Spring 1993

arnoldia

The Magazine of the Arnold Arboretum

arnoldia

Volume 53 Number 1 1993

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

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

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

Karen Madsen, Editor

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

Page

Front cover: *Amelanchier arborea*, downy serviceberry or shadblow, explodes with flowers on Meadow Road. Photo by Al Bussewitz.

Inside front cover: Looking down from North Woods toward Meadow Road. Photo by Rácz & Debreczy.

Back cover: The deeply pigmented flowers of *Kalmia latifolia* f. *rubra*, American mountain laurel. Photo by Al Bussewitz.

Inside back cover: *Fothergilla major*, one of the witch alders, photographed in mid-May by Rácz & Debreczy.

Infinity in a Bottle Gourd: Understanding the Chinese Garden

Kongjian Yu with photos by Peter Del Tredici

As places where humans exercise control over space and nature, gardens can serve as eloquent expressions of cultural ideas. The author offers a model of a fairyland or utopia as a guide to the structure and meaning of Chinese gardens.

Once there was an immortal who lived in a bottle gourd and emerged each morning to sell medicine. Every night he returned to the bottle gourd to sleep. Curious about this strange behavior, a mortal followed him into the bottle gourd. There he found a spacious fairyland with landscapes of unearthly beauty. This story was told by Ge Hong, an important figure in the development of Taoism, in his fourth-century biographies of the immortals, *Sheng Xian Zhuan*, and thus for the Chinese "the world in the bottle gourd" became a synonym for paradise.

A similar bottle gourd space was described by the Tao Yuanming (365-427) in his prose poem Records on the Land of Peach Blossoms (*Tao Hua Yuan Ji*). He told how a fisherman lost his way as he travelled along an unfamiliar stream. Suddenly he is surprised by a pure stand of peach trees stretching along the length of the streambank. The peach forest ends at the source of the stream, at the foot of a cliff. The fisherman spies a small hole in the cliff. A beam of light shines from it, and he leaves his boat to explore the hole. Narrow and rugged at the start, the passage opens out into the light as he penetrates deeper into it. He comes upon a peaceful and flourishing landscape where young and old, all equally comely, play together. He learns that the people of the Land of Peach Blossoms are descendants of refugees from the warring dynasties. They have lived in this isolated world free from intrusion for hundreds of years. Over time the Land of Peach Blossoms (the Heaven of Peace) has become the most influential of Chinese models for utopian society and landscape.

The desire for longevity and peace, or perhaps the fear of death and unrest, are the essential motivations behind these stories, but what interests us here is the structure of their physical settings: An enclosing wall pierced by a narrow hole that leads to a generous space, that is, a bottle gourd model. It is this model that remains the ideal landscape in Chinese culture (Yu 1990a, 1990b). With the model in mind it becomes much easier to understand the "confusion" or "magic" of the Chinese garden that Keswick, Jencks, and other Western writers have remarked on.

The Chinese Garden as an Infinite Hierarchy of Bottle Gourds

Classical Chinese gardens were the monopoly of the elite, a class that has traditionally aspired to scholarly taste in their gardens (Tung 1978). It was Taoism that provided the strongest conceptual framework for garden

Figure 1. The Liu Yuan (Lingering Garden), Suzhou, west of Shanghai.

design: "The Tao (the Way, meaning the Order of Nature) inspired its followers to be profoundly conscious of the process of change in nature. Taoist humility in the face of nature is clearly expressed in the design of landscapes and in the adaptation of buildings to their site. Taoist philosophers, motivated by a desire to obtain peace of mind, were the main advocates of the observance of nature" (Johnston 1991). Thus the ideal landscapes described by Taoist scholars like Tao Yuanming and Ge Hong became the favorite theme of the garden. The bottle gourd model expresses these concepts in visible structure. One of the most famous Chinese gardens, the Liu Yuan (Lingering Garden) in Suzhou, can serve as an illustration of the structure of classical Chinese gardens.

