardener seems almost rough with them.

Who are these experienced gardeners he's been watching, and what seedlings have they been almost rough with? If he is referring to coarse and husky young tomatoes or zinnias, maybe they can stand being slammed around. But use that same treatment on tiny and fragile primula or gentian seedlings and see how many of those survive. Again it comes back to experience: Pollan either has not transplanted enough different kinds of seedlings, or he has not met enough experienced gardeners. Or both.

Pollan has a chapter he calls "Planting a Tree." After an extended and uplifting philosophical discussion—ranging from oaks in Germany to cypresses in California, from William James and the Puritans to Zeus himself—what species does he finally choose to bring shady pleasure to future generations in rural Connecticut? A Norway maple. A *Norway maple.* What a gift! In the pantheon of bad trees, the Norway maple is right up there with the strangler fig. Coarse leaves, greedy roots, gloomy shade, and seedlings everywhere: what more could anyone want? Sadly but surely, a number of other gardening novices will now follow Pollan's example and also plant this dreadful tree to shade their houses.

In his chapter "Weeds Are Us"—whatever that means—Pollan admits to having read too much Emerson. Though he seems finally to reject Ralph Waldo Emerson's old canard about weeds being plants whose virtues no one has yet discovered, he typically dwells upon it far too long. Even if such horticultural terrors as poison ivy, goutweed, or *Campanula rapunculoides* eventually turn out to be saviors of the world, they will still be noxious weeds to anyone who has the misfortune of finding them in the garden.

And nowhere in this weedy threnody does he mention the value of mulch, that great natural weed-suppressing weapon. Of course, no mention either of the controversial but wonderful weed fighter, Roundup® and Surfan.® At least I don't think there was; when I went to the index to see if I had missed them, I found that the publisher neglected to include an index.

In another chapter, Pollan tells us that Nature abhors a garden. Nonsense. Nature only abhors some gardens. And from Pollan's description of his own gardens, I suspect they would be at the top of Nature's hate list! Vegetable gardens are unnatural; perennial borders are unnatural; orchards are unnatural; rose gardens are extremely unnatural.

When you get right down to it, almost any human intervention on the land—merely moving a spadeful of earth—could be considered an unnatural act, yet there are plenty of gardeners and gardening styles that try to work with Nature, not against it. Wildflower meadows, woodland gardens, the new ornamental grass gardens, naturalistic tree and shrub plantings at places like the Arnold Arboretum—all of these gardening styles seem hardly to bother Nature, much less enrage her. You can tell Nature doesn't mind them because well-executed gardens in each of these styles stay beautiful with only a minimum of upkeep.

My quarrel is not with Pollan's choice of subject matter. Any gardening book can focus more on the philosophical than the practical. But I don't think a discussion of such lofty ideas as whether or not God is a gardener, how to honor the past landscape, or what Thoreau really thought about his bean patch can compensate for a lack of experience in the discussion of weeds, carrots, and compost. In natural history and gardening, hours in the library don't take the place of hours in the field or in the dirt. And I always have believed that people should first become authorities on a subject before they write a book about it.

So why all the hype over *Second Nature*? Why all the gushing reviews? As a colleague pointed out, it is ironic indeed, when there are so many gardeners and naturalists with important things to say who never get the chance, that a neophyte like Michael Pollan gets a huge chance and then says almost nothing important. A book jacket endorsement proclaims, "You don't have to be a gardener to love *Second Nature*." That may be the answer to its popularity.

Perhaps if you are a person for whom nature and gardening happen on country weekends sometime between tennis and cocktails, you may find this book fascinating. But if you're a serious gardener or naturalist, you'll probably want to pass it by.

Arnold Arboretum Weather Station Data — 1991

	Avg. Max. Temp. (°F)	Avg. Min. Temp. (°F)	Avg. Temp. (°F)	Max. Temp. (°F)	Min. Temp. (°F)	Precipi-tation (in.)	Snow-fall (in.)
JAN	35	17	26	50	-1	3.89	8.4
FEB	44	28	36	65	9	1.58	2.8
MAR	49	34	42	79	23	4.33	3.4
APRIL	60	42	51	86	35	4.84	0
MAY	73	53	63	91	44	0.92	—
JUNE	79	61	70	97	50	2.89	—
JULY	83	67	75	99	58	1.95	—
AUG	82	66	74	93	57	5.27	—
SEPT	72	56	64	90	39	6.32	—
OCT	64	49	57	80	34	4.27	—
NOV	51	39	45	73	28	4.06	Trace
DEC	43	29	36	64	10	2.58	5.8

Average Maximum Temperature	61°F
Average Minimum Temperature	45°F
Average Temperature	53°F
Total Precipitation	42.9 inches
Total Snowfall	20.4 inches
Warmest Temperature	99° on July 20 and 21
Coldest Temperature	-1° on January 23
Date of Last Spring Frost	28° on March 31
Date of First Fall Frost	32° on November 9
Growing Season	222 days

Note: According to state climatologist R. Lautzenheiser, 1991 was the third warmest year in the 121 years of record keeping by the National Weather Service. This follows 1990, the fourth warmest year on record. Nine months were warmer than average with February showing the greatest discrepancy at 5.4 degrees above normal. Precipitation was 1.56 inches above normal; snowfall was 16.9 inches below normal.

Summer 1992

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The Magazine of the Arnold Arboretum

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Volume 52 Number 2 Summer 1992

Arnoldia (ISBN 004-2633; USPS 866-100) is published quarterly, in winter, spring, summer, and fall, by the Arnold Arboretum of Harvard University. Second-class postage paid at Boston, Massachusetts.

Subscriptions are $20.00 per calendar year domestic, $25.00 foreign, payable in advance. Single copies are $5.00. All remittances must be in U.S. dollars, by check drawn on a U.S. bank, or by international money order. Send orders, remittances, change-of-address notices, and all other subscription-related communications to: Circulation Manager, *Arnoldia*, The Arnold Arboretum, 125 Arborway, Jamaica Plain, MA 02130-3519.
Telephone (617) 524-1718.

Postmaster: Send address changes to:
Arnoldia, Circulation Manager
The Arnold Arboretum
125 Arborway
Jamaica Plain, MA 02130-3519

Peter Del Tredici, Editor
Judith Leet, Associate Editor

Arnoldia is set in Trump Mediaeval typeface and printed by the Office of the University Publisher, Harvard University.

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Front cover: *Paeonia* 'Joseph Rock'. Photo by Roy Klehm of Klehm's Nursery, Rte. 5, 197 Penny Rd., South Barrington, Ill., 60010. The nursery specializes in hostas, peonies, and daylilies.

Back cover: Various chestnut blight strains: a single normal strain at top; three white and three orange hypovirulent strains, below. Photo by S. Anagnostakis.

Inside front cover: In 1925, Joseph Rock wrote the following caption for this photograph: "The great Buddha of Barang is also youthful. Like Choni and Guya, Barang has recently installed a boy god. The young Living Buddha was photographed at Angkur Gomba, a monastery five days' journey to the north of Choni." Photo by Joseph Rock.

Inside back cover: A second-growth stand of American chestnut trees in Voluntown, Connecticut, July 1911.

Figure 1. A pre-blight specimen of Castanea dentata *growing in Ware, Massachusetts. Photo by E. A. Richardson, April 1905. From the Archives of the Arnold Arboretum.*

Evolution of the Chestnut Tree and Its Blight

Sandra L. Anagnostakis and Bradley Hillman

Recent research into the genetics of the fungal blight provides hope that chestnut trees may someday return to the forests, parks, and orchards of New England.

American chestnuts (*Castanea dentata*) have been in this country for a long time. When biologists started looking at the leaves preserved in the Clarkia fossil beds of northern Idaho, some of the 17- to 20-million-year-old leaves were chestnut. Pollen records prove that they were on Long Island at least as long ago as between the last two glaciers, about 30,000 to 50,000 years ago. They expanded their range northward as the last ice receded, and became a major component of New England forests. The studies of David Foster and his colleagues at the Harvard Forest in Petersham, Massachusetts, revealed abundant chestnut pollen in 2000-year-old soil layers.

When George Emerson reported *On the Trees and Shrubs Growing Naturally in the Forests of Massachusetts* in 1846, he mentioned several very large American chestnut trees in the state. One *Castanea dentata* on Monument Mountain near Sheffield had a trunk that was almost 3 meters (9.5 feet) in diameter at the base. A reliable, yearly crop of tasty and nutritious nuts fed people and their domestic animals, as well as many of the wild creatures of the forest (Figure 1). The hard, durable wood had many uses, and the split-rail fences built in the last century still wend their way through forests where large American chestnut trees are no longer found.

When American chestnut trees suddenly started dying in the Bronx Zoo in New York City in 1904, they were found to have girdling cankers caused by a fungus. At first pathologists thought that a resident fungus had mutated and become lethal to our chestnut trees, but nothing exactly like the fungus could be found in the United States. Murrill reported in 1908 that Japanese chestnut trees (*Castanea crenata*) in the New York Botanical Garden had the disease, and that the Botanical Garden's American chinquapins (*Castanea pumila*) were also attacked. When F. N. Meyer discovered the same fungus in Asia on Chinese and Japanese trees, he reported that they were rarely killed by the disease. Since Japanese trees had been imported and planted here since 1876, the fungus probably hitched a ride on some of them. Pathologists named it *Endothia parasitica*, but the name has now been changed to *Cryphonectria parasitica*.

The Search for Resistance

As chestnut blight disease proceeded unchecked through the whole native range of the American chestnut tree (essentially the eastern half of the United States), a desperate effort was made to find a substitute for these valuable trees (Figure 2). The European chestnut trees (*Castanea sativa*), which had been widely planted since early importation by Eleuthère Irénée Du Pont de Nemours (1799), were also very susceptible. Large orchards of

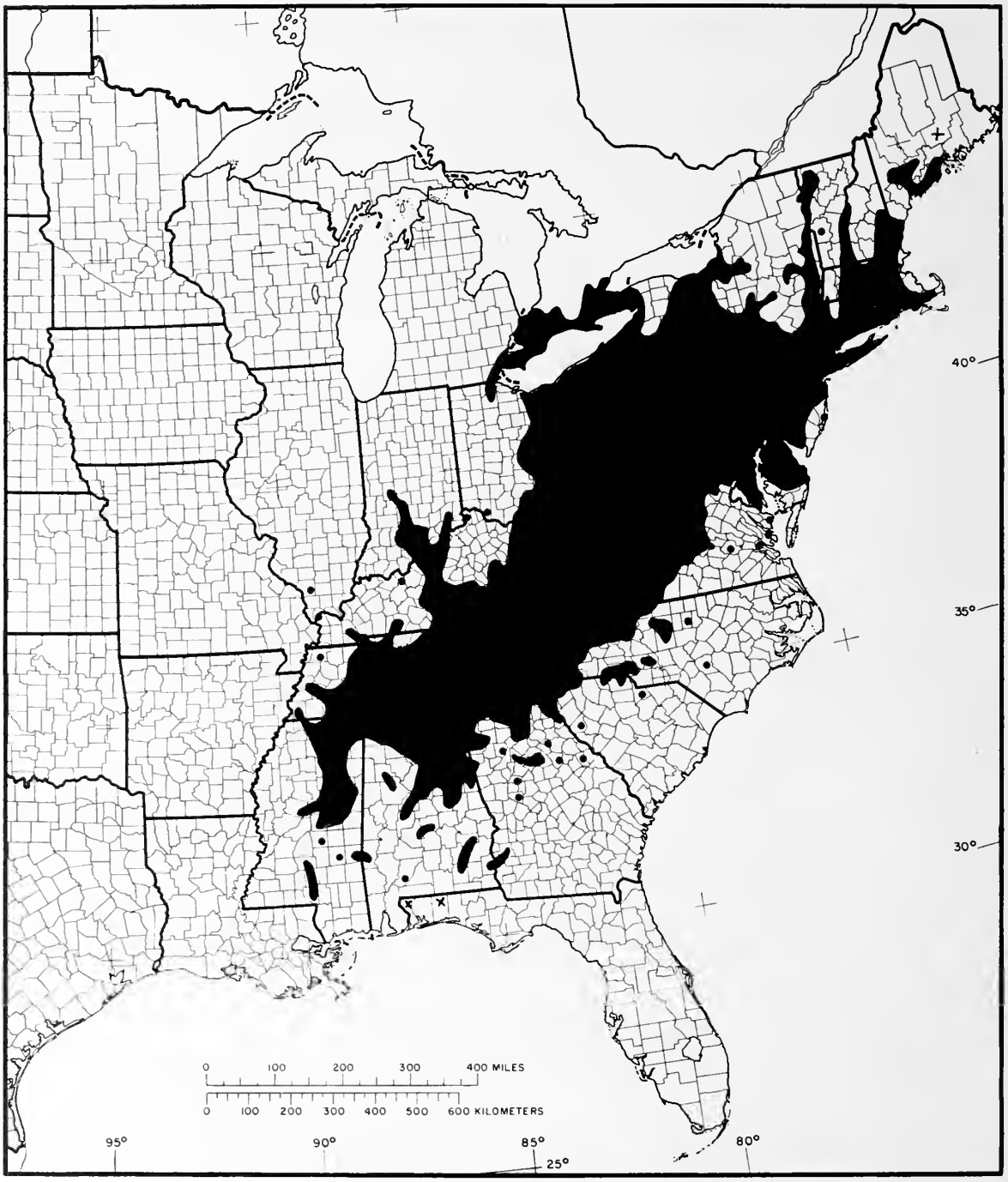

Figure 2. The natural range of the American chestnut. From Atlas of United States Trees. *Vol. 4:* Minor Eastern Hardwoods *by E. L. Little, Jr. USDA Forest Service Misc. Publ. 1342, June 1977.*

C. sativa established in New Jersey and Pennsylvania were decimated by the chestnut blight disease.

Japanese chestnuts that had been imported by S. B. Parsons of Flushing, New York, in 1876 proved both disease-resistant and able to survive our winters. Two of these are still growing in southern Connecticut. Ellwanger and Barry's Mt. Hope Nursery near Rochester, New York, had been selling trees of the Japanese chestnut cultivar 'Japan Giant' by mail order for several years, and Luther Burbank, in Santa Rosa, California, sold 'Miracle'. Three of Burbank's other selections of Japanese chestnut became 'Hale', 'Coe', and 'McFarland' and were sold by the Connecticut nursery of J. H. Hale. All of these Japanese chestnuts were shorter in stature than American trees, with a branching habit that made them unsuitable for timber. Although their nuts were larger than American chestnuts, they were often bitter.

The U.S. Foreign Seed and Plant Introduction Section had imported Chinese chestnuts (*Castanea mollissima*) as early as 1901, and when they proved to be resistant to chestnut blight, imports were increased. C. S. Sargent sent Chinese chestnut seed to the Arnold Arboretum in 1903, but the seedlings raised from these have not survived. The oldest living Asian chestnut in the Arboretum is a Chinese, planted in 1918 (AA #7892A). This tree was sent by the Rochester (N.Y.) Parks Department, with whom the Arboretum had close ties. J. W. Kelly in Rochester is fairly certain that this was one of the seedlings from Plant Introduction #36666, a shipment of 250 pounds of chestnuts collected in the Pang Shan region, northeast of Beijing, by the famous plant explorer F. N. Meyer (Figure 3).

In the next few years, the U.S. Plant Introduction Section shipped, to Massachusetts alone, 3,441 Chinese chestnut trees and about 30 pounds of seed, 553 Japanese chestnut trees and 60 pounds of seed, 15 seguine (*Castanea seguinii*) from China, and 11 trees and 1 pound of seed of *Castanea henryi*, the Chinese chinquapin. Since other Asian chestnut trees were also available from nurseries, we have no way of knowing with certainty how many non-American chestnuts have been planted in Massachusetts (Table 1).

What happened to all of these trees? Many were planted in forested areas by people hoping to restore some kind—any kind—of chestnut to the Massachusetts woods. Plant breeders, who were trying to cross Asian and American chestnut trees to produce American-like trees with blight resistance, soon discovered that all of the species of chestnut were cross-fertile. Thus, all of the Asian chestnut trees in Massachusetts were able to cross with each other, and with any American sprouts that survived long enough to flower.

Chestnuts planted by diligent squirrels may survive the winter, unfound or unneeded for food. As these germinate and grow, many will be killed by deer browsing on the foliage and tender stems. Those that survive to grow are the beginning of a "natural" breeding experiment. In time, chestnut trees with the cold-hardiness of the American chestnut, the tall stature that would allow them to compete in the forest canopy, and the blight resistance genes of the Asian chestnuts would probably evolve in our New England forests. Many people who have found chestnut trees surviving with blight in Massachusetts have sent leaf samples to the Connecticut Agricultural Experiment Station for identification. All of these have been hybrids.

Since all of the sprouts formed from the bases of killed chestnut trees come from a few dormant cells, mutations could lead to some blight resistance. Trees have been located in Connecticut and New York that are clearly American but are resisting the blight better than expected. If this is really genetic resistance, it is another potential starting point for the evolution of trees able to survive in the presence of chestnut blight.

However, plant breeders are impatient to see results sooner than the slow progress likely to occur without our intervention. A back-cross breeding program was outlined for the

*Figure 3. The trunk of a large specimen of the Chinese chestnut (*Castanea mollissima*) described by Frank Meyer as "showing some big wounds caused by bark fungus. My assistant, Mr. J. J. C. de Leuu, is standing beneath. Near San tun ying, Chili Province, China, June 1, 1913." Photo by F. N. Meyer. From the Archives of the Arnold Arboretum.*

American chestnut by Charles Burnham. His experience in corn genetics convinced him that a few generations of crossing resistant Asians, and then their hybrids, to susceptible American trees and of selecting resistant progeny would provide us with the kinds of trees we want much more quickly. Chestnut breeding was started in the 1930s at the Connecticut Agricultural Experiment Station, and its collection of trees of all of the species of *Castanea* is probably the finest in the world. Hybrids of all kinds were made by A. H. Graves, W. Van Fleet, J. D. Diller, H. Nienstaedt, R. A. Jaynes, and many others. The fact that some of their best trees still survive in the Connecticut orchards makes it possible to select the fittest for new breeding experiments.

Evolution of the Blight Fungus

The blight fungus has maintained its destructive vigor in New England for at least eighty years (Figure 4). The original chestnut trees, "killed" by *C. parasitica* in the early 1900s, sprouted from the base only to have the new stems reinfected by the blight and "killed" again. This seemingly endless cycle of sprouting and reinfection has continued unabated

CHESTNUT SPECIES

SECTION Castanea [three nuts per bur]	
Castanea dentata (Marshall) Borkhausen	American Chestnut
Castanea sativa Miller	European Chestnut
Castanea mollissima Blume	Chinese Chestnut
Castanea crenata Siebold/Zuccarini	Japanese Chestnut
Castanea seguinii Dode	Chinese Dwarf Chinquapin
SECTION Balanocastanon [one nut per bur]	
Castanea pumila (Linnaeus) Miller	American Chinquapin, Bush Chestnut
variety *pumila*	
variety *ozarkensis* (Ashe) Tucker	Ozark Chinquapin
Castanea X *neglecta* Dode	Possible wild hybrid between *dentata* and *pumila*
SECTION Hypocastanon [one nut per bur]	
Castanea henryi (Skan) Rehder/Wilson	Henry Chinquapin

Table 1. Taxonomy of the genus *Castanea*

to this day. It was only with the discovery of weakened strains of the fungus in Italy that researchers in the United States were spurred on to search for similar "hypovirulent" strains in this country that were not virulent enough to kill healthy chestnut trees.

The European hypovirulent strains lacked the orange pigment of virulent strains, and produced fewer spores (the "seeds" of fungi). As these spread through the chestnut orchards of Italy and France, the trees began to survive longer, and to "heal" over the blight cankers with lumpy bark tissue. Similarly, cankers in Michigan, Tennessee, Virginia, and West Virginia yielded orange strains of the blight fungus that were also less able to kill chestnut trees. Virologists have now confirmed that these American strains, and the European hypovirulent strains of *C. parasitica*, are infected with viruses (see back cover).

When scientists put bits of a hypovirulent blight fungus into holes in the bark around killing cankers, viruses move into the virulent strains that caused the cankers. The cankers then stop expanding, and the tree's natural defenses of walling off invaders succeed in protecting the tree's living cambium. Once hypovirulence has been established in a chestnut blight population, hypovirulent spores are moved around in test orchards and in the forest by every creature that moves up and down the trees.

The European hypovirulent strains have effected a biological control of chestnut blight in the orchards of *C. sativa* in France and Italy (Grente and Sauret, 1978). Tests were begun here in 1978, and for four years in a row, blight cankers in an orchard of American chestnut trees at the Experiment Station Farm in southern Connecticut were stopped by treat-

ing them with mixtures of hypovirulent fungal cultures. No cankers on these trees have been treated for the last ten years, although new infections occur every year. A few branches are killed, but most cankers are swollen and superficial by the time that they are large enough to be noticed. The trees have continued to grow and produce nuts, and are now being used for breeding purposes.

In the Connecticut forest, hypovirulent strains have survived and have spread slowly. They have allowed American chestnut trees on good soil, with plenty of water, to grow large and bear nuts, but on poor sites the trees do not compete well. Many other woody species are striving to capture the sun and nutrients, and the energy used by the chestnut trees to deal with blight infections puts them at a disadvantage. A little more resistance, or more effective viruses, might give them a competitive edge.

Figure 4. Chestnut blight canker on an American chestnut tree. The fungus has grown in concentric circles in and under the bark from the point of infection, which was probably the broken branch on the left. Photo by R. A. Jaynes.

What Are These Viruses, and Can They Change?

Don Nuss and his colleagues at the Roche Institute of Molecular Biology in New Jersey have determined that the closest relatives of these viruses are plant viruses that are responsible for many important plant diseases. The viruses from hypovirulent strains discovered in the United States are not closely related to viruses from European hypovirulent strains, based on tests of their nucleic acids, but most appear to have evolved from the same progenitor. In a recent summary of the research on hypovirulence viruses in *C. parasitica*, Hillman suggests they can be divided into at least three distinct families, but most of them belong to one common family (Figure 5). The European types, which belong to this common family, have been studied the most, and all strongly affect the way strains of the fungus look in culture in the laboratory.

When Peter Bedker was searching wooded areas in New Jersey for American chestnut trees to use in his experiments, he found some that were surviving in spite of many blight cankers. Hillman tested the normal-looking *C. parasitica* isolates from these cankers and found that they contained viruses very similar to the European hypovirulence viruses. The genes in the New Jersey viruses were different enough to allow more sporulation by the fungus and to allow the fungus to make its normal orange pigment (the European hypovirulent strains are white in culture and produce few spores). We have no idea whether the pigment change will help the hypovirulent strains survive, but the increased sporulation will certainly help them spread around.

The New Jersey discovery resulted in a phone call to Connecticut to discuss the find. A search of Experiment Station records revealed that European hypovirulent strains had been sent to experimenters in New Jersey five times, beginning in 1978. Thus the strains found by Bedker and Hillman were either the fittest survivors of the early canker treatments, or were strains that contained mutants of those original viruses, which were rapidly

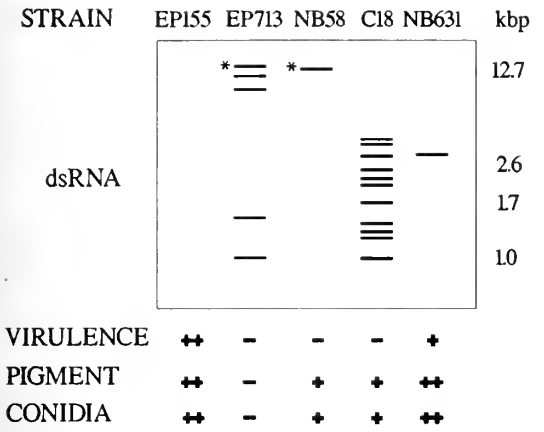

Figure 5. Characteristics of the viruses that cause hypovirulence in the chestnut blight fungus, based on the research of Bradley Hillman. The genes that cause hypovirulence are on nucleic acids called double-stranded Riboses Nucleic Acids (dsRNA). When hypovirulent strains of C. parasitica *are ground up and their nucleic acids purified and separated on gels using an electrical current (electrophoresis), different patterns of dsRNA pieces result. Strain EP155 is a typical virulent strain of the fungus and contains no dsRNA; the others are all different hypovirulent strains, representing three different types of viruses. EP713 and NB58 are related to one another, while C18 and NB631 are distinct.*

selected because they were better adapted to the New Jersey woods. Rapid mutation and selection are qualities typical of viruses adapting to new situations. It is interesting that no white hypovirulent blight strains have been found in New Jersey, even though many were used to treat cankers there. Anagnostakis in Connecticut and MacDonald in West Virginia both have noted that orange isolates of the blight fungus are now common in test plots where European hypovirulence was used to control chestnut blight. No tests have been made of the nucleic acids of these orange strains, but Hillman's results suggest that they should be checked. This may be our first glimpse of the evolution of hypovirulence viruses, adapting to the American chestnut blight and to the American climate.

Connecticut records show that hypovirulent strains were sent to twenty-one other states after the U.S. Plant Quarantine Office lifted the restriction on transfer in 1976. Fourteen such shipments were made to people in Massachusetts, and Anagnostakis has been treating the chestnut trees at the Arnold Arboretum for several years. Terry Tatter and his student Jong-kyu Lee at the University of Massachusetts are now studying chestnut blight in the state and using hypovirulent strains to establish biological control. So far, they have not found any "natural" hypovirulence in Massachusetts.

Reason to Hope

American chestnut trees in Connecticut are surviving better, thanks to hypovirulence, making it easier for us to carry on Burnham's backcross breeding program. In a decade we should have true-breeding resistant hybrids to plant in our forests. The presence of hypovirulence viruses in the blight fungus population should also make it easier for resistant trees to evolve in the forest—whether from rare mutations or because of resistance genes in natural hybrids derived from planted Asian trees. Perhaps the hypovirulence viruses that we have introduced will adapt to provide even better control of chestnut blight disease in the future. We hope to be able to tell our grandchildren that we had a hand in restoring chestnut trees to the forests, parks, and orchards of New England. In the words of Robert Frost:

> Will the blight end the chestnut?
> The farmers rather guess not.
> It keeps smoldering at the roots
> And sending up new shoots
> Till another parasite
> Shall come to end the blight.
>
> —"Evil Tendencies Cancel," 1932

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Sandra Anagnostakis has worked at the Connecticut Agricultural Experiment Station in New Haven, Connecticut, for twenty-five years; Bradley Hillman teaches at Rutgers University in New Brunswick, New Jersey.

Christopher Columbus as a Botanist

John M. Kingsbury

Using Columbus' log as a guide, a biologist retraces the Voyage of Discovery from a botanical perspective.

"Demimillennial" rings more grandly to my ear than "quincentennial." The question of which word to choose arises from the fact that 1992 follows 1492 by five hundred years. By whichever name you call it, 1992 will see pageantry of a lifetime on both sides of the ocean that was first crossed at tropical latitudes by Christopher Columbus, thereby stretching minds, opening pocketbooks, changing civilizations, filling royal coffers, inviting wars, enslaving peoples, and incidentally moving plants around the globe in a way that a single historical event has rarely entrained before or since.

As part of the celebration, WGBH-TV Boston produced a seven-program series on the voyage of Columbus that first aired on PBS in the fall of 1991 and is scheduled for rebroadcast in 1992. An unexpected set of circumstances suddenly involved me in that television series. On six short weeks' notice I found myself in San Salvador, Bahamas, a probable spot where Columbus first made landfall on New World shores. There I boarded the SSV (Sailing School Vessel) *Westward*, a magnificent 125-foot staysail schooner belonging to the Sea Education Association of Woods Hole, Massachusetts (Figure 1). The ship was about to retrace, with a small class of students and the WGBH filming crew, the course Columbus took from island to island as he explored the New World.

My role was to lecture to the students about the plants and plant materials Columbus was looking for, what he actually found, and what he thought he found. A most important aim was to attempt to deduce from the roughly 250 botanically related entries in Columbus' log of this first voyage as much as I could about the man himself. Along the way, my deductions met counterfoil and amplification from the several nautical, archaeological, and historical specialists aboard and ashore as we worked together to flesh a log account written five centuries ago into a real person and to materialize the now almost mythical first voyage into a real event.

Here I wish to share with readers some of the more interesting insights that have come from this experience, really an unparalleled adventure, that began in San Salvador and ended in Puerto Plata, Dominican Republic. Our general route took us first south-southwest through the southern Bahamas, where we turned east as did Columbus, sailing into the trade winds, making several stops along the rural Cuban coast. We sailed across to Hispaniola and made several more stops along the northern shore of Haiti, including the spot where the *Santa Maria* sank and the sites of the first and second European settlements in the tropical New World, Navidad and Isabela (Figure 2).

Columbus Encounters Sargasso

The botanical entries actually begin early, however, on the transatlantic leg of Columbus' voyage from the Canary Islands.

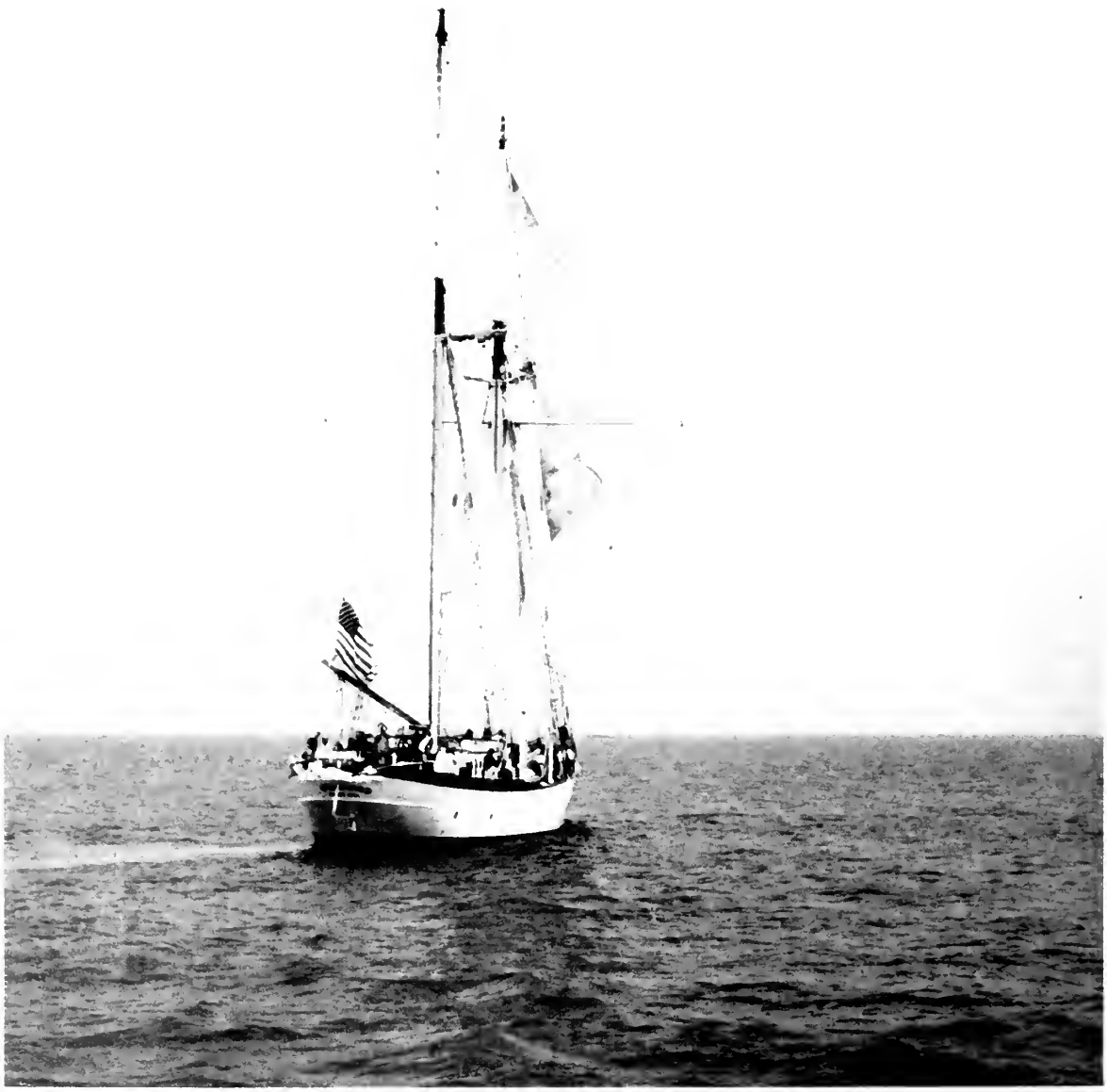


Figure 1. The 125-foot staysail schooner, SSV Westward, *under sail in the Caribbean as it follows Columbus' course through the New World. Photo by John M. Kingsbury.*

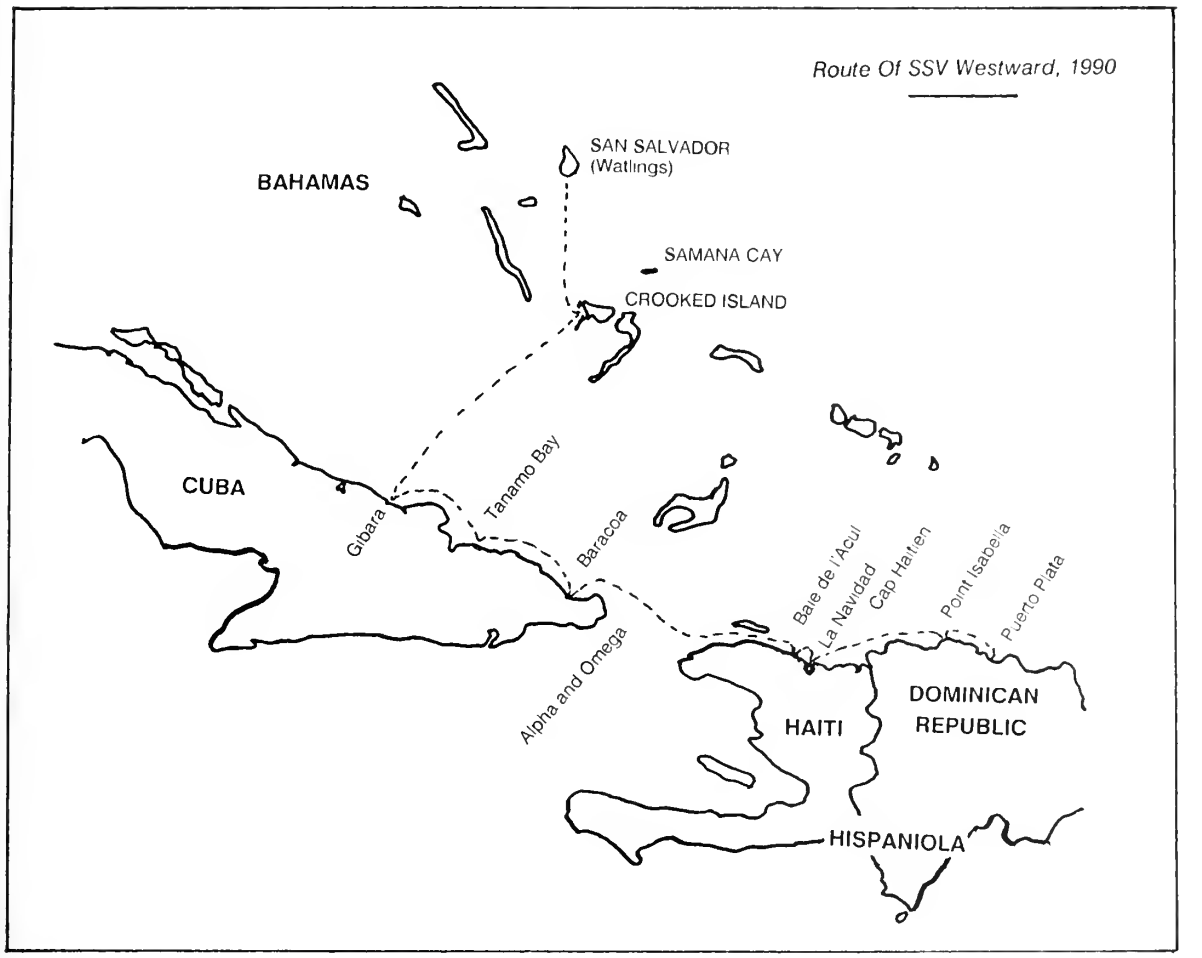


Figure 2. The route of the SSV Westward *through the Caribbean in 1990.*

They record observations that had special significance in the changing attitudes of the crews, as the three small vessels traversed unknown waters, and the increasing urge toward mutiny.

