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Front cover: A storm-splintered *Tsuga canadensis*. Many plants on Hemlock Hill fell victim to the blizzard of April 1, 1997. Photograph by Peter Del Tredici.

Inside front cover: Ellen Shipman designed this Colonial Revival dooryard garden at "Old Farms," Wenham, Massachusetts, in 1913. This 1914 photograph is by Edith Hastings Tracy.

Inside back cover: Specimens of *Pinus sylvestris* throughout the Arboretum were destroyed by the snow of April 1. Photograph by Peter Del Tredici.

Back cover: The Arboretum's new lilac introduction, *Syringa* x *chinensis* 'Lilac Sunday'. Photograph by Peter Del Tredici.

Ellen Biddle Shipman's New England Gardens

Judith B. Tankard

This pioneering landscape architect, distinguished for her innovative planting designs, described her use of plants as "painting pictures as an artist would."

Ellen Biddle Shipman (1869–1950) was one of the most important landscape architects during the 1910s and 1920s, the great years of estate building across the United States. Shipman's approach to garden design was steeped in the traditionalism of the Northeast, especially the Colonial Revival style. She owed her great success in the design and planting of small gardens to early years of gardening at her New Hampshire country home. "Working daily in my garden for fifteen years," she wrote, "taught me to know plants, their habits and their needs."[1]

Shipman brought a fine-tuned artistic sensitivity to garden design. She transformed the flower border into an art form by using carefully articulated compositions of flowers, foliage, and color, thoroughly grounded in her exceptional knowledge of plants. This planting expertise set her apart from other landscape architects of the period. Shipman's simple, unpretentious designs for gardens served as a framework for her dazzling plantings. To create the proper setting, she would surround the garden with an enclosing curtain of trees and always used generous quantities of small flowering trees, shrubs, vines, and standards (such as roses, lilacs, or wisteria) to create structural notes and to cast shadows over the borders. Invariably her gardens were enhanced by her delightful designs for rose arbors, pergolas, benches, teahouses, dovecotes, and other structures that carefully echoed the architectural style of the house. Shipman collaborated with numerous architects and landscape architects, including Charles Platt, the Olmsted Brothers, and James Greenleaf. Warren Manning, with whom she collaborated on many projects, considered her "one of the best, if not the very best, Flower Garden Maker in America."[2]

Once hailed as the "Dean of American Women Landscape Architects," Shipman designed nearly six hundred gardens throughout the country during the course of her thirty-five year career (1912–1947).[3] Clusters of her gardens once proliferated in areas such as Grosse Pointe, Michigan; Greenwich, Connecticut; and Chagrin Falls, Ohio, where she designed several dozen gardens. She also carried out a number of commissions in the New England states, where she had gotten her start. Sadly, few examples remain in their original condition.

Ellen Biddle was born into a prominent Philadelphia family, the military rather than the financial branch. Her father was a career soldier, and she spent an adventurous childhood in frontier outposts in Nevada, Texas, and the Arizona Territory. Her discovery of gardens came when she was sent back East to live with her grandparents, who had an old-fashioned, rose-filled garden in New Jersey. Later, when she attended finishing school in Baltimore, interests in art and architecture were awakened.

During her early twenties, Ellen lived in Cambridge, Massachusetts, sharing a house with Marian Nichols, who later married the landscape architect Arthur Shurcliff, whose professional path would intersect with Shipman's. Ellen's brief academic career at Radcliffe (then known as the Harvard Annex) ended when she married Louis Shipman, a dashing young playwright from New York who was then attending Harvard. They moved to the artists' colony in Cornish, New Hampshire, where they were part of a lively coterie surrounding the colony's founder, American sculptor Augustus Saint-Gaudens, who was also Marian Nichols' uncle. Years later, recalling her first visit to Cornish in 1894, she wrote, "a garden became for me the

COURTESY OF NANCY ANGELL STREETER

Ellen Biddle Shipman (1869–1950) in her New York City home on Beekman Place in the 1920s.

most essential part of a home."[4] This would become Ellen Shipman's credo in garden design.

In 1910, when Ellen Shipman was in her early forties and the mother of three children, she turned to garden design at the suggestion of her Cornish neighbor, the country house architect Charles Platt. By then the Shipmans' marriage had deteriorated, leaving Ellen to fend for herself financially after her husband left her. Platt admired her garden at Brook Place, the Shipmans' colonial farmhouse in nearby Plainfield, New Hampshire, and the remodeling she had recently carried out there. Platt thought she had a good eye for design and no doubt felt that her plantings would be an asset for his gardens. While the Shipmans' elder daughter (also named Ellen) managed the household, Ellen studied drafting and construction under Platt's tutelage. Within two years she was collaborating with Platt as well as undertaking small, independent commissions.

Shipman's originality as a garden designer came from several different sources. The country gardens in Cornish, once dubbed "the most beautifully gardened village in all America," were the pre-eminent influence on her early years.[5] Gardens such as those of Thomas Wilmer Dewing, Stephen Parrish, Augustus Saint-Gaudens, and other artists brimmed with old-fashioned flowers, dirt paths, and simple ornaments and features, such as rose arbors and circular reflecting pools. As a young wife of an aspiring but penniless writer, Ellen was not able to take the grand tour of European gardens as did other prominent colleagues such as her Cornish neighbor, landscape architect Rose Standish Nichols (a sister of her friend Marian Nichols), or Beatrix Jones (Farrand).[6] Instead, she read *House Beautiful*, *House and Garden*, and popular gardening magazines that would later feature her own work. She consulted recent books such as Mabel Cabot Sedgwick's *The Garden Month*

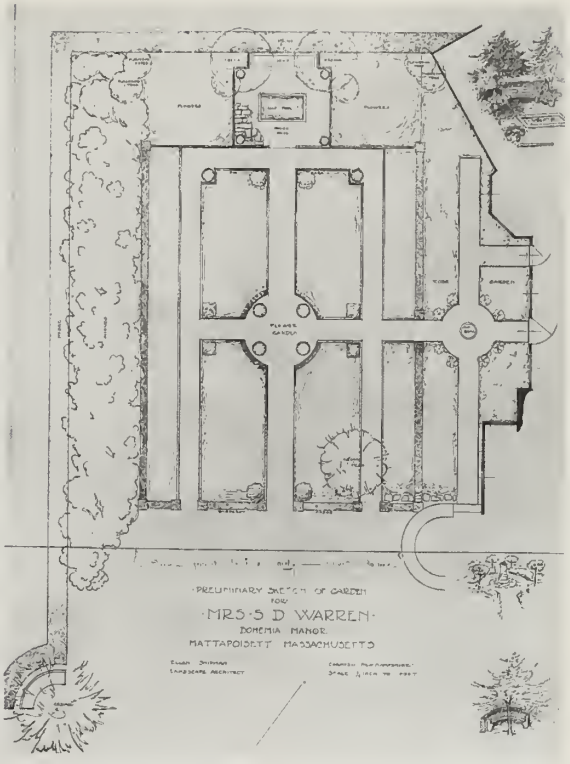
Clusters of peonies and summer phlox with vines climbing on the pergola in Ellen Shipman's own garden at Brook Place, New Hampshire. Photograph by Mattie Edwards Hewitt, 1923.

by Month, Helena Rutherfurd Ely's *A Woman's Hardy Garden,* and others that promoted the revival of interest in hardy plants. As a result, Ellen Shipman's approach to garden design, in particular her planting style, was refreshingly American in spirit, escaping, for the most part, European influences that dominated the work of Farrand and Marian Coffin.

Shipman's apprenticeship with Platt strengthened her design sensibilities. She loosely adapted his basic axial garden plan and habit of placing at regular intervals features such as the tubs of plants, statuary, and clipped evergreens associated with Italianate gardens. The resulting compositions, which varied little throughout Shipman's career, balanced formality and informality, more in the manner of Colonial Revival gardens of the era. At the crux of her garden design philosophy was the close integration of house and garden, with easy transitions from one area to the next, without stiffness and artifice.

Ellen Shipman had nearly four dozen clients in Massachusetts and several gardens in the Boston area exemplify the range of her capabilities, including two designs from her fledgling years. In 1912, when she was just starting out, she designed a small seaside garden in Mattapoisett for Mrs. Samuel D. Warren as a complement to the modest shingle-style summer house. Shipman's simple, four-square Colonial Revival plan consisted of beds of phlox and lilies edged with low, clipped barberry hedging, with converging stone walks. A sundial and a Lutyens bench—at the time a novelty in America—appear to have been the two major ornaments. The garden was enclosed on one side by a dense wall of evergreens, and existing cedars *(Juniperus virginiana)* were accommodated in the plan. Shipman felt an unswerving belief in the importance of privacy: "Planting, however beautiful, is not a garden. A garden must be enclosed . . . or otherwise it would merely be a cultivated area."[7] In this respect she differed from Platt, whose walls and hedges defined spaces but rarely offered a sense of seclusion. The present status of this garden is unknown.

The following year, in March 1913, Shipman designed an innovative garden in Wenham, on Boston's North Shore, for Alanson Daniels. Her



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Preliminary sketch for a garden in Mattapoisett, Massachusetts, for Mrs. Samuel D. Warren, 1912. Shipman's Colonial Revival-style plan has four main beds edged in clipped barberry, a small lily pool, and a sundial on a side path.

design for "Old Farms" harmonized with its country setting and the clapboard seventeenth-century house. At the front entrance, she designed a Colonial Revival dooryard garden with mounds of hardy plants such as peonies, phlox, and lilies in boxwood-edged beds, but behind the house she created a new-style garden that would quickly become one of her signature creations. Here she made a garden with low stone walls of native fieldstone, set in an old orchard. Happily, the "bones" of the garden still exist. The design was composed of a series of rectangular beds and walks culminating in a pool and a semicircular "apse" with a curved stone bench. Since several of the old apple trees were allowed to "stray" into the garden, its character derived directly from its setting. Screening was provided by clumps of small trees and shrubs around the perimeter. Photographs of the garden show it to be one of the earliest instances in which Shipman used more innovative plantings than the simple flowerbeds filled

A wall of evergreens frames flowerbeds filled with phlox and lilies in the Warren garden. Fieldstone paths converge at the sundial. Photograph by Edith Hastings Tracy, 1912.

with masses of only two or three kinds of plants. In the Daniels garden, she created a strong sculptural effect around the small reflecting pool by using clusters of bold foliage—hostas, bergenia, and iris. Her comment, that she used plants "as a painter uses the colors from his palette," is admirably demonstrated in this garden.[8] In this respect, her approach to garden design was similar to Gertrude Jekyll's. However, Shipman's style of planting, with her structural "notes," was more architectural than Jekyll's, and she juxtaposed colors in fan-shaped clusters in contrast to Jekyll's impressionistic drift plantings.

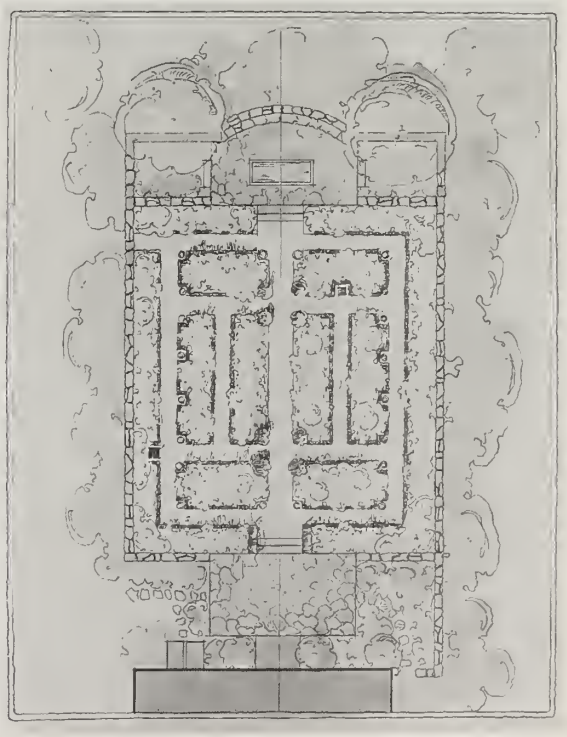
By the early 1920s Shipman's gardens were receiving wide notice in magazines and books, inspiring many new clients to commission a Shipman garden. One editor summed up a well-publicized garden in Philadelphia: "Sheltered and friendly and livable . . . a delightful bit of artistry, so skilful and so finely balanced that one forgets the plan and is conscious only of the pervasive pleasantness of it all."[9] This was the kind of garden that appealed to her clients, wealthy women, the wives of prominent industrialists, who sought traditionalism in the form of good taste and privacy. Often her clients were gardeners themselves, affiliated with local garden clubs where Shipman was a frequent speaker.

For Mrs. Henry V. Greenough of Brookline, Shipman designed a small garden in 1926, when she was at the height of her fame. In her design—an excellent example of her facility with small spaces—Shipman skillfully combined formal and wild gardens in a compressed suburban setting. Using her prototypal layout, the garden was surrounded by high brick walls.[10] The plantings around the house and terraces were designed for all-season horticultural interest, with an emphasis on foliage and the color green. Juniper and pachysandra carried the garden through winter. In the adjacent formal garden, her prescription for perpetual bloom—from bulbs in spring, heliotrope and petunias in summer, and asters and boltonia in the autumn—was precisely outlined on her planting

Above, low stone walls and a small reflecting pool, with plantings of bold foliage around the edges, in the Daniels garden. Photograph by Edith Hastings Tracy, 1913. A plan for the garden is below.

plans. One of Shipman's planting secrets was that she used no more than six to eight types of flowering plants in each design, letting "each, in its season, dominate the garden. For the time one flower is the guest of honor and is merely supplemented with other flowers."[11] The other flowers were drawn from lists that she maintained in her working notebooks. If the client was not a gardener herself, then Shipman helped her find a gardener who could maintain the garden to her satisfaction.

In the Greenough garden, the farthest point from the house, under a dense tree canopy, was the setting for a naturalistic garden with a pool. Although Shipman will forever be associated with flower borders, she designed a number of wild gardens, sometimes in association with Warren Manning. As in the Greenough garden, she augmented the naturalistic effect by using native stone and creating tiny rills of running water. As a formal counterpart, she also incorporated sculptures, such as a tiny frog sitting on a lily pad. The planting palette included a wide variety of native and non-native species to make



A naturalistic pool with native plants, part of a garden in Brookline, Massachusetts, designed for Mrs. Henry V. Greenough in 1926. Photograph by Dorothy Jarvis, c. 1931.

it seem as natural as possible: mountain ash, arborvitae, hemlock, dogwood, laurel, rhododendron, viburnum, big-leaf saxifrage, calla lilies, waterlilies, iris, eupatorium, shortia, and native creeping woodland and water-loving plants.[12]

For Mrs. Holden McGinley (Mrs. Greenough's sister), Shipman designed a large garden in Milton in 1925 that was awarded a blue ribbon by the Massachusetts Horticultural Society for its "great charm and restraint . . . planted in an unusually interesting manner."[13] It exemplifies the best of Shipman's approach to garden design at the peak of her career. The gently sloping site overlooking the Blue Hills to the south, with massive trees on the west and north, elicited an imaginative design solution. To take advantage of the view, Shipman created a two-part plan that coaxed visitors across the lawn and into a walled garden before glimpsing the view outward to the hills.

The enclosed garden, with whitewashed brick walls, is divided into three long, narrow gardens, each on a successively lower level and each with its own distinctive character. The uppermost garden, planted with iris and peonies in low clipped hedges, has as its centerpiece a central, bluestone-bordered lily pool extending the length of the garden. The pool itself is a classic Lutyens and Jekyll design, clearly lifted from the pages of Gertrude Jekyll and Lawrence Weaver's pivotal book, *Gardens for Small Country Houses* (1912).

The long, narrow central garden, on axis with the door of the sunroom of the house, has a central greensward flanked by perennial borders, with a blue-bronze sculpture at the far end. Hedges of Carolina hemlock and low walls, with posts covered with climbing roses, separate this area from the gardens on either side. The lower garden is given over almost entirely to roses—'Golden Salmon' polyanthus around

For Mrs. Holden McGinley of Milton, Massachusetts, Shipman designed a garden of successively descending rooms. The upper one, with the bluestone rill, has yellow 'Emily Gray' roses covering the walls. A lotus fountain is the centerpiece of the middle garden, and the lower one is filled with roses. Photograph by Herbert W. Gleason, 1932.

In the McGinley garden, an opening in the wall of the lower garden frames a view of the Blue Hills in the distance. Photograph by Herbert W. Gleason, 1932.

The spring border in the McGinley garden has double-flowering peach trees, pearlbush (Exochorda racemosa), Spiraea prunifolia, *dapline,* Phlox divaricata, *and flowering almonds. Photograph by Herbert W. Gleason, 1932.*

the central circular pool and lotus-leaf fountain; standard and bush roses, hybrid teas and perpetuals in apricot, copper, and yellow tones in the beds.

Another delightful bit of Shipman's artistry can be seen in the spring border adjacent to the house. Along the walls she placed double-flowering peach trees interspersed with pearlbush, and overhead, a canopy of flowering almonds. Masses of tulips in shades of pink and lavender—"crescendos," as she called them in her planting notes—were underplanted with pansies and *Phlox divaricata.* A simple stone-lined dirt path separated the border from the lawn.

Even though the example of Shipman's career, and those of Beatrix Farrand and Marian Coffin, opened the door for women in the profession of landscape architecture, relatively few examples of Shipman's work can be seen today. One reason is that her gardens, which were unusually plant-intensive and therefore fragile, had already begun to disappear before she died in 1950. Another aspect is that her practice was devoted almost exclusively to private gardens, and only a handful of these have been converted to public use. Had circumstances been otherwise, two Massachusetts gardens could have fallen into the latter category.

In 1925 Shipman prepared plans for replanting part of Alice Longfellow's garden in Cambridge, originally laid out by Martha Brookes Hutcheson in 1904. Hutcheson was no longer designing gardens at the time of Shipman's commission. Shipman's charge was to rejuvenate the garden by preparing planting plans, plant lists, and horticultural notes only, without any changes to the overall design of the garden.[14] Many other landscape architects would not have done this type of work—rejuvenating gardens designed by others—but Shipman's willingness to do so exemplifies her complaisant attitude toward garden design. It may also account for the large number of projects she car-

ried out in her career, six hundred as opposed to Farrand's two hundred. The Shipman plantings disappeared years ago and now the property is known as the Longfellow National Historic Site and managed by the National Park Service. The historic significance of the landscape, including Shipman's planting plans, is currently being evaluated with the possibility that Shipman's garden may be reinstated.[15]

In April 1930 Shipman sketched a preliminary design plan for Long Hill, the Beverly, Massachusetts, home of Mrs. Ellery Sedgwick (better known as Mabel Cabot Sedgwick, the garden writer), now a property of The Trustees of Reservations. Shipman proposed a series of garden rooms encircling the house and taking full advantage of the dramatic setting. All the features associated with Shipman's work can be found in this plan, including three square gardens to the east of the house, one of which was a rose garden with a serpentine wall and dolphin fountain. There were several pools, long walks, boxwood-edged flowerbeds, a series of terraces descending the hill, and woodland paths. The areas farthest from the house were to be planted with native plants, especially flowering trees and shrubs, while the areas closer to the house were more formally planted. Had her scheme been installed, we would have had a delightful example of Shipman's mature work. Mabel had her own ideas about the garden, so the project went no further.

While the "bones" of several of Shipman's private gardens in the Boston area have survived—stone walls, pools, or paths—none has yet been discovered with the original plantings and it is unlikely that they will be found. For Shipman gardens open to the public, the garden visitor must travel; one of the best examples of her work is Stan Hwyet Hall, in Akron, Ohio. As in the Longfellow garden, Shipman's task was to rejuvenate a walled garden originally designed by Warren Manning. The garden was recently restored, following Shipman's 1929 plans and planting lists but using modern-day cultivars to create her precise color scheme.[16] Two other gardens that may be visited are examples of her late work: Longue Vue Gardens in New Orleans, designed for Edith and Edgar Stern in 1936, and the terrace gardens at Sarah P. Duke Gardens, in Durham, North Carolina. Both of these gardens are hosting symposia in 1998 to honor the significance of Ellen Biddle Shipman.

Notes

[1] Shipman, foreword, Garden Note Book, p. 4 (box 10, folder 15, Rare and Manuscripts Collection, Cornell University).

[2] Manning, letter to Frank Seiberling, Akron, Ohio, 20 July 1917 (Archives, Stan Hwyet Hall).

[3] "House and Garden's Own Hall of Fame," *House and Garden*, June 1933, 50.

[4] Ibid., 1.

[5] Mary Caroline Crawford, "Homes and Gardens of Cornish," *House Beautiful*, April 1906, 12–14.

[6] See Jane Brown, "Lady into Landscape Gardener—Beatrix Farrand's Early Years at the Arnold Arboretum," *Arnoldia* 51 (Fall 1991): 2–10.

[7] Design chapter, Garden Note Book, 38.

[8] Preface, Garden Note Book, 2.

[9] "Three Pennsylvania Gardens," *Garden Magazine and Home Builder*, September 1924, 11.

[10] See plan and photograph in Mac Griswold, "Fairsted," *Arnoldia* 56 (Summer 1996): 11.

[11] Lamar Sparks, "A Landscape Architect Discusses Gardens," *Better Homes and Gardens*, November 1930, 20.

[12] "Variety of Form and Abundance of Bloom within a Small Area: The Garden of Mrs. Henry V. Greenough, Brookline, Massachusetts," *House Beautiful*, March 1931, 62.

[13] Ethel B. Power, "A Blue-Ribbon Garden: The Garden of Mrs. Holden McGinley," *House Beautiful*, March 1933, 86–89, 118.

[14] Catherine Evans, *Longfellow National Historic Site, Cultural Landscape Report*, Boston: National Park Service, 1993, 71–73.

[15] The National Park Service is currently reassessing the garden. Shary Page Berg and Lauren Meier, *Longfellow National Historic Site, Cultural Landscape Report, Volume 2: Analysis, Significance, Integrity*, forthcoming.

[16] To learn more about Stan Hywet Hall, see Judith B. Tankard, "The Artistry of Ellen Shipman," *Horticulture*, January 1997, 72–76.

Judith B. Tankard teaches British garden history in the landscape design program at Radcliffe Seminars, Radcliffe College, and at the Arnold Arboretum. She has written two books on Gertrude Jekyll and a new book, *The Gardens of Ellen Biddle Shipman*, all published by Sagapress. She is also editor of the *Journal of New England Garden History Society*.

'Lilac Sunday'—The Cultivar

John H. Alexander III

Lilac cultivars may be selected for fragrance, color, and abundance of flower. 'Lilac Sunday' was chosen for all these traits but even more for its very attractive habit.

Botanical gardens and arboreta routinely share seeds with one another, which they list in publications called *Index Seminum*. Reviewing the 1978 *Index Seminum* from the Botanical Garden of the Chinese Botanical Academy, Beijing, Peoples Republic of China, I checked the olive family to see what lilacs might be offered. What I found was puzzling. Listed was *Syringa persica*. The plant I knew as *Syringa* x *persica* is of uncertain parentage, believed to be a hybrid, and not known to produce progeny. If *S. persica* and *S.* x *persica* were one and the same and the Chinese plant had produced seed, the seedlings might yield evidence of the presumed parentage. Or perhaps it was no hybrid at all but an incorrectly named species native to China, in which case it was a problem for taxonomists. Whatever the parentage, I wanted to grow the plant.

We received the seeds in spring 1979. Since lilac seeds usually germinate better after a cold stratification of several months, they were so treated and were ready for sowing on August 20, 1979. By September 4, eighteen had germinated and were later potted. The seed leaves of lilacs are similar regardless of species, but when the next set of leaves appeared, the true leaves, I was surprised. Most had entire leaf margins, as do most species of lilac, but two had cut leaves like *Syringa protolaciniata* (then known as *S. laciniata* and previously as *S.* x *persica* var. *laciniata*).

What had happened? My own suspicion is that the seed-bearing parent was *S. protolaciniata*. When *S. protolaciniata* is crossed with *S. vulgaris*, the common lilac, the hybrid progeny are known as *S.* x *chinensis* (which is commonly confused and sold as *S.* x *persica*, or the Persian lilac). Still, the possibility exists that the male parent is *S.* x *hyacinthiflora*, or even *S. oblata*.

However, what is important is not the confusion in identity and nomenclature, but that one of the above-mentioned seedlings has matured into a very attractive landscape plant. The Living Collections staff of the Arboretum is pleased to introduce this new cultivar, *Syringa* x *chinensis* 'Lilac Sunday'.

The plant that bears the name of the Arboretum's annual celebration must be special. This time-honored Boston tradition draws thousands to the Arboretum in mid-May to experience firsthand the showy, fragrant flowers of the lilac collection. The Arboretum's lilacs were becoming a popular destination in peak bloom time even before the early 1900s when it became an official institutional event.

Added to that consideration is another: With the number of lilac cultivars approaching a thousand, the decision to add yet another can't be taken lightly, even though few collections hold more than a fifth of that number, and most of those are cultivars of *Syringa vulgaris* or *S.* x *hyacinthiflora*. (*S.* x *chinensis* can claim less than twenty cultivars.)

Truly the cultivar 'Lilac Sunday' *is* special, as became clear from comments made by staff members. An advantage of working at an arboretum is the ability to plant potential cultivars where other horticulturists will routinely see them. I planted the future 'Lilac Sunday' in a prominent spot at the edge of the greenhouse nursery and watched and waited. I soon learned that I was not alone in falling victim to the charms of 'Lilac Sunday'. Some of my colleagues even came looking for it after it had been relocated to a special site in the lilac collection.

The flowers of 'Lilac Sunday' are a fragrant, pale purple—78-C on the Royal Horticultural Society Colour Chart—and they produce an abundant display every year, coinciding with

PETER DEL TREDICI

Branches arching under the weight of the abundant blooms of 'Lilac Sunday'.

the earlier cultivars of the common lilac, *Syringa vulgaris*, and a few days before *S.* x *chinensis* 'Saugeana' and 'Alba'. Although each individual flower is small, about half-an-inch (13 mm), the flower panicles are produced not only at the branch tips, like the common lilac, but also from the lateral buds along the stems at a distance of two or more feet from the branch tips. The branches themselves are willowy, arching under the weight of the flowers and giving the impression of being two feet long. 'Lilac Sunday' should attain a size similar to other cultivars of *S.* x *chinensis*, about twelve feet high and as wide. With its cascading blossoms, it will make a very attractive lilac "fountain."

Easily rooted from cuttings, five hundred plants have been propagated by tissue culture for distribution at the Arboretum's fall plant sale.

Jack Alexander is Plant Propagator of the Arnold Arboretum.

JOHN H. ALEXANDER, III

Numerous inflorescences from lateral buds along a branch.

Leitneria floridana: A Shrub for Wet Woodland Conditions

Gary L. Koller

Finding shrubs that grow in wet, shaded locations poses a real challenge. Many tolerate shade and some tolerate wet soils, but tolerance of both rarely occurs in one shrub. These attributes can be found in a rare native American known as corkwood.

Leitneria floridana was first discovered in 1835 in the saline marshes of Florida's Apalachicola River where it empties into the Gulf of Mexico. The genus commemorates Dr. E. T. Leitner, a German naturalist of the early nineteenth century. *Leitneria* is monotypic, meaning that the species is alone in its genus. Until recently, the genus, too, was alone in its family, Leitneriaceae. However, recent molecular studies have shown that it belongs with the Simaroubaceae, the so-called quassia family, which includes *Ailanthus* (the tree-of-heaven) and *Picrasma*.

Leitneria floridana is called corkwood for its light wood, one of the lightest in the New World. With a bulk density of less than thirteen pounds per cubic foot, *Leitneria* is only slightly heavier than balsawood *(Ochroma lagopus)*, and its buoyancy once made stem sections useful as floats for fishing nets. The wood itself is pale yellow, soft, and close-grained, with no trace of heartwood.

Corkwood occurs naturally in three widely separated geographical areas, the largest in Missouri and Arkansas, another in Georgia and Florida, and the third in Texas. It remains rare, its range diminished due to habitat destruction. In all these locations it grows in shaded marshes in the company of other wet-tolerant species such as *Fraxinus profunda* (pumpkin ash), *Nyssa sylvatica* (tupelo), *Acer rubrum* (red maple), and *Taxodium distichum* (bald cypress). In the wild, it occurs in both fresh and brackish water. It has been theorized that *Leitneria* colonizes shaded marshes in order to escape competition from aggressive dryland species. From a horticultural perspective, this tolerance of brackish water might make *Leitneria* useful in poorly drained urban planting islands or in other plantings subjected to extremes of soil moisture and salt spray.

Leitneria is variable in both height and habit. Some colonies are loose and open while others are full and dense. The plant has been so little grown in cultivation that it is unknown whether this diversity is due to clonal variation or environmental conditions. If it is genetic, it could be the basis from which to select superior forms for garden use.

Corkwood characteristically produces a large, multistemmed colony or thicket varying from five feet to twenty in height with an equal or greater spread. At the Arnold Arboretum the largest planting dates from the late 1800s and includes five accessions, the first originating from B. F. Bush in Dunklin County, Missouri, in 1894. It is interesting to note that Bush discovered *Leitneria* in 1892 and just two years later supplied the Arboretum with plants. Additional plants came from the Parks Department in Rochester, New York, in 1925, 1927, and 1968. All are growing in what is known as the *Leitneria* swamp, a low spot where water collects and stands most of the year. They have been allowed to spread over the wet ground and have coalesced to form a thicket twelve to fourteen feet tall, approximately fifty feet long and forty feet wide.

This photograph of the Leitneria *swamp at the Arnold Arboretum gives an idea of the plants' trunk spacing, branching habit, and bark quality.*

The colony consists of a multitude of slender stems that rise separately, unbranched to a height of four or five feet. Some trunks rise straight to the upper tips while many lean with no apparent organization. The snow of April 1, 1997, squashed our colony, turning it into a tangle of stems, and led me to suspect that the disarray noted earlier is caused by storms. It would probably benefit from coppicing to encourage growth and renewed order to the trunks.

The largest stems are three-and-a-half inches thick at one foot above soil level and twelve to fourteen feet tall. Leaves are held along the upper one-third of the trunk, creating a light and airy effect. The trunks—light chocolate in color with prominent lenticels—are slender and tapering from bottom to top. I am told that in the wild, plants that grow in standing water produce thick stems at or above the water level, but that is not the case at the Arboretum, perhaps because water pools only near the center of the

Note the density of the Leitneria *colony and the play of light across its irregular contour.*

colony seasonally and is rather shallow at its maximum depth. Plants sucker from the root system, but here the spread is slow and easily contained, due in part, I would guess, to frequent grass mowing at its perimeter. In Florida, however, given the opportunity, they become one of the most rapidly spreading woody aquatics.

Flowering occurs in late April with full bloom coinciding with that of downy serviceberry *(Amelanchier arborea). Leitneria* is dioecious, bearing either male or female flowers. The flowers appear before the leaves as clustered, erect axillary catkins about one-and-a-half inches long; female catkins are smaller and more slender than the male catkins. Both are grayish in color and are relatively inconspicuous. Fruit occurs in clusters of two to four flattened, dry, brown drupes, three-quarters of an inch long and a quarter-inch wide, looking like small leathery plums. Our colony has never produced fruit, but we have recently added female plants and perhaps in a few years will have a seed orchard available for northern growers.

Leaves are simple and entire with an even edge, smooth and leathery in texture, dark green and glossy above and narrowly elliptical in shape. The gray-green undersurface has a prominent midrib and pinnate secondary veins that stand out or away from the underside. Larger leaves in the Arboretum's colony reach nine inches from the tip of the leaf to the distal end of the petiole and measure half-an-inch at their widest.

Foliage emerges just after flowering—early May in Boston. In midsummer the leaves have an attractive luster, glimmering as they reflect sunlight. The foliage is among the most persistent of the deciduous autumn leaves, remain-

The Arnold Arboretum

SPRING · NEWS · 1997

Harvard University Herbaria Open House

Robert E. Cook, Director

It seemed like an interesting idea for a birthday party, but would anyone come?

Last fall, as we planned activities to celebrate our 125th anniversary in 1997, a staff member suggested that we might have an open house at the Harvard University Herbaria. The Herbaria are the repository of five million plant specimens from around the world that, with its library holdings, constitute the most important resource for Asian botanical research in North America. The Arboretum collections are integrated with those of four other former botanical institutions: the Gray Herbarium, the Oakes Ames Orchid Collection, the Botanical Museum, and the Farlow Herbarium of Cryptogamic Botany. We thought possibly a few people might be interested in what goes on behind the scenes, so we set the date for the evening of May 8, 1997.

The exotic menu of exhibits would include a wide range of posters and presentations such as Molecular Systematics—DNA: How You Get It, How You See It, What It Means; The Baobabs of Madagascar; Clusiaceae and HIV—The Medical Connection; An Interactive Rainforest Key; Botanical Illustrations—Linking Past and Present; The Flora of China and the World Wide Web; Biodiversity Mapping Tools;

John Furlong

Long-time volunteer Bob Reed, right, and friends look on as Jinshuang Ma discusses the distribution and conservation of the flora of his native China.

Mangroves, Figs, and Chocolate. Professor Mike Donoghue, the director of the Harvard University Herbaria, and I would host the evening.

At five in the afternoon the doors opened and more than four hundred friends of botanical studies at Harvard, many of them members of the Arboretum, enjoyed the displays and talks over the next four hours. The staff were astounded at the large numbers and the level of interest shown by all in the more arcane recesses of botanical research. The visitors were enthralled, and many left with the recommendation that we hold an open house every year.

Scientists often underestimate the appetite of the general public for genuine scientific information, especially when it is presented by the researchers themselves, who cannot help but communicate their excitement with the process of discovery. Our 125th Anniversary Open House brought the truth of this home to me again; and we shall indeed find an occasion before long to bring our friends together around the botanical research that is the mission of the Arboretum.

John Furlong

A good friend of the Arboretum, Mrs. F. Stanton Deland, Jr., and Lisa Hastings, Arboretum Director of Development, view botanical prints in the reading room of the Farlow Herbarium.

Best Wishes for a Loyal Friend

Karen Madsen

Patrick Willoughby, Superintendent of Grounds for the past thirteen years, has left the Arboretum to become Assistant Director of Physical Plant at Wellesley College. With a staff of twenty-one, Patrick will be in charge of maintaining Wellesley's 300-acre campus, including natural areas, athletic fields, and a nine-hole golf course.

Patrick came to the Arboretum in 1980 as Assistant Superintendent of Grounds. Soon after, he received a Garden Club of America scholarship for study in Great Britain. As Superintendent of Grounds since 1984, he has nurtured the Living Collections through droughts, ice storms, and blizzards, errant visitors and rampant dogs. Patrick's last month here was spent putting the Arboretum back in order after the Blizzard of '97. He's been a valuable colleague and a good friend; we will sorely miss his wit and good humor.

First Call for the Annual Fall Plant Sale

Mark your calendar for the Arboretum's Annual Fall Plant Sale, scheduled for Sunday, September 21, 9 a.m., at the Case Estates in Weston. A well-established Arboretum tradition, the fall sale is our largest membership event. Last year, over eight hundred members attended the sale with its live and silent auctions and Plant Society Row. Unusual plants this year will include a new introduction, *Syringa* x *chinensis* 'Lilac Sunday' (see Jack Alexander's article), the golden larch *(Pseudolarix amabilis)*, and *Cornus kousa* 'Milky Way'.

Arboretum members will be mailed plant sale catalogs in August and vouchers for free plants in early September; members also benefit from special members-only hours and dis-

counts on all purchases made in the barn on the day of the sale. Members at the sustaining level ($100) receive an invitation to the plant sale preview beginning at 8:30 a.m. This year we will be adding a new feature: thirty-minute education sessions on planting, pruning, and overwintering plants. Mark your calendar for this horticultural happening and plan to join us!

Storm Recovery Appeal

Lisa Hastings, Director of Development

Response to the special appeal following the dramatic April storm has been tremendously positive. We received swift and very strong support from many loyal members and donors and also an overwhelming number of donations from new supporters. This generous and broad-based support is most appreciated, especially by the Living Collections staff.

To date, members and friends have made gifts totaling $122,102. All gifts are directed to the Storm Restoration Fund, which was established to help defray immediate costs associated with the cleanup as well as to support the long, deliberate process of rebuilding the Living Collections.

Our spring visitors have also shown great support for our cleanup efforts. In the two months following the storm, nearly $6,000 was collected from the donation canisters located on the grounds. Beautiful weather and extensive media coverage brought record numbers to Lilac Sunday. Special tables set up to offer information about the storm's effects on the Living Collections increased donations on the grounds, bringing the total to $8,400. We were heartened not just by the donations but also by notes applauding the Arboretum's speedy cleanup.

The work associated with replacing trees that were lost will continue long after media and public attention subsides. From this great natural disturbance, however, came a show of support that will motivate and inspire Arboretum staff for months to come.

Chris Strand

Record numbers of visitors on Lilac Sunday were overwhelmingly generous.

Dogwood Collection Named for Mrs. Fessenden

Mrs. David L. Ferguson and Mrs. Karl Riemer, both longtime members of the Friends of the Arnold Arboretum, recently made a very generous gift to endow and name the *Cornus* collection in memory of their mother, Elizabeth Taylor Fessenden. Mrs. Fessenden, who died last year at age 89, graduated from the Winsor School and served as trustee of the Women's Educational and Industrial Union, president of the Chilton Club, and member of the Ladies Visiting Committee at Massachusetts General Hospital. Mrs. Ferguson commented, "Mother had great appreciation for the gardens of Boston; we felt that endowing a collection at the Arboretum was a wonderful way to honor her memory."

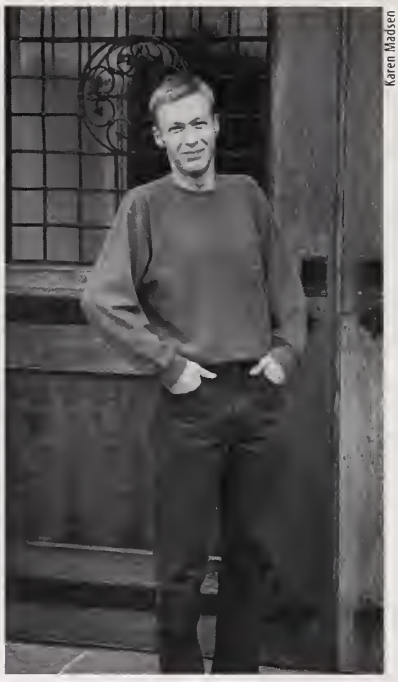
The dogwood collection—284 plants strong—is one of the Arboretum's most attractive spring features. Unlike most of the plant collections, the dogwoods have been sited throughout the grounds. One of the earliest harbingers of spring is *Cornus mas*, the cornelian cherry, which produces clusters of small, delicate yellow flowers along its leafless branches even before the forsythias

have begun to bloom. Our oldest and most beautiful specimen stands next to Rehder Pond, across Bussey Hill Road from the forsythia collection; it came to us from France in 1883. Then, when spring in the landscape is no more than a subtle green haze of emerging leaves, the snowy white and salmon pink bracts of our native *Cornus florida* arrive to enliven it. And just as they are beginning to fade, the pointed white bracts of the Japanese dogwoods begin to open. We are pleased that this special collection will be supported by a generous endowment.

For information about endowment opportunities, contact Lisa M. Hastings, Director of Development, at 617/524-1718 x 145.

Meeting the Arboretum's Public

Many friends of the Arboretum have already come to know Joseph Melanson, who came to us from Harvard's Natural History Museum. As part of the Arboretum's public programs department, he provides guidance to visitors at the information desk in our new exhibit space. Joe answers inquiries ranging from basic facts about Arboretum history to the location of both collections and specific plants. He also works closely with the membership and adult education departments to ensure that visitors are aware of all that the Arboretum has to offer.



Karen Madsen

PROGRAMS & EVENTS

The Arboretum's Education Department offers a wide variety of courses, programs, and lectures in horticulture, botany, and landscape design. A selection of summer courses is shown here. For a complete catalog of programs and events at the Arboretum, please call 617/524-1718 x 162. Note that fees shown in **boldface** are for Arboretum members. For information about becoming a member, call 617/524-1718 x 165.

HOR 338 Basic Care for Trees and Shrubs

Joseph J. Camilliere III, Consulting Arborist

Trees and shrubs are key structural elements in the landscape. In three sessions, learn the basic techniques used to care for and enhance woody ornamental trees and shrubs—from identifying stresses to pruning and feeding.

Fee: $45, $54

3 Wednesdays, July 9, 16, 23/ 6:30–8:30 pm (CE)

HOR 182 The Art of Hybridizing Perennials

Darrell Probst, Horticultural Consultant and Landscape Designer

Many of the perennials grown in American gardens are hybrids, created by intentional pollination or selected from observation of suitable species. Using the Case Estates perennial garden, Darrell Probst will demonstrate the basics of perennial plant hybridizing. He will identify flower parts, show what to look for to determine when to pollinate, and speak about helpful tools and record keeping.

Fee: $20, $24

Thursday, July 24/ 6:30–8:30 pm (CE)

HOR 292 Summer Flowering Trees and Shrubs

Chris Strand, Outreach Horticulturist, Arnold Arboretum

After the great burst of bloom in spring, what trees and shrubs delight the viewer's eye? Such handsome lesser-known horticultural stars as *Aesculus parviflora,* the bottlebrush buckeye; *Albizia julibrissin,* the silk tree; *Hydrangea quercifolia,* the oakleaf hydrangea; *Koelreuteria paniculata,* the golden rain tree; *Oxydendrum arboreum,* the sourwood; *Clerodendrum trichotomum*, the harlequin glory bower—all these are summer standouts. On this walk you will see the trees and shrubs themselves and learn about their natural history, habitat, and landscape uses.

Fee: $12, $15

Wednesday, July 30/ 6:30–8:00 pm (DG)

ing green till late November, then becoming greenish-yellow or falling still green by early December. In 1995 the Arboretum colony was thick with leaves through November 29 when the weight of a snowfall wrenched the majority of leaves from the stems.

The northern hardiness range of *Leitneria* has yet to be determined. Plants under good snow cover have survived minus 19 degrees Fahrenheit in Rochester, New York, and gone on to produce fruit. In an area of Missouri where the normal winter low falls in the range of minus 10 to minus 20 degrees Fahrenheit, a *Leitneria* colony survived unscathed an abnormally early cold snap with temperatures of minus 35 degrees Fahrenheit. Another planting in Missouri grows in a habitat very different from those found in the wild. While it is in partial shade, it grows on a five-percent slope in dry-mesic soil. It has survived serious drought and summer temperatures of 110 degrees Fahrenheit; in these conditions, it is not surprising that the colony does not spread.