Three distinctive types of gardens developed in China: the smaller private gardens of scholar-officials, the large and extravagant imperial gardens, and gardens associated with temples. The Liu Yuan, with a total area of two hectares, boasts one of the largest scholar gardens in Suzhou, a city famous for the number and beauty of its gardens. It was built between 1522 and 1566 (Liu 1978). A quick visit or a glance at the plan reveals the remote gate, narrow and twisted corridors leading to various enclosed spaces, and most important, the high, solid walls that enclose it. Like Ge Hong's fairyland or the utopian Land of Peach Blossoms, it stands apart from the secular urban landscape. "We can feel a pure atmosphere around our table and chair; the common dust of the world is far from our souls" (Ji 1988).

And yet, a bottle gourd of two hectares or less is too small and too monotonous, ways to

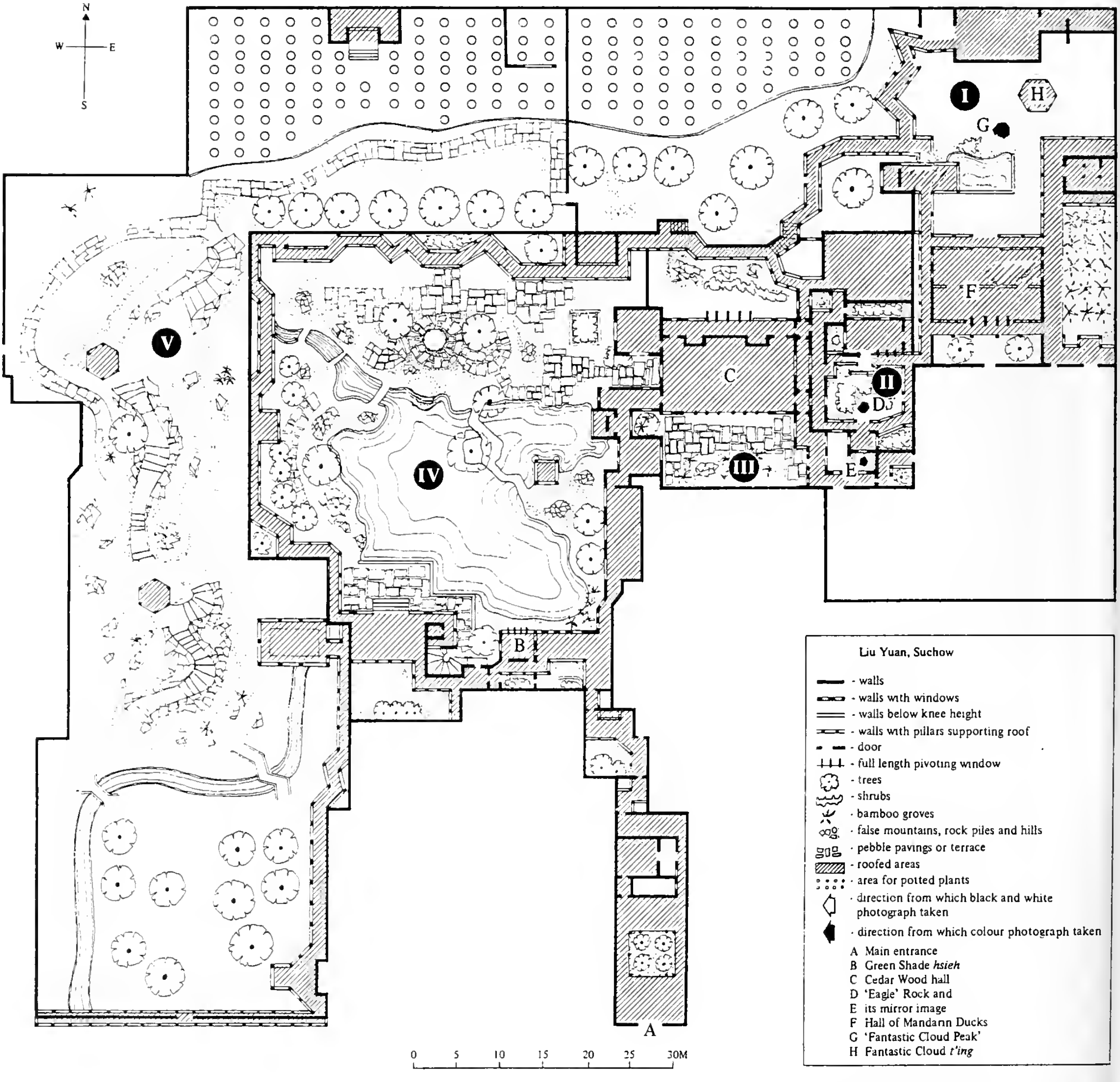


Figure 2. Plan of the Liu Yuan, Suzhou: A hierarchy of bottle gourds. Modified by permission from Keswick 1986.