The *Niña*, *Pinta*, and *Santa Maria* were crewed by some eighty-seven to ninety men, most of whom were simple sailors who had rarely been far offshore, recruited suddenly and perhaps with some coercion from the ordinary maritime people of the Spanish seashore. The first botanical entries in the log (which, in a nautical sense, is really more of a daily journal or diary than a simple record of courses, distances, sail settings, and weather) had to do with seaweed. The seaweed entries begin on September 16, the tenth day away from the Canaries, and continue until October 8, two days before land was sighted. Altogether there are twelve entries on seaweed in that four-week period of sailing into the unknown.

Christopher Columbus had perhaps, or even probably, heard some sketchy accounts of what we know now as the Sargasso Sea from Portuguese mariners who had ventured

far enough west to have encountered its eastern edge. But Columbus was the first person to experience it fully, to traverse its vastness, and to record a transect of it. This is of great historical and biological importance. Of equal importance is the reaction of his sailors to the seaweed with which the Sargasso Sea is populated.

In most instances when we look at the botanical entries, we first have to overcome the problem of what Columbus actually meant when he identified a plant with a word or phrase in the Castilian Spanish of five centuries ago. Fifteenth-century Spanish plant names were, of course, those of two and a half centuries before the great Swedish botanist Linnaeus and his contemporaries brought some stability into botanical nomenclature.

The seaweed of Columbus, however, is easily identified with the genus *Sargassum* for two reasons: Columbus described it well, and no other seaweed lives in that part of the open ocean. In the log entry for September 16, Columbus records: "We have begun to see large patches of yellowish green weed, which seems to have been torn away from some island or reef. I know better because I make the mainland to be farther on." September 17: "I saw a great deal of weed today from rocks that lie to the west. I take this to mean we are near land. The weed resembles a grass except that it has long stalks and shoots and is loaded with fruit like the mastic tree."

The two species of *Sargassum* that inhabit the Sargasso Sea are yellowish branching plants with long irregular stalks, leaf-like blades (with midvein), and small, spherical, fruitlike bladders scattered in the branchlets (Figure 3). Columbus' description fits the plant quite well.

Nearly all seaweeds, whether of the red, green, or brown groups, are firmly attached to the substrate. Unlike land plants, they do not have roots, nor do they obtain mineral nutrition from the substrate. They do not have to because the seawater surrounding them contains everything they need, though not always in abundance. What they do require is that the water next to their surfaces be continuously replenished. By attaching to rocks or other permanent, hard underwater surfaces, a seaweed stays put as waves and currents wash by, bringing it new nutrients and taking its wastes away. If you tear a seaweed free from its rock attachment, look at it, and then put it back in the water, it floats about, moving with the water surrounding it, and soon exhausts the nutrients within immediate reach of its surface. Its wastes accumulate there, too. Usually within a matter of days under these conditions the seaweed dies, decays, and disappears.

Figure 3. Sargassum *collected by the author in the Sargasso Sea. Note the spherical, fruitlike bladders that are scattered along the branchlets.*

Although they may not have known the reason why, the sailors on the *Niña*, *Pinta*, and *Santa Maria* did know from experience that

healthy seaweeds floating in the water meant rocks in the near vicinity! At least that had always before been the case.

The fleet of small, square-rigged vessels bearing Columbus and his men westward from the Canary Islands was being blown "downhill" by the prevailing, strong easterly winds at that latitude (the trade winds). Columbus, who was a widely traveled mariner, knew about those winds and planned to use them for a fast downwind passage to the East Indies, the location of which he also was sure he knew. (He *did* know the latitude from observations made by the overland spice traders; it was the longitude that gave him trouble.)

The crew saw it differently. They were being blown inexorably away from their homes in vessels that, as square-riggers, could not turn about and make headway back into the wind. How would they ever get home? How long would their provisions last? Or would their end come soon, shipwrecked on the rocks the seaweeds promised?

Unlike their admiral, they had not moral certainty about good things ahead (September 20, twenty-two days out): "And we saw much weed of the kind I have already mentioned, even more than before, stretching to the north as far as you can see. In a way this weed comforted the men, since they have concluded that it must come from some nearby land. But at the same time, it caused some of them great apprehension because in some places it was so thick that it actually held back the ships. Since fear evokes imaginary terrors, the men thought that the weed might become so thick and matted that there might happen to them what is supposed to have happened to St. Amador when he was trapped in a frozen sea that held his ship fast. For these reasons we kept as clear as possible from those mats of weed."

The explorers were now far enough away from home (as I see it) that in the minds of the sailors the danger of wrecking on rocks began to lessen before the greater danger of never finding land. Apprehension remained strong and fostered a new worry, that of entrapment by seaweed. Real entrapment of the vessels was, of course, not possible; but in light winds, the *Sargassum* (which sticks some of its branches above the water and blows somewhat with the wind) probably moved downwind at about the same speed as the beamy, blunt vessels, which therefore did not make much visible passage through it.

One of the characteristics of Columbus that appears and reappears throughout the log is his ability to talk with his men, give reasonable explanations of things from his store of experiences, and calm their fears. Columbus was able (though barely at times) to overcome whatever fear the *Sargassum* engendered among the men and to talk them out of mutiny.

Every few days from September 21 to October 3, Columbus says something, but not much, about the floating seaweed; either it is abundant or scarce. By now (a month out) it must have been clear to all hands that the *Sargassum* of the Sargasso Sea does not mean either land ahead or rocks nearby.

On October 3, a new element arises: "There is more weed, but it is withered and appears old. There is a little fresh weed that bears something like fruit."

Here is my interpretation of that entry. First, the *Sargassum* was not doing well. Perhaps it was not the same kind of *Sargassum* as that typical of the Sargasso Sea. *Sargassum* exists in many species (some fourteen in the tropical Americas). Only two of those species account for the floating, healthy *Sargassum* of the Sargasso Sea. All the remaining species are found solely as typical attached seaweeds of the shore, and they soon die if torn free in a storm. Perhaps the fleet had newly encountered some of these attached kinds ripped by a storm from the fringes of the Caribbean islands, where they are common, withering and dying as they floated about.

Second, a new seaweed of about the same color (or Columbus would probably have noted the difference) had appeared in the drifting *Sargassum*. It bore "fruit" different from

the small, spherical bladders of *Sargassum* (or he would not have noted them specially in the log). This weed was "fresh." I think Columbus probably found some *Turbinaria* with its heavy, somewhat pear-like tips, among the withered "island" *Sargassum*. *Turbinaria* will not grow unattached, but it does remain alive longer than most tropical seaweeds when torn free from its substrate. Did the combination of withered old *Sargassum* and fresh, different weed finally mean land ahead?

On October 8 comes this entry: "Very fresh weed has been seen." Then, late on October 10, landfall was made. Ultimately, the seaweeds were right. Land *was* ahead.

Was the evidence of the *Sargassum* "wrong" at first? No. Christopher Columbus was the first person to record a new life form of seaweed, one that lives, grows, and reproduces afloat at sea and nowhere else. Only two species of *Sargassum* (*S. natans* and *S. fluitans*) have evolved that ability. Unlike their relatives at the shore's edge, these species have become unusually efficient at absorbing and recycling nutrients while drifting with the oceanic surface water masses. They have facilitated the evolution of a complex community of animals and microscopic plants that attach or shelter among their branches, aiding in the capture and recycling of nutrients from what is, *au fond*, a desolate and impoverished source.

Having adapted to an unusual niche in which no other seaweed has been able to compete, those two species of *Sargassum* have given up the sexual reproduction characteristic of shore-based species of *Sargassum*. Instead, they increase solely by vegetative means. A branch grows by active cellular division at the tip. As the plant ages, the cells at the other end of the axis eventually die and disappear. The amount of plant material existing at any one moment thus reflects the consequences of a race between the amount of tip growth and the rate of death catching up from behind. Occasionally a tip develops into two branches, creating a branching point in the axis behind. When death catches up with that branching point, two separate plants appear where there was but one before. The size of the population measured by numbers of individuals in this way is also determined by a balance between growth and death.

Over the past five hundred years, growth and death of *Sargassum* have been in relatively good balance. The log entries describe a Sargasso Sea of patchy nature—no weed some days, dense mats or windrows on others. That is the way it still is; although, as shown by studies aboard SSV *Westward*, weathered petroleum and plastic granules permeate all of it now, and some evidence suggests that the *Sargassum* is not as plentiful as it was when Columbus first described it five centuries ago. Nevertheless, we still do have the Sargasso Sea. Moreover, John Teal of the Woods Hole Oceanographic Institution has noted that, by the nature of this process, some of the *Sargassum* out there now, which is in a sense immortal, must have seen Columbus pass by.

In Botany, Columbus Was "Dismal"—Or Was He?

A recent, well-received colloquial English (American) translation of the log of Columbus' first voyage (1492–1493) is that by Dr. Robert H. Fuson (*The Log of Christopher Columbus*, 1987; International Marine Publishing Company, Camden, Maine). In a comment on page 34, Professor Fuson assesses Columbus in the following words: "In summary, the log tells us much about Columbus the sailor, the scientist, and the captain. As captain/sailor he was unsurpassed. As a scientist, he lacked much, especially in botany (dismal!), ornithology (only fair), and ichthyology (poor). In other sciences he was better: astronomy (good), meteorology (better than average), navigation (A plus), ethnology (good), geography (excellent)."

In a similar vein, L. A. Vigneras says of Columbus in a foreword to Cecil Jane's earlier familiar translation of Columbus' journal: "His knowledge of flora and fauna was limited and most of his identifications of trees and plants are only approximate."

Figure 4. Aloe from the Old World, Aloe barbadensis.

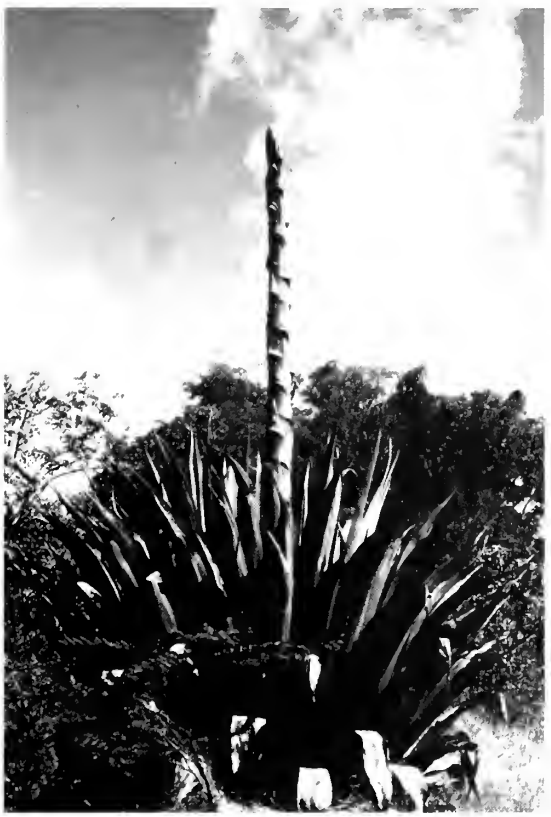


Figure 5. One of the native American Agaves *that Columbus mistook for* Aloe barbadensis.

The few writers on Columbus, such as Robert H. Fuson and Samuel Eliot Morison, who have immensely valuable, practical first-hand knowledge of the sea and the lands that Columbus explored as well as the academic tools and abilities to review his writings critically, appear, nevertheless, to have lacked the professional expertise needed to assess closely the botanical entries themselves. Fuson gives no specific credit for his botanical treatments, but has certainly sought informed help in writing his addendum on plant tubers as well as many of the footnotes. Morison credits several of Harvard's eminent plant specialists for his botanical names and comments. Despite this collaboration of experts, botanical misunderstandings have occasionally occurred and useful insights have escaped capture in the most widely read accounts of Columbus' first voyage.

Columbus himself was the first to admit that he didn't know much about plants. He notes about a week after the first landing (October 21): "I am the saddest man in the world for not knowing what kinds of things these are because I am sure that they are valuable."

As expressed to Queen Isabella and the king, Columbus proposed to attempt three things in 1492: first and foremost, to find a direct water route to the exceedingly valuable spices of the East Indies; second, to find wealth; and third, to bring Christianity to the natives. Although gold was the name of the

game when Columbus returned home in 1493, spices were a major objective when he set forth. Let us then look at the matter of spices, broadening that definition a little to include as well drugs, herbs, and other plant extracts of high value.

The most valuable spices that came only from the distant east in the time of Columbus were pepper, ginger, rhubarb, cardamom, cinnamon, nutmeg, mace, and perhaps cloves. We know for sure that Columbus was seeking at least pepper and cinnamon because he says, on November 4: "I showed samples of cinnamon and pepper, which I had brought with me from Castile, to some Indians."

The Wrong Kind of Aloe

The first thing Columbus found, however, that he thought he recognized was not one of the precious spices, but what he called "aloe." On October 21, about a week after the first landing, Columbus records: "I recognized the aloe here, and tomorrow I am going to have one thousand pounds of it brought to the ship because they tell me that it is very valuable." The next day: "I have taken as much aloe as I could find." And on October 23: "And I know nothing except this aloe which I am carrying to your Highnesses in great quantity."

Unfortunately, he didn't find the "right" aloe (*Aloe barbadensis*), the one he had probably known in the Mediterranean region from which he came (Figure 4). *A. barbadensis* didn't grow in the New World in 1492, though it is common in the Caribbean now.

Today the principal use of *Aloe barbadensis* is in skin conditioners and similar cosmetics. As a home remedy, the mucilaginous "pith" of the leaf is commonly used to soothe burns. In the fifteenth century, *A. barbadensis* had a different, more important use. The yellow sap that drips from the cut leaf was collected, dried, and used in small doses as a potent laxative. It will cleanse the human gut quickly and thoroughly.

If not *Aloe barbadensis*, what did Columbus actually find? The common Caribbean plant that looks superficially like aloe is an agave or century plant: *Agave missionum*, *A. bahamense*, and perhaps others. While these agaves are distinctly larger than aloe and the leaves not as fleshy, leaf color, shape, and the general appearance of the agaves and aloe are quite similar (Figure 5).

That the local "aloe" was larger than the European aloe did not trouble Columbus overmuch if he noted and wondered about it. Because he arrived in the West Indies during the rainy season, Columbus found everything lush and green. He saw open fields of tall, luxuriant grasses that at home would have been eaten down by cattle, horses, sheep, goats, and the like—while on these islands there were no large herbivores at all. The forests had not ever been cut and the size of the mature trees impressed him greatly. His log entries frequently display a feeling that everything is and ought to be generally larger, more lush, more showy, or more fragrant in the New World than at home. That the Caribbean aloe was bigger was quite reasonable in this context.

Perhaps some of the enthusiasm embedded in Columbus' comments was aimed at selling Isabella on his discoveries—mild hype is understandable in the circumstances, and must have been effective, because the Spanish crown furnished Columbus with seventeen vessels and some twelve hundred men on royal salary for his second expedition to the New World in late 1493. Even so, much of Columbus' enthusiasm was clearly genuine and entirely supportable.

Columbus mentions aloe six more times in the log from November 5 to January 7. His enthusiasm for it had clearly decreased over that period because in each of those six entries he mentions it only in passing. For example, on November 7: "There is a lot of aloe but it is the mastic that is worth paying attention to . . . "

Aloe is not among the materials Columbus listed as being removed from the *Santa Maria*, after she foundered on a reef near Cape Haitien on December 26. One wonders if his half ton of fresh century plant in the hold had

begun to mold or ferment in the warm, moist maritime air and had been heaved out long since.

Columbus rarely if ever admits in the log of having made a mistake, but that and a great deal of other evidence suggest that neither did he ever alter an entry in the log once it had been made. In this instance and in several others, we see glimpses of a progression from enthusiastic but uninformed certainty, to doubt, to no further mention—admission in his own mind if not on paper that things weren't exactly as he first thought.

Mastic from Gumbo Limbo

What was the "mastic" that was more desirable than the "aloe"? Before the epic voyage of 1492, Columbus had visited or lived for a time on the island of Chios, off the Greek mainland, then politically a satellite settlement of the city-state of Genoa, where he probably was born. That gave him an opportunity to become familiar with the growing and harvesting of mastic. Chios at that time was the primary, perhaps sole, source of the highly valued mastic resin. European mastic is a yellowish resin that bleeds as occasional "tears" from the bark of *Pistacia lentiscus*, the mastic tree. It can be harvested more copiously if the bark is scored with a knife.

Columbus makes brief mention of mastic first on October 17: "[Another] had leaves like mastic . . ." He identifies it definitely on November 5, about three weeks after the first landing. That day and the next two he gives it lots of attention (four lengthy entries) including the following:

> While the *Niña* was beached, its boatswain came to me to beg a reward for finding mastic. But he did not bring a specimen because he had lost it. I . . . sent two men to the trees, and they brought a little of it, which I kept to carry to the Sovereigns. I also kept some of the tree, for I knew that it was mastic. Although it must be gathered at the right time of year, there is enough in this vicinity to produce fifty tons a year.
>
> But it is the mastic worth paying attention to, for it is found only on Chios and they derive over fifty thousand ducats a year from it, as I recall. Although the leaves and fruit of this tree appear to be those of the *lentiscus*, the tree here is much larger than the trees on Chios. I ordered many of the trees tapped in order to get resin. I could only get a little bit since it has rained every day, but I am bringing it to Your Highnesses. Also, it may not be the season to tap them. I think it should be done after winter, just as they are about to flower. Here the fruit is almost ripe.

Nor is that the end of it. Eight more entries appear that mention mastic: one in November, three in December, and four in January. Columbus didn't lose his enthusiasm for mastic resin the way he did for aloe, but he couldn't get any significant amount from the trees, and he explains, quite reasonably, why that is so. His later references pay passing attention to the abundance of mastic trees (which the crews gathered as firewood), but the evidence suggests he gave up trying to obtain financially significant amounts of the resin to take back to Spain.

What was the New World mastic? *Pistacia lentiscus* did not grow in the Caribbean area when Columbus arrived. Undoubtedly Columbus' "mastic" tree was *Bursera simaruba* (Figure 6), which today is variously called gumbo limbo, gum elemi, turpentine, birch gum, or tourist tree in the English-speaking Caribbean islands—the last because its trunk is always red and peeling. Among the several uses of European mastic was treatment of diarrhea, and the New World Indians told Columbus that the resin from their tree was good for stomach pains.

Given Columbus' proclivity to believe everything was bigger and better in the New World, who can blame him for this mistaken identification? Would the average American tourist have done better?

A Case of Mistaken Identity

On the very first day after landing, Columbus saw something no white man had ever seen before; on November 6, just three weeks later, he realized what it was. October 12: "[The Indians] brought us . . . many other things, including a kind of dry leaf that they hold in great esteem." October 16: "Also, he had . . . some of those dry leaves which are much

Figure 6. The gumbo limbo tree, Bursera simaruba.

valued by these people, for they brought some to me on San Salvador as a gift." November 6: "My two men found many people who were going to different villages, men and women, carrying a charred hollow wood in their hand, and herbs to smoke in this wood, which they are in the habit of doing."

The herb was, of course, tobacco. The word *tobacco* is Arawak, the native language of these island tribes. The charred hollow wood in which it was smoked (through the nostrils) might have been a small pithy branch from *Cecropia peltata* (trumpet tree) with the pith reamed out, or a piece of a bamboo-like cane, several kinds of which are native to the American tropics.

We can, now, perhaps deduce what it was that Columbus mistook for cinnamon. November 4: "[Martín Alonzo] Pinzón came to me with two pieces of cinnamon and said that a Portuguese sailor on his ship had seen an Indian who was carrying two very large handfuls of it . . . The boatswain of the *Pinta* said that he had found trees of cinnamon. I went to see for myself and found that it [the trees] was not cinnamon. I showed samples of cinnamon and pepper, which I had brought with me from Castile, to some Indians [who] recognized these spices and indicated by signs that there was a great deal of it nearby." November 6: "My men showed the Indians the cinnamon and pepper and other spices I had given them, and they were told by signs that there were many such spices nearby . . . but they did not know if they had those things in their own village."

What would an Indian be carrying "two very large handfuls of," that looked like cinnamon?

True cinnamon (*Cinnamomum zeylanicum*) didn't grow anywhere in the New World when Columbus arrived. Cinnamon spice is the thin brown bark peeled off young branches of the cinnamon bush. The bark from small branches tends to roll up into tubes or cylinders. Coarse tobacco leaves also tend to roll up and turn brown as they dry. I suspect the Indian was carrying two handfuls of tobacco.

Columbus was doubtful about the identification of cinnamon bark from the first, as he reports it as hearsay from Captain Pinzón (whom he didn't particularly trust), who in turn lays it to "a Portuguese sailor." He was certain the identification was wrong when he went to see the trees themselves. Note that no further entries about cinnamon appear in the log after those two. Even the Indians were doubtful that they had cinnamon, telling Columbus (as usual) what they thought he wanted to hear (that there was plenty nearby), while admitting that they didn't know if it was to be found in their own village. Score another botanical point for Columbus!

Pepper by Another Name

The spice Columbus was most anxious to find was probably pepper. True pepper (*Piper nigrum*) was imported to Europe from its native Asia and India in Columbus' time and was paramount in importance among the imported spices. Old World black pepper, distributed as peppercorns, is prepared from the green berries of the pepper vine (Figure 7). The berries are harvested, fermented a little (thus blackened), and then dried. White pepper consists of the same berries picked a little later (ripened a little more), soaked in water, and rubbed to remove the outer layers, thereby yielding a hard, gray peppercorn.

As can be seen in the log entry for November 4 (see cinnamon), Columbus was actively seeking pepper, but despite what the Indians told him about its being plentiful nearby, he never found anything he believed to be Old World black or white pepper. He did experience something with a similar pungent

Figure 7. The immature fruits of the black pepper vine, Piper nigrum.

taste which the Indians used copiously in their stews. Just when this first happened is not determinable, but after the *Santa Maria* grounded, Columbus dined with the Indians regularly and surely ate frequently from the Arawak pepper-pot stews. On his very last day on land in the New World (January 15), Columbus writes his sole entry about pepper in the log: "There is also much *aji*, which is their pepper and is worth more than our pepper; no one eats without it because it is very healthy. Fifty caravels can be loaded each year with it on this *Isla Espaniola*."

The New World peppers are species of *Capsicum*. These plants grow as herbaceous shrubs and produce the familiar red, yellow, and green peppers of the vegetable garden. The fruits range widely in hotness and the two common species have many varieties. *Capsi-*

cum annuum includes the bell, pimento, paprika, chili, and red or cayenne peppers. *Capsicum frutescens* includes the tabasco peppers. The Arawaks used the dried fruits of one or the other both as a spice and also for preserving foods. They have been shown to have antibacterial, and perhaps antioxidant, abilities.

American peppers are one of the most important gifts of the New World to the Old. Columbus deserves credit not only for realizing that our peppers were something quite different from the peppers known in the Old World, but even more for recognizing their potential value. He deserves credit, also, for describing the New World pepper situation accurately in his log.

Although Columbus made several world-shaking discoveries on his first voyage, he actually found not one of the spices he was after. Sublime irony lies in the fact that, in seeking a fast route to the "pepper islands," Columbus got the wrong islands, named the wrong Indians, and found the wrong peppers.

Until his death, Christopher Columbus believed that he had found the right islands, but from his very first encounter with it he knew he hadn't found the right pepper. One could conclude from this superficial assessment that Columbus' botany was brilliant, while navigation and ethnology were the studies in which he was "dismal."

In Keeping Alive, It's the Starch That Counts

The islands of the Caribbean had been settled, over the period of a millennium or so, by agricultural Indians who had worked their way in large dugout canoes from northern South America to Trinidad, and then, island by island, north and west to Cuba and the Bahamas. These Indians carried their principal food plants with them as they migrated. They called themselves the Arawaks, a word which, I have heard, means the "tuber eaters." Certainly two root crops that they carried with them in the canoes were among their most important staples.

Figure 8. Local Caribbean "bread," made from cassava tubers, Manihot esculenta.

When Columbus and his men arrived in the New World in October of 1492, their fresh provisions were largely exhausted. Although finding spices was officially a top objective of the expedition, of practical necessity Columbus took an immediate overriding interest in what the Arawaks were eating and in trying these new foods himself. October 14: "Some brought us water; others things to eat . . . Many men and women came, each one with something." October 16: "He carried a bit of bread about the size of your fist."

Columbus soon realized that the native bread (Figure 8) was made from tubers, but he had a lot of trouble identifying or describing them. At various places and times in the log, he compares the Arawak tubers with carrots and radishes, yet clearly he recognized that the Arawak tubers were neither carrots nor radishes. In appearance, he found them more like certain large tubers he had experienced on his voyages to northern Africa. In the African tongue, those tubers were called, as transliterated, *niames*. Thus on November 4 we find: "These lands are very fertile. They are full of *niames*, which are like carrots and taste like chestnuts." And on November 9: "The roots that taste like chestnuts are their principal food, and much land is planted to it."

Figure 9. The main Arawak tubers: [*left and center*], *the cassava,* Manihot esculenta, *in the Euphorbiaceae;* [*right*], *the sweet potato,* Ipomoea batatas, *in the Convolvulaceae.*

In mid-December Columbus had occasion to learn quite a bit more about the Arawak tubers and how they were grown. December 13: "They brought the bread of *niames*, which are tubers and look like large radishes. They are planted in all their fields and are their staff of life. They make bread from them and boil and roast them, and they taste like chestnuts—anyone who eats them will say they taste like chestnuts." December 16: "These fields are planted mostly with *ajes*. The Indians sow little shoots, from which small roots grow that look like carrots. They serve this as bread, by grating and kneading it, then baking it in the fire. They plant a small shoot from the same root again in another place, and once more it produces four or five of these roots. They are very palatable and taste exactly like chestnuts. The ones grown here are the largest and best I have ever seen anywhere."

Altogether, Columbus refers to bread or tubers in well over a dozen log entries. In these entries, the Arawak word for the tubers (*ajes*) replaces the word Columbus first used for them (*niames*) on December 16, and *niames* does not appear in the entries after that date. This seems clear evidence, if such were needed, that Columbus never exactly equated the New World tubers with the African *niames*, but merely used that word for lack of a better one until he learned the Arawak word. By late December Columbus had learned the Arawak word for the bread made

from *aje* tubers. The log for December 26 notes: "And other foods they have, including their bread, which they call *cazabe*."

A Niame by Another Name

The Arawak tubers were two: *Ipomoea batatas*, the sweet potato of the morning glory family (*Convolvulaceae*), and *Manihot esculenta* of the spurge family (*Euphorbiaceae*) (Figure 9). The latter and its products possess several names in English, principally manioc, cassava, and tapioca—all three words are transliterations of Indian names.

If Columbus was confused about the Arawak tubers, it was only in how many kinds there were. At first it seems he did not differentiate between the sweet potato and cassava. As time went on, however, he undoubtedly saw both as they grew in the Indian fields. While their tubers are grossly similar, the plants themselves could hardly be more different. The sweet potato grows as a compact, ground-hugging, viney plant—something like a squash, with small, pinnately veined, pointed leaves. Cassava plants (as Columbus notes on December 16) start as erect shoots that eventually grow into long-stemmed, upright, head-high, almost woody plants with large, long-stalked, palmately veined and divided leaves. Even a dismal botanist could not have confused these two plants as one.

On December 26 (just after the *Santa Maria* grounded on a reef), Columbus records that he has eaten with his Indian hosts "a meal with two or three kinds of *ajes* . . ." Today, both cassava and sweet potato exist in many horticultural varieties, including different flesh colors among the sweet potatoes; and it is likely that, in the millennium during which the Arawaks had been island hopping, they had already established several selections of each species with differing tuber characteristics. Thus, Columbus could easily have had several varieties of *ajes* at the Indians' table.

The flesh of the cassava tuber is poisonous if eaten raw. Its toxicity comes from the presence of a glycoside that releases cyanide (HCN) when eaten. The cyanide potential in the raw tuber depends partly on genetics and partly on growing conditions. Somewhat loosely, the "sweet cassava" varieties are genetically of low toxicity, while the "bitter cassavas" usually are highly toxic. Small quantities of sweet cassavas can be eaten raw with little risk (though they can become fairly toxic under certain conditions of growth), but bitter varieties should never be eaten raw, even in small amounts.

The Arawaks had, of course, learned all about these properties of cassava. They used bitter cassava as a source of spear poisons. They routinely detoxified the cassava they ate. Fortunately, cyanide is easily destroyed by simple treatments of the raw tuber, even if present in high concentration. Cooking (boiling or roasting) is always effective. Cassava tubers were typically cut into pieces and cooked in the ubiquitous pepper pot of the Arawaks. The other usual method of detoxifying cassava was to make it into bread in the way Columbus himself described. The juice is squeezed out of the scraped and kneaded pulp, and the dough thus prepared is baked in a fire. The common method was to spread it in a thin layer on a hot flat stone or a pottery wheel made for the purpose. Modern cassava bread is prepared in a similar way.

These tubers, the sweet potato and the cassava, were the staples of Indian life, their primary source of carbohydrates. The Spanish sailors had to accept them when their supplies of boat provisions ran out. Like most people, they preferred familiar foods to something new. On subsequent voyages to the New World, Columbus (and others) brought seeds for growing European grain crops. None grew well, if at all. Subsisting on native tubers was a source of dissatisfaction to the conquering Europeans and was seminal in generating the unrest, insubordination, and downright mutinous behavior that often prevailed in the early sixteenth century.

But subsist on tubers the Europeans did when nothing else was available. On the return leg of the first voyage (January 13): "I

NEWS

from the Arnold Arboretum

Where Do Plants Get Their Food?

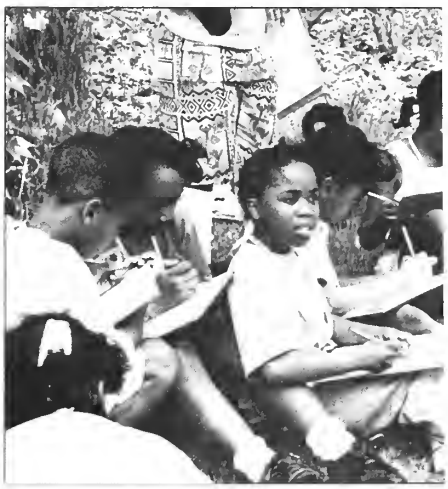
Last November, when I dedicated our annual Fall Appeal to our education program for children, one of our members wrote me a note saying that she felt her dollars should only support the important work of the Arboretum. I responded with an offer to restrict her gift to whatever purpose she designated. Her concern, however, gave me pause. Is the education of children an important part of our mission?

The trustees of two local foundations think so. Last month the Arboretum received a very generous grant of $40,500 from the Davis Educational Foundation to support the costs of our training workshop for Boston area teachers this coming summer. It will introduce teachers to a new curriculum, called LEAP (LEarning About Plants), that has proved successful as a friendly medium for teaching basic science concepts. Earlier this spring, the Jessie B. Cox Charitable Trust also awarded us a grant of $28,000 which will cover the administrative costs of the program and permit us to provide teachers with in-class assistance during the school year. Our pilot effort last winter found that this follow-up support is critical to the success of the training.

Why is this an important priority for the Arboretum? Our work with school children and their teachers is the most significant way in which we reach out to our neighboring community in the City of Boston. As both a scientific arboretum and a major component of the Boston Park system, the Arnold Arboretum is ideally situated to apply the educational research of Harvard University to the critical need for reform in our public schools, especially in the area of math and science. And in the end, I am convinced that children who truly understand at the age of seven that *plants make food* will become adults who are in a far better position to appreciate the importance of preserving the world's flora, and who will value the work of institutions dedicated to this purpose.

Bob Cook

Robert E. Cook, Director



Bringing the Arboretum to Boston Schoolyards

If you believe most Boston Schools are surrounded by asphalt and concrete, look again, just outside the schoolyard gate. You may find nearby open spaces where the potential for outdoor science studies promises a new kind of classroom for Boston schoolchildren. Some fifth grade teachers from the Joseph Lee School near Franklin Field in Dorchester made just such a discovery, and asked Diane Syverson of the Arnold Arboretum Children's Program to come have a look. From that first site visit came a proposal to adapt the Arboretum's program of Field Study Experiences to the mini-ecosystems of a small cemetery adjoining the schoolyard. Working with $400 out of the school improvement fund, Lee school teach-

(continued on page 2)

(continued from page 1)

ers collaborated with Arboretum staff to conduct a successful pilot program, and a year later the Massachusetts Cultural Council awarded the Children's Program $8,600 to extend the program to 4th and 5th graders at the Lee School and the Mattahunt School in Mattapan.

Involving activities both at the Arboretum and in schoolyard natural areas, the collaboration sought to sensitize children to the beauty and intricacy of nearby ecosystems. As 4th grade teacher Ann Connolly enthused, "My children are really turned on. They're bringing in flora and fauna, my room is jumping!" Kids learned about the winter survival tactics of plants and animals on Hemlock Hill, and then made a spring study of the plant diversity in their schoolyard. To understand the challenges of botanical exploration, fifth graders used compasses and the historic plants of Bussey Hill to relive the travels of plant explorers, while in their own neighborhoods they used map and compass to chart their explorations of schoolyard natural areas.

How do we think this idea worked in the end? It created lots of new learning and new friends, and enabled the Arboretum to further encourage the curiosity all children have about the natural world, and demonstrate how good teaching can build on that grain. The Children's Program staff thanks the Massachusetts Cultural Council for its support, and expresses special appreciation for the fine work of program volunteers Barbara Balasa, Stepha Genelza, Marianne Rothnie, and Loren Stolow.

Marcia Mitchell Joins Arboretum Staff

The Arboretum is pleased to announce the appointment of Marcia Mitchell as Adult Education Manager. Marcia brings many years of experience in horticultural writing and program development, and, as president of the Massachusetts Chapter of the American Rhododendron Society, has worked closely with Arboretum staff in the development of the Rhododendron Garden at the Case Estates. Please join us in welcoming Marcia as she works to continue the Arboretum's tradition of excellence in horticultural education.

Dr. Lily May Perry 1895 -1992

When Dr. E.D. Merrill came to the Arnold Arboretum as Supervisor of Botanical Collections in 1936 he found Lily May Perry working as an assistant to Professor M.L. Fernald at the Gray Herbarium in Cambridge. Merrill needed help with the collections of plant specimens he was acquiring from the South Pacific area. He recruited Miss Perry, transferred her to Jamaica Plain, and for the next thirty years she worked closely with him in maintaining bibliographic files and organizing and identifying the botanical collections of L.J. Brass from four Archbold Expeditions to New Guinea, as well as those made by C. Kajewski and Mary Strong Clemens. Certainly "Merrill and Perry" have named more of the plants of Papua-New Guinea than any other botanists or team. For this work, Miss Perry learned the Dutch language in order to translate the important descriptive articles of H.J. Lam and others. These translations were published and proved of great value to the U.S. Armed Forces in the World War II battles from New Guinea and Guadalcanal northward.

Miss Perry reached retirement age in 1960 but she was permitted to continue her work on a manuscript which became the book "The Medicinal Uses of Plants of Southeastern Asia," published by the M.I.T. Press. A grant from the National Institute of Health supported this work which has become a model for current work in ethnobotany. In 1971 she was honored by Acadia University with the degree Doctor of Science, *honoris causa*. Dr. Perry was born in New Brunswick, Canada and graduated from Acadia University in 1921. She earned a M.A. degree from Radcliffe in 1925 and a Ph.D. from Washington University in 1932. She worked under two directors of the Gray Herbarium and three of the Arnold Arboretum. Her published contributions include 60 papers, most of which appeared in the Journal of the Arnold Arboretum. She was indeed a friend to the many botanists who used the herbarium of the Arnold Arboretum which she helped to develop for so many years.

– R.A. Howard

Jim Gorman

Arboretum and Neighbors Clean Up!

Earlier this spring it seemed as if it rained every weekend. All the better when Saturday, May 6, provided a clear sunny day for a hugely successful clean-up in and around the Arnold Arboretum.

The Arnold Arboretum Committee has organized many clean-ups during its ten year history. This spring, the Committee worked with neighbors to clean-up the Walter/ Weld Tract, an Arnold Arboretum parcel abutting the Hebrew Rehabilitation Center.

Altogether, two dozen people of many ages and backgrounds came together to make a positive difference at the Arboretum. Through their hard work, scores of bags of accumulated litter, ubiquitous tires and hubcaps, as well as more unwieldy metal refuse, were finally removed.

This ambitious project was greatly aided by the generous support provided by Waste Management Inc. of Somerville. WMI employees Charles Bockman and John Cronin worked energetically alongside other Arboretum supporters, and volunteered the disposal truck that later hauled away a total of 20,550 pounds of rubbish. We express special thanks to our neighbors, the Arnold Arboretum Committee, and Waste Management, Inc., for dramatically enhancing the appearance of the Arboretum and the surrounding community.

Plants • Unusual Plants • Rare Plants

Annual Plant Bonus, Sale, and 10th Annual Auction

of

The Arnold Arboretum Sunday, September 20, 1992

9:00 a.m. – 11:00 a.m.
*Plant Bonus and Sale for Members Only**

EVENTS OPEN TO THE PUBLIC

Plant Sale
11:00 a.m. - 3:00 p.m.