It has also been reported from Missouri that when springtime roadside fires kill back the stems of *Leitneria*, plants resprout vigorously and return to their original height in about three months. Periodic mowing also stimulates new growth. Seedlings often spread into wet fields, and they thrive in areas of disturbance but are threatened by encroachment from competitors such as persimmon *(Diospyros)* and sweet gum *(Liquidambar).*

There is currently little documentation regarding corkwood's predators. Reports from the Missouri Botanical Gardens indicate that their plants suffered minor damage from the *Ailanthus* webworm *(Atteva punctella):* caterpillars attack the young growth—leaves and young fruit—making small holes. However, spraying has not been required for control. The Missouri Department of Conservation reports that in its natural habitat, corkwood develops cankers on trunks of old plants. The causative organism has not been identified. Neither problem has occurred in the Arnold Arboretum's planting.

A grower in Florida who specializes in establishing breeding colonies of native plants col-

GARY KOLLER

The flower buds of Leitneria floridana, *which expand in mid-April, are beautiful viewed close up.*

GARY KOLLER

This inflorescence, photographed near the end of April, is at the peak of flowering.

RACZ & DEBRECZY

The dark, glossy green leaves of Leitneria *are smooth and leathery in texture.*

lected wild seedlings of *Leitneria* some years ago. The young plants were gathered from a ditch with brackish water in the Big Bend area of the Florida Gulf Coast, growing under a thin canopy of sweetbay magnolias and cabbage palms. In three years a test colony of *Leitneria* grew twenty to thirty feet in every direction, sparse at first but quickly filling in and spreading faster than sweetspire *(Itea)* or chokeberry *(Aronia)*. The planting so quickly overgrew its neighbors that he cut it down and treated it with herbicides, but not before male and female plants were identified and rescued to establish a new planting for seed production.

In the more northerly climate of Massachusetts, I have lifted small divisions soon after spring thaw, well before any new growth has started. These divisions were pencil thin, twelve to eighteen inches in length, each with a small section of root. The potted propagules

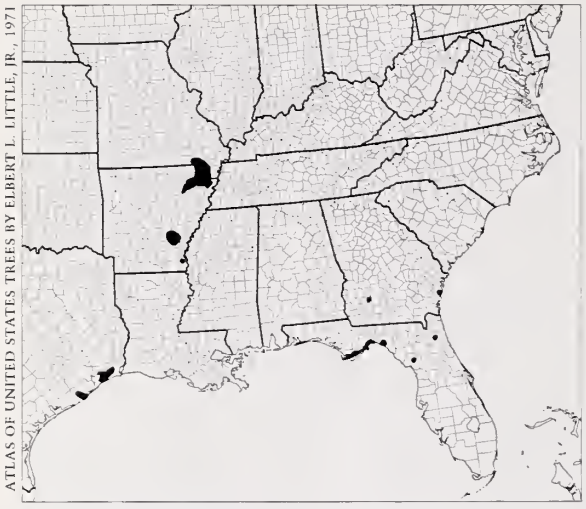
took only two to three months to develop a strong root system, and by the second spring they were sending up new shoots. *Leitneria* is also easily reproduced from layers; in Florida, one layer planted in autumn will produce eight to twelve new suckers by the end of the next fall.

What makes corkwood worthy of special attention to gardeners is that it occurs naturally in standing water, up to two or three feet in depth. In a 1940 *Gardeners' Chronicle* article, Donald Pasfield notes "that there are few other trees so strictly aquatic in distribution, *L. floridana* thrives best in permanently inundated swamps and deep sloughs where its roots are constantly wet and where to inspect it closely one must either go in a boat or wade through mud and water. Should any specimens be growing in less permanently inundated localities, where the water supply is less constant, they plainly suffer the deprivation and, under such conditions seldom exceed five feet in height."

Leitneria floridana *drawn by C. E. Faxon for C. S. Sargent's* The Silva of North America, *1890.*

In New England there are many cultivated sites with poor drainage or naturally wet conditions, often with some degree of shade. One of my recent challenges was to select plants for a shaded kettlehole pond, five to six feet deep, whose only source of water is from surface drainage. It has no natural outlet so in very wet years the pond fills up completely. It has, in fact, overflowed its banks on two occasions in the past quarter century. At the other extreme, during the drought of 1995 the pond dried up completely except for some muck at the lowest point. Few plants will survive a fluctuation of this magnitude. The owners considered their muddy oval to be an eyesore during times of low water and wanted its edge enhanced with a planting. I decided to experiment with *Leitneria.*

During the fall of 1995 when the pond remained almost dry, I planted dormant layers, two to two-and-a-half feet tall, two to three feet away from the water's edge. To my surprise, several of the young plants, anchored only by a poorly developed root system, were quickly dislodged by waterfowl and pond-dwelling animals. Spring rains caused the water level to rise two feet, almost swamping the new plants and leaving only a few inches and a small tuft of foliage above the waterline for the whole summer of 1996. Nonetheless, the corkwoods survived, producing sparse growth as they struggled



Leitneria floridana *occurs in the wild in disjunct populations in just five states—Florida, Georgia, Texas along the Gulf Coast, Arkansas, and Missouri. Nowhere is it very common, and due to habitat destruction has been placed on the federal list of threatened plants.*

to take hold. Were we to begin again, we would certainly select well-rooted container-grown stock. In the past months rain has again been abundant, and as of mid-May, 1997, the plants remained completely submerged by three to four feet of water. Will they survive? Only time will tell.

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Gary Koller is Senior Horticulturist at the Arnold Arboretum.

Book Review

Peter Del Tredici

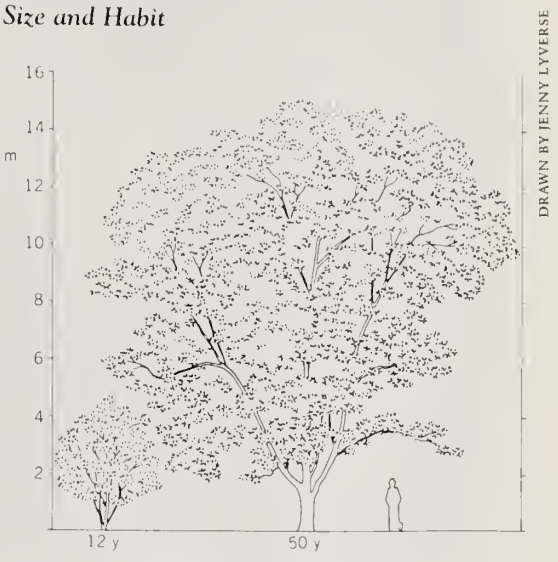
Landscape Plants for Eastern North America, 2nd edition. Harrison L. Flint. John Wiley and Sons, 1997. 852 pages. Hardcover. $95

When the first edition of Harrison Flint's *Landscape Plants for Eastern North America* appeared in 1983, it offered an alternative to many other books in the field. In particular, its strong graphic display of plant adaptation as well as its excellent line drawings by Jenny Lyverse provided a visual approach to how plants might fit into the landscape and what their habitat requirements are. The excellent graphics made the book particularly useful to landscape architects who need to visualize the forms of the plants as part of the design process.

After being out of print for a number of years, the long-overdue second edition of Professor Flint's classic work is again available. While the "Cultivars" and "Related Species" sections for most of the one thousand entries have been greatly expanded over the first edition, the book retains its primary focus on the horticultural characteristics of the species themselves. Compared with other, more cultivar-focused books, Flint maintains a measure of objectivity about the plants he describes and presents a refreshingly nonjudgmental portrait of a given plant's horticultural strengths and weaknesses.

One of the most useful features of the first edition was the twenty-four appendices at the end of the book, which categorized species according to their various horticultural attributes—size, shape, function, adaptation, and seasonal interest. The number of appendices has been expanded to forty-seven, and they cover a much broader range of plant attributes. Again, for landscape architects and designers, these lists should prove extremely useful.

On the negative side, the second edition still retains a small selection of about twenty-five herbaceous "groundcovers," included, I suspect, for the sake of completeness. The decision to include herbaceous plants may have made sense in 1983, but given the book's overwhelming concentration on woody plants, and the subsequent emergence of perennials as a subject area in their own right, their inclusion makes little sense.



Magnolia virginiana.

I was also disappointed that not all of the author's comments appear to have been updated since 1983. For example, the entry on *Eleagnus umbellata*, the autumn olive, reads: "This shrub is trouble-free, requiring no maintenance other than pruning to develop fullness and to control size when necessary." Nowhere is it mentioned that the species has become a serious pest throughout much of the East because of its invasive tendencies. On the other hand, the entry on the Bradford pear has been updated to include a thorough discussion of the problems associated with the plant's upright structure. All in all, the publication of the second edition of *Landscape Plants for Eastern North America* is an opportunity not to be missed by anyone who missed the book the first time around.

PETER DEL TREDICI

Storms and the Landscape: 1938–1997

Susan Kelley

The ice and snow storms that occur in late spring after a few unseasonably warm days come as sharp, cruel surprises, and for trees and shrubs in which the sap is rising and buds are beginning to break, the damage can be severe and even permanent. Its extent may not be seen for months or even years.

The blizzard that dumped 25 inches of snow on Boston and the surrounding area on April 1, 1997, is the most recent in a long series of weather events that have affected the trees and shrubs of the Arnold Arboretum. Although it did not pack the destructive winds typical of hurricanes, the damage incurred by this storm—the worst since that of the 1938 hurricane—has altered the Arboretum's landscape just as significantly. Indeed, each storm inflicts its unique wounds on the contents, scope, and shape of the collection. Evidence of these past events remains in the form of assymetrical or distorted crowns, wounds incurred by massive branches ripped from trunks, cracks in trunks and branches, and insect and disease infestations that result indirectly from storm damage. Mature specimens, especially, bear the scars of past storms, and as often as not, individual trees have been touched more than once. Following are some facts and figures from the major storms, 1938 to 1997: together they add up to dramatic changes in the Arboretum's collections and overall structure.

1938—The Great Hurricane

With a sudden change of course off the coast of North Carolina, the hurricane of 1938—the first to hit New England since 1815—took the North Atlantic states by surprise. Instead of curving out to sea, the storm turned and headed up the coast. When it was over, furious winds and heavy rain had caused 400 million dollars in property damage, the deaths of 608 people, and the destruction of 730 million board feet of commercial timber across New England.[1] In the Arboretum collections, where wind velocities at times exceeded 100 miles per hour and 60 mile-per-hour winds were sustained for four hours, approximately 1,500 trees were uprooted or snapped off, with the majority of the damage occurring on the tops and exposed areas of Hemlock Hill, Peters Hill, and Bussey Hill. On Hemlock Hill alone at least 400 hemlocks *(Tsuga canadensis)*, some of which dated back nearly two hundred years, were uprooted, and on Peters Hill most of the poplar collection was leveled. The conifer collection and several small flowering trees behind the Hunnewell Building were also severely damaged, and along South Street 100 red and white pines were destroyed, leaving exposed the 1,000 torch azaleas *(Rhododendron obtusum* var. *kaempferi)* and 750 mountain laurels *(Kalmia latifolia)* that were planted by E. H. Wilson in 1929 and 1930.[2]

Because most of the damage occurred in the natural woodland areas of the Arboretum, only 12 accessioned specimens destroyed by this "Great Hurricane" were not duplicated in the collections. Except for obvious gaps on exposed sites, much of the remainder of the collections was left unscathed. By late spring of 1939 most of the fallen timber had been cut and hauled away, and 625 two-foot to six-foot Canadian hemlocks and red and white pines had been planted on Hemlock Hill and along South Street. Several Carolina hemlocks *(Tsuga caroliniana)* were transplanted from the Walter Street tract to the slope behind the Hunnewell Building. Today, Hemlock Hill's pit-and-mound

Arborists John Del Rosso and Todd Byrnes begin the removal of Pinus leucodermis *amidst uprooted* P. rigida, P. cembra, *and* P. banksiana *in the Arboretum's conifer collection.*

formations remain as subtle reminders of the hurricane of 1938.

1954—Carol and Edna; 1960—Donna

On the morning of August 31 Hurricane Carol blew through the Arboretum destroying 300 trees in its path. Of the specimens removed, 46 were from the conifer collection and an additional 40 from Hemlock Hill. Spruce *(Picea)* and fir *(Abies)* were the most heavily damaged of the conifers; more than half of the specimens had trunks of 15 to 36 inches in diameter. The oak *(Quercus)* and poplar *(Populus)* collections also lost 13 and 18 trees, respectively. Several specimens from the tulip tree *(Liriodendron)* grove on Peters Hill were downed as well as 5 ashes *(Fraxinus)*, 7 hickories *(Carya)*, and 6 trees in the maple *(Acer)* collection. Only 7 of the destroyed trees were not duplicated in the collection. New gaps introduced new vistas, but some areas, such as the base of Hemlock Hill where the hill itself was exposed, were for years a constant reminder of the force of this hurricane.

Hurricane Edna hit eleven days later, on September 11, but caused just 15 percent of the damage to the collection as Carol had. Only 24 accessioned plants had to be removed plus several nonaccessioned Douglas firs *(Pseudotsuga menziesii)*. Of the 24 trees destroyed, 8 were not duplicated in the collection. Hurricane Donna, which struck the Northeast on September 12, 1960, was even less destructive. It damaged only 40 trees and shrubs in the Arboretum, and of these, 8 were removed.

1966

In February, heavy wet snow fell throughout the eastern part of the United States, causing many branches of trees and shrubs to bend and break. Arboretum horticulturist Donald Wyman, who devoted much of his writing to plant hardiness, reported on the effects of the heavy snow on woody plants. Without making specific reference to trees in the Arboretum collection, he noted the damage to willows, red and silver maples, and lindens, which are weak-wooded species and thus more likely to break under such conditions. Specimens of Douglas fir, another weak-wooded species, and dogwood

Pulling Back Trees

In the midst of post-storm clearing of broken branches and downed trees, the Arboretum's grounds crew has often gone to great efforts to salvage as many trees as possible. After the 1938 hurricane, some of the smaller trees that were blown over were pulled back into position, and in 1954, within ten days of Hurricane Carol, the grounds crew was able to upright and stake 100 young, immature trees that were uprooted or tilted. Of these 100, 24 remain in the collection today, including a stately *Magnolia acuminata* (494-40*B) dating from 1940 and standing next to the Arborway wall; a large *Magnolia kobus* (141-41*A) from 1941, growing near the Hunnewell Building; a *Tsuga caroliniana* (19447*D) planted on Peters Hill in 1926; and 20 of the crabapples and hawthorns on Peters Hill.

Twenty-seven individuals that were either blown over or loosened at the base in Hurricane Edna (1954) were straightened and staked, but only 3 of those remain in the collection today: *Cedrus libani* (5-42*C) on Bussey Hill, dating from 1942; *Juniperus communis* (792-41*A), from 1941; and a *Crataegus crus-galli* (14015*A) on Peters Hill that dates from 1903. Interestingly, 10 of these 27 plants had been uprighted after Carol. These 10, along with the other salvaged trees from Edna, were dead within two to ten years of the date of the storm.

After Hurricane Donna (1960) 25 plants were pulled back and staked; 8 of those had been pulled back after Carol in 1954. Today 12 of those damaged by Donna survive in the Arboretum's collection, including 2 that were uprighted in 1954—*Carya laciniosa* (12898*P) and *Malus glabrata* (11165*B).

ARNOLD ARBORETUM ARCHIVES

Arboretum crew "pulling back" a box elder (Acer negundo) *after Hurricane Carol in 1954.*

apparently also broke up under the weight of heavy snow that winter.

1969

Reports of record-breaking snow in the *Boston Globe* likened the destruction from the nor'easter on February 9 to that of the hurricane of 1938. Yet another storm, February 24 through 28, was touted as the worst in Boston's history. In all, an estimated 50,000 trees in Boston alone were damaged by the storms, including approximately 100 trees in the Arboretum. Most were damaged from the wet, heavy snow that fell early in the month. Although no trees were uprooted or felled, many in the beech, hornbeam, maple, and magnolia collections and several crabapples on Peters Hill were broken up, as were 8 of the prominent magnolias growing in front of the Hunnewell Building. Three of those magnolias were removed in 1992 for the construction of the new access ramp. Three others suffered major damage in the storm of 1997 but remain in the collection today.

1976, 1977, 1978

No one living in New England at the time can forget the winter of 1978. January brought 40 inches of snow to Jamaica Plain with another 27 on February 6 and 7. The February blizzard was so severe that the governor of Massachusetts declared a state of emergency. Traffic was halted, businesses were closed for days, and citizens were advised to stay at home. Several weeks passed before the grounds of the Arboretum were accessible to clean-up crews. Clear skies and harsh winds desiccated many broadleaved evergreen plants. That year the flowers of spring-blooming shrubs and trees were confined mostly to lower branches since the buds on the top portions, injured by the winds, did not fully develop. Nonetheless, although great drifts accumulated, the snow was light and powdery, and there is no recollection, verbal or written, of any lasting damage to the trees and shrubs in the Arboretum.

In Boston the events of the blizzard of 1978 certainly overshadowed the harsh winter of 1976–1977, but for the plants in the Arboretum, the cold temperatures, snow accumulation, and high winds of 1976–1977 had lasting effects. Whereas Arboretum plant records contain no reference to the 1978 blizzard, no less than 42 entries note damage to plants from the January 1977 snow. Several groups of plants located between the Hunnewell Building and Bussey Hill experienced especially severe damage: the maples, amelanchiers, birches, hackberries, magnolias, lindens, and elms.

1985—Gloria

On September 27, the Arboretum staff prepared for what was predicted to be the worst hurricane since the Great Hurricane of 1938. Fortunately, Gloria traveled inland and northwesterly through the Connecticut River Valley. Although wind velocities in the Boston area never reached hurricane force, sustained winds of 50 to 60 miles per hour were recorded and the damage to the Arboretum was significant. A total of 45 accessioned trees were destroyed and another 100 sustained major damage. Two taxonomically important plants were lost in Gloria: *Euptelea polyandra,* the only remaining individual of that taxon of C. S. Sargent's Japan collection, and x *Crataegosorbus miczurinii,* which was severed at its base. It was during Gloria that the "sibling" of the silver maple *(Acer saccharinum)* on Meadow Road, which is the tallest deciduous tree currently on the property, was destroyed. Four plants of the 45 destroyed were the only representatives of their taxon—including *Abies concolor* 'Glenmore' and *Carya* x *laneyi,* the type specimen collected in 1895 by John Jack on the shores of the St. Lawrence River—and have not been replaced since.[3]

The Blizzard of 1997

The 1990s have seen their share of hurricanes, snow, and ice, but in terms of damage to plants, none compare to the blizzard of 1997. Indeed, no single weather event since the 1938 hurricane has altered the Arboretum's landscape as did the blizzard of April 1, 1997. Coming after a mild and essentially snowless winter, the freezing rain followed by more than 25 inches of heavy, wet snow that accumulated during the afternoon of March 31 and into the next day was truly a surprise. The grounds maintenance crew worked quickly to clear roads and pathways and

KAREN MADSEN

Although the spring flow of sap makes branches more flexible, the weight of the snow from the April 1 storm was too great for many trees. This Carpinus betulus *is one of six hornbeams scheduled to be removed.*

to remove the hazardous trees and branches. Within three weeks the curatorial staff had surveyed the entire Arboretum property (except for the Walter Street tract) and identified a total of 1,705 damaged plants, or 13 percent of the Arboretum's total accessions.

We defined various categories of damage: trees with more than 50 percent crown damage or large stress fissures in the trunk are considered "removals"; trees with 25 to 50 percent damage sustained "major" damage; and trees with less than 25 percent have "minor" damage. Of the total, 584 trees suffered major damage, another 836 had minor damage, and 285 are removals. Thirty trees were uprooted. An additional 200 nonaccessioned trees growing on Hemlock Hill experienced damage: 12 were uprooted, 28 had major damage, 40 had minor damage, and at least 85 were either snapped off at one to fifteen feet from the base or had the very top broken out and are considered removals.

Although the extent of the damage rivals that of the Great Hurricane, wind did not play a major role in this storm. Out of almost 2,000 damaged trees, there were relatively few blowdowns, as would be typical of wind damage. Rather, the damage was mechanical, more a function of how branches caught and held the wet snow. The evergreen foliage of conifers provided a large surface area for accumulation, and small flowering trees with horizontal branching structure bent to the ground under the weight of the snow, which was greater than the branch size could accommodate. In many cases, evidence of previous damage, disease, or rot was apparent in broken branches, but what was surprising was that many of the trees damaged appeared to be healthy, adding to our determination that the sheer weight of the snow was the primary cause of destruction.

Accordingly, damage was not uniform throughout the collection. Most affected were the conifers, beeches, hornbeams, oaks, Japanese maples, and lindens. Conifers were the hardest hit group: 698 of the total 1,705 experienced some form of damage. Of these, 141 will be removed. A walk along Conifer Path reveals

the devastating effects. Although not necessarily of significant taxonomic importance to the collection, many trees, long a part of the defining character of that section of the Arboretum, are either gone or their typical forms destroyed. Pines in particular suffered tremendous damage. Throughout the collection nonaccessioned specimens of our native white pines *(Pinus strobus)* lost numerous massive branches, and at least 16 of those accessioned were damaged. Eight of the 16 damaged Japanese black pines *(P. thunbergii)*, which are so distinctive in the landscape, may have to be removed. Scots pines *(P. sylvestris)* planted within the main conifer collection and elsewhere on the property also broke up under the weight of the snow: 14 had major damage, 10 minor damage, and at least 6 were removed. In all, 208 specimens of *Pinus* were damaged; 109 *Picea*; 67 *Abies*; 52 *Tsuga*; 40 *Chamaecyparis*; and 36 *Thuja*. Included in the damaged conifers are several original collections of C. S. Sargent and E. H. Wilson.

Even the most casual observer walking along Valley Road cannot help but notice the devastating effects of this storm. Massive limbs were ripped from 80- to 90-foot oaks, and the hornbeam collection may never look the same. Their densely spaced branches, made more limber by the spring flow of sap, bent to the ground and in many instances snapped. In all, 27 of 78 hornbeams were damaged: 6 will probably be removed, 15 suffered major damage, and 6 minor damage.

The oak trees adjacent to the walnut collection were basically unhurt, but those growing at slightly higher elevation farther down Valley Road toward the beeches experienced some of the worst damage in the entire Arboretum collection. Hundreds of fallen branches littered Valley Road and the ground below the oaks, while many other broken limbs hung precariously above. No fewer than 62 oaks bear the scars of this storm, and an additional 12 will be removed. The beech collection, weakened by disease and previous storms, was also ravaged by the weight of the snow. At least 51 were damaged. The stately *Metasequoia glyptostroboides* that graces the intersection of Valley Road and Hemlock Hill Road also could not withstand the load of the snow: several branches broke

PETER DEL TREDICI

Pinus leucodermis, *one of three removed from the conifer collection. Another specimen of the same accession sustained major damage in the 1997 blizzard.*

PETER DEL TREDICI

A variety of Japanese white pine (Pinus parviflora *var.* pentaphylla), *a graft from a scion taken by Charles S. Sargent in 1881 from a plant on his estate in Brookline.*

PETER DEL TREDICI

Arborists from the Bartlett Tree Company helped for a week in the clean-up after the April 1 storm, using their alpine aerial lift. Several of the black oaks (Quercus velutina) *visible from Valley Road had to be heavily pruned or removed.*

about 4 feet out from the trunk. Five other dawn redwoods growing in the conifer collection and near the Hunnewell Building experienced similar damage.

Throughout the landscape, small flowering trees such as magnolia, crabapple, dogwood, hawthorn, witchhazel, pear, and cherry—230 in all—suffered. Thirty-two of this number were magnolias, of which 4 had to be removed. The gap left by the removal of the *Magnolia* 'Leonard Messel' that grew in front of the *Leitneria* swamp constitutes a significant change to that section of the Arboretum. Twenty-two magnolias growing around the Hunnewell Building had limbs broken by the snow; 3 of these prominent trees also suffered broken limbs in the snow storm of 1969.

In this blizzard, unlike the hurricane of 1938, the exposed areas of Bussey Hill and Peters Hill were spared. Birches that are prominent on the slopes of Bussey Hill were untouched, but those that were planted within the conifer collection were at the mercy of the many branches falling from the evergreens. On Peters Hill over 200 specimens of conifers and small flowering trees growing in more protected areas at the base of the hill on the north and northeast sides experienced heavy damage: 40 trees were identified as removals, 73 had major damage, and 94, minor damage.

A major loss to the collection is a venerable specimen of *Styrax japonica* that was grown from seed collected by C. S. Sargent in Japan in 1892 and planted near the Centre Street gate. After the ice storm of March 1995, a large limb was removed from this specimen, and several cracks formed in some of the remaining limbs so it was only a matter of time before another storm would strike the final blows. *Carya* x *brownii*, a hybrid of the native pecan *(C. illinoensis)* and bitternut *(C. cordiformis)*, was completely uprooted in the same Centre Street gate area. It is the only tree lost in this storm that is not represented elsewhere in the collection.

The heavy, wet snow of the April 1 blizzard clearly wrought an enormous amount of damage on the Arboretum collections. The grounds maintenance staff along with summer interns will spend many months cleaning up from this storm, and the greenhouse staff will attempt to repropagate severely damaged species. The arborists and curation staff no doubt will continue to uncover damage from this latest storm, and plant records will be amended and maps edited to reflect the changes in the collections. The gaps left by the lost specimens and the scars on those that remain will for years serve as reminders of the effects the Blizzard of 1997.

Endnotes

Curatorial staff can draw on a variety of resources for historical data on plants. Plant records, which have been maintained since the Arboretum's inception, offer invaluable information on the condition (current and past) of individual plants. Daily weather records maintained by greenhouse personnel and dating back to 1918 give concise meteorological data. Arboretum directors' reports and articles published in *The Bulletin of Popular Information, Arnoldia*, and local newspapers describe the severe damage suffered by groups of plants and individual specimens in the collection as well as the not-uncommon inconsistencies of New England weather and its effects on trees and shrubs. In addition, photographic images of individual specimens and portions of the collection that have been affected by storms are maintained in the Arboretum's archives and provide a unique perspective of the landscape over time.

[1] Leonard Ware, *New York Times*, Sept. 24, 1939; Donald Wyman, letter to Charles F. Irish, Nov. 29, 1938, Arnold Arboretum Archives.

[2] Ida Hay, *Science in the Pleasure Ground* (Boston: Northeastern University Press), 1995, 213.

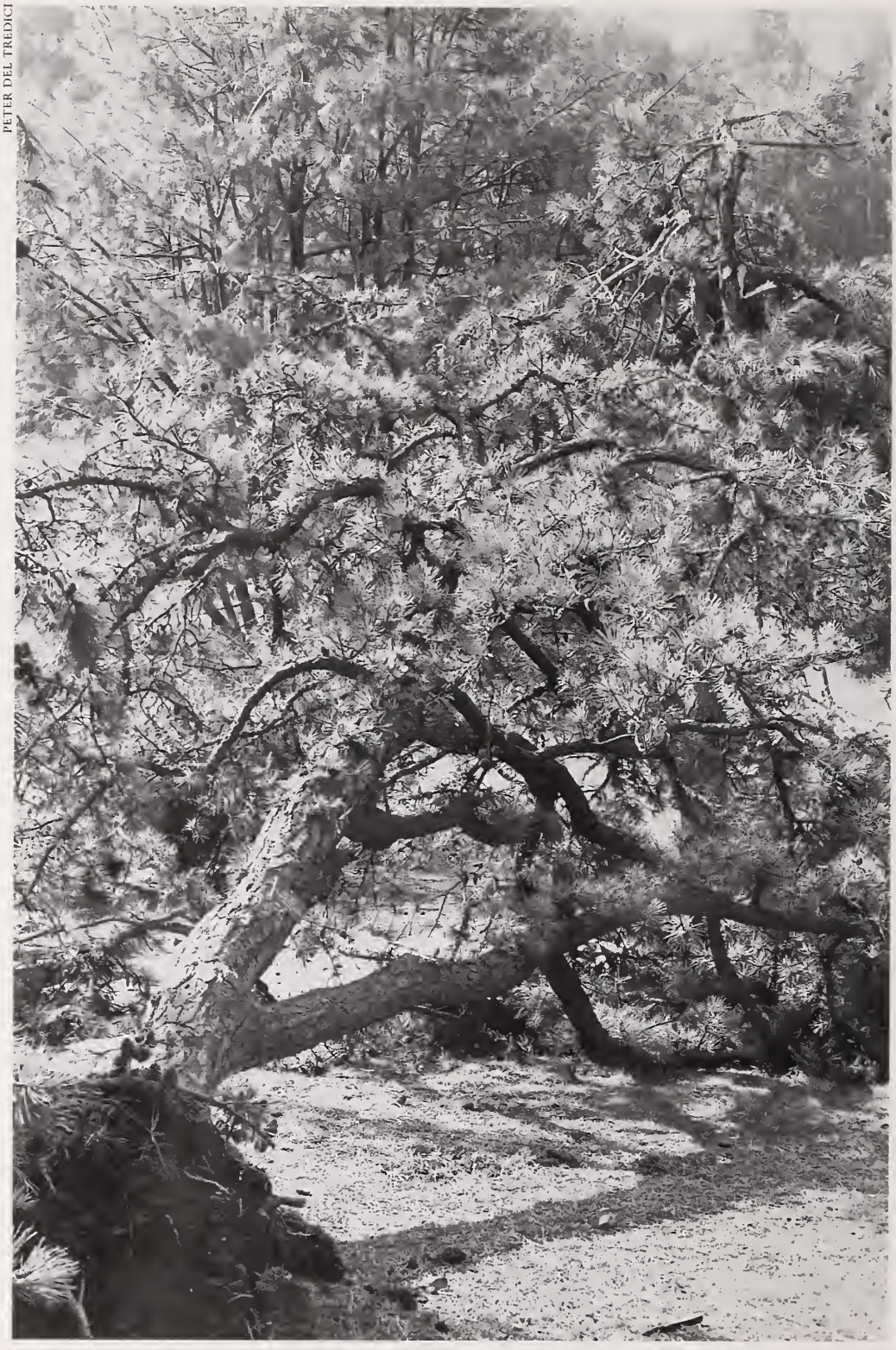
[3] *Carya* x *brownii*, like *C.* x *laneyii*, a plant lost in Hurricane Gloria that was also unduplicated in the collection, are both taxa named by Charles S. Sargent: in the first instance, from a plant he saw growing near a small grove of *C. illinoensis* near the Arkansas River, and in the second, from a single tree growing in dense shade with *Carya cordiformis* and *Carya ovata* in Quebec. Because the identity of each of these new species was based upon single individuals, one could perhaps question the taxonomic merit of such plants.

Acknowledgments

Special thanks to Kyle Port, Curatorial Assistant responsible for plant records, for his energy, expertise, and wit while assessing storm damage, and to Beth Bardon, mapping and labeling intern, who saw and touched more plants in the Arboretum in three weeks than do most interns in an entire summer.

Susan Kelley is Curatorial Associate in charge of mapping and labeling at the Arnold Arboretum.

PETER DEL TREDICI



This pitch pine (Pinus rigida) *was one of 30 accessioned trees uprooted in the 1997 blizzard. The heavy, wet snow, poor soil, and shallow roots all contributed to this tree's demise.*

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Front cover: Forest plantations at the Biltmore Estate in Asheville, North Carolina, photographed by Alan Ward.

Inside front cover: A 65-foot tall paperbark maple *(Acer griseum)* photographed in eastern Sichuan by E. H. Wilson in 1910.

Inside back cover: In 1917, Wilson photographed *Acer triflorum* in the mountains of what is now North Korea. He considered it "among the handsomest of Korean trees." Three young specimens grace the path to the Arboretum's Hunnewell Building.

Back cover: Mosses under a forest of red spruce *(Picea rubens)* on an island off Maine. Photograph by Peter Del Tredici.

GARDEN CLUB OF AMERICA

From Private Allée to Public Shade Tree: Historic Roots of the Urban Forest

Henry W. Lawrence

Since the middle of the nineteenth century the urban landscapes of Europe and America have been notable for their extensive plantings of trees. Along boulevards and in the large parks and small squares of most cities, trees shape and ornament the landscape in ways that are familiar everywhere. Before the 1850s the use of trees in public areas was less common, and planting patterns differed distinctly from one country to another. These patterns originated in the late sixteenth century, when ornamental plantings first began to shape the public landscapes of Western cities. Before that time, during antiquity and the Middle Ages, city trees were found mostly in private gardens and only rarely in streets or other public spaces. Most of the early plantings in the public landscape were patterned after those of private gardens, but as the use of trees increased, new landscape forms were developed for new settings and new purposes; these new forms even added new words to the vocabulary of urban geography.[1]

The distinctive patterns by which trees were introduced into the public urban landscape reflected national differences in urban life and in the way cities expanded from their medieval conformations. As urban cultures converged, planting forms that were

A watercolor showing the avenue of Lombardy poplars planted under the direction of Thomas Jefferson along Pennsylvania Avenue, leading to the U.S. Capitol. Signed by G. Burton, 1824.

developed first in one country for one purpose were adopted later in other countries, often for different purposes. The major cultural centers that fostered new types of urban plantings were found in France, the Low Countries (especially the Netherlands), Great Britain, and the British colonies that later became the United States. Italy and Germany, and to a lesser extent Spain, played vital roles in this process but were much less important as centers of innovation.

The First Innovations: Urban Allées

The earliest public plantings in cities adapted the form of the garden allée to new purposes. Since the Renaissance, rows of trees had been used to help structure the spatial composition of large private gardens, first in Italy and then more widely in France. In the late sixteenth century, ancient city walls were converted into massive earthworks to withstand the new weapons and siege tactics of the age, and these newly enlarged structures were planted with allées of trees. The first were apparently in Antwerp, in the Spanish Netherlands (in what is now Belgium), and in Lucca, Italy, both planted in the 1570s. They were meant primarily to provide shady promenades for city residents, although they may also have been intended to camouflage the city walls when seen from a distance.[2]

COURTESY OF THE LIBRARY OF CONGRESS

A section of De Wit's 1695 plan of Cologne shows rows of trees planted on the city walls and two medieval church squares also planted with trees.

At the end of the sixteenth century allées began to appear in recreational areas, where they were used for bowling, for archery, and most importantly, for a new game very popular with the upper classes in the first half of the seventeenth century, similar to croquet and called in Italian *pallo a maglio*, in French *palmail*, and in English *pall mall*. Special areas of lawn lined with trees were laid out for the game, first in Paris in the 1590s and later in Berlin (Unter den Linden) and London (Pall Mall) by the 1650s.[3]

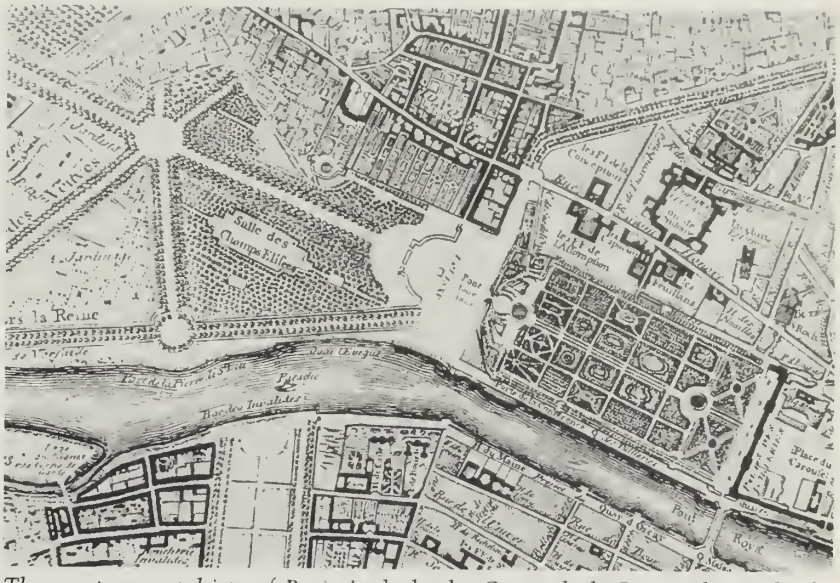
In 1616 another innovation appeared in Paris: an allée of much larger proportions, planted specifically for recreational carriage riding. Called La Cours de la Reine, it was built on the orders of Marie de' Medici, the new Queen of France, who had learned the pleasures of carriage riding in Florence. The Cours was laid out alongside the Seine, just beyond the walls of the newly enlarged Tuileries garden, and was itself walled off to public access.[4] The form of the *cours* was imitated in most major French cities by the middle 1600s and in London, Berlin, Madrid, and Rome by the end of the century.

Later in the seventeenth century another form of allée emerged in France, most prominently in Paris: the exterior avenue, a tree-lined road leading from a main city gate. The most important was the Avenue des Tuileries (now the Avenue des Champs Elysées) to the west of the Tuileries garden, just north of the Cours de la Reine. The avenue combined the form of the garden allée with that of the tree-lined rural road, which goes back farther in history.

Around the same time a fourth variant of the allée was constructed, again in Paris, in the form of the circumferential tree-lined boulevard, no longer atop rebuilt defensive walls but on the remnants of ramparts Louis XIV had decommissioned beginning in 1670. By the

end of the century the whole of the ramparts on the north side of Paris were transformed into a continuous promenade with double lines of elms on either side. Here at the boundary between city and countryside, the allée provided a delightful elevated pleasure ground, popular for promenades on summer evenings. In the eighteenth century it attracted a number of expensive shops, restaurants, theatres, and other amusements, thereby becoming more like a tree-lined street than originally intended.[5]

All these variants of the allée were first introduced into the urban landscape at its edges: alongside, just beyond, or atop city walls. Most were originally intended as places for recreation, separate from the city itself. It was only when the cities later expanded that the allées were surrounded by buildings and made part of the street system, as in the case of Unter den Linden, which as a result of Berlin's growth changed from an exterior mall into a tree-lined street in the heart of a newly built-up area.



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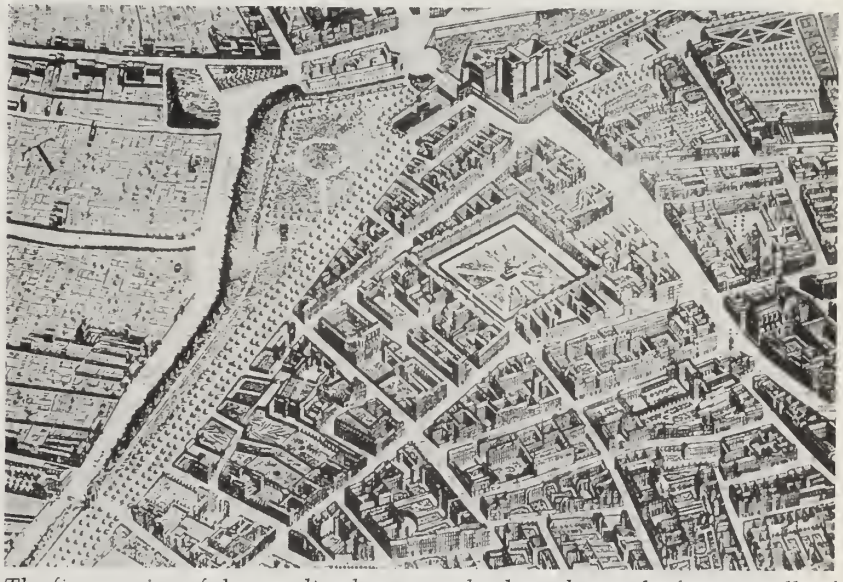
The western outskirts of Paris include the Cours de la Reine alongside the Seine and the Avenue des Tuileries running through the Champs Elysées. Plan of Paris by John Roque in 1754.



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The first section of the tree-lined promenade planted atop the former walls of Paris in the 1670s is shown as it was in 1739 in Turgot's engraving. The large bastion was known as the Grand Boulevart and gave its name to the promenade and to posterity.

The Use of Trees in New Urban Areas

As towns and cities grew in population in the seventeenth and eighteenth centuries they were at first prevented from expanding outside their newly enlarged walls by the enormous expense required to rebuild these massive fortifications. When population pressures finally forced a move beyond the walls, the expansions were carefully thought out and followed long range plans that sometimes included open spaces with trees. This early form of city planning took on different characteristics in different countries, resulting in widely different patterns of tree plantings. The cases of Holland and Great Britain provide good illustrations of these differences.[6]

Urban Expansion in Holland: Tree-lined Canals and Streets

The earliest and most widespread planting of trees in the newly enlarged cities occurred in the Netherlands. It appears that trees were first planted along exterior canals (much as they were elsewhere on city walls) that later were surrounded by new construction. But in the early years of the seventeenth century, as several Dutch cities expanded rapidly to accommodate a sharp rise in population, entirely new areas were laid out around new canals lined with trees. The rows of trees thus became widespread throughout the urban fabric, in residential and commercial areas as well at the periphery of the city.

The expansion of Amsterdam after 1615 was the largest and best known, but many other towns and cities also included tree-lined canals in their new districts. In some Dutch towns old canals were filled in to form streets and in a few towns these streets were planted with rows of trees. These new urban landscapes were unprecedented and astounded people from other parts of Europe. Even French visitors, familiar with a wider use of urban greenery than other Europeans, were amazed at the extensive tree plantings in the interior of Dutch cities. One visitor in the 1660s facetiously reported that he could not tell whether he was seeing a town in a forest or a forest in a town.[7]

COLLECTION OF THE AUTHOR

One of the earliest tree-lined canals of the Netherlands was the Oude Delft, seen in this early twentieth-century postcard view of Delft.

COLLECTION OF THE AUTHOR

An old postcard view of Leicester Square in London. The gardens were first laid out around 1720.