enlarge and enrich the spaces must be found. One solution is to construct more bottle gourds within it, each with its own theme dominated by certain landscape features. For example, space I is dominated by intricately eroded limestone rocks (Figure 2). Staring at the slim rock (Figure 3), one can imagine a graceful lady, perhaps the owner's favorite daughter, combing her long and elegant hair by the pond, her image reflected in the water. In space II the Eagle Rock forms the main theme (Figure 4) while water dominates space IV.

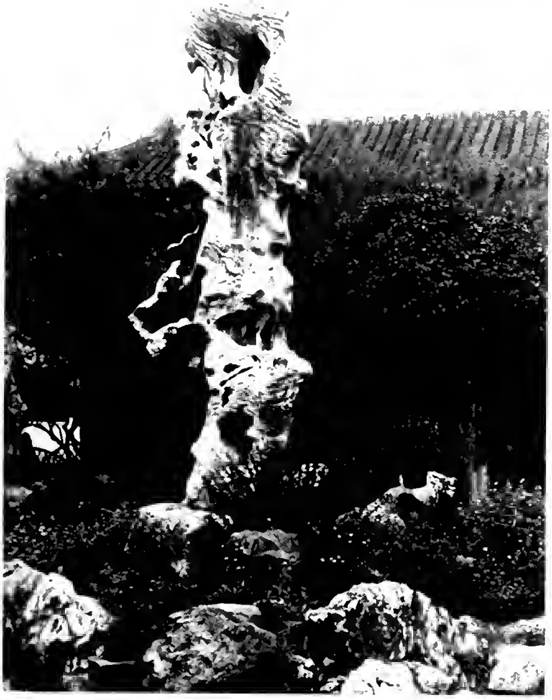


Figure 3. Guan Yuan Peak (Fantastic Cloud Peak). A beautifully water-worn limestone rock comprises the main theme in one of several gardens within the Liu Yuan.

Figure 4. Detail of the Eagle Rock, located in space II. Like other rocks in the Liu Yuan and gardens throughout China, it is of limestone excavated from Lake Tai near Suzhou.

Figure 5. A corridor wall pierced with openings divides the space and yet allows adjacent scenes to leak through, enlarging and enriching the garden, and sometimes, as here, adding three or four layers to the visual experience.

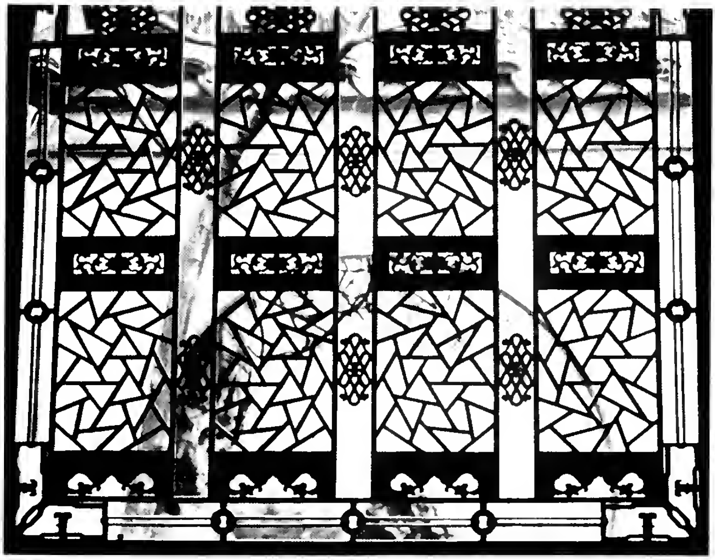


Figure 6. A window pierced in the cracked ice pattern, one of many symbolic patterns used in windows and paths.