10th Annual Silent Auction of Selected Plants
9:00 a.m. - 1:00 p.m.

10th Rare and Unusual Plant Auction
1:00 p.m. Live Bidding Begins

Specialty Plant Societies Sales and Information
9:00 a.m. - 3:00 p.m.

To be held at the
CASE ESTATES
135 Wellesley Street
Weston, Massachusetts

Plant Information *Lunch*

* Become a member of the Friends of the Arboretum. Join now or anytime Sunday, September 20 and get free plants and other benefits. Call (617) 524-1718 for more information.

Jeanne Bamforth, Elizabeth Heriza, Sonya Del Tredici, Todd Burns, Betsy Hopkins; 2nd row, Lalo Castillon, Elizabeth Caffrey, Gary Bregman, Erin Crowley, Suzanne Thimet; 3rd row, Lisa Mackinnon-Rambo, Brian Core, Rob Chambers.

Community Master Plan Meeting

On April 22, over eighty friends and neighbors gathered at the State Labs auditorium for an introduction to the Arboretum's master planning process. Director Bob Cook and Victoria Williams, Assistant Commissioner, Boston Parks and Recreation, began the meeting by defining the Arnold's dual mission as university arboretum and public open space. Joe Hibbard and Martha Lampkin of Sasaki Associates, the Watertown planning firm responsible for master plan development, then discussed their ongoing work with visitor services, the management of gates, fences and walls, and other Arboretum planning issues.

The next meeting, which will include a progress report on recent site analysis and design studies, will be held this fall. For more information, please call Richard Schulhof at 524-1718.

1992 Summer Interns Arrive

Summer has brought another exceptional group of horticultural trainees to learn from the staff and living collections of the Arnold Arboretum. The interns get hands-on experience in several aspects of Arboretum operations, including grounds maintenance, labeling and mapping, arboriculture, and plant propagation. As part of their training, interns participate in classes in plant identification, and join Arboretum staff members for tours and talks.

Flora Of The Lesser Antilles

The Arnold Arboretum is pleased to announce that the six-volume *Flora of the Lesser Antilles*, a long-term project of Dr. Richard A. Howard, a former director of the Arnold Arboretum, is still available in limited quantities.

These six volumes constitute the first comprehensive flora of the area, and the treatments present keys to the genera as well as the species for easy identification. For each genus and species a complete modern description is provided, which includes coloration as well as measurements of floral parts. The descriptions are followed by geographic distribution both within and without the Lesser Antilles. All volumes are profusely illustrated with line drawings that are both highly artistic and botanically accurate. All species known from the Lesser Antilles, both native and introduced, are included.

All volumes in the six-volume series are still available either individually or as a complete set. The complete set is available at a special price, including shipping and handling, of $260 (add $5 for shipping outside of the U.S.). For volumes 4,5 and 6 only, the special price is $205.

Individual volumes may be purchased at the prices listed below, plus $2 per volume for shipping and handling:

Volume 1, Orchidaceae	$20
Volume 2, Pteridophyta	$25
Volume 3, Monocotyledoneae (other than Orchidaceae	$35
Volume 4, Dicotyledoneae, 1	$75
Volume 5, Dicotyledoneae, 2	$85
Volume 6, Dicotyledoneae, 3	$85

Checks should be made payable to the Arnold Arboretum, and all orders should be addressed to the attention of Frances Maguire, Arnold Arboretum, 125 Arborway, Jamaica Plain, MA 02130, USA.

sent the men ashore to get some *ajes* to eat." January 15: ". . . and many other men came with cotton, bread, and *ajes*." Thus were the *Niña* and the *Pinta* reprovisioned. They departed Hispaniola before dawn on January 16. When these two tiny vessels eventually reached Spain after weathering a severe storm and other difficulties, some of the sweet potato store was still sound. These sweet potatoes were planted locally, and this act constituted the initial introduction of *Ipomoea batatas* to Europe.

Beans and Gourds

The only European food bean in the time of Columbus was the broad bean of the Mediterranean region (*Vicia faba*). Columbus probably knew this one bean when he left the Canaries. On November 4, about three weeks after the first landing, he writes in his log: "They [the Arawaks] have beans very different from ours . . ." Two days later: "The land is very fertile and well cultivated with those *niames*, beans very different from ours, and panic grass."

The "very different" beans Columbus found were *Phaseolus vulgaris*, now selected and bred into such varieties as navy beans, pea beans, kidney beans, green and yellow string beans, French horticultural beans, Kentucky wonders, and so forth—another major gift of the New World to the Old. Columbus was accurate in observing that the New World beans are very different from those of the Old World.

The Arawaks carried these New World beans, as well as corn and squashes, from South America with them as they migrated. Columbus never once mentions squashes (*Cucurbita* spp., *Lagenaria* sp.) by that name in the log, but surely does note them under gourds on December 3: "I climbed a mountain and came to level ground, which was sown with many different crops and with gourds." New World species of *Cucurbita* can be used as utensils when the squash skin has been cleaned out and dried. They also can be eaten as vegetables when fresh. The cultivated

Figure 10. The calabash or wild gourd tree, Crescentia cujete.

"gourds" that Columbus saw were squashes and not those described next.

There are six entries on gourds in the log, scattered from the day after landing to late December. Beyond the one just quoted, the other five entries have to do with an entirely different kind of gourd, one used for carrying water. On October 13, for example, when Columbus was watching the Indians right an overturned dugout canoe, he notes: "Then they bail out the rest of the water with gourds that they carry for that purpose." And in another entry, on December 21: "They also brought us water in gourds and in clay pitchers shaped like those of Castile." The gourds the Arawaks used principally for carrying or storing water were undoubtedly from the wild calabash tree (Figure 10) or wild gourd tree (*Crescentia cujete*). These native

Caribbean implements are still used for bailing and are definitely less damaged by prolonged contact with water than is a squash gourd. They are also usually more nearly spherical and larger, and are not cultivated or used for food.

Corn, Of Course

Columbus never mentioned corn (maize) as such in the log either, but we can be quite confident he saw it. The best clue lies in the entry quoted above, which mentions the cultivation of "panic grass." The actual Spanish word for the latter is *panizo*, and is perhaps best understood as meaning any tall, coarse, broad-leaved grass.

The corn, *Zea mays* (whose species name is from the Indian *mahiz* and becomes *maize* in English), of the Arawaks was not the highly selected and carefully bred plant we know today. Instead, it was a waist-high, broad-leaved grass with extending sparse tassels and separate heads of grain hidden below, among the leaves. These heads of grain were small, and the grains themselves somewhat similar to today's flinty popcorn kernels.

Knowing that, and remembering the absence of large herbivores on the island, the reader of the log can understand better some entries, such as that of December 6: ". . . beautiful fields . . . all cultivated, or at least a large part of it, and the crops look like wheat in the month of May in the vicinity of Cordoba." Or December 7: ". . . a very large valley. It was all sown with something resembling barley, and I thought there must be a large (human) population." There was no wheat nor barley, nor any other cultivated, large coarse grass except corn on the islands Columbus visited. He definitely found corn, perhaps the greatest gift of all from the New World to the Old.

Cotton and Kapok

On the same day he first observed Arawak beans (November 4), Columbus also made another discovery: "They have beans very different from ours, and a great deal of cotton, which they do not sow and which grows in the mountains to the size of large trees. I believe that they can gather it any time, for I saw pods already open and others just opening, and flowers all on one tree." Can we really believe Columbus saw cotton growing on large trees?

Figure 11. The kapok tree, Ceiba pentandra.

At the time of Columbus, cotton was well known in the Mediterranean region. It was obtained from *Gossypium arboreum* and *G. herbaceum*, of Africa and Asia. These cottons were like the New World cottons except that the fiber length (staple) was shorter. Columbus should definitely have known cotton (the white fuzz) when he saw it.

New World cotton is obtained from *Gossypium hirsutum* and *G. barbadense*. These are distinctly long-staple cottons (which agreed with Columbus' concept that everything is bigger and better in the New World). Although the Arawaks didn't sow cotton

annually, they did transport it to and among the islands with them. They traded from island to island regularly in their canoes. If a naturalized cotton thicket gave out, they could easily reintroduce it from the next island over.

The Arawaks had learned to spin and weave cotton. They also made hammocks from it (the word *hammock* is of Arawak origin). Columbus was much impressed. He writes about cotton nineteen times in the log. Here are a few representative entries. October 12 (the day of the first landing): "They brought us . . . balls of cotton thread." November 4: "Today many canoes came to the ships to trade things made of spun cotton, including the nets in which these people sleep called hammocks." November 6: "[The ships' crews] saw a great quantity of cotton that had been gathered and spun and worked—in one house alone more than twelve thousand pounds of it. Two hundred tons could be had there in a year. I have already mentioned that they apparently do not plant this cotton and that it bears fruit all year. It is very fine and has a large pod . . . It is true that the women wear a cotton swatch only large enough to cover their private parts and no more."

One of the European cotton plants (*G. arboreum*) grows into a larger bush than either of the common New World species of *Gossypium*. This seemed to violate Columbus' idea of "bigger and better" in the New World. But then he found "large trees" of cotton. Did he make up this entry to satisfy the "bigger and better" doctrine? I think not. Columbus probably found some mature kapok trees (*Ceiba pentandra*). These magnificent smooth, gray-barked trees (Figure 11) with buttressed bases can reach up to 45 meters (150 feet) or more. They bear copious quantities of cotton-like pods with cotton-like (though grayer) fuzz within, the source of the kapok used in life preservers before the advent of man-made fibers for that purpose. The *Ceiba* tree is generally called the silk-cotton tree in English-speaking Caribbean areas, and most people would undoubtedly think it was another kind of cotton if they saw only the pods and the fuzz from each. Five centuries ago people had concepts about "kinds" of plants, not genera and species or genetic relationships. Columbus was lumping in the word *cotton* two closely similar kinds of pods and fuzz, one from bushes, the other from trees. Perfectly reasonable.

A Botanical Oddity

Of all of the plant entries, the one that most predisposes people to think that Columbus' botany was dismal comes early in the log, on October 17: "Many of [the trees] have branches of different kinds, all on one trunk; one twig is of one kind and another of another, and so different from each other that it is the greatest wonder of the world. For example, one branch has leaves like cane, another like mastic; thus on one tree five or six kinds, and all so different. Nor are these grafted so that one can say the graft does it, for these trees are right there in the woods, and the people do not take care of them."

This makes one think of early medieval times and of herbals with drawings of plants bearing human arms and legs, does it not? What could Columbus have seen that could come even near to this description? For a person who looks at trees while visiting the Caribbean islands even today, the answer is not difficult. It consists of three parts.

The first is the phenomenon of juvenile foliage. Sometimes when a tree is injured it will respond by budding forth branches that bear leaves of a different size (often larger) or shape from the mature leaves. These are the same kind of leaves that are characteristic of seedlings of that species, but may look startlingly different when they appear among the mature foliage of a large tree.

The second is the ubiquitous presence of the green, woody, parasitic mistletoe (*Phoradendron* spp.) on tree hosts of all descriptions. On anything but the closest examination, the mistletoe branch appears to grow directly as a lateral from the host branch. Usually the leaves of the mistletoe are dis-

tinctly different from those of the host in color, size, shape, placement, and the like, and we have a tree ostensibly with two conspicuously different kinds of branches.

The third type of "different branches" one sees in the Caribbean is the epiphyte. When Columbus visited in 1492–93, the island forests were better provided with mature trees, denser in the foliage canopy, richer in species, and more like a true rain forest than the impoverished and exploited remnants existing today. These forests conserved moisture better too, creating high humidity among the tree tops, and the opportunities for epiphytes to grow in bark crevices high in the branches were more numerous. One can envisage Columbus looking up into such a tree and seeing a bromeliad with grasslike strap leaves, or an autograph tree seedling (*Clusia rosea*) with large, heavy leaf blades contrasting with the foliage of the host while appearing to grow forth from it.

Did Columbus see trees with five or six different kinds of branches? Perhaps he exaggerated a little, but a single tree with three or four apparently different kinds of branches is not at all unrealistic.

I conclude that, although Columbus' botany was uninformed, his observations were accurate, his descriptions were excellent, his conclusions were mostly correct (discounting a little hype for the queen), and that he was willing to admit occasional mistakes, perpetrating them no further once recognized. My knowledge of the admiral has increased significantly as a result of this little study. My admiration for him has increased even more.

Acknowledgments

The author acknowledges with appreciation the helpful comments made in preparation of this article by the Hon. Mauricio Obregon, Colombian ambassador to the Caribbean, and Dr. Norton H. Nickerson, professor of botany at Tufts University.

John M. Kingsbury is Professor Emeritus of Botany at Cornell University. He received both his A.M. (1952) and Ph.D. (1954) degrees from Harvard University. He is a former Director of Cornell Plantations as well as a founding director of the Shoals Marine Laboratory on Appledore Island in Maine. This article first appeared in the *Cornell Plantations Quarterly* (Vol. 45, No. 4, 1991), and is reprinted in abbreviated form with permission.

The Botanical Legacy of Joseph Rock

Jeffrey Wagner

Joseph Rock not only collected some remarkable plants but also took some remarkable photographs.

Joseph Rock's rich botanical legacy is especially impressive considering he was a self-taught botanist and already thirty-six years old at the time of his first expedition to Asia. He established his name in botanical circles through his work on the flora of the Hawaiian islands between 1910 and 1920. During his years there, he explored extensively and wrote several landmark works on Hawaiian plants. He almost single-handedly established Hawaii's first official herbarium collection with over twenty-nine thousand specimens, most of which he collected himself. This work prepared him well and set the stage for his next career as a botanical explorer and plant hunter in Asia.

The United States Department of Agriculture was Rock's first employer in this new role and, in 1919, sent him to India and Burma to locate and collect seed of the Chaulamoogra tree (*Taraktogenos kurzii* and related species), which provided a substance proven effective in the treatment of leprosy. Rock's expedition was a success, and the seed he collected resulted in a plantation of several thousand trees in Hawaii.

The National Geographic Society and the Smithsonian Institution were his first sponsors in China. From 1922 to 1924, Rock was based in Yunnan province and, as had the plant explorers before him, he began to discover the incredible diversity of China's montane deciduous and evergreen forests. This is a unique temperate flora, unusually rich in species and habitat diversity because of the particular circumstances of southwest China's geography and geological past. The only other area of the world remotely similar is eastern North America, with its extensive yet comparatively homogeneous forests dominated by oaks, hickories, ashes, maples, and a few other species. In western China, however, with some of the world's highest mountains and deepest river valleys, as well as close proximity to tropical and subtropical evergreen forests and expanses of desolate uplands, the flora is correspondingly diverse. It is no surprise that Rock and his explorer colleagues collected and sent shipment after shipment of plants that held both botanists and horticulturists in wonder.

Rock was a latecomer to the field, and since many before him had made their reputations on the discovery of countless plants new to science and horticulture, he was destined to follow in their footsteps and collect the discoveries of others. He did this with care and acumen, but never published a single book or article on China's flora. On the first Chinese expedition, Rock collected nearly eighty thousand plant specimens for the Smithsonian's herbarium and seed of innumerable plants from the high alpine meadows of the Yulong Xueshan range and the immense montane forest covering the slopes and valleys of the Sino-Tibetan borderlands. Among these plants were several horticulturally valuable forms of rhododendrons, from the fifty-foot *Rhododendron sinogrande* tree to the smaller alpine species that carpet the mountain meadows with blue, violet, pink, white, or yellow flowers. Many of Rock's exceptionally handsome,

hardy, floriferous forms still grace the public and private botanical collections of Scotland, Wales, southern England, northern continental Europe, and America's Pacific Northwest.

After this first expedition, Rock became known for his meticulous, thorough collecting and well-prepared specimens in many duplicate sheets; these enabled herbaria to trade or distribute the extra sheets to allow other institutions ample material for their own studies. Another valuable aspect of Rock's collecting was his passion for plant photography, illustrating a particular plant's habit and habitat, and supplementing the pressed material and his field notes to make an invaluable botanical record of the rugged areas through which he traveled. He is remembered as well for the quantity, quality, and purity of the seed he sent back from China.

On two more expeditions, one for Harvard University's Arnold Arboretum and another for the National Geographic Society, Rock explored areas farther to the north, all the way to the Minshan range, the upper reaches of the Yellow River, the Kokonor Lake, and beyond. These regions yielded fewer yet hardier plants, several of which are still in cultivation and production as ornamentals.

One incomparable contribution by Rock was a stunningly beautiful copper birch (*Betula albo-sinensis* var. *septentrionalis*). This tree has a shimmering, dark, coppery-red trunk, the result of a silky smooth, paper-thin bark that peels away to reveal a waxy bloom underneath. Previously known to grow well in cooler climates such as that of northern Europe, Rock's find was an exceptional, horticulturally superior form.

Another excellent plant that Rock collected is a tree peony that bears his name, *Paeonia suffruticosa* subsp. *rockii*. He found it growing inside Choni Monastery in Gansu province and, although he had never encountered it in the wild, thought sufficiently highly of this specimen to photograph it and collect seed. It is a remarkable hardy and attractive shrub, some four feet tall, with large white flowers, each with a single layer of petals, and each petal stained deep purple at the inside base. It is a favored plant in both Europe and America and with age becomes increasingly impressive, covering itself each spring with more and more blossoms. The original plant was destroyed in 1928 when Muslim soldiers attacked and burned Choni to the ground. No other example of the subspecies has been found since in China.

Farther to the north, the country was very barren, as a result of climatic extremes, but again at a lamasery—this time the famous Kumbum Monastery—in the Yellow River's desolate loess plain, Rock collected seed from a venerable old lilac (*Syringa oblata*). It was, he claimed, the very tree that inspired Tsongkhapa, founder of Tibetan Buddhism's Gelugpa school. The fourteenth-century lama reputedly saw a thousand shining images of the Buddha in the leaves of this lilac.

The expedition conducted for the Arnold Arboretum was a botanical and horticultural success. In addition to the birch, peony, and lilac, Rock collected species of fir, spruce, juniper, rowan, linden, maple, poplar, rose, rhododendron, mock orange, and many other trees, shrubs, and alpine species. These valuable herbarium specimens and propagation materials were sent back to the Arboretum and further distributed to other institutions in North America and Europe. His contributions today provide an excellent record of the flora of western China, now under great pressure from exploitation.

Rock's last expedition, sponsored by the National Geographic Society, to the Minya Konka region in Sechuan provided such a great volume of material that it has not yet been worked over completely by botanists. One of his best-known yet least-documented finds comes from this area, and there is irony in the fact that this plant, one of obvious ornamental quality, cannot be unequivocally attributed to Rock. It is an attractive rowan whose outstanding qualities include its emerald-green, finely sculpted, and divided leaves that in autumn turn a fiery red in colorful contrast to its amber-yellow fruit. It appeared as a chance seedling among Rock's

The people of Chingshui, Kansu, are gathered in front of the inn where Joseph Rock stayed, listening to his phonograph playing the sextet from Donizetti's Lucia di Lammermoor. *Soldiers are guarding the entrances to the inn. Photographed 11 April 1925.*

collections at the Royal Botanic Garden in Edinburgh. No record could be found of an herbarium specimen or field note, and some even believe it to be a hybrid. It is variously classified either as a hybrid or as a species form of other Chinese rowans. It goes by the name *Sorbus* 'Joseph Rock' and most likely will never be classified with absolute certainty.

Although Rock continued to do some collecting during his final years in China, mostly for the American Rhododendron Society, he did not return to botany with real zeal until the last years of his life in Hawaii. During this time, while in his seventies, he would often dash up a volcano to collect a specimen of some nearly extinct plant for the botanic gardens of Kew, Edinburgh, or elsewhere. Rock reported to botanists at Kew that he was appalled at the besieged state of native Hawaiian plants. He was among the last botanists to see several now-extinct plant species growing in their native habitats.

The solid achievements of this self-taught botanist in the rugged and spectacular world of plant hunting in western China will long outlast the eccentricities of character and scholarship for which he is otherwise remembered.

Jeff Wagner, who holds a master's degree in forestry, did his research for this article at the Arnold Arboretum. This article was reprinted from Michael Aris, *Lamas, Princes, and Brigands: Joseph Rock's Photographs of the Tibetan Borderlands of China*, the catalogue of an exhibition at China Institute in America, New York, April 18 through July 31, 1992. The photographs are from the Archives of the Arnold Arboretum.

Overleaf: "The central portion of the Labrang Monastery, Kansu, China, showing the large buildings, either yellow or red, the market, and a crowd of people can be seen to the left near the trees. Spruces are in the left hand corner, while poplars are in the squares near the bottom of the picture." Caption written by Rock. Photographed 30 April 1926.


R229

"Pale red sand stone mountains, absolutely bare and deeply eroded as if sculpted, in a valley back of Kansu, which is situated directly in the valley of the Yellow River, west of Shun Hoa." 24 November 1925.

"An alpine meadow at the summit of Tsarekika," Joseph Rock wrote, "the last pass across the Minshan to the valleys debauching into the Tas River. It was here that our party was attacked last year by Tebbu brigands and one of my men badly wounded. It is a rendezvous place of Upper Tebbu robbers as three trails converge there." Elevation 11,250 feet. Photographed 18 September 1926.

Populus simonii *growing at Choni, southwest Kansu, China. Note the large burl at the base of the tree and the smaller ones along the trunk. Elevation 8,300 feet. Photographed in January 1926.*

Little-Used Perennials for the Garden Designer

Gary L. Koller

More unusual plants for the adventurous gardener.

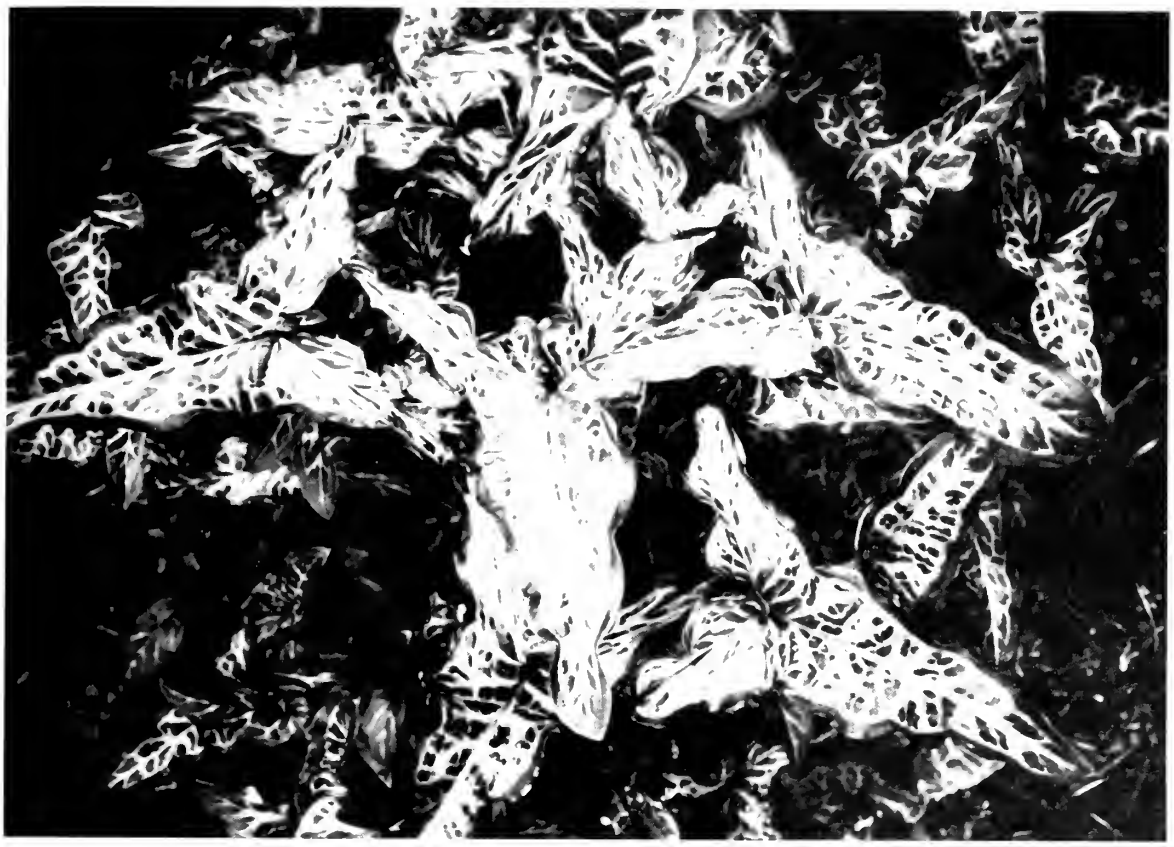
As a garden designer, I find that my reputation depends on applying unusual plants in unexpected applications. I also attempt to achieve planting compositions that look finished from the start but will age well, as some plants—chosen for a short-lived role—get squeezed out by the growth and maturation of neighboring plants. Herbaceous perennials, which are essential at the start in order to achieve the look of a "finished" landscape, will soften and age gracefully, eventually allowing the woody materials to take over.

Adonis amurensis *in bloom. From the Archives of the Arnold Arboretum.*

Learning about and applying new plants becomes part of the satisfaction of garden making, for isn't it more challenging to try new combinations than to repeat standard gardening formulas? While I do learn and draw from the work of others, I am constantly trying to acquaint myself with new plants and to envision creative design solutions that include them. I'd like to share some of my recent plant discoveries, which I am still getting to know at this point. I will feel more comfortable using them once I gain greater familiarity and experience with their habits. I would like to hear from readers with any additional observations about these plants, based on their own site and environmental conditions, as well as their talent for gardening. Unless otherwise noted, all the perennials mentioned are hardy and can be grown successfully in the Boston area.

Adonis amurensis

This plant, known as pheasant's-eye, is an early ephemeral that comes and goes so quickly that it is apt to be forgotten until its surprise return the next season. At the first warmth of spring, it is especially cheerful to see small golden flowers perched atop bright green ferny foliage. In New England the flowers last two weeks or slightly longer, and are significant for their abundance and earliness. Barry Yinger, Supervisor of Horticulture



The foliage of Arum italicum. *Photo by Gary Koller.*

at the Buck Garden in Far Hills, New Jersey, tells me that he has collected six cultivars and they are thriving at his Pennsylvania garden. The earliest in bloom was 'Beni Nadeshike', which began flowering on January 13, while the other cultivars extended the bloom season into early May.

One of life's great treats is to take a stroll along the March Walk at Winterthur Gardens in Delaware and see sheets of *Adonis amurensis* 'Fukujakai', mixed with *Galanthus*, scattered across the woodland floor. According to Yinger, 'Fukujakai', with a single golden-yellow blossom, is the most commonly grown clone in the United States. 'Beni Nadeshike', with a single orange flower, is the most common of the non-yellow clones in Japan. He also described clones with flowers that are near-white, pale to dark yellow, and pale to dark orange, as well as flowers that are semi- or fully double.

While presently not common in gardens, the reason certainly is not that *Adonis* lacks toughness, for once established it is durable and long-lived. I blame its scarcity on gardeners' lack of familiarity with the plant, the difficulty of propagation (the seeds are either rare or short-lived), and a flowering time that occurs before most people have focused on the spring planting season. *Adonis* thrives in deep, moist, well-drained acid soil in a location where it has full sun at the time of flowering and light shade after flowering. This shade protection can be achieved by planting it near deciduous trees or shrubs. People who have access to this plant will find that it can

be easily increased by division just after flowering.

Angelica gigas

During the summer of 1990, I first discovered *Angelica gigas*, a Korean native, displayed in the gardens of some of the finest plantspeople in Massachusetts, New York, and Vermont. All these plants could be traced back to an introduction made by plant collector Barry Yinger. *Angelica gigas* is a statuesque plant with large, textured, boldly incised foliage borne on a a stout, straight central stem. In New England, flowering occurs in July and August. Prior to opening, the flower buds are enclosed in a lime-green tunic and presented on axillary stems with a charming crook in their "necks." Blossoms look like maroon heads of cauliflower and unfurl over the course of several weeks. The flowers are presented in a fashion that displays them handsomely, and, in my opinion, majestically. The color provides a nice echo displayed with maroon foliage plants, such as *Berberis thunbergii* var. *atropurpurea* 'Rose Glow', *Cotinus coggygria* 'Royal Purple', and *Sedum maximum* 'Atropurpureum'. Plants like some protection from the hottest sun and thrive in lightly dappled shade. In my own garden I lost plants to some kind of, as yet undetermined, browsing animal. With optimum environmental conditions, seeds are abundant, and therefore this *Angelica* should quickly move into the trade.

Arum italicum

An unusual growing cycle characterizes *Arum italicum*: the foliage emerges in early autumn, remains green throughout the winter, and dies away in early summer. In spring, greenish-white, calla lily-like flowers appear, followed in the summer by a stalk of berries that ripen to a shiny bright red and are quite showy in the autumn garden. What attracts my attention is the handsome white markings on the leaves, markings that are quite variable between individual plants. Although selections have been made (I have observed beautiful variants at Pamela Harper's garden in Virginia), I am not aware that they are yet commercially available in North America.

Bletilla striata *in bloom. Photo by Richard Weaver.*

Since the plant is grown from a corm, it should be possible to achieve quick stock increase. While still uncommon in the gardens of New England because of hardiness limitations, it has been successful in many southern gardens where it has naturalized freely. It should thrive in Cape Cod and on Nantucket where the climate is more moderate than in the Boston area.

Bletilla striata

This terrestrial orchid, native to Japan and China, thrives in locations as diverse as Nantucket and Kansas City, as well as many locations in the Pacific Northwest. On Nantucket,

where I have observed it most frequently, it forms a dense clump of broad, lance-shaped leaves that, at the edges of the colony, arch outward. Plants prefer locations with cool summers, growing in open sandy soil with good drainage and in full sun to light shade. Mature plants stand 30 to 60 centimeters tall (1 to 2 feet), bearing medium-green leaves that appear gently pleated. The foliage tends to be very architectural in design, and I consider it elegant solely as a foliage plant. Multiple plants look attractive as a ribbon flowing through a ground cover of contrasting texture, such as prostrate junipers or *Asarum europaeum*. In northern areas *Bletilla* can be grown in pots set out in the summer and overwintered in a cold frame or other sheltered sites.

Flowering occurs in mid-June and, depending on the type, can be a rich purple or a pure white. Just beginning to make its way around in gardens is a variegated clone on which each leaf is bordered by a white pinstripe and whose flowers are a rich purple color. An entirely different variegation is represented in a plant with yellow stripes on its leaves; the stripes are most evident in spring but gradually fade, becoming less distinctive by midseason. The green-leaved, purple-flowered form of *Bletilla* has been available in the United States for some time, but has remained largely ignored by the gardening public. As I surveyed nursery catalogues, I was amazed at how many mail order nurseries list this plant for the 1992 growing season. Perhaps *Bletilla* will not remain unknown for long.

Calamintha nepeta subsp. *nepeta*

Lesser calamint is a perennial native of Europe that has naturalized itself in several of the mid-Atlantic states. Growing 30 to 60 centimeters tall (1 to 2 feet), it blooms from mid-summer until frost and provides the effect of a long-flowering baby's-breath. In full flower, it tends to be thin in density and wispy in appearance, with small, mint-like blossoms occurring in clusters. During mid-summer blossoms are pale white, but with the onset of autumn, they assume tints of pale lilac. The flowering stalks tend to be a bit lax and arch across neighboring plants. Garden designers will find this habit a desirable characteristic as a filler and weaver—to soften the distinction between individual plants.

Carex stricta 'Bowles Golden'

This sedge is normally a plant of moist soils, thriving on lake and stream banks in full sun or light shade and forming a small haystack-like mound with golden-yellow leaves. Flowering is insignificant, but the plant does produce thin, wiry flowering stems that move and produce animation in the landscape. 'Bowles Golden' grass is visually effective because of the wispy habit of the plant and the distinctive foliage color of golden-yellow to chartreuse-green that is dependable in its presentation all summer long. These features can be combined with other herbaceous perennials to create pleasing compositions in the garden.

Cassia hebecarpa

A native American plant that in nature inhabits moist stream banks and open woodlands, *Cassia hebecarpa* in cultivation thrives in full sun and poor soil. Plants grow 1 to 2 meters tall (3 to 6 feet) and bear attractive, pinnately compound foliage topped by golden-yellow blossoms from mid- to late summer. Since its growth habit is tall and bushy, it functions almost like a small shrub. It can be used in the landscape as a summer barrier, but it dies back to soil level in the autumn, exposing a much simplified landscape scene. After flowering, it seeds abundantly and produces a surplus of new plants for the next season.

Corydalis lutea

The delicately cut, light-green foliage of *Corydalis lutea* reminds one of ferns or *Dicentra eximia*. The plant bears charming, tiny golden blossoms all summer long, making it one of the longest-flowering perennials. Many years ago, I visited Lincoln and Timmy Foster,

Cassia hebecarpa *in flower. Photo by Gary Koller.*

supremely skilled rock gardeners in northwestern Connecticut. Their front entry included a large stone wall engulfed with *Corydalis* that conveyed a sense of exuberance. Once established, *Corydalis lutea* has the appealing tendency of making itself at home and seeding itself about the garden in nooks and crannies. Some might call this behavior weedy, but it allows nature to participate in loosening up the garden and providing change, as plants appear in unexpected locations. Like bleeding heart, the stems of this plant are fragile and easily broken by errant feet or careless garden maintenance. One note of caution: on several occasions I have purchased *Corydalis lutea* at a garden center only to end up with *Corydalis ochroleuca*, which has a pale, cream-colored flower and is probably less aggressive as a spreader. For many it may be a preferred choice, but I like the "weediness" of *Corydalis lutea*.

Disporum flavum

Richard Weaver, of We-Du Nursery, first introduced me to this elegant woodland plant more than ten years ago, and after learning of its merits, I marvel that it isn't grown more widely. Korean fairy-bells form a multiple-stemmed clump growing 80 to 100 centimeters tall (2.5 to 3 feet) and stand erect in a statuesque fashion. Stems, rather open at the base, are topped by foliage that remains attractive all summer long. Appearing in May, the flowers are nodding, roughly bell-shaped, and golden-yellow. Plants thrive in light shade

and, when grown in moist, organically rich soil, increase rapidly, but not invasively. Richard Weaver tells me that in North Carolina this plant sometimes emerges so early in the spring that it gets cut back by late frosts. He hastened to add that he never experienced this problem when growing *Disporum* in Boston. In my garden, *Disporum flavum* is tough and durable, but cannot endure the intensity of full sun.

Filipendula camtschatica

Large, dramatic plants are useful for the back of the border and for creating effects of enclosure and division in cultivated settings. In wet meadows, bold plants also offer a size and scale appropriate to vast outdoor spaces. One giant perennial that offers exciting opportunities for creating spatial modulation in the garden is *Filipendula camtschatica*. I have seen it growing beautifully in a garden in northern Maine situated in front of a tall walled enclosure. The plants stand nearly 3 meters tall (10 feet), and the blossoms appear as huge billowy puffs of creamy white. In Maine, full bloom occurs from the end of July till early August.

Hosta montana 'Aureo-marginata'

I find this hosta especially useful in creating visual compositions in the shaded landscape. The plant has an upright, vase-shaped form, and each leaf has a bold margin of golden-yellow. A dramatic composition can be achieved by underplanting with the ornamental grass *Hakenochloa macra* 'Aureola', which forms a ground cover of fine leaves to mimic the color and tone of the hosta foliage while allowing a change of height and texture. For a planting at Harvard University, I used these two plants in combination with *Berberis thunbergii* 'Aurea' to create a composition of golden foliage that remained visually showy all summer long. This planting, beneath huge old elm and oak trees, is growing in moderate shade. I find it most attractive on cloudy, gloomy days when it resembles a shaft of sunlight brightening the landscape. It also is at its best at the approach of twilight when its golden colors appear as visual highlights.

Corydalis lutea *in flower. Photo by P. Del Tredici.*

Humulus lupulus 'Aureus'

Commonly seen in English gardens, the golden hop vine is just beginning to make its way here, distinctive for its medium-sized, pale golden-yellow, lobed leaves. This color persists from the time leaves emerge until early summer, when the yellow foliage turns to green for the rest of the summer. When I was given the plant, the donor warned me that, once established, it could grow 9 to 12 meters (30 to 40 feet) each season. After two years, my plant, which I grow on pea netting, has almost exceeded this potential. Each autumn after the plant has died to soil level, I cut it back to the ground and remove and replace the netting. The hop vine is exceptionally hardy, and I have seen it growing luxuriously in Banff, Canada, where winters are often long and severe.