Urban Expansion in Great Britain

An altogether different landscape form was used as urban areas expanded in Britain from the late seventeenth century into the middle of the nineteenth century—the residential square. Unlike most public squares on the continent, British squares were used as centerpieces for new development projects comprised of several blocks of new housing around an open space that was usually railed in, with a garden at the center. The earliest squares were paved or simply planted with grass, but in later years they included trees and shrubs. By the end of the eighteenth century most of the residential squares had been turned into leafy parks, some with a great variety and density of plantings. London, Bath, and Edinburgh made extensive use

of green squares and the variant forms of circuses and crescents. These parks were for the exclusive use of the surrounding tenants, however, and were not open to the general public. Some are still private today, but others rank among the most important public green spaces in what is now central London: Grosvenor Square, Berkeley Square, Russell Square, Leicester Square.[8]

Early Tree Choices in Europe

Evidence regarding the tree species used in these early forms of urban planting is scanty at best, but they are known to be limited in number. Elms *(Ulmus)* seem to have been preferred above others and were used on the boulevards and the Cours de la Reine in Paris and for the avenues at Versailles, as well as on the Mall in London. The Avenue des Tuileries, however, was first planted in the 1670s with horse chestnuts *(Aesculus hippocastanum)* and sycamore maples *(Acer pseudoplatanus)*. Lindens *(Tilia)* were used on the canals in Amsterdam in 1615 and along Unter den Linden in Berlin in the 1640s and were intermixed with elms on the Avenue des Tuileries in Paris when it was replanted in the 1760s. The London plane tree *(Platanus* x *acerifolia)* did not appear until the end of the seventeenth century. Berkeley Square is reputed to have the oldest surviving plane trees in London, planted in the 1760s. All these species are tolerant of compacted, somewhat poorly drained soils, and are easy to transplant—vital attributes for urban trees then as well as now.

American Innovations and Imitations

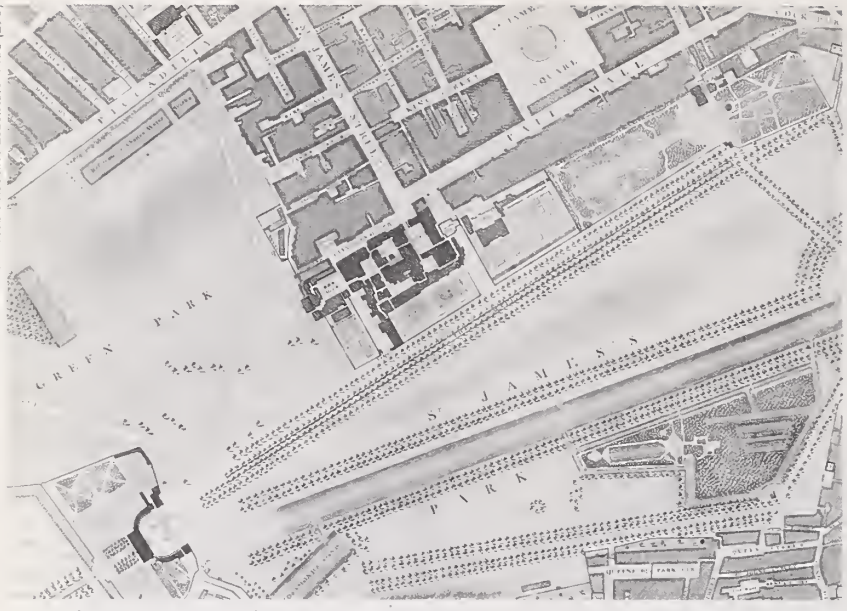
An entirely different opportunity arose in the American colonies where plans for many new towns were informed by a strong desire to experiment with idealized urban forms, including new kinds of public spaces that were often planted with trees. New Haven with its nine equal squares, the middle one left open as a kind of public park; Philadelphia with its original plan for five public squares; and Savannah with its repeating pattern of squares and parks were among the most innovative.[9]

More significant for the later development of urban landscapes in America, however, were two distinctive features common to colonial towns. The first was building density, which varied widely from town to town but was usually much lower than that of towns in Europe. After receiving a map of New Amsterdam in 1660, the directors of the Dutch West India Company in Amsterdam complained to Peter Stuyvesant that the houses were surrounded by "excessively large lots and gardens."[10]

The second characteristic that distinguished most colonial towns from their European counterparts was the practice of leaving street tree planting to private citizens, rather than making it the responsibility of the government. This resulted in a heterogeneity unknown in Europe. In 1748 trees that lined many of New York City's streets attracted the attention of Peter Kalm, the Swedish botanist. He noted the presence of plane trees *(Platanus occidentalis)*, black locusts *(Robinia pseudoacacia)*, lindens, and elms. Albany in the 1760s was described by another observer: "The town . . . was a kind of semi-rural establishment; every house had its garden, well, and a little green behind; before every door a tree was planted, rendered interesting by being coeval with some beloved member of the family; many of their trees were of a prodigious size and extraordinary beauty, but without regularity, every one planting the kind that best pleased him."[11]

Large City Parks and Gardens

After allées, the most important landscape forms for bringing trees into cities were the large city park and the large public garden. Most public gardens began as royal gardens, of which large sections were usually open to the public and which devolved into state ownership with the demise of monarchies. The gardens of the Tuileries and of Luxembourg in Paris and the Tiergarten in Berlin are the best-known examples, but there were dozens more across Europe. On the continent these semi-public open spaces usually included carefully tended beds of flowers and shrubs between allées of trees lining crushed gravel paths, all laid out in regular geometric arrangements characteristic of formal gardening. Outside some cities were large hunting parks, usually forested, and less frequently open to the public. Near London, however, were several royal hunting parks that



Part of Green Park and St. James's Park in Westminster in 1746 are seen in a portion of John Roque's map of London. The original Pall Mall had been replaced by a street, but a new mall ran alongside St. James's Palace, at center, to Buckingham House (later Buckingham Palace), at lower left.

admitted certain classes of the public for recreation as early as the seventeenth century. The first of these was St. James's Park, followed by Green Park and Hyde Park, all to the west of London in Westminster.[12]

In America there was no comparable public use of private gardens and parks, although some wealthy residents occasionally opened their gardens to visitors. More important for the eventual development of parks were the large areas of publicly owned land adjacent to some towns and reserved for future expansion. In the early years much of this land was used for recreational purposes, as well as for grazing livestock or drilling militias, and portions were kept for public parks when the majority was sold to developers to accomodate urban growth. The Boston Common, the earliest example, and New York's City Hall Park originated this way. Other large parks were created in the nineteenth century on land purchased for that purpose by city authorities, such as Philadelphia's Fairmount Park and New York's Central Park.

Late Eighteenth- and Early Nineteenth-Century Elaborations

By the middle of the eighteenth century trees were being planted in an ever increasing number of ways in the urban public landscapes of western Europe and America. Regional differences were beginning to give way to more cosmopolitan landscape forms. Especially prominent in much of Europe were forms derived from innovative uses of the allée in France. These forms were variously called malls, promenades, or boulevards. Allées laid out originally for playing pall mall might be converted to carriage promenades, then to pedestrian promenades, and finally to arterial streets when the area succumbed to urban expansion.

As cities grew larger, parks and gardens also began to play a more important public role, as places for recreation and as open space inside a densely built urban landscape that was beginning to lose touch with its rural surroundings. On the continent most of the large parks and gardens owned by royalty had been opened up to the entire public, but as late as the 1830s access to most of the royal parks to the west of London was still limited by gatekeepers to well-dressed people, thus excluding the lower classes. The need for public space in the city became a contentious issue in Parliament, forcing grudging action upon the reluctant crown, city, and local boroughs. The first new London park meant for full public access was Victoria Park, to the east of the city, opened in 1846.

Provincial towns and cities in Britain, on the other hand, had been laying out public parks since 1830. One of the most influential of these, laid out in the 1840s in the community of Birkenhead, near Liverpool, was dubbed "the people's park." It was visited by Frederick Law Olmsted in 1850, and its accessibility and rural atmosphere served as models for Olmsted a few years later when he and British-born architect Calvert Vaux designed New York City's Central Park.[13]

To a certain extent, the design of these new British parks reflected the changing tastes of the

COLLECTION OF THE NEW YORK HISTORICAL SOCIETY

New York City's Union Square, about 1840.

times, as the geometrically arranged allées and avenues of the early eighteenth century gave way to irregular clumps of trees scattered across open fields by the end of the century, with beds of shrubbery and perennials added during the nineteenth. But even earlier, British parks had had a predominantly rural atmosphere, unlike the more formal public gardens on the continent, creating a contrast with the urban environment that became even more striking in later years when the parks' relative locations changed from peripheral to central as they were surrounded by urban developments. A much larger number of tree species was used in the parks than was the case along streets or in residential squares, including many of the "forest trees" deemed unsuitable for other urban uses, such as oaks *(Quercus)* and beeches *(Fagus)* and the occasional conifer, as well as a wide variety of smaller trees and shrubs.

In the independent United States of the 1780s, along with an increase in the number of street tree plantings in many towns, there was some movement toward establishing city parks and gardens. Around this time, the municipal government of New York City established the Battery, City Hall Park, and the cemetery in Greenwich Village that later became Washington Square. The 1790s saw a continued increase in planting, especially of the newly arrived Lombardy poplar (*Populus nigra* 'Italica'), which Thomas Jefferson had first encountered in France in the 1780s and ordered installed along Pennsylvania Avenue in Washington, D. C., when he was President. Although Lombardies were intensely disliked by some, they were planted in many cities to commemorate George Washington after his death in 1799, and most of the streets in New York and Philadelphia had at least a few of them by 1800.

By this time Americans had their share of all the forms of urban greenery used in Europe. Most towns had at least a bowling green, a public park with shady walks, a seaside promenade, and perhaps a pleasure garden named after London's Vauxhall, Ranelagh, or Spring Garden. New York had the most complete ensemble, with its Bowling Green, Battery, City Hall Park; tree-lined streets (by the 1830s most major streets had rows of trees on both sides); several private pleasure gardens; and even a British-style residential square, Hudson Square, laid out in the first decade of the nineteenth century, with others like Gramercy Park and Washington Square following in the 1830s and 1840s. In Boston, the Common had had a mall since the 1720s; in the 1790s Charles Bulfinch created the British-style Tontine Crescent, modeled on the crescents of Bath and London, where he had studied architecture; and Britain's residential squares were imitated in Pemberton and Louisburg Squares, the latter still gracing Beacon Hill though closed to the public. And in the late 1830s the Public Garden had been added to the Common.[14]

Internationalization of the Western Urban Landscape in the Late Nineteenth Century

By the 1840s most cities in western Europe and America had begun to use a range of landscape forms that incorporated trees in the urban landscape and were accessible to the entire public. National differences still remained: residential squares were found in both Britain and America, but Americans planted trees along many inner

city streets, unlike the British. Formal gardens and tree-lined boulevards were most common in France. The tree-lined canals in Holland were still unique. Germany presented a more complicated picture with many different forms being used, some similar to French models, others more like the British. But almost everywhere the most common forms were shared: tree-lined promenades, large public parks and gardens, and small plazas and squares. The language of urban design had become as internationalized as the languages of architecture or painting. Each new urban expansion or redevelopment used more cosmopolitan forms than had the preceding ones, and by the 1850s there were fewer and fewer differences among the new sections of most cities, be they in France, Germany, or the United States.

The renovations of Paris in the 1850s and 1860s under Baron Eugène Haussmann brought all these forms together in one urban setting and created a model that exerted a powerful influence on urban designers throughout the world in the next half century. Haussmann's methods of renovation were incorporated into the Beaux Arts style of architectural and urban design that was used throughout the Western cultural realm, including foreign colonies of Europe and America. The style influenced cities as varied and far-flung as Chicago, Manila, Rome, Buenos Aires, Saigon, and New Delhi. It brought together combinations of allées, boulevards, parks, gardens, and squares in ways that differed widely but were recognizable to everyone as variations on a single theme: the use of trees and green spaces in public landscapes to frame and integrate new kinds of urban architecture and provide a new urban way of life.

Endnotes

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[2] Mark Girouard, *Cities and People: A Social and Architectural History* (New Haven: Yale University Press, 1985), 143–144.

[3] Henry W. Lawrence, Origins of the Tree-Lined Boulevard, *The Geographical Review* (1988) 78: 355-374.

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[13] George Chadwick, *The Park and the Town: Public Landscapes in the Nineteenth and Twentieth Centuries* (New York: Praeger, 1966), 70–72.

[14] Lawrence W. Kennedy, *Planning the City upon a Hill* (Amherst, MA: University of Massachusetts Press, 1992), 25–29.

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Trees in the Frame

Alan L. Ward

As a designer as well as a photographer of landscapes I am haunted by images of trees. Trees are frequently the skeleton of a landscape composition, giving structure and order. In design, trees are used to create spaces in the same way that walls are used to create rooms in an architectural plan. Many of the photographs in my book, *American Designed Landscapes: A Photographic Interpretation,* are of views that are framed, filtered, or focused by trees. Just as trees direct the eye and frame views in the experience of these places, they serve to reinforce the structure of these photographic compositions.

At Middleton Place, a single monumental live oak *(Quercus virginiana)* arches over the water's edge. This ancient tree, probably predating the settlement at Middleton, evokes rich associations of life and longevity. The photograph frames the marked horizontality of the tree, with its twisting limbs seeming to defy gravity in their reach over the water. The panoramic camera emphasizes its horizontality, and the asymmetric composition suggests the weight of the outward-spreading branches.

An ordered repetition of trees may direct a view or define a path. At Dumbarton Oaks, the north vista is defined by a mixture of hardwoods and conifers that extend from the center of the house and converge over a series of lawn terraces, enhancing the sense of distance as the viewer's eye moves outward. These borders are rendered as a unified mass of vegetation, framing the vista. Only the picturesque form of a deodar cedar *(Cedrus deodara)* stands out against the sky.

The repetition of trees along the street edge is characteristic of American urban spaces, an arboreal equivalent of arcade columns along city streets in Italy and Switzerland. Matched, tightly spaced plane trees *(Platanus* x *acerifolia)* flank the entrance roads at Solana, an office park on the Texas prairie. The low, early evening sun dramatizes the repeated tree trunks, which diminish in size as the eye moves toward the entrance of the building.

In the orchards of both the Miller Garden in Columbus, Indiana, and Naumkeag in Stockbridge, Massachusetts, the geometry of planting creates views along linear arrangements of redbud *(Cercis canadensis)* and apple trees *(Malus)*. In the Miller Garden the midday light flattens the lines of redbud trees to a graphic blackness. Soft light reveals the texture of apple trees at Naumkeag.

There are also designs that imitate natural settings, such as groves or forests in parks and gardens. At Naumkeag, a birch grove is the setting for whimsical blue steps that descend through densely planted birches *(Betula papyrifera)* on a hillside. Bloedel Reserve (overleaf) is a series of gardens created on reclaimed timberlands on Bainbridge Island, Washington. The moss garden under a canopy of firs *(Abies)* and hemlocks *(Tsuga)* feels like an ancient place, exhibiting the ongoing processes of nature in the forest.

A photograph is a frame of the world, defined by vertical and horizontal edges. Trees likewise frame views, with their vertical tree trunks and leaves overhead. Photography is also about light. The light-modifying qualities of trees are subtly revealed in black-and-white film. Trees may appear in silhouette as lines and pattern, or with delicate and understated shades of vegetation. As trees define the vegetative edge of spaces, the individual trees recede and become subtle shades diminishing in the distance.

These photographs by Alan Ward are from his book, *American Designed Landscapes: A Photographic Interpretation*, which will be published this fall. He is a landscape architect and urban designer at Sasaki Associates in Watertown, Massachusetts.

The Arnold Arboretum

SUMMER • NEWS • 1997

Celebrating the Close of Our 125th Year

Members and supporters of the Arnold Arboretum are invited to attend this final event in our year-long 125th anniversary celebration on Friday, October 17. Join us at the Arboretum to tour the Hunnewell Building, meet the staff, view the new Science in the Pleasure Ground exhibit, and hear a lecture by renowned British horticulturist Roy Lancaster.

Plant collector, British television personality, and gardener extraordinaire, Lancaster has authored books on his explorations in China and Nepal, on Mediterranean plants and gardens, on plants for connoisseurs, and most recently, *What Plant Where.* For our anniversary, he will present a slide-talk on Japan and its plants in autumn color. We hope you'll join us in celebrating 125 years of discovery while taking an inside look at the Arnold Arboretum and spending an evening with one of the world's most distinguished plantsmen. An invitation along with RSVP form will be sent to all members in September.

5:00–7:00 P.M.
OPEN HOUSE
AT THE HUNNEWELL BUILDING

7:30 P.M.
LECTURE BY ROY LANCASTER AT THE MASSACHUSETTS STATE LABORATORY, 305 SOUTH STREET, JAMAICA PLAIN
(near the Arboretum's Forest Hills Gate)

The Institute for Cultural Landscape Studies

Robert E. Cook, Director

This fall the Arnold Arboretum will launch a new enterprise, the Institute for Cultural Landscape Studies. It is a natural outgrowth of our six-year collaboration with the National Park Service. The mission of the Institute will be to develop and disseminate information about cultural landscapes and their conservation to practitioners and the public. We believe that the Institute will become an important organization throughout the New England region and the nation.

What is a cultural landscape? In practical terms, cultural landscapes are parcels of land that have experienced historic land uses of continuing importance to the community and often have significant natural and economic value as well. The Arboretum, of course, is a cultural landscape, one whose cultural history forms the central theme of our recently opened exhibit, Science in the Pleasure Ground, on display in the Hunnewell Building. Other examples might be the highly designed and documented gardens that surround historic houses such as the Longfellow House in Cambridge, or Fairsted, the home of Frederick Law Olmsted in Brookline.

But the concept of a cultural landscape embraces a much broader range of land uses. A large, working dairy farm in southern New Hampshire not far from a growing suburb of a major city may have been held in a single family for half-a-dozen generations. It may also have been the scene of a significant engagement or troop movement in the Revolutionary War. Finally, it may once have been the seasonal center of a native American settlement, and its soils today could contain abundant archeological evidence of this past.

Through case studies, conferences, and selected field projects, the Institute will collaborate with a number of organizations actively involved in protecting natural and historic resources, such as the Nature Conservancy, the Trust for Public Land, the Society for the Preservation of New England Antiquities, and The Trustees of Reservations. Our goal will be to produce new information leading to practical solutions to difficult problems that arise when both cultural and natural resources are important for parcels of land whose economic value is changing. We hope to make this information readily available to practitioners in formats that are accessible and easy to understand. We also believe that such information, when provided through the Internet, will become increasingly valuable to citizen volunteers who serve their communities. Whether those volunteers work through local government or local land trusts, the Institute will support their commitment to preserve one of their most important resources—the land and its traditional uses.

Summer Interns of 1997

Karen Madsen

From left, standing, Spencer Sears, Beth O'Donnell, Bess Wellborn, Lidia Szabo; sitting, Marla Zando, Jeremy Dick, Priscilla Allendorf, Cathlene Leary, Thomas Por, Sunny Bennett, Beth Bardon, Krissy Mayberry, Elwood Roberts; in front, John Ciesielski.

The interns of 1997 came from as far away as California, Michigan, and Canada, and from as near as Connecticut and Maine. Pictured here are the interns and a project some worked on under the leadership of Arboretum apprentice Alistair Yeomans. Over the last few years, the death of trees associated with increased foot traffic and mountain-bike activity has accelerated erosion on the eskers located between the greenhouse/nursery area and the legume collection. Using wood downed in the blizzard, they installed a series of "check dams" on some badly damaged slopes. Much of the interns' other work this year was created by the April Fool's Day Blizzard.

Instruction in woody plant identification, horticultural maintenance, and plant propagation, visits to Walden Pond and the Olmsted National Historic Site, and a walking tour of the Emerald Necklace as well as other field trips, classes, and lectures supplement the interns' hands-on training.

New Staff

Karen Madsen

Matthew Davies has joined the Arnold Arboretum as staff assistant in the development department. Matt comes to the Arboretum from Suffolk University, where he provided administrative support to the director and assistant director of development on all aspects of annual giving. His experience includes event planning and coordination and database management. Matt will provide administrative support to the director of the Arboretum and members of the development department.

Life on a Limb

John H. Alexander III

"Harvard Hero" takes on added meaning with the recognition of Arboretum head arborist John Olmsted for outstanding service to the University. Initiated by Sally Zeckhauser, Harvard's Vice President for Administration, the "Harvard Heroes" program recognizes employees for work of exceptional quality and commitment.

At the ceremony, before family and friends, John was lauded for maintaining the Arboretum's trees with dedication, initiative, and fortitude. John has characteristically gone beyond expectations since joining the staff in 1990. He was also commended for the training in arboricultural techniques he gives to Arboretum interns.

Stephen A. Spongberg

Roy Lancaster, plantsman, author, and British television personality, will offer a slide-talk on Japan and its plants, Friday, October 17. He is seen here with *Rhododendron falconerii* x *sinogrande* 'Fortune'.

The Arboretum Campaign Goes Public

On Friday, June 13, 1997, Harvard President and Mrs. Neil Rudenstine, members of the Director's Advisory Board, Arboretum director Bob Cook, and 90 longtime Arboretum friends and donors gathered for a special dinner in celebration of the public phase of The Campaign for the Arnold Arboretum.

Campaign chairman Francis O. Hunnewell announced that in this first fundraising campaign since 1927 (following the death of Charles Sprague Sargent), the goal is to raise $8.2 million for the Arboretum's endowment and capital projects, of which $3.8 million has been committed to date. Campaign objectives include adding significantly to the endowment for the living collections and establishing permanent endowments for two critical Arboretum programs in the areas of children's science education and international biodiversity conservation. The campaign will also raise funds to build and endow a new garden for sun-loving vines and shrubs.

Speaking at the June dinner, President Rudenstine underscored the campaign's priorities while reflecting on the Arboretum's significance to the University and the larger community. The campaign, Rudenstine noted, aims to "sustain the Arboretum and its programs at the level of excellence that has been established and maintained. It will sustain the Arboretum's vital educational efforts for both children and adults. And it will contribute directly not only to the understanding of our natural surroundings close to home, but also to research on important questions of biodiversity abroad and to the larger goal of environmental protection."

Martha Stewart

From left, Arnold Arboretum Director Robert E. Cook, Arboretum Director's Advisory Board Co-Chair Ellen West Lovejoy, Campaign Chair Francis O. Hunnewell, Harvard President Neil L. Rudenstine, and Director's Advisory Board Co-Chair David B. Stone.

"The cause could not be better," Rudenstine added, "because the Arboretum touches on so many different aspects of our lives: natural beauty and the beauty of design; the process of teaching and learning; the discovery of new knowledge, driven by deep curiosity about the natural world; and the effort to improve the environment we live in."

We plan to complete the fundraising effort by the conclusion of Harvard University's comprehensive campaign on December 31, 1999. For more information about The Campaign for the Arnold Arboretum, contact Lisa M. Hastings, Director of Development, at 617/524–1718 x 145.

佐藤恵子

Keiko Satoh

Karen Madsen

I arrived in Boston from autumn in Canberra, Australia, just in time for Lilac Sunday, to take up a one-year appointment as a Putnam Fellow at the Arnold Arboretum. I was quite prepared for the New England weather because just four years ago I graduated from Mount Holyoke College in western Massachusetts. During my year here, I will be working under Sheila Connor's guidance on the E. H. Wilson and plant distribution archives and, with Stephen Spongberg, editing an unpublished manuscript by E. H. Wilson. Written in the late 1920s, its subject is the species that he considered his best introductions into cultivation. Another part of my project is the creation of a computer database of Arboretum plant distribution records, which were kept on index cards from 1910 to 1970. The database will track information on Arnold Arboretum plant introductions. In addition, I will be producing botanical illustrations of *Sorbus* for Dr. Spongberg.

Having lived in several different countries by virtue of my father's diplomatic postings, I have had many opportunities for travel and extraordinary experiences. I received my first exposure to the world of taxonomy and training in nomenclature when I curated shells (Architectonicidae: Gastropoda) at the National Natural History Museum, Leiden. This in turn led me to undertake a Master of Science course in biodiversity and taxonomy of plants at the University of Edinburgh and the Royal Botanic Garden, Edinburgh. It was there that I learned a great deal about the Arnold Arboretum and E. H. Wilson through my classmate Andrew Bell, himself a former intern and Putnam Fellow (summer 1995). Also during that time I was able to meet Dr. Spongberg and Susan Kelley on their respective trips to the Garden.

Working on the Wilson material offers me more than professional interest: it teaches me a great deal about the history and culture of my home, Japan, and also of China, where my great-grandparents were posted at around the same period as Wilson was traveling there. Many of his photographs depict aspects of those countries that have since changed drastically or disappeared.

Karen Madsen

Youngest celebrants at the Arboretum staff's 125th-anniversary gala were the director's daughters, Christina Farrow Cook and Katherine Farrow Cook, born on June 12 to Lee Farrow and Bob Cook.

Arnold Arboretum Open House

The Arnold Arboretum once again cordially invites the public to an Open House on Saturday, October 18, from 11:00 am to 3:00 pm. The day's events will include tours of the landscape and a behind-the-scenes peak into the greenhouse led by Arboretum staff (at 11:00, 12:00, and 3:00), a maple tree activity for families (from 1:00 to 3:00), and opportunities to talk with Director Bob Cook and other staff about Arboretum plans and programs. For information or directions, call 617/524–1718 x 100.

Amazing Grace: The Cutleaf Maples

Rob Nicholson

Ask average gardeners to draw a maple leaf, and they will probably try to render a palmately veined, coarsely toothed, simple leaf similar to the symbol adorning the Canadian flag. This only shows the limited conception most people have of a genus whose members grow from Mexico to Manitoba and from Malaysia to Siberia.

Maples are one of the two genera of the Aceraceae *(Dipteronia* of China is the other*)* and number about 150 different species worldwide. As only a dozen of these species are native to North America, it is little wonder that our perceptions of what a maple can be are so limited.

Asia, and in particular China, is where maple species are found in abundance; China lists 85 while Japan has 22 and Korea 9. It is toward the species of these countries that my list of favorite maples is most heavily weighed. (Where would horticulture be without top ten lists?) My preference is away from the broad, palmately leafed tribe and toward the cutleafed trifoliate and even pentafoliate species—graceful trees of unparalleled beauty. These maples are those with a compound rather than simple leaf and are composed of three similar leaflets, one terminal leaflet with two attending laterals.

Trifoliate maples, those of section Trifoliata, first began to appear in the United States as early as 1891 when C. S. Sargent of the Arnold Arboretum brought back seed of *Acer nikoense* from the mountains of Japan. Since then, many more species of trifoliate maple have been introduced and are now among the most highly regarded landscape trees. Having propagated hundreds of these maples and recently returned from seeing two of them in their native forests, I hope to raise the reader's appreciation for these wonderfully useful and sublime plants.

Acer maximowiczianum

Japan and central China are home to a species of trifoliate maple known as the Nikko maple. Originally named for the Japanese temple city of Nikko, the tree was once known as *Acer*

RICHARD MUNSON

The trifoliate foliage of the Nikko maple turns to pleasing shades of scarlet and orange in the fall.

RICHARD MUNSON

The compact, neat, roundheaded habit of Acer maximowiczianum *makes it a useful specimen for smaller scale landscapes.*

nikoense, but a nomenclatural change has brought it to its present Latin name of *A. maximowiczianum*. It grows in the cool-temperate forest, preferring moist and fertile soils near streams. In central China it grows with such genera as *Tilia, Carpinus, Betula, Fagus, Davidia*, and other species of *Acer*. Trees of sixty-five feet have been reported from the wild, but most mature trees in cultivation are from forty to fifty feet. A tree raised from Sargent's seed collection of one hundred years ago now measures forty-five feet high with a broadly domed canopy of forty feet. Its two-foot thick trunk shows a number of main branches close to the ground, the first at three feet, and these rise at a 45-degree angle upward to the canopy. The bark is more subtly colored than that of other trifoliate maples, being a tight medium gray, sometimes forming small plates and with curious vertical rows of bumps. The Nikko maple distinguishes itself most clearly by its foliage; it has the largest leaves of the trifoliate group. Each leaf consists of three leaflets, with two lateral leaflets at nearly right angles to the third, terminal leaflet. These thick leathery leaflets are oblong-ovate in shape, deep green above and pale green below, with the lower leaf surface and petiole having felty, silvery-white hairs. The edges of these leaflets are slightly wavy, although a few coarse teeth may be present. The size averages from 3 to 5 inches long and 1.5 to 2.5 inches wide, although trees from China have been reported with 7-inch long leaflets. This crisp, fresh greenery is the most outstanding attribute of the species, especially when it changes hue in mid-October (all times are for Boston). Luminous shades of scarlet and orange are made even more pronounced by the darkness of the gray bark. Oddly, the underside of the leaf remains a duller color. The flowers are held in threes, each a third of an inch long with ten chartreuse petals in two rings of five. While interesting on close examination, it is really a flower only a botanist could love.

The plants in cultivation in the United States have been reported to survive winters with lows of minus 25 degrees Fahrenheit without damage. As a woodland native the Nikko maple prefers fertile brown soils and a moist site. The proportions of *Acer maximowiczianum* make it an ideal tree for suburban gardens; if grown as a specimen tree on a lawn, it does not attain too large a size to keep in scale with most houses.

Acer griseum

The star of the trifoliate group is the renowned paperbark maple, *Acer griseum*. Native only to the central Chinese provinces of Hubei, Sichuan, Honan, and Shensi, it was introduced into cultivation by the prolific plant hunter E. H. Wilson and has come to be regarded as perhaps the best of his hundreds of plant introductions. He first found the plant in May of 1901, when he jotted in his field notebook "Hupeh's best maple." He later came to regard it as "China's best maple," and modern horticulturists may go even farther. Wilson recorded the

species on steep slopes of moist, rich woodlands of western Hubei between 4,000 and 5,500 feet. The maximum size of the tree was sixty feet with an eight-foot circumference, but trees of thirty to forty-five feet were more typical. Seed from these trees was collected for the Veitch Nursery of England in 1901 and for the Arnold Arboretum in 1907. Veitch raised a hundred plants from their seed, and the Arnold raised one seedling to pair with two seedlings Wilson had dug up in China and brought home to Boston.

The collector who seems to have seen the plant in the greatest numbers of localities was the Belgian Joseph Hers. He recorded it from five sites in Honan and two in Shensi, but I have not been able to determine if any seed was collected from these plants and, if so, whether they resulted in any seedlings. The Arnold Arboretum was a recipient of many kinds of seed collected by Hers, as was the Vilmorin Nursery in France, but no entries for *Acer griseum* exist in the Arnold's records among the four hundred items sent by Hers between the years 1919 to 1927. The same is true for the records of the National Botanic Garden of Belgium, another recipient of Hers' seed. A recent sighting of the tree was made in China by Wilson's spiritual heir, Roy Lancaster, but no seed was collected. The Sino-American Botanical Expedition of 1980 found the tree in the Shennongjia Forest District of Hubei (Wilson's old terrain), but none of the seed they collected resulted in seedlings.

PAMELA BRUNS

The first Acer griseum *to take root in North American soil still grows at the Arnold Arboretum.*

It seems probable then that Wilson's collections in 1901 and 1907 are the only ones that have been brought out of China and that until very recently all trees in cultivation were descendants of these. In 1994 an expedition of the North American-China Plant Exploration Consortium collected 25 seedlings of *Acer griseum* on Hubei's Wudang Shan, and they are now growing at the Arnold Arboretum, Morris Arboretum, Longwood Gardens, and U.S. National Arboretum.

The bark of this Chinese species is unique in the maple family, a striking collage of textures and colors. The oldest bark, at the base of mature trees, is often an interlocking puzzle of irregular plates of copper and smoky gray. Younger wood is sheathed in tight bark of a ruddy maroon brown with patinas of orange brown and weathered bronzy olive surrendering curled shavings of cinnamon. The wood is hard and dense, and at certain points looks sinewy. The effect of this singular stem is of a dense, aged, metallic pillar of exotic alloy.

To photograph a frame of "typical" *Acer griseum* bark is akin to photographing a "typical" three-inch square of Monet, Seurat, or Pol-

lack, as every section of stem has its own composition, subtly different in character, a unique blend of curls and plates, bronzes, mahoganies, and coppers. It is a trunk that begs to be surrounded by snow as it literally shines in defiance of gray skies and chilling winds.

The foliage of the paperbark maple is reddish-brown when unfurling in spring but soon turns to a soft, deep green above, pale green and felty below. The margins of the leaflets are coarsely toothed with two to five large teeth on each leaflet's side. The foliage turns a striking crimson in late October and early November, blending beautifully with the coppery bark. Flowers are similar in size and color to those of the Nikko maple but the petioles are less hirsute.

The oldest paperbark maple that I know of graces the grounds of the Arnold Arboretum and is one of E. H. Wilson's original trio. Unlike other *Acer griseum* trees in the collection, this specimen has a squat, fat trunk that begins to branch at three and a half feet. Its dome is broad, some forty feet wide and twenty-five feet high. It is a venerable and monumental tree, a piece of living sculpture that honors its collector far more nobly than any work from an artist's hand.

The paperbark maple is ideally proportioned for lawn and specimen plantings as it doesn't attain a tall stature in full sun. It works particularly well alongside the red brick dormitories and lecture halls of our Smith College campus, but it would be superb as a focal point in a woodland or courtyard garden, and as a grove of twenty, an unsurpassable luxury.

ROB NICHOLSON

The Wolchong-sa temple complex was founded in 654 A.D. *and is now within the boundaries of Odae-san National Park. A beautiful specimen of* Acer triflorum *rises from behind the small temple.*

Collecting Trifoliate Maples

I recently fulfilled a longheld wish to collect seed of trifoliate maples in the wild. I had failed to do so earlier while on a visit to the town of Nikko, Japan, as I did not find the local trifoliate when I collected there. Botanists at the Nikko Botanic Garden have since written me that *Acer maximowiczianum* is now rare in those woods, perhaps because of its value for tool handles and construction.

My luck turned during a collecting trip to South Korea. Due to the hospitality of Ferris Miller, the owner of the Chollipo Arboretum, collecting in South Korea has become a relatively simple task, with good roads and well-maintained national parks adding to the ease of seed harvesting. It has become in recent years the preferred hunting grounds in temperate Asia, Japan being costly and China restrictive. Mr. Miller was host to two other collecting parties during my brief visit, and he now talks of being swamped with collectors.

The woodland forests of Korea have very fine fall foliage color, thanks mainly to their nine maple species. *Acer pseudosieboldianum* (sometimes called the purplebloom maple) has the most vivid colors, scarlets and reds, but close behind are two trifoliate species native to the mountains, *A. triflorum*, the three-flowered maple, and *A. mandshuricum*, the Manchurian maple. The three-flowered maple ranges from South Korea, where I saw it at 2,000 feet in the foothills of the Odae Mountains, north into northeastern China, with isolated disjunct stands reported in Shensi Province growing at 5,600 feet. It usually

grows to about fifty feet, but older trees in the wild have been recorded as high as seventy feet. I collected seed in the Odae Mountains, where I found the species next to a brook on the edge of a forest of huge *Abies holophylla*, the Manchurian fir. A mile up the road was the ancient temple complex of Wolchong-sa, and on a crisp fall day in the mountain forests I found a beautiful tableau, two maples with temple. To the front was a small *A. pseudosieboldianum*, its branches covered in leaves of pink and brilliant cardinal red. The temple is small, with a sedate gray tile roof covering two chambers that face an open middle section. Intricately painted beam work and panels counterbalance the somber roof and straightforward architecture. Behind it, fronting a screen of dark firs, was a glowing orange three-flowered maple, its lowest branches peeking through the alcove of the temple. Standing sixty-five feet high with a basal trunk diameter of three feet, it was far bigger than the tree I'd previously seen downriver. The bark at the lower portion of the trunk was splashed in pale gray-green lichens, these contrasting pleasantly with the gray and buff colored bark.

ROB NICHOLSON

Acer mandshuricum *grow almost to the summit of Mt. Odae, here photographed at 4,600 feet.*

The three-flowered maples I have seen in cultivation have a silvery-beige bark, flaking in small plates to reveal coppery-orange and even pinkish tones beneath. These trees were over sixty feet high at seventy years of age and were more upright in habit than the Nikko maple. Unlike the Nikko maple, the three-flowered maple tends toward a single dominant trunk.

Its trifoliate leaf can be distinguished from others of the group by its bristly upper surface (the lower surface has a hairy midrib). Leaflets are medium green above, paler beneath, up to 3.5 inches long and half as wide, with two to four coarse teeth along the margin. In Boston its fall color usually appears during mid- to late October and is a blend of pumpkin, yellow, and wines, with orange being the dominant hue.

My hike from the Wolchong-sa temple complex to the highest point in the park, Mt. Pirobong at 5,100 feet, was a two-and-a-half kilometer climb through sublime fall forest color, an interplay of the maples' blaze and the solid, somber green of fir. I first found the Manchurian maple, *A. mandshuricum*, at 3,400 feet, a small grove of trees on a sharply steep, cool slope anchored in dry brown soil. Sharing the hillside were *Betula schmidtii* and *B. davurica*, *Viburnum wrightii*, *Magnolia sieboldii*, *Rhododendron schlippenbachii*, *R. brachycarpum*, *A. pseudosieboldianum*, *A. ukurunduense*, *Astilbe koreana*, and *Hepatica asiatica*. In this tight, competitive canopy, the Manchurian maples were tall trees to eighty feet, with their first branches at thirty-five feet, yet had a relatively thin trunk diameter of about one foot. Toward the top of the mountain, one thousand feet higher, the canopy was lower and more open and here the Manchurian maple was a round-headed tree of thirty-five feet. Its bark was tight, plating slightly, and of a dark battleship gray color. The leaves of *A. mandshuricum* have narrower leaflets when compared to its cousins, the two laterals being held at a closer angle to the terminal and sometimes overlapping it. The oblanceolate leaves are a dark, glossy green above and pale green below, with a long tapered

tip and a margin of up to twenty small teeth. The leaves are carried in dense tufts at the ends of the branches and give this species a fine, feathery texture. I was struck by how much variation there was in the fall color of this species, especially when I recalled those trees cultivated stateside. In the wild, a dull ruddy purple to soft maroon seems to be the most common color, with undertones of blended pink, orange, and yellow. Among the yellows of birch and poplar in the high mountains, these reddening plumes were the standouts. In sharp contrast to these wild plants is the fall color of a specimen at the Arnold Arboretum. Grown from seed sent by the St. Petersburg Botanic Garden in 1906, the tree grows in full sun and measures fifty-five feet high by fifty feet wide. It colors early, usually in the first week of October, displaying a superb soft rose color. Once turned, the leaves last but a few short glorious days, then drop too soon. Based on its fall color alone, this striking tree is worthy of cultivar status.

Flowers of the Manchurian maple are less prone to the chartreuse coloration of the other trifoliates and can be a dull pink. But by late May, clusters of dark pink and chartreuse samaras are forming and these contrast beautifully with the soft green undersides of the leaves. Of all the trifoliate maples, *A. mandshuricum* is probably the hardiest, growing near the tops of frigid mountains in South Korea and surviving the brutal winters of northeastern China. It can probably withstand temperatures of minus 25 to minus 30 degrees Fahrenheit.

Propagation

Propagation of the trifoliate maples is problematic, which accounts for their scarcity in the nursery trade, although it is far easier to obtain one of these than it was even fifteen years ago. Viable seed rarely develops, as it is uncommon to find trees in cultivation close enough to each other to ensure pollination. I know of instances where nurserymen have converged on the same grove on the same day and proceeded to get into a roaring shouting match over the precious seed.

The seeds of these maples have what is known as a double dormancy, requiring a stratification period of moist and warm conditions (five months at 65 to 85 degrees Fahrenheit) followed by a period of cold and moist conditions (three months at 35 degrees Fahrenheit). After this pretreatment some germination will result, but most germination occurs only after a second period of stratification.

I have sucessfully propagated the three-flower maple by cuttings, taking them in mid-June, applying a medium-to-high strength hormone (IBA), sticking them in a medium of sand and perlite, and keeping them misted. More recent attempts at vegetative propagation involved grafting. Based on the advice of my college propagation professor, Sidney Waxman, I used sugar maple *(Acer saccharum)* as understock and got three different trifoliate species to take. The long-term outlook for these is uncertain, but so far the plants show remarkable vigor.

Other Cutleaf Maples

In researching the botanical and horticultural journals for information on these unusual maples I was surprised to find a few with dissected leaves that I had never before encountered and that are rare in cultivation or have yet to be introduced. One of them, the five-leaf maple, *Acer pentaphyllum*, was first reported by plant explorer Joseph Rock in China in 1929. He found the tree west of the Yalong River near Muli, in southwestern Sichuan province. It has been reported that only two to three hundred trees still exist. For generations, the only known adult tree in cultivation was in the Strybing Arboretum in San Francisco, but this plant has recently died. Seedlings have been raised from the Strybing plant and a number of nurseries on the West Coast now offer this rare tree. According to Rock, it forms a small tree growing to thirty-five feet with widely spreading or slightly pendulous branches. The bark on younger branches is brown to yellowish brown, while older bark is ashen. The most remarkable feature of this maple is its beautiful leaves, which are divided into five thin leaflets 2 1/2 to 4 inches long, a bright yellowish green above and soft green below. These wispy leaflets are held in a star pattern, with the interplay between the leaves and the slender, delicate stems producing an extremely fine, linear texture. Fall color is said to range from yellow to crimson. West Coast nurserymen consider the plant hardy

through the low 20s but question how much more cold it could take.

A number of varieties of trifoliate maples have been described in Chinese journals but are not now known to be in cultivation in any botanic garden nor have I seen most of them personally; I only add them as grace notes. *Acer kansuense*, originally described as a new species, was later reduced to a subspecies of the Manchurian maple and is now known as *A. mandshuricum* subsp. *kansuense*. If Wen-Pei Fang's report is accurate, this maple, from the drier province of Gansu, could be an interesting, more drought-tolerant trifoliate maple.

Acer sutchuenense was first discovered by Père Paul Farges in northeastern Sichuan Province and was later collected twice by E. H. Wilson in western Hubei between 6,000 and 9,000 feet, although he considered it rare. It was probably not brought into cultivation until collected by the Sino-American Botanical Expedition of 1980, which included Arnold Arboretum taxonomist Stephen Spongberg. The SABE team collected the plant in the Shennongjia Forest of Hubei, and the seed was germinated at the U.S. National Arboretum. This trifoliate maple is said to grow to a small tree of twenty-five feet with leaves similar to *A. triflorum*. Hardiness is untested.

Other obscure varieties within the Trifoliata section include two of *Acer triflorum*. *A. triflorum* var. *subcoriacea* differs from the species by having leaves that are sparingly papillose on both surfaces. The variety *leiopodum* was described in 1934 from a specimen collected by G. Fenzel from a temple woods in Shensi Province in north central China. It is described as having smaller leaflets, glaucous below and

E H WILSON

The village of Changyang Hsien in western Hubei proved fertile ground for E. H. Wilson. It was there he found the famous magnolia 'Diva' and collected the maple Acer henryi, *seen here clothed in a January snow.*

slightly pilose or nearly glabrous on the nerves and petioles. As Joseph Hers later collected *A. griseum* from the same mountain, the identification of the *A. triflorum* is questionable.