Figure 7. Liriope spicata *lines a twisted path that makes the walk longer and the space seem larger.*

Another way to make a small garden feel larger is to borrow scenes from outside the garden. Walls that separate the spaces within the garden are not solid. Pierced with openings of various shapes and configurations, scenes can be stolen from other spaces (Figures 5 and 6). This technique creates a montage of very different landscape elements, creating a scroll of painting out of pieces from a variety of landscapes. This contributes to the powerful and confusing "magic" of the Chinese garden.

A third technique is to avoid straight lines. The simplest law of geometry is that the straight line between two points is the shortest. Thus, twisting the lines of corridors, paths, watercourses, and even the boundaries of buildings makes a space feel larger (Figure 7). And yet another way to enlarge and enrich a space is through reflections in a body of water or simply a piece of mirror (Figure 8). This is the same technique a shrewd storekeeper uses to display his goods.

Thus Chinese classical gardens depict the owners', or rather the scholars', ideal of an abode after the basic landscape model of the bottle gourd. While efforts were made to produce a small isolated refuge, techniques were also invented to make this bottle gourd refuge feel larger and richer. This is one principle for understanding the meaning as well as the structure of Chinese gardens.

References

Jencks, C. 1978. Meanings of the Chinese Garden. In: Keswick, M. *The Chinese Garden: History, Art & Architecture.* 2nd rev. ed. New York: St. Martin's Press.

Ji Cheng. 1988. *The Craft of Gardens.* Translated by Alison Hardie. New Haven: Yale University Press.

Johnston, R. S. 1991. *Scholar Gardens of China.* Cambridge, GB: Cambridge University Press.

Keswick, M. 1986. *The Chinese Garden: History, Art & Architecture.* 2nd rev. ed. New York: St. Martin's Press.

Liu, D. 1978. *Suzhou Classical Gardens* [in Chinese]. Beijing: China Building Industry Press.

Tung, C. 1978. Soochow Gardens [in Chinese with English abstract]. In: Liu, D., *Suzhou Classical Gardens.* Beijing: China Building Industry Press.

Yu, K. 1990a. The ideal environmental model for the Chinese and its ecological origin [in Chinese with English abstract]. *Journal of Beijing Forestry University* 12 (1): 9-16.

Figure 8. Water features mirror the scene and double the space.

Yu, K. 1990b. Exploration of the deep meaning of the ideal Feng-shui landscape model [in Chinese with English abstract]. *Exploration of Nature* 9 (1): 87-90.

Kongjian Yu has studied and taught in the Department of Landscape Architecture of Beijing Forestry University, P.R.C., where he received two national awards for his research and teaching. The ideal landscape model in Chinese culture is a frequent theme in his publications. He is currently studying in Harvard University's Doctor of Design Program, concentrating on planning and design for China's federally protected landscapes.

Plant History: Expanding the Horizons of a Small Garden

Mary Harrison

While waiting for spring, the pleasures of plant history can add another dimension to the pleasures of the garden.

We city gardeners tend to covet the acres enjoyed by the country or even suburban gardener whose every plant whim, we imagine, can be readily indulged. With no space limitations the need to choose carefully and eliminate ruthlessly evaporates. Each new object of desire can be acquired and, within limits, given the best possible living conditions. Not so for us. Each and every plant acquisition must be justified on a very rigorous set of values. No variable can be ignored: color, size, seasonal interest, exposure, prejudice, the family, the neighbors, even the cats.