Lysichiton americanum

Planting and managing wetland areas are still poorly understood and rarely done well by gardeners. I am, therefore, always delighted to

Lysichiton americanum *in flower. Photo by Judy Glattstein.*

find the yellow skunk cabbage thriving in wetland gardens in New England. One might assume that *Lysichiton americanum*, a native of the West Coast from California to Alaska, would not be particularly successful in New England, yet it thrives at the Garden in the Woods in Framingham, Massachusetts. The foliage is boldly elegant, especially effective in spring and early summer, if somewhat tattered by late summer after slugs have feasted on the leafy tissue. Individual leaves are elliptic in shape, 30 to 100 centimeters long (1 to 3 feet), light green, of a thick and fleshy substance, and grow clustered, rising from a crown. Frances Clark, at the Garden in the Woods, tells me that she has seen it in Alaska where it grows along streams beneath thickets of willows. She remarked on how odd the combination looked with the bold foliage of the *Lysichiton* among the tangle of the willows. The distinctive foliage of the *Lysichiton* worked well, she added, when planted along pathways where it was visually tied to the landscape.

Milium effusum 'Aureum'

The golden wood millet, a grass that grows 45 to 60 centimeters tall (18 to 24 inches), does best in light shade, in which case its foliage remains a lime green all summer long. Of delicate, textured, upright habit, it can be used as a specimen to provide spots of chartreuse in shade. In my own garden, however, I have used it as a small hedge or border combined with *Hakonechloa macra* 'Aureola', as they both have similar textures but different growth habits. When sited in particularly appropriate locations, the *Milium* will seed itself and wander about the garden. I particularly like it mixed with *Corydalis lutea* as a color echo; both naturalize themselves in unexpected spots and form changing color schemes in the garden. The foliage of this grass emerges early in spring and looks especially attractive when combined with the blue flowers of *Chionodoxa*.

Osmunda claytoniana

Elegant and *statuesque* best describe this beautiful native fern. The form of the plant is an upright vase shape, and the foliage is a pale green. The common name of this plant, interrupted fern, refers to the fact that the middle portion of the fronds are occupied by fertile spore-bearing structures of a dark cinnamon brown that attractively divide the leaf. More drought-tolerant than most ferns, *Osmunda claytoniana* mixes handsomely among evergreen ground covers such as *Hedera helix*, *Vinca minor*, and *Juniperus horizontalis*. In Maine landscapes, this plant is often found growing through masses of *Pachysandra terminalis*. Interrupted fern can be used around the base of houses as a substitute for small shrubs. The advantage is that it never overwhelms the structure by growing

excessively tall; the disadvantage is that it dies to the ground in fall, leaving the base of the house exposed.

Plantago major 'Atropurpurea'

A noteworthy colony of this purple-leafed plantain grows along the edge of a brook in the Van Dusen Botanical Garden in Vancouver, British Columbia. While the leaf shape is similar to the common turf grass weed, the foliage of this type tends to be somewhat larger and of a rich maroon color. At Van Dusen, combined with other plants of silver foliage and white flowers, it made a beautiful visual composition. Plants in my Massachusetts garden seem a duller and less intense purple than those I remember in Vancouver, but they are still attractive to me. This is an abundant seeder of easy germination.

Podophyllum hexandrum

Our native mayapple, *Podophyllum peltatum*, forms great spreading colonies beneath the trees and shrubs of Eastern woodlands. While the spring foliage is quite beautiful, it tends to go dormant in early summer. As an alternative, I admire an Asian species, *P. hexandrum*, with several desirable characteristics. The new season's leaves emerge in May and for several days resemble small umbrellas as they rise up and unfurl. While the leaves remain still somewhat gathered together, the flower bud sits perched atop the leaf and opens wide to reveal a white flower with maroon stamens. The flower is followed by a roundish fruit about the size of a plum, which ripens to a beautiful reddish-orange color. The leaves, a light green with pale maroon markings, persist throughout the summer, becoming unattractive only in the fall or when suffering from drought. The plant forms dense clumps and is more easily contained in the garden than the native species. *Podophyllum hexandrum* looks beautiful interplanted with *Hedera helix*, for the light-green, young-season foliage of the mayapple makes a stunning visual contrast against the dark green of the ivy.

Smilacina racemosa *in full fruit. Photo by Gary Koller.*

Ranunculus ficaria

Many of you may view this plant as a weed that needs to be eradicated from the landscape. Others will see it as a charming and colorful interloper that spreads freely in moist meadows brightening the late April landscape. I find it interesting in that, once established, tubers will be moved about in the process of lawn mowing and garden cultivation so that it will eventually spread over much larger areas than originally planted. At the Arnold Arboretum, lesser celandine inhabits moist areas adjacent to Goldsmith Brook and mixes with *Scilla bifolia* and *Scilla sibirica* in great masses of yellow and blue, which drift discreetly, and ephemerally, across the landscape. While many know the typical golden-yellow form, few gardeners are aware of several wonderful color forms, ranging from whitish to

Tovara virginiana *'Variegata'. Photo by Gary Koller.*

buff to bright orange. Tubers can be obtained from Potterton and Martin, a specialty bulb company in England.

Rohdea japonica

Broad, fleshy, strap-shaped leaves characterize *Rohdea japonica*, the Nippon lily. Individual specimens grow from a crown sending up the bold evergreen leaves that are either solid green or beautifully variegated. *Rohdea* is highly prized by collectors in Japan, who, according to Barry Yinger, have made over 700 named selections based on leaf color, size, fruit color, and overall growth form. Two of the most common garden forms are 'Taishokan', which has been long cultivated in Japan to produce foliage for the florist industry, and 'Miyako No Jo', which is a strong-growing, green-leaved type.

Richard Lighty of Kennett Square, Pennsylvania, has established a large colony resembling a ground-cover planting, with all the plants grown from the same individual by division. Although established for many years, the colony has yet to fruit (fruits occur in cone-like clusters and ripen to a bright red color). The Arnold Arboretum has supplied Lighty with several seedlings with a different genetic base, in the hope of cross pollinating with his stock to achieve seed production.

The American literature suggests that *Rohdea japonica* is hardy only as far north as Washington, D. C., but it has proven to be cold-hardy in the Boston area. It does not die

back in the wintertime, and flowers and fruits freely. Yinger suggests that the plant is probably only reliably hardy to USDA Zone 7, and that it needs careful microclimate selection in colder areas. The plant thrives in well-drained, acid soil. In my experience, the plant grows slowly, needs little care, and is exceptionally drought tolerant.

Perhaps the greatest potential for our gardens comes from the as yet unavailable fancy-leafed forms, which will require performance evaluation under our growing conditions. The variegated-leaf forms can be used as stripes, ribbons, clusters, or colonies interplanted with *Vinca minor;* and the green-leafed forms can be beautifully set among a bed of *Asarum europaeum.*

Smilacina racemosa

False Solomon's-seal is a native woodland plant that deserves to play a greater role in garden making. It forms clumps of upright stems with many longitudinally parallel-veined leaves of a lovely light-green color. Tiny creamy-white blossoms appear in great feathery terminal clusters, the weight of the inflorescence causing the stems to arch over. And during late summer, clusters of pea-sized fruits ripen, ranging in color from purplish to orange-red. While *Smilacina racemosa* is widespread across North America, I am unaware of horticultural selections, though I have heard of a variegated form available in England. It seems reasonable that selections could be made for form, larger inflorescences, and enhanced fruiting characteristics.

Stipa gigantea

Dramatically veiled and *filmy* best describe the flowering effect of the giant feather grass. This grass forms a dense clump of foliage that stands about 60 centimeters tall (2 feet). During May, thin, erect stalks of flowers rise a meter (3 feet) or more above the foliage. These delicate stalks draw the observer's eye through to distant views, as they divide space, create a foreground, and bring animation to the garden when each stirring of the breeze sets the stems swaying.

***Tovara virginiana* 'Variegata'**

This cultivar competes for attention with *Tovara virginiana* var. *filimormis* 'Painter's Palette'. Each has a green leaf splashed with creamy yellow, but in 'Painter's Palette', markings of chocolate and pink are added. I prefer 'Variegata' as I have found it to be a stronger and more dependable grower. In addition, I prefer the appearance of the creamy variegation by itself—without the intrusion of the browns and pinks. I have seen plants used in Kansas City, Missouri, as bold clumps in full sun where they functioned as small shrubs. Personal preferences aside, both types are useful for they allow designers different coloring opportunities. The plant seeds abundantly, and seedlings sprout freely, creating white spots against the dark brown earth.

Gary Koller is Senior Horticulturist at the Arnold Arboretum. His companion article on "Ground Covers for the Garden Designer" appeared in the Spring 1992 issue of *Arnoldia.*

BOOKS

Neil Jorgensen

The Exuberant Garden and the Controlling Hand by William H. Frederick, Jr. Little, Brown, 1992. 342 pages. Hardcover; 230 color photographs and 38 appendices. $50.00.

There is so often in landscape gardening a special difficulty: that gap so hard to bridge, between good design and good planting . . . the gardener or designer who can combine the two is a rare bird.

—Russell Page

A rare bird indeed! The horticultural ignorance of so many landscape architects is a great failing of the profession. But as both a master plantsman and a wonderfully creative designer, landscape architect William Frederick is a happy exception to the stereotype.

Beyond the surprise and curiosity of a planting book written by a landscape architect, *The Exuberant Garden and the Controlling Hand* is important in other ways. First, it is a book of opinion and personal knowledge gained from over fifty years of hands-on gardening; this experience alone would make it worth owning. Second, it is a book of case studies using actual gardens that Frederick has designed. Third, it is a visual treat both for its layout (designed by Susan Marsh) and for its illustrations. Fourth, it is a valuable reference book written for professionals and serious gardeners. Frederick has chosen his audience; he doesn't pander to the vast population of gardening beginners.

Though big and glossy, *The Exuberant Garden* is a far cry from the vacuous gardening "lifestyle" books—full of pretty pictures but little else of substance—that regularly appear in bookstores each spring. Its fifty-dollar price is about ten dollars higher than the average of these lifestyle books, but considering the wealth of information that Frederick shares, it is a bargain.

His organization is splendid. The book contains five chapters, one for each of five different kinds of gardens, among them gardens for viewing, stroll gardens, and swimming pool gardens. In each chapter, he compares several examples of that particular garden type. For each, he provides a clear plan, a rationale for the design, an illustrated list of the plants used, and a chart of bloom sequence to show how visual interest progresses through the year.

After each example, Frederick expands a particular design feature into a more general discussion on some aspect of garden design: one feature is a comparison of rectilinear and curvilinear design, another discusses fragrance, yet another suggests plants for winter interest, and so on.

The appendices, which account for over half of the book, are database charts of what landscape architects call "plant material," for those with little horticultural experience who might need a blue-flowered, three-foot-high, shade-tolerant, June-blossoming, Zone 6 shrub for a garden project. Even accomplished plantspeople would find these exhaustive lists useful to keep the various possibilities in mind.

After reading Edward Tufte's superb book, *Envisioning Information*, I am perhaps oversensitive to shortcomings in tabular layouts, but I can't help feeling that the design of these charts does not match the design of the main body of the book. The information in each could have been easily condensed onto one page, symbols used at times instead of confusing initials, the names of the plant families dispensed with entirely, specific Latin names given in italics, and notes placed at the

bottom of the page as footnotes rather than listed on a separate page. The charts are still useful, but a better design would have made them easier to read.

For years I have owned two copies of Frederick's earlier book, *One Hundred Great Garden Plants*, just in case I loaned out one copy and never got it back. I don't know how many times, when confronted with a vexing planting problem, I have turned to Bill Frederick for advice. *The Exuberant Garden* does not cover the same ground but almost begins where this earlier book leaves off.

My only other criticism of the new book—a minor one—is that since *One Hundred Great Garden Plants*, Frederick's sentences have grown in length, perhaps because many of his ideas are complex. Though his writing remains clear, sometimes making two sentences out of one would have increased the readability of the text. But even if you did not read one word of the text—which would be a pity—the book is well worth owning for the garden plans, for the plant databases, and above all, for the sumptuous photographs.

I'll admit it: William Frederick is one of my gardening idols. For years I have seen snippets of his work in various publications. Three years ago and again this year, I have had the good fortune to visit his Delaware garden in person. The blue butterfly chairs against the brilliant bank of azaleas—the same view that is on the book jacket and frontispiece of his splendid new book—will always remain in my memory.

The Exuberant Garden and the Controlling Hand should be in the library of every landscape architect and serious gardener here in the East. And while you are at the bookstore, pick up a copy of *One Hundred Great Garden Plants*. That should be on your bookshelf as well.

Judith B. Tankard

The Golden Age of American Gardens: Proud Owners, Private Estates, 1890-1940, by Mac Griswold and Eleanor Weller. Harry N. Abrams, in association with the Garden Club of America, 1991. 408 pages. Hardcover. $75.00.

Not since the Garden Club of America sponsored the publication of *Gardens of Colony and State* over sixty years ago has there been such an impressive attempt to record an important era of America's rich garden history. The earlier publication presented a rarefied view of select colonial gardens known to the GCA at the time. It was edited by Alice B. Lockwood, who assembled contributions from the club's membership network. As soon as the two large folio volumes appeared in 1931-34, handsomely designed and produced by Scribner's, they rapidly became a major document for a number of the gardens, many of which vanished within a few years.

This present publication is a worthy successor, and one hopes that it will enjoy an equally valued existence. The inspiration for the new book is a collection of over 1400 hand-colored glass lantern slides originally commissioned by the GCA to document representative members' gardens. After the original collection was reassembled about a dozen years ago, it was augmented by 60,000 35-millimeter slides of other American garden images—postcard views, plans, and black-and-white photographs. That enlarged collection, now known as the Archive of American Gardens, is housed at the Smithsonian Institution where it is presently being catalogued and where, after 1993, it will be available for use by researchers. Unquestionably the collection provides extraordinary visual documentation

of a long-vanished era, and the present authors set out to create a book around the material. Their initial task was to identify the gardens shown in the slides, and by the end of six years of research, they had unearthed enough information to fill many volumes.

The publisher is to be commended for undertaking the project, but it is regrettable that the opulent book-publishing standards of the 1930s have become as obsolete as many of the gardens described in the book. The realities of present-day trade publishing apparently precluded spreading the information out over the multiple volumes the project deserved, setting the text in a readable typeface, and presenting the book in a larger, more traditional format. The minute point size selected for the back matter is a tragedy, as the reference material alone is worth the price of the book.

Reproductions of the over-colorful slides form the backbone of the book. The previous book was enhanced immeasurably by the halftone illustrations, so it is refreshing that the present book has been created entirely around archival images in an era when glossy photography emphasizing color and detail is the norm. The slides that were hand-painted in the studio range from enchanting to lurid, but it is the black-and-white photographs that reveal more about garden design.

The chronicle of American estate gardens prior to World War II, when the economic conditions that supported such activities changed dramatically, is arranged geographically from the Northeast to the West Coast, loosely following the trail of land exploration, development, and culture. With tantalizingly brief entries on some of its notable gardens, each region cries out for its own individual volume. Unlike *Gardens of Colony and State*, which seems a quaint period piece in comparison, the book treats that vast expanse of America between Mississippi and California.

American estates were more than homes of millionaires; they were the regal family headquarters for newly established American dynasties. The style of architecture and gardens was a mix of eclecticism and the latest advances in artistic and cultural developments as promoted in popular English-style books and periodicals of the time. In horticulture, the lessons from England were sometimes abused, as in Mrs. Curtiss James's all-blue garden in Newport that relied heavily on annuals and expensive tricks to create the effect; at times the climate proved a challenge, as in the case of Lila Vanderbilt Webb's "Shelburne Farms" in Vermont where the terraces overlooking Lake Champlain were decorated with tubbed bay trees.

Uniquely in America, women were able to play an enormous role in shaping the character of some of these gardens, whether through their own writings and the development of the garden club movement, or through the work of design professionals. Outstanding contributions to garden design in the country house era by women such as Ellen Shipman and Marian Commin are presented alongside the better-known work of Charles Platt and the Olmsteds, thereby providing a viewpoint not often stressed in more traditional studies of the period.

Even though the book has scholarly reference material, including forty-five columns of endnotes, thirty columns of bibliography, and extensive caption information, the text is more contemporary than scholastic in style and is thereby accessible to a broad audience. Skimming, however, is not possible. Whether a novice to the field of garden history or a seasoned professional, one is encouraged to work through the book, slowly digesting the wealth of information. A newly corrected second printing is expected early this summer.

The authors, the publisher, and the Garden Club of America have produced a serious but splendid book that deserves a permanent place in libraries and book shops, alongside equally notable studies on the American country house.

Fall 1992

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arnoldia

The Magazine of the Arnold Arboretum

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arnoldia

Volume 52 Number 3 Fall 1992

Arnoldia (ISBN 004-2633; USPS 866-100) is published quarterly, in winter, spring, summer, and fall, by The Arnold Arboretum of Harvard University. Second-class postage paid at Boston, Massachusetts.

Subscriptions are $20.00 per calendar year domestic, $25.00 foreign, payable in advance. Single copies are $5.00. All remittances must be in U.S. dollars, by check drawn on a U.S. bank, or by international money order. Send orders, remittances, change-of-address notices, and all other subscription related communication to: Circulation Manager, *Arnoldia,* The Arnold Arboretum, 125 Arborway, Jamaica Plain, MA 02130-3519. Telephone (617) 524-1718.

Postmaster: Send address changes to:
Arnoldia, Circulation Manager
The Arnold Arboretum
125 Arborway
Jamaica Plain, MA 02130-3519

Peter Del Tredici, Editor
Judith Leet, Associate Editor

Arnoldia is set in Trump Mediaeval typeface and printed by the Office of the University Publisher, Harvard University.

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Front cover: The curious flowers of *Asimina triloba,* the pawpaw. Photo by Al Bussewitz.

Back cover: The fall foliage of *Lindera obtusiloba* growing at the Arnold Arboretum. This plant consistently produces spectacular clear-yellow autumn color. The red foliage of *Sassafras albidum* can be seen above and to the right. Photo by Peter Del Tredici.

Inside front cover: The fruit of *Maclura pomifera,* the Osage orange. From *The Sylva of North America* by C. S. Sargent, drawn by C. E. Faxon.

Inside back cover: This gate, made of Japanese cypress *(Chamaecyparis obtusa),* was built in Kyoto and reassembled on site at Tenshin-en. Photo courtesy of the Museum of Fine Arts, Boston.

Pawpaw flower buds. Photo by Rácz and Debreczy.

Tenshin-en: A Japanese Garden at Boston's Museum of Fine Arts

Julie Moir Messervy

An urban haven for contemplation that embraces two cultures.

For many Westerners, the idea of owning a Japanese garden is an unreachable dream. Busy, stressed in their workaday world, they imagine returning home to a serene paradise of ancient stones perfectly set in a bed of moss, flanked by rippling waters of a *koi* pond. Here, in this miniature world, they can give voice to their inner thoughts, daydreams, and spiritual longings; they can become their true selves in a garden of beauty.

Few of us will have the space, find the time, or have the money to create such a sanctuary in our lives. How fortunate it is, then, that the Museum of Fine Arts, Boston, built just such a garden for all of us to experience and enjoy. Sitting within its walls, closed off from busy Boston traffic and passersby, one feels sheltered in an oasis, paradoxically surrounded by, yet removed from, present-day urban life and times.

One sits in a curiously transcendent world, feeling the stones as venerable souls set with a modern freshness and vigor, reminiscent of rocky shorelines of New England, yet universal in the abstract power of their dry composition. At first, the visitor feels overwhelmed by the energy of the place, nearly 200 rocks, set here and there, and senses a mixture of design prowess and accident. Equally impressive are the lushness and quantity of the plantings: over 70 species—1750 specimens in all—adorn the landscape, changing the feeling and form of the garden through the seasons. In early spring, the white-panicled flowers of andromeda hang as tresses from the shiny green of the shrub's leaves. Mid-spring into early summer brings a continuous bloom of azaleas in shades of white, fuchsia, rose, salmon, and pale pink, hummocking as small hills at the feet of tall stones and lanterns. Early to midsummer brings the purple, yellow, and white iris, standing in upright sheaths behind rocks. In fall, the maples, azaleas, and enkianthus turn brilliant hues of red, yellow, and orange to mark the onset of colder weather, before the snows drape the garden in winter. One could attend the garden every day and discover oneself anew through the continuously changing appearance of plants amidst the unchanging stolidity of the stone elements.

A Merging of Cultures

Tenshin-en, the Garden of the Heart of Heaven, is a 10,000-square-foot contemplative viewing garden located at the north side

The Japanese lantern located near the water basin at Tenshin-en. *Photo courtesy of the Museum of Fine Arts, Boston.*

The crushed gravel "sea" at Tenshin-en. *Raking gives the effect of ripples on the water's surface. Photo courtesy of the Museum of Fine Arts, Boston.*

of the West Wing of the Museum of Fine Arts, Boston. Completed in 1988, the garden is named in honor of one of the museum's first curators of Asiatic Art—Okakura Kakuzo, also known as Okakura Tenshin.

Tenshin-en is one of New England's few semipublic viewing gardens in the Japanese style. A true Japanese garden, according to cultural traditions, derives—and takes inspiration—from the landscape around it. In this spirit the project team of landscape artists flew over the New England region in a small plane to gain a sense of its geography and aesthetic qualities. The resulting garden is an interpretation of two cultures, combining the depth of meaning of Japanese garden symbolism with a feeling of beauty and repose that evokes the New England landscape. Rocky coastlines, deep forests, soft hillsides, and craggy mountains are abstracted and recreated to remind viewers of the beauty and diversity of this region. The intent, according to Professor Nakane, the garden's designer, was to create in the garden "the essence of mountains, the ocean and islands . . . as I have seen them in the beautiful landscape of New England."

Each rock, plant, and paving stone was chosen from local materials and combined with artifacts selected from the Museum's collection or brought from Japan. Together these intermingle to create a contrast

Looking along the curved path towards the gate at Tenshin-en. *Photo courtesy of the Museum of Fine Arts, Boston.*

between natural materials and human objects and arrangements.

Origins of *Tenshin-en*

The Museum of Fine Arts, Boston, asked an internationally known garden master from Kyoto, Professor Kinsaku Nakane, to design and construct a Japanese garden as an important addition to the museum's world-renowned Asiatic collection. Funds for the project were donated by the Nippon Television Network Corporation, Mr. Yosoji Kobayashi, Chairman of the Board.

As the garden master's project coordinator, my responsibility was to assemble a project team to carry out his conceptual designs. The Halvorson Company, a Boston landscape architecture firm, was chosen to produce the technical documents and details necessary to build a garden of another culture in this country. Our mandate was to combine an acute sensitivity to the nuances of Japanese design with a full understanding of the legal and technical requirements of building projects in this country. Also included in the team were various subcontractors from this country and from Japan, each of whom brought specialized training and craftsmanship to different aspects of the project. The landscape contractor was Donald B. Curran, Incorporated of Ipswich, Massachusetts.

The garden evolved through a style of collaboration quite different from normal American landscape architectural practice. The garden master's concept and execution were upheld by the efforts of every team member in an atmosphere of unstinting commitment to the creation of a work of art: the Museum's curatorial staff guided the garden process and provided and conserved many of its artifacts; the Italian masons set Kyoto roof tiles on its walls; the Japanese carpenters built a traditional gate in Kyoto, dismantled it, and reinstalled it on site with the American carpenters' help. All upheld the master's concept, in a collaboration of the highest order.

On one of his trips to the site, Professor Nakane was present to set the critical elements that make up the structure of the garden. To watch him was to see a true master at work. For six hot days in July, 1987, Professor Nakane established the positions of the rocks in the garden. Attending to an image of power and beauty that existed only in his sketches and in his imagination, he set almost two hundred stones.

With the aid of a 100-foot hydraulic crane, its highly attentive operator, and three landscape crews, the shape of the garden began to emerge. One by one, the boulders, filling eight tractor-trailer trucks, were bound and chained to the crane's wire. Like the conductor of a symphony orchestra, Professor Nakane would indicate to one crew how deep into the ground they should dig, and to another which way the stone should face—and where its head, feet, front, and back should be positioned. The crew placed the stones, some weighing as much as eight tons, in the ground and made minute adjustments under Professor Nakane's watchful eye. All this was done without a word spoken, as Professor Nakane speaks only Japanese.

Professor Nakane, in a calm and almost casual way, would set one stone at the *takiguchi* (waterfall), the next stone on the *tsurujima* (Crane Island), and the next in the foreground of the garden. He saw the final result in his mind's eye and worked around the whole garden to balance his composition right from the start. As well as fitting into the design as a whole, each stone grouping had to be balanced in its own right—all of which Professor Nakane accomplished with split-second decisions. When the composition was complete, nothing needed to be altered; the whole felt dynamic and yet balanced.

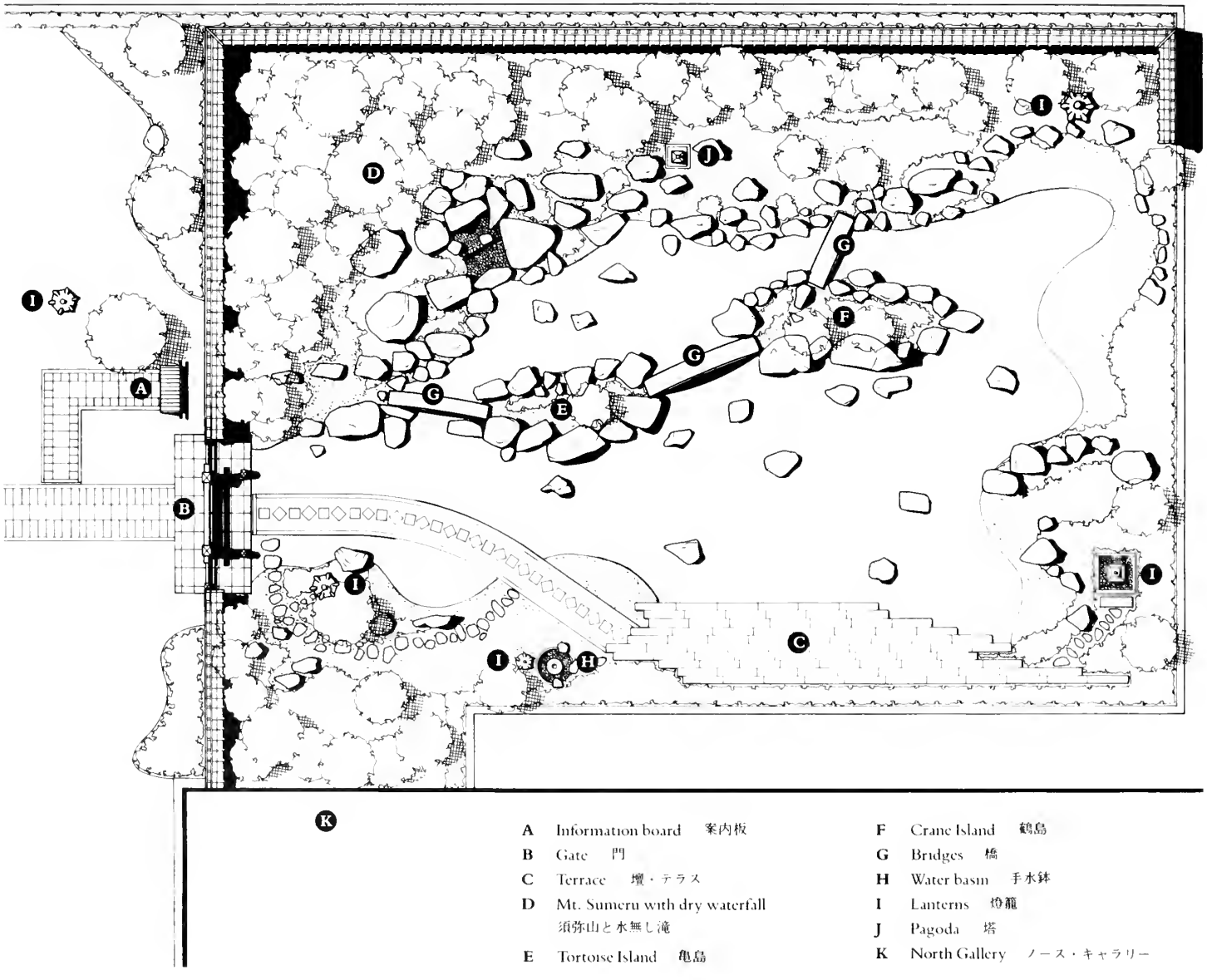
After he had set the stones, Professor Nakane returned to Japan while the walls and new sidewalks were installed. On his next trip to Boston he set fifty-two trees on the day he arrived, but unexpectedly returned to Japan the following day, called back because of a death at the Osaka University of Fine Arts, which he heads. At that point, his son and chief assistant Shiro Nakane took over and set the remaining plantings, ornaments, and stepping stones, and supervised the erection of the Japanese gate.

Professor Nakane returned one more time for the opening of the garden on October 24, 1988. At that time, he declined to speak but chose instead to paint a sign for the garden in *sumie*—Japanese ink. Inscribed is *ten, shin,* and *en* (with Chinese characters) in his own beautiful calligraphic hand. Since then, *Tenshin-en* has been opened to the public from spring through fall and is visited by thousands of people every year.

Design Features of *Tenshin-en*

Tenshin-en is designed as a viewing garden in the *karesansui* style, harkening back to Zen temple gardens of the fifteenth century in Japan. *Kare* means "dry," *san,* "moun-

The plan of Tenshin-en *at the Museum of Fine Arts, Boston. Reproduced courtesy of the Museum of Fine Arts, Boston.*



A Information board 案内板
B Gate 門
C Terrace 壇・テラス
D Mt. Sumeru with dry waterfall 須弥山と水無し滝
E Tortoise Island 亀島
F Crane Island 鶴島
G Bridges 橋
H Water basin 手水鉢
I Lanterns 燈籠
J Pagoda 塔
K North Gallery ノース・キャラリー

tain," and *sui*, "water"; thus it is a "dry mountain water" garden, or a dry landscape garden. Water is suggested by the raked gravel "sea," which unites all the landforms of the garden—the mountains, islands, and rocky shoreline formed by mounded earth and rocks.

Tenshin-en relates to its surroundings by a technique called *shakkei*, that is, by borrowing and echoing the distant landscape and bringing it into the garden walls. Curved shorelines and bridges within the garden echo the lines of the Fenway landscape that abuts the museum on its north side, designed by America's premier garden master, Frederick Law Olmsted. Olmsted designed parks and green spaces during the late 1800s, creating Boston's "Emerald Necklace," the park system that links open space from Franklin Park to the Boston Commons as one nearly continuous sweep of green. Although conceived and designed on a scale far vaster than *Tenshin-en's* miniature landscape, Olmsted understood the need to evoke a harmonious understanding of nature, as he wrote in 1879: "We want a ground to which people may easily go after their day's work is done, and where they may stroll for an hour, seeing, hearing, and feeling nothing of the bustle and jar of the streets, where they shall, in effect, find the city put far away from them."

A Deeper Reading of the Garden

Visitors who understand the garden's symbolism will probably have a richer experience of it. The dry "waterfall" (*takiguchi*) to the back and left of the garden represents the Buddhist concept of *shumisen* or Mt. Sumeru, a mythic mountain thought to support the heavens above and the world below, and around which the universe was believed to be centered. The two "islands" in the left and right center of the garden are two of the "Mystic Isles of the Immortals," Taoist mythical islands said to bring immortality and prosperity to those who incorporated them in their gardens. To the left is *kamejima*, the Tortoise Island; to the right is *tsurujima*, the Crane Island. Looking carefully, one can see the head, feet, tail, and flippers of the tortoise, and the head, wings, and tail of the crane.

According to Professor Nakane, "The mountains and islands symbolize the natural beauty of this region [New England], and, at the same time, mean enduring prosperity and happiness for the Museum visitors." If one studies the garden's design features, the rocky coastline to the right recalls the Maine Coast, and the two large rocks on Crane Island suggest Mt. Fuji (on the right) and one of New England's best known peaks, Mt. Monadnock (on the left). Looking carefully, one can see a profile much like that of New Hampshire's "Old Man in the Mountain" on the floating island between the Crane Island and the rocky coast. The stepping stone path area is an abstraction of deep forests, and the mossy hillside behind the Crane Island recalls the softly forested landscape of New England.

The Stones

In the Japanese garden, the stones are the backbone and provide the overall structure. Rocks from Topsfield, Boxford, and Rockport, Massachusetts, total about 390 tons. Each is placed according to ancient rules and traditions dating back to the Middle Ages of Japanese history. A dark granite vertical stone and base, carved in Japan, is located to the left of the waterfall, and says *Ten-shin-en* in Chinese characters, a gift of the garden's donor, Yosoji Kobayashi.

The Wall and Japanese Gate

The wall is a modern interpretation of a Japanese mud-and-wattle wall, seen in temple compounds and surrounding traditional gardens all over Japan. This wall, varying in height from five to seven feet, was constructed of poured concrete mixed with a light colorant, which was then sandblasted

One of the curved bridges which link the "islands" to the "mainland." Photo courtesy of the Museum of Fine Arts, Boston.

to roughen the texture. The base band is of granite from Deer Isle, Maine, resembling the facade of the museum's West Wing.

From the outside, one can see only a narrow round cap of tiles of a simple design to meld with the spare lines of the West Wing. From the inside, one sees the full slant of the roof that protects a typical wall from the elements. These silver tiles are made of clay baked four times rather than the usual two, in order to accommodate Boston's more severe climate. An old Kyoto firm, Yokoyama Seiga Kojo, specializing in shrine and temple roof tiles supplied the 1500 pieces that make up the roof, including round roof tiles, stacked tiles, beam tiles, and eaves tiles. A special Museum of Fine Arts emblem tile, *onigawara*, featuring the museum's seal, was also made up and grouted to the end wall at the Education Entrance.

The imposing Japanese gate is called *kabuki-mon*, meaning "hanging gate" (and does not refer to the famous Japanese theater.) A traditional gate for a mountain castle or large palace in Japan, it was chosen as a Japanese-style horizontal counterpoint to architect I. M. Pei's large concrete beam at the entrance to the West Wing. The gate is built of Japanese cypress, a wood with excellent natural preservatives. Special design features of the gate are the 13-inch-wide post

Perennials in *Tenshin-en*

Six hundred perennials adorn the garden. Ferns of many varieties are used with hostas and liriope to soften the appearance of the rocks. Leatherleaf ferns as well as lady, hart's tongue, Japanese painted, Christmas, and maidenhair ferns, abound in the garden. Hostas include 'Gold Standard', 'Green Fountain', 'Francee', 'Blue Cadet', 'Nakiana', and 'Flavo Circinalis', with five giant hostas featured outside the walls ('Halcyon', 'Christmas Tree', 'Nigrescens', 'Frances Williams', and 'Blue Angel'). Other perennials include bloodroot (*Sanguinaria canadensis*), trillium (*Trillium grandiflorum*), goatsbeard (*Aruncus canadensis*), lady's mantle (*Alchemilla pubescens*), iris (*Iris ensata, sibirica,* and *cristata*), geraniums (*Geranium endressi* 'Johnson's Blue', *G. sanguineum*), astilbes (*Astilbe chinensis* 'Pumila', 'William Buchanan'), bleeding heart (*Dicentra eximia* 'Zestful'), wild ginger (*Asarum europaeum*), liriopes, and sedges (*Liriope spicata, Carex conica* 'Variegata'). One can also spot pachysandra (*P. terminalis* 'Cutleaf') planted as a specimen near the water basin and stepping stone path. The groundcover moss is *Polystrichum commune,* known as haircap moss.

and beams (*kasugi,* or "umbrella wood" curved beams above the two small doors), the ornamental nail covers, and ironwork.

The gate was constructed in Japan by Suzuki Komuten, carpenters who specialize in building traditional Japanese structures. After being erected once for approval in Japan, it was disassembled and rebuilt in Boston. The wrought-iron fittings, hinges, and nail covers, also fabricated in Japan, are of traditional design.

The Water Basin

The water basin, or *chozubachi,* enables a visitor to ritually purify his or her body and mind as preparation for contemplating the garden and for receiving inspiration and renewal from its spiritual meaning. Similar stone basins were used in tea gardens as vessels for ritual cleansing before taking tea. This *chozubachi* is in the *fusen* style, *fu* meaning "to proclaim" and *sen* meaning "spring of water."

The stones around the water basin are arranged in the original Koho-an style. The large stepping stone upon which one kneels to partake of the water is called a *maeishi,* or "front stone"; the stone to its right is the *yuokeishi,* or "hot water container stone," on which such a container would be placed in winter so that guests could add hot water to the basin to warm their hands. The stone to the left is the *teshokuishi,* or "hand candle stone," on which a guest might place a portable candlestick when using the garden at night.

The Stone Lanterns

Stone lanterns were originally used as votive lights placed in front of Buddhist temple buildings. In later years they played a more ornamental role and were designed specifically for garden use—to light the path to a tea house or to light certain areas of a garden. Near the water basin is a small Japanese lantern of the Edo period (1603-1867), originally located in the Japanese Court of the museum's Asiatic Collection. It has a tall mushroom-shaped "hat" and is placed so that it can cast light over the water basin at night.