The Chinese trees of *Acer maximowiczianum* were assigned by the taxonomist Alfred Rehder to the variety *megalocarpum* because they show greater size in every part and greater pubescence than Japanese trees, but Chinese botanists consider it synonymous with the typical species.

Other Asian cutleafed maples can be found in the section Negundo, which takes its name from *Acer negundo*, the North American box elder, with three to nine leaflets. The Asian members, *A. cissifolium* and *A. henryi*, I consider superior to the weak-wooded *A. negundo*. The ivy-leafed maple, *A. cissifolium*, is native to Japan, where C. S. Sargent collected it and gave it strong marks. He wrote of it, "*Acer cissifolium* is a handsome compact round-headed little tree with slender graceful leaves, of a delicate green in summer, and orange and red in late autumn, and where it is one of the most distinct and satisfactory trees that have been tried in our climate." Two plants, AA10649-A and 10649-B, grown from seed collected in 1918 by Wilson still grow on the grounds of the Arnold Arboretum.

I recently stumbled onto the Chinese relative of *Acer cissifolium* at the Morris Arboretum in Philadelphia. Henry's maple, *A. henryi*, was a broadly domed tree of forty-five feet and had leathery leaves of a pleasing medium green with reddish petioles. It is said to be unique among trifoliate maples in the entire (untoothed) margins of its leaflets, but I did see a few toothed leaves on this tree. Bark was a gray-beige with irregular vertical lines of orange lenticels. Some twig dieback and bark damage was observed, so this species may be at the limit of its hardiness in Philadelphia. If so, it might be a good ornamental for more southerly sections of the country.

From the hands of a very few plant explorers have passed the seeds of these legacy maples. Over several generations their horticultural reputation has grown and only now are they in the nursery trade to any degree. The elegance and beauty of these rare and wonderful trees is almost mystical. They become more striking, noble, and desirable as they age. We should all be so lucky in life.

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Oglethorpe and the Oglethorpe Oak

Allen J. Coombes and W. Nigel Coates

A newcomer to the white oak group, rare in the wild and in cultivation, commemorates the founder of Savannah.

In March of 1994, a young oak tree from the state of Georgia was planted in a walled garden at the Meath Home, Godalming, England, to commemorate a famous son of Godalming, General James Oglethorpe, founder of Savannah, Georgia. The connection between this picturesque Surrey town and an oak from the "Peach State" may seem tenuous, but the tree chosen for the planting was, very appropriately, the Oglethorpe oak *(Quercus oglethorpensis* W. H. Duncan). A few years previously, the Sir Harold Hillier Gardens and Arboretum, which holds the United Kingdom's national collection of oaks, had managed to obtain seed of this distinct and unusual species collected in Georgia and were pleased to be able to donate a young tree for the planting. The place of planting was also significant, for the Meath Home was originally Westbrook Place, the home of James Oglethorpe.

James Edward Oglethorpe, reputedly the last person to shoot snipe in Piccadilly, was born in 1696, the son of Theophilus Oglethorpe who that year had settled in Godalming, Surrey, where he had earlier bought the manor of Westbrook. The family were keen supporters of the Jacobite cause, particularly James' sisters, Anne and Eleanor, who were involved in several plots; there were even rumors that Prince Charles Edward secretly visited Westbrook to plan the 1745 rebellion.

James himself kept aloof from such matters, and after education at Eton and Corpus Christi College, Oxford, spent his early life as a soldier in Europe. He returned to Godalming at the age of twenty-five to take up his inheritance and succeed his brother as member of Parliament, soon earning a reputation as an ardent social reformer, concentrating particularly on the injustices of the prison system. He found time to interest himself in local affairs and is recorded as donating a guinea here and there to local causes. He added to his estate by building a great wall of local Bargate stone to enclose a vineyard that soon became well known for its white wine.

General James Oglethorpe, probably in his late forties, after his return from Georgia in 1743 (Archives of Oglethorpe University).

Meanwhile, the idea of forming a new colony in America had been suggested and Oglethorpe was one of the prime movers in the project. It would be named after King George II and would occupy the space between the Carolinas and the Spanish settlers in Florida—far enough south

to grow grapes and to produce silk, for it was reported that mulberry trees, grown to provide food for silkworms, were likely to flourish in the area. Georgia thus became the thirteenth British colony in America. Godalming's wealth was founded on wool, so there were plenty of local people skilled in producing textiles, and some of these, with others attracted by national advertising of the opportunity to start a new life, made up the 120 settlers who sailed with Oglethorpe from Gravesend in November 1732. They reached their goal on February 12, 1733, still annually celebrated as Georgia Day, and within a few weeks had laid out the rectangular street plan of the city of Savannah.

Each family was given three lots, space for a house, a five-acre garden on the edge of the settlement, and forty-five acres in the neighboring countryside to be cleared for farming. On the edge of the town Oglethorpe created a ten-acre Trustees' Garden to try to find the best conditions for growing mulberries and other plants, now acknowledged as the first agricultural research station in America.

In a letter to Sir Hans Sloane dated September 19, 1733, Oglethorpe apologized for not having time to "make a collection of such things as might be agreeable to one of your curiosity." He did, however, send specimens, and some thirty-eight collections are held in the Sloane Herbarium at the Natural History Museum in London. Annotated with pre-Linnaean names in Oglethorpe's own hand, these consist of a variety of mainly herbaceous plants but certainly include a specimen of poison ivy *(Toxicodendron radicans;* synonym *Rhus radicans).*

The Trustees' Garden had auspicious beginnings. With sponsorship from Sir Hans Sloane and the Society of Apothecaries, and advice from Philip Miller of the Chelsea Physic Garden, many plants of potential commercial importance were introduced, including white mulberries, oranges, peaches, figs, pomegranates, olives, vines, and cotton, as well as vegetables to supply the needs of the expanding colony. Cotton and peaches still remain two of the major commercial crops of Georgia. Unfortunately, the garden soon became neglected and many plants were killed in a hard frost in March 1738. It continued to supply mulberry trees, which were available to planters free of charge, until about 1748, but was eventually abandoned and converted to residential use in 1755. A bronze marker, commemorating the 250th anniversary of the founding of the garden was erected on the site in 1983.

The local natives, the Yamacraw tribe, responded favorably to the colonists' overtures of friendship, and when Oglethorpe returned to England he took with him ten of their number, including Chief Tomochichi. They met the trustees of the colony, the King and Queen, and caused quite a stir in Godalming when their host took them to dinner at the White Hart.

On his second voyage, James was accompanied by the brothers John and Charles Wesley, family friends who were going to minister to the spiritual needs of the colonists and the natives. The government's idea of funds for running the new colony proved miserly, and the estate at Westbrook had to be mortgaged to raise the necessary money to keep it going. Once back in Georgia, Oglethorpe founded the settlements of Frederica on the coast and Augusta farther up the Savannah River. He then made one more quick trip to England to try to raise a regiment to meet the growing threat of Spanish invasion. The expected blow fell in 1742; the invaders were defeated at the battle of Bloody Marsh and driven back into Florida, for which achievement James Oglethorpe was rewarded with promotion to the rank of Brigadier General.

The following year he returned to England for the last time, married, did a little more soldiering in Europe in the service of Frederick the Great, then retired to the country, where he died at the age of eighty-eight. Oglethorpe is still honored in the state that grew from his colony. His statue stands in a square in the center of Savannah; the map of Georgia shows Fort Oglethorpe City and Oglethorpe County; and Oglethorpe University was founded in Atlanta. The City of Savannah has proposed the restora-

The vigorous shoots of the second flush of Quercus oglethorpensis. *Painted by Siriol Sherlock from a plant in the Sir Harold Hillier Gardens and Arboretum, Hampshire, England.*

tion of the Trustees' Garden on its original site. It would surely please the General's philanthropic heart to know that his house in Godalming has been run for one hundred years as a home for epileptics, and it is good to record that it has been presented with an Oglethorpe oak to grow in the walled garden that the founder of Georgia knew so well.

M. NIGEL WRIGHT

Quercus oglethorpensis *at the Morton Arboretum, Lisle, Illinois.*

While James Oglethorpe's involvement with Georgia goes back more than 250 years, the Oglethorpe oak is a relative newcomer to the genus, described too late to be featured in C. S. Sargent's two-volume work *Manual of Trees of North America* (1905) or *The American Oaks* by William Trelease (1924), but in time to be included in a list of additions and corrections in Volume 3 of *Les Chênes* by Mme A. Camus (1952–1954). It was originally noticed as distinct as late as 1940 by Wilbur H. Duncan of the University of Georgia in Athens, who, in the company of Professors G. N. Bishop and A. D. McKellar, found trees growing in abundance on Buffalo Creek near Lexington, Georgia. These trees had previously been thought to be *Quercus imbricaria* (shingle oak), but further investigation by Duncan showed them to represent an unnamed species that he described as *Q. oglethorpensis*. An earlier collection made by T. G. Harbison from Elbert County, Georgia, was also referred by Duncan to this species. The name does not commemorate James Oglethorpe directly, but Oglethorpe County, in which the trees were found and the type specimen was collected. In 1950, Duncan reported the finding of *Q. oglethorpensis* by Professor Bishop in Greenwood County, South Carolina.

The Oglethorpe oak makes a large tree to 25 meters (80 feet) or more in the wild, the young shoots sparsely covered with stellate hairs and glands at first, becoming smooth and deep red in winter. The deciduous, elliptic to obovate leaves to 13 centimeters (5 inches) long are usually without teeth and often with wavy margins, but can be slightly lobed, particularly on vigorous shoots of the second flush (as seen in the illustration). They emerge bronze-tinged, becoming a rich, glossy green, and remain on the tree late into autumn when they can turn briefly red, then brown. When they first emerge, they are dotted with short-stalked red glands above and with sparse stellate hairs, becoming glabrous, while the undersides are thinly covered with persistent stellate hairs. The acorns

mature the first year and are ovoid, about 11 millimeters (1/2 inch) long and one-third enclosed in the cup, which is sessile or shortly stalked. Although originally confused with *Quercus imbricaria* (a red oak), the Oglethorpe oak is not closely related to that species and is, in fact, a white oak. It is considered by Duncan to be a relict species closely related to *Q. margaretta*, and a tree found by Duncan in Oglethorpe County appears to be a hybrid with this species.

Oglethorpe oak is of very restricted distribution in the wild, confined to two isolated populations, with its main range in a few counties in the Piedmont of northeast Georgia and neighboring western South Carolina. It is found on poorly drained bottomlands and neighboring slopes, uplands, and stream terraces associated with *Acer rubrum, A. saccharum* subsp. *leucoderme, Celtis laevigata, Fraxinus pennsylvanica, Quercus alba, Q. falcata, and Q. pagoda* (formerly *Q. falcata* var. *pagodifolia*). In the wild it is susceptible to chestnut blight. Until an extensive study of its distribution by Haehnle and Jones, Oglethorpe oak was known from only forty-five sites. They added another one hundred to this and considered that its absence from five of the previously recorded localities was due to land clearance for agricultural development. It was also suggested that although populations of Oglethorpe oak had probably not been seriously affected since its discovery, it was likely that prior to this, agricultural development had reduced the range of the species and its population density. The Georgia Department of Natural Resources describe it as threatened in the wild and its habitat has suffered clearance for agriculture and forestry. Oglethorpe oak has recently been assigned endangered status by the International Union for Conservation of Nature and Natural Resources.

Oglethorpe oak has also been reported from other states. The population found near Copenhagen, Louisiana, is, according to Dr. Kevin Nixon, *Quercus sinuata* (formerly *Q. durandii*), but what appears to be *Q. oglethorpensis* was reported by Wiseman from three sites in the Bienville National Forest, Scott and Jasper Counties, Mississippi.

In cultivation, both in North America and Britain, this species is uncommon. Plants growing at the Sir Harold Hillier Gardens and Arboretum date from two accessions; firstly, scions received in 1978 were grafted onto *Quercus robur* and planted in the early 1980s, and secondly, plants derived from seed collected in the Oconee National Forest in Jasper County, south of Monticello, Georgia, in late 1988 by Marshall Adams. The Meath Home plant derives from the latter collection. In spite of its southern American origin, this species is proving reasonably hardy in cultivation. At the Sir Harold Hillier Gardens and Arboretum the oldest specimens have made bushy plants up to 3.5 meters (11 feet) tall with a spread of 4.5 meters (15 feet), often branching from just above the base.

In Britain, young shoots of this species are frequently damaged by frost during winter, when temperatures typically reach 20 degrees Fahrenheit or below, but this is probably due to the lack of sufficient summer heat to ripen adequately the growth rather than winter cold, which can be just as or more intense in the southern United States. As a result of winter damage here, the plants grow slowly and usually produce numerous young shoots in summer from the frost-damaged wood.

That the poor performance of this species in Britain is due to lack of summer heat rather than low winter temperatures is clearly shown by plants growing at the Morton Arboretum in Illinois. There, plants grown from seed collected in Greenwood County, South Carolina, have reached 3 meters (10 feet) tall in fifteen years. In the winter of 1993–1994, following ideal conditions for wood ripening the previous autumn, little injury was incurred even when temperatures fell to minus 22 degrees Fahrenheit. However, growth that occurs late in autumn and does not ripen properly can be injured at a temperature of zero.

Also in Illinois, at Guy Sternberg's Starhill Forest, near Petersburg, this species grows slowly but has survived even the coldest winters undamaged. Further south, Oglethorpe oak grows more vigorously, and on the campus of the University of Georgia, Athens, ten- to twelve-year-old trees have reached 6 meters (20 feet) tall and 5 meters (15 feet) in spread with

coarse, scaly bark. The leaves remain until late autumn when they turn brown and (on these young trees) remain through winter. Planted trees can also be seen at the Oglethorpe County courthouse, Lexington, Georgia.

Judging by specimens in the Kew herbarium collected by Duncan near Lexington, Oglethorpe County, Georgia, in 1942, this species comes into leaf much earlier in its native habitat than it does in Britain. Whereas at the Sir Harold Hillier Gardens and Arboretum and the Morton Arboretum it is normally well into May before the foliage starts to emerge, a flowering specimen collected on April 18 already had the young leaves opening, while a specimen in full leaf was collected on July 12. In cultivation in Savannah, the leaves emerge in mid- to late March.

Although the Oglethorpe oak is unlikely to make a tree suitable for landscape use either in Britain or the United States, its historical associations with James Oglethorpe, as well as its rarity, make it of great interest. Oglethorpe oak is rarely available from nurseries, but plants can be obtained from Woodlanders, Inc., 1128 Colleton Avenue, Aiken, South Carolina 19801.

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Book Review: Mosses in the Garden

Benito C. Tan

Moss Gardening Including Lichens, Liverworts, and Other Miniatures. George Schenk. Timber Press, 1997. 261 pp., 97 colored photos. Hardcover. $34.95

MARION PRESSLEY

Moss-covered steps in a New England garden.

This book is one of the few available in bookstores that deals with the use of bryophytes, mainly mosses, and other forest cryptogams, such as lichens, lycopods, and spikemosses, in cultivation both outdoors and in. The author has lived and worked in several mossy cities around the world, including North Vancouver, Seattle, and Auckland, where a mild temperate climate promotes a lush and rich moss flora, and he has developed a strong affection for the beautiful world of mosses. The humid environs of the Pacific Northwest also assure his success in introducing natural moss populations into home gardens and potting designs. Readers living in drier or colder regions, however, may not be as successful.

Moss Gardening consists of fifteen chapters that cover a wide variety of topics, from moss gardens in Japan and Europe, alpine and rock gardens, to bonsai moss decoration. Practical tips and observations on growing mosses under garden conditions and in miniature containers are scattered throughout the pages. Included in the text are exhilarating color photographs of pretty moss gardens and individual moss species. The reader cannot help but be infected by the author's love and appreciation for mosses after reading the book. Mr. Schenk, also the author of *Rock Gardens* and *The Complete Shade Gardener,* is to be congratulated for a job well done.

As a professional bryologist who studies moss diversity and also grows mosses in small containers for teaching demonstrations, I am impressed by Mr. Schenk's general knowledge of mosses, especially of the conditions they grow in in nature. The author repeatedly reminds us that success in moss gardening depends on choosing the right mosses for the garden site and matching the site to the conditions of the natural habitat. Despite this, I would caution readers that the book is not a guide to growing ornamental mosses from spores. Moss gardeners or potential users of mosses for ornamental purposes should not look to this book for formulas for growing particular species of moss in your backyard.

Anyone who has tried growing mosses outside their natural habitats quickly learns about the difficulty of maintaining a transplanted population under manmade conditions over a period of time. Seen in this light, I particularly like Chapter 7, in which the author describes five practical methods of planting and maintain-

ing moss carpets in gardens. Likewise, Chapter 10, which introduces the growing of *mame*, or tiny mosses, in containers and miniature terraria for indoor display, is elucidating and educational. Tips for growing green moss cover for vascular bonsai plants are equally useful. As a lover of mosses, I do not like Chapter 15, which discusses the business aspect of selling mosses and lichens to the public. Since these two groups of forest cryptogams are slow growers in nature, this suggestion will further diminish our mossy forests, which are still the only profitable source of marketable moss material in this country. Reports of damaging harvests of wild populations by nurseries and plant shops in the Pacific Northwest have seen print many times in local newspapers and national news magazines.

Scientifically, I found only a few errors. For example, Plate 77 is not *Drepanocladus uncinatus* as identified, but is a *Rhytidiadelphus*, and it is doubtful that the moss illustrated in plate 81 is *Hygrohypnum luridum*. Also, I would not follow the advice to grow *Encalypta ciliata* on a slab of lava with *Hypnum cupressiforme* (see page 132, also plate 56). *Encalypta* is a strong calciphile and will grow only on a calcareous substrate.

Moss Gardening is mainly concerned with the garden beauty of the subject plants and minimally the science, as its author notes in Chapter 1, and it is for the book's aesthetic and horticultural values that I recommend it to both gardeners and nongardeners of mosses. This lyrically written book has done justice to a group of plants that is often overlooked and underappreciated in our biological world.

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Front cover: *Ailanthus altissima*, the tree-of-heaven, in the courtyard of Wuhan Temple, China. Photograph by Peter Del Tredici.

Inside front cover: The first illustration of *Ailanthus altissima* to appear in the West, from a 1788 article by the French botanist René L. Desfontaines. Courtesy of the Archives of the Gray Herbarium.

Inside back cover: Kudzu *(Pueraria lobata)* twines over roadside vegetation in South Carolina. Photograph by Peter Del Tredici.

Back cover: This *Ailanthus altissima*, seen growing in the wall that surrounds the courtyard of Wuhan Temple, also appears in the left corner of the photograph on the front cover.

JAMES O. LUKEN

Amur Honeysuckle, Its Fall from Grace

James O. Luken and John W. Thieret

This account of the history and biology of *Lonicera maackia* explains how and why the plant became so wildly successful as an "exotic invasive."

Scientists throughout the world are concerned about the apparent homogenization of regional floras being caused by invasive, nonindigenous plant species. A new term for this process, *biological pollution*, has come into use, and removal of nonindigenous plants to protect native species and to maintain the integrity of communities is now a common practice in many parks and nature reserves. However, human activity is an important determinant of the eventual rate and extent of diffusion of a non-native species into a new geographic range, whether the plant was introduced intentionally or accidentally.[1] Therefore, as the time, effort, and resources committed to managing nonindigenous plants increases, a need is emerging for greater understanding of the naturalization process on the part of people who may either facilitate or limit plant invasions, especially since human influences can often be modified by effective policy decisions.

In this article we trace the almost 150-year-long involvement of Western plant scientists with the eastern Asiatic shrub Amur honeysuckle—*Lonicera maackii*, a member of the Caprifoliaceae. The story of Amur honeysuckle parallels that of various other Eurasian deciduous shrubs—for instance, Russian olive *(Elaeagnus angustifolia)*, Tatarian honeysuckle *(Lonicera tatarica)*, and buckthorn *(Rhamnus cathartica)*—that were introduced for their floral, fruit, and foliage displays but eventually became troublesome.

Less than a century after its deliberate introduction into North America, Amur honeysuckle is growing and reproducing in at least twenty-four states of the eastern United States and in Ontario, Canada.[2] The plant is perceived by many resource managers as an undesirable element in parks, natural areas, and preserves: "It would be difficult to exaggerate the weedy potential of this shrub."[3] This perception, however, is not shared by gardeners and horticulturists—W. J. Bean wrote that "[I]t is one of the most beautiful of bush honeysuckles"[4]—and its garden value has encouraged widespread introduction. Such varied and sometimes opposing values must be considered along with ecological data as future management policies for nonindigenous species are debated.

Our case study will address the following questions: How and why was Amur honeysuckle intentionally introduced into cultivation in the United States? What life-history traits of the species contribute to present-day valuations of the species, both positive and negative? To what extent are these differing perceptions reflected in management policies?

The Species

Amur honeysuckle (also known as bush honeysuckle, tree honeysuckle, or Maack's honeysuckle) is an upright, multistemmed, deciduous shrub that can achieve heights of twenty feet. The leaves are dark green, with a variety of shapes ranging from lance heads to broad ellipses that taper to a slender point. Amur honeysuckle leaves are particularly noticeable in early spring as they open well before those of other plants. Likewise, in autumn this honeysuckle holds its leaves later than its neighboring plants.

In its native range—central and northeastern China, the Amur and Ussuri river valleys of Korea, and isolated parts of Japan—Amur honeysuckle is commonly found on floodplains

The bright red berries of Amur honeysuckle remain on the shrub until January unless removed by birds.

Native and invaded ranges of Amur honeysuckle. Isolated occurrences in Japan are not shown.

and in open woodlands. In the invaded areas of the eastern United States and Ontario, it occurs mostly in urban or urban-fringe landscapes, where it occupies open sites, forest edges, and the interiors of forest patches. Its reproductive characteristics give Amur honeysuckle its greatest appeal. It consistently produces an early spring profusion of white flowers that turn dull yellow with age. Fruit set can be heavy, and the bright red berries remain on the shrubs until January unless removed by birds.

Introducing Amur Honeysuckle in the West

Anecdotal evidence suggests that Amur honeysuckle was cultivated in gardens of China long before European plant hunters discovered the species. In the nineteenth century, these gardens offered many new species to the landed aristocrats of the West who had grown weary of standard cultivars and were eager for novelties. The first herbarium specimen of Amur honeysuckle was collected in 1843 by an English plant explorer, Robert Fortune, probably from a Chinese garden; but it was specimens collected near the Amur River in 1855 by the Russian plant explorer Richard Maack that served as the basis for eventual description of the species.[5]

Beginning in the late 1800s, European and American plant hunters who exported living plant materials from Asia played a pivotal role in introducing Amur honeysuckle to Western horticulture. A German horticulturist, E. Regel, reported the first successful cultivation of Amur honeysuckle outside its native range, at the Imperial Botanical Garden in St. Petersburg in 1883, using propagules sent from Manchuria in 1880. Regel's 1884 report was soon translated into English and used as the basis for writings on Amur honeysuckle published in Great Britain. It was being cultivated in Germany by 1889 and at the Royal Botanic Gardens at Kew by 1896. The original plants in western Europe probably came from St. Petersburg, which was distributing seeds of Amur honeysuckle as early as 1887.[6]

JAMES O. LUKEN

Basal stems of Amur honeysuckle.

JAMES O. LUKEN

An Amur honeysuckle grown in an open environment.

The St. Petersburg Garden was also the source of the first seeds recorded in the United States, which arrived at the Arnold Arboretum in 1897. The second record of introduction—sent to the New York Botanical Garden by the United States Department of Agriculture—followed by only a year. However, the earliest known report of Amur honeysuckle cultivation in North America is in the archives of the Dominion Arboretum in Ottawa, indicating that plants of Amur honeysuckle were received there in 1896, from Spaeth Nurseries in Germany.[7]

Major botanical gardens, commercial nurseries, and horticultural societies of that time worked together to inform private gardeners about new introductions. During the late 1800s and early 1900s, botanical gardens in Europe maintained active seed-exchange programs and annually published inventories of available seeds. In 1907 and 1915 the plant received awards of merit from the Royal Horticultural Society. Since 1900, it has been described frequently in horticultural literature published in Belgium, France, Germany, Great Britain, and the United States.

Location of garden	Year of listing
St. Petersburg	1887
Cambridge	1913
Oslo	1917
Dublin	1919
Copenhagen	1924
Edinburgh	1924
Amsterdam	1929
Paris	1931

This table gives the year that European botanical gardens first listed Amur honeysuckle in their inventories of seeds available through their exchange programs.

Disseminating Amur Honeysuckle in the United States

In an effort to obtain potentially valuable, cold-resistant varieties of alfalfa, the USDA dispatched an agricultural explorer, Niels E. Hansen, to Russia in 1897. Hansen unilaterally expanded his charge and began shipping seeds of many other species to Washington, D.C. His seed packets began arriving at the same time that a new unit within the USDA, the Section of Foreign Seed and Plant Introduction (SPI), was being funded and organized. Amur honeysuckle seeds gathered in Russia by Hansen and received in 1897 were among the first seeds catalogued by the SPI.[8]

The SPI facility in Washington, D.C., served as a center for distributing seeds to commercial growers, botanical gardens, and private individuals throughout the United States. Seed distributions were designated as "Plant Introduction Experiments," and it was assumed that recipients would report back to the SPI regarding their success or failure with the seeds. Indeed, the 1898 introduction of Amur honeysuckle to the New York Botanical Garden was a Plant Introduction Experiment. The results of this introduction are not known, but almost certainly it was successful, considering the ease with which the species can be propagated.

The SPI's records indicate that its facility received at least seven shipments of Amur honeysuckle between 1898 and 1927. (This represents a minimal number of shipments because imported honeysuckles were often not identified as to species.) These importations originated at botanical gardens in Great Britain or were collected in Manchuria by agricultural explorers working for the USDA. Clearly the Amur honeysuckle now naturalized in the United States represents a variety of genotypes, although the specific geographical range over which these genotypes were collected is not known. The SPI's introduction effort was successful: In 1931, the species was available from at least eight commercial nurseries throughout the country.[9]

From the 1960s to 1984, the USDA Soil Conservation Service (SCS; now known as the Natural Resource Conservation Service) sponsored a program to develop improved cultivars of Amur honeysuckle. These plants were intended for the traditional SCS functions—soil stabilization and reclamation—as well as improving habitat for birds and serving as ornamental landscape plantings.

Five introductions occurred during this period. From plants already naturalized in various parts of the United States, specimens were selected for more abundant fruit production, propagated vegetatively, and then cultivated at centers for plant materials around the country. Occasionally the SCS would make seedlings available to other government agencies involved in reclamation work. Although Amur honeysuckle did not prove particularly useful for soil stabilization, the ease of harvesting its seeds mechanically and the high survivability of seedlings after cold storage facilitated its distribution and establishment in large reclamation projects. In addition, the consistently high flower and fruit production of Amur honeysuckle proved well suited for wildlife habitat improvement. More commonly, however, seeds were made available on request to commercial nurseries and the resulting plants were sold to private individuals. The most successful of these cultivars, 'Rem-Red', is still recommended by the SCS (now the NRCS) and is commercially available.[10]

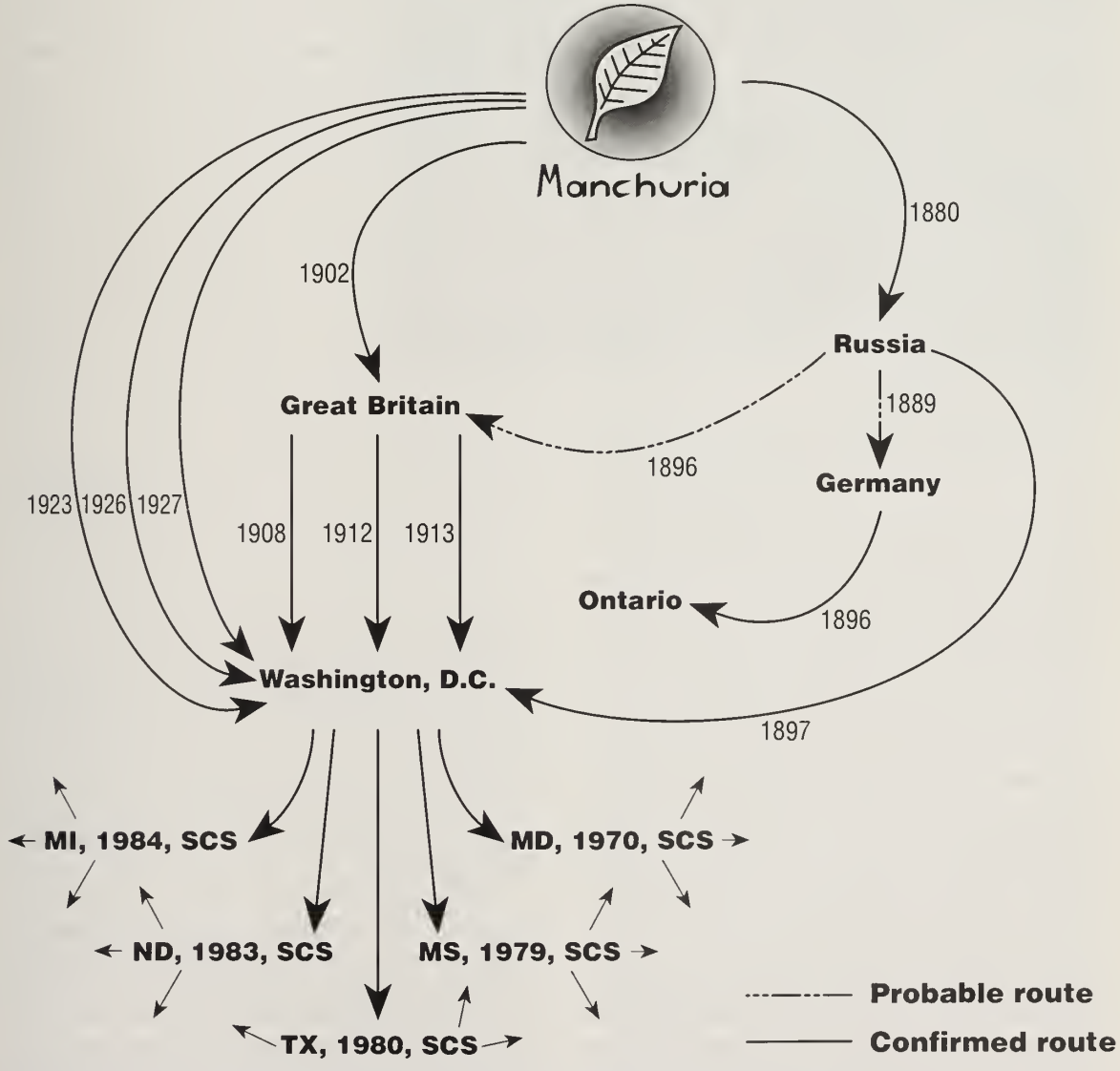
Escape of the Amur Honeysuckle

The first record of Amur honeysuckle's tendency to spread beyond the point of initial planting is found in the archives of the Morton Arboretum, near Chicago, and dates from the mid-1920s. In spite of this early warning, the Morton Arboretum was still touting the virtues of the plant more than a decade later. Evidence of naturalized populations did not begin to appear until the late 1950s, continuing through the early 1970s. These initial reports were harbingers of the invasion to come. For example, Lucy Braun, in her 1961 book on Ohio woody plants, noted that the Amur honeysuckle was "reported only from Hamilton County, where it is becoming abundant in pastures and woodlands." Thirty-three years later the species was reported in thirty-four Ohio counties.[11]

The relative delay between first introduction (1897) and widespread escape (1950s) of Amur

honeysuckle was to be expected for a plant with its life-history traits and mode of introduction. First, it is a long-lived woody plant that does not produce fruit until it is three to five years old and, therefore, will increase slowly compared to an annual plant. Second, during this earlier period (1898–1950s) Amur honeysuckle was typically used in small quantities in landscape plantings, so the area of subsequent spread was for some time more limited than would be the case with annual weeds, which often contaminate crop seed and are thereby disseminated quickly.

In Europe, Amur honeysuckle has been intensively cultivated longer than in the United States, but no naturalization has been reported. Fruit production by the species, at least in western Europe, seems to be less regular and abundant than in eastern North America. Although the first report of Amur honeysuckle flowering in eastern Europe (in St. Petersburg in 1883) mentioned the "sanguineous" fruit, early west-



Pathways and dates of Amur honeysuckle introduction to Europe and North America. "SCS" indicates release of improved cultivars by the U.S. Department of Agriculture Soil Conservation Service.

ern European notes included data on flowers only, or remarked on lack of fruit development. Not until approximately two decades after the shrub's introduction into England were the fruits described in British horticultural literature. Even as late as 1934, the merits of the plant as a fruiting shrub were said to be not well known in England, although "in warm seasons and on certain soils" fruiting could be abundant.[12] Western European regions apparently lack certain environmental conditions shared by the eastern United States and eastern Asia, where fruit production is heavy.

Ecology in the Invaded Range

Ecological research on Amur honeysuckle did not begin until the 1980s, after the plant had achieved a critical level in local plant communities.[13] Earlier reports had assumed that Amur honeysuckle seeds were dispersed by birds, but it was only in 1983 that proof was found by collecting seeds from the guts of birds. In 1992 a group of researchers found that small mammals also consume seeds of Amur honeysuckle, but their low consumption rates are unlikely to affect seed availability.[14]

The dominant position of Amur honeysuckle in both forest understories and open sites prompted researchers to compare net primary production (or annual biomass accumulation) in the two environments. Results from the northern Kentucky region indicated that populations in open areas were more productive than forest populations. Net primary production of dense open-grown thickets (as high as 1,350 grams per meter per year) approached that of entire mixed woodland communities, suggesting that Amur honeysuckle has a large impact on carbon and nutrient budgets in open sites, whereas carbon gain is relatively restricted in shaded habitats. In addition, open-grown shrubs readily resprout and reestablish growth when clipped annually, but forest-grown shrubs cannot sustain this stress.[15]

Light availability is particularly important for Amur honeysuckle during the seedling stage. Seeds are released in a nondormant condition, and germination and seedling establishment may occur year-round, with a distinct increase in activity during relatively warm, wet periods in winter and early spring. However, seedling growth in forests is severely curtailed by low light conditions, which inhibit production of the long shoots that enable seedlings to reach better light environments. Even as adults, Amur honeysuckle shrubs are moderately shade intolerant and are not likely to replace themselves in shady environments unless past disturbances create a window of opportunity.[16]

The success of Amur honeysuckle in a wide range of habitats and light conditions has logically led to research on its life-history traits, the expression of those traits in various environments, and the importance of preadaptation. In its original, eastern Asiatic range, Amur honeysuckle thrives in frequently disturbed habitats. For example, during 1994, one of us (JOL) found Amur honeysuckle growing almost alone in low-density, low-elevation woodlands and floodplain forests in northeastern China. Evolution in these habitats would presumably favor traits commonly found among early successional, colonizing species, such as a high reproductive output, seeds that can be efficiently dispersed by birds, flexible morphological and physiological characteristics that enable easy response to changing light conditions, and tissues that are readily replaced when lost or damaged.[17] And indeed, Amur honeysuckle possesses all these traits.

With these traits in place, genetic changes were not necessary for Amur honeysuckle to succeed in the United States; the primary determining factors for population spread were probably efficiency of distribution and competitive pressure. Distribution—first through SPI and later through commercial nurseries—was widespread and efficient; competitive pressures were minimal in urban and urban-fringe environments where long histories of human disturbance had created vacant niches and abundant bare ground.[18]

Although much is now known about its biological relationships within its environment, no study has yet determined whether local extinctions of native plants are directly linked to invasion by Amur honeysuckle.[19] Nonetheless, in response to its spread and increasing importance in various plant communities, the Illinois Department of Conservation adopted a policy in

1989 that made its use unacceptable in that state, and many methods have been developed for eliminating this species from natural areas.[20]

Lessons for the Future

Considering the varied functions that scientists envisage for the new cultivars they develop and the differing values that people hold regarding nature preservation, it is not surprising that conflicts arise over resource-management policies. For example, at the same time that the SCS was releasing cultivars of Amur honeysuckle for conservation plantings and horticulturists were recommending it as an ornamental, various botanists were decrying its weedy tendencies. Furthermore, Amur honeysuckle and many other nonindigenous plants—crown-vetch *(Coronilla varia)*, for example—are still being planted across large areas of land, often by managers of public land, at the same time that other managers of parks and natural areas are attempting to control these species and actively pursuing an indigenous-species-only policy. Clearly, the time has come for innovative policies and multidisciplinary protocols that can be used for both nonindigenous plants already firmly established as components of regional floras and potential new introductions that could homogenize regional floras even further.

DRAWING BY WORTHINGTON SMITH. LIBRARY OF THE ARNOLD ARBORETUM

This drawing of Lonicera maackii *first appeared in* The Gardeners' Chronicle *in 1907, accompanied by a description attributing the plant's attraction to "its slender, arching branches with nearly glabrous, ovate, acuminate leaves and dense clusters of creamy-white flowers."*

Sound science, which should be the basis for any attempt to remove or control plant species, requires proof that the species is negatively affecting management efforts in natural communities, whether the goals of those efforts are to establish presettlement conditions, to preserve rare species, to maximize species diversity, or to maintain patterns of disturbance. However, unlike the effect of a weed in agricultural plots, which can be measured in terms of crop quantity or quality, the impact of a single plant species in a natural community is much more difficult to measure. Furthermore, ecologists may disagree on the important levels of impact (whether population, community, or ecosystem). Still, such studies can be done and can be much simplified if management goals are prioritized before research is begun.

A special problem is posed by resource-management policies for preserves and other natural areas that call for indigenous species only. The origin of these policies can be traced to the formative years of our national park system, when conservation goals were first established by scientists and park administrators. Underlying the goals set at that time, which generally used pre-Colombian conditions as the benchmark, was a concept that envisaged successfully preserved ecological systems as assemblages of native species that were balanced, stable, and free of human influence. However,

achievement and maintenance of the pre-Colombian benchmark has become increasingly difficult, if not impossible, because the disturbances that operated historically in natural areas have been suppressed or altered and the contexts in which species compete have been changed.[21]

Some researchers have devised a new paradigm for conservation that recognizes the dynamic nature of all ecological systems.[22] This paradigm does not call for nonindigenous plants to be eliminated from biological communities simply because they were not present in the past. Instead, they would be evaluated on the basis of their roles in ecological processes. In addition, as ecologists Hobbs and Huenneke rightfully pointed out in 1992, certain management activities that attempt to modify ecological processes for the benefit of indigenous species, such as prescribed burning to stimulate seed germination, may at the same time facilitate invasion by nonindigenous plants. Resource managers may therefore need to choose from a menu of conservation goals; some of these goals may call for inclusion of nonindigenous species while others call for their elimination.

Increased effort should be devoted to studying the interactions between indigenous and nonindigenous species and the functional roles that nonindigenous species now play in biological communities with long histories of human influence. For example, Schiffman found that endangered giant kangaroo rats *(Dipodomys ingens)*, indigenous to California grasslands, facilitate colonization and dispersal of nonindigenous plants by creating bare ground and dispersing seeds. Indeed, "eradication of [these] exotic plants would probably have a significant negative impact on populations of this endangered species."[23] Amur honeysuckle, to give another example, achieves its greatest dominance in heavily disturbed, urban landscapes. The impact of the species in these systems is not well understood, but it is possible that valuable ecological functions—nutrient retention, carbon storage, animal habitat improvement—are served by Amur honeysuckle in the absence of indigenous species or when niches are unfilled.[24] Assessing the function of nonindigenous species in urban landscapes and surrounding areas is likely to require the kind of large-scale research that is now mostly limited to pristine systems.

Finally, careful examination of the life-history traits of the thousands of plants that have been accidentally or intentionally introduced, coupled with an analysis of when, where, and if these species have naturalized, would be a useful exercise. Such an analysis would likely have some predictive value when new introductions are proposed or when new cultivars are being developed.[25] Attention should focus on seed production and germination, as suggested by the case of Amur honeysuckle as well as by a 1985 survey of other plants that eventually became problem weeds and by a rating system for management of nonindigenous plants established in 1993.[26] Species with high and consistent seed output, poorly developed seed dormancy, rapid germination, and the ability to germinate at low temperatures and low light may be most likely to spread rapidly across a wide range of habitats. Since the proportion of all introduced horticultural species and cultivars that have naturalized is small (usually about one percent) and eventually become components of our regional floras, the goal of such a screening process would not be to drastically reduce plant introductions but to lessen the risk of future problems.

Endnotes

[1] Mack 1985.

[2] Trisel and Gorchov 1994.

[3] Swink and Wilhelm 1994, 474.

[4] Bean 1973.

[5] Bretschneider 1898, Herder 1864.

[6] Regel 1884, Thatcher 1922, Anonymous 1884a, b, Dippel 1889, Royal Gardens Kew 1898, Imperial Botanic Garden 1887.

[7] Rehder 1903.

[8] Fairchild 1938, USDA 1899.

[9] Farrington 1931.

[10] Sharp and Belcher 1981, Belcher and Hamer 1982, Gaffney and Belcher 1978, Lorenz et al. 1989.

[11] Kammerer 1939, Braun 1961, Pringle 1973, Trisel and Gorchov 1994.

[12] Anonymous 1934.

[13] E.g., McClain and Anderson 1990; Yost et al. 1991.

[14] Ingold and Craycraft 1983, Williams et al. 1992.

[15] Whittaker 1975, Luken 1988, Luken and Mattimiro 1991.

[16] Luken and Goessling 1995, Luken et al. 1995a.

[17] Bazzaz 1986, Luken and Mattimiro 1991, Ingold and Craycraft 1983, Luken 1988, Luken at al. 1995b.

[18] E.g., Yost et al. 1991.

[19] See, however, Luken 1990, Trisel and Gorchov 1994.

[20] Harty 1993, Nyboer 1992.

[21] Luken 1994, Hobbs and Huenneke 1992.

[22] Pickett et al. 1992.

[23] Schiffman 1994, 534.

[24] Whelan and Dilger 1992; Woods 1993.

[25] Reichard and Hamilton 1994, Ruesink et al. 1995.

[26] Forcella 1985, Hiebert and Stubbendieck 1993.