At the beginning of winter, rather than yearn for plants my plot cannot accomodate, I turned my thoughts to the plants that lay buried in the snow. As individuals appeared in my mind's eye, I realized that I didn't know much about them beyond their physical characteristics and their willingness to survive. I began to make an inventory, thinking perhaps to compare their qualifications, justify their presence. I found my city lot supported quite a large collection. Most of the trees and shrubs, bought as seedlings at Arnold Arboretum plant sales, are barely out of their adolescence and still cause anxiety when any threat to their development is manifest. But their size and age do not reduce the pleasure of observing them gradually acquire some of the characteristics that make their mature brethren so desirable.

As I continued to think and read about this hodgepodge of plants, a new dimension began to absorb me, to transform my attitude to the "collection," and double its interest for me. I have been exploring the origins and history of these plants: When were they discovered and by whom? Where did they originate and who introduced them to the worlds of botany, horticulture, and domestic gardening? Who named them and what factors contributed to those names? Suddenly my diminutive plot seems as large as the world itself. Not only do these trees and shrubs and flowers connect me with all the hemispheres, but they take me back in time and introduce me to the company of gardeners, natural historians, clerics, physicians, illustrators, and botanists, many of whose names are borne by the plants themselves.

These people were part of a long established tradition and a time when professions and occupations were not neatly compartmentalized. The boundaries of explorer, botanist, and geologist were blurred. Politicians might also be gifted illustrators and observers of nature. John White, of the colony of Roanoke, recorded all classes of the animal kingdom he observed, as well as the flora and people of the area. John Smith, of the Virginia colony and friend of John Tradescant, thought of himself primarily as a soldier of fortune, an explorer, and mapmaker. Yet he has left us detailed descriptions of the vegetation, the geography, and geology he observed in North America.

It is our great good fortune that these were glorious days of letter writing and journal keeping, when it was routine to record and comment upon everything new. It was to just such journalists and recorders that I eventually turned for the details of plant histories. As in tracing human genealogy a good starting point seemed to be the origins and meanings of plant names. This proved profitable and very entertaining. Many plants have names that describe features of their structure (*Calycanthus*) or behavior (*Impatiens*); some have names derived from the names of naturalists (*Fothergilla*) or collectors (*Tradescantia*). Although I explored the names of all the plants on my list, it was largely the group whose names are associated with people that most appealed to me, and I began the next stage of the search with *Tradescantia.*

Tradescantia

I referred earlier to the selection process my plants are subjected to, yet I find one of the most interesting and well documented has joined the garden uninvited. Indeed, I see it popping up in sidewalk cracks and intruding in otherwise disciplined perennial borders. I refer to *Tradescantia*, spiderwort, whose blues range from the palest to the deepest in these spontaneous outbursts. It bears the name of John Tradescant (1570-1638), gardener to Charles I and collector of plants in his own Lambeth garden.

John Tradescant traveled in Egypt, Europe, and the East in search of new plants, and his son John (1608-1662) had the good fortune to travel to North America at a time when its vast and diverse vegetation was becoming known to Europeans. As was observed by John Josselyn, a seventeenth-century English visitor and author of *New England's Rarities Discovered*, "The plants of New England for the variety, number, beauty, style, and vertue may stand in Competition with the plants of any Countrey in Europe."

Tradescantia virginiana, *spiderwort. Gerard's* Herball *of 1633.*

John Parkinson (1567-1650), a contemporary collector and writer about seventeenth-century gardens, tells us, "This spiderwort is of late knowledge, and for it the Christian world is indebted unto that painfull industrious searcher and lover of all nature's varieties, John Tradescant." He adds that he "first received it of a friend [John Tradescant, the son] that brought it out of Virginia." Tradescant records receiving another spiderwort in 1633, this one with white flowers. By 1640 a third, with pink and reddish blooms and known as Moses-in-the-Bullrushes, had joined the others in the gardens at Lambeth.