In the northeast corner of the garden is a *kasuga*-style lantern, a reproduction of one from the Kawageta Temple, the original considered a "very important cultural property" by the Japanese Government. Dating from 1311, the lantern is a very good example of late Kamakura-period (1185-1333) lanterns. It shows the then prevailing concern with power and beauty in its attacking lion and peacock carvings. Single petals of lotus are carved at the base, a Buddhist symbol of the soul's ascent from mud to the glory of flowering.

Just inside the gate is another *kasuga*-style lantern, a reproduction of the main lantern at the Joruri-ji Temple near Kyoto, carved about 1366. The shape of this lantern follows the composition of the Kawageta lantern but it is narrower overall: the lotus petals are taller, the window is smaller, and the curve to the roof is steeper.

A large Korean lantern in a fourteenth-century style, originally located in the courtyard of the museum, is situated in the southeast corner of the garden. Outside the garden wall is a Meiji-period lantern, dating from about 1880, featuring ornamental friezes of mountains and deer.

The Paths

Japanese garden paths are based on the principle of *shin-gyo-so*. The path outside the gate is of the *shin*, or "formal" style, the stepping stones are of the *so*, or informal style, and the curved *nobedan* path is of the *gyo* style (somewhere between informal and formal in style). The cut stones on the curved path are surrounded by black-washed Mexican river stones set in mortar. This path brings one to the cut stone terrace on which are three *shogi* benches of traditional design. The informal stepping stones paths called *tobiishi*, take the visitor to the Korean lantern, the water basin, or are used as an alternate route back to the Japanese gate.

There are also three bridges that link the "islands" with the "mainland" and form a path for the viewer to take a visual rather than an actual journey. These bridges, called *soribashi*, or "curved bridges," are as long as 17 feet and weigh as much as 1.5 tons.

The Plantings

Over seventy species of plants give color and texture to the garden. Cherries, Japanese maples, and pines are all signature plants of a Japanese garden and serve as symbols of the changing seasons. *Tenshin-en* is composed of a mixture of Japanese and American species; such plants as Japanese *Cryptomeria* combine with American holly to create a new horticultural interpretation of an ancient art form.

Trees: Japanese maples, called *kaede*, or "frog's hand" or *momiji*, are mainstays of a Japanese garden. Used to create a feeling of mountain scenery at the edge of a forest, they link open land to forested land. Broadleaf evergreen trees are generally not hardy in the Northeast, so American hollies, *Ilex opaca*, were used in place of some of the evergreen oaks that, in Japan, act as tall evergreen screens to give the sense of a deep forest. Needle-leaf trees, including compact selections of the Canadian hemlock (*Tsuga canadensis*) and *Cryptomeria japonica* 'Yoshino', are used to create a lush background to the waterfall and mountain path areas. *Cryptomeria* is part of the indigenous vegetation in Japan and are planted extensively in holy areas such as shrine precincts. Red pines (*Pinus densiflora*) and tanyosho pines (*Pinus densiflora* 'Umbraculifera') are used to highlight the islands.

Deciduous trees used in the garden include *Stewartia pseudocamellia*, mountain ash (*Sorbus decora*), star magnolia (*Magnolia stellata*), and of course cherries: the weeping cherry by the gate (*Prunus subhirtella* 'Pendula'), October cherries (*Prunus subhirtella* 'Autumnalis') and Sargent cherries (*Prunus sargentii*). The Japanese admire cherries as symbols of a life well-lived—they

Stone lanterns are used to light paths and highlight special areas of the garden's design. Photo taken in 1988 and reproduced courtesy of the Museum of Fine Arts, Boston.

bloom suddenly and abundantly, but are gone nearly overnight, suggesting a good way to face death as well.

Shrubs: The 1100 shrubs in the garden provides its finished and colorful look. About 500 azaleas of many varieties provide color over two months in the spring. Early bloomers include the Korean azalea (*Rhododendron poukhanensis*) and varieties of *R. mucronulatum*. The popular 'Delaware Valley White' azaleas and early reds ('Hinocrimson' and 'Hinodegiri') mix with midseason bloomers of various colors: salmon ('Guy Yerkes'), silver-pink ('Kaempo'), white with pink throat ('Geisha'), white ('Girard's Pleasant White', 'Polar Bear'), rose-red ('Vyking'), and the beautiful 'Purple Gem'. Late-blooming varieties include the North Tisbury hybrids ('Wintergreen', 'Yuka', and 'Marilee'). Azaleas are pruned in the *karikomi*, or cloud-form shape, to suggest the billowing forms of hills and to soften the base of the stones.

Other shrubs used extensively are mountain laurels (*Kalmia latifolia*), andromeda

(*Pieris japonica, P. floribunda*), enkianthus (*Enkianthus campanulatus*), kerria (*Kerria japonica*), daphne (*Daphne burkwoodii* 'Carol Mackie'), forsythia (*Forsythia intermedia* 'Arnold Dwarf'), barberries (*Berberis thunbergii, B. mentorensis*), junipers (*Juniperus procumbens* 'Nana', *J. chinensis* 'Sargenti'), euonymus (*Euonymus alatus*), holly (*Ilex pendunculosa*), and dwarf spiraea (*Spiraea japonica* 'Little Princess').

Maintenance

Contrary to popular opinion, a Japanese garden is not a low-maintenance landscape. One day a week throughout the garden's open season, a maintenance crew comes to tend the garden. Every week the crew prunes certain trees and shrubs, weeds the moss, and rakes the gravel. Other gardening chores occur at specific intervals during the year: moss is trimmed for propagation, perennials are cut back or divided, fertilizers or horticultural sprays are applied, hemlock bark mulch is spread; azaleas are deadheaded and also pruned at least twice a year to maintain their shape and size.

Viewers are always curious about how the garden is raked. Crushed granite gravel from Mt. Airy, North Carolina, represents the "sea" of the garden's landscape. A heavy six-tine rake is used to give the effect of ripples on the water's surface. Starting from the near right-hand corner of the garden, the crew rakes in lines parallel with the West Wing wall. When the raker reaches an obstacle, such as a stone or island, he stands on it and rakes around it in a circle, continuing the pattern under the bridges and around all detached stones. Finally, the raker follows the edge of the garden's "sea" around the perimeter until meeting the gate. The abstract lines of "water" are most apparent during rainy or cloudy days, or when the textures are emphasized by a thin veneer of snow.

Tenshin-en is frequented by viewers coming to learn about another culture's garden art, to enjoy the verdant atmosphere, or to seek a moment's peace. In the Garden of the Heart of Heaven, visitors will feel the truth of the words of Okakura Tenshin who once said, "One may be in the midst of a city, and yet feel as if one were far away from the dust and din of civilization."

Tenshin-en *is open to Museum of Fine Arts visitors from April to November, Tuesdays through Sundays, from 10 a.m. to 4 p.m.*

The designer of the Arnold Arboretum's Linda J. Davison Memorial Path and the project coordinator of *Tenshin-en* during its construction, Julie Moir Messervy is a landscape designer living in Wellesley. She is author of *Contemplative Gardens* (Howell Press, 1990) and is currently finishing a new book, *The Inward Garden*, to be published by Little Brown and Co. in September 1993.

Magnificent *Maclura*—Past and Present

John C. Pair

New cultivars of the Osage orange have stimulated interest in this distinctive native tree.

The Osage orange, *Maclura pomifera*, has a long and interesting history of use by both Native Americans and early pioneers (Sand, 1991). Its wood was once in demand for making hubs and wheel rims for horse-drawn vehicles, mine timbers, posts, and other uses where resistance to rotting was important. Its decay resistance is due to the chemical 2, 3, 4, 5-tetrahydroxystilbene, located in the wood and toxic to many fungi (Smith and Perino, 1981).

Perhaps the species is best known as a "living fence" because of its stout thorns on zigzagging branches, ease of propagation, rapid growth, and tolerance to heat, drought, and wind. Osage orange was first cultivated in the South in the early 1800s. The plant reached Jacksonville, Illinois, by 1830, brought north by Professor Jonathan Turner, a biology teacher from Illinois College, and promoted through the efforts of John A. Wright, editor of *The Prairie Farmer*. By 1847 Turner was convinced that Osage orange was the best fencing material available, describing it as "horse high, bull strong, and pig tight"; it functioned as a fence long before the invention of barbed wire, which did not come into wide use until 1875 (Dick, 1975).

Maclura pomifera, a member of the mulberry family (Moraceae), grows best in the rich bottomlands along the Red River between Texas and Oklahoma. It also occurs naturally across southern Missouri, Arkansas, and parts of Louisiana (Smith and Perino, 1981). The species is often referred to as hedge apple, or just "hedge," from its common use as hedges and windbreaks in the plains states. Dunbar and Hunter suggested the idea of cultivating Osage orange as a hedge to President Thomas Jefferson upon return from their expedition to the Red River in 1806 (Morton, 1967).

The common name of the plant comes from its globular, characteristic fruit, about the size of a large orange, borne on female trees of this dioecious species (Figure 1). The French found the Osage Indians making their bows from its wood and called it *bois d'arc* (meaning wood-of-the-bow). Such bows were so highly regarded by Indian tribes to the north that they were considered worth a pony and a blanket in trade. Recently the tree has been advocated as an urban tree for difficult planting sites (Powell, 1979).

The Champion Tree

The champion Osage orange tree in the United States was reported in 1939 to be located in Charlotte County, Virginia; it measured 15.5 meters (50.9 feet) high, with a circumference of 7.5 meters (24.5 feet) and a spread of 28.2 meters (92.5 feet) (Collingwood, 1939). Recent correspondence has indicated that this same tree, although somewhat in decline, is still on

Figure 1. Typical fruit and thorns of Maclura pomifera, *both undesirable when the tree is planted for landscape use.*

the front lawn of the restored home of Patrick Henry, near Red Hill, Virginia, and is now nearly 18 meters (59 feet) high with a crown spread of 30.5 meters (100 feet) and a trunk diameter of 2.7 meters (9 feet) (Figure 2). The Henry family reports that the family physician present when Patrick Henry died on June 6, 1799, became so upset at not being able to save the legendary patriot that he went outdoors and "threw himself underneath a large tree, weeping bitterly" (Daily, 1983). The Osage orange is thought to be the "large tree" mentioned, a living landmark of another era.

The largest Osage orange in Kansas grows in Labette County and measures 18 meters (59 feet) tall with a 21.3-meter (70 feet) crown spread and a 4.8-meter (15.8 feet) circumference. Although doubts have been expressed about the hardiness of this southern species, it has survived as far north as the Platte River in central Nebraska (Dick, 1975). Large specimens occur across southeastern Iowa and central Illinois and Ohio, and it has also been planted along the West Coast. Internationally, it has been reported growing in the British Isles, France, Germany, Italy, the Netherlands, Portugal, Romania, Russia, Switzerland, and Australia (Spaulding, 1956).

After the Osage orange became widely planted as fencing around small farms, it quickly invaded the prairies, occurring as small, pure stands or with mixed hardwoods;

Figure 2. The champion Osage orange tree at the home of Patrick Henry in Charlotte County, Virginia. The tree is nearly sixty feet tall, with a nine-foot trunk diameter.

it moved into the eastern states, becoming naturalized in abandoned fields. The species has no natural pests.

Thornless and Fruitless Selections

Although Rehder (1967) reported a thornless variety of the Osage orange, *Maclura pomifera* var. *inermis*, such specimens are uncommon, and some horticulturists suggest that they are merely mature specimens of trees that were typically thorny when they were more juvenile. However, isolated thornless trees have been identified, and a few are creeping into the commercial trade. Kansas State University has been identifying and evaluating thornless selections for over twenty-five years (Pair and Keen, 1980). The first introduction made in the mid-1970s was 'Pawhuska', named after an Osage Indian chief. The most recent release is 'Wichita' (Figure 3), a thornless male selection found growing near Wichita, Kansas (Pair, 1991).

Other selections propagated from large specimens located in Oklahoma, Kansas, and Iowa continue to be evaluated. Quite promising is one called 'Whiteshield', found growing along Whiteshield Creek, and

NEWS

from the Arnold Arboretum

A Mission Reaffirmed

Robert E. Cook, Director

The historical mission of the Arnold Arboretum has been captured in the story of E. H. "Chinese" Wilson, vividly recounted by Steve Spongberg in his wonderful book about botanical exploration, *A Reunion of Trees*. In a disastrous collision with a rockslide on a mountain trail in central China, Wilson suffered a severely broken leg that required three operations. Despite this, he managed to return to Boston with 1,285 packets of seeds and more than 50,000 pressed and dried herbarium specimens. As a result there grows today, on the south side of Bussey Hill, accession number 7272, a magnificent specimen of the Sand Pear (*Pyrus pyrifolia*) that first came to this country in seed lot 395 collected by Wilson near Ichang, China.

In 1988 the President and Fellows of Harvard College reaffirmed the historical mission of the Arboretum:

- To maintain and curate a documented collection of woody plants hardy in the Boston climate;
- To study such plants through maintenance of a library and herbarium for research and teaching;
- To give instruction, including public education, about the biology of trees.

E. H. Wilson began his first Arboretum-sponsored expedition with the purchase of a houseboat for travels on the Yangtze River. Pictured here with its crew in 1907, the craft was christened "The Harvard."

The modern execution of this mission, and its roots in the heritage of Wilson, is embodied in the work of Dr. Jun Wen, a Putnam Research Fellow at the Arboretum. For the past two months she has been traveling in her native China to collect seeds, prepare herbarium specimens, and sample living tissue, which is frozen in liquid nitrogen for later analysis. These collections will complement comparable collections she gathered at the Arboretum last spring.

Dr. Wen is examining an old scientific problem: Why do so many species of plants native to eastern North America also have closely related sister species growing in eastern Asia? Is this an evolutionary coincidence, or were these species once part of widely distributed ancestors? With her collections of living tissue from the Arnold Arboretum and from distant locations in China, Dr. Wen will be using the techniques of molecular biology to isolate DNA from her specimens and compare the genes of these apparently closely related species. By combining these

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results with traditional morphological and paleobotanical evidence found in the herbarium and library collections of the Arboretum, she will be able to reconstruct the history of divergences that created these groups and come to a much more fundamental understanding of their evolutionary relationships.

Dr. Wen also collected and shipped seeds of a number of Asian species to the Arboretum, some of which have never been grown in this country before. Of special interest are propagules of *Aralia henryi* and *Halesia macgregorii*. They have been logged into our computer database for future germination and planting on the grounds. There, beside the original collections of Wilson, they will someday provide critical material for some other research project unseen by us today.

As we lay plans for the next quarter century at the Arboretum, we are continually returning to the fundamental importance of our collections, including the historic Olmsted landscape in which they are set. We shall maintain our traditional commitment to their exceptional care and curation. At the same time we are actively seeking new opportunities for the use of these collections that transcend our historical mission. As was the case with E. H. Wilson in the early years of this century, challenging opportunities, often in distant, unexplored regions of the world, will make the Arboretum an international leader in botanical research and education.

The Arnold Arboretum Associates conducted their Tenth Annual Rare Plant Auction on September 20. Shown here are some of the volunteers whose hard work made the event run so smoothly. They, and many others, deserve congratulations and a big thanks for a tradition of excellence that has brought people and plants together in support of the Arnold Arboretum.

A Federal Grant for LEAP

Diane Syverson

The Arboretum has been awarded a $37,000 grant from the Dwight D. Eisenhower Math and Science Education Program for the teacher training component of the 1993 LEAP (Learning About Plants) Teacher Project. Allocated through the Massachusetts Higher Education Coordinating Council, this funding will support an expanded Arboretum commitment to improving the quality of science education in the Boston elementary schools. In collaboration with the Boston Public School Science Department, 25 teachers from twelve schools will be selected to participate in the 1993 summer workshop. These teachers will take part in an intensive study of botany, horticulture, and ecology that emphasizes the basic plant science concepts and hands-on learning strategies that underlie the LEAP curriculum. Participants will mentor others in their home schools, ultimately introducing the LEAP curriculum and related Arboretum resources to a total of 75 Boston teachers and their students.

First Arboretum Deland Award

Stuart Davies, a graduate student at Harvard University, has received the Arnold Arboretum's Deland Award in support of his studies of the comparative systematics and ecology of tropical rainforest trees.

The Deland Award was recently established from a bequest of F. Stanton Deland, Jr., to support research on the biology of woody plants. Mr. Davies, the first recipient of the award, will combine ongoing field studies in Malaysia with research in the Harvard University Herbaria in Cambridge.

Completion of the Lilac Renovation

Peter Del Tredici

With the planting of eighty new accessions, the restoration of the lilac area, which was started over five years ago, has been completed. Most notable among the new additions are forty large specimens that were moved in from the Case Estates with the generous assistance of labor and equipment by Ollie Capizzi of Capizzi and Company of Acton, Massachusetts.

Working with Tony Capizzi and a mechanical tree spade, Jim Nickerson and Bruce Munch of the Arboretum grounds crew dug the forty plants over a three-day period and moved them into Jamaica Plain on a flatbed truck. All were planted in their permanent locations within a week of being dug, no small task given that many of the plants weighed close to a thousand pounds.

A new bed containing seven cultivars recently introduced by the late Father John Fiala of Medina, Ohio, has also been established. All of the introductions selected for the display have spectacular flowers and appear to be fairly mildew resistant.

To round out the renovation, thirty lilac accessions from the Dana Greenhouse nursery were planted throughout the lilac area. In all, over one hundred plants were added to the collection, all within the space of six weeks, a remarkable feat considering that the Arboretum was packing up and moving during the same time period. A hearty congratulations to everyone who worked so hard.

Photo by P. Del Tredici

The Arnold Arboretum has been awarded the City of Boston's 1992 Award for Best Kept Neighbor in the Open Space category. The people responsible for keeping the Arboretum are, from left to right, top row: Bruce Munch, Pat Willoughby, Bob Famiglietti, Jim Nickerson, Mike Gormley, Luis Colon, Julie Coop, Karl Homes; bottom row: Dave Moran, Jim Papargiris, Mark Walkama, Dennis Harris, Maurice Sheehan, and Don Garrick. Kenny Clarke is missing from the picture.

With this issue **Peter Del Tredici** leaves the editorship of *Arnoldia* and turns his full attention to the Living Collections. He was appointed Assistant Director for the Living Collections this past summer. Peter has been associated with Harvard University for 20 years, first at Harvard Forest in Petersham as a researcher, then as Assistant Plant Propagator of the Arnold Arboretum. He was awarded the PhD in biology by Boston University in 1991 for study in the evolution and natural history of *Gingko biloba*. Recently Peter has been studying patterns of regeneration in a variety of woody plants, including *Kalmia, Castanea, and Sequoia*.

Karen Madsen has been appointed Editor of *Arnoldia*. She brings long experience in editing both books and periodicals and is an instructor in the Graduate Program in Landscape Design and History of the Radcliffe College Seminars. A past contributor to *Arnoldia*, Karen has participated in many of the courses and tours of the Arboretum. She will welcome your opinions and ideas as she begins work on the next issue.

Botany Courses at the Arboretum

Marcia Mitchell

bot•a•ny *n. The division of biology that treats of plants with reference to their structure, functions, classification, etc.*

Many people first encounter the Arnold Arboretum's Living Collections on a casual stroll through the grounds. On subsequent visits, as they become familiar with the geography of the Arboretum's 265 acres, they come to see the diversity of plant structures and the variations in form and texture. Some visitors remain quietly interested observers, content to pursue private thoughts or conversations as they walk the Arboretum's roads.

For other visitors, however, the initial contact with the Arboretum's vast collection of woody plants is the beginning of a lifelong exploration. It is for these visitors that the Arboretum has long offered adult education courses in botany, as well as many courses in horticulture.

Through these courses, most designed to cover the planned material in six course sessions or fewer, adult students can gain a greater appreciation of the links between species of woody plants, and an understanding of the systems of classification by which plants are described. Some of the Arboretum's botany courses are designed solely as classroom learning: many of these take place during the cold winter months. Others are planned around study of specimen trees and shrubs on the Arboretum's grounds, and these are invariably some of the most popular courses offered in the Arboretum's adult education program. For those who find that their curiosity is whetted by the display around them, the Arboretum's botany courses will introduce the careful observer to new worlds of plant appreciation and enjoyment.

A Selection of Botany Offerings

BOT 131 **Flora of New England: A Comprehensive Survey**
This course provides an opportunity for the experienced plant enthusiast to gain a comprehensive knowledge of our native New England flora. Participants will learn the region's major vascular plant families, including characteristic species and habitats.

BOT 100 **Introduction to Botany**
Designed as an introduction to botany for students new to the discipline, this course also serves as a refresher for those who feel the need to brush up on old skills. Among the topics to be explored are plant cells and tissues, cell division, plant anatomy and morphology, plant diversity, evolution, and ecology.

BOT 228 **The Conifers**
The conifers, or cone-bearing plants, are a major component of the New England landscape. We will discuss the natural history of conifers and learn how to recognize the native genera and species. Students will see what traits distinguish one conifer species from another, how conifers reproduce, and why conifers are such special plants.

Please call the Education Department, 524-1718, to request a course catalogue or to register for Arnold Arboretum

Lilacs, recently moved in from the Case Estates, had to be planted with a backhoe.

named after a Cheyenne Indian chief. The tree has glossy, cordate-shaped leaves (Figure 4) and was discovered by John Flick near Hammond, Oklahoma. Another large male specimen without thorns, found by Al Ferguson growing in an old nursery near Denmark, Iowa, is being propagated for comparison with nine other clones at the Horticulture Research Center in Wichita, Kansas.

Figure 3. A ten-year-old specimen of Maclura pomifera *'Wichita', a thornless, male cultivar.*

Propagation

Osage orange is easily propagated in a variety of ways. Seedlings, traditionally used for windbreaks or as understock for improved selections, are grown from stratified seed removed from the large, leathery fruit collected in the fall. Seed slip easily from the pulp if allowed to ferment in water for several days. Stratification for 30 to 45 days at 4 degrees Centigrade (40° F) is usually sufficient to break dormancy so seed can be planted in the greenhouse in January or February. If sown outdoors in the fall, germination will occur in April or May the following spring. Seedlings large enough for T-budding can be produced by mid-August.

Budding can be done in August using vigorous, current season's growth directly from any superior plant. Such buds will remain dormant until forced out the following April or May. Alternatively, dormant scionwood can be collected during winter and stored for June budding once bark slips on the understock.

Bench grafting is also easily accomplished using either a whip and tongue or cleft graft in midwinter. Grafts should be allowed to callus six weeks at near 12 degrees Centigrade (55° F) before potting up or lining out in the spring. The rootstock should be the same size as the scions used, or larger. Wrapping with grafting tape or masking tape secures the union until callusing occurs.

Cuttings, both softwood and hardwood, are commonly used to propagate thornless and fruitless selections vegetatively. Tender shoots, fifteen centimeters (6 inches) long, taken in May or early June and placed under intermittent mist, will root in five to six weeks. Rooting hormones greatly increase the percentage and the numbers of roots produced. Concentrations of indolebutyric acid (IBA) ranging from 2,500 to 5,000 parts per million are usually adequate. The commercial talc formulation Hormodin® No. 2 (3,000 ppm) works well. Softwood cuttings ready for potting in August need winter protection before lining out the following spring.

Hardwood cuttings can also be propagated easily with wood collected from January to March. With this method, plants of sufficient size can be produced for lining out the same season. Pair and Khatamian (1984)

Figure 4. A fruitless and thornless selection of Maclura *with glossy, cordate-shaped leaves.*

found basal stem portions rooted better than terminal sections when taken off mature trees. Wood collected in winter should be cut into six- to eight-inch cuttings, dipped in 5,000 to 10,000 ppm IBA, and placed over bottom heat near 21 degrees Centigrade (70°F) in a cool greenhouse (13 to 18 degrees Centigrade [55-65° F]). The rooting medium can be either perlite or a mixture of perlite and peat in a two-thirds to one-third ratio, and should be kept moist, but not too wet. Bottom heat allows callusing and rooting to occur before leaves emerge from the cuttings (Figure 5).

Cuttings taken as late as March 1 often root in three weeks and can be potted up in eight weeks—until of sufficient size for lining out in early summer. Since there is a strong tendency for multiple stems to occur in this species, cuttings can be grown for one season without pruning or training. If the plant is cut back to a single bud near the base the following spring (as in propagation by budding), a strong central leader can be produced to form a better, single-stemmed tree.

Osage orange has seldom been used as a common residential tree. Its wide-spreading root system requires ample space, but its rustic beauty—particularly when the glossy green leaves turn yellow in autumn—can provide shade and ornamental value to parks and landscapes and at the same time symbolize the American frontier.

As improved selections become available and the demand for stress-tolerant, pest-resistant trees increases, greater use may be

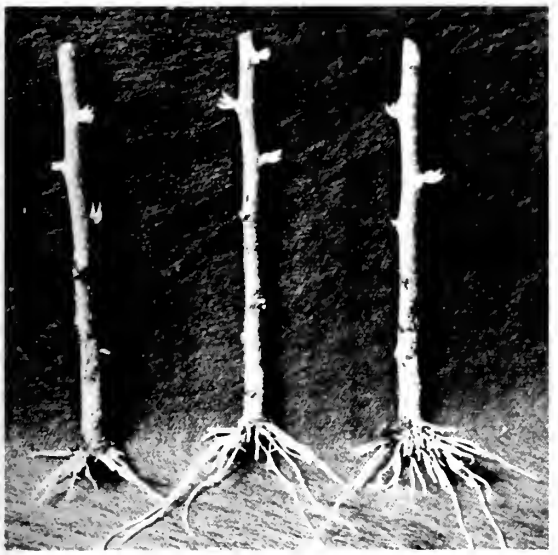

Figure 5. Rooted hardwood cuttings of Maclura *after four weeks of bottom heat and a treatment of 5,000 ppm IBA.*

made of male *Maclura* cultivars. From the windswept prairie to the inner city, this tree may fill the need for those difficult planting sites where few other species can survive.

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John Pair is a Research Horticulturist for Kansas State University at the Horticulture Research Center in Wichita, Kansas.

Our Native Pawpaw: The Next New Commercial Fruit?

M. Brett and Dorothy J. Callaway

Asimina triloba can add a distinctive look to your garden and a tropical taste to your table.

If someone told you about a tree bearing fruits that are delicious and exotic in flavor, custard-like in texture, and larger than any other native to the United States, you would probably assume that this fruit was already popular in the marketplace. If you learned that this same tree possessed large, highly ornamental, dark-green leaves that turned a brilliant gold in the autumn, you would suspect that you had probably seen it in many yards. You would, however, be mistaken in both cases. The tree in question is the native pawpaw, *Asimina triloba*. But why is a fruit with such potential not already a commercial crop? How can the pawpaw benefit from what we know of the commercial development of other fruit crops?

Species and Taxonomy

The genus *Asimina* has the northernmost range within the primarily tropical family, the Annonaceae. It includes eight species and one named hybrid, all native to temperate North America. Each of the eight species and one hybrid of *Asimina* are briefly described below and in Table 1. Either deciduous shrubs or small trees, *Asimina* species produce flowers in the spring, often before the alternately arranged leaves have emerged. The flowers are protogynous, that is, the stigmas in a given flower mature before the stamens. Flower petals are arranged in two whorls of three (or more rarely, four). The fruits are cylindrical, many-seeded berries, usually ranging in length from 2 to 9 centimeters (1-4 inches), although some specimens of *A. triloba* bear fruit as long as 15 centimeters (6 inches). Table 1 provides a comparative list of *Asimina* species, their synonyms, flowering and fruiting times, and other plant characteristics.

The most recent taxonomic study of the genus *Asimina* was carried out by Kral (1960). His treatment is widely followed, except for one species that Kral calls *A. speciosa*, but that is more commonly referred to in the literature as *A. incana* or *A. incarna*. We believe *A. incarna* to be the legitimate name of this species. Detailed distribution maps for species in the genus *Asimina* are provided by Callaway (1990).

Species in the Genus *Asimina*

***Asimina incarna*,** a small shrub with obovate leaves and white flowers, is native to sandy ridges and old fields from central Florida north to southeastern Georgia.

Asimina triloba, *from* The Sylva of North America *by C. S. Sargent. Drawn by C. E. Faxon.*

Table 1. Description for species of *Asimina* native to the United States

Species	Synonyms	Time of Bloom	Plant Height (m)	Fruit Length (cm)	Flower Width (cm)	Flower Color
A. incarna	*Asimina incana* *Asimina grandiflora* *Asimina speciosa* *Pityothamnus incanus*	March-May	1.5	8	4	white
A. longifolia	*Asimina angustifolia* *Asimina pygmaea* *Pityothamnus angustifolius*	April-July	1.25	7	6	white
A. obovata	*Anona grandiflora* *Asimina grandiflora* *Asimina secundiflora* *Orchidocarpum grandiflorum* *Pityothamnus pygmaeus* *Porcelia grandiflora* *Uvaria pygmaea*	March-June	2.5	7	8	white
A. parviflora	*Orchidocarpum parviflorum* *Porcelia parviflora* *Uvaria parviflora*	April-May	2	2	1.5	maroon
A. pygmaea	*Anona pygmaea* *Asimina secundiflora* *Orchidocarpum pygmaeum* *Pityothamnus pygmaeus* *Porcelia pygmaea* *Uvaria pygmaea*	April-June	0.3	4	2	maroon
A. reticulata	*Asimina cuneata* *Pityothamnus reticulatus*	—	1.5	5.5	5	white
A. tetramera	*Pityothamnus tetramerus*	May-August	2	9	3	maroon
A. triloba	*Annona pendula* *Annona triloba* *Asimina glabra* *Orchidocarpum arcitinum* *Porcelia triloba* *Uvaria triloba*	March-May	10	5.5	3.5	maroon
A. x nashii		March-May	—	7.5	5	white

The attractive foliage of Asimina triloba. *Photo by Al Bussewitz.*

A. longifolia, a small shrub with narrow leaves and white flowers, is native to flatwoods and sand ridges from northeastern Florida to southeastern Alabama.

A. obovata, a shrub or small tree with obovate leaves and white flowers, is native to dry sand ridges, coastal dunes, and hammocks throughout most of peninsular Florida.

A. parviflora, a large shrub or small tree, with oblong leaves and maroon flowers, is native to rich woods, lime sinks, and alluvial soil of coastal hammocks from Florida to southeastern Virginia, west to Tennessee and eastern Texas.

A. pygmaea, a dwarf shrub with obovate or oblanceolate leaves and maroon flowers, is native to flatwoods and savannahs from central Florida to southeastern Georgia.

A. reticulata, a shrub with oblong or elliptic leaves and white flowers, is native to most of the Florida peninsula.

A. tetramera, a shrub with oblanceolate or elliptic leaves and maroon flowers, is native to coastal sand dunes in the area of Martin and Palm Beach counties, Florida.

A. x nashii, the only named *Asimina* hybrid, is a naturally occurring cross between *A. incarna* and *A. longifolia.* Described by Kral as occurring where the ranges of the two parent species overlap, it is a shrub with white flowers; its leaves are intermediate in size between the two parents. Although other *Asimina* hybrids were discussed by Kral (1960), only *A. x nashii* was named.

Asimina triloba, by far the most widespread and northernmost species of *Asimina,* deserves special attention. A shrub or small tree with maroon flowers, it is native to most of the eastern half of the United States from Florida to Ontario, west to Nebraska and Texas (see range map). The fruit of *A. triloba,* unlike that of most of the other species, is palatable, large, and deserving of commercial exploitation.

Horticulture of *Asimina triloba*

Because of transplanting difficulties, pawpaws are best started as seedlings in deep containers and grown to a height of 0.6 to 0.9 meters (2-3 feet) before they are transplanted to the field. Seedlings should be protected from direct sunlight for the first year of growth because of their sensitivity to ultraviolet light. In their second and subsequent years, however, plants should be placed in full sun for best fruit production (Willson and Schemske, 1980). The limited cultural

Growing in the understory of a forest in South Carolina, the alternate arrangement of the foliage of the pawpaw is both obvious and distinctive. Photo by Peter Del Tredici.

information available for pawpaw is summarized by Callaway (1990, 1993).

Diseases and Pests

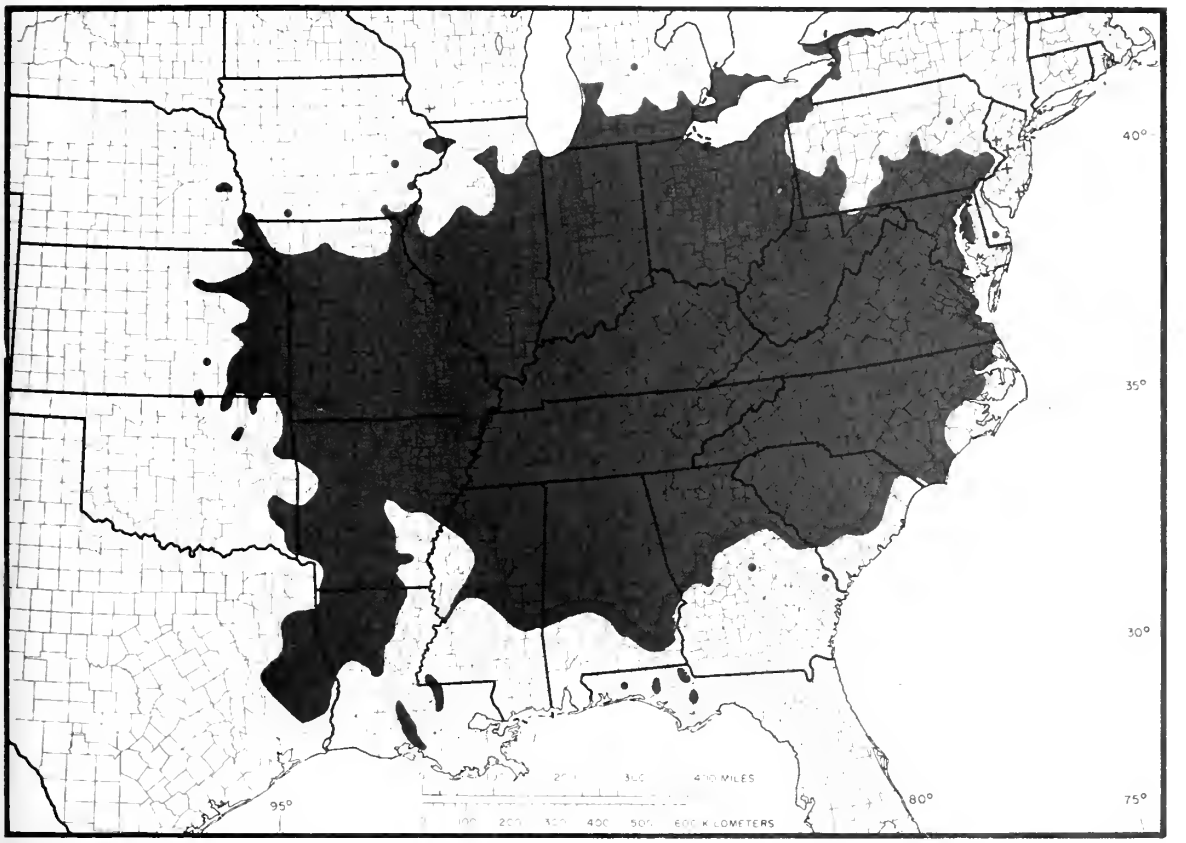
Diseases of *Asimina* include flyspeck (*Zygophiala jamaicensis*) and a leaf spot caused by a complex of pathogens (*Mycocentrospora asiminae, Rhopaloconidium asiminae,* and *Phyllosticta asiminae*) (Nasu and Kunoh, 1987; Peterson, 1991). None of these diseases cause significant damage to the fruit. Insect pests include two leaf feeders, *Eurytides marcellus* and *Omphalocera munroei* (Damman, 1986), and one peduncle borer, *Talponia plummeriana* (Allard, 1955). *T. plummeriana* may cause serious flower loss in some years. A number of vertebrates (foxes, opossums, and squirrels) are known to eat pawpaw fruit.

Propagation

Pawpaw seed should not be allowed to dry out before planting. Small quantities are placed in polyethylene bags containing damp sphagnum moss. Cold stratification at 2 to 4 degrees Centigrade (35-39°F) for 60 to 100 days is recommended (USDA, 1948). Rate of germination is improved by bottom heat (27 to 30 degrees C [80-86°F]) and shading (Callaway, unpublished; Evert and Payne, 1991; Peterson, 1991). The most reliable method of vegetative propagation is chip-budding. Root cuttings have also been successful (USDA, 1948). Tissue culture and softwood propagation methods have not been satisfactorily developed.