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Acknowledgments

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James O. Luken is an associate professor and John W. Thieret is a professor in the Department of Biological Sciences at Northern Kentucky University in Highland Heights. Luken is an ecologist studying the physiological ecology of invasive woody plants. Thieret is a plant systematist specializing in the taxonomy of grasses and in floristics.

Japanese Knotweed: A Reputation Lost

Ann Townsend

A saga of well-meaning culprits in the dispersion of a plant that has become a nuisance: twentieth-century horticulturists find cause to regret the enthusiasm of nineteenth-century plant promoters.

JIM GORMAN

A typical, healthy mass of Japanese knotweed in flower in late summer.

Japanese knotweed *(Polygonum cuspidatum* Siebold & Zuccarini, now reclassified as *Fallopia japonica* (Houtt.) Ronse Decraene[1]), a member of the Polygonaceae, is a large, shrubby perennial native to the sunny hills and high mountains of Japan, Korea, China, and Taiwan that grows rankly throughout the eastern United States, the Pacific Northwest, and parts of the Midwest. Great clumps of it are found along riverbanks, roadsides, and in other untended places. It is a serious problem in many of our parks. Ecologists increasingly view it as a threat to species diversity and wildlife habitat. In Great Britain, where it is virtually ubiquitous, it is considered the nation's most pernicious weed, and planting it in the wild is forbidden by law.[2]

Ninety years ago nurseries in the United States were marketing Japanese knotweed as "a bold, handsome plant four to six feet tall ... [with] white flowers, small but very numerous, which bloom in great clouds, producing a very

soft and pleasing effect." It was considered "very hardy and desirable."[3] Why, one might ask, if it is such an obnoxious weed and a serious threat to the natural ecosystem, was it ever so esteemed that gardeners paid money for it?

The Problem

Fallopia japonica, commonly known as Mexican bamboo, false bamboo, and fleeceflower as well as Japanese knotweed, is without question an obnoxious weed. When this became evident to Western gardeners it fell from favor, but unlike many other garden plants that became unfashionable and were dropped from the trade, it did not disappear. It has persisted in gardens despite gardeners' heroic efforts to get rid of it, and it thrives in the wild.

It is not hard to understand knotweed's early popularity. Its sturdy red-brown asparagus-like shoots appear in early spring and grow rapidly, as much as three inches a day, becoming hollow bamboo-like stalks that can reach ten feet in height. The leaves, pale to bright green and strongly veined, are broadly egg shaped, two to five inches wide and two to six inches long, with sharply pointed tips. Knotweed flowers in late summer, when for several weeks the entire plant is a froth of tiny (2.5–3 millimeters long), creamy or greenish-white blossoms borne on axillary panicles, and sets seed in winged, three-angled, shiny black-brown achenes. Except for its autumn debris—it dies back to the ground in October in a messy litter of dry leaves and broken stems—knotweed's outward appearance is not so bad, really. The clusters of stems, the heart-shaped leaves, and the clouds of bloom are attractive. The troubling aspect of the plant lies below ground.

PETER DEL TREDICI

The bamboo-like spears of Fallopia japonica *breaking ground in spring. They grow as much as three inches a day.*

Although knotweed produces seeds, they are rarely viable and reproduction occurs primarily through extensive rhizomes. The rhizomes, as large and sturdy as the rest of the plant, form thick, gnarly masses at the base of the stalks and send up new shoots as they extend outward in tough, ropy, underground stems that may reach lengths of sixty feet and are extremely difficult to uproot. Furthermore, small fragments of rhizomes, even from internode tissue, can regenerate, and new clumps of Japanese knotweed often sprout from rhizome fragments washed downstream or transported by humans in topsoil or landfill operations. The shoots are amazingly strong, and have been observed to emerge from rhizomes buried three feet deep; they have even been known to thrust their way up through two inches of asphalt.

Limited only by its need for sun, Japanese knotwood grows in almost any conditions on open sites. Its rapid growth in spring enables new shoots to outcompete other plants for space, light, and nutrients. Less aggressive plants cannot grow in the accumulated debris of old stems and leaves or survive in the dense shade of established stands. Unchecked, knotweed seems capable of endless expansion.

Efforts to control Japanese knotweed have met with mixed success. It is possible to limit its spread in areas near established stands, since new plants can be removed by hand fairly easily. Keeping young plants cut to prevent sturdy rhizomes from developing is also quite effective. The literature on eradicating established stands is not encouraging, however. A combination of frequent cutting and repeated application of herbicides is recommended, but the knotweed will reemerge if this procedure is discontinued or relaxed. Research has begun on biological con-

trol, but the discovery of an effective agent is probably some years in the future and most biologists conclude woefully that complete eradication of the plant may not be possible.

However, while its negative impact on the landscape may outweigh its "soft and pleasing effect," knotweed can nonetheless be appreciated it for its interesting history.

GARY KOLLER

The flowers of Japanese knotweed appear in late summer and last for weeks.

The Introduction of Japanese Knotweed to the West

In 1822 or 1823, a Bavarian physician named Phillipp Franz Balthasar von Siebold (1796–1866), surgeon major in the Dutch East Indies Army, was assigned to the Dutch East India Company's outpost on the Japanese island of Deshima in Nagasaki Harbor. Siebold was a scientist and adventurer as well as a physician, intensely interested in Japanese customs, politics, and natural history; he was also ambitious and eager to win fame and fortune. Deshima, a 32–acre wasteland that the Japanese had constructed of rubble and debris to house foreigners under severely controlled conditions, was an unlikely spot for Siebold to explore and cultivate his interests.

Siebold, a man of "extraordinary intellectual brilliance,"[4] was nevertheless undaunted. Shortly after his arrival he revived the herbal and medicinal gardens established by his predecessors Engelbert Kaempfer (in 1690–1692) and Carl Pieter Thunberg (in 1775–1776), and with the help of medical students and grateful patients began collecting and documenting native plants. In time Siebold gained the trust of the Japanese and was permitted to move to the mainland, where he established a larger garden and an arboretum; and despite the Japanese prohibition against plant exports, he managed to introduce several hundred new species into European cultivation. When he left Japan in 1830, and again in 1862 after a second visit, "the deck of the vessel on which he sailed was a veritable nursery."[5] Many of the plants he introduced, or their cultivated descendants, are now so commonly found in American gardens that we think of them as American plants, among them Siebold forsythia *(Forsythia suspensa)* and PeeGee hydrangea *(Hydrangea paniculata* 'Grandiflora'), a shrub much planted in the late nineteenth century and "still a hallmark of rural and small-town North America."[6] Japanese knotweed was also among the plants that Siebold took home.[7]

After returning from Japan in 1830 Siebold established his *Jardin d'Acclimatation* in

ARCHIVES OF THE ARNOLD ARBORETUM

This illustration of Japanese knotweed in flower appears in William Robinson's 1881 edition of The Wild Garden *with this text:*

"If, instead of the formal character of much of our gardening, plants of bold types similar to the above were introduced along the sides of woodland walks and shrubbery borders, how much more enjoyable such places would be, as at almost every step there would be something fresh to attract notice, and gratify the eye, instead of which such parts are generally bare, or given up to weeds and monotonous rubbish."

Leiden where he cultivated Japanese plants for sale to the public. His 1863 *Catalogue Raisonné et Prix Courants des Plantes et Graines du Japon et de la Chine* listed knotweed as

> one of our most important introductions from Japan, a perennial ornamental plant, inextirpable, with shining foliage, clusters of flowers 'tres gracieuses,' useful in creating groves, sheltering young plantings, and fortifying sandy hills and dunes. The plant, which can be cut in the spring many times over, provides an excellent forage for fattening livestock, which eat it out of preference; the flowers, which appear in autumn, are very sweet and give bees winter food; the bitter and tonic root is a medicine of repute among the Chinese and Japanese; finally, even the stalks which die in winter are good for burning and for matches. Already there have been very satisfactory trials stabilizing trenches and slopes along railroad tracks and sandbanks with plantings of this arborescent, inextirpable plant.

Knotweed was also documented and described in *Flora Japonica*, a handsome two-volume flora published in Leiden by Siebold and his collaborator J. G. Zuccarini in 1835, and in the smaller, unillustrated edition in 1845.

Japanese Knotweed in England

The first English reference to Japanese knotweed may have be a description included in *Paxton's Flower Garden*,[8] published in 1850–1851, which noted that it was "only to be found at present" in Siebold's garden in Leiden.[9] Shortly afterward it crossed the Channel; in 1880 Sir Joseph Dalton Hooker, the director of the Royal Botanic Gardens at Kew, wrote in *Curtis's Botanical Magazine* that Japanese knotweed had been grown "for a quarter of a century at Kew, to which it was, [Dalton believed], sent from Holland."[10]

William Robinson (1838–1935), however, was most responsible for Japanese knotweed's popularity in England. Robinson, the Irish-born horticulturist and writer who became known as the Father of the English Flower Garden, almost single-handedly changed garden design in the second half of the nineteenth century from the formal bedded-out geometry of the Victorians to the more naturalistic plantings best represented in the gardens designed by Gertrude Jekyll. "Knowing," Robinson said, "a little of the vast world of plant beauty quite shut out of our gardens by the 'system' then in vogue . . . [I] was led to think of the vast numbers of beautiful hardy plants from other countries which might be naturalized, with a very slight amount of trouble, in many situations in our plantations, fields, and woods." He saw this giant knotweed as well-suited to his wild garden, and promoted it not only in the various editions of *The Wild Garden* but also in *The English Flower Garden*, published from 1870 to 1935, and in *Hardy Flowers* (1872), where he set forth his opinion that

> [i]f anybody will select some open grassy spot in a pleasure-garden or grassy glade near a wood—some spot considered unworthy of attention as regards ornamenting it—and plant a group of three plants of [Japanese knotweed . . . it] will spring up every year to a height of from six feet to eight feet if planted well; it has a graceful arching habit in the upper branches, and is covered with a profusion of small bunches of pale flowers in autumn.

Robinson's appreciation for Japanese knotweed is further evident in his labeling it a perennial of "noble port" in an otherwise straightforward botanical listing, and including it in his list of "A choice Selection of the very finest Herbaceous Perennials."[11]

In 1884, however, his discussion of knotweed in *The Garden*, while encouraging his readers to plant it "on the lawn, in the shrubbery, or in woodlands . . . placed so that they may have plenty of room in which to fully display their gracefully arching stems," included a warning that knotweeds were "not plants for the border, being of such spreading growth, and being gross feeders would soon overrun and harm plants of a weaker character." And in the 1921 edition of *The English Flower Garden*, Robinson limited his entry on knotweed to three rather terse sentences, of which only the first retains a trace of his earlier enthusiasm:

> Of fine graceful habit, its creamy-white flowers are borne in profusion. It should be grown apart on the turf or in the wild garden. It is easier to plant than to get rid of in the flower garden; a rank weed, right in copse or pond side.[12]

In fact, by the early twentieth century knotweed was beginning to be viewed with disfavor all over England, where it had been extensively cultivated for thirty years. It had proven to "make itself a nuisance when planted in borders or shrubberies, its rootstocks creeping beneath the surface for some distance, throwing up new plants at every point, and the more they were chopped up the more they grew, unless completely eradicated[13] and even one who admired its ability to flourish where nothing else would grow and pronounced it "a plant we ought to be devoutly thankful for to our allies in the Far East" admitted that "it thrives too well in most cases, becoming somewhat of a weed, if not carefully watched and restricted."[14]

Japanese Knotweed in the United States

It is often claimed that Frederick Law Olmsted (1822–1903) is responsible for introducing Japanese knotweed into the United States, planting it in Central Park or along the Muddy River in Boston's "Emerald Necklace." It is known that Olmsted met William Robinson when Robinson visited the United States about 1870 and that he later owned a copy of *The Wild Garden*, which he recommended to his partner Calvert Vaux (1824–1895) when Vaux was laying out the Rambles in Central Park.[15]

However, hard evidence that Olmsted actually specified knotweed's use seems not to exist. It is not on the Muddy River Improvement Plant Lists (1892 and 1893),[16] though it is so well established on the river's banks that it may have been growing there since then; a hundred years later it formed a solid mass between the river and the roadway, through which the pedestrian pathway became a mere tunnel in summer and fall when it was in full foliage. Knotweed is also something of a problem at the Biltmore Estate in Asheville, North Carolina, which Olmsted designed in the 1890s, but the plant does not appear on the original plant list for the estate nor on the 1893 list of plants in the estate nursery.[17] According to Charles E. Beveridge, editor of the Frederick Law Olmsted Papers, "while the vigor of [Japanese knotweed] might have appealed to Olmsted, there are at least two qualities of the plant that [probably] would have made it not so attractive for him. One is the size of the leaf and the density with which . . . it would grow under any circumstances: in the masses of shrubs that he planted, the elements of delicacy, intricacy, and variety [were] key, and . . . [knotweed] would not be a good plant for achieving such effects. Also, the amount of bloom would have made the plant less desirable in his view."[18]

Whether or not Olmsted ever specified knotweed, by the turn of the century it had become a firmly established ornamental garden plant in the United States, recommended for planting in wet soil by the sides of pond and streams. In *Our Garden Flowers: a Popular Study of Their*


GARY KOLLER

Cascading over the wall in the center of this photo is Fallopia japonica *'Crimson Beauty', said to be a cultivar that knows how to keep to its place. Other cultivars available in the trade include 'Devon Cream' and 'Spectabile,' as well as a compact variety.*

Native Lands, Their Life Histories, and Their Structural Affiliations, first published in 1910, Harriet Keeler (1846–1921), a botanist and writer of popular garden books, describes knotweed as "effective for bold effects and desirable for the flowering mass it produces in autumn," also noting "one should think twice, possibly thrice, before planting [it] within the garden enclosure."[19]

By that time, Japanese knotweed was a staple in nursery catalogs, sold by such companies as Bobbink and Atkins in New Jersey, H. Kohankie and Son of Ohio, Palisades Nurseries of Sparkill, New York, and Bay State Nurseries and R. and J. Farquhar and Company in Massachusetts. In the 1920s Farquhar's catalog listed Giant Knotweed, "a decorative plant growing five to six feet high and producing in the fall long drooping clusters of white flowers" for $2.50 per dozen or $18.00 per hundred, the going rate for other perennials such as balloon flower *(Platycodon grandiflorus)* and Jacob's ladder *(Polemonium caeruleum).*

The Final Chapter

It is easy to imagine that by the late 1920s those gracefully arching stems and drooping clusters of bloom had already found their way into many gardens via garden club plant swaps and church fair garden tables, but by this time gardeners were of two minds about Japanese knotweed. In September of 1928 *Horticulture* magazine printed Frank Waugh's description of the lusty knotweed as "effective in background plantings" and "a beautiful sight" in full flower, to which the editor appended a warning that it resisted control except by strong weed killer and should be planted with caution.[20] The Massachusetts Horticultural Society's *Gardener's Omnibus* of 1938 included a paragraph entitled "Exterminating the Knotweed" interposed between "Burning Weeds with a

The Arnold Arboretum

F A L L · N E W S · 1 9 9 7

Preservation in a Dynamic Landscape

Robert E. Cook, Director

The Arnold Arboretum was the first part of Boston's Emerald Necklace, the system of parks designed by Frederick Law Olmsted, father of American landscape architecture. It is, therefore, a landscape of considerable historical importance. Together with his student Charles Eliot, Olmsted worked with Charles Sprague Sargent, the first director, to develop a precise planting scheme that served the educational purpose of instructing visitors about the evolutionary history of woody plants.

Today, through our commitment to preserve Olmsted's legacy, there is a temptation to adhere strictly to the final planting design created in his office. Yet I believe that Olmsted would have found this foolish, given the scientific mission of the Arboretum. A scientifically useful collection, especially one growing outdoors in the climate of Boston, must be dynamic and continually changing with the death of old or sick trees and the planting of new ones.

The dynamic nature of the collection has never been more evident than in the past year. Twenty-five inches of wet snow in April damaged more than a thousand trees; hundreds will have to be removed. The past summer was one of the driest on record, and we will lose many specimens over the next several years due to this drought.

At the same time, two separate expeditions to China this summer secured large collections of living plant cuttings and seeds, many new to the Arboretum and to this country. Stephen Spongberg traveled to the higher elevations of western Sichuan while Peter Del Tredici collected plants in Jilin Province, along the border with Korea in northwestern China. They returned with many rare and interesting species such as *Chosenia arbutifolia, Acer pseudosieboldianum* (the Korean maple), *Thuja koraiensis* (the Korean arborvitae), *Carpinus fangii,* and *Pterostyrax psilophylla.* Over the next decade, these collections will be integrated into the landscape of the Arboretum in ways consistent with our original mission to grow all the plants hardy in the Boston area.

Peter Del Tredici

Chosenia arbutifolia in the wild, Chang Baishan, China.

I believe that the dynamic process of collections management—the acquiring of documented material, its propagation and establishment, its care for a century or more if necessary, and its removal after death—this process should be the true object of our preservation efforts, not the precise design Olmsted created to guide the process. In this way, we acknowledge that the Arboretum is a working landscape designed to serve both a research and an educational mission. Olmsted would surely have understood the need for this dynamic management. In adhering to this process for over a century, we fully honor and preserve the legacy of his accomplishment at the Arboretum.

Arboretum Council

This fall, the Arnold Arboretum initiated a new volunteer organization known as the Arboretum Council. Conceived by the Director's Advisory Board, this group is intended to create a closer link between the Arboretum and its most dedicated supporters. It reflects the desire to benefit from the involvement and expertise of individuals who believe in the Arboretum's work and who are willing to promote the programs and initiatives of the institution among a broader constituency than we now reach.

Semi-annual gatherings of the Council will give participants the opportunity to hear, first hand, the plans, achievements, and challenges of the Arboretum, to advise the director in specialized areas of expertise, and most of all, to serve as advocates for the Arboretum within the various communities we serve. As the organization develops, the Board anticipates the beginning of a lively dialogue among a group of friends who share a special interest in the programs, research, and mission of the Arboretum. Peg Hedstrom will be the staff member coordinating the events and ongoing activities of the Council.

A Brisk and Sunny Plant Sale

On Sunday, September 21, more than a thousand Arboretum members and friends gathered at the Case Estates in Weston for a full morning of activities at the 17th Annual Fall Plant Sale. Drawn by sunny, early autumn weather and an exceptional array of plants for sale, crowds began gathering at the barn before 8:00 am for the Preview, open only to members at the Sustaining Level and above. According to greenhouse manager and propagator Tom Ward, seven thousand plants were sold in the barn alone.

Dorothy Greco

In the display gardens, Richard Stomberg, Arboretum member and glasshouse manager at Harvard's Department of Organismic and Evolutionary Biology, taught two well-attended education sessions on dividing perennials and planting new plants. As in years past, more than a dozen plant societies and horticultural organizations participated in Society Row. Up on the hill, a wide selection of donated plants was available for sale in the live and silent auctions and the straight sales area, with all proceeds supporting the living collections at the Arboretum.

Special guest auctioneers Roger Swain (seen here), Susan Dumaine, and Patrick Conley joined Arboretum staffers and bidders under the live auction tent. Combined sales from the two auctions totaled $8,500, a significant increase over last year, with straight sales receipts pushing the grand total on the hill to $17,000. Donations of plants and other garden-related items were received from more than one-hundred nurseries and individuals this year, from Boston to California and the Pacific Northwest. We would like to thank the donors, members, volunteers, and friends who support the Arnold Arboretum by supporting the Annual Fall Plant Sale.

If you are interested in volunteering for next year's plant sale, call Kara Stepanian at 617/524–1718 x 129.

Dorothy Greco

On the Grounds

Karen Madsen

Julie Coop has been promoted to Superintendent of Grounds. She has been with the Arboretum since 1988, initially in charge of maintenance at the Case Estates, and for the past six years as Assistant Superintendent in Jamaica Plain.

Karen Madsen

Todd Burns has joined the grounds staff as arborist. A 1991 horticultural trainee at the Case Estates and a 1992 arborist intern in Jamaica Plain, Todd attended the Stockbridge School of Agriculture, University of Massachusetts, and has worked for commercial tree companies.

This Business Called Landscape

A Symposium Co-Sponsored by Radcliffe Seminars and the Arnold Arboretum

The expertise of designers, contractors, arborists, and horticulturists lies in their landscape work and not necessarily in business. However, success is measured not only by the service provided but also by how it is administered. In panel discussions and workshops, this symposium will bring together business and landscape professionals to discuss project management, decision-making, service coordination, and information technology—all areas that can make the difference between loss and profit, keep you on top of your business, and allow you to better serve your clients.

Topics for morning panel discussions

- Decision-making to save your sanity
- Locating your practice in the market spectrum
- Negotiation and conflict resolution

Afternoon workshops

- Accounting for your design: Running projects for profitability
- Computers in the office: Controlling work flow
- Insurance, taxes, certification, and the law: Know your options

Date: Friday, January 9, 1998. 8:30 am–3:30 pm

Fee: $80 (includes lunch)

Location: Cronkhite Graduate Center, Radcliffe College, 6 Ash Street, Cambridge

Advance registration required; deadline is January 2. Fee nonrefundable after the deadline; $10 cancellation fee prior to deadline. Register through the Arnold Arboretum at 617/524–1718 x 162.

Karen Madsen

Seldom Seen Treasures

During the Open House held on October 17 in celebration of the Arboretum's 125th anniversary, Charles Sprague Sargent's Civil War uniform stood front and center at the entrance to the reading room while staff and visitors examined a selection of other treasures from the Arboretum's archives.

New Staff

Karen Madsen

Alice Ingerson has joined the Arboretum staff as Associate Director of the newly formed Institute for Cultural Landscape Studies. Alice comes to the Arboretum from the Lincoln Institute of Land Policy, where she led the publications staff in creating a distinctive series of reports, written by professional journalists but representing the views of both scholars and practitioners on current land use issues. From 1984 to 1991 Alice edited *Forest and Conservation History*, the quarterly journal of the Forest History Society (since merged into a new journal, *Environmental History*). Alice has a Ph.D. in cultural anthropology from Johns Hopkins University. She will be working with Institute Director Phyllis Andersen to gather and distribute information about managing and interpreting cultural landscapes, using the Internet as well as traditional conferences and publications.

Peg Hedstrom brings over ten years of development experience to her new position as Membership Director and Development Officer. She served as Director of the Annual Fund at Bentley College, Associate Director of Annual Funds at Boston University, and Director of Reunion Giving, also at Boston University. Peg's responsibilities include managing the membership program and the annual appeal, launching the new Arboretum Council (see related story), and working to increase support for the Campaign for the Arnold Arboretum.

Karen Madsen

Consider a Gift of Appreciated Securities

When you give appreciated securities to the Arboretum, you receive a double tax benefit: avoidance of all capital gains taxes and a charitable deduction for the full fair-market value of the stock given.

Alternatively, with a gift of appreciated securities to a life income plan, you can:

- Invest in the growth and future of the Arboretum
- Receive an income stream for life
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- Avoid capital gains tax
- Save on gift or estate taxes
- Provide income to a family member or friend
- Benefit from Harvard's professional investment management at no cost to you

We are happy to help you explore the many mutually beneficial ways to make a meaningful gift to the Arnold Arboretum. To learn more about these creative opportunities, please contact:

Anne D. McClintock, *Director,* or Brandi M. Sikorski, *Associate Director*
University Planned Giving Office, Harvard University
124 Mt. Auburn Street, Cambridge, MA 02138-5762
800/446-1277 or 617/495-4647, fax 617/495-0521
e-mail bsikorsk@harvard.edu

Letters of Participation

The Arboretum began offering Letters of Participation in Temperate Woody Plant Materials and in Woody Plant Propagation in September 1993. This fall the Arboretum added a Letter of Participation in Historic Landscape Preservation. For more details, contact the Adult Education Department at 617/524–1718 x 162 or consult the current catalogue of adult education programs.

Since 1993, Letters of Participation have gone to:

Temperate Woody Plant Materials
Margaret Amdur,
Maureen Doherty

Woody Plant Propagation
Pat Beirne, David Brockway,
Liz Brown, Maureen Doherty,
George Hibben, Faye Lieb,
Anne Senning

Torch" and "Burning Out Tree Stumps." And finally, the Bush-Browns in the 1965 edition of their widely consulted *America's Garden Book*, give knotweed no quarter, finding it not only ubiquitous but of "a very rank character of growth, quickly crowding out everything in its path," mentioning it only in their discussion of shrubs with undesirable characteristics.[21]

Japanese knotweed, which a century earlier Siebold had considered one of his most important introductions, had so fallen in public esteem that gardeners were interested only in methods for removing it. What Robinson saw as a plant laudable for its ability to survive the hardest frosts and spring up every year with renewed vigor had become an impossible nuisance, and gardeners were throwing endless clumps of it on rubbish heaps, though not as quickly as it spread throughout their gardens and beyond. Boldly displaying its unquenchable spirit, knotweed, transplanted from its native Japan by a German doctor employed by the Dutch, had established itself as a permanent though unwanted member of plant communities throughout the Western Hemisphere, its arching stems and clouds of bloom appearing indomitably anywhere one of its stout rhizomes—or a piece of one—lay hidden in the soil.

Endnotes

[1] L.-P. Ronse Decraene and J. R. Akeroyd, Generic limits in *Polygonum* and related genera (Polygonaceae) on the basis of floral characters, *Botanical Journal of the Linnean Society* (1988) 98: 321–371.

[2] Jisaburo Ohwi, *Flora of Japan* (Washington, DC: Smithsonian Institution, 1965), 413; Leslie Seiger, Element Stewardship Abstract for *Polygonum cuspidatum* (Arlington, VA: Central Conservation Data Bases of The Nature Conservancy and Network of Natural Heritage Programs, 1992). Unless otherwise specified, botanical and ecological information is taken from the latter document.

[3] 1907 Biltmore Nursery Catalog, Biltmore, NC.

[4] S. A. Spongberg, *A Reunion of Trees* (Cambridge: Harvard University Press, 1990), 101.

[5] Ibid., 102.

[6] J. A. Gardner, *The Heirloom Garden* (Pownal, VT: Storey Communications, 1992), 93.

[7] Siebold was not, however, the first to bring Japanese knotweed to Europe. It had been been introduced to Western science earlier, via a herbarium specimen. In 1777 Martinus Houttuyn (1720-1798), a Dutch collector, merchant, and author of *Natuurlyke historie*, introduced *Reynoutria japonica*, which in 1901 was determined to be *Polygonum cuspidatum* (now *Fallopia japonica*). Thunberg had sent Houttuyn (who had helped to underwrite Thunberg's travel to Japan) a number of specimens but no seeds or living plants.

[8] Translated from a description in the Annales de Gand (Ghent) 5: 461, written by C. F. A. Morren (1807–1858), a Belgian botanist and horticulturist.

[9] The entry goes on to say that the plant has been cultivated in the Royal Horticultural Society's garden for a quarter of a century, introduced from "China as *Houttuynia cordata*," which is possibly the source of the 1825 date often given for its introduction, but *H. cordata* is not the same taxon as *Fallopia japonica* (*Polygonum cuspidatum*).

[10] J. D. Hooker, *Polygonum cuspidatum*, *Curtis's Botanical Magazine* (1880) 36 (3rd Series): Tab 6503.

[11] J. Tankard, Introduction to Facsimile of the 5th Edition of W. Robinson, *The Wild Garden* (Portland, OR: Timber Press, 1994), xi, xiii-xv; W. Robinson, *Hardy Flowers* (London: F. Warne,1872), 15–16.

[12] *The Garden* (1884) 26: 317; *The English Flower Garden*, 13th ed. (NY: Scribner's,1921), 640.

[13] J. Weathers, *A Practical Guide to Garden Plants* (London: Longmans, Green, 1901), 769.

[14] *Gardeners' Magazine* (1904) 47: 861.

[15] Tankard, *op. cit.*, xi.

[16] Cynthia Zaitzevsky, *Frederick Law Olmsted and the Boston Park System* (Cambridge: Harvard University Press, 1982), 215–220.

[17] According to William Alexander, Landscape Curator, The Biltmore Company, Asheville, NC, Japanese knotweed (as *Polygonum cuspidatum*) was included among the plants offered in the 1907 Biltmore Nursery catalog, but these plants were grown for the nursery trade and reflect market demand rather than Olmsted's preferences.

[18] Personal correspondence with Charles E. Beveridge, Series Editor, The Frederick Law Olmsted Papers, Department of History, American University, Washington, DC, January 6, 1997.

[19] Harriet L. Keeler, *Our Garden Flowers* (NY: Scribner's, 1925), 108.

[20] *Horticulture* (1928) 6(17): 407.

[21] James and Louise Bush-Brown, *America's Garden Book* (NY: Scribner's, 1965), 602.

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PETER DEL TREDICI

The Checkered Career of *Ailanthus altissima*

Behula Shah

The history of the tree-of-heaven since its introduction into cultivation is a convoluted one. Once highly praised and widely planted as an ornamental, the species has made itself at home as a weed along our roadsides and in our fields. *Ailanthus* is now viewed by many as a symbol of dereliction and abandonment, but its hardiness also makes it deserving of our admiration.

The genus *Ailanthus*, part of the Simaroubaceae, includes five species distributed widely from eastern Asia to Australia. The species *A. altissima*, native to northern China, is the only one that has adapted to the temperate environment of Europe and North America (zones 4–8). Most species have traditionally been revered in the cultures where they grow. The ancient Chinese name for the plant is "God's tree," and in its native range it is planted near Buddhist temples. The name of the genus derives from its common East Indian name, *Aylanto*, meaning "heaven-tree" or "tree reaching for the sky." The English name, "tree-of-heaven," transposes the original meaning, which probably alludes to the East Indian mythic tree that reaches the heavens from the earth.[1]

During its days of respectability in the United States—the first half of the nineteenth century—tree-of-heaven was valued primarily for its ability to provide shade and to make an effect in the landscape within a relatively short time, growing up to five feet in a year. It happily grows in any soil condition and can be propagated in large numbers, both because of its tendency to sucker and because its distinctive winged seeds germinate easily without pretreatment. (In a moist medium, seedlings appear within two months.) It had the additional attraction of being a foreign plant that, as Andrew Jackson Downing so poetically put it, could "whisper tales to you in the evening of the 'Flowery Country' from whence you have borrowed it . . ."[2] But these were some of the very attributes that contributed to its fall from grace during the middle of the nineteenth century.

Ailanthus altissima matures to almost sixty feet, with a spreading, light canopy and a grayish, slightly rough bark that stands out against darker backgrounds. Its leaves remain green without significant autumn color until the first frost, when they drop all at once. These alternate, pinnately compound leaves are distinguished by a characteristic gland that can be felt on the underside of the numerous leaflets near the base. (It was this gland that gave the tree its first species name, *Ailanthus glandulosa*, in use until 1919.) Its flowers are whitish to greenish-yellow, formed in clusters borne on long panicles at the ends of branches in June. The trees are usually dioecious, but occasionally both sexes exist on the same tree. The male flowers are notable for a unpleasant smell that lasts for a few weeks. Fertile flowers develop into showy clusters of seed pods that are green at first, gradually becoming tinged with a pink that darkens to red and finally to a reddish-brown by late summer.

Ailanthus altissima in Europe

Ailanthus altissima was first grown in Europe in about 1751 from seed sent to England from Nankin (Nanjing) by a French Jesuit priest, Pierre Nicholas d'Incarville. Among the recipients was Peter Collinson, who grew from them "a stately tree." The Royal Society in London

Ailanthus altissima *thrives on the banks of the Charles River near Boston.*

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Tree-of-heaven seen just beneath Paulownia tomentosa *(empress or princess tree) in the wild in northern China.*

also received seeds, which it distributed to Philip Miller of the Chelsea Physic Garden and to an enthusiastic gardener in Surrey, a Mr. Webb, both of whom raised plants from the seeds.[3]

Tree-of-heaven was among the first plants to come from China, a country that was still difficult to penetrate during the eighteenth century but had nonetheless inspired a craze for *chinoiserie* in England and France. In 1755 a popular magazine, *Connoisseur,* described the fad by saying "the chinese taste . . . has already taken possession of our gardens, our buildings and our furniture . . ." Literary descriptions of Chinese gardens had been filtering into England and *chinoise* architectural features had been introduced into gardens, but no Chinese plants were yet available. Curiosity about *Ailanthus* must therefore have been high.[4]

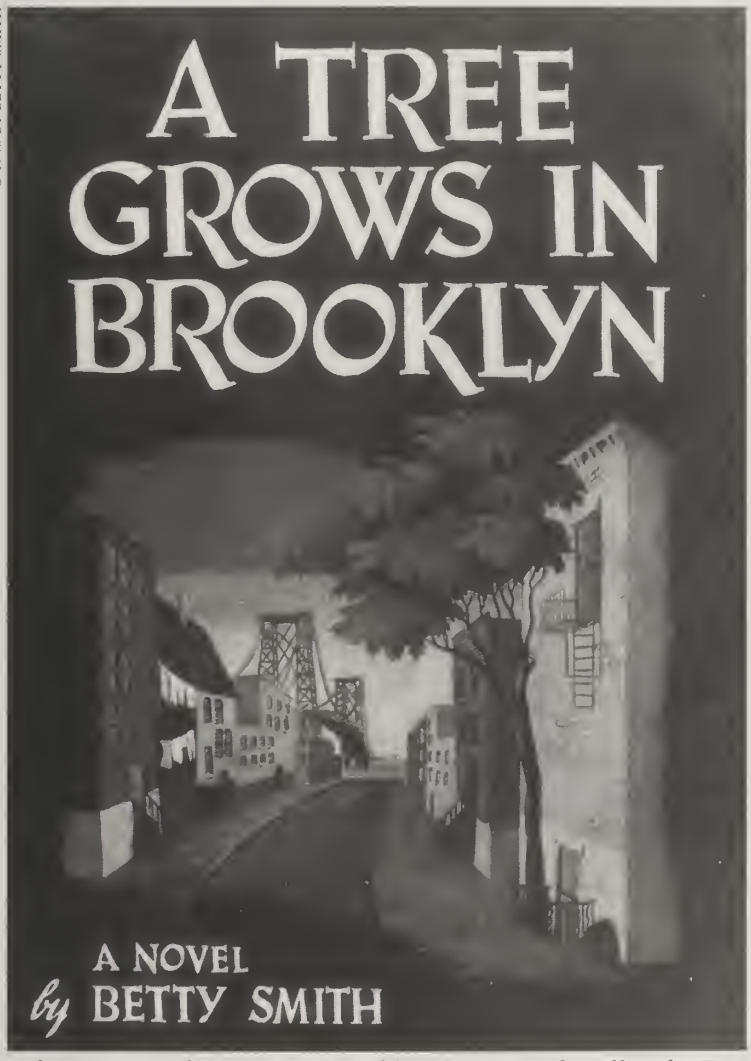
By 1756, however, Mr. Webb's garden superintendent, John Ellis, had already noticed that the tree emitted an offensive, even sickening odor, and that it suckered profusely. Eighty years later, in 1838, J. C. Loudon confirmed these impressions in his influential *Arboretum et Fruticetum Britannicum,* noting the suckering tendency of the tree as well as "the disagreeable odour" of its whitish flowers. Nevertheless, by the 1840s many mature specimens of *Ailanthus* were growing in Europe and it was being widely used as a shade tree for public promenades in Italy and France, valued particularly for its resistance to insect devastation.[5]

Ailanthus altissima in the United States

It was William Hamilton of Philadelphia, an avid plant collector and landscape improver, who in 1784 introduced *Ailanthus* into North America, together with other Chinese trees including *Ginkgo biloba,* presumably sending the seeds from England himself. At that time many people (including Philip Miller in his *Gardener's Dictionary* of 1768 and probably Hamilton also) confused *Ailanthus* with the Chinese varnish tree, *Rhus verniciflua,* or thought it to be a new species of sumac. It did not receive its own generic status until 1786, when René Desfontaines described the tree and published a plate of its flowers and leaves.[6]

By the 1840s, the European practice of using *Ailanthus* for public walks was being emulated in cities like Philadelphia and New York, where it was known as "the celestial tree." In March of 1847 Downing editorialized in his magazine, *The Horticulturist*, that

> the variety of trees for cities—densely crowded cities—is but small; and this, chiefly, because the warm brick walls are such hiding places and nurseries for insects, that many fine trees—fine for the country and for rural towns—become absolute pests in the cities. Thus, in Philadelphia, we have seen, with regret, whole rows of the European Linden cut down within the last ten years, because this tree, in cities, is so infested with odious worms, that it often becomes unendurable. On this account that foreign tree, the Ailanthus, the strong scented foliage of which no insect will attack, is every day becoming a greater metropolitan favorite.[7]



"There's a tree that grows in Brooklyn. Some people call it the Tree of Heaven. No matter where its seed falls, it makes a tree which struggles to reach the sky. It grows in boarded-up lots and out of neglected rubbish heaps. It grows up out of cellar gratings. It is the only tree that grows out of cement. It grows lushly . . . survives without sun, water, and seemingly earth. It would be considered beautiful except that there are too many of it."

Ailanthus was well suited to meeting the growing demand for landscape trees that accompanied the unprecedented economic and social transformations of the 1840s, years that can be described as the clipper ship era. Between 1840 and the 1860s, the United States' economy was invigorated by the China trade, resulting in the rapid growth of urban centers and suburban estates. By the 1850s, *Ailanthus* was being extensively used in urban plantings and was the only shade tree to be seen on many streets of New York. It was also grown in suburban gardens as boundary plantings.[8]

At the same time, it continued to be popular as a specimen tree on the pleasure grounds of country homes, in large part because of the aesthetic qualities described by Downing in 1841 in the first edition of his influential work, *A Treatise on the Theory and Practice of Landscape Gardening*, when *Ailanthus* was "one of the commonest trees sold in the nurseries." For some reason Downing chose to ignore the "disagreeable odorous" flowers that Loudon had written about in 1838 and instead commented that "The male forms a finer ornamental tree, the female being low and spreading. . . . It is a picturesque tree, well adapted to produce a

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Two trees grow up out of cellar gratings in Manhattan.

good effect on the lawn singly or grouped; as its fine long foliage catches the light well, and contrasts strikingly with that of the round-leaved trees." To counter its suckering habit, Downing suggested planting *Ailanthus* in "a heavy sward, where the surface of the ground is never stirred by cultivation." He noted that its "singularly naked look in winter [is] well calculated to fix the attention of the spectator at that dreary season."[9] Its suckering habit was of great advantage to nurseries, allowing them to meet increasing demand rapidly and profitably.

The Slow Decline of *Ailanthus* in the United States

By July of 1852, when Downing was again editorializing about *Ailanthus* in *The Horticulturist*, his enthusiasm was waning. He admonished his readers for planting "odorous Ailanthuses and filthy poplars, to the neglect of graceful elms and salubrious maples." The following month, his disapproval of *Ailanthus* became more passionate. "Down with the Ailanthus!" he wrote. "[T]his 'tree of heaven,' (as the catalogues used alluringly to call it,) has penetrated all parts of the union, and begins to show its true character." He now viewed *Ailanthus* as

> an usurper in rather bad *odor* at home, which has come over to this land of liberty, under the garb of utility to make foul the air, with its pestilent breath, and devour the soil, with its intermeddling roots—a tree that has the fair outside and the treacherous heart of the Asiatics, and that has played us so many tricks, that we find we have caught a Tartar which it requires something more than a Chinese wall to confine within limits![10]

This outburst must be viewed within the context of the preceding decade's events. At the end of the Opium War in 1842, China had signed treaties with the United States and other foreign powers allowing foreigners free access to the walled city of Canton as well as certain other privileges. But the tensions continued: conciliatory promises were continually made by the Chinese government, only to be repeatedly broken under the influence of antiforeign sentiment in China. Downing associated the negative attributes of *Ailanthus* with his perception of Chinese morality and viewed his distaste for the tree as "a patriotic objection"; it had "drawn away our attention from our own more noble native American trees."[11]

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A tree-of-heaven escaped to Arizona.

This was Downing's "last and best essay," wrote Thomas Meehan, a prominent Philadelphia horticulturist, in 1853.[12] Many Americans must have shared the sentiment because large numbers of *Ailanthus altissima* were uprooted and discarded, primarily from country homes. Nevertheless, Meehan still considered it a useful tree for urban conditions where insect infestations and pollution made it difficult to keep any other tree healthy. For the same reason, perhaps, *Ailanthus* continued to be a favorite urban tree in Europe. After spending a year in France, William Robinson, author of many horticultural books including *The Parks, Promenades and Gardens of Paris,* was convinced that *Ailanthus* was indispensable for parks and avenues because of its ability to remain fresh even in the harshest city conditions.[13]

But in the United States, opinion about *Ailanthus* remained divided throughout the latter half of the nineteenth century. Its root bark was reported to be efficacious against dysentery. An 1874 issue of *The Horticulturist* gave directions for preparing the medicinal concoction and the proper dosage. The medicinal value, however, was negated by reports of problems arising from the tree's pollen; many people developed allergic reactions, with hay fever symptoms lasting for a few weeks. However, it was believed that the *Ailanthus* flower was causing much more serious health problems. One report claimed that patients suffered from chronic sore throats, disturbed stomachs, and nausea, and finally, over time, tuberculosis. The District of Columbia and several states legislated a ban on *Ailanthus.* This movement may be an example of a social problem being blamed on a tree that was very common and therefore an easy scapegoat. In 1888 Charles Sprague Sargent attempted to redirect attention to other urban conditions that might have caused the illness. In response to a letter, he wrote,

> What we believe to be an entirely unfounded belief in the injurious properties of the Ailanthus tree has taken possession of communities in this country at different times and different places. . . . it seems not improbable that the particular cases [of illness] to which our correspondent calls attention have been the result of malaria or improper drainage or impure drinking water—a belief sustained, in part at least, by the fact that the Ailanthus is one of the most commonly planted, and most highly esteemed trees in Paris and other European cities, while its bad reputation, so far as we can learn, is confined to this country. As it is only the flowers of the male plant which are disagreeable, all risk, real or fancied, in planting this tree can be obviated by selecting the female plants only."[14]

Sargent was not alone in his point of view. *Ailanthus altissima* continued to be planted in parks and on streets, as, for instance, by Samuel Parsons, Jr., who had been greatly influenced by the parks of Paris and thought it was "in some respects the toughest and finest of trees." When he drew up plans for the extension of New York's East River Park in 1892, he specified *Ailanthus* for a significant percentage of the trees.[15]

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A tree-of-heaven grows in Boston.