Aquilina multiplex, *Gerard's name for double columbines. Gerard's* Herball *of 1633.*

A companion to these acquisitions was another North American plant, *Platanus occidentalis* L., our native sycamore. In 1640 the younger Tradescant took some form of propagating material of *P. occidentalis* to England from a collecting expedition in North America. Thomas Johnson (1604-1644) noted that "growing in the Tradescant garden were one or two young Asian planes (*P. orientalis* L.)" Some botanists have speculated that a natural hybrid, *P.* x *acerifolia* Aiton, the London plane, resulted from the proximity of the two species. Others think that the Asian plane might not flower freely and thus not produce pollen in England, and that the cross might have been made in a more benign climate and the issue brought to England. Whatever its origins, there is a tradition that the London plane grew in the Tradescant garden. Spiderwort would certainly have been among its companions. Spiderwort and plane, both tough survivors, continue their association on this side of the Atlantic, and the street tree outside my garden provides afternoon shade for its seventeenth-century companion.

Aquilegia

Almost as tenacious as the spiderwort is the columbine, another plant collected by Tradescant in North America and taken by him to England. Parkinson, in *Theatrum Botanicum*, published in 1640, described it as "a plant newly introduced from Virginia by Mr. John Tradescant." It had already appeared in France, having been collected by Jesuits in Canada in 1633.

John Gerard approved of the columbines and recommended they be "sowne in gardens for the beautie and variable colors of the floures." He described their wanton behavior of producing a large range of colors, saying, "these floures are of a colour somtimes blew, at other times of a red or purple, often white or mixt colours." Of the double varieties he says, "The floures thereof be very double, that is to say, many of those little floures (having the form of birds) are thrust one into the belly of another, sometimes blew, often white and otherwhiles of mixt colors, as nature list to plaie with hir little ones." John Parkinson observed the columbine's way of surprising us each year by appearing in new locations and varying hues, and commented, "The rarer the floures are the more trouble to keepe; ordinary sorts on the contrary will not be lost, doe what one will."

Aster

It seems that contemporaries kept very close track of what went on in the Tradescant garden. Gerard noted that "There are kept in the gardens of Mr. Tradescant two starreworts . . . which bear blueish floures . . . said to have come from Canada or Virginia." Indeed, this aster was collected in North America by John Tradescant the Younger. It was first known as *Aster virginiana* and later as *A. tradescantii* L. This was the first of many asters introduced by Tradescant before 1633, and it is not surprising that he remarked, "Sure your country is inexhaustible in asters," a commentary that anticipated Asa Gray's. "Never was there so rascally a genus, they reduce me to despair."

Aster tradescantii grows from southern Nova Scotia to New York and west to Michigan, but not in my garden. *A. novae-angliae* L., the New England aster, continues to be my prime representative. In 1710 it, too, found its way to England. The transatlantic traffic in asters went two ways, and Peter Collinson (1694-1768), who was very active in introducing North American plants to England, sent the "China aster," *Callistephus hortensis* (now *C. chinensis* L.) to his good friend John Bartram in 1735.

Fritillaria imperialis **L.**

A plant with the name *Fritillaria imperialis* would inevitably have a less democratic background than plants with *vulgaris* and *canadensis* in their names, and indeed this proved to be so. It is a native of Persia and the Himalayas and was introduced to Vienna by Carolus Clusius (1526-1609), Director of the Botanical Gardens at Leiden. Gerard knew it as Crowne Imperiall and described it in the section on lilies. (*Fritillaria* was then known as the Chequered Daffodill.) Crowne Imperial reached England in 1596 and by 1597 Gerard had it in his garden "in great plenty." It was on the list of plants in the Tradescant garden by 1634 and came to North America by way of Peter Collinson, who sent seed to John Custis, father of Martha Washington.