Varieties

Compilations of information on past and present varieties of *Asimina triloba* have appeared in reports by Callaway (1990, 1993) and Peterson (1991). Much of the information available on varieties is subjective and of questionable value. Many so-called varieties are trees that were named by their owner and reported in the literature of various fruit-grower societies, but never propagated for distribution. However, until properly conducted variety trials are carried out, these are the best sources of information available. Of the sixty-eight varieties listed by Callaway (1993), commercial suppliers are known for nineteen. However, only 'Sunflower' is listed by more than two nurseries. (It is listed by six.) Eight are listed by two nurseries and 10 by only one. 'Davis', 'Overleese', and 'Sunflower' are probably the most widely grown varieties. 'Overleese' and 'Sunflower' are generally considered among the best selections currently available. Selected from the wild around 1950 in Rushville, Indiana, 'Overleese' bears fruit weighing approximately 350 grams (12.3



The range of Asimina triloba, *the pawpaw. From* Atlas of United States Trees, Vol. 4, Minor Eastern Hardwoods. *1978. USDA Misc. Publ. 1342.*

ounces) and ripens about the first week of October in Michigan. 'Sunflower' fruits, somewhat smaller, weigh approximately 250 grams (8.8 ounces) and ripen in Michigan at about the same time as 'Overleese'. 'Sunflower' originated in Chanute, Kansas.

Utilization and Prospects

Currently, pawpaws are primarily consumed as fresh fruit. They may also be processed into ice creams, juices, and other products as are their *Annona* relatives. In addition to food uses, scientists at Purdue University have isolated compounds from vegetative parts of the pawpaw that exhibit highly effective pesticidal and anti-tumor properties (Alkofahi et al., 1989; Rupprecht et al., 1986; Rupprecht et al., 1990). Pawpaw also develops into a very handsome ornamental plant. In the open, trees assume a pyramidal form. Throughout the summer they are adorned with large, drooping, dark-green leaves which turn brilliant golden in the fall.

Despite the fact that pawpaw is native to the United States, its commercialization is apparently more advanced in other countries, such as Japan and Italy. We are aware of only one commercial planting in the United States and their plants are still too small to bear fruit. Fortunately, this lack of interest seems to be changing. Pawpaw plants have recently been selling briskly in the nursery

The fruit of Asimina triloba *hanging from a tree at the Arnold Arboretum. Photo by Al Bussewitz.*

trade, particularly grafted varieties, and none of the nurseries selling pawpaw varieties have been able to meet the demand for plants within the last two years. Although adequate assessment of market demand for new crops is quite difficult, recent trends indicate that the prospects for successful commercialization of this fruit appear to be improving.

Difficulties in New Crop Introduction

Asimina triloba was widely used by Native Americans before European settlement. Although early settlers also used pawpaw, they also brought fruit—such as apples, peaches, and pears—with them from Europe. In the Old World, superior varieties of these fruit had been selected over several centuries and propagated widely by grafting. Therefore, these improved fruits were more widely grown than unimproved native fruits.

Although exceptional specimens of pawpaws can be found in the wild, the proportion of superior plants, as with any wild fruit (apples, peaches, and pears included), is small. Historically, many years are required for exceptional specimens to become widely distributed. Early efforts at collecting exceptional specimens were made by the American Genetic Association (Anonymous, 1916, 1917) and by a few individuals, most notably Dr. G. A. Zimmerman (1938, 1940, 1941) of

A selection of Asimina triloba *producing exceptionally large fruits. Photo by Brett Callaway.*

Harrisburg, Pennsylvania. Unfortunately, many specimens identified during this period were lost during World War II. In recent years renewed efforts by a few individuals have led to a resurgence of popular interest in pawpaws.

The improvement of crops through breeding is particularly slow for tree crops because of the long intervals between generations. Often a breeder is only able to evaluate five or six generations in an entire career. When one considers that a corn breeder can evaluate three generations a year, the comparative difficulty of developing new varieties of fruit crops from trees or shrubs becomes obvious. However, there have been successes. Domestication of the blueberry (*Vaccinium* spp.) has taken place entirely in the twentieth century (Galleta, 1975). The first commercial plantings were established in Florida in the late 1800s (Lyrene and Sherman, 1979) and breeding work began in the early 1900s. 'Tifblue', probably the most widely grown rabbiteye type of blueberry (*V. ashei*) is derived from parents collected from the wild (Austin, 1985). Kiwi (*Actinidia chinensis*) is another example of a recently developed fruit enjoying commercial success. Therefore, *Asimina* germplasm collections made in recent years by Peterson (1986) and Callaway (1991), and a number of superior varieties collected from the wild (listed by

Callaway, 1993), provide the foundation for pawpaw breeding work to begin.

Lessons from Other Crops

Important lessons are to be learned from the early efforts at commercialization of blueberries. Between 1921 and 1925, a boom in the Florida blueberry market took place. Hundreds of thousands of plants were dug from the wild and planted in commercial fields. The extreme variation in fruit quality from these wild plants (as would be the case for any wild fruit) led to a decline in demand for the Florida fruit and caused the industry to shift to more northern parts of the U.S. where superior varieties were clonally propagated and grown (Lyrene and Sherman, 1979). The great demand for pawpaws in recent years has led to a shortage in plants of superior varieties. Customers are placed on waiting lists, sometimes for years. Under these conditions, as in the boom years of the Florida blueberry industry, the temptation to plant seedlings of variable quality is great. However, this practice is shortsighted and can potentially destroy a nascent industry.

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M. Brett Callaway is Tropical Germplasm Manager for Pioneer Hi-Bred International and Adjunct Assistant Professor of Horticulture at the University of Kentucky. Dorothy Callaway is a freelance horticultural writer and author of *The World of Magnolias*, soon to be published by Timber Press, Portland, Oregon.

Make Mine Mulch

Peter Del Tredici

Using mulch in the garden not only reduces maintenance, but also contributes to the overall health of the plants.

The use of organic mulches in landscape situations mimics the natural processes that occur in deciduous forests where a "blanket" of leaves is deposited on the forest floor every fall. Leaves not only act to insulate the soil during the winter but also are the mechanism by which carbon and mineral nutrients are recycled through the ecosystem (see The Organic Matter "Recycle" flow chart). In the list below I have summarized the principal benefits of mulch from the gardening perspective, along with some cautions about its use.

Benefits of Organic Mulch

1. Conserves Water
The most immediate effect of mulch is to reduce water evaporation from the soil surface. By protecting the soil surface from the drying effects of the sun and wind, mulch promotes water conservation.

2. Inhibits Weed Growth
A one- to two-inch layer of mulch will suppress the growth of many weeds, especially annuals, thereby reducing the amount of weeding time required.

3. Improves Soil Structure
Organic mulch acts as a source of carbon for soil decomposers, which turn it into humus. Humus benefits the soil by improving its tilth and water-holding capacity, and by increasing soil aeration. Mulch is the most cost-effective way of improving the compacted condition of many urban soils.

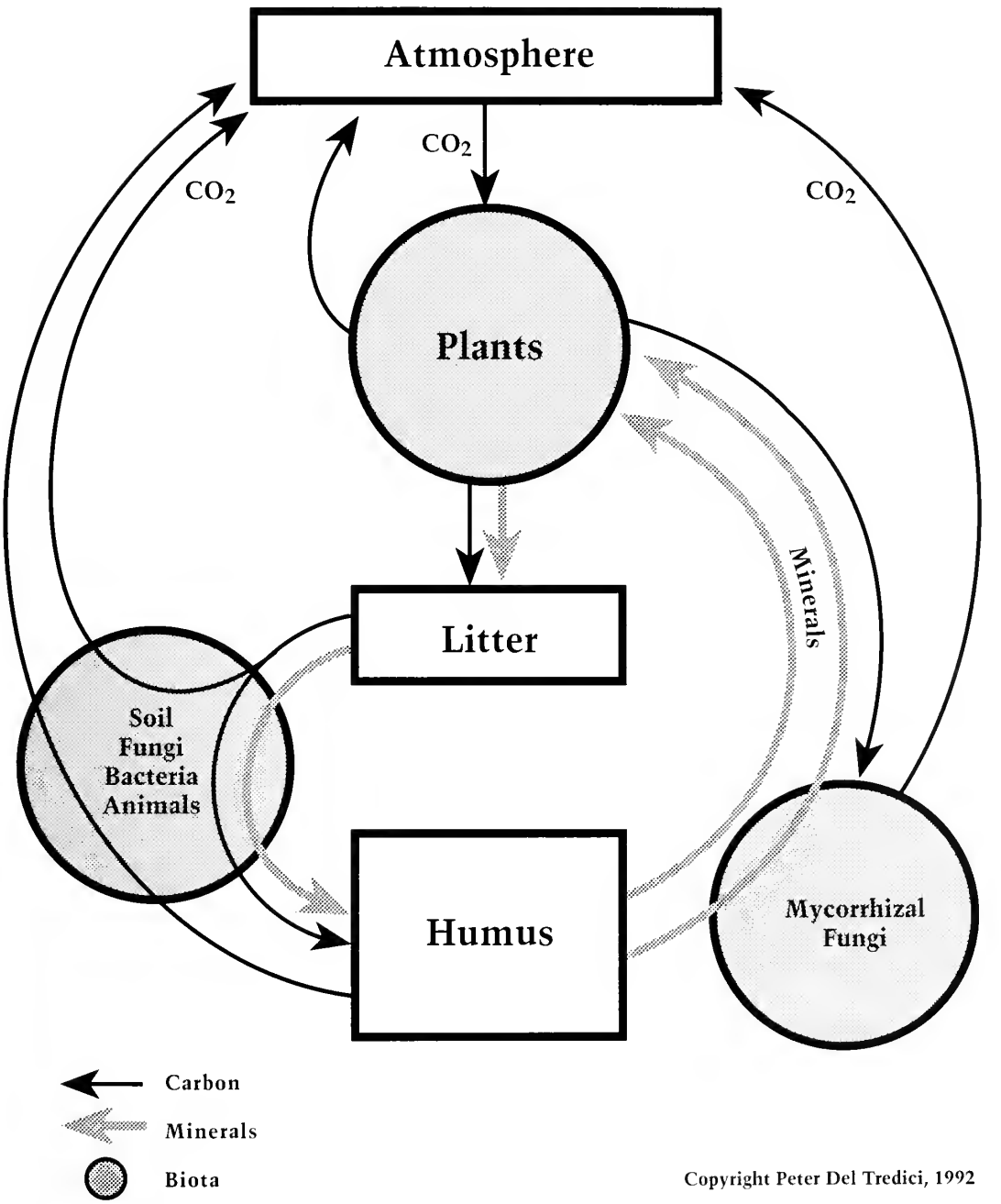
4. Adds Mineral Nutrients
As organic mulching material decays, mineral nutrients are absorbed by symbiotic mycorrhizal fungi, which pass them on to plants in "exchange" for carbon (see flow chart). These nutrients, including phosphorus in particular, are essential for the healthy growth of plants.

5. Moderates Soil Temperature
Mulch helps protect the root zone of plants from fluctuations in temperature. In summer, the soil under mulch is both cooler and more uniform in temperature than bare ground. In winter, mulch can act as an important soil insulator, particularly in years when there is no protective snow cover. By reducing soil temperature fluctuations, mulch also helps to prevent small plants from being heaved out of the ground during the winter.

6. Reduces Soil Erosion
Soil covered with mulch is better able to absorb rainfall than bare soil, thereby reducing soil erosion, particularly on steep slopes.

(continued on page 32)

The Organic Matter "Recycle"



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Problems With Mulch

1. Can Cause Temporary Nitrogen Deficiency

Because of the high carbon-to-nitrogen content ratio of most organic mulches, they should always be top-dressed with a light sprinkling of an all-purpose garden fertilizer (such as 5-10-5) in the spring. Supplemental nitrogen not only speeds up the decomposition process, but also serves to minimize the temporary translocation of nitrogen from the soil to the mulch layer by fungal decomposers.

2. Can Provide Habitat for Herbivorous Animals

Mulch provides excellent habitat for voles and other rodents, as well as for slugs and snails, making control measures more difficult than they would be if the soil were bare.

3. Can Be Applied Too Thickly

On young plantings, too much mulch can be detrimental by inhibiting water penetration and air flow. In general, two inches of mulch should be the maximum depth with woody plants. With herbaceous perennials, too much mulch can lead to rot problems, particularly during a wet growing season.

Conclusion

From the gardening perspective, mulch accounts for the improved growth of plants in two ways: first, it improves conditions for the growth and development of beneficial soil microorganisms by providing them with both carbon and mineral nutrients; and second, it promotes increased root growth by increasing the water-holding capacity of soil and improving its tilth. The use of organic mulches in the garden promotes the same harmonious interactions between plant roots and soil microorganisms that occur naturally in our native forests.

Peter Del Tredici has recently been appointed to the position of Assistant Director for Living Collections at the Arnold Arboretum. He has served as Editor of *Arnoldia* for four years.

Winter 1992

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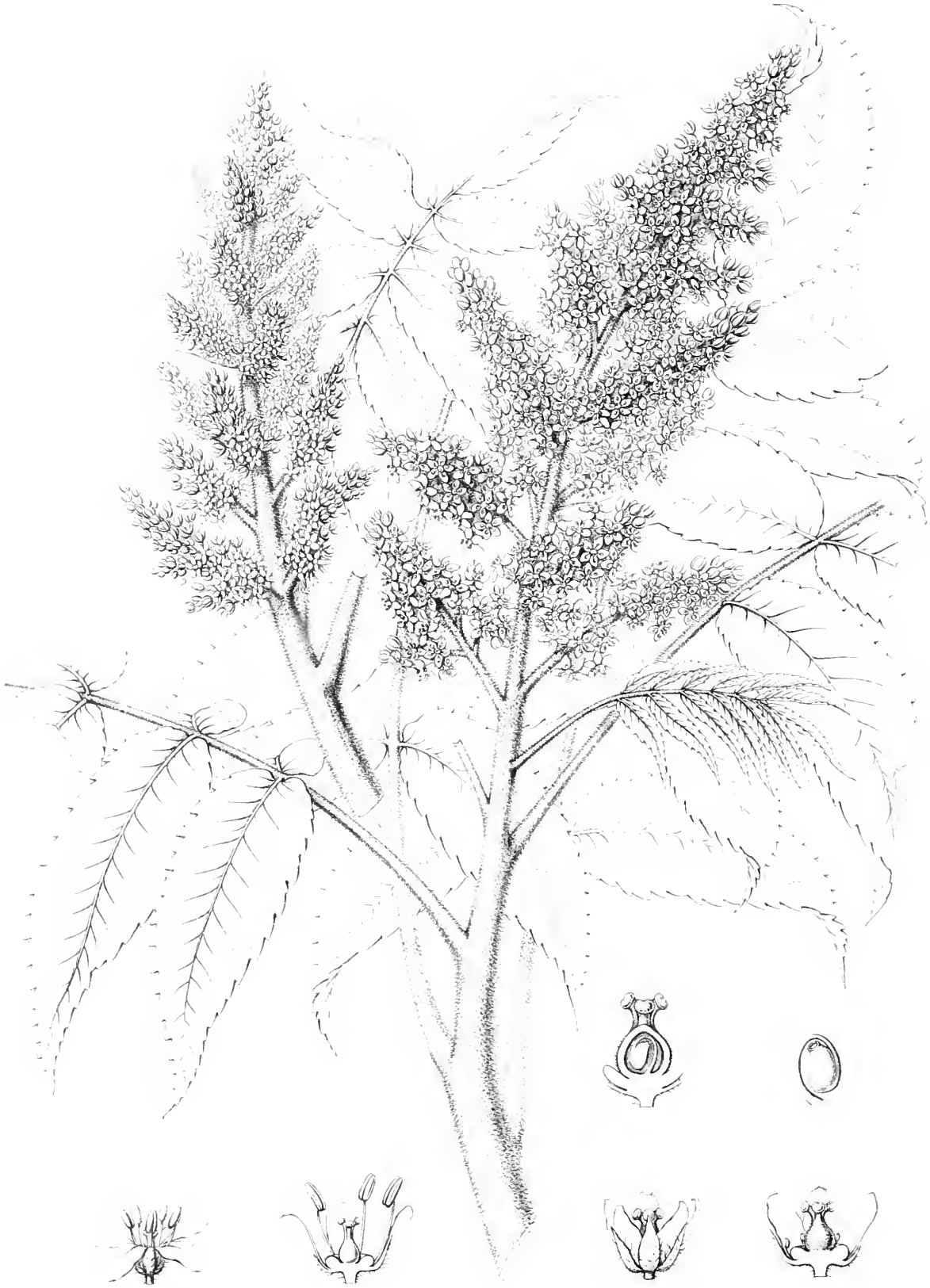
The Magazine of the Arnold Arboretum



GRAY HERBARIUM
JAN 2 8 1993

arnoldia

Volume 52 Number 4 1992

Arnoldia (ISBN 004-2633; USPS 866-100) is published quarterly by the Arnold Arboretum of Harvard University. Second-class postage paid at Boston, Massachusetts.

Subscriptions are $20.00 per calendar year domestic, $25.00 foreign, payable in advance. Single copies are $5.00. All remittances must be in U.S. dollars, by check drawn on a U.S. bank, or by international money order. Send orders, remittances, change-of-address notices, and all other subscription-related communications to: Circulation Manager, *Arnoldia*, The Arnold Arboretum, 125 Arborway, Jamaica Plain, MA 02130-3519. Telephone 617/524-1718

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Karen Madsen, Editor

Arnoldia is set in Trump Mediaeval typeface and printed by the Office of the University Publisher, Harvard University.

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Front cover: A grove of birches, *Betula* spp., at the Arnold Arboretum. Photo by Al Bussewitz.

Inside front cover: The fruit of *Rhus typhina*, the staghorn sumac, is bright crimson in early fall, darkens in the cold of winter, and often remains colorful into spring. From *The Sylva of North America* by C. S. Sargent, drawn by C. E. Faxon.

Back cover: The late-summer fruit of *Ailanthus altissima*. Photo by Al Bussewitz.

Inside back cover: Winter at the Arnold Arboretum. Photo by Rácz and Debreczy.

Where the Wild *Ginkgos* Grow

Peter Del Tredici

The question of whether there are wild *Ginkgos* in China has bedeviled botanists for years. After visiting Tian Mu Mountain in Zhejang Province, the author concludes that the question may not be as important as it once seemed.

The question of whether or not the *Ginkgo* still exists in the wild has been debated by scientists for over a century. Based on very limited fieldwork in Asia in the late nineteenth and early twentieth centuries, western botanists—including both C. S. Sargent and E. H. Wilson of the Arnold Arboretum—expressed the often-quoted opinion that *Ginkgo* was probably extinct in the wild and that it was saved from total extinction by Buddhist monks who cultivated it in the gardens surrounding their temples. This romantic idea, which was based more on speculation than fact, became embedded in the horticultural literature despite the report in 1915 by F. N. Meyer of the U.S. Department of Agriculture of a large population of *Ginkgos* growing spontaneously in the forests of eastern China. Meyer communicated his discovery in a letter to his superiors in Washington (Cunningham, 1984), but unfortunately he failed to write up any of the details for publication. It was C. S. Sargent and E. H. Wilson who saved Meyer's observations from archival oblivion by quoting from the letter in two separate publications:

> One of the remarkable things about the Ginkgo-tree is the fact that although it has been undoubtedly cultivated by the Chinese for many centuries, the region where it grows naturally and spontaneously has remained unknown, travelers having failed to find any trees growing in the forests or anywhere except in the neighborhood of temples or shrines where they had evidently been planted. A year ago [May, 1915], however, Mr. F. N. Meyer, the well-known botanical explorer for the Department of Agriculture, found the Ginkgo growing spontaneously in rich valleys over some ten square miles near Changhua Hsien, about seventy miles west of Hangchou, in the Chekinag province. There were many seedlings and the trees here were so common that they were cut for firewood, something which has never been seen before in China. It is by no means certain that this is the original home of the Ginkgo as these trees may all have descended from a planted tree. It is exceedingly interesting, whatever may be the history of these trees, to find that there is at least one place in China where the Ginkgo grows in the woods and reproduces itself spontaneously. (Sargent, 1916)

> According to Frank N. Meyer, botanical explorer for the U.S. Department of Agriculture, "the Ginkgo grows spontaneously in rich valleys over some ten square miles near Changhua Hsien, about 70 miles west of Hangchou in the Chekinag province, China." There "the trees are so common that they are cut for firewood." It is however by no means certain that this is the original home of the Ginkgo as these trees may all have descended from a planted tree. Meyer's discovery, however, is interesting, for there is no other evidence of the Ginkgo growing spontaneously or that it is cut for any purpose. (Wilson, 1916)

As presented by Sargent and Wilson, Meyer's discovery is considerably diminished by their unjustified suggestion that a population covering some ten square miles

Figure 1. A view of the south-facing slope of the west peak of Tian Mu Shan, now protected as part of a Chinese government nature reserve.

"may all have descended from a planted tree." Sargent's restatement of Meyer's letter is particularly misleading because no quotation marks distinguish Meyer's words from Sargent's interpretation of them.

Be that as it may, in the late 1920s and 30s, Meyer's discovery was corroborated by Chinese botanists who not only visited Changhua Hsien but also reported the existence of other "wild" populations of *Ginkgo* in the surrounding area, primarily in the vicinity of Tian Mu Shan (Tian Mu Mountain) in Zhejiang Province (Cheng, 1933; Li, 1956; Wang, 1961). In 1956 the Chinese scientific community determined that Tian Mu Shan was of sufficient biological interest to warrant a formal proposal recommending its protection, but it was not until 1960 that the Chinese government acted on the proposal and established the Tian Mu Shan Nature Reserve, encompassing one thousand hectares on the south-facing slope of its western peak.

Despite the establishment of the Tian Mu Shan Reserve, questions about the "wildness" of the *Ginkgo* population have persisted. A detailed census of the population published by the Zhejiang Forestry Bureau in 1984 concludes that the *Ginkgos* are wild, as does Ling Hsieh of the Zhejiang Forestry Bureau (1965). Wang and Chen (1983) and Chen (1989), on the other hand, doubt the wildness of the trees, suggesting instead that they are the offspring of plants that were cultivated in the vicinity of an ancient temple located near the top of the mountain. One

recent report by Wang and his colleagues (1986) concludes ambiguously that "The question of whether this area is part of the natural distribution of wild *Ginkgo* needs further study."

The Tian Mu Shan Environment

At 1506 meters in elevation, the main peak of Tian Mu Shan (119° 25′ E; 30° 20′ N) is one of the highest mountains in Zhejiang Province (Figure 1). The steep slopes are crisscrossed with a network of streams and ridges that create a mosaic of sheltered valleys and exposed cliffs. Subtropical evergreens, typical of south China, mingle with temperate conifers and deciduous plants on the slopes of the reserve, resulting in an exceptionally rich flora consisting of some 1,530 species of vascular plants (Zhejiang Forestry Bureau, 1984; Zheng, 1986). Three distinct vertical zones of vegetation have been described on Tian Mu Shan: (1) between 380-800 meters, a mixed subtropical forest with a canopy of conifers, broadleaf evergreens, and deciduous trees; (2) between 800-1200 meters, a warm-temperate forest with a canopy of conifers and deciduous trees and a subcanopy rich in broadleaf evergreens; and (3) between 1200-1506 meters, a deciduous dwarf forest with a canopy of stunted trees and shrubs.

In addition to its rich species diversity, Tian Mu Shan is also noted for its exceptionally large trees. According to the only published census of the reserve, prepared by the Zhejiang Forestry Bureau in 1984, the most common large tree species is *Cryptomeria japonica* var. *sinensis*, of which there are 398 individuals with a diameter at breast height (DBH) greater than one meter. *Pseudolarix amabilis*, the golden larch, also grows wild on the mountain with some 98 individuals with a DBH greater than half a meter and heights mainly between 40 and 50 meters. Most notably, there are 244 large individuals of *Ginkgo biloba* growing throughout the reserve with a mean DBH of 45 centimeters and a mean height of 18.4 meters. According to the Zhejiang Forestry Bureau report about ten percent of the *Ginkgo* population is estimated to be over a thousand years old.

Along with these three gymnosperms, exceptionally large *Torreya grandis*, *Liquidambar formosana*, *Nyssa sinensis*, *Cyclocarya paliurus*, *Litsea auriculata*, and *Emmenopterys henryi* are also common in the woods, as well as extensive stands of the timber bamboo, *Phyllostachys pubescens*. Three plants are recognized as endemic to Tian Mu Shan, and a total of twenty-nine taxa growing within the reserve are included in Volume One of the *Plant Red Data Book* of rare, endangered, and threatened plants of China (Zheng, 1986; He et al., 1987).

Human Activities on Tian Mu Shan

Located just ninety-four kilometers west of the ancient and populous city of Hangzhou, Tian Mu Shan has been visited by monks, herbalists, poets, botanists, and tourists for close to fifteen hundred years. The most famous structure on the mountain, at 1,020 meters elevation, is Kaishan temple built by Buddhist monks between 1283-1287. Around 1665, a second temple, Chanyuan, was built at 330 meters. Other smaller temples and shrines are located elsewhere on the mountain.

In 1941 the Japanese army invaded the area, bombing the mountainside and ransacking Chanyuan temple. In 1958, during Mao Zedong's "Great Leap Forward," many of the trees in the forest were cut down to make charcoal. When the reserve was established in 1960, only the relatively undisturbed south-facing slope of the west peak was included within its boundaries. Between 1960 and 1965 considerable clean-up was done in the reserve, including the planting of more than a hundred *Ginkgo* seedlings just above the main gate. Maintenance of the reserve was suspended during the ten years of the "Cultural Revolution," from 1966 to

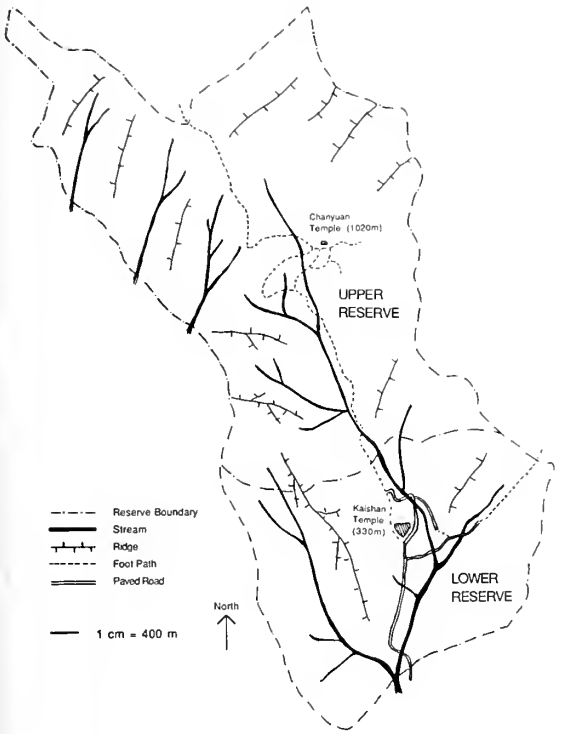

Figure 2. Map of the Tian Mu Shan Nature Reserve. Located on the south-facing slope of the west peak of Tian Mu Shan, the total area of the upper reserve is 652 hectares and the lower reserve 366 hectares.

1976, and effective protection was not achieved until 1982 when construction of the reserve headquarters was completed. Unfortunately, the forests surrounding the reserve are not protected and, as of 1989, they were rapidly being cut, primarily for charcoal manufacture by the local population.

Administratively, the reserve is divided into two sections: the *lower* reserve, covering 366 hectares, which includes the lower Chanyuan temple, numerous hotels, houses and the reserve headquarters. (With the exception of the temple, all of the other buildings were built after 1960.) The *upper*, "special," reserve, consisting of 652 hectares, has experienced relatively little disturbance in comparison (Figure 2). The upper reserve covers both sides of a sheltered valley that extends from 420 meters to the summit at 1506 meters. A stone path, built about a hundred years ago, follows the course of the main stream, crossing it several times, to Kaishan temple. Portions of this path are lined with large *Cryptomerias* that were probably planted at the time of its construction (Del Tredici, 1990). Beyond the temple a narrow footpath leads to the summit where an army weather station is located.

The *Ginkgo* Population

In October, 1989, the author, along with two Chinese collaborators, Ling Hsieh of the Zhejiang Forestry Department and Yang Guang of the Nanjing Botanical Garden, counted the *Ginkgos* growing in the reserve. During the course of our work, we walked all the paths and trails in the reserve and measured and mapped the locations of all the *Ginkgos* that we could locate. *Ginkgo* leaves were turning yellow when we were there, making it easy to locate the trees even at some distance. To be on the conservative side it can be said that we located all the *Ginkgos* within fifty meters of the extensive network of paths.

We measured the DBHs of all trunks greater than 10 centimeters and estimated the heights of all the trees. Unfortunately, the steep terrain of the site and the fact that the top of many trees could not always be clearly seen made accurate height measurements difficult. Under every tree we also made a thorough search of the immediate vicinity for intact seeds or the remains of seeds and for the presence of seedlings. For the purposes of our study, we divided the *Ginkgos* into two groups, those in the upper reserve, which have experienced little disturbance due to human activities, and those in the lower reserve, which have experienced much more human disturbance.

We found a total of 167 spontaneously growing *Ginkgos*, with a mean DBH of 52

Figure 3. Professor Ling Hsieh is dwarfed by Ginkgo *#42, located in the upper reserve. It consists of three large trunks 106.7, 85.3, and 61.8 centimeters in diameter and innumerable small suckers.*

centimeters during the course of the survey, a figure considerably lower than the 244 trees found by the Zhejiang Forestry Bureau in 1984. No doubt this discrepancy is due to our brief stay in the reserve. In ten days' time we did not locate some of the trees that were growing more than fifty meters away from the paths. In the upper reserve, where 72 trees were located, the *Ginkgos* were most common on disturbance-generated microsites, including stream banks, rocky slopes, and the edges of exposed cliffs, all locations where the effects of soil erosion were readily apparent. With the exception of three large trees growing in front of Kaishan Temple, none of the *Ginkgos* in the upper reserve appeared to have been planted. In the lower reserve, where signs of human activities were much more common, many of the 95 censused trees were obviously planted.

The largest *Ginkgo* in the upper reserve had a DBH of 123 centimeters and in the lower reserve it was 121 centimeters. The heights of the larger trees were quite variable, with a maximum of just over 30 meters. The *Ginkgos* were growing between 330 and 1,200 meters elevation, where the terrain has an average slope of seventeen percent. Despite reports of *Ginkgo* seedlings in the woods, we were unable to locate a single plant with a basal diameter less than 5 centimeters. There were only three trees with a basal diameter between 5 and 10 centimeters in the upper reserve, and only two trees within that range in the lower reserve. Clearly the *Ginkgo* population was not actively reproducing from seed under the shady, mature forest conditions that currently prevail on the mountain.

The most striking feature of the Tian Mu Shan *Ginkgos* was the multistemmed form of many of the larger trees (Figure 3). One individual, growing on the edge of a steep cliff at 950 meters occupied a total surface area of approximately twelve square meters and consisted of fifteen stems larger than 10 centimeters DBH (Figure 4). In contrast to such multistemmed trees that were common in the woods, the three cultivated *Ginkgos* growing near the Kaishan temple were all single-trunked specimens. In the upper reserve fifty percent of the *Ginkgos* had at least two trunks greater than 10 centimeters DBH, while in the lower reserve, the figure was one-third. Of these 67 multistemmed trees, the primary trunk was intact in seventy-three percent, clearly indicating

Figure 4. The author standing next to the "living fossil" Ginkgo *on Tian Mu Shan. This ancient ovulate tree occupies an area of approximately twelve square meters and consists of fifteen stems greater than ten centimeters in diameter. The fence protecting both the tree and the tourists was built in 1980.*

that logging in the area is not the primary cause of secondary sprouting (Figure 5).

Vegetative Reproduction From Basal Chichi

While we could find no signs of recent seedling reproduction on Tian Mu Shan, most of the larger *Ginkgos* were reproducing vigorously from suckers arising near the base of their trunks. In some cases these basal suckers came out of the ground anywhere from two to twenty centimeters away from the trunk, and in others they were attached to large rhizomelike structures that originated from the trunk at ground level. Wherever the base of the trunk of a large *Ginkgo* came into direct contact with a large rock or where its base was exposed by erosion, these structures developed. They either enveloped the rock or grew around it, extending up to two meters from the parent trunk (Figure 6). When these growths reach friable soil, they produce lateral roots, develop vigorous, vertically growing shoots, and continue their downward growth.

Superficially, these structures resemble the well-known "air-roots" produced on old cultivated trees, called "chichi" (nipple or breast) in Japan and "zhong ru" (stalactite) in

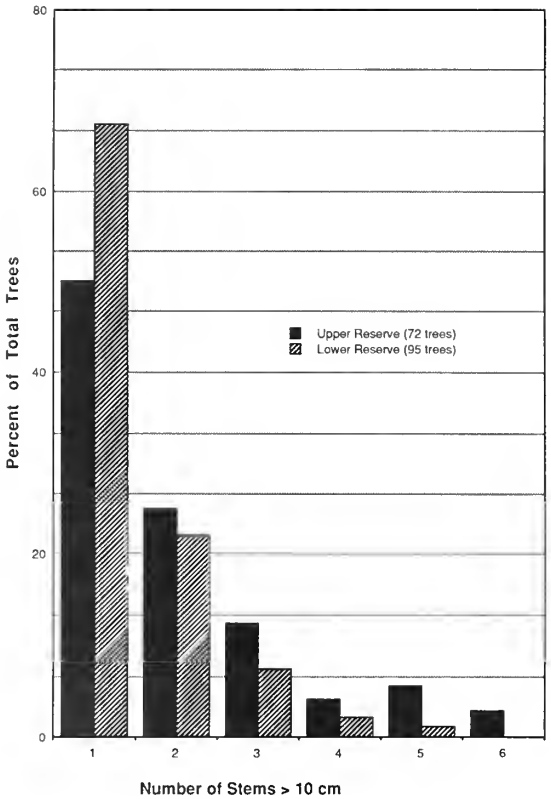

Figure 5. The distribution of the number of stems greater than ten centimeters for 167 Ginkgos *on Tian Mu Shan. Forty percent of the population had more than one stem greater than ten centimeters diameter.*

China. These unusual, downward growing burls form along the underside of large lateral branches. The first anatomical description of chichi was published by Fujii in 1895, who considered them a "pathological formation" that developed in association with an embedded shoot bud.

The only chichi that we saw on the Tian Mu Shan *Ginkgos* were those that originated from the base of trees, particularly those that had experienced damage due to erosion or logging. These growths should be called "basal chichi" to distinguish them from the more familiar "aerial chichi" described above. The strongly clasping nature of this unique structure helps the species survive on sites where disturbance to its root system is a common phenomenon, and no doubt they play a crucial role in the long-term persistence of the species on such sites. Based on subsequent greenhouse work with cultivated seedlings, I have been able to demonstrate that basal chichi develop from suppressed cotyledonary buds (Del Tredici, 1992).

Seed Production and Predation

According to the reserve records, 1989 was a light year for seed production on Tian Mu Shan. In our census work we found intact seeds or the remains of seeds under 54 of 167 trees (32%). Seed drop typically occurs during the last two weeks of September on Tian Mu Shan, depending on the weather. By the time of our arrival on October 3, very few seeds were left on the trees, and we were able to collect more than a hundred seeds from under only two trees. It turns out that most of the nuts had been collected before our arrival by the local populace. The fact that people have been living in the Tian Mu Shan area for at least a thousand years and that *Ginkgo* nuts have long been considered a valuable food and medicine (Li, 1956; Del Tredici, 1991) suggests that the collection of seeds by people could well be an important factor limiting seedling establishment on Tian Mu Shan.

Under every tree that produced seeds in 1989 we found probable signs of feeding activity by the locally abundant red-bellied squirrel (*Callosciurus flavimanus* var. *ningpoensis*). The fleshy outer coat of the seed, which is notoriously foul smelling and can produce a skin rash in animals as well as people, had been pulled off and left uneaten while the edible kernel was consumed, leaving only fragments of the sclerified shell behind. Since we never actually saw squirrels eating or "scatterhoarding" *Ginkgo* seeds, however, their potential role as dispersal agents of *Ginkgo* seeds is still unclear.