Toward the end of the nineteenth century, both C. S. Sargent and his uncle H. H. Hunnewell commissioned tree nurseries to plant large acreages in *Ailanthus* to evaluate the tree as a timber crop and for other commercial uses such as furniture, fuel, and railroad ties.[16] These commercial efforts ultimately failed, however, and by the second decade of the twentieth century *Ailanthus* was no longer being used in the United States, even as an ornamental tree. Since then, it has essentially been neglected and allowed to spread on its own in disturbed sites, where often it shades and ornaments otherwise barren ground. With better treatment, *Ailanthus* could once again become a respected tree. If left to grow to its full stature instead of being repeatedly cut to the ground—a common practice that results in bushy, weedy plants that sucker profusely—it can actually enhance a landscape. We might stop associating *Ailanthus* with pollution, erosion, and general urban neglect, and instead see it as the valuable tree it can be, with the tenacity and perseverance to provide greenery in spaces that society neglects.

Endnotes

[1] Osvald Siren, *Gardens of China* (New York: Ronald House, 1949), 38; D. J. Mabberley, *The Plant-Book* (Cambridge, UK: Cambridge University Press, 1989), 15; W. T. Swingle, The early European history and the botanical name of the tree of heaven, *Ailanthus altissima*, *Journal of the Washington Academy of Sciences* (1916) 6: 490–498.

[2] "Shade Trees in Cities," *The Horticulturist* (1852) 7(8): 345–349.

[3] L. W. Dillwyn, ed, *Hortus Collinsonianus* (Swansea, 1843), 2.

[4] J. E. Vollmer, E. J. Keall, and E. Nagai-Berthrong, *Silk Roads, China Ships* (Toronto: Royal Ontario Museum, 1983), 127. William Chambers (*Dissertation on Oriental Gardening*, 1772) reported that the earliest descriptions of Chinese gardens came to Europe via a letter written by Denis Attiret, a French Jesuit priest at the imperial court in Beijing, and translated by Joseph Spence in 1752.

[5] Swingle, 490–491; J. C. Loudon, *Arboretum et Fruticetum Britannicum*, Vol. I (London: 1838), 490–492.

[6] Swingle, 495.

[7] *The Horticulturist* (1847) I(9): 397.

[8] A. J. Downing, "Shade Trees in Cities," 345–349, and *Treatise on the Theory and Practice of Landscape Gardening*, 1st ed. (NY, 1841), 202–204.

[9] Loudon, *op. cit.*; Downing, *Treatise*, 203–204. Subsequent editions of the *Treatise* continued to carry Downing's original, favorable report of *Ailanthus*, despite his changed opinion. In the 7th edition, 204, edited and supplemented by H. W. Sargent, a footnote acknowledges the changed opinion and suggests that tree-of-heaven can be replaced by the princess tree *(Paulownia tomentosa)*, a newer introduction from Japan and one that would prove to create its own problems.

[10] "How to Popularize the Taste for Planting," *The Horticulturist* (July 1952) 7(7): 297–301; "Shade Trees," 345–349.

[11] "Shade Trees," 346.

[12] *American Handbook of Ornamental Trees* (Philadelphia: Lippincott, 1853), 69–70.

[13] *Parks, Promenades* (London: John Murray, 1869), 171.

[14] "Remedial Action of the Ailanthus," *The Horticulturist* (1874) 29(340): 320; Correspondence: C. V. Tice, Ed. [C. S. Sargent], *Garden and Forest* (1888) I: 179–180.

[15] *Samuel Parsons, Jr., and the Art of Landscape Architecture*, Wave Hill, NY, Exhibition, Charles Birnbaum, curator, 1994; Parsons, *The Art of Landscape Architecture* (NY: Putnam's, 1915), 315.

[16] H. Douglas, *Gardener's Monthly* (1882) 24(280): 117; T. Meehan, *Gardener's Monthly* (1885) 28(324): 369–370; C. S. Sargent, *Garden and Forest* (1888) I: 385–386.

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Allelopathy and the Secret Life of *Ailanthus altissima*

Rod M. Heisey

Although the reputation of the tree-of-heaven as an ornamental has declined over the past century, investigations now underway may discover a new role for the species as the source of a natural herbicide.

Ailanthus altissima (Simaroubaceae) has been extremely successful in invading and dominating certain habitats since its introduction to the United States in 1784. In parts of the northeastern United States, especially in southern Connecticut, southern Pennsylvania, and the lower Hudson Valley of New York, *A. altissima* forms nearly pure stands that are resistant to invasion by other tree species.[1]

A number of characteristics contribute to the invasiveness and success of *Ailanthus altissima*, often called tree-of-heaven. First, the versatility of its reproduction methods provides a decided advantage. The trees regularly produce large crops of winged seeds that are widely dispersed by the wind. *A. altissima* can also spread rapidly by sprouting from stumps or from its wide-ranging lateral roots, particularly in openings or at the edges of forested areas. Another of its advantageous characteristics is the extremely rapid growth rate that enables it to outcompete many other species, especially when reproducing from root or stump sprouts. Average heights reported for one-year-old trees in south and central Pennsylvania were 1.3 feet for seedlings, 2.7 feet for root sprouts, and 6.0 feet for stump sprouts; two-year-old trees averaged 3.9 feet, 5.6 feet, and 9.2 feet, respectively.[2] These rates make *A. altissima* one of the fastest-growing trees in the temperate zone.

Allelopathy: The Secret Weapon?

Another contributor to the invasiveness and success of *Ailanthus altissima* may be a secondary metabolite that provides competitive superiority through a process known as "allelopathy." Many plants produce chemical compounds that have no apparent role in life processes or plant structure; hence, these compounds are called secondary metabolites. As techniques for identifying naturally produced chemicals have improved in recent decades, it has become apparent that plants manufacture a great diversity of secondary metabolites, including terpenoids, alkaloids, glycosides, flavonoids, coumarins, quinones, saponins, and phenolic compounds. Humans have found a variety of uses for some of these compounds, including menthol, a terpenoid produced by mint; nicotine, an alkaloid produced by tobacco; caffeine, an alkaloid produced by the coffee plant and other species; and salicin, a phenolic compound having analgesic properties, from the willow tree. Why do plants produce secondary metabolites? An early hypothesis suggesting that they were simply waste products of normal metabolism has been largely discounted, since it does not explain the wide variety of secondary metabolites. Much evidence now indicates that some of these allelochemicals, as they are termed, play a defensive role for the producer organism, protecting plants from herbivores by making the plant tissues toxic, perhaps, or by reducing their palatability.[3] Other compounds have antimicrobial effects and may protect plants from invasion by pathogens.

Another role that secondary metabolites may play is that of allelopathy (Greek, *allelo-*, of one another; *patheia*, suffering), the inhibition of one plant's growth by another through the production and release of toxic chemicals into the environment. Many secondary metabolites have

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A typical stand of Ailanthus altissima *showing a sparse understory with scattered* Ailanthus *root sprouts.*

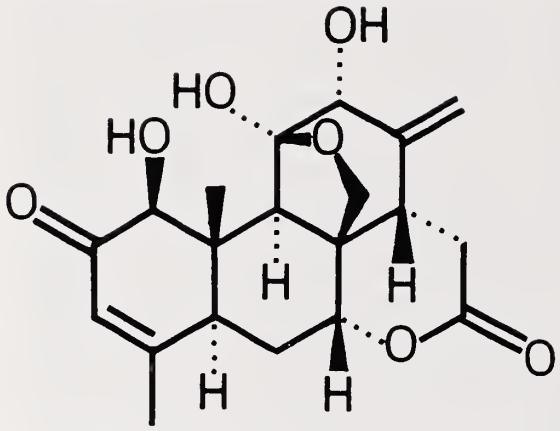
been shown to inhibit seed germination or plant growth in laboratory tests, and entire books have been written attributing a broad range of effects to allelopathy;[4] however, some researchers question how widespread or important it really is in natural habitats.[5] Two examples where the argument for allelopathy seems most convincing are the purple sage *(Salvia leucophylla)* in the coastal sage scrub community of California and the black walnut *(Juglans nigra)* in the eastern United States.[6] But in fact, allelopathy has not yet been proven to exist in any plant to all researchers' satisfaction.

Testing for Allelopathic Effects

My research has focused on two areas: (1) determining whether *Ailanthus altissima* actually is allelopathic under natural conditions, and (2) evaluating the potential of its secondary metabolite as a natural herbicide.

Members of the Simaroubaceae, including *Ailanthus*, produce a class of bitter-tasting secondary metabolites called quassinoids, which exhibit a wide range of biological activity including negative effects on insects, fungi, protozoa, viruses, and cancer cells.[7] In China *A. altissima* has long been used as medicine and as insect repellent.[8] The first publications on allelopathy by *A. altissima* were by Mergen (1959) and Voigt and Mergen (1962), who reported that water extracts of foliage and stems were injurious to tree seedlings of other species. The major phytotoxic compound produced by *A. altissima* was recently identified as a quassinoid compound called ailanthone.[9]

A major tool for research on allelopathy is the bioassay, a test that allows us to isolate phytotoxic compounds and quantify their effects under controlled laboratory conditions. A good bioassay should possess high sensitivity, give reproducible results, and take a relatively short time to perform. I usually use seeds of garden cress *(Lepidium sativum)* for bioassays, because they germinate rapidly and are very sensitive to phytotoxins. A basic bioassay involves placing garden cress seeds on filter paper in petri dishes, treating them with plant extracts, and then incubating them under standard conditions. At

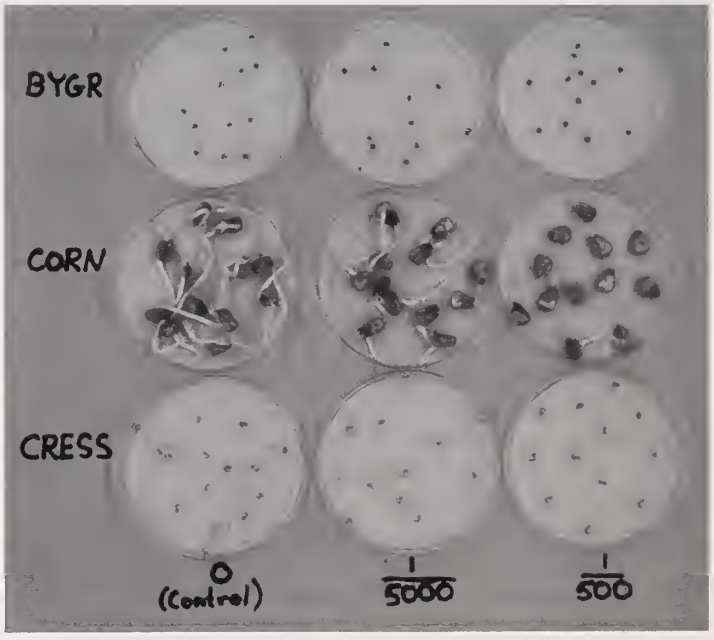


Chemical structure of ailanthone (molecular weight 376), the phytotoxic compound produced by Ailanthus altissima. *Ailanthone is extremely bitter and belongs to the class of compounds called quassinoids.*

the end of the incubation period, the growth of the radicle (the initial root formation) of the treated seedlings is compared to that of control seedlings that received only deionized or distilled water.

In order to learn whether ailanthone could indeed serve as an allelopathic agent for *Ailanthus altissima*, I first needed to find out where in the tree the phytotoxic compound is found. This was important because the location helps determine the quantity of toxin released into the soil as well as the release mechanism. I began by assaying water extracts of different *A. altissima* tissues, using the method described above. Phytotoxic effects were highest for the inner bark of the trunk and the bark of roots and branches, intermediate for leaves, and lowest for the thin outer bark of the trunk and for the wood of the trunk and roots.[10] These results suggested two possible release mechanisms for the phytotoxin: (1) extraction of toxin from bark and foliage by rain, followed by stemflow down branches and trunks; or (2) exudation from roots.

Tests were designed to learn which of these mechanisms, if either, could deliver biologically effective amounts of the toxin from *Ailanthus altissima* trees to nearby soil. Stemflow collars were placed around *A. altissima* trunks, and rain was collected as it flowed down the trees. At the same time, precipitation was collected in open areas nearby to serve as a control. The water samples were then tested using the cress seed bioassay. Surprisingly, stemflow stimulated more cress radicle growth than either control precipitation or deionized water.[11] In retrospect this result was not unreasonable. The outer bark of *A. altissima* (low in ailanthone) probably prevents the toxin from being leached from the high-ailanthone inner bark in large enough quantities to inhibit plant growth; the bark may also contribute inorganic nutrients or growth hormones to the stemflow, thereby offsetting the effect of any ailanthone that does reach the soil. In any case, the results certainly did not support stemflow as a mechanism responsible for allelopathy under natural conditions.



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Bioassay of water extracts of Ailanthus altissima *root bark on seeds of barnyard grass (BYGR,* Echinochloa crusgalli*), corn* (Zea mays), *and garden cress* (Lepidum sativum). *The seeds were moistened with (left to right) deionized water for control or a water extract of* A. altissima *root bark corresponding to 1 gram of bark in 5000 and 500 milliliters, respectively. Both concentrations of extract caused considerable inhibition of radicle growth of all three species compared to the control.*

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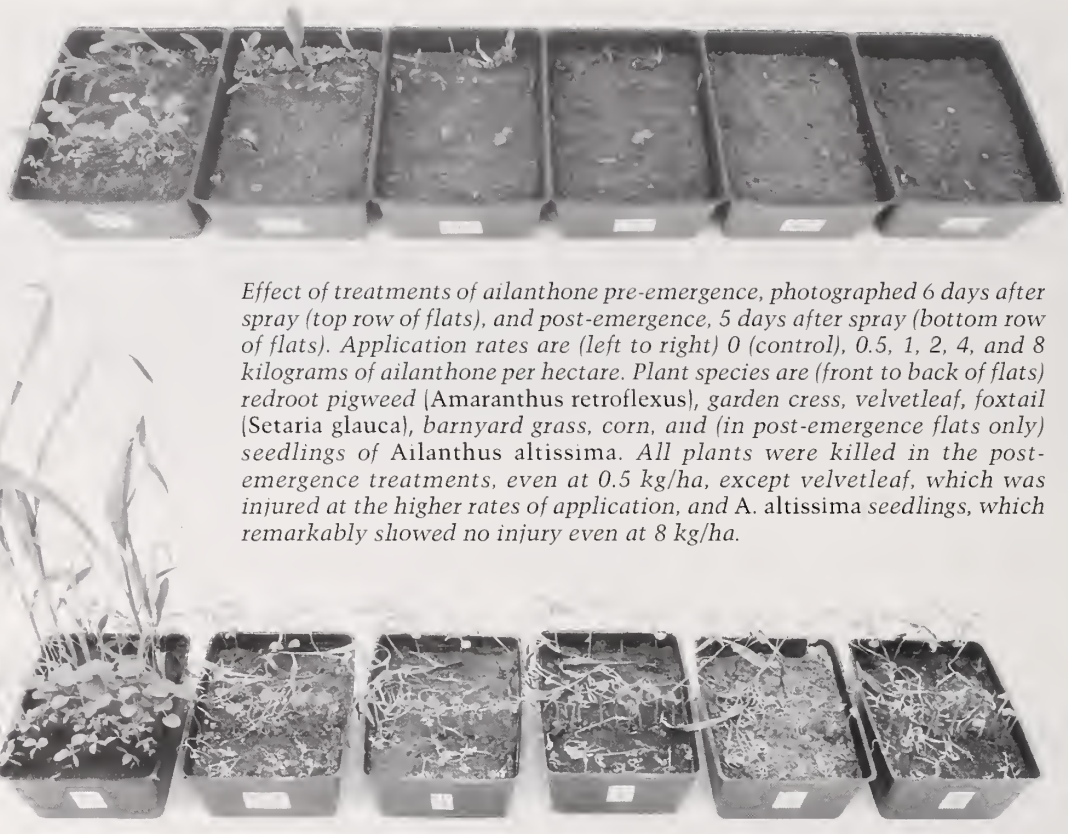
Effect of adding Ailanthus altissima *leaflets and root bark to soil on growth of garden cress. The pots received (left to right) no bark (=control); 2 grams of leaflets and 2 grams of root bark from which ailanthone had been extracted with methanol; and 0.5, 1, and 2 grams of non-extracted root bark. The non-extracted bark caused obvious inhibition of cress growth, but bark from which the ailanthone was removed with methanol stimulated growth compared to the control containing no bark. The leaflets reduced cress growth slightly, but much less than the bark.*

To test whether significant amounts of ailanthone could be released by *Ailanthus altissima* roots, some roots were added to soil in petri dishes. Control dishes contained identical soil, but no roots. The dishes containing roots were stored in a refrigerator (to retard degradation of the toxin by soil microorganisms) for 6 or 13 days to provide time for the toxin from the roots to exude into the soil. The dishes were then removed from refrigeration, seeds of garden cress were placed on the soil near the roots, and radicle growth was measured 3 days later. The results showed that significant amounts of ailanthone had been released from the roots. Exposure of the soil for 6 days to fine roots (less than three millimeters in diameter) reduced cress radicle growth to 50 percent of that in the control soil, and exposure to larger roots (five to ten millimeters in diameter) reduced cress radicle growth to 74 percent. In soil stored for 13 days, cress radicle growth was reduced by exposure to fine roots to 33 percent of growth in the control soil and to 74 percent by exposure to larger roots.

In another test *Ailanthus altissima* root bark and leaves were added separately to soil in pots and the effect measured on garden cress seeds. Root bark strongly inhibited growth of the seeds, whereas leaves had a much weaker effect. Dry root bark added in quantities of 0.2, 0.4, and 0.8 percent of dry soil weight reduced cress seedling emergence to 39, 21, and 5 percent respectively of that in pots containing no root bark; cress shoot biomass was reduced to 55, 25, and 5 percent of biomass in the control pots. Dry leaflets added to soil in similar quantities only reduced cress emergence to 94, 88, and 93 percent of that in control pots and shoot biomass to 81, 81, and 64 percent. These results support the hypothesis that exudation of ailanthone from *A. altissima* roots is a mechanism whereby allelopathy could occur, whereas exudation from leaves probably is not.

The experiments described so far had a serious weakness: the *Ailanthus altissima* tissues used had been removed from the trees and injured by cutting or drying. It could therefore be objected that the experiments did not mimic natural situations. Another investigation was performed to assess more realistically the potential for allelopathy caused by root exudation of ailanthone. Soil within two centimeters of *A. altissima* roots was collected in a twenty-year-old stand of trees and assayed using garden cress seeds. Control soil was collected from a nearby forested area containing few *A. altissima* trees. Cress radicle growth in soil from near *A. altissima* roots was 85 percent of radicle growth in control soil. The bioassay was repeated because the difference was so small; in the



Effect of treatments of ailanthone pre-emergence, photographed 6 days after spray (top row of flats), and post-emergence, 5 days after spray (bottom row of flats). Application rates are (left to right) 0 (control), 0.5, 1, 2, 4, and 8 kilograms of ailanthone per hectare. Plant species are (front to back of flats) redroot pigweed (Amaranthus retroflexus), *garden cress, velvetleaf, foxtail* (Setaria glauca), *barnyard grass, corn, and (in post-emergence flats only) seedlings of* Ailanthus altissima. *All plants were killed in the post-emergence treatments, even at 0.5 kg/ha, except velvetleaf, which was injured at the higher rates of application, and* A. altissima *seedlings, which remarkably showed no injury even at 8 kg/ha.*

second test, cress radicle growth in soil near *A. altissima* roots was 77 percent of control radicle growth.

The investigations of root exudation provide evidence that ailanthone may be released into the rhizosphere of *Ailanthus altissima* in amounts sufficient to influence the growth of other plants. Before concluding that *A. altissima* is allelopathic, however, another factor had to considered. Many organic compounds are rapidly degraded by soil microorganisms; juglone, for example—the allelopathic compound from black walnut—can be degraded rapidly by soil bacteria to concentrations below which phytotoxicity would occur.[12] If the same is true of ailanthone, its biological effectiveness could be greatly reduced.

The persistence of ailanthone in soil was therefore examined. In one investigation, a solution of ailanthone was mixed with soil in petri dishes. In some dishes, soil that had been sterilized by autoclaving was used, whereas nonsterile soil was used in other dishes. The dishes were then incubated at 25 degrees Centigrade for time periods ranging from 0 to 21 days, and the soil was subsequently tested for phytotoxicity with a cress seed bioassay. Strong toxicity persisted for 21 days in the dishes containing sterile soil; by contrast, it persisted for only 2 or 3 days and rapidly disappeared thereafter in the dishes containing nonsterile soil. A similar pattern was observed when powdered *Ailanthus altissima* root bark was mixed with soil and incubated. These results clearly demonstrate that the toxic effects of ailanthone in soil are short-lived, probably because of microbial degradation, and raise questions about allelopathic potential of *A. altissima* under natural conditions.

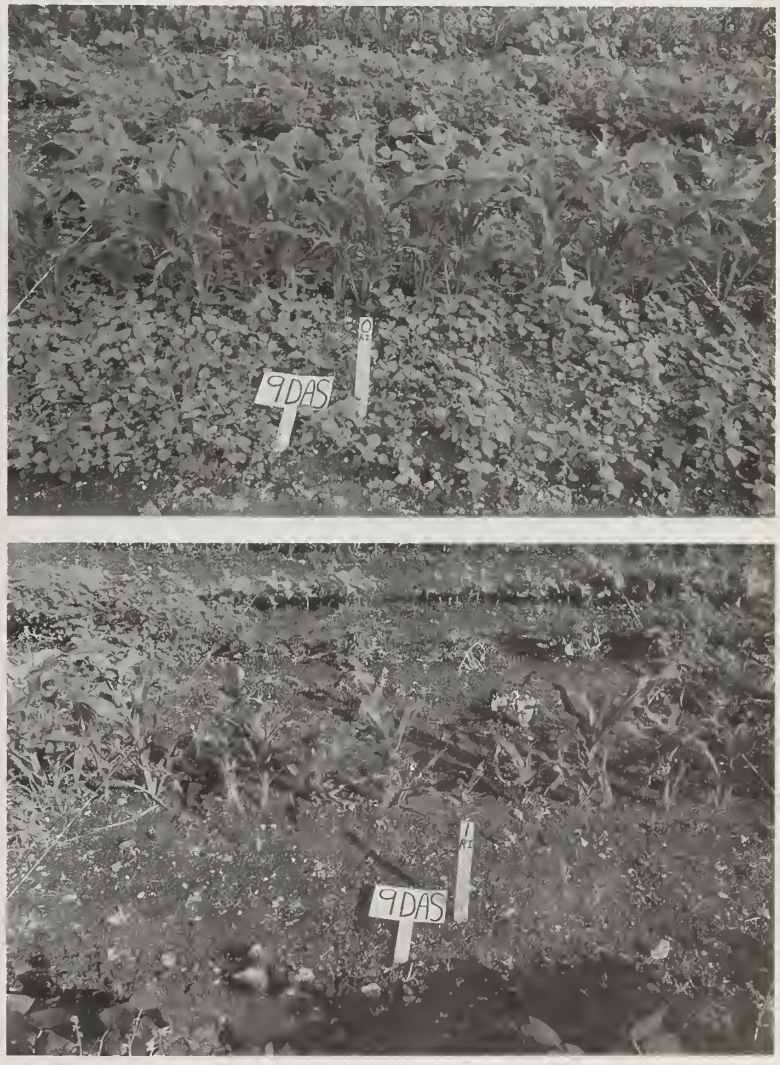
Ailanthus altissima as a Herbicide

Regardless of its ecological role, ailanthone is a very powerful herbicidal compound: in the standard garden cress bioassay, radicle growth

is typically reduced to 50 percent by a solution containing only 0.7 milligrams of ailanthone per liter (0.7 parts per million).[13] Ailanthone is therefore being evaluated for commercial use, since a natural herbicide could have several advantages over synthetic ones: (1) rapid degradation of the herbicide in soil or water, resulting in less environmental pollution; (2) reduced dependence on fossil fuels since the herbicide could be made biosynthetically rather than from petrochemicals; and, perhaps (3), lower toxicity of the herbicide to nontarget organisms.

Ailanthone can be described as a broad-spectrum herbicide that is toxic to many plants, both weeds and crop species. It has its greatest effect on annual plants shortly after they have emerged, but it also has a significant pre-emergence effect. Ailanthone is toxic to both monocots and dicots, but dicots tend to be the more sensitive. It has a very low degree of selectivity; however, *Ailanthus altissima* seedlings and certain species in the Malvaceae such as cotton *(Gossypium hirsutum)* and velvetleaf *(Abutilon theophrasti)* are resistant.

Initial investigations of the herbicidal effects of *Ailanthus altissima* were made in the greenhouse using a crude extract of root bark. Later, after the herbicidal compound had been identified, purified ailanthone was used. Both the crude extract and the purified ailanthone were sprayed onto the surface of soil sown with weeds and crop species to test for pre-emergence herbicidal effects. The soil was then watered so that the herbicidal material would be carried down into the seed zone. To test post-emergence herbicidal effects, the crude extract or purified ailanthone was sprayed directly onto emerged seedlings of weeds and crop species. Strong herbicidal effects resulted from both pre- and post-emergence applications, but the post-emergence effects were especially striking: even the lowest application rate of ailanthone



ROD M. HEISEY

ROD M. HEISEY

Field trial of post-emergence spray with extract of A. altissima *bark nine days after application. The plot at top (control) received no extract, and the plot below received the equivalent of 1.1 kilogram of ailanthone per hectare. The predominant weed is* Galinsoga ciliata. *The crop plants are (front row to back row) corn, cauliflower* (Brassica oleracea *var.* italica), *tomato* (Lycopersicon esculentum), *and green bean* (Phaseolus vulgaris). *A significant reduction in weed population of the treated plot is apparent, but injury to the crops is also evident.*

A mature Ailanthus altissima *in August showing the characteristic compound leaves, giving a somewhat palm-like appearance, and abundant clusters of ripening samaras.*

(equivalent to 0.5 kilogram per hectare) caused complete mortality of most plant species tested.

The most recent tests of ailanthone were conducted in outdoor field plots. Because large amounts of the herbicidal material were required and isolation of pure ailanthone is expensive and time-consuming, a crude extract of *Ailanthus altissima* trunk bark was used. Weeds and crops were planted in the field and sprayed after emergence with an extract containing a known amount of ailanthone. Symptoms of damage were evident on many weeds and crop species within a few days of spraying. As demonstrated previously in the laboratory, ailanthone does not persist long in the soil, so new weeds germinated and some injured weeds

recovered within a few weeks of spraying. A single application of ailanthone would therefore be insufficient to control weeds over an entire growing season. Future research will investigate ways to extend the herbicidal effects over a longer time and to minimize toxicity to crops.

Conclusion

Despite the positive results of many laboratory investigations, we do not yet have enough information to state unequivocally that *Ailanthus altissima* is allelopathic: too little is known of the complex interactions and potentially mitigating circumstances that occur in the natural environment. However, from an evolutionary standpoint it makes little sense that *A. altissima* would expend the energy to produce a compound unless it somehow conferred a selective advantage. It is certain that ailanthone has powerful herbicidal effects and may have evolved to inhibit competing plants, but it may also have other functions. Anecdotal evidence suggests that it is toxic to some fungi and may therefore function to protect *A. altissima* against fungal pathogens. It might also act as a feeding deterrent to herbivores because of its extremely bitter taste, a possibility suggested by the fact that few animals feed on *A. altissima* plants. Clearly, there is much we have yet to learn about ailanthone and the secret role it plays in the life of *A. altissima*.

Endnotes

[1] Illick and Brouse 1926, Hu 1979, Peigler 1993.

[2] Illick and Brouse 1926.

[3] Swain 1977, Bell 1981.

[4] Rice 1984, Putnam and Tang 1986.

[5] Harper 1977.

[6] Muller and Muller 1964, Muller and del Moral 1966; Massey 1925, Fisher 1978.

[7] Klocke et al. 1985, Polonsky et al. 1989; Hoffmann et al. 1992; Trager and Polonsky 1981; Pierre et al. 1980; Ogura et al. 1977.

[8] Yang and Tang 1988.

[9] Heisey 1996.

[10] Heisey 1990a.

[11] Heisey 1990b.

[12] Schmidt 1988.

[13] Heisey 1996.

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Rod Heisey, professor of biology at Penn State University, grew up on a farm in Lancaster County, Pennsylvania. While a graduate student at the University of California, Davis, and a postdoctoral researcher at the Pesticide Research Center of Michigan State University, he became interested in allelopathy and the use of natural products for controlling agricultural pests. His research focuses on plant ecology and microbial ecology, with emphasis on allelopathy and natural-product pesticides.

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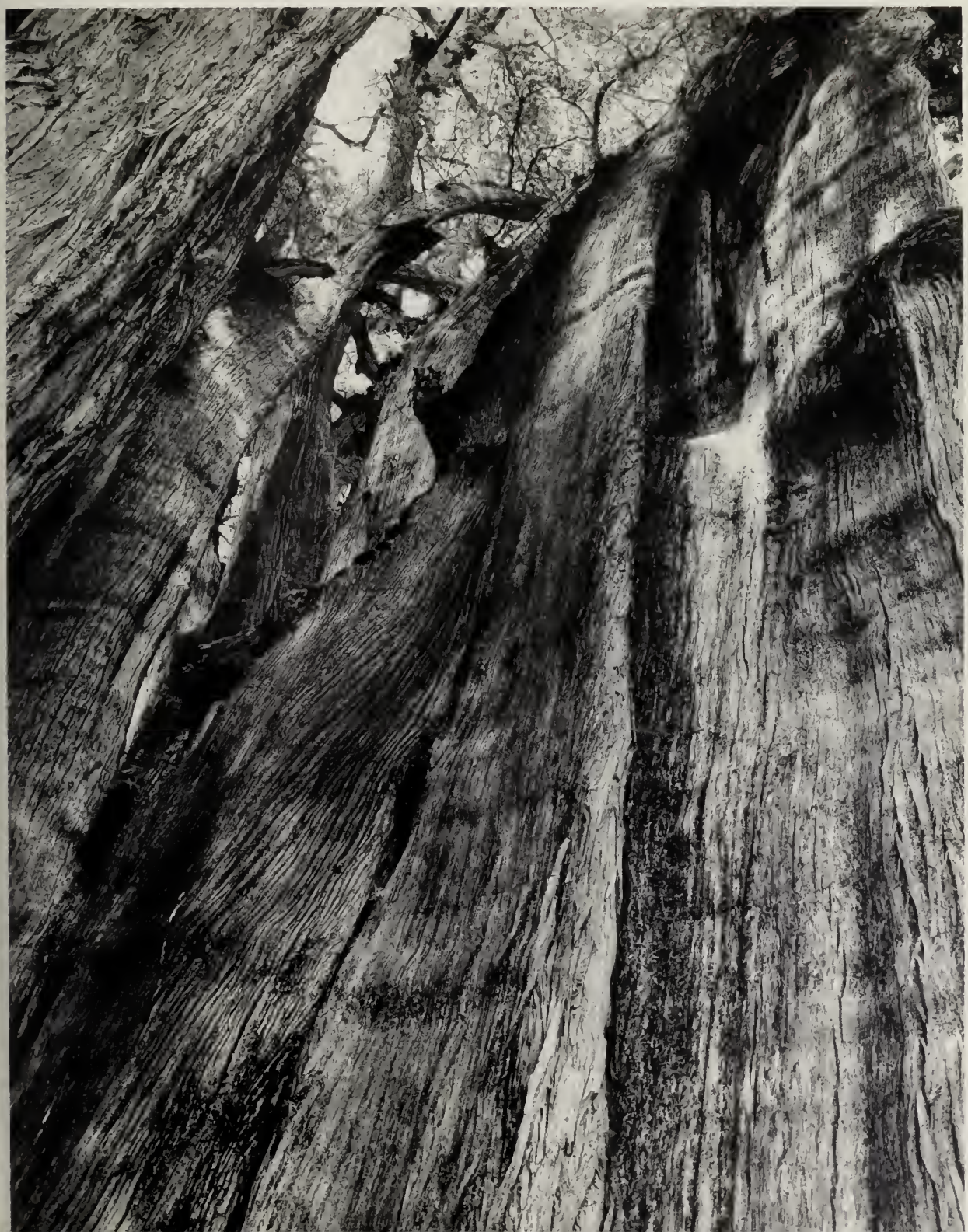

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Front cover: El Arbol del Tule, a venerable giant of the species *Taxodium mucronatum*, the Mexican bald cypress. Photograph by Rácz & Debreczy.

Inside front cover: *Magnolia tripetala*, an Asian umbrella magnolia, in flower in Pomona, New York. Photograph by Richard B. Figlar.

Inside back cover: *Magnolia macrophylla*, the large-leaved cucumber tree, photographed at the Arnold Arboretum by Peter Del Tredici.

Back cover: A mature stand of *Taxodium mucronatum*, just north of Sola de Vega, Oaxaca, Mexico. Photograph by Rácz & Debreczy.

El Arbol del Tule

RÁCZ & DEBRECZY

El Arbol del Tule: The Ancient Giant of Oaxaca

Zsolt Debreczy and István Rácz

The famous tree that has puzzled travelers and botanists for hundreds of years with its legends now raises new questions about its future.

Outside the city of Oaxaca, on the ancient lands of the Mixtecs and Zapotecs in southern Mexico, stands a tree, perhaps the most famous and most frequently measured among the giants: a unique specimen of the fast-growing southern bald cypress, *Taxodium mucronatum*, known by the Aztecs as an *ahuehuete*, the "graybeard of the swamp." What "General Grant" is to the giant sequoias, El Arbol del Tule is to the bald cypresses.

The Mexican bald cypress is a member of the Taxodiaceae, the family of giant sequoias, California redwoods, and bald cypresses, which, excluding tropical species, has the greatest potential of all tree families for achieving both great age and enormous size. Amazingly, this family of giants, like other conifers, is described as primitive because of its elementary conducting system of single-celled tracheids. In fact, this simple system can carry water and minerals to heights over 110 meters (366 feet), even under extreme conditions such as those found on the slopes of the Sierra Nevadas of western North America, which remain dry for many months at a time, and those in the waterlogged, oxygen-deficient swamps, the habitat of *Glyptostrobus* of southeast China and *Taxodium* of the southeastern United States and Mexico. *Taxodium mucronatum* represents the southernmost species of the genus, which was once found all over the Northern Hemisphere but is now restricted to North America.

The giant tree grows in the town of El Tule, little more than fifteen kilometers from the city of Oaxaca, the capital of the southern Mexican state of the same name. The highlands where it is located, at an elevation of about 1,550 meters (5,100 feet), form a wide valley up in the Sierras. The area has only two distinct seasons: a humid, often cloudy, hot, rainy season typical of the "summer-rain tropics" south of the Tropic of Cancer, and a warm, dry "winter" season with bright sunny days, cool nights, and frequent frosts in the mountains. Near the city, frost has been reported only once a decade or so.

At one time, the tree ruled over wide fields of the brown-headed cattail—*Typha domingensis*, a close ally of *T. latifolia* of the north temperate regions of the world—called the *tule* in the native Zapotec tongue. Today, instead of an extensive swamp supplied by such rivers as the Atoyac and its tributary, the (local) Rio Grande, flowing down from the nearby Sierra de Juárez, the tree is surrounded by a neatly maintained lawn, colorful flowerbeds, and a wrought iron fence. The growing village of Tule has swallowed the swamp, its buildings and yards gradually encircling it, forming a lethal noose around it.

Our First Encounter

Having seen giant sequoias and redwoods in both the higher Sierras and the Coast Ranges of California, we were accustomed to the drama of large specimens. However, when engulfed by the spreading arms of Arbol del Tule, we experienced a totally different degree of awe, not comparable to anything we had previously encountered. While the big trees of California are majestic, like the skyscrapers of downtown New York they are out of reach. Arbol del Tule is an accessible "seated giant," welcoming us with broad, sweeping branches that extend almost the length of two tennis courts.

El Arbol del Tule, near Oaxaca City, Mexico.

Although the tree is not particularly tall, it takes seventeen people with outstretched arms to encircle its gigantic trunk.

Fascinated at first by its enormous dimensions, we soon turned to the details of the tree. Each limb, towering upward, could itself be an independent tree of huge size. Like a gothic cathedral, arches rise above arches as the limbs disappear into the jungle of the crown 40 meters (130 feet) above, simultaneously reaching outward an incredible distance. Dramatically fluted in outline, the trunk has an air of mystery: sunlit ribs alternate with deeply shadowed recesses that are partly curtained by a veil of fine, light-green foliage.

The Inevitable Question

A correlation between the age and size of trees, at least within a species, would seem logical: the bigger the tree, typically the older it is. Seeing the almost 60-meter (200-foot) circumference of our giant, one assumes that this tree must be thousands of years old. Poets, politicians, scientists, and the technically ingenious have tried to answer the inevitable question: how old is it? Estimates have varied; some have gone as high as three thousand years, as suggested by A. Villaseñor in 1892, or even six thousand, as put forward

The giant tree dwarfs schoolboys and the chapel of Santa María alike in these postcards. The sign tells us that in 1987 El Arbol del Tule was 41.85 meters (137 feet) high, 57.9 meters (190 feet) in circumference, and 14.5 meters (48 feet) in diameter, with an estimated volume of 816,829 cubic meters and a weight of 636,107 tons. In 1992, our clinometer measurement showed that the tree was only 39.40 meters (130 feet) high, which, assuming the data are correct, indicates an almost two-meter (seven-foot) decrease in height in five years.

RACZ & DERRECZY

Taxodium mucronatum *differs little from its northern relative,* T. distichum. *C. S. Sargent in his* Silva of North America *(1896) wrote that "it may prove to be a mere geographical form of our tree." Others, like Harper in 1902, consider it a "Sonorized" form of the northern species. Except for its "knees," which are absent or short and roundish, the differences lie mostly in phenological characters: the growth of the southern tree is more compact; its cones are smaller and leaves shorter, often pruinose gray ("bloomy") and semipersistent. These two old trees grow in the highlands near Oaxaca.*

by E. W. Berry in 1923. An old legend among the local Zapotecs and Mixtecs tells us that the tree, along with several others nearby, was planted for the benefit of the people by Pecocha, a representative of the Aztec god of wind and storms, Ehecatl. This story puts the age of the tree at around fourteen hundred years.

Estimates, to be correct, should consider the tree's rate of growth, but in the case of the Tule tree, another question has been raised through the past two centuries: is it a single tree or a group of trees that have coalesced to form a single individual? Although the tree is thought to have been visited by Alexander Humboldt on his visit to Mexico in 1803, evidence suggests that he never reached Oaxaca and therefore never visited the tree. However, he wrote in his *Political Essay on the Kingdom of New Spain:*

> In the village of Santa María del Tule, three leagues from the capital, there is an enormous sabino *(Cupressus disticha* [now *Taxodium mucronatum])*, the trunk of which is 36 meters [120 feet] in circumference. This old tree is even more corpulent than the cypress of Atlixco of which we have spoken above, than the Dragon tree of the Canary Isles and than any of the baobabs *(Adansonia)* of Africa. But examined closely, señor Anza has observed that, that sabino which is such a surprise to travelers is not a single individual but a group of three trunks united (II: 45–47).

In 1892, Alejandra Villaseñor summed up nearly a century of controversy:

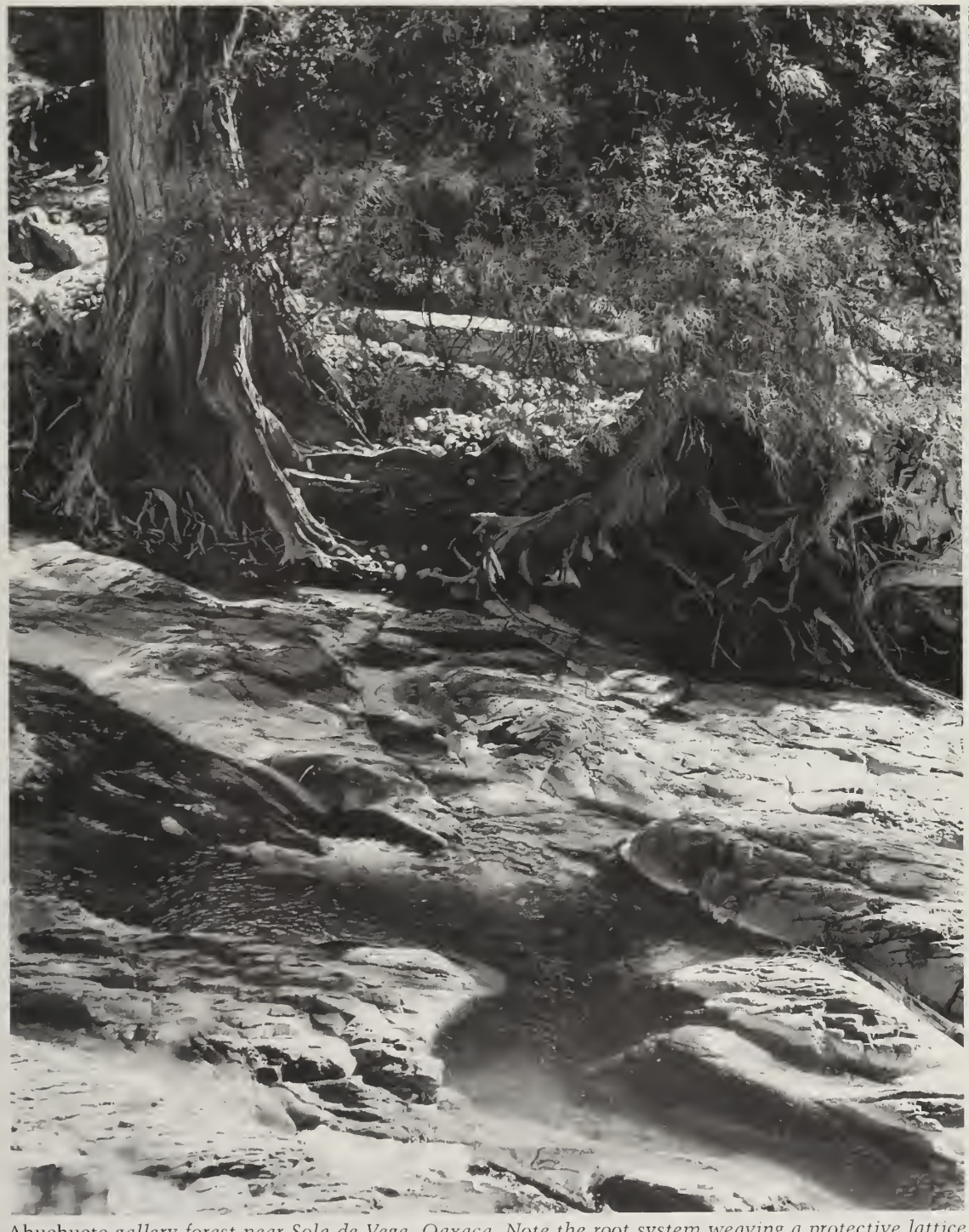
> The trunk of the tree of Santa María del Tule, far from being compact and almost cylindrical, is, on the contrary, rough-barked, unequal, and fissured, covered with senile excrescences [burls], some of large size, with bold projections which made a certain Sr. Anza suppose that it was not a single tree but three united; but later observations by Dr. J. Bolaños in 1840 and by other people have shown the error of the supposition.