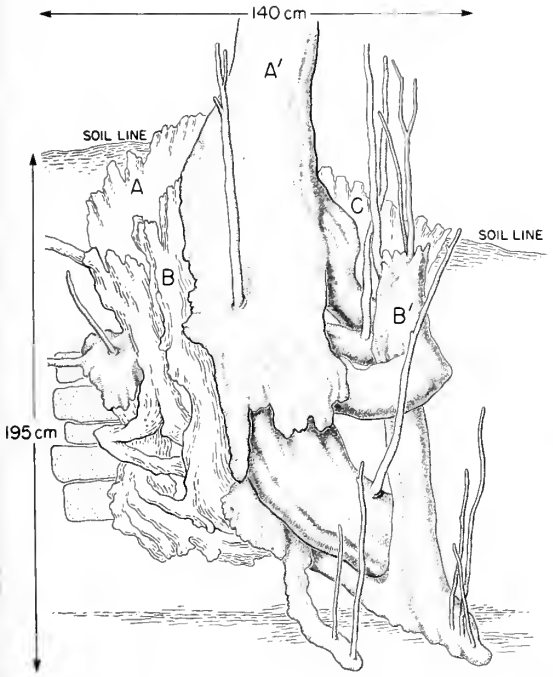

Figure 6. The chichi-developed shoot system of Ginkgo *#163, probably planted, growing over the face of an old rock wall in the lower reserve. At least three generations of stems can be seen: the oldest represented by the cut trunks A, B, and C (diameters = 55, 40, and 37 centimeters); the second by the living trunks A' and B' (diameters = 26 and 20 centimenters); and the third by suckers arising from the zone of active chichi proliferation (stippled). Drawing by Laszlo Meszoly, based on photographs by the author.*

Long-time workers in the reserve reported that a "catlike" animal with a long, thick tail also eats *Ginkgo* seeds in their entirety, vesicatory seed coat and all, and that some of the seeds pass through its digestive system intact. While we did not ourselves see the animal or any signs of its feeding, the workers were probably referring to *Paguma larvata*, the masked palm civet (Viveridae), an omnivorous carnivore (Nowak, 1991) (Figure 7). Interestingly, in the only other study of a "semiwild" *Ginkgo* population located in Hubei Province, Jiang and his colleagues (1990) reported observations of local peasants that the leopard-cat, *Felis bengalensis*, consumes *Ginkgo* seeds and that some of the nuts pass through the cat's digestive system undamaged. The existence of these two independent reports of members of the Carnivora consuming intact *Ginkgo* seeds raises the interesting possibility that the foul smell of the rotting seed coat may be attracting dispersal agents by mimicking the smell of rotting flesh, making *Ginkgo* a carrion mimic, if you will!

Figure 7. The masked palm civet, Paguma larvata. *Photo reprinted with permission from* Walker's Mammals of the World *by R. M. Nowak.*

Conclusions

Because *Gingko* is an economically important plant and because Tian Mu Shan has been the site of human activities for approximately fifteen hundred years, it is very difficult, if not impossible, to resolve the long-standing argument about the wildness of the *Ginkgo* population. In many ways the debate has more to do with the definition of the term "wild" rather than with the biology of the plant itself. Such semantic considerations should not be allowed to obscure the important biological implications of the Tian Mu Shan *Ginkgo* population that have existed as part of a complex, natural community for a least a thousand years (Figure 8).

More than any other factor, the presence of Kaishan temple has raised doubts about

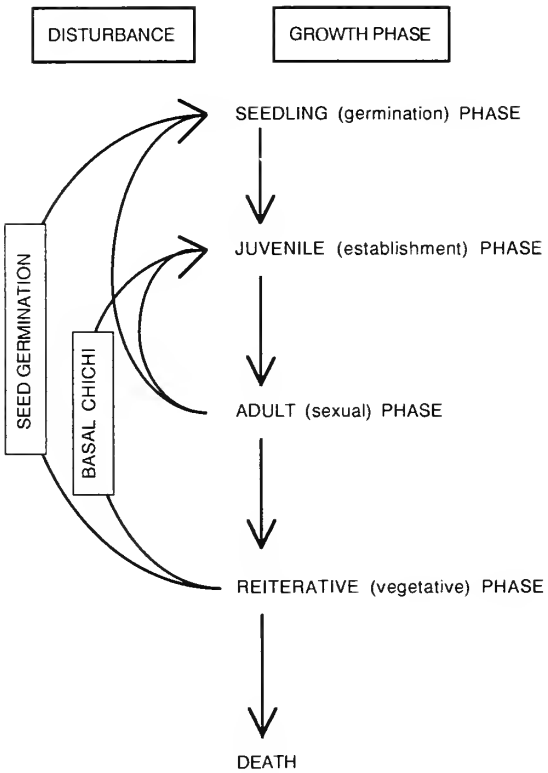

Figure 8. A schematic representation of the life cycle of Ginkgo biloba *on Tian Mu Shan.*

the origin of the *Ginkgos*. In this regard, however, Hui-lin Li has pointed out that throughout China such temple sites were initially selected because of their great scenic beauty, and that the forests surrounding them were secondarily preserved by resident monks—both Taoist and Buddhist. The fact that some of the large *Ginkgos* and *Cryptomerias* in the reserve were planted by humans should not be interpreted to mean that all of them were. Such guilt by association may be the cautious position, but it is not necessarily the correct one. Away from the paths, at elevations between 800 and 1,200 meters, there is little indication that the surrounding woods have been disturbed by humans, and the *Ginkgos* that are growing there, by virtue of their size and their multistemmed growth form, give the distinct impression of being wild.

The significance of the lack of *Ginkgo* seedlings in the reserve is also difficult to interpret. On the one hand it might be seen as evidence that *Ginkgo* is not native to the area, but on the other it can be viewed as evidence that *Ginkgo* does not reproduce from seed under the closed canopy conditions that now prevail on Tian Mu Shan. This latter suggestion is supported by the 1990 report on the "semiwild" *Ginkgo* population in Hubei Province, in which Jiang and his colleagues from the Wuhan Institute of Botany concluded that *Ginkgo* is a high light-requiring species and that seedling establishment occurs only in those portions of the forest where the canopy had opened up.

While it is difficult to answer with certainty the question of whether the *Ginkgo* population on Tian Mu Shan is "truly" wild, it is clear that the phenomenon of secondary trunk formation from basal chichi is an important factor in explaining the species' long-term persistence on the mountain. It is also possible that vegetative reproduction from basal chichi may have played a significant role in the extraordinary persistence of *Ginkgo* throughout geological time.

Acknowledgments

This article was excerpted from a more detailed study, "The Ginkgos of Tian Mu Shan," written by P. Del Tredici, H. Ling, and G. Yang, published in *Conservation Biology* 6: 202-209 (1992).

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Peter Del Tredici is Assistant Director for Living Collections at the Arnold Arboretum.

The Convenience of *Arabidopsis*

Elizabeth A. Kellogg

It's small, it's plain, it's absolutely ordinary, but it's become one of the most popular lab plants around. It's *Arabidopsis thaliana*, and its most important characteristic is that it's handy.

Scientists have a long tradition of working with the handy stuff, literally the things close at hand, to answer questions about phenomena that are otherwise inaccessible. Charles Darwin opens *The Origin of Species* with a chapter that describes in some detail breeding experiments on pigeons. Pigeons were convenient and served as a model. If people could select pigeons for complex characteristics, Darwin reasoned, then nature could select other organisms the same way. Hence, evolution by natural selection: an all-encompassing theory supported in part by experiments on the very plain, thoroughly homely pigeon.

Using whatever's handy is of course an art fully exploited by schoolteachers. If they want to make a mask or a turkey, they use a paper plate. An egg carton does fine for an alligator (or stegosaurus or a bouquet of flowers), and noodles are clearly necklace material. Lab scientists use a lot of those same items. Just like Charles Darwin and schoolteachers everywhere, we work with whatever's handy.

One common procedure in molecular biology labs, called Southern blotting after the man who invented it, is carried out in Tupperware containers. Rubbermaid does fine, too; the lid just has to be watertight. This same procedure can be done with specialized chemicals like dextran sulfate—dextran sulfate being notable because it costs about $400 a pound—but for many purposes ordinary powdered milk from the supermarket works just fine. The standard procedure then involves washing a bit of high-tech nylon membrane in powdered milk in a plastic kitchen container. When the procedure is finished the piece of nylon is wrapped in Saran Wrap. (In fact, in the standard chemical stockroom Saran Wrap is on the shelf right next to all the fancy chemicals.) This procedure is like many others in research; for some purposes only a very particular tool will do (like the special bit of nylon membrane), but there are many cases where you can simply use what's handy.

This same "principle of handiness" applies to choosing organisms to study, especially in the rapidly growing field of plant molecular biology. People who study plant molecular biology are trying to understand exactly how plants work, down to the details of the DNA that make up their genes. Because almost anything they discover will be new, several plants are equally good to begin working on. So why not start with the most convenient? I currently make my living studying genetic relationships in the wheat tribe, a group that

Arabidopsis thaliana. *Photo and © by Kurt Stepnitz, MSU/DOE Plant Research Laboratory.*

includes barley and rye and a lot of other species, many of them native to Mongolia, Turkey, and the Mideast. It happens, however, that three wheat-related species are weeds that grow near the parking lot of the Harvard Bio Labs, and another grows next to the playing fields in my Cambridge neighborhood. It's obvious which ones I looked at first. As the study has progressed I have had to seek out the less accessible members of the group to fill in the story, but the starting point was arbitrary and determined as much by convenience as by logic. That's the major attraction of *Arabidopsis thaliana* to molecular biologists.

It does have a common name—mouse ear cress—but it's rarely used. The plant has no horticultural value. It isn't edible. But for some purposes it is very convenient, and it has thus become important because of its value as a scientific tool, analogous to the fruit fly (*Drosophila*).

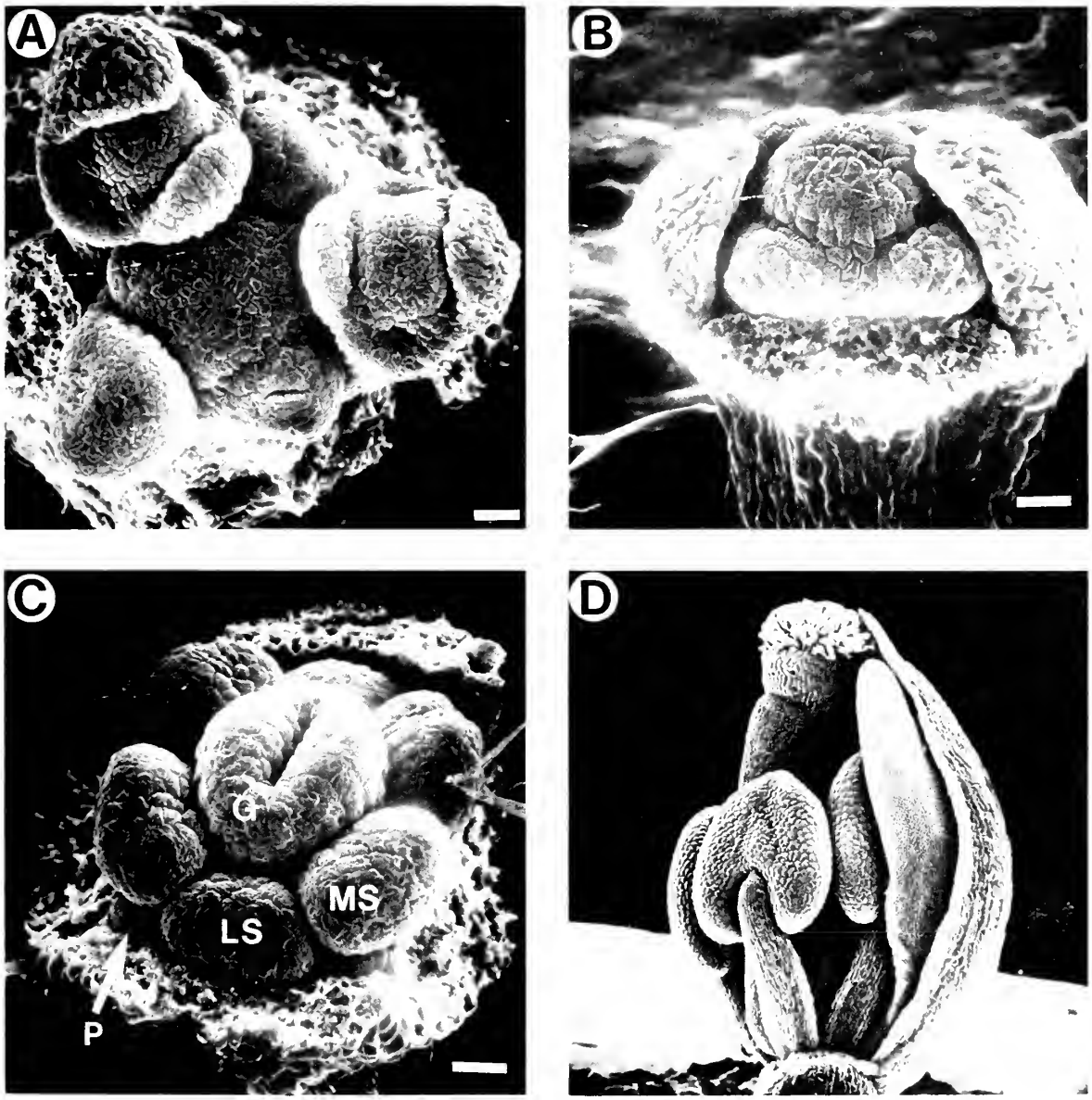
Arabidopsis thaliana is a tiny relative of the cabbage and part of the same family, commonly known as the mustard family and botanically as Cruciferae or Brassicaceae (either name is acceptable). At maturity it is about eight inches tall. It can be germinated by the hundreds on petri plates. Populations of thousands of plants fit easily on one greenhouse bench. The generation time (seed to seed) is about three months. Compare this to that other workhorse of the plant genetics world, maize. Maize plants are large, well over eight inches tall, and planting thousands requires acres of land and scientists with strong backs. The generation time is about six months, but to get two generations a year requires that you plant one winter crop in Hawaii. *Arabidopsis* clearly has a logistical advantage, although you do lose the excuse to winter in Hawaii.

Arabidopsis is also handy in that its internal workings, its genetic machinery, are unusually simple. No extras, no add-ons, no window dressing. One scientist, Dr. Jerry Fink of the Whitehead Institute, has described it as the plant equivalent of a Hyundai. For many studies this makes it the plant of choice. The Boston Area *Arabidopsis* Group alone includes sixty or so scientists who specialize in topics such as hrp, GA, auxin, rubisco activase, and ribozymes.

Most of these formidable-sounding specialities have direct applications to understanding the crop plants that feed humanity. Hrp, for example, is a gene or set of genes involved in the plant's response to a pathogenic fungus or bacterium. If we know exactly how plants respond to pathogen attack and what allows some plants to resist some pathogens, then we might be able to find ways to reduce our dependence on the toxic chemicals that are now used to control damage by plant pests and to engineer resistant crop plants. GA and auxin are plant hormones that control the rate and timing of growth and development. It's all basic research, the fertile ground that fosters direct applications.

So it is that a modest weed is achieving an eminence formerly reserved for crop plants. There are seedbanks that store *Arabidopsis* seed, there is an *Arabidopsis* newsletter and an *Arabidopsis* Information Service as well as an *Arabidopsis* Research Initiative. It is becoming, in its own curious way, economically important.

There are, of course, questions that *A. thaliana* can't help us with. Since we know almost nothing about the relatives of *Arabidopsis* and very little about its natural history, it is almost useless in studies of evolution within the mustard family. It has, however, become a big part of one story that promises to tell us a lot about the evolution of flowers and their multiple forms. If you look closely at a developing flower during the very early stages when it is best seen with an electron microscope, you will see tiny nubbins for all the floral parts. In *Arabidopsis* there are four that will be sepals, four that will become petals, six stamen nubbins, and two carpels that will form



Scanning electron micrographs of a developing Arabidopsis *flower. A. The top of the inflorescence and flower buds. B. A flower bud with one sepal removed to show nubbins that will become stamens; the mound in the center will become the pistil. C. A flower at a slightly later stage. P = petal; LS = lateral stamen; MS = medial stamen; G = gynoecium (pistil). D. A flower bud shortly before opening. Some of the sepals and petals have been removed. Note that the stamens have not yet elongated fully. Bar = 10 mm in A, B, and C; 100 mm thick. Photographs reproduced with permission from Bowman et al.(1992).*

the two halves of the ovary. Scientists in a California lab headed by Elliot Meyerowitz have found the chemical signals that tell the various nubbins how they should develop. Altering these chemicals can make the stamens turn into petals, or the petals turn into stamens, or even turn all the flower parts into leaves. (This last idea—that flower parts can be viewed as modified leaves—was first suggested in the eighteenth century by the German poet Goethe.) Comparing work on *Arabidopsis* with studies done on snapdragons shows that similar substances appear in other dicot flowers as well. It is now a tantalizing possibility that these chemicals may be involved in generating some of the startling diversity of floral form that we enjoy in our gardens, fields, and forests.

Scientific papers are typically written as though the scientist had thought of an unanswered question, carefully designed an experiment, chose a perfect model system, and concluded with a formal and thoroughly rational analysis. (This, incidentally, was not the structure used by Darwin.) Such papers are fairly easy to read once you get the hang of it, although rarely as pleasurable as *The Origin of Species*. The style of the scientific paper is simply a late-twentieth-century convention. Unfortunately, it obscures the way that science actually works, the way decisions are made and directions taken. There is a lot of serendipity involved. There are insights from chance conversations, opportunities created by particular combinations of people, place, and time. And there is the very practical tendency to grasp the tools at hand.

Reference

Bowman, J. L., H. Sakai, T. Jack, D. Weigel, U. Mayer, and E. M. Meyerowitz. 1992. SUPERMAN, a regulator of floral homeotic genes in *Arabidopsis*. *Development* 114: 599-615

Elizabeth Kellogg is Research Associate in Organismic and Evolutionary Biology at Harvard University and an Associate of the Arnold Arboretum.

The Flying Dogwood Shuttle

Sheila Connor

In earlier times it was the strength and durability of dogwood, not its beauty, that attracted attention.

Right up to the end of World War II the production of wooden goods played a major role in the New England economy. While fuel wood, pulpwood, and lumber for ties, poles, and beams left the forest or sawmill in rough form, a thriving concentration of regional industries converted forest resources into more finished "secondary" products. The shuttles, spools, and bobbins manufactured for the textile mills as well as the lasts and fillers destined for shoe factories were not only made and used in New England but were also exported worldwide. And all of New England's products—wooden or not—were packed and shipped in pine crates and excelsior out of mills from Maine to Connecticut.

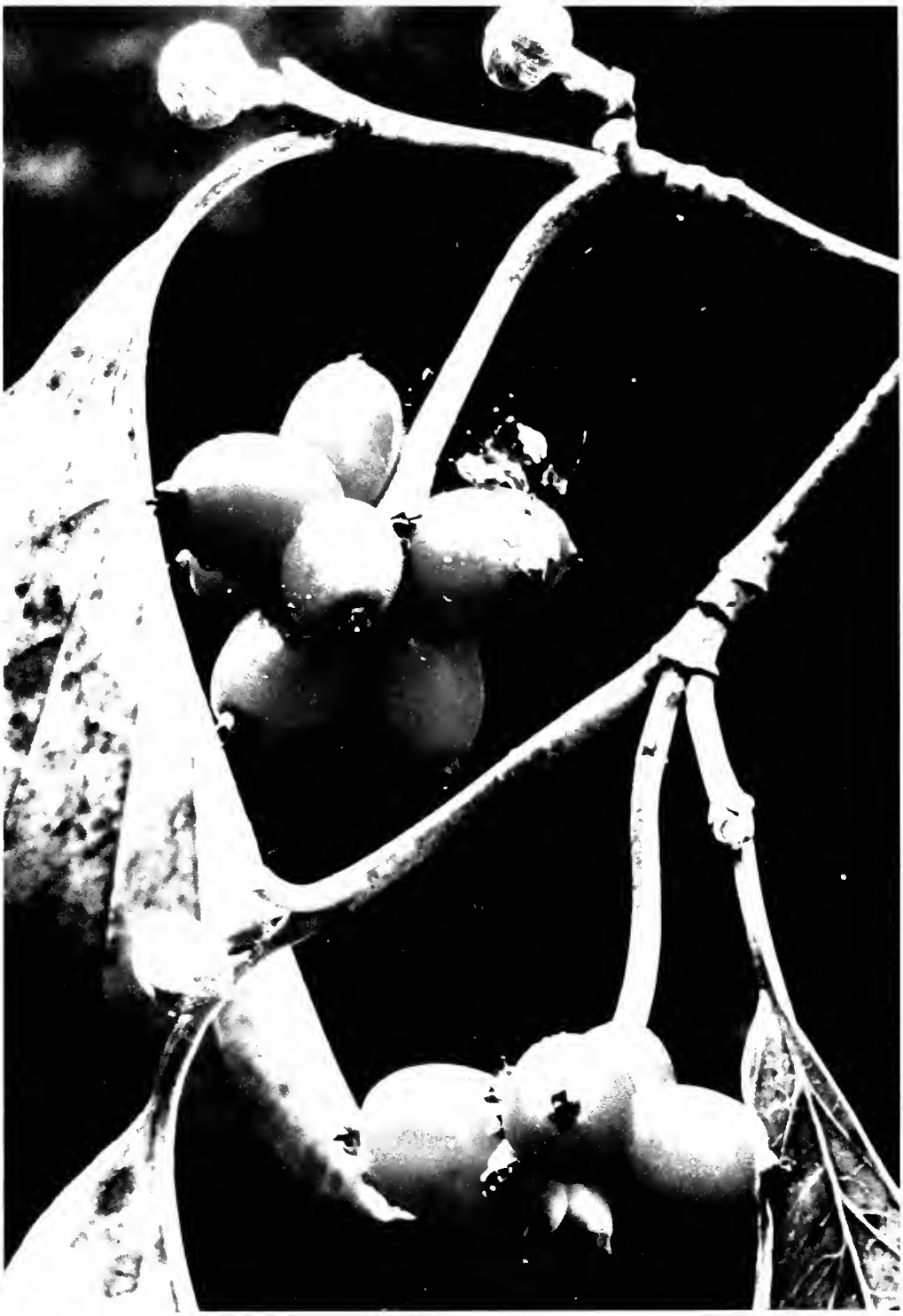
By the 1960s, textile and shoe manufacturers had all but forsaken New England. Like their predecessors the tanning, naval stores, and shipbuilding industries as well as the arms and charcoal makers, they had ceased to be great consumers of wood. New technologies evolved, and just as large-scale manufacturing dwindled in New England, so too has the role of wood. The age of the plastic "peanut" has no need for paper packing or its nearly forgotten precursor, the wonderfully fragrant excelsior. Pocket calculators have completely replaced rock-maple and even plastic slide rules. Cedar and spruce canoes are made of Kevlar and fiberglass; and baseball bats, formerly made of ash, are now fabricated in aluminum.

Working with wood once meant dealing with either the whole tree or with products made from portions of its trunk, and the qualities specific to each species—its capacity to bend, its moisture content, hardness, strength, or brittleness as well as its ability to hold nails, take paint, and saw easily—determined which trees were used. One such tree, the native flowering dogwood, *Cornus florida*, is now best known for its beautiful spring blossoms. But in earlier times it was the strength and durability of its wood, not its beauty, that attracted attention.

The Demand for the Dogwood Shuttle

For over a century, the dogwood's usefulness to the nation's textile industry would compete with its value as an ornamental tree. From the American Industrial Revolution's northern beginnings until long after most textile manufacturers moved their operations south and left New England's mills standing silent, the wood of the flowering dogwood was an intrinsic part of the weaving process. In the complex process of weaving cloth, one simple device remained unchanged: the fast-flying, bullet-shaped shuttle made of dogwood.

The first shipment of dogwood logs bound for England left America in 1865. After their arrival, it is presumed that these logs were cut, seasoned, and turned into shuttles for England's textile mills. Up until midcentury, boxwood (*Buxus sempervirens*) shuttles had



been the mainstay of the industry, but as the lumber needed for shuttles rose proportionally to the number of looms in operation in the Northeast and in England, the American tree became a popular substitute. By the third quarter of the nineteenth century, the use of dogwood had increased markedly.

The wood of flowering dogwood is hard, heavy, tough, close-grained, and abrasion-resistant. When textile manufacturers realized that the longer a dogwood shuttle was in use the smoother its satiny wood became, dogwood became the wood of choice. Smoothness rose to top priority soon after John Kay, an English carpet weaver, invented a mechanized shuttle in 1733. Prior to Kay's invention, almost any hardwood made a satisfactory shuttle; hand weavers simply passed the small, oblong piece of wood that held the bobbin from one hand to the other. As a weaver of carpets, Kay had to deploy two workers, one on either side of his large, oversized looms, to toss the shuttle back and forth. Besides requiring two people for the work of one, the shuttle often dropped uncaught onto the warp threads, damaging the fabric and stopping the loom. Inspired, no doubt, by clumsy workers, Kay devised a driver attachment controlled by a cord that propelled the shuttle from one side to the other. But because the shuttle now remained in contact with the warp threads as it shot back and forth, a wooden shuttle that checked, split, or had rough edges was worse than useless. Kay's invention, aptly called the flying shuttle, was the first step in the automation of weaving.

The bullet-shaped weaving shuttle made of dogwood was prized for its satiny smoothness. Photo by the author.

The Lowell Mills

The first American mill to produce shuttles began operating in Lowell, Massachusetts, in about 1875. Like its English counterparts, the Lowell mill acquired dogwood logs from the forests of Virginia. Flowering dogwood grows in the wild from extreme southwestern Maine southward into northern Florida. Even in the center of its commercial range, which is in the southern Mississippi Valley and the southern Appalachian Mountain region, this tree is seldom found growing in pure stands. In the years of its commercial use, woodcutters had to scour between ten and fifteen acres of forest before finding enough flowering dogwoods to harvest a cord of wood. While it is not rare in eastern Massachusetts, this small understory tree appears with greater frequency in the Connecticut River Valley and in Rhode Island and Connecticut.

The fruits and flower buds of Cornus florida.

THE PLYMPTON SKATE.

The Plympton Skate is too well known to need any extended description, having been used in rinks for nearly twenty years. We are now prepared to offer this skate to the trade and to rinks at a price corresponding with other skates on the market.

Sizes from 7 1-2 to 11 1-2. Price, per pair, $3.00.

Price List of Parts.

Ebonized Foot Boards	per pair,	$0 40
Heel Straps	"	35
Toe "	"	35
Heel Bands	each	7
Trucks	"	20
Hangers	"	20
Steel Axles	"	10
Turkey Boxwood Wheels	"	5
Cotters	per 100,	35
Large Screws	each,	3
Rubbers	per doz.,	35
Double Rivet Buckles	per gross,	1 50

Although boxwood was used in the original Plympton Skate, as shown here in an 1884 advertisement in Spalding's Manual of Roller Skating, *it was soon replaced by the stronger, more durable dogwood. The roller skate was invented by furniture manufacturer James Leonard Plimpton. Having enjoyed a winter of ice skating in Central Park, he was determined to continue skating year-round. Within one year he had invented and patented his roller skate, organized the New York Roller Skating Association, and undertaken a promotion campaign directed at the "educated and refined class."*

By 1926, ninety percent of the flowering dogwood harvest went into shuttles. Most were manufactured in Massachusetts and Rhode Island, and over half were exported to Germany, France, and Great Britain. In 1942, demand for military cloth and war-use textiles heightened the need for shuttles to the point that the country ran out of reserve supplies. The U.S. Department of Agriculture issued a plea for harvested dogwood, noting that although many substitutes had been tried, no wood with similar qualities had been found. Farmers and woodlot owners were urged to contact block mills or buyers to arrange for the sale of marketable trees.

As late as 1945 a U.S. Department of Agriculture publication commented, "Shuttles are indispensable to the cotton, woolen, and silk mills of the country." Plastic shuttles replaced wooden ones shortly thereafter, but they didn't last long. New shuttleless looms were designed, and within a generation New England mills still using the old machines were antiquated, surpassed by their southern competitors. Except for artisans who use hand looms and a few specialty weavers who create one-of-a-kind fabrics on older wooden power looms, fabric is now woven entirely by shuttleless looms. Flying shuttles made of satin-smooth dogwood have become a thing of the past.

The Future for New England Forest Products

Today new methods for processing wood and tree products determine how many New England species are used. In some cases, these advances have permitted the substitution of one wood (or a combination of woods) for another. The development of durable synthetic resin adhesives during World War II expanded and redefined an entire range of wood-based products. Glue-laminated timbers, exterior plywood, and sandwich panels (two thin facings of wood bonded to a thick core of weak and low-density material such as rubber foam, foamed glass, cloth, metal, or even paper) increased the capacity of wood to bend, weather, and provide thermal insulation. It even makes the wood more fire resistant.

Raw materials need not come from the forest in log form: particleboard, flakeboard, waferboard, and oriented stand board all use wood that is first reduced to small fragments and then bonded. Sawmills no longer create waste; every part of a log is usable, whether as bark, chips, or sawdust. And coarser

NEWS

from the Arnold Arboretum

A Rhododendron Display Garden for the Case Estates

Robert E. Cook, Director

Rhododendron 'Album Elegans'

Last November, after more than a year of discussion, I signed a collaborative agreement with the Massachusetts Chapter of the American Rhododendron Society that will permit the Society to develop a five-acre display garden at the Case Estates in Weston, Massachusetts. This agreement facilitates a long-standing partnership to grow and display the finest rhododendrons hardy in New England. The Society now plans to expand its collections with examples of the work of prominent New England hybridizers such as Ed Mezitt of Weston Nurseries.

For over a decade the Arboretum has struggled to justify the annual expenditure of approximately $150,000 for the maintenance of the land and buildings of the Case Estates, which was donated to the Arboretum nearly half a century ago. Located ten miles from our living collections in Jamaica Plain, the Estates was used many years ago as a suburban nursery for plants propagated in the greenhouses at the Arboretum. During the many years when Dr. Donald Wyman lived in one of the houses there, he established display collections of horticultural cultivars throughout the landscape. In 1978, several years after the retirement of Dr. Wyman, the collections policy of the Arboretum was thoroughly revised to concentrate on wild-collected species (rather than cultivars), a change consistent with the original intentions of Charles Sprague Sargent, the director of the Arboretum for its first fifty-five years.

By the 1980s, the container production of propagated plants on site at the Arboretum was far more

(continued on page 2)

(continued from page 1)

efficient than transport to and from a suburban nursery. Forty acres of fallow Case Estates land was sold to the Town of Weston in 1985. In 1988, a new mission statement for the Arboretum contained no explicit goal to develop display collections of horticulturally interesting cultivars. Consequently, in 1991, I relocated the grounds staff from Weston to our primary collections in Jamaica Plain. We now manage the Estates' land through a local landscape contractor, and we continue to hold horticultural classes there.

Despite this changing role for the Case Estates, many people missed the pleasures of horticultural display collections there. Now the license with the Rhododendron Society allows an organization whose mission is dedicated to cultivars and their display to develop a landscape garden without great cost to the Arboretum. Although we receive no financial benefit from allowing this use of the land, we will be able to incorporate the Society's collections into appropriate classes in our education program. Because the display garden will be open to the public free of charge, it will surely make a real contribution to gardening and horticulture in New England.

Bob Cook

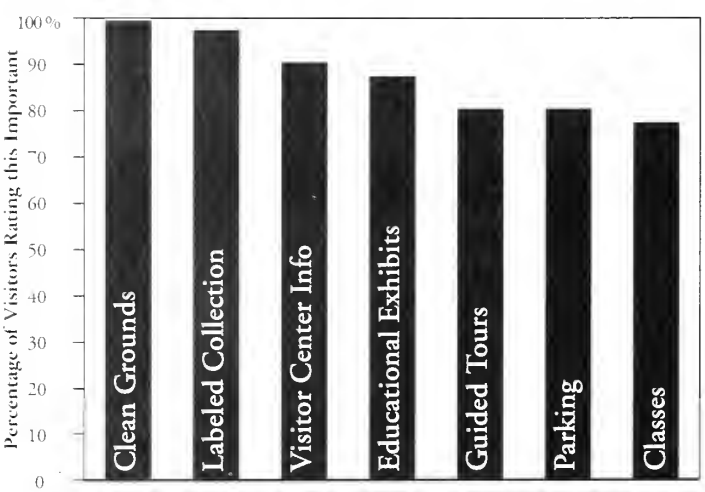
Visitor Survey

What do visitors value most about the Arnold Arboretum? How do people get here, and what are their needs and interests once they arrive? To find the answers to these and other questions, Arboretum staff, volunteers and Rangers from the Olmsted National Historic Site surveyed the interests and impressions of over five hundred visitors during a six-week period in the spring in 1992. Visitors were asked to respond to a questionnaire on basic demographic information—age, zip code, visit frequency—as well as a range of questions on what they enjoy about the Arboretum and what they'd like to see in the future.

Coordinated by staff member Jim Gorman, the survey provided some invaluable information about the Arboretum visitor. We discovered, for instance, that during the study period a full 70% of our visitors came by automobile, 15% by foot, 9% used public transportation, and 6% came by bicycle. And what was important to these visitors once they arrived? As shown by the accompanying graph, 99% stressed the importance of clean, well-maintained grounds, 96% stressed the importance of well-labeled collections, 90% valued visitor center information, and 87% emphasized the importance of educational exhibits.

These and other survey results will inform plans to better provide for the educational interests and basic needs of our estimated 250,000 annual visitors. Special thanks go to volunteers Lyn Gaylord, Anne Joseph, Pauline Perkins, Loren Stolow, and Arlene Theis.

What do *you* think is most important at the Arboretum?



Aid for the Fairchild Tropical Garden

Before sunrise on August 24, Fairchild Tropical Garden in Miami, Florida, was devastated by Hurricane Andrew. Winds of over 165 mph swept away many of the Garden's renowned botanical collections of palms and cycads from around the world. The largest tropical botanical garden in the continental United States was reduced to a tangle of broken trunks and leafless branches. Staff at the Fairchild estimate that about seventy percent of the trees were blown over or snapped.

Botanical triage, selecting which trees should be cut and which might survive replanting with the aid of cranes and braces, began within six days. The Garden was not fully insured against damage, and funds to cover the costs of restoration, new greenhouses, and shade cloth areas are needed.

In response to the distress call issued to colleagues in the horticultural and botanical community by the Fairchild's Director, Dr. William McK. Klein, Jr., Arboretum Director Robert E. Cook forwarded a contribution from the Arboretum and especially from the Arnold Arboretum Associates. The $5000 contribution represents a portion of the net profit from our annual Rare Plant Auction held last September.

Phyllis Andersen Joins Arboretum Staff

The Arnold Arboretum is pleased to announce that Phyllis Andersen has joined the staff as Landscape Historian. She will be working on implementation of the Arboretum's cooperative agreement with the National Park Service that includes the development of a curriculum plan for training professionals in historic landscape preservation techniques. She will also be participating with other AA staff members in a plant identification project at three National Park Service sites in New England: the Longfellow House in Cambridge; the Adams National Historic Site, Quincy; and the Saint Gaudens National Historic Site in Cornish, New Hampshire.

Phyllis Andersen

Phyllis has been a consultant to a number of government agencies including the Boston Parks Department, the M.W.R.A., and the Department of Environmental Management. She is an instructor in the Radcliffe Seminars Graduate Program in Landscape Design and has also taught at the Boston Architectural Center and in the Yale College Seminar Program.

With the Hunnewell Visitor Center closed for renovations, participants in the Arboretum's Field Study Experiences Program enjoyed temporary quarters under a tent in the fall landscape.

WANTED!

Rollerskates with dogwood wheels and other treasures!!

In preparation for an Arnold Arboretum exhibit on the role of wood in New England history, we are looking for 18th-, 19th-, and early 20th-century wooden objects. If you have any wood tools, utensils, machine parts, or other objects you'd be willing to donate or loan, please call Richard Schulhof at 617/524-1718 x113.

Upcoming Lecture Series

Landscapes in Transition: Rethinking Regionalism

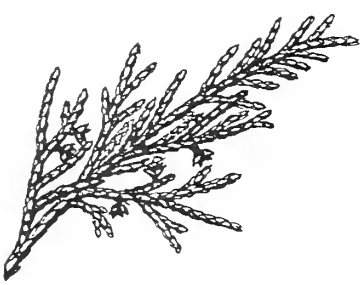
The Arnold Arboretum joins the Frederick Law Olmsted National Historic Site of the National Park Service; the Harvard University Graduate School of Design, Department of Landscape Architecture; and Historic Massachusetts Inc. in sponsoring this series of lectures. All are free of charge and will be held in Piper Auditorium, the Harvard University Graduate School of Design at 48 Quincy Street, Cambridge, at 6:30 p.m. For more information, call the Olmsted Historic Site at 617/566-1689.

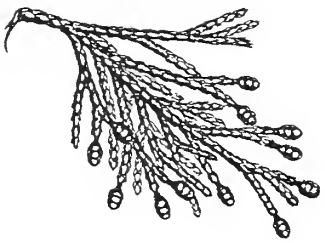
4 February 1993

LANDSCAPE AND THE AMERICAN WRITER

William Howarth, Princeton University

Drawing on the works of Hemingway, Faulkner, and recent writers such as Annie Dillard and Barry Lopez, Professor Howarth examines American ideas of space and region and the tendency of our artists to invoke a nostalgic "sense of place" in response to environmental change.





18 February 1993

100 YEARS OF THE METROPOLITAN PARK SYSTEM

Program Moderator

Alan Altshuler
Harvard University

Panel

M. Ilyas Shatti
MDC Commissioner
William J. Geary
MDC Commissioner 1983-1989
John W. Sears
MDC Commissioner 1970-1975

The Boston Metropolitan Park System celebrates its centennial as one of the nation's earliest examples of regional park planning. Karl Haglund, MDC Planner, will present an overview of its history. The panel will discuss the past, present, and future of these treasured lands. A reception will follow the program.

4 March 1993

INTEGRATING SOCIAL NEEDS AND CONSERVATION; CASE STUDIES FROM THE NATURE CONSERVANCY'S BIORESERVE PROGRAM

George Fenwick
The Nature Conservancy

Mr. Fenwick will describe current Nature Conservancy projects including the Virginia Coast Reserve and the Texas Hill Country, which link regional and community needs to large-scale ecosystem protection.

18 March 1993

THE FUTURE OF THE GREAT PLAINS; A PRESERVATION PROPOSAL

Frank Popper and Deborah Popper, Rutgers University

Mounting economic and environmental difficulties provide the background for this landscape preservation proposal for the Great Plains — sometimes called Buffalo Commons — and its implications for other rural regions.

NEW PUBLICATION!

The 1993 edition of the Arnold Arboretum's *Inventory of Living Collections* has just been published. This 161-page, bound volume lists all the names and locations of the 5,909 different plant taxa found in the Arboretum's magnificent living collections. In addition, this new edition of the inventory contains over fifty full-page illustrations of many Arboretum plants, reprinted from *A Student's Atlas of Flowering Plants* by Carroll E. Wood, Jr., professor emeritus and former Arboretum staff member.

Copies of the inventory can be obtained by sending a check made out to the Arnold Arboretum in the amount of $20.00 to:

Arnold Arboretum Inventory
The Arnold Arboretum
125 Arborway
Jamaica Plain, MA 02130

The Dogwood Through the Seasons

When the dogwoods flower the Arnold Arboretum seems to sparkle. Although most of the Arboretum's major groups of trees are arranged taxonomically, when it came to siting the dogwoods Charles Sprague Sargent, the Arboretum's first director, wisely chose to ignore scientific dictates and instead followed the advice of Frederick Law Olmsted. Rather than restricting them to their place in botanical sequence, Sargent interwove them throughout the grounds just as they grow in natural forests.

Flowering dogwoods can reach forty feet in height, but in New England they usually grow to only fifteen to twenty-five feet. *Cornus florida* flowers well in shade or sun but forms a more compact shape with a flat-topped crown when growing in the open. With wide-spreading horizontal limbs that are delicately aligned tier upon tier, a mature dogwood tree can often become as wide as it is high.

In spring these small understory trees are covered with large, handsome, bright-white bracts that surround the small clusters of the true, minute yellowish-green flowers. The flowers begin to form during the previous summer. Throughout fall and winter they remain enclosed and protected by four light-brown to grayish involucral scales. In winter the flower buds are conspicuous. Looking like little Turkish caps or turbans the size of a large pea, they are held up from the ends of the branchlets by stout, reddish, quarter-inch peduncles, or stalks. In spring the peduncle lengthens to become an inch to an inch-and-a-half long. The bud's protective scales, the bracts, begin to unfold, enlarge, and turn white. Some trees have pinkish-white bracts, and occasionally a tree will sport bracts of a deeper pink.

By midsummer, two to five berrylike drupes, each containing two very hard, notched stones that enclose the seeds, have developed. By fall, these oval-shaped drupes are a brilliant red and become a source of food for migrating flocks of birds.

Dogwood leaves are from two to five inches long, have wavy margins, and grow opposite one another. The fall color of this small tree's leaves and berries make the dogwood as handsome a tree during that season as it is in spring. By October the upper surfaces of the leaves have turned from a dark green to a shiny rose, scarlet, or violet color. Providing an ideal foil for these deeper hues, the underside of the leaves remain as pale and whitish as they have been throughout their growing season.

residues from secondary forest products, such as planer shavings, plywood mill waste, round wood waste, and wood chips, have become an important source of raw material for fiber-based reconstituted woods. Insulation board, fiberboard, and laminated paperboard are just a few of the products composed of wood that is first reduced to fibers (or fiber bundles) before being reconstituted by a manufacturing process that produces panels of relatively large size and thickness. Innovations such as these have impelled the industry to improve forest management practices.

The Regrowth of the Forest

Early New England colonists came to a land that they described variously as "a well-wooded earthly paradise" or "a hideous and desolate wilderness." By the nineteenth century, fear that the nation's forest resources could be depleted had taken hold. In 1880 Charles Sprague Sargent, then the young and ambitious director of a new Arnold Arboretum, undertook a study of the nation's forests, "the much needed work [to show] the great wealth and value of our forests, and the dangers with which their destruction will threaten us." He could not have foreseen our situation in 1992. At no time since the arrival of the first Europeans has so much of New England's landscape been forested as today. It's neither paradise nor wilderness, but a new Yankee forest aptly described as a patchwork of wildlands and woodlots. From the sandy promontories of Cape Cod, where the wind sculpts the waist-high scrub oaks and twisted pitch pines, westward to Connecticut's stands of oaks and hemlocks, and northward into the "big woods" of Maine, the country of spruce and balsam spires, eighty-one percent of the region's land surface is once again covered by forest.

Today over 108,000 New Englanders work either in the forest or with the forest's products. Of these, over 61,000 people hold jobs associated with the paper industry. Lumber and wood products employ an additional 30,000 people, and close to 17,000 workers make furniture and other wooden fixtures. While synthetics are now often substituted for wood, wood remains the best material for much of what we use daily. Tradition and aesthetics influence our preference for wood, but in many instances its durability, coupled with its renewability as a resource, makes it a sound, economically and environmentally wise choice as well. Thus New England's forests continue to support a multitude of specialized industries and countless small, family-owned businesses that transform trees into durable goods. New Englanders are makers of paper and boxes, wooden ware and picture frames, tennis rackets, tool handles, toys and snowshoes and musical instruments. Working with lathes, saws, and drills, skilled operators turn out cabinets, doors, windows, and millwork as well as sashes, trims, plywood, and pallets. And artisans make everything from furniture to boats with hand tools, occasionally in conjunction with ancient woodworking machines driven by waterpower. In so doing, they insure that many of our old ways with wood endure.

This article is excerpted from Sheila Connor's forthcoming book, *New England Natives* (Harvard University Press, 1993), part of the Arnold Arboretum Sourcebook Series funded in part by the National Endowment for the Humanities. Sheila Connor is Horticultural Research Archivist at the Arnold Arboretum.

Native Dictates

Gary Koller

Invasive exotic plants and attempts to curb them through legislation have been the subject of debate among horticulturists, landscape designers, and other professionals concerned with the environment. Here's why one horticulturist advocates continued access to introduced plants along with improved access to native species.

As a gardener do you see yourself as an environmental bandit? Few horticulturists would characterize themselves as threats to the American landscape, yet this is an increasingly common viewpoint in state legislatures and municipalities. Urged on by environmentalists, some officials now believe that gardeners and the landscape industry are helping to destroy the "natural" American landscape by introducing, producing, selling, and growing non-native plants.

Around the United States, several ordinances already require landscape architects, designers, and contractors to include a certain percentage of native plants in their projects. The possibility of much more restrictive laws is very real.

Minnesota is one prominent example. The introduced species *Lythrum salicaria* has become so rampant there that it is now illegal to sell any *Lythrum*—not just *L. salicaria*—and the state is considering more extensive legislation. Last year Minnesota's nursery industry narrowly averted the passage of a law that would have banned the sale of all plants not growing in the state before 1800.

Environmentalists have a legitimate concern. Some introduced plants have become naturalized in American landscapes, crowding out weaker, less competitive species and radically altering local ecosystems. Consider, for example, *Polygonum cuspidatum*, called Japanese knotweed or Mexican bamboo. This plant was included in the original planting plans for Boston's Emerald Necklace. Today it takes enormous amounts of time, energy, and money to keep this plant from completely overtaking our urban parklands.

Many species of bamboo are becoming popular in home and public landscapes, but plant a running bamboo in the native habitat of a lady's slipper orchid and it's quite possible, in fact almost certain, that the orchid will be overrun and wiped out. Environmentalists are trying to keep natives from being pushed out of their niches, from being run out of their own home grounds.

The environmentalists' arguments have merit—and I do want to see native plants better used and more respected—but we need non-native plants, too. They serve as important options for regreening the hostile environmental conditions found in more and more urban sites. To protect the landscapes of today as well as build those of tomorrow we need all the useful plants we can get—whether from five or five thousand miles away.

Imagine a diet restricted to native foods. A typical American dinner—say pork chops, white rice, lettuce and tomato salad and peach cobbler—would be unthinkable. None of those foods are North American. To eat a native dinner, you'd have to substitute something like buffalo for the main course, Jerusalem artichoke for the vegetable, blueberries for the dessert. A purely native American agriculture would be just as lacking in diversity. Wheat, corn, soybeans, potatoes—all are non-native crops. In fact, in terms of commercial value the biggest native North American crop is the sunflower.

The landscape industry and in turn the home garden is in a similar situation. Imagine spring without callery pears, cultivated crabapples, Yaku rhododendrons—even dandelions. If environmentalists had passed non-native legislation fifty years ago, we would not have many of the species, hybrids, and cultivars that have become important to our daily lives.

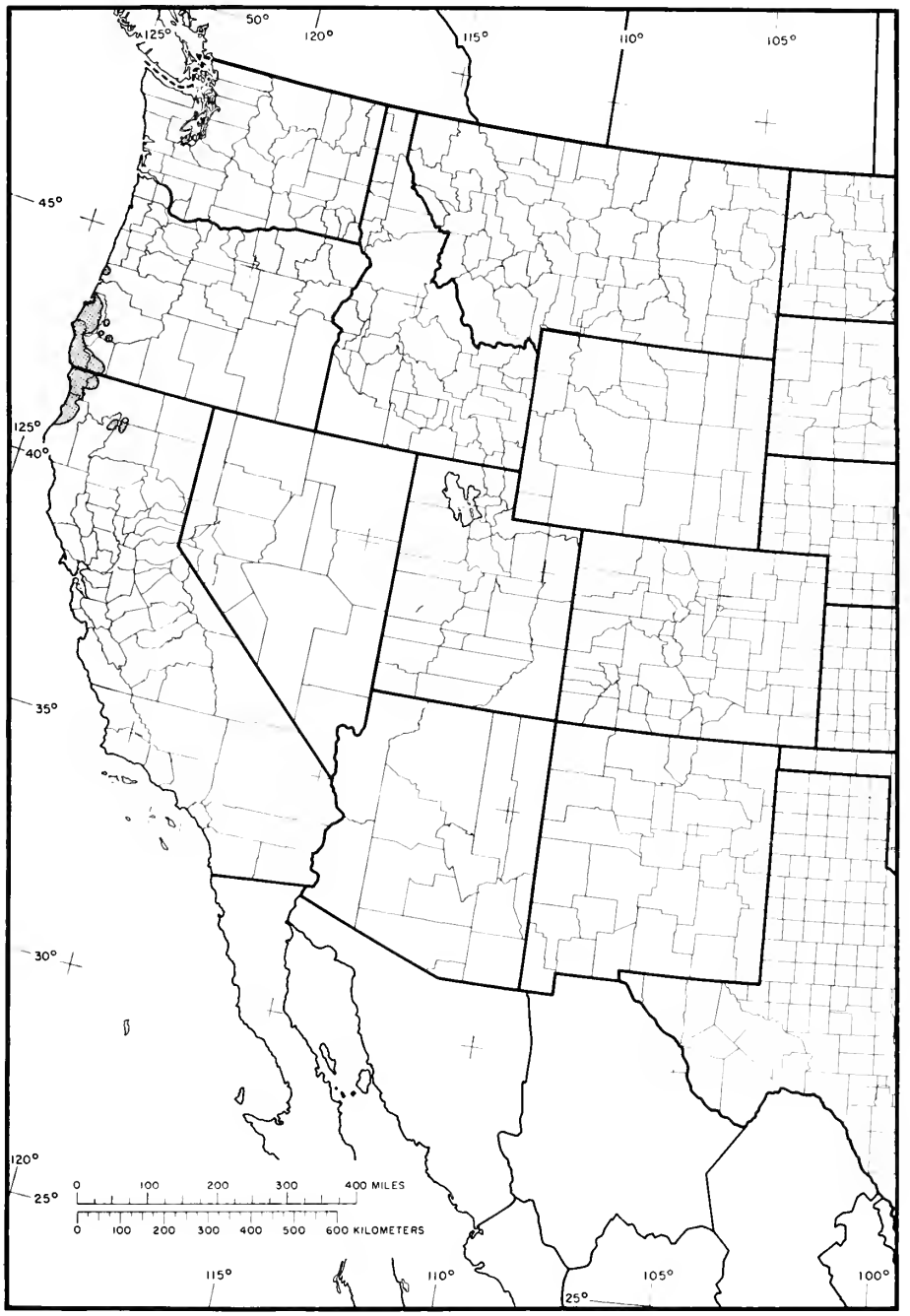
Many plants grown in North America today, in vegetable gardens, flower and shrub borders, in parks, on streets, and in orchards, have a hybrid parentage. Often, interbreeding of American, Asian, and European species has resulted in increased cold hardiness, greater productivity and yield, more vigorous and dependable growth, improved pest resistance, adaptability to a wider range of growing conditions, or the expansion of desirable ornamental features. Would we, as gardeners, want to return to a strict North American diet of garden, nursery, and forestry crops? Beyond the simple desire for diversity, there are several reasons for believing that legislation banning non-native plants would cause as many problems as it might solve.

The Danger in Overly Restrictive Definitions

Those who would ban non-native plants face at least one immediate difficulty: how to define the term *native*. Even if there were agreement that all plants growing in North America before such-and-such a year are to be considered native, that alone won't solve the problem. For instance, if you live on the East Coast, you probably don't consider the West Coast to be exotic. Nevertheless, in the strictest sense a plant like Lawson cypress (*Chamaecyparis lawsoniana*), which hails from a tiny area of the Pacific Northwest, is just as exotic in New England as paperbark maple (*Acer griseum*), which is native to China.

Chamaecyparis lawsoniana, *the Lawson cypress. Photo by the author.*

Take another case, *Metasequoia glyptostroboides*, which in modern times was introduced to North America from China in the late 1940s. A careful examination of the fossil record has shown that it, like the ginkgo, grew in North America several million years ago. Should they be viewed as native plants in the places where the fossils were recovered?



The tiny dotted area in the Pacific Northwest shows the very limited range of the Lawson cypress (Chamaecyparis lawsoniana). *From* Atlas of United States Trees, *Volume 1, by Elbert L. Little, Jr. U.S. Department of Agriculture Miscellaneous Publication No. 1146, 1971*

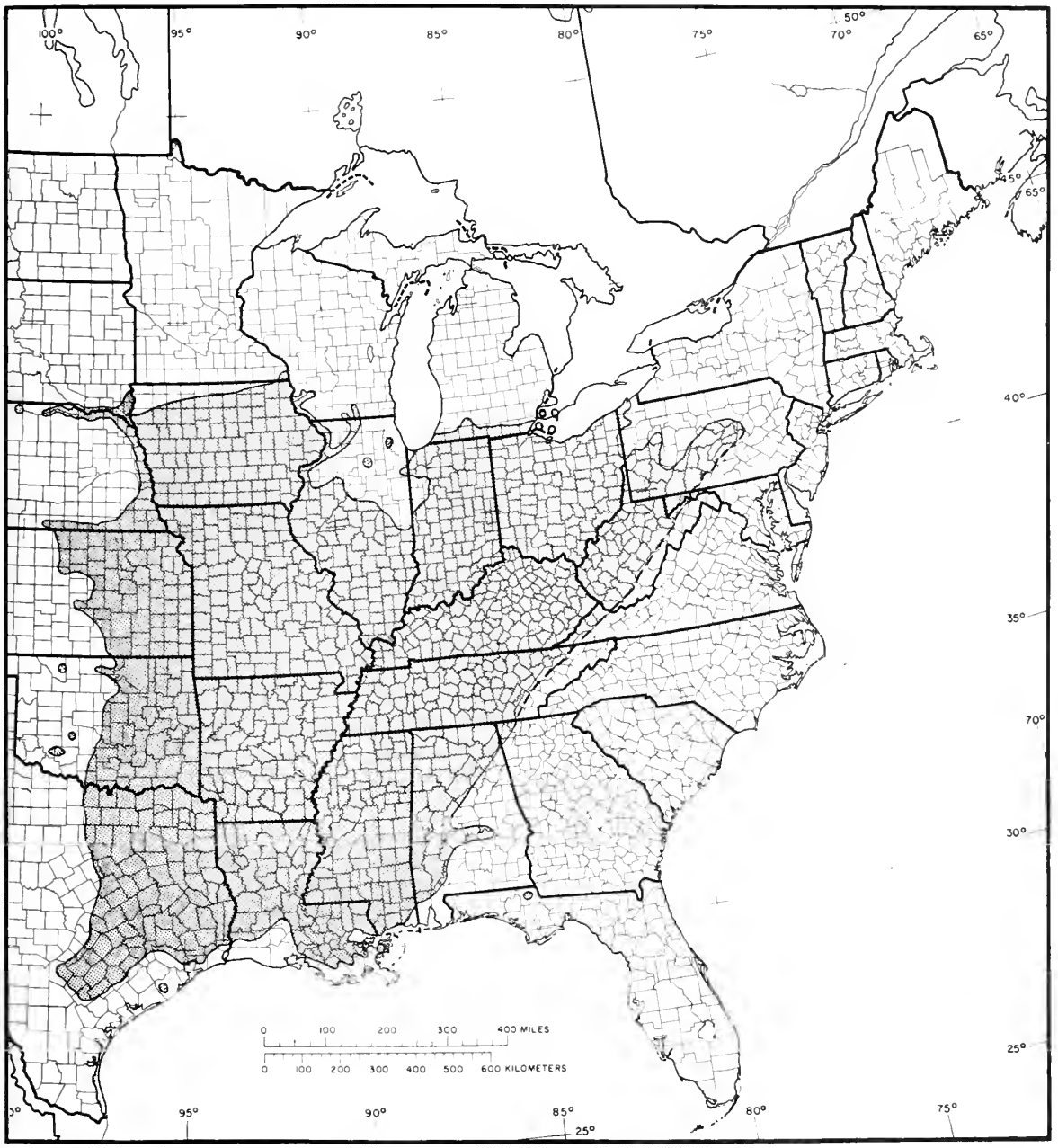
Here's an example of far more consequence. The honey locust (*Gleditsia triacanthos*) has a fairly small native range—from Pennsylvania and Nebraska south to Mississippi and Texas. This beautiful tree has had a profound impact on cities like New York and Boston, but it's no more native to those places than is ginkgo. What if, when the honey locusts in gardens and parks and along streets outside its native range die out, we could not replant them? Would that make any sense? What replacements could provide comparable survival, growth, and longevity? Horticulturists have been very successful with this tree, selecting thornless, seedless cultivars, developing different forms and foliage colors. I don't see how honey locust could ever be restricted to its true native range; it's simply too important to our built landscapes. Yet this is where a narrow definition of the term *native* would lead us.

Gleditsia triacanthos, *the honey locust. Photo by the author.*

The Need for Plants That Meet Specific Needs

In 1992 we marked the quincentennial of the arrival of Europeans in North America. Certainly our presence here over the past five hundred years has changed the way America looks, and it can be fairly said that it has not enhanced the well-being of our land, water, and air. Consider the urban environment. We have created artificial wind tunnels along city streets. We douse those streets with de-icing salts that kill the plants we have squeezed into the barest minimum spaces. We build roof gardens that are warm underneath and cold on top. Foot traffic and heavy vehicles compact the soil of our public spaces. These and many other factors, occurring both singly and in combination, make for difficult sites, demanding as a first order plants that will survive. Our urban landscape is a completely non-native environment. Should we now be restricted to planting natives, knowing that many opportunistic exotics actually thrive in human-altered landscapes? The Tree-of-Heaven (*Ailanthus altissima*) is a prime example. It waits for us to disturb the soil, then quickly invades and establishes itself, outcompeting other vegetation. It would not make sense to outlaw such trees. Rather, we should encourage the research community in its investigations of the biological factors that enable its rapid establishment.

Our landscape needs extend beyond the city. We have transformed the countryside by carving it into suburban homesites, many too small for the kinds of plants that originally grew there. In altering the natural landscape, we have opened the door to erosion and flooding. Even worse, we have dumped pollutants on our earth and pumped them into the air, creating the need for plants that thrive under polluted conditions and at the same time brush, scrub, screen, and filter those pollutants.



The dotted area shows the range of the honey locust (Gleditsia triacanthos). *From* Atlas of United States Trees, *Volume 1, by Elbert L. Little, Jr. U.S. Department of Agriculture Miscellaneous Publication No. 1146, 1971*

Tilia americana, *the American linden or basswood. Photo by Rácz and Debreczy.*

In short, we need tough, adaptable plants that can enhance the landscape while making a real ecological contribution. Instead of restricting ourselves to natives or to introduced plants, we need to ask which plants, regardless of origin, can be most useful in our built landscapes. Isn't a live exotic better than a dead or dying native? Or worse, a plastic substitute?

Natives Are No Panacea

It's often thought that native plants are inherently better than introduced plants. Natives grew up with the local climate,

pests, and soils so they must be tougher and better adapted. But look at our native chestnut (*Castanea dentata*) or the American elm (*Ulmus americana*). Planted in monocultures, native plants can be just as vulnerable as exotics—sometimes more so when a disease or pest is introduced from another country.

Dogwood is a more recent example. With dogwood anthracnose (a fungus called *Discula* sp.) occurring from Atlanta to Boston as well in the Pacific Northwest, many gardeners are reluctant to plant native dogwoods (*Cornus florida* and *C. nuttallii*). *Cornus florida* is a beautiful plant and extremely important in our landscape. But in Boston it's not as cold-hardy as the Chinese species, *Cornus kousa*. Neither is it as drought-hardy, and it's certainly not as anthracnose-resistant. For now, at least, *C. kousa* or some of the new *Kousa x florida* hybrids may be better, more dependable choices than our native dogwood.

In New England parks we use a lot of European horse chestnut (*Aesculus hippocastanum*). This exotic is a good, tough plant, but it is very susceptible to summer leaf scorch and browning. Yellow buckeye (*Aesculus octandra*) seems more resistant to scorch, and it's being used more often as a substitute. But *A. octandra* is no more native to Massachusetts than *A. hippocastanum*. Strict native dictates would mean that, in Boston, we could not test or use either of these species in our city parks, along our streets, and in our home and institutional landscapes.

The Market Factor

Many of the most ornamental of the garden plants tend to be non-natives and their cultivars. Enjoying high consumer name recognition, they can be marketed far more easily than unfamiliar plants. Aesthetic sensibility also plays a part. Earlier this year I visited my mother in central Pennsylvania. On a drive we passed an abandoned quarry that had been allowed to revert to native growth. Just as I was thinking what a reasonable solution it was to a blighted area, my mother said, "I wish they would take out this messy-looking stuff and put in some nice bushes." By "nice bushes" she meant something like 'PJM' rhododendron, forsythia, or callery pears.

Her attitude is not uncommon. How many gardeners are itching to try sweet fern (*Comptonia peregrina*), native sumacs (*Rhus typhina*), or goldenrod (*Solidago* spp.)? Too many gardeners see them as weeds of the roadside. To promote and sell native plants there must be consumers who can appreciate them. Native plants must be valued not as flashy ornamentals but as part of a complex community that gives definition to a specific area and fosters a sense of place. Education programs like those at the Arnold Arboretum and the New England Wild Flower Society help to change attitudes but often only for an audience that is already well informed and sympathetic to the cause.

Regional Identity

In Louisville, Kentucky, zelkovas, sugar maples, and callery pears are among the common landscape trees. In Boston, Chicago, and Seattle the same trees are used with the same degree of frequency. But who wants Louisville to look like Boston, and who wants Boston to look like Seattle? Yet the most frequently used trees are so pervasive that there are few options for creating a landscape with a true regional flavor.

Littleleaf linden (*Tilia cordata*) is one of the street and parkland trees most commonly deployed by landscape architects and street tree commissioners. As young plants they resemble uniform lollipops, but with age they loosen up and achieve a majestic style and form. Today all the big nurseries grow and offer littleleaf linden, and many continue to make cultivar selections even though there are already thirty or forty on the market. Personally, I find it almost

The catkin of Betula lenta, *the sweet birch, which is also called black or cherry birch. Photo by Rácz and Debreczy.*

impossible to distinguish the merits of each because the distinctions are so poorly defined, illustrated, and explained. And I can't help wonder if the glut of European littleleaf lindens shouldn't open the door for further development of native lindens, like *Tilia americana.*

In the past native plants had to go to Europe to get "cultured" before they could be brought back and accepted in the gardens of North America. This has rapidly changed as skilled plantspeople with excellent observational skills comb our native plant communities for improved and superior selections. The recently introduced *Boltonia asteroides* 'Pink Beauty' is one of those. Joe-Pyeweed (*Eupatorium maculatum*) is another good example of a native plant that is becoming widely available in the commercial market. Three years ago almost no one grew it as a garden plant. During the summer of 1991 a few plants could be found, but during the summer of 1992 *Eupatorium* entered Boston's retail market in quantity.

Despite the inroads of many nurseries, there is still progress to be made in the production of native plants. Many of our finest native plants are rare or difficult to obtain, and locating quantities of plants in larger sizes or matched in size, form, and structure is difficult. I know a landscape designer who is looking for a hundred matched specimens of sweet birch (*Betula lenta*) in a larger landscape size. She could probably find six-inch-tall *Betula lenta* seedlings in quantity, and it might be possible to locate a handful of three-foot-tall plants, but nowhere could she locate a hundred large, matched specimens. They are probably not to be found anywhere across the land.

Too few nurseries offer our native trees and shrubs in the sizes and quantities that will give landscape designers and gardeners those kinds of choices. This in turn forces us back to the same short list of trees that are available, locatable, inexpensive, tried and tested and preferably failsafe. And that in turn forces our landscapes into ever more homogenized and characterless forms.

Landscape Needs

Our modern landscapes constitute a demanding range of environments. Just as some sites cry out for natives, others require that we survey the entire plant world for those that will thrive under the existing conditions. For our toughest city and urban locations I firmly believe that the most important color we can add is the green of trees, with the quality of flowers, fruit, and autumn color being rather minor or ephemeral characteristics.

One of the least understood aspects of horticulture today is how to take a disturbed wetland and turn it back into a native wet meadow or marsh. In most cases we still don't know how to recreate a representative plant community, how to effectively estab-

Carya ovata, *the shagbark hickory. Photo by Rácz and Debreczy.*

lish it, and how to manage it once we put it in. At the Arnold Arboretum *Lythrum salicaria* is slowly taking over the wet meadow in front of the Hunnewell Building, and it's been suggested that we eradicate the lythrum. Well enough said, but how is this accomplished without affecting neighboring plants that remain desirable?

Here's another example. Suppose I'm trying to restore a mine spoil in the spent coalfields of Pennsylvania. One plant that not only survives but in fact thrives on these

highly altered soils is black locust (*Robinia pseudoacacia*). Ask almost anyone who knows this tree and you get a similar response. "Black locusts get borers and locust leaf miner. It suckers up. It's weak-wooded. It's dirty." They're right; black locust has all these problems. Still, there is a place for it in the American landscape. Black locust is often shunned for street plantings, but it ought to be available for specific applications such as mine spoil reclamation.

Environmental Responsibility

Having made a case for exotics, I in turn need to make the case for environmental responsibility. The great majority of exotic plants rarely become problematic; they just aren't that invasive. There is, however, a group of plants that is well equipped to leap over the garden wall. They are more than capable of scattering multitudes of fertile seeds or sending rhizomes over great distances as they conquer new territory. In many cases the potential for trouble is well documented. It is from this group of plants that we must protect our native vegetation. While I am a great proponent for the use of the arborescent, running bamboo species, I also believe a warning label should be attached to each plant so that less informed gardeners will recognize the invasive potential of these beautiful woody grasses and implement effective measures against it.

Individually and collectively gardeners are part of the re-greening of America. How will our countryside look a hundred years from now? Five hundred years from now? In New England we worry that our woodlands will be filled with Norway maple, European and Japanese honeysuckles, and buckthorn. Today as we replant our parks in both cities and small towns, all too often it is with Callery pears, littleleaf lindens, and zelkovas. Do we want America to be re-greened largely with European and Asian plants? Do we care enough about the quality of our natural world to grow and market a larger array of natives so that the process of restoration will be easier to plan and implement?

I grew up in Pennsylvania where hickory (*Carya* spp.) was mixed into the woodland. Who's planting hickories in our parks and suburban landscapes? It's known that hickories don't transplant well and that the fruits make ideal missiles for child's play. Nonetheless I want the children of tomorrow to be able to go into parks and see hickories, not just vast stands of Norway maple, which is where a continual thrust in the direction of a few useful exotics will ultimately push us.

Many gardeners shun natives because they supposedly lack pizzazz. Some do have wonderful foliage, flowers, bark, or winter color, but we need not advocate them for those reasons. We need them because they are part of the native environment of each region and a part of our native heritage. If we want to maintain, protect, and restore these environments, we must have an expanded availability of native plants ranging all the way from grasses and wildflowers to trees and shrubs.

For Further Reading

Harrison L. Flint. Native Plants: Another View. *Arnoldia* 43(1): 39-44

Gary Koller is Senior Horticulturist of the Arnold Arboretum and Lecturer in the Department of Landscape Architecture at the Harvard Graduate School of Design. This article is adapted from a talk presented at The Management Clinic of the Wholesale Nursery Growers of America, which was subsequently published in *American Nurseryman* 175(12): 7-10.

BOOKS

Judith B. Tankard

Keeping Eden, A History of Gardening in America. Walter T. Punch, general editor. A Bulfinch Press Book, in association with the Massachusetts Horticultural Society, 1992. 277 pages. Hardcover. $50.00

Green-jacketed picture books on American gardens, planting design, and garden ornament swell the shelves of bookshops across America, but it's rare to find a beautifully illustrated one that is well written *and* does justice to the manifold issues in American garden history. This splendid book combines rich visual material with an unusually high standard of writing that makes it a book definitely worth keeping. Green jacket notwithstanding, its handsome presentation is certain to attract many unsuspecting readers to an entirely new and rewarding territory.

That territory encompasses garden literature, horticulture, science and technology, horticultural institutions, and the cultural and economic issues that shaped America's garden history. Walter Punch, librarian of the Massachusetts Horticultural Society, conceived and edited the book, and it is appropriate that the concept of the book came from a librarian although it was originally envisioned as a television series. He commissioned essays on a highly personal selection of topics, and the result is a pleasant mix of scholarly and popular writing styles. The work of well-known historians such as William Howard Adams, Diane Kostial McGuire, and Melanie Simo, accompanies that of others not so well known, whose work is usually buried in scholarly tomes often unseen by the general public. More popular writers, such as Mac Griswold and Tovah Martin, each of whom has published several books, give balance to the book. The essays that concentrate on a single topic are more successful than the broad overviews, but on the other hand, those more general essays may be precisely what the neophyte finds most helpful.

Gordon De Wolf traces the earliest interest in gardening by the explorers of the New World, who out of necessity had to glean information on native plants and methods from native peoples. The familiar later gardens of the colonists in Virginia and elsewhere on the Atlantic coast, which were heavily influenced by English and European sophistication, are considered by Diane McGuire. David Streatfield's chapter, one of the best in the book, follows the settlers as they moved westward and explains how distinctive garden styles echo geographical concerns. Melanie Simo considers modernism in the context of regionalism from the Midwest to California.

American artists have provided a visual resource for information about flowers, gardens, and landscapes, and some of the more spectacular examples are included in Mac Griswold's essay, including a painting by Georgia O'Keeffe and one of Mattie Edwards Hewitt's evocative garden photographs. Charles Willson Peale's portrait of William Paca, squire of Annapolis, demonstrates the documentary uses of garden art. A tiny detail provided information for an accurate restoration of Paca's eighteenth-century garden.

Consideration is given to public gardens, cemeteries, and townscapes as well as private gardens. Phyllis Andersen traces the relationship of city and garden as colonial

towns evolved into dense urban centers. The changing needs for green space that began with the colonists' ideal pastoral city can be seen today in traditional community gardens as well as in small townhouse gardens. Walter Punch offers insights into the role of horticultural societies, garden clubs, and the botanical gardens and arboreta in public education, and considers the relevance of an entirely twentieth-century venture, the Garden Conservancy, which seeks to orchestrate the survival of America's premier gardens.

Some of the elements in the creation of gardens—books, plants, technology—are vast subjects that the volume skillfully introduces to the novice. One of the most obvious topics in any discussion of American gardens is the diversity of horticultural books that shaped and recorded the subject. The late Elisabeth Woodburn, whose extensive knowledge of the topic grew out of forty years' experience as an antiquarian dealer specializing in gardening and horticulture books, sketches the nineteenth-century work of Bernard M'Mahon, Joseph Breck, and Peter Henderson as prelude to the explosion of gardening titles by women such as Neltje Blanchan and Louise Beebe Wilder in the early twentieth century. Peggy Newcomb details the colorful history of plants in American gardens with illustrations from seed catalogues and plant monographs in the collection at the Massachusetts Horticultural Society. The scientific aspects of the garden are pondered by D. Keith Crotz who discusses plant culture as well as some of the paraphernalia necessary to maintain the garden, from hand tools and garden carts to water sprinklers and Budding's lawnmower. More follows on the lawn from Michael Pollan, who concludes the book with a provocative afterword.

Excellent notes, bibliographies, and reference material enhance the usefulness of the book. This is a book to be enjoyed chapter by chapter, provided the reader is not sidetracked by a trip to the library to learn more on the chapter just finished. *Keeping Eden* should become a standard text on American garden history; certainly it can play a role in educating the public about America's garden heritage.

Index to Volume 52 (1992)

Numbers in parentheses refer to issues, those in ***boldface*** *to illustrations of the entries.*

U.S. POSTAL SERVICE
STATEMENT OF OWNERSHIP, MANAGEMENT, AND CIRCULATION
(Required by 39 U.S.C. 3685)

1A, Title of publication: *Arnoldia.* 1B, Publication number: 00042633. 2, Date of filing: 31 Dec. 1992. 3, Frequency of issue: Quarterly. 3A, Number of issues published annually: 4. 3B, Annual subscription price: $20.00 domestic, $25.00 foreign. 4, Complete mailing address of known office of publication: Arnold Arboretum, 125 Arborway, Jamaica Plain, Suffolk County, MA 02130-2795. 5, Complete mailing address of the headquarters of general business offices of the publisher: Arnold Arboretum, 125 Arborway, Jamaica Plain, Suffolk County, MA 02130-2795. 6, Full names of the publisher: Arnold Arboretum, 125 Arborway, Jamaica Plain, Suffolk County, MA 02130-2795. 6, Full names and complete mailing address of publisher, editor, and managing editor: Arnold Arboretum, 125 Arborway, Jamaica Plain, Suffolk County, MA 02130-3519, publisher; Karen Madsen, Arnold Arboretum, 125 Arborway, Jamaica Plain, MA 02130-3519, editor. 7, Owner: The Arnold Arboretum of Harvard University, 125 Arborway, Jamaica Plain, MA 02130-3519. 8, Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities: none. 9, The purpose, function, and nonprofit status of this organization and the exempt status for federal income tax purposes have not changed during the preceding 12 months. 10, Extent and nature of circulation. A, Total number of copies. Average number of copies of each issue during preceding 12 months: 5,000. Actual number of copies of single issue published nearest to filing date: 5,000. B, Paid and/or requested circulation. 1, Sales through dealers and carriers, street vendors, and counter sales. Average number of copies of each issue during preceding 12 months: none. Actual number of copies of single issue published nearest to filing date: none. 2, Mail subscription. Average number of copies of each issue during preceding 12 months: 3,921. Actual number of copies of single issue published nearest to filing date: 4,112. C, Total paid and/or requested circulation. Average number of copies of each issue during preceding 12 months: 3,921. Actual number of copies of single issue published nearest to filing date: 4,112. D, Free distribution by mail, carrier, or other means (samples, complimentary, and other free copies). Average number of copies of each issue during preceding 12 months: 47. Actual number of copies of single issue published nearest to filing date: 47. E, Total distribution. Average number of copies of each issue during preceding 12 months: 3,968. Actual number of copies of single issue published nearest to filing date: 4,159. F, Copies not distributed. 1, Office use, left over, unaccounted, spoiled after printing. Average number of copies of each issue during preceding 12 months: 1,032. Actual number of copies of single issue published nearest to filing date: 841. 2, Return from news agents. Average number of copies of each issue during preceding 12 months: none. Actual number of copies of single issue published nearest to filing date: none. G, Total. Average number of copies of each issue during preceding 12 months: 5,000. Actual number of copies of single issue published nearest to filing date: 5,000. 11, I certify that the statements made by me are correct and complete. Karen Madsen, Editor.