Botanist Juan Bolaños climbed the tree to the point where the common trunk ends and the primary branches begin

RACZ & DEBRECZY

Some characteristics of Taxodium mucronatum *are strongly influenced by climate. The compound leaves are semipersistent: the foliage of the previous year detaches only when the new leaves unfold. The southern species is less cold-hardy than its northern cousin, especially in sudden frosts. When cultivated in areas where the winter temperatures fall below freezing, most of the green foliage becomes yellowish brown and falls, even on the trees of Tule.*

In the United States, the Montezuma bald cypress grows well throughout the West and mostly below 30 degrees North latitude in the East while it is easy to cultivate in the Mediterranean basin up to 40 to 44 degrees North, and in western Europe, it survives far above the latitude of 50 degrees North.



RACZ & DEBRECZY

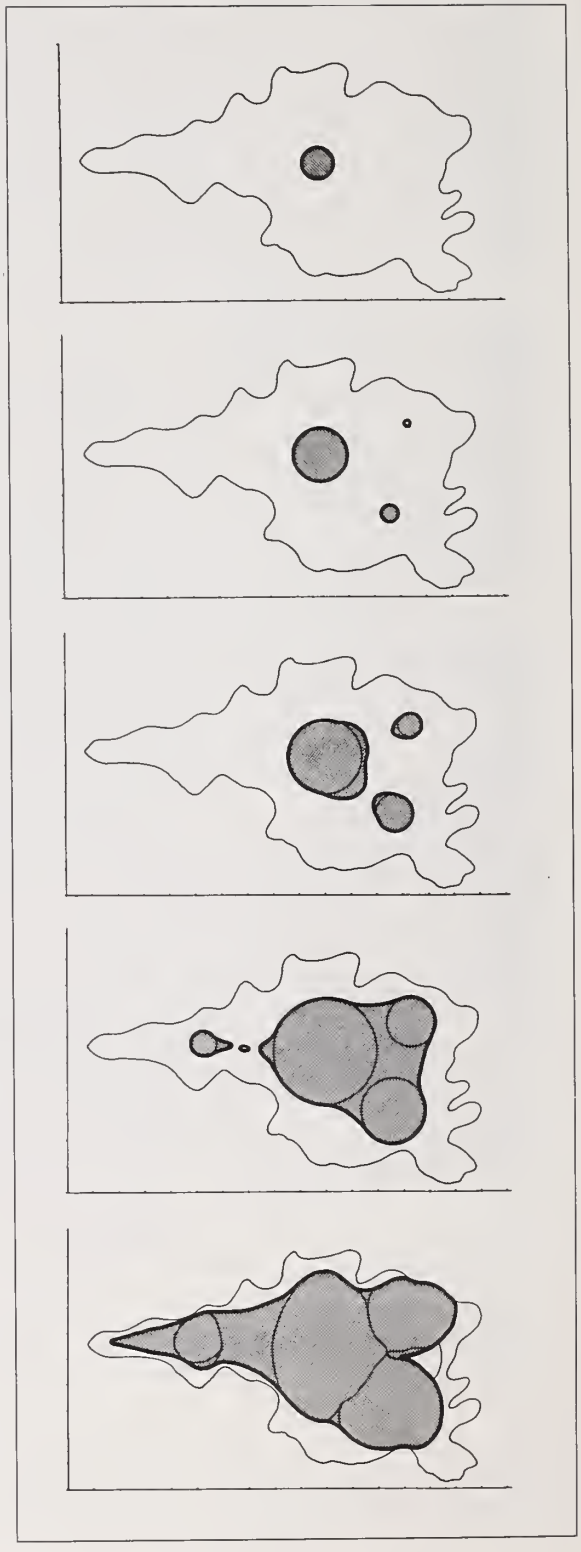
Ahuehuete *gallery forest near Sola de Vega, Oaxaca. Note the root system weaving a protective lattice on the riverbank. Instead of adaptation to anaerobic swamps,* Taxodium mucronatum *is adapted to periodically high riverbeds and riversides. The fantastic root systems grasp the riversides, fencing the riverbed with such efficiency they seem to be created for that purpose. At Sola de Vega, the most beautiful riverbed habitat of the species is still untouched, providing dramatic views of trees 12 to 15 meters (40 to 50 feet) tall.*

and found a large enclosed place "which could serve as a habitation in case of need." This observation convinced him that the trunk belonged to one individual and that the divisions at the base of the trunk, considered to stem from separate trees, are only parts of a sole specimen.

Another botanist, Casiano Conzatti, after a year spent studying the tree, published his findings in a 1921 article entitled in its English translation, "Monograph on the Tree of Santa María del Tule." Conzatti drew on records from previous writers—Desiré Charnay (1863), Manuel Ortega Reyes (1884), and Manuel F. Alvarez (1900) as well as Bolaños (1841) and Villaseñor (1892)—to make comparisons. To get an idea of the growth rate of the species locally (without damaging the venerable one), he correlated size and age of bald cypresses in the area by measuring trunk sizes and counting annual rings of cut branches. He found that the species has a surprisingly fast growth rate, and that, as a rule of thumb, the diameter of the trunk in centimeters is about half the age of the tree in years. Using this number in conjunction with an average diameter of 8 meters (more than 26 feet) for the irregularly shaped trunk of the giant, his calculations suggested that the tree was between 1,433 and 1,600 years old (numbers which, interestingly, approach the planting time given in the legend of Pechoca).

Three or More, Yet One

Three trees, three genetically different organisms—as we stood before Arbol del Tule in 1990, the fusion of several trunks appeared plausible.



Biologist Angel Salas Cuevas proposed a scenario for the life history of El Arbol del Tule: The young tree is small and single. Its trunk is joined by a second trunk—a root sprout—about 2.5 meters (8 feet) away. When the third trunk appears, the original tree and its two suckers form an almost equilateral triangle. After their fusion, the newly enlarged trunk, with its deep ribs along the fusion lines, takes on a cloverleaf shape in cross section. These trunks become a single trunk scored with deep furrows and gaps, and a fourth trunk appears 3.5 meters (12 feet) away on the east side. The greatest change, however, is yet to come: the fourth trunk gradually joins the triad. The tree is now almost 5 meters (16 feet) in diameter, and the main section quickly expands to over 7.5 meters (25 feet) at its widest.

However, the crown, the foliage, and the cones were so strikingly uniform that we were doubtful of its multiple nature. Boone Hallberg of the Instituto Tecnologico de Oaxaca confirmed our doubts, noting that in the thirty years he has been observing the tree, the timing of budding, the development and color of the leaves and strobili, the shedding of pollen, as well as the leaf color after frost—all were the same. In contrast, he had watched another tree growing along a nearby stream, a fusion of two different seedlings. The two trees were easily distinguished by subtle differences in both morphology and phenology.

To be three trees and one at the same time implies the union of sprouts of the same tree. The Taxodiaceae, including the genus *Taxodium*, possesses the ability to sprout from stumps following logging, as is often seen in the northern bald cypress, *T. distichum*, a very close ally of *T. mucronatum*. It is quite possible that the independent trunks that gradually "built" Arbol del Tule originated as sprouts from the trunk of a single damaged tree, or as layered branches from a tree whose single central trunk died out, after which the layers grew and fused together. The process by which the tree could have formed from several separate trunks has been illustrated by biologist Angel Salas Cuevas, using old descriptions, drawings, and photographs as a basis. His proposed scenario for the life history of the Tule tree from the appearance of the first tree, to its fusion with two of its suckers, and finally its coalescence with a later, third sucker can be seen on the preceding page.

In 1990 (Hall et al.), the results of enzyme analysis of samples taken from eight major segments of the tree provided undeniable evidence to support the theory of a single specimen, and as such, one of the world's largest trees in circumference. These results were further supported in 1996 (Dorado et al.) by evidence of genetic uniformity from DNA analysis. The competing theories of multiple trees vs. a single tree were thus apparently resolved.

Epilogue

Before being leveled by the Europeans, the 300,000-person Aztec capital, Tenochtitlan, was a large, well-organized city, a place of spectacular art, its market loaded with food brought from Xochimilco's floating gardens through a dense network of canals. Reaching almost 5,500 meters, the snow-covered peaks and rims of the sacred mountains, the Popocatepetl and his partner, Iztaccihuatl, hung like floating crystals above the city. The graybearded *ahuehuetes* were revered and planted everywhere along the canals, including areas that were later incorporated into the beautifully nurtured parks of Texcoco and Chapultepec. Some of their biggest trees were still with us only two or three decades ago, and it sends a shiver up the spine to think that the Aztecs once walked in their shade.

Smog and especially the drop in water table—pressures of a dramatically changing world—finished Mexico City's El Sargento in the 1970s, as well as the famous Ahuehuete of Popotla, the Arbol de la Noche Triste, and the big tree near the temple of the Aztec king Netzahualcoyotl in Texcoco. With a leaf surface of 9,300 square meters, the Tule tree has a tremendous evapotranspiration rate. It is enough to look at the tree to see that something is wrong. Gone is the beauty of the light-green foliage drooping ten meters downward with no branches visible beneath it, as it was seen just a human generation ago. The entire circumference of the tree, but particularly its southern side, is now full of twisted, skeletal branches. The tree has begun to decline, losing crown size in response to the changing environment. Anyone who has ever dealt with conifers knows exactly where this will end if the process is not halted and reversed as soon as possible.

Just decades ago, in the 1950s, Oaxaca was still a peaceful town of 40,000 people: somewhat provincial, with friendly merchants, silent streets of colonial elegance, and mainly Zapotec and Mixtec vendors in the market. The city has expanded rapidly and is now ten times as large, and it is about to celebrate a half million inhabitants. Water is used freely and El Tule's water table has dropped to its lowest level ever. Once a citizen of the swamp with a root system developed for a high water table and a crown adapted to higher humidity, Arbol del Tule and its neighboring, smaller giants, the Son and Grandson, are now clearly suffering. The soil is compacted

RÁCZ & DEBRECZY

A treasure of Chapultepec Park, the once beautiful giant, El Sargento (or El Centinela), died in the 1970s. Like most of the massive bald cypresses that witnessed the fall of the Aztec empire, it succumbed to the rapidly changing environment in and around Mexico City. The species—Taxodium mucronatum, *the Mexican, or Montezuma, bald cypress— was voted National Tree of Mexico during the celebration of the centenary of independence in 1910.*

by the many tourists and those who use the little chapel nearby. Although the small lawn around the giant is irrigated, this cannot replace the loss in humidity. In 1994, major changes were completed: the main road was diverted and the formal park with paths and flowerbeds around the trees extended. These have been major steps forward but by no means enough to secure the future of the giant in Oaxaca.

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The authors are researchers, Dr. Debreczy with the Massachusetts-based International Dendrological Research Institute and Dr. Rácz at the Hungarian Museum of Natural History. They are working on the Coniferae (Gymnospermae) volumes of their dendrological atlas with original field research, photo documentation, and connected conservation activity. For more information on their project, write IDRI Inc., P.O. Box 812910, Wellesley, MA 02181, U.S.A., or find them on the WEB at http://world.std.com/~jegan/idri.html.

To assist the group dedicated to saving El Arbol del Tule, contact Patronado Estatal de Promotores Voluntarios, 604 Garcia Vigil Oaxaca de Juarez, Oaxaca, Mexico.

The St. Vincent Botanic Garden—The Early Years

Richard A. Howard

Late in the eighteenth century, while France and Great Britain were vying for control of the sugar-rich Caribbean islands, the first program of plant introductions in the British West Indies was instituted on the small island of St. Vincent. The garden's second superintendent—a master plantsman and collector of more than 100 plants new to science—not only expanded that program but also began propagating and distributing new discoveries from around the world.

The peace treaty signed in Paris in 1763 ended for a brief period the fighting between Great Britain and France in the Caribbean. British general Robert Melville (1723–1809) was appointed governor of the southern British Caribees—Dominica, Tobago, Grenada, St. Vincent and the Grenadines—and made Grenada his headquarters. In June 1765 he visited St. Vincent and discussed with George Young, surgeon of the military hospital there, his plan for a botanic garden, primarily to provide medicinal plants for the military as well as to improve the life and economy of the colony. Dr. Young agreed with the proposal, and Melville ordered that six acres of land previously designated for military use be set aside for the garden, with Dr. Young as the superintendent. This marked the beginning of the St. Vincent Botanic Garden, which eventually expanded to twenty acres.

The garden was to serve as a repository for all useful plants that could grown on St. Vincent but also, in contrast to the botanic gardens at Kew, Oxford, Cambridge, and European botanic gardens at the time, as a nursery for plants to be distributed around St. Vincent and to other islands. Melville wrote to Young in 1766:

> I need not repeat to you how desirous I am that my foundation of a botanical plan entrusted to your skill and perseverance should prove successful, nor do I suppose it necessary that I give you fresh assurances how much my attentions and support may be relied on, for already you know my assistance shall be as great as my situation and multiplicity of public affairs will possibly permit. . . . The articles of plants and seeds commissioned from the Main near Honduras I shall soon hope to receive, and seeds of the best cinnamon from Guadeloupe. If you have once made tolerable progress in raising useful and curious plants, I should not despair of obtaining from Home encouragement in books, machines, instruments, etc., but till then I find I must hazard what expenses are unavoidable (as I have already done). . . . Pray get as much information as possibly you can from all quarters relative to the indigenous medicines. It is against your craft but would be highly beneficial to the public and do yourself honour. And I should think for this purpose physical practitioners of the country, natives of experience, and even old Caribs and slaves who have dealt in cures might be worth taking notice of, and if at any time you should think that a secret may be got at or even an improvement for small expense, I shall readily pay for it.[1,6,8,14]

In spite of Melville's promises, the government in London did not fund the garden, and neither of Melville's two successors as governor, Leybourne and Morris, was willing to assist in its maintenance. Nevertheless, by drawing on a variety of resources, Young was able to initiate the first program of plant introduction in the British West Indies. The War Department and the East India Company sent seeds and plants from tropical India and from British North Borneo, Sabah, and Sarawak in the East Indies, and others may have come from French horti-

culturists in the area. Since by 1770 Young had received only two plants of the cinnamon promised by Melville, he traveled to Guadeloupe himself to obtain ten more; in 1771 he obtained 1,200 seeds from a tree in Grenada from which he grew an additional 130 plants.

Proof of Young's success in spite of limited resources is found in a 1773 publication by John Ellis, an English botanist with interests in the Caribbean, entitled *Some Additional Observations on the Method of Preserving Seeds from Foreign Parts, for the Benefit of our American Colonies, with an Account of the Garden at St. Vincent, under the Care of Dr. George Young* (1773), in which Ellis states:

> Dr. Young has favored me with a catalogue of what plants are now growing in this garden, and of the plants he has lately collected here to carry out with him; which I take the liberty to insert, for the satisfaction of the public.

Ellis listed those plants and added, "Besides these articles, there are several without names that have been raised from Chinese and other seeds." A second list indicated those plants Young would be able to get from the royal and other botanic gardens in and about London.[5]

In the same year, London's Society for the Encouragement of Arts, Manufacture and Commerce awarded its Gold Medal to Young, "for the

Lithographs by Reverend Lansdown Guilding, 1824, from his Account of the Botanic Garden in the Island of St. Vincent *(1825).*

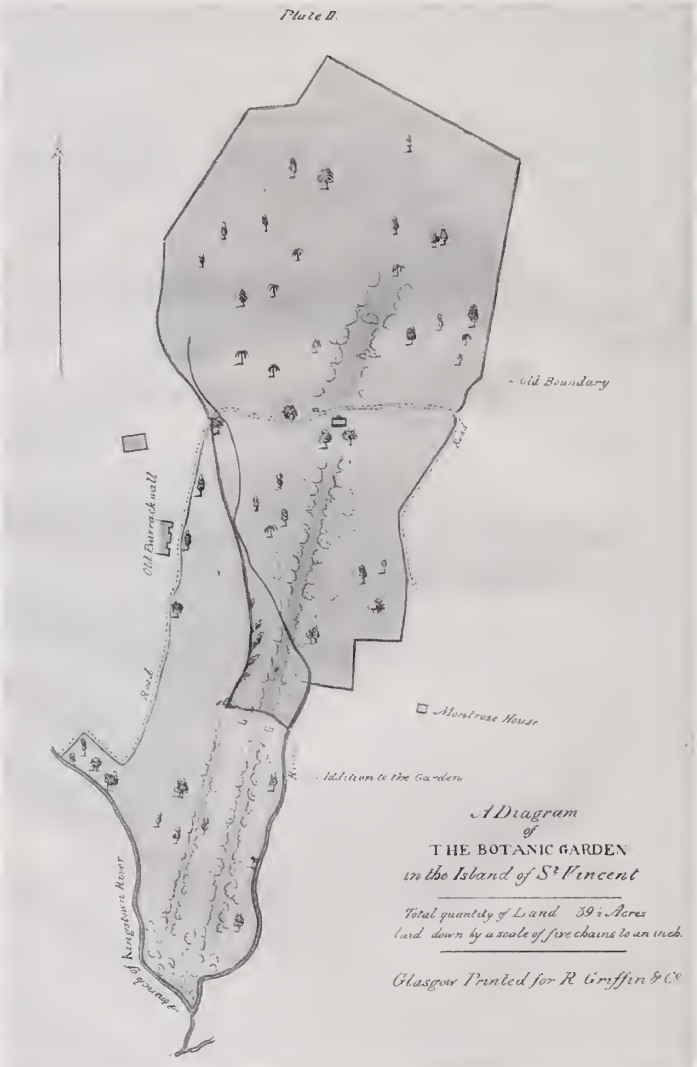
1. *House of the Superintendent*
2. *View of the Botanic Garden St. Vincent, taken from the Superintendent's House*
3. *Botanic Garden, from the bottom of the Central Walk*

Plants of the St. Vincent Botanic Garden, 1773

The following plants were reported by John Ellis in 1773 as growing in the St. Vincent Botanic Garden due to the efforts of Dr. Young. Over half are of reported medicinal value, reflecting Young's service as a physician to the military forces in the Caribbean.

MEDICINAL PLANTS

safflower: *Carthamus tinctoria*
turmeric: *Curcuma longa*—an aromatic stomachic and hemostatic
scammony: *Convolvulus scammonia*—a resinous cathartic
colocynth: *Citrullus colocynthis*—a powerful cathartic
simarouba: *Simarouba amara*, a source of extremely bitter bark, used in treating malaria
spigela: *Spigelia marilandica*
citron: *Citrus medica*, a source of candied peel used for coughs
bergament orange: *Citrus bergamia*, a source of bergament oil, a substitute for mint
Italian senna: *Senna italica*—a strong purgative
aloes: *Aloe vera*—a healing sap for treating burns
balsam capivi: *Copaifera officinalis*, a resin valued in cough medicines
Cassia fistula—a laxative
guaiacum: *Guaiacum officinale*—a cure for syphilis; also used as building material
China root: *Smilax china*, a medicine—an alterative and diuretic
gum galbanum: *Ferula galbiniflua*, a source of resin used both medicinally and for incense



FROM L. GUILDING, *ACCOUNT OF THE BOTANIC GARDEN IN THE ISLAND OF ST. VINCENT*, 1825. ARNOLD ARBORETUM LIBRARY

EDIBLES

cinnamon: *Cinnamum vera*, a spice, seasoning
East Indian mango: *Mangifera indica*, a fruit
rhubarb: *Rheum rhaponticum*, a vegetable
Tobago nutmeg: *Virola surinamensis*, a South American relative of the true East Indian nutmeg
coriander: *Coriander sativa*, a fruit used for flavoring
vanelloes: *Vanilla planifolia*, a tonic and flavoring in cooking
nopal: *Opuntia cochinellifera*, an edible fruit, host plant for cochineal insect
sesamum: *Sesamum indicum*, a source of cooking oil made from the seed
dates: *Phoenix dactylifera*, a fruit
annatto: *Bixa orellana*, a food or cosmetic coloring agent
China tallow tree: *Sapium sebiferum*, a source of vegetable oil burned in candles

OTHER PLANTS

logwood: *Haematoxylon campechianum*, a dye
paper mulberry: *Broussonetia papyrifera*, a source of bark fiber for tapa cloth or writing paper
bamboo cane: *Arundinaria macrosperma*, a building material used for furniture and construction

Botanic Garden, for superintending its cultivation, and for relating the event of some trials and proposing further attempts."[20]

The Garden Under French Administration

Early in 1778 hostilities between the French and the English were renewed in the Caribbean. In June of that year, when it became clear that the French would again occupy St. Vincent, Dr. Young was ordered by the chief of the British forces to move to St. Lucia to head the military hospital there. He left the botanic garden in charge of a Mr. Swartz (or Zwartz), who later obtained a position as secretary to the commanding officer of the French forces. Swartz was to later claim that this officer had given him title to the garden.

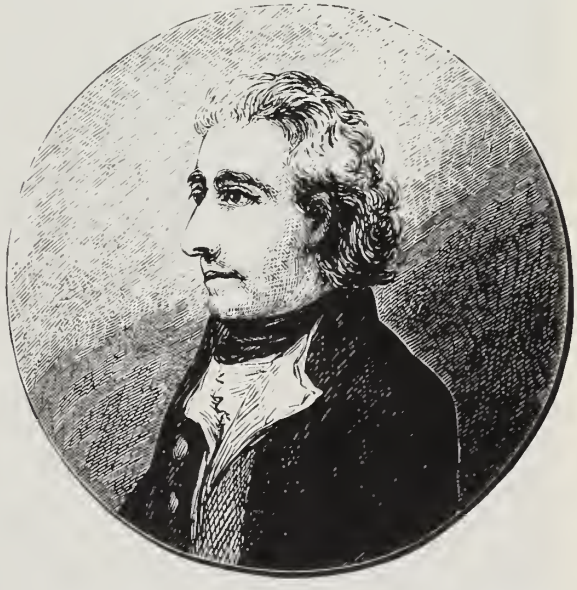
The French maintained the garden during most of the five years that they held the island, but when they realized that it would be returned to the British as part of the latest peace treaty, they abandoned the garden and it grew up in weeds. By the time Dr. Young was able to return to St. Vincent in 1784, he was no longer interested in resuming the directorship of the Botanic Garden, and with good reason: portions of the garden had been given over to the cultivation of cotton and tobacco by local people and the remainder had deteriorated badly; Swartz was pressing his dubious claim to the land, leading to legal wrangles, and the military was also competing to resume full control of the land; and finally, the financial operations of the garden were no more secure than before the war.[14] Young recommended that an acquaintance from St. Lucia, Alexander Anderson, be appointed as his successor; his recommendation was approved in 1785 by Sir Joseph Banks, acting in his capacity as scientific advisor to the king and liaison with the Royal Botanic Garden at Kew.

Unlike his predecessor, Anderson had the full support not only of Banks and General Melville, but also of General Robert Adair, Inspector-General of the regimental hospitals, as well as the War Department and the East India Company. It was during the period of his administration—1785 to 1811—that the garden made its most significant contribution to the world's knowledge of tropical American botany.

The Botanic Garden Under the Management of Alexander Anderson

Alexander Anderson was born in Aberdeen, Scotland, and studied for a period at the university in Edinburgh although he did not complete the work for a degree. He was employed briefly at the Chelsea Physic Garden by a fellow native of Aberdeen, William Forsyth, at that time head gardener at the Physic Garden and later at St. James's and Kensington Palace Gardens. In 1774 Anderson went to New York to seek employment as a gardener, taking up residence with his brother John, a printer.[7] During this period he sent botanical specimens and seeds from Long Island and York Island (now Manhattan) to Forsyth. At the same time he listed other plants he could send and asked for plants from England in exchange.

Being a loyalist, Anderson sailed for Surinam when the American revolution began, rather than be pressed into military service.[1] By 1783 he was on St. Lucia, employed as an orderly in the military hospital then headed by Dr. Young. Young asked Anderson to search for local



The only known portrait of Alexander Anderson, engraved by Stephen H. Brelett from a drawing made by Anderson's nephew in 1798 in St. Vincent.

From Benson J. Lossing, A Memorial of Alexander Anderson M.D., The First Engraver on Wood in America *(New York, 1872). By permission of Houghton Library, Harvard University.*

medicinal plants, particularly one that could provide quinine for treating malaria. One of the plants he found, called *quina*, or *china*, was sent to London for testing and was eventually described and named as *Cinchona santaeluciae*, a relative of *C. officinalis*, the source of quinine, but although it tasted as bitter as quinine, it did not contain the cinchona alkaloids and was eventually placed in the genus *Exostoma*.[4,15]

Anderson also traveled to other British-held islands, with Dr. Young or at his direction, and accompanied Young on his return to St. Vincent in 1784. When Anderson became the first person known to climb the Soufrière of St. Vincent (at 4,048 feet, the highest peak on the island), Young realized that he was not only an experienced naturalist but an active field man as well and recommended him as his successor in the superintendency of the garden.[2,10,11]

Along with the formal notice of his appointment by Sir Joseph Banks and the War Department in 1785, Anderson received orders to submit a list of the plants then growing in the Botanic Garden and to report new introductions or other developments at quarterly intervals, which he did, but if they were preserved, few have been located. In *A Catalogue of Plants in His Majesty's Garden on the Island of St. Vincent*, dated June 1, 1785, and now preserved in the British Museum (Natural History), Anderson listed at least 348 different

Anderson was first to climb St. Vincent's Soufrière and to see the crater of this volcano. His report to the Royal Society was published in 1785, giving credit to the wrong Anderson. Above is his sketch of the volcano circa 1780. Below is the author's 1972 photo of the volcano, which evaporated the lake and left a residual cinder cone. Soufrière has erupted once again since then.

kinds of plants, his heritage from Young, including all 31 plants of economic importance mentioned by Ellis in his 1773 publication. The top portions of several pages of the manuscript were charred in the World War II bombing of London, but it appears that Anderson categorized the plants as commercial, medicinal, esculent, ornamental, or timber species. He is not known to have made subsequent reports until around 1800, when he compiled a manuscript entitled *Hortus St. Vincentii*, which describes the plants then found in the garden. Each of its nearly 2,000 taxa is identified not only by its Latin, English, and French names, but also, where possible, by its Carib and "Negroe" names, showing that Anderson had fulfilled General Melville's instructions to Dr. Young by seeking out native plants. Each taxon is also given a description, along with data on propagation and culture as well as uses and sources of the plants.[9]

Anderson was a prolific letter-writer, with virtually a worldwide network of correspondents. Most extant correspondence was with William Forsyth, but there are also letters to an assortment of others in England as well as in the United States, where his most important contact was William Hamilton of the Woodlands in Philadelphia. Hamilton provided Anderson with many plants of the eastern United States for trial in St. Vincent and helped him establish exchanges as far away as Calcutta. Anderson also had correspondents in the French islands of the Caribbean as well as in Jamaica, the Bahamas, and Barbados, where his closest contact was Governor Lord Seaforth (1801–1806). He regularly sent plants to Seaforth for transshipment to England, with the result that the introduction into Europe of many plants that Anderson had obtained in the wild are credited instead to Lord Seaforth.[1,3]

First-day cover and postage stamps in commemoration of the two hundredth anniversary of the St. Vincent Botanic Garden. The talipot palm is shown here in flower, meaning that it would die shortly after.

The Breadfruit Tree Arrives in St. Vincent

Great expectations were attached to the cargo of the H.M.S. *Providence.* A Jamaican newspaper declared: "The introduction of the breadfruit into this island will constitute a remarkable era in its annals. In less than twenty years, the chief article of sustenance for our negroes will be entirely changed: —plantains, yams, cocos, cassava, will be cultivated only as subsidiary, and be used merely for change; whilst the bread-fruit, gaining firm hold in the earth . . . will afford in the greatest abundance, for nine months in the year, the choicest and most wholesome food."[19]

Breadfruit, Artocarpus altilis.

The excitement that greeted the ship's arrival in St. Vincent is evident in Alexander Anderson's account.[14] Imagine years of waiting for the H.M.S. *Bounty* to arrive, only to learn that a mutiny had put an untimely end to the expedition; then, after months of uncertainty about the *Providence,* to have it suddenly appear, quickly unload the least healthy of the plants in its cargo, and depart again just as suddenly. Anderson's account of the events shows an admirable willingness to put the best light on what must have been a rather disappointing outcome to the affair.

> About nine o'clock of night of the 23rd of January 1793 arrived in Kingstown Bay the long wish'd for Providence, Captain Bligh, from the South Seas with the breadfruit and other useful and curious plants. The voyage was remarkably short and in every respect prosperous. Such a number of live plants were never before seen on board a single ship. On her arrival she was one of the most beautiful objects of the kind it is possible to conceive. Such a number of live plants of many different kinds brought from the remotest parts of the globe in such a state of preservation and carried through nearly all the climates of it was surprising to behold. Too much praise cannot be given to Captain Bligh for his great attentions to the chief object of his mission nor to the two young men who had the collecting and immediate management of them. Nor is it less surprising that the share of them allotted to the Garden have arrived to such perfection in so short a time in it. Some of the breadfruit plants began to produce fruit at the end of eighteen months from their arrival. In two years and three months all the fifty plants reserved in the Garden produced a large crop. This will appear the more surprising as the half left here were the smallest and the most sickly looking plants. The largest and most healthy in appearance went to Jamaica. In this division there appeared partiality; however, I conceived it just and could not with propriety object to it, as there was still the risk by sea of ten or twelve days passage from St. Vincent to it. Therefore necessary for the preservation, the weakest and the most probable to suffer by continuing them in their confined situation should be landed as soon as possible, and I was confident that out of the number of 300 plants I should be able to preserve sufficient as a nursery for the Windward Islands.

Anderson collected not only on St. Vincent but also in the other Lesser Antilles, the Spanish Main, Trinidad, Tobago, and the Guianas, sometimes traveling on the schooner of William Lochhead of Antigua.[14] The garden's collection was also augmented by plants Anderson received from sea captains, from other gardeners, and from Kew. In return, as noted in its Garden Record Book, Kew received several shipments from Anderson between 1787 and 1798, of which the largest and best known was the one containing the breadfruit trees, *Artocarpus altilis*, brought by Captain William Bligh on his return from the *Providence* expedition in 1793.[17,19]

The Introduction of Breadfruit

Bligh had been a lieutenant on the first of Captain James Cook's expeditions to the Pacific in 1768, the voyage on which Joseph Banks traveled as a naturalist. When Cook's enthusiastic report on the role of breadfruit in the diet of Polynesians induced planters in St. Vincent and Jamaica to ask for breadfruit trees of their own, Banks persuaded King George III to order a collecting expedition and was instrumental in choosing Bligh to command the *Bounty*.[17] St. Vincent was to be the first stop for dropping off breadfruit on the return trip, but the infamous mutiny occurred only a few days out of Tahiti, and the *Bounty* never reached St. Vincent.

On the second attempt Bligh commanded the H.M.S. *Providence*, with the armed brig *Assistant*, manned by twenty marines, as escort to prevent another mutiny. When the *Providence* arrived in St. Vincent in 1793, it carried about 1,300 Polynesian plants, of which it left 559 plants (including 331 breadfruit trees) for the Botanic Garden. Anderson noted that many of these were in poor condition; Bligh had kept the healthiest for Jamaica and Kew. The arrival of the *Providence* caught Anderson unprepared, but he hastily potted 350 plants from his garden to send with it to Jamaica and Kew. As Bligh was preparing to leave Jamaica for England, he received orders to join a Honduras convoy. When he finally left Jamaica for England several months later, he carried a large number of plants, but the list of those delivered to the Royal Gardens at Kew does not identify the ones from Anderson and many were mistakenly credited to the horticulturists at Jamaica.[16,18,19]

In his *Hortus St. Vincentii* Anderson described eight varieties of breadfruit trees received from Bligh. He propagated these and other plants brought by the *Providence*, distributing them throughout the Caribbean from the Bahamas to Trinidad and the Guianas.

The Unpublished Manuscripts

In addition to his work in the Botanic Garden and his voluminous correspondence, Anderson also made time to write a number of unpublished manuscripts; they are all now in the archives of the Linnean Society of London. Two of these have been transcribed by the author and Elizabeth Howard and were published in 1983. *The St. Vincent Botanic Garden* is the history of the early years of the development of the garden, and *The Geography and History of St. Vincent* is a firsthand account of Anderson's travels around the island.[13,14] Also of great interest to botanists and horticulturists are the manuscripts that describe the plants of St. Vincent and the garden. Anderson may have had two separate publications in mind: a *Flora Caribbea* as well as the *Hortus St. Vincentii* already mentioned. In many cases the plant names used by Anderson differ from the modern names: he named, but did not publish, plants that were new to him. This author has identified most of the plants in the *Hortus* by their modern names and organized them into families and genera, aided in some cases by watercolor illustrations made by Anderson's associate John Tyley (which are now preserved at the Linnean Society or, in a few cases, at the Hunt Institute for Botanical Documentation). Though as yet unpublished, this transcription may be useful to botanists.

The textual material of the *Hortus*, still untranscribed, gives brief descriptions of each plant as well as its origin or source. Many of the botanical specimens prepared by Anderson and shipped to Forsyth in London are now in the herbaria of the British Museum (Natural History) or the Royal Botanic Gardens, Kew. While it is often difficult to associate the specimens with Anderson's descriptions, the *Hortus* remains valuable as the earliest record of

RICHARD A. HOWARD

This temple houses a fountain in the form of an allamanda flower. The garden still maintains many historical medicinal plants such as the source of chaulmoogra oil, which is used in treating leprosy, and the lignum vitae, long thought useful in treaing symptoms of syphilis. The collection of palms is especially notable, and a new inventory is much desired. The garden's largest breadfruit trees represent three of the varieties introduced by Bligh on the Providence. *All are vegetative propagations of an earlier plant. The original superintendent's house is now a museum that specializes in artifacts of the Caribs and other indigenous groups.*

plants introduced into cultivation in the British Caribbean.

The last printed inventory of the plants in the garden was one drawn up by Anderson in 1806 and published in 1825 as part of the *History of the St. Vincent Botanic Garden* compiled by the local chaplain, Lansdown Guilding. It also included letters and other lists of plants that may have been among the Anderson manuscripts.[8,12]

Anderson died in St. Vincent in 1811 and was succeeded for a short time by his friend and associate William Lochhead, who died unexpectedly in 1815 and was in turn succeeded in 1816 by an Australian, George Caley. Caley's tenure on St. Vincent was marked by his constant dissatisfaction with everything on the island, including the garden, and upon his departure in 1822 the garden was returned to local administration and began a long decline.

So great a wealth of plant material has never again been assembled in the American tropics. Anderson was a master plantsman, to be remembered for his dynamic program of introduction, propagation, and distribution. He is commemorated in the names of one genus—*Andersonia* of the Epacridaceae was named for Alexander and two other Andersons—and at least six species. However, although over 100 of the plants he collected were new to science, none was published under the name he applied to it; had the *Hortus* been published in his lifetime, many common plants of the Caribbean flora—perhaps as many as 75—would now carry the names he proposed. One hopes that the botanical information in his manuscripts and his records of plant introduction will one day be salvaged and published as a tribute to this worthy man of science from the King's Botanical Garden of St. Vincent, once the horticultural capital of the Western Hemisphere.

The Arnold Arboretum

WINTER • NEWS • 1997–1998

A New Director for a New Arboretum

Robert E. Cook, Director

Karen Madsen

In January, Dr. Stephen Spongberg, who for twenty-seven years has been the horticultural taxonomist at the Arboretum, announced his retirement at the ripe young age of fifty-five. Steve is not planning to collect sand between his toes on the beaches of St. Barbados. His early retirement was prompted by an offer few could refuse: he has been appointed director of a new botanical organization on Martha's Vineyard, the Polly Hill Arboretum. Here he will have the opportunity to create a horticultural and educational institution built on the extensive private collections of the legendary and deeply revered horticulturist Polly Hill, who for decades has been establishing a unique landscape of plants around her home in West Tisbury. Visited by thousands of friends and lovers of plants since she began collecting in the 1950s, Barnards Inn Farm became the Polly Hill Arboretum in 1997, with plans to formally open to the public in 1998.

Steve will be greatly missed at the Arboretum, though he will retain a research appointment here and we anticipate calling upon his botanical expertise often. Steve began his career at the Arboretum in 1970 when he worked on the *Generic Flora of the Southeastern United States* project as a postdoctoral graduate of the University of North Carolina. Over the next two decades he edited and published numerous taxonomic review articles in the *Journal of the Arnold Arboretum,* now published as part of the *Harvard Papers in Botany.* He became especially interested in the close evolutionary relationship between the flora of eastern Asia and that of eastern North America, and he developed deep taxonomic expertise in the genera *Magnolia* and *Sorbus.* These interests culminated in three great achievements.

In 1980 Steve participated in the first cooperative venture between Chinese and American scientists, the Sino-American Botanical Expedition to western Hubei Province. Among its many collections, this excursion brought back *Magnolia zenii, Heptacodium miconioides,* and *Sorbus yuana* as new introductions to North America. In 1990 Steve published *A Reunion of Trees,* a rich and detailed history of the search for new botanical species around the world and the critical role of the Arnold Arboretum in discovering the botanical treasures of Asia. Seven years later he was honored by the Royal Horticultural Society with the award of the Gold Veitch Memorial Medal for contributions to horticulture. With this honor he joined previous staff members Ernest Henry Wilson, William Judd, and Donald Wyman, four of only fifteen Americans who have received the distinguished British award.

Steve will be greatly missed at the Arboretum and by his many colleagues and friends at the Harvard University Herbaria. We all wish him the greatest success in this challenging and exciting new endeavor.

Campaign Tops $5 Million

Lisa Hastings, Director of Development

The Campaign for the Arnold Arboretum passed the five-million-dollar mark as of January 31, 1998, a significant milestone in this first major fundraising effort at the Arnold Arboretum since 1927. Total cash and commitments reached $5,140,000 toward the campaign goal of $8.2 million, which was publicly announced last June. The campaign will end when the university-wide campaign concludes on December 31, 1999.

The five-million-dollar figure reflects several large gifts received during the last eighteen months and significant, steady growth in both the membership and annual appeal programs. In the category of gifts over $10,000, the Arboretum has received $1,468,334 from twenty-one donors since July 1, 1997. This compares with $285,000 received from ten donors in FY97 and $330,000 received from seven in FY96. The number of gifts ranging from $1,000 to $10,000 has also increased significantly. In this category, the Arboretum received 49 gifts totaling $120,000 in FY97, an increase of 80 percent over 27 gifts with a total of $67,000 in FY96. To date this year, we have received 36 gifts for a total of $96,861.

ANNUAL APPEAL APPROACHES $100,000

In his annual, year-end letter to members, Director Bob Cook admitted that his appeal—which didn't ask for money—left the Arboretum's director of development "turning white." Nonetheless, the 1997 annual appeal has raised $88,000, an increase of 31 percent over total dollars received at this time last year. The number of gifts has increased 38 percent.

In spite of, or perhaps because of, Bob's unorthodox approach to fundraising, the 1997 annual appeal has grown in several categories: The most notable growth is in the $100 to $999 bracket, with total dollars up 46 percent and the number of gifts at this level up 28 percent. Like membership dues, annual appeal dollars provide important unrestricted, current-use funds that support the Living Collections and other Arboretum programs and initiatives.

We are much encouraged by these generous responses. Bob Cook said, "The increase in overall giving on the part of both our most loyal members and many new supporters this past year represents a tremendous vote of confidence in the current work of the Arboretum. While the campaign has been a major undertaking, the success of this effort to date reflects a deep interest in the future of this unique institution."

Flora of the Lesser Antilles

Copies of the six-volume *Flora of the Lesser Antilles*, a long-term project of Richard A. Howard, former director of the Arnold Arboretum, are 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; it 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 abundantly illustrated with line drawings that are botanically correct and highly artistic. All species known in the Lesser Antilles, both native and introduced, are included.

The six volumes are available either individually or as a complete set. For the complete set a special price of $260 is offered that includes shipping and handling within the U.S.A. (Add $5 for shipping outside the U.S.A.) For volumes 4, 5, and 6 only, the special price is $205.

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

Volume 1: Orchidaceae $20

Volume 2: Pteridophyta $25

Volume 3: Monocotyledoneae $35
(other than Orchidaceae)

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, U.S.A.

A New Outlook on Peters Hill

Peter Del Tredici
Director of Living Collections

Karen Madsen

This yellowwood, *Cladrastis kentuckea,* which grows near Faxon Pond, was moved to the Arboretum from the Harvard Botanic Garden at Cambridge in 1881. A new generation of yellowwoods will be planted on Peters Hill this spring.

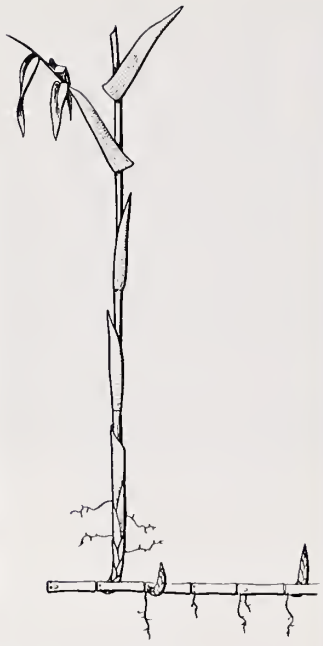
The drought of 1997 delayed the planting phase of the improvements to Peters Hill that have been underway since last May, but it is at the top of the list for the spring planting season.The plan is to enhance the pastoral character of Peters Hill as a passive public open space in the Olmstedian tradition of "scenery in the natural style." Following the recommendations in the master plan prepared by the landscape architecture firm of Sasaki Associates in 1992, a series of short- and long-range views will alternate on the approach to the summit, with broad expanses of greensward broken occasionally by groves of trees and islands of mound-forming shrubs. The effect will be naturalistic, consistent with both the Olmsted/Sargent plan for the core area of the Arboretum and with Beatrix Farrand's unrealized 1949 plan for Peters Hill. The visitor's experience at the top of the hill, with its views of the Boston skyline and local surrounds, will affirm Olmsted's goal of a spiritually restorative, "enlarged sense of freedom."

Three distinct "communities," or spatial/ecological types that refer to existing natural and planted groupings, will form the structure of the four-acre-plus hilltop. In keeping with Farrand's recommendation that "no plants should be set out which are incapable of fighting their own battles against wind, cold and drought," we have chosen a combination of native and imported species for their likely adaptability to the rigorous site conditions. As individual plants thrive or decline over time, dynamic interactions will gradually lead to a blurring of the edges.

- A mixed deciduous forest of trees and understory/edge shrubs will march up the southeast slope from the existing natural forest. Trees will include several species of oak, sassafras, sweet birch, hackberry, American hornbeam, and common persimmon. Some of the root-suckering understory and edge shrubs will be native viburnums, witch hazel, shadblow, meadowsweet, and low- and highbush blueberries.
- Mound-forming shrubs and groundcovers—all sun-loving and stoloniferous or root-suckering—will include sweetfern, bayberry, several sumacs, and bottlebrush buckeye.
- Woody legumes will fill out a savannah of leguminous trees. Among them will be American yellowwoods, Kentucky coffee tree, *Amur maackia,* and the Japanese pagoda tree.

New England Grows!

The annual convention of New England's green industry, called New England Grows!, gives Living Collections and other Arboretum staff a welcome break in the midwinter routine. Held near the end of January at the Hines Auditorium in Boston's Back Bay, it offered three days of lectures, demonstrations, and exhibits. Among this year's lecturers were Arboretum Senior Propagator Jack Alexander, on lilacs, and Director of Living Collections Peter Del Tredici on "The Radical Underground: The Myths & Realities of Tree Root Systems." The Membership staff set up a display and, along with other Arboretum staff, dispensed information on the programs of the Arboretum.



Demystifying Bamboos

Bamboos are invasive and not hardy. Or are they? From 7:00 to 8:00 pm on Monday, March 30, Ian Connor of England's Sir Harold Hillier Gardens and Arboretum will demolish the myths surrounding this exotic and undervalued group of plants. His slides will demonstrate how beautiful and varied bamboos are, and Connor will show how they can be grown in your garden without acting the villains that they have been branded. Come be converted by this self-proclaimed bamboo fanatic and learn how to bring this plant group out of isolation and back into the garden.

The fee for members is $10, $12 for nonmembers. To register, call 617/524-1718 x 162. Connor's booklet, *A Cultivation Guide for Bamboo,* will be available for sale at the lecture.

1998 American Landscape Lecture Series

THE LANDSCAPE OF STEWARDSHIP
Theory and Practice

This sixth year of the American Landscape Lecture Series takes up the subject of stewardship and the implications for contemporary conservation in a time of changing views of nature. The series is a collaboration among the Arnold Arboretum, National Park Service, Harvard Graduate School of Design, and other landscape-oriented sponsors.

All lectures are free and begin at 6:30 pm at the Harvard Graduate School of Design, 48 Quincy Street, Cambridge. For information, call the National Park Service at 617/566-1689 x 204.

Thursday, February 12: People and Nature: Can We Find a Balance?

Daniel B. Botkin, President, The Center for the Study of the Environment, Santa Barbara, California, and Professor of Biology, George Mason University

Thursday, February 26: Common Lands, Common People: Lessons from New England History for Contemporary Conservation

Richard William Judd, Professor of History, University of Maine, Orono

Thursday, March 12: A New Approach to Vermont's Forests: Managing for Jobs and the Environment

Jeffrey Roberts, Vermont Land Trust
Brenden Whittaker, Northeast Vermont Development Association
Carl Powden, Vermont Land Trust
John Roe, The Nature Conservancy of Vermont

Thursday, April 9: Common Ground in the Range War: The Malpai Borderlands Group

John C. Cook, Vice President, The Nature Conservancy, and Co-Director, The Malpai Borderlands Group

Mark Your Calendars

The Arnold Arboretum's two most popular annual events—Lilac Sunday and the Fall Plant Sale—have been scheduled.

May 17 is the day for enjoying a long-standing spring tradition in Boston. The lilacs should be in peak bloom, so come view the collection and plan to spend the day exploring the May landscape. Bring a picnic—only on Lilac Sunday is picnicking permitted at the Arboretum.

September 20—also a Sunday—is the date set for the Annual Fall Plant Sale at the Case Estates in Weston. The Plant Sale offers something for everyone, serious plant collector and novice gardener alike. As in the past, this year's event will feature plant sales in the barn; live auction, silent auction, and straight sales tents; plant society row; and—due to their popularity last year—informal education sessions in the teaching garden. Members will receive their sale catalogs and free plant vouchers in the mail in advance of the sale. For information about plant sale benefits for members, call Kelly Harvey in the membership office at 617/524–1718 x 165.

THE HUNT INSTITUTE OF BOTANICAL DOCUMENTATION, CARNEGIE-MELLON, PITTSBURGH, PENNSYLVANIA

Painting by John Tyley, protegé of Alexander Anderson, of fruits said to have been introduced by the St. Vincent Botanic Garden.

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Professor of Dendrology, Emeritus, Harvard University, and former director of the Arnold Arboretum, Dr. Richard A. Howard is the author of the six-volume *Flora of the Lesser Antilles.*

An earlier version of this article was published in *Harvard Papers in Botany* (1996) 8: 7–14.

Molecular Analysis: A New Look at Umbrella Magnolias

Richard B. Figlar

Taxonomists have long been frustrated in their attempts to decipher the complex evolutionary relationships within the genus *Magnolia*. Recent molecular research has shed new light on the problem and helped to clarify the long-standing confusion.

The magnolias of section *Rytidospermum*—one of sixteen categories that subdivide the 128 species of the genus *Magnolia*—have always been an intensely interesting group, not only for their large flowers and enormous whorled leaves, but because several species occur in both eastern Asia and eastern North America. Within the genus, this intercontinental distribution is shared only with section *Tulipastrum*, but in that case the two species involved, our native cucumber tree, *Magnolia acuminata*, and *M. liliiflora*, the famous Mulan magnolia from China, share few characteristics beyond the same number of chromosomes and the presence of reduced outer tepals.

The *Rytidospermum* section, according to most taxonomists, consists of six species: *Magnolia tripetala*, the umbrella magnolia; *M. fraseri*, the mountain magnolia; *M. macrophylla*, the big-leaf magnolia; *M. obovata (M. hypoleuca)*, *M. officinalis*, and *M. rostrata*—the first three native to southeastern United States into Mexico and the latter three native to eastern Asia, from the

RICHARD B. FIGLAR

These three closely related magnolias share large, whorled leaves, ranging from a foot to two feet in length, and large, white flowers with diameters in the range of six to twelve inches. The flowers, which open after the leaves have developed, are strongly scented, Magnolia tripetala, *above, unpleasantly so. A native of the Allegheny region of the eastern United States, it seldom exceeds forty feet and is uncommon both in the wild and in cultivation.*

At top right is the Japanese Magnolia obovata. *It grows to eighty feet in its native damp, rich, highland forests, and is one of the hardiest Asian magnolias (zones 6 to 9). Its slightly less hardy Chinese sister,* M. officinalis *var.* biloba, *at bottom right, also grows at altitudes from 2,000 to 5,500 feet, and achieves heights up to seventy feet. Its bark is so highly valued as medicine that the tree has been nearly extirpated in its native provinces of Hubei and Sichuan.*

RICHARD B. FIGLAR

RICHARD B. FIGLAR

PETER DEL TREDICI

Like other members of the subgenus Magnolia *(one of three within the genus), the fruits of* M. tripetala *tend to be bright red and showy. They persist for several weeks in late summer.*

Kurile Islands and Japan westward to southwest China. Among the various morphological characteristics shared by members of this group, the most distinctive are the enormous whorls of deciduous leaves, which are crowded in parasol fashion at the ends of the branches. For this reason, the *Rytidospermum* magnolias are often referred to as umbrella trees. Indeed, to the uninitiated, the first impression of these plants is often more reminiscent of the houseplant known as the umbrella tree—the giant tropical *Schefflera*—than it is of a *Magnolia*. However, unlike *Schefflera*, whose compound leaves represent true whorls, the leaves of *Rytidospermum* magnolias are arranged in false whorls; that is, the individual leaves actually emerge in alternate fashion but with very little stem growth (internodes) between successive leaves.

The pattern of many leaves emerging almost simultaneously is called *flushing*. Apparently, *Rytidospermum* magnolias adapted this flush-type leaf-emergence pattern in order to compete effectively in the gaps of forest understory during early spring. By producing more leaves more or less simultaneously, such plants are better able to compete with other species for scarce sunlight. And since little stem growth is produced, the process itself is very energy efficient. Later in the spring, the growth reverts to the more typical pattern, where leaves are produced one at a time along longer stem shoots, as in other magnolias. Flush-type leaf-emergence patterns are common in many other plant species of the understory; for instance, some of the deciduous azaleas, although because of their much smaller leaves, the umbrella effect is less noticeable than in the *Rytidospermum* magnolias.[2]

Clearly, among the magnolias this trait is unique, and for that reason taxonomists have suggested that, despite their intercontinental distribution, they all form a natural group and should be very closely related. This provokes several questions. Did today's species evolve from a common ancestor? If so, how and when did its descendants cross the Pacific Ocean? Which one of the North American species is the most closely related to its Asian counterpart(s)?

Using modern molecular systematics, researchers Yin-Long Qiu, Clifford Parks, and Mark Chase analyzed the chloroplast DNA (cpDNA) of all section *Rytidospermum* species. (CpDNA is the part of the DNA chromosome that is reponsible for photosynthesis.) By com-

paring the differences in the cpDNA of the various species, they were able to quantify the amount of evolutionary change, measured as molecular divergence, that had taken place between them. The underlying assumption or theory in this method is that the amount of genetic difference is proportional to the amount of time elapsed since the species diverged from their common ancestor, relative to other pairs or groups of organisms being compared. The results of the study team were published in two separate papers in the *American Journal of Botany,* both in 1995. This article attempts to summarize the findings of these researchers and to interpret how molecular data, when used in conjunction with traditional morphological studies, can lead to better understanding of the evolutionary relationships among plants. No attempt will be made in this article to decode the complexities of their analytic techniques, the details of which are treated in the study team's original papers.[4,5]

CpDNA Restriction Site Analysis

Qui, Parks, and Chase used three different laboratory techniques to assess the divergence among *Magnolia obovata, M. tripetala, M. fraseri, M. macrophylla,* and *M. officinalis* var. *biloba* (a variety of *M. officinalis* with notched or bilobed leaves; shown in the tables as *M. biloba*). The first method, cpDNA restriction site analysis, randomly samples changes (between all combinations of pairs of species) over the entire chloroplast genome. The analysis counts the number of site changes encountered, then calculates the cpDNA sequence divergence (as a percentage of sequence divergence) between all species pairs. The results are shown in Table 1.

This analysis clearly shows that *Magnolia tripetala* from eastern North America has diverged far less from the Asian species *M. obovata* and *M. officinalis* var. *biloba* than it has from other North American species. It also indicates that the other North American species have diverged just as much from each other (including *M. tripetala*) as they have from the two Asian species.

Allozyme Electrophoresis

The study team used a second method, allozyme electrophoresis, to examine genetic variation of enzyme-coding genes. This analysis results in the calculation of a parameter called Nei's unbiased genetic identity for each of the species pairings. The numbers are from zero to one, with one being a perfect genetic match. One of the authors, Clifford Parks, suggests that as a rule of thumb, readings greater than 0.90 suggest populations of the same species, while readings less than 0.67 indicate distinctly different species. The results can be seen in Table 2. Though not shown in the table, it should also be noted that Nei's genetic identity for intraspe-

TABLE 1

Species Pair (NA=North American; A=Asian)	% Divergence
obovata (A) vs. *biloba* (A)	0.042%
biloba (A) vs. *tripetala* (NA)	0.083%
tripetala (NA) vs. *obovata* (A)	0.083%
macrophylla (NA) vs. *obovata* (A)	0.378%
fraseri (NA) vs. *tripetala* (NA)	0.414%
fraseri (NA) vs. *obovata* (A)	0.416%
fraseri (NA) vs. *biloba* (A)	0.416%
macrophylla (NA) vs. *tripetala* (NA)	0.418%
macrophylla (NA) vs. *biloba* (A)	0.420%
fraseri (NA) vs. *macrophylla* (NA)	0.457%

TABLE 2

Species Pair (NA=North American; A=Asian)	Nei's Genetic ID
obovata (A) vs. *biloba* (A)	0.897
tripetala (NA) vs. *obovata* (A)	0.809
tripetala (NA) vs. *biloba* (A)	0.712
fraseri (NA) vs. *obovata* (A)	0.444
macrophylla (NA) vs. *tripetala* (NA)	0.423
fraseri (NA) vs. *biloba* (A)	0.419
macrophylla (NA) vs. *obovata* (A)	0.365
fraseri (NA) vs. *tripetala* (NA)	0.321
macrophylla (NA) vs. *biloba* (A)	0.292
fraseri (NA) vs. *macrophylla* (NA)	0.234

cific comparisons was nearly 1.000, as would be expected: the values ranged from 0.993 for *M. obovata* vs. *M. obovata* to 0.932 for *M. macrophylla* vs. *M. macrophylla.*

The results of this second method almost mirror the results of the restriction site analysis, giving very strong evidence of a close relationship between *Magnolia tripetala* and the Asian species and relatively distant relationships among the rest of the species. It is interesting to note that in both analyses the relationship between *M. fraseri* and *M. macrophylla* is the most distant of any of the pairs. Ironically, some texts on North American trees refer to these two species as closely related on account of their similar auriculate (earlobe-shaped) leaf bases.

Chloroplast Gene rbcL Sequencing

Finally, the study team compared *Magnolia tripetala, M. macrophylla,* and *M. obovata* to each other by analyzing (i.e., sequencing) a specific segment of the chloroplast gene called *rbcL.* This analysis involves comparing the 1,432 base pairs of the rbcL gene for each pair of species in the analysis, which in this case is three *(M. macrophylla* vs. *M. obovata, M. macrophylla* vs. *M. tripetala,* and *M. obovata* vs. *M. tripetala).* The results, once again, confirm the findings of the first two analyses, which suggest that *M. tripetala* and the two Asian species form a *clade,* or "sister group." In fact, the sequencing of the chloroplast gene rbcL yielded no divergence between *M. tripetala* and *M. obovata* for that portion of the DNA strand.

The researchers believe that since the results from all three methods have yielded the same pattern of divergence, they can be considered reliable for determining divergence among those *Magnolia* species. They emphasize that "the molecular divergence between *M. tripetala* and its Asian sister taxa, *M. officinalis* var. *biloba* and *M. obovata,* is extremely low—the lowest divergence ever reported for any eastern Asia–eastern North America disjunct taxa." For example, the sequence divergence over the entire chloroplast genome (cpDNA) between *Liriodendron tulipifera* and *L. chinense* was found to be 1.24 percent (as compared to 0.083 percent between *M. obovata* and *M. tripetala*),[3] which is a remarkable difference in that many taxonomists long considered both *Liriodendron* taxa to be varieties of the same species.

The study team speculated how and when *Magnolia tripetala* and its sister species became separated from their common ancestor. One hypothesis is that the common ancestor could have migrated between the continents via the Bering land bridge during one of the earth's warm periods in the middle Miocene (17 to 15 million years before the present) or early Pliocene (6 to 5 million years before the

TABLE 3

Species Pair	% rbcL Divergence	% cpDNA Divergence
obovata (A) vs. *tripetala* (NA)	0.000%	0.083%
tripetala (NA) vs. *macrophylla* (NA)	0.140%	0.418%
obovata (A) vs. *macrophylla* (NA)	0.140%	0.378%

PETER DEL TREDICI

The shared earlobe-shaped bases of their leaves notwithstanding, molecular analysis has shown that Magnolia macrophylla *and, seen here,* M. fraseri *are the most distantly related of the magnolias of section Rytidospermum.*

PETER DEL TREDICI

PETER DEL TREDICI

Molecular analysis of Magnolia macrophylla *var.* macrophylla *(above) and* M. macrophylla *var.* asheii *(below) revealed no differences between the two varieties, despite the greater size of the variety* macrophylla, *which attains sixty feet, as compared to that of variety* asheii, *at twenty-five feet.*

RICHARD B. FIGLAR

JOHN D. TOBE

Above are the leaves of Magnolia fraseri *var.* fraseri, *and below, those of* M. fraseri *var.* pyramidata. *Molecular analysis of these taxa revealed very little separation between them.*

present). Perhaps the answer will come from fossil evidence.[3]

Expanding the Scope of the Study

In a second paper, Qui, Chase, and Parks expanded their phylogenetic study to include restriction site analyses of many pairs of magnoliaceous species, including *Magnolia officinalis* var. *officinalis*, *M. rostrata*, *M. macrophylla* var. *ashei*, *M. macrophylla* var. *dealbata*, *M. fraseri* var. *dealbata*, *M. fraseri* var. *pyramidata*, as well as many others. One result was an extension of the sister relationship among *M. tripetala* and the Asian *M. officinalis* var. *biloba* and *M. obovata* to include *M. officinalis* var. *officinalis* and *M. rostrata* in the group. Summaries of other findings follow:

(1) Though *Magnolia officinalis* var. *officinalis* and *M. officinalis* var. *biloba* are closely related and part of a sister group, they are separated by four restriction site changes, whereas only one restriction site change separated *M. officinalis* var. *officinalis* and *M. rostrata*. This suggested to the team that "full species status for *M. officinalis* var. *biloba* is justifiable," but since delineation of a species depends on examination of samples from across a plant's entire range, they recommend a detailed study of wild populations of all four Asian taxa before any decision is made.

(2) Only one restriction site change separated *Magnolia macrophylla* var. *dealbata* and *M. macrophylla* var. *ashei*, and no change was found between these two and *M. macrophylla* var. *macrophylla*. In this, the study team agrees with the 1979 judgment of botanist Dorothy Johnson Callaway[1] and rejects species status for the varieties *dealbata* and *ashei*.

(3) Similarly, the team rejects species status for *Magnolia fraseri* var. *pyramidata* since they found only one restriction site change between it and *M. fraseri* var. *fraseri*. Also, separate allozyme profiles established in an earlier study of wild populations of *M. fraseri* at low elevations in north Georgia indicated that those plants were intermediate between the varieties *fraseri* and *pyramidata*.[6]

For some, the major finding of this work—the sister relationship between *Magnolia tripetala*

and the Asian species (especially *M. obovata*), comes as no surprise, since these three are the only species that share grooved seed coats (the name *Rytidospermum* means "wrinkled seed") and are highly compatible when cross-pollinated. Phil Savage, an experienced magnolia breeder, has found that of the many crosses he has made between species within section *Rytidospermum*, only those within the sister group were vigorous, worthy hybrids. In fact, where *M. tripetala* grows in close proximity to *M. obovata*, there have been many cases of putative hybrids occurring spontaneously.[8,9] Other crosses made by Savage—*M. tripetala* x *M. fraseri*, *M. obovata* x *M. macrophylla*, *M. tripetala* x *M. macrophylla*, and *M. obovata* x *M. fraseri*—generally produced smaller leaves and flowers than their parents, and all lacked vigor.

Other affinities have been addressed using different morphological characters. Savage speculated that *Magnolia obovata* and *M. fraseri* may be closely related because of their long-beaked, carpelled fruit, which are nearly identical.[7] Some have agreed with that point of view, but others have argued that because all *Rytidospermum* magnolias share a very striking morphological feature—the false whorls of leaves produced at the branch tips—they all must be closely related. However, since molecular analysis suggests a close relationship for only *Magnolia tripetala* and its Asian sister species, perhaps the responsibility for the similar false whorls produced by *M. fraseri* and *M. macrophylla* as well as the similarities in the fruit of *M. fraseri* and *M. obovata* lies in convergent evolution—that is, similar characteristics may have developed in unrelated, or distantly related, plants as each responds to similar conditions.

Molecular analysis as a taxonomic tool is still relatively new, and it brings with it the allure of results that can be stated in precise numbers. But taxonomy is far from a cut-and-dried procedure: no matter how many characters are examined and how much evidence is marshalled in support of a particular position, a taxonomic decision is always a judgment call. As the case with *Magnolia* demonstrates, molecular analysis does promise to help distinguish similarities that result from genetic affinity between species from those that merely reflect similar responses to similar environmental variables, such as climate. But lest false hope be raised, be warned that molecular analysis will not resolve the arguments among taxonomists, nor, certainly, does it offer respite from the frequent name changes that have become such a predictable part of botanical taxonomy.

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Richard Figlar, a past president of the Magnolia Society, has been studying and collecting magnolias for 25 years. He grows more than 125 taxa in his personal arboretum in the foothills of the Blue Ridge Mountains of South Carolina.

Principles of Taste: Book Review

Phyllis Andersen

Accents as Well as Broad Effects: Writings on Architecture, Landscape, and the Environment 1876–1925. Mariana Griswold Van Rensselaer. Selected and edited by David Gebhard. Berkeley: University of California Press, 1996. Hardcover, 367 pages.

With the advantage of hindsight, it might be said that Mariana Griswold Van Rensselaer (1851–1934) led a life of quiet contradiction. She was a noted writer on art, architecture, and landscape subjects; the first biographer of Henry Hobson Richardson and Frederick Law Olmsted.[1] She was thoroughly professional in her work, precise in her negotiations for a proper fee, and never hesitant to ask for timely payment. She was a friend of Charles Sprague Sargent and a valued contributor to his weekly, *Garden and Forest.* Yet Mariana Van Rensselaer was an active opponent of women's suffrage and wrote a popular pamphlet on that subject, "Should We Ask for the Suffrage?" (1894). Her answer was no, women should concentrate on their families and on educational and intellectual matters, leaving business and public affairs to men. Perhaps this was a comment on the politics of her day; to be fair, she was also concerned that new money interests would exploit working women who would be unable to defend themselves.

Until the publication of this collection of her writings, Van Rensselaer's work had fallen into relative obscurity. With the exception of her biography of H. H. Richardson, to which subsequent generations of Richardson scholars invariably pay homage, her work has been treated as that of a rather quaint lady writer who presented to the world the ideas of designers, whom she strongly promoted as "artists." As evidenced by this collection, her work is much richer than that, more nuanced and original. If Van Rensselaer's work has not been given more prominence, it may be because of her commitment to the explication of taste, that illusive predilection for form (and fashion) tightly bound to social class that is just now engaging the attention of the academic community. In the world of serious critical writing, the consideration of taste has often been treated in a patronizing, if not outright contemptuous, manner. But if in popular literature the issue of taste has now become the domain of Martha Stewart and the shelter magazines, it has also become the territory of serious critical battle: Susan Sontag on kitsch, Martha Schwartz on the viability of bagels as garden ornament, and any number of writers on the sociological implications of well-clipped suburban lawns vs. their treatment as wildflower meadows.

Insofar as a concern with good taste is a characteristic of the upper middle class—since both the aristocracy and working class can afford to indulge eccentricity—Van Rensselaer was speaking for a world she knew well. But her writing on taste went well beyond the proper and the decorous to encompass appropriateness as well. Included in this collection is an important essay, "Architectural Fitness," first published in *Garden and Forest* in 1891 (some say at the instigation of Charles Sargent). Her reflection on the quality of stonework and boulders in Central Park and Franklin Park predates the modernist dictum of "truth to materials" but is certainly on the same intellectual path.

Mariana Griswold Van Rensselaer was born in New York City in 1851 to parents well positioned socially and financially to give her a broad, sophisticated education, albeit by private tutor and extensive European travel. The family relocated to Dresden, Germany, when Mariana was still in her teens, and it was there that she met and married Schuyler Van Rensselaer, a young mining engineer and scion of the great New York family. The couple returned to the United States where their only child, George, was born. Sadly, Schuyler Van Rensselaer died

in 1884, followed by their young son only eight years later, and Mariana found herself alone at the age of forty-three. While she had begun to write for publication during the years of her marriage—an activity not wholly supported by her husband—she now recast her life to include serious scholarship and travel in order to further her writing career.

Van Rensselaer's position in American landscape history is firmly established by her 1893 book, *Art Out-of-Doors: Hints on Good Taste in Gardening*. With this publication she emphatically aligned herself with the naturalistic/pastoral landscape movement led by Frederick Law Olmsted, supported by Sargent and with a debt to Andrew Jackson Downing.

> I have assumed that the naturalistic methods of gardening are the most interesting and important to Americans . . . for nature speaks to us more variously and naturally in America than in Europe.[2]

The enemy here was the ornamental style of gardening. The promulgators of carpet bedding ("ugly things of which no sensitive eye can approve") had a strong voice in both public and residential horticulture. The use in public parks of bold-colored plants arrayed in tight, highly organized groups, with no respect for their natural form let alone their natural habitat, was beloved by the public, who borrowed these patterns for their home gardens. Beds of geraniums, coleus, lantanas, heliotropes—any plants that could be manipulated either by the designer or the hybridizer to take on a brighter hue—were filling the great lawns of Newport, the village squares in New England, and, to Van Rensselaer's great dismay, Boston's Public Garden.

> Our public has seen too few good examples to know, theoretically, what it likes in the way of gardening art. Naturally it likes flowers and bright-hued plants of all kinds. When it sees them as they are shown in the Public Garden, it delights in them for their own sakes while it rarely thinks of the general effect of the place. But if it could once see this place as it ought to look, softly green and quiet, enlivened but not confused by a few touches of brilliant color, I am sure it would recognize the improvement, and not mourn the scores of vanished beds.[3]

ARCHIVES OF THE ARNOLD ARBORETUM

Mrs. Schuyler Van Rensselaer in 1927.

Van Rensselaer's biographical essay on Olmsted, originally published in *Century Magazine* in 1893, and included here in its entirety, offers a much more vivid picture of the man than many later works. Suspicious of personal publicity and certainly not garrulous by nature, Olmsted nonetheless met with and maintained a vigorous correspondence with Van Rensselaer, providing her with rich material for her article.

> In answer to a question asked not long ago, Mr. Olmsted said, "The most interesting general facts of my life seems to me to be that it was not as a gardener, a florist, a botanist, or one in any way specially interested in plants and flowers, or specially susceptible to their beauty, that I was drawn to my work. The root of all my work has been an early respect for an enjoyment of a more domestic order—scenery which is to be looked upon contemplatively, and is productive of musing moods.[4]

The late David Gebhard, a noted architectural historian, has done a great service in editing this collection. His introduction surveys her life and gives her work a new importance in American design history, although in the space of an intro-

duction he was not able to delve deeply into the intellectual roots of her work. It is a minor criticism to say that he uses that oddly speculative manner of biographical writing that relies on "she must have . . . ," "expected of upper middle class women," etc. The collection is divided into three sections: Architecture and the Decorative Arts, Recent Architecture in America, and Landscape Architecture and the Environment; while heavily slanted to her writings on architecture—perhaps a reflection of Gebhard's interests—her writings on the context of architectural practice transcend specific disciplines.

> Architecture is a necessary trade as well as an art. Its work must be done, and as nature is not likely ever to give us geniuses in sufficient number to do the whole of it, the second or third rate architect is a very necessary and valuable citizen. All our architectural work cannot be great, but all of it ought to be good; and fair intelligence, earnest study, and conscientious effort may make it good, though only a high artistic gift can make it great.[5]

Van Rensselaer was one of many voices at the end of the nineteenth century calling for the professionalization of many pursuits earlier seen as "crafts." In an important essay, "Client and Architect," she points out the need for an educated client and deplores the limitations placed on the designer by a client with a stubbornly limited vision. She is, as always, protective of the creative force.

> Even apart from competitions, the public's conduct is not what it should be to encourage loyal service. Often enough in all his dealings the client shows a disregard for truth, honesty, and business methods which he would find very shocking were the architect the sinner and he the sufferer. And when the work is complete, he constantly takes credit for good ideas which do not belong to him, blames the architect for defects that his own ignorant demands have brought about, and, above all, cries out against an excess in cost that has been necessitated by changes from the original scheme which he himself has suggested.[6]

In addition to the essay on Olmsted and the short but insightful "Landscape Gardening: A Definition," the landscape section reprints several pieces of local interest. Van Rensselaer summered in Marion, Massachusetts, and her piece on the protection of roadsides was prompted by a concern for the insensitivity of road commissioners and the dreaded linemen in clearing vegetation. ("There seems to be no science or art, no reason or plan in their work.") She acknowledges the difficulty in managing the publicly owned wild border with its thickets of rose, viburnum, and vines as it grows into privately owned lawns, but suggests that a simple appreciation of natural growth could create rural roads as beautiful as any English lane.

This collection of Van Rensselaer's writing has expanded our understanding of the maturing of America's design professions, the period when they cut their close ties with Europe and began to look to our own history and culture for reference points. For the landscape community, one hopes that the collection, positioning Mariana Van Rensselaer among the original thinkers of her period, will lead to the republication of *Art Out-of-Doors*, making this classic text on American landscape gardening accessible once more.

Endnotes

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[5] Ibid., 38.

[6] Ibid., 48.

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"Open to All Real Plant Lovers": Book Review

Judith Siporin

The Bulletins of Reef Point Gardens. Beatrix Farrand. Bar Harbor, ME: The Island Foundation, 1997. Hardcover, 134 pages.

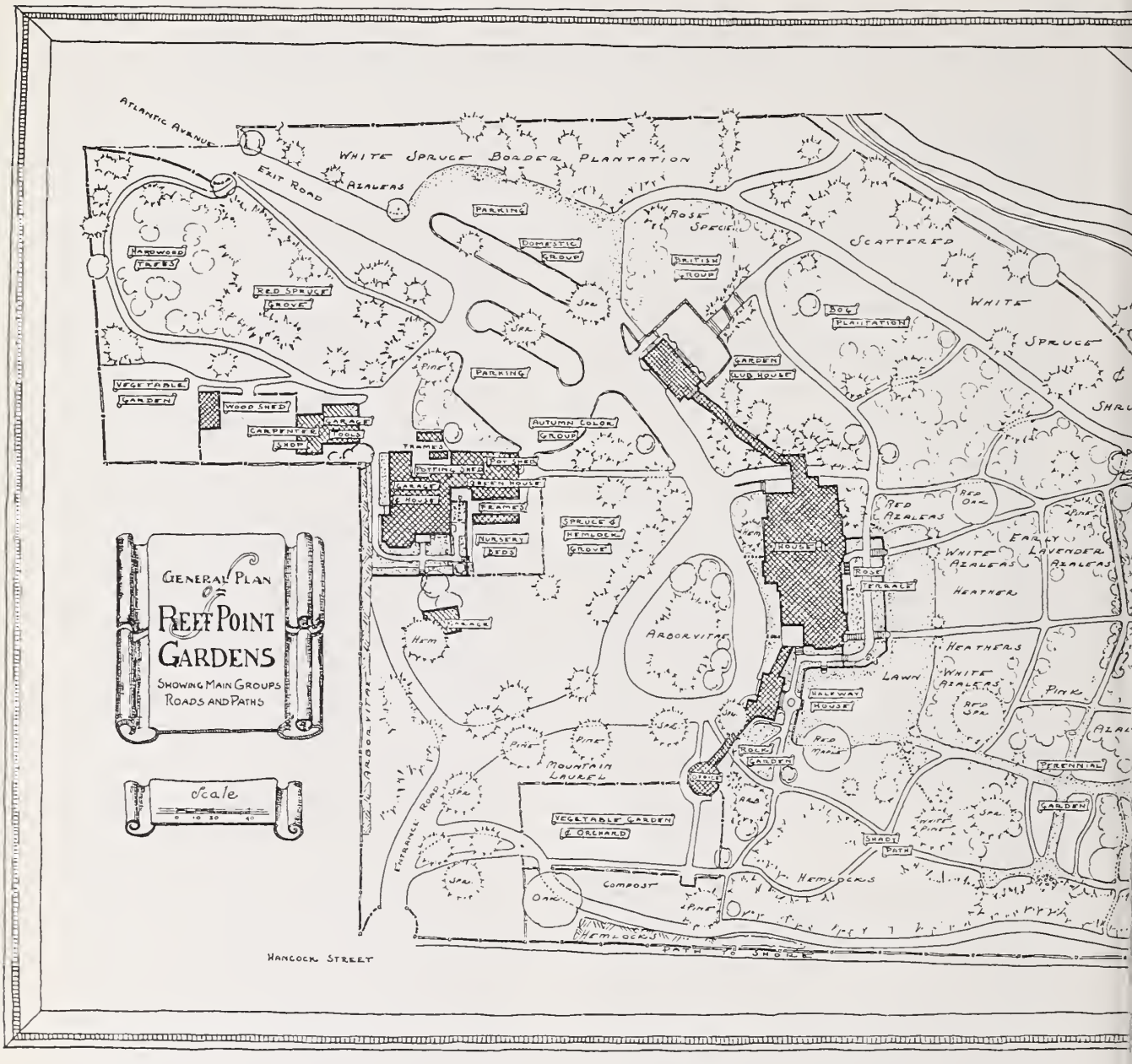
Beatrix Farrand's Reef Point Gardens in Bar Harbor, Maine, were dismantled and her house torn down about forty years ago. The granite gate pillars and giant sentinel spruces that marked the entrance remain on the site, as does the gardener's cottage beyond them, but the flowerbeds and the paths with their strategically placed benches are gone. Only the magnificent views of the Maine coast are unchanged. Farrand accepted the transitory nature of human creations with courage and a total lack of sentimentality: it was she herself who, fearing an uncertain future for the property when she was no longer there to look after it, put an end to her much loved gardens and house. But with the re-publication in one volume of *The Bulletins of Reef Point Gardens*, written by Farrand in the conviction that "words and illustrations outlive many plantations," we can recover a vivid sense of what the garden once was.

The bulletins, seventeen in all, published between 1946 and 1956, were distributed worldwide and could be purchased by visitors to the gardens for ten cents each. Written for the most part by Farrand with help from four staff members who worked closely with her in the gardens, they share a clear, concise prose style grounded in detailed observation of plants and knowledge of their cultivation. They also express devotion to a mission, to creating "a place in the world where those who are moved by outdoor art may study or enjoy books, gardens, birds, and the beauty of sky, sea, colour, and the changing seasons—ever different and yet eternal." The new compilation, a project of the Island Foundation of Bar Harbor, presents the bulletins in chronologically arranged facsimile with an informative introduction by Paula Deitz.

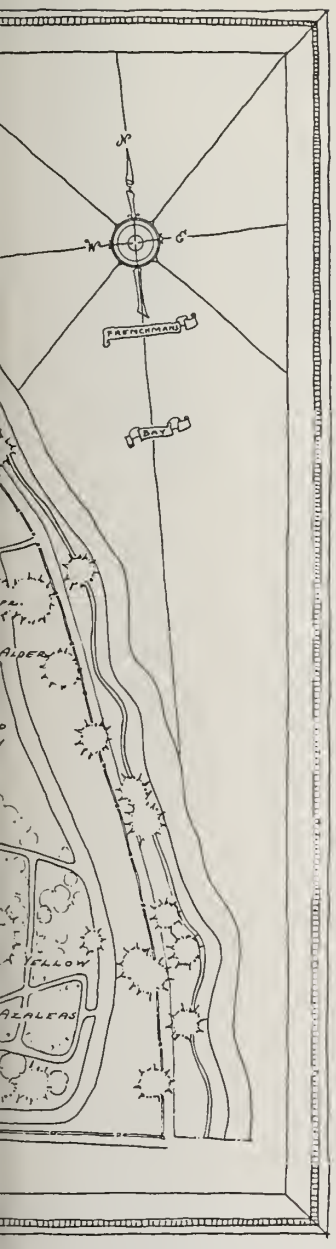
Farrand's ambition at Reef Point was to adapt her parents' picturesque garden and summer house, built at the end of the nineteenth century in the newly fashionable summer community of Bar Harbor, for use as a self-sustaining institution for the study of horticulture and landscape design.

Throughout her career, commissions (including the White House gardens during Woodrow Wilson's administration, the Yale and Princeton campuses, and Dumbarton Oaks) took her away from Maine, but in 1939 the Farrands formally established the Reef Point Gardens Corporation, and her energies became increasingly focused on this personal project. Although her hopes for building an ongoing institution were never fulfilled, her creation became in its day the only public botanic garden in Maine and was said to contain "the finest collection of plants north of the Arnold Arboretum."

Indeed, Farrand owed her own early education in horticulture to the private tutoring of Professor Charles S. Sargent at the Arnold Arboretum. He also encouraged her to enter the field of landscape design, which at that time ordinarily would have been denied to her as a woman, and he recommended her for her first commission. The Arboretum nourished a scientific and scholarly interest in plant collections, which in many respects determined the character of her own garden. Not only were a number of the unusual plants she grew at Reef Point propagated at the Arboretum, but in return she sent to its propagators cuttings from rare plants she had herself collected. She aimed to establish the proper classification and nomenclature, worthy of the best botanic gardens, and to accomplish this relied heavily on the advice of Arboretum staff, who identified more than eighty of her specimens from flowers.



The bulletins define the long-range plans drawn up by Farrand and her husband (a scholar and professor of history) and describe the steps she took toward establishing an institution that could serve a far-reaching community. Some of them focus on specific aspects of Reef Point Gardens: the site and its ancient geological history; the buildings and their redesign to accommodate public visitors; the plan of the grounds; a walking tour; the library with its impressive collection of more than 2,700 volumes, documents, and archival material; the herbarium with over 1,800 pressed and dried specimens collected from the grounds; and the print collection. Some bulletins are devoted to special groups of plants in the garden and their cultivation and maintenance: conifers, single roses, the climbing plants that created what Farrand



termed "vertical beds," heaths and heathers, and native Maine woodland plants. They also include contemporary black-and-white photographs of the grounds and of the house and its interior; detailed plans of the gardens, paths, and roads; plant lists with comments on particular species; and a list of blooming plants month by month. The appendix provides miscellaneous additional material, such as a list of "treasured seeds still intact in envelopes" that Farrand collected from around the world.

The aesthetic aspect of Reef Point Gardens was often closely allied with a scientific one, apparent in the emphasis on exact order and classification, the organization of coherent collections of plants, and the inclusion of natural habitats and their plants. Farrand loved the simplicity and purity of single roses, which she likened to illuminations in a medieval book of hours or to the drawings from nature of Dürer or Leonardo. Nurserymen had told her that these beautiful roses were so far out of fashion that they no longer listed them in catalogs. Farrand's collection was said to be "the most complete group of single hybrid tea roses in this country and abroad"; several varieties were to be found only at Reef Point, having been "almost lost to cultivation." Such a collection could serve as a counterpoise to the dictates of fashion and preserve varieties for posterity.

Farrand makes clear in the bulletins that Reef Point Gardens were made for the serious student of nature and gardens rather than for the casual tourist. She nonetheless took pains to preserve the welcoming character of the house, with its comfortable library and the thirty-foot terrace where visitors could "spend a long afternoon with books and enjoy the quiet harbour view." She offered her garden to the general public "in the hope they will glean some of the pleasure it has given the first owners for over fifty years." Beyond her own property, she left her mark on the wider community by designing over fifty gardens in Bar Harbor, including that of the Rockefellers, and donated a great deal of her time to the planning of Acadia Park, consulting extensively with John D. Rockefeller, Jr., about the plantings to be used along the carriage roads.

In the last bulletin, written three years before her death and intended for use as her obituary, Farrand was at pains to place her accomplishments in the context of her collaborations and other strong alliances. It was especially fitting, then, that when Farrand declared her intention to destroy the gardens, friends found a way to perpetuate her exceptional collection of plants. Charles Savage, the owner of a local inn and a member of the Reef Point Gardens Corporation, designed two gardens in Northeast Harbor to which many of Farrand's plants were moved—"a remarkable feat of plant preservation," according to the introduction. One of these is an azalea garden modeled after a Japanese "stroll garden" with a pool that reflects the carefully composed sequence of colors of the azaleas; proceeds from the sale of *The Bulletins of Reef Point Gardens* will go to an endowment for this garden. Now called the Asticou Azalea Garden, it is, in the words of the sign that marked the entrance to Reef Point, "open to all real plant lovers."

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Arnold Arboretum Weather Station Data — 1997

	Avg. Max. Temp. (°F)	Avg. Min. Temp. (°F)	Avg. Temp. (°F)	Max. Temp. (°F)	Min. Temp. (°F)	Precipitation (in.)	Snowfall (in.)
JAN	36	19	28	52	–1	3.3	10.6
FEB	43	26	35	67	13	2.65	.8
MAR	45	27	36	68	15	4.07	5.57
APRIL	54	35	45	75	23	5.06	28
MAY	67	45	56	81	36	2.69	0
JUNE	84	55	70	97	40	.68	0
JULY	86	57	71	96	56	.54	0
AUG	84	59	72	94	52	2.83	0
SEPT	75	53	64	88	38	1.4	0
OCT	63	40	52	84	24	2.05	0
NOV	47	31	39	66	18	6.19	3.5
DEC	40	24	32	52	12	3.45	7.3

Average Maximum Temperature	60°
Average Minimum Temperature	39°
Average Temperature	50°
Total Precipitation	34.91 inches
Total Snowfall	45.35 inches
Warmest Temperature	97° on June 23
Coldest Temperature	–1° on January 19
Date of Last Spring Frost	16° on April 29
Date of First Fall Frost	30° on October 22
Growing Season	188 days

Note: According to state climatologist R. Lautzenheiser, 1997 was an extremely dry year, tying 1905 as the seventh driest year in 127 years of state weather records. By the end of the year the average precipitation for the state (32.07 inches) was 9.43 inches below normal, the lowest since the 29.39 inches of 1980.

Here at the Arboretum, the precipitation was average or above during only three months, and for six straight months—May through October—it was well below normal. When rain did come, all too often it was in the form of fast, hard showers that could not soak into the ground. Like 1997, 1995 was also a year of severe drought. Add to this the summer droughts of 1993 and 1994, when little rain fell throughout May, June, July, and August, and the result has been a great deal of stress on the living collections in four out of the last five years.

But the biggest weather event of 1997 in terms of records broken and direct effects on the Arboretum was the April Fool's Day Blizzard. Twenty-five inches of wet, cement-like snow driven by gusty winds wreaked havoc on the collections. This storm surpassed the Hurricane of 1938 as the most destructive in our 125-year history. Given the trials of the past year, we can only hope that the old saw about the changeability of New England weather—if you don't like it, wait a minute—will bring us entirely different and better weather in 1998.

Index to Volume 57 (1997)

Numbers in parentheses refer to issues, those in ***boldface*** *to illustrations of the entries.*