According to Parkinson, it "doth grow sometimes to be as great as a pretty bigge child's head, but somewhat flat withal" and "of an orange color." Gerard's description of the nec-

Fritillaria imperialis, *Crown imperial, drawn by Sydenham T. Edwards.* Curtis's Botanical Magazine *1809. By courtesy of the Gray Herbarium Library, Harvard University.*

taries at the base of the petals inspired him to write, in his characteristically lyrical fashion, "In the bottom of each of these bels there is placed six drops of most cleare shining sweet water in taste like sugar, resembling in show sweet orient pearles." These nectaries inspired a story in the plant's Persian homeland. It tells of a queen who was unjustly doubted by her husband. A compassionate angel turned her into *Fritillaria imperialis,* and until the queen is reunited with her husband, her tears remain.

Another legend says fritillaria was too proud to bow with the other flowers as Christ entered the Garden of Gethsemane. When reprimanded, it blushed and hung its head in shame and ever since has had tears in its eyes. But not everyone sees it in the glow of romance. The name Stink Lily has been bestowed on it for the "root being rub'd a little smells as like a Fox, as one Fox smelleth like another." (Parkinson rose to its defense, stressing its "stately beautifulness," adding that the smell was not unwholesome.) More recently Vita Sackville-West described it as a "sullen and foreign looking thing."

Browallia

Seeds of *Browallia* were gathered in the neighborhood of Panama by Robert Millar, who gave them to Phillip Miller of the Chelsea Physic Garden in 1735. He in turn gave a specimen to the Royal Society under the name *Dalea.* Linnaeus named it *Browallia* in honor of his friend Browall, fellow countryman, botanist, and Bishop of bo in Sweden.

An entry in Allen J. Coombes' *Dictionary of Plant Names* provoked a search into the question of the specific names attached to *Browallia.* Coombes states, "*Browallia demissa* (weak). Renamed by Linnaeus from *B. elata* (tall) after falling out with Browall." Further reading revealed that Browall had advised Linnaeus to finish his studies abroad, then marry a rich girl—this despite Linnaeus' engagement to Sara Lisa Moraea. Linnaeus did, indeed, spend the winter of 1737-1738 in Leiden and went on to France. While abroad, he had news that "his best friend B." had taken advantage of his absence to court Sara Lisa Moraea and had almost succeeded in persuading her that her fiance would never return to Sweden. However, the bishop's suit failed; Sara Lisa and Linnaeus were married in 1739.

The entry under *Browallia grandiflora* in *Curtis's Botanical Magazine* of 1831 reports: "The intimacy and subsequent rupture between Browall and Linnaeus were commemorated by the latter in the specific appellations which he bestowed on the only three individuals of the Genus then known. *B. elata* expresses the degree of their union; *B. demissa* its cessation; while the ambiguous name of a third species, *B. alienata,* while it intimates the uncertain characteristics of the plant, implies the subsequent difference between the two parties." Much to my regret I have so far

Browallia demissa, *spreading browallia, drawn by Sydenham T. Edwards.* Curtis's Botanical Magazine *1808. By courtesy of the Gray Herbarium Library, Harvard University.*

not tracked down any other reference to *B. alienta.*

Calycanthus floridus L.

This shrub is one of the great number of plants John Bartram (1699-1777) brought back from his many collecting trips. A farmer by occupation, Linnaeus considered him "the greatest natural botanist in the world." His interest in botany led to an active role as agent, collecting and exchanging seeds and plants with notable clients in England. Peter Collinson, the prosperous English merchant, was among his most enthusiastic recipients. In 1765 Bartram became Botanizer Royal to King George III, and in addition to this honor, received a small stipend.

Calycanthus floridus, Carolina allspice, had neither flowers nor seeds when Bartram came upon it in South Carolina, so he wrote a description of its location to Samuel Wyly, an Irish Quaker in whose house he had been staying before setting out on this collecting trip, and asked for his help. Wyly sent Bartram a plant that grew vigorously in his garden at Kingsessing, Pennsylvania. Seeds were sent to friend Peter Collinson in England, and calycanthus was blooming in his garden by 1763.

Alexander Garden (1730-1791), a Scottish physician who settled in Charlestown in 1752, said of calycanthus, it diffuses "an aromatic fragrance seemingly of strawberry, pineapple, and the clove, called sometimes by the name of Bubby Blossoms from ladies often carrying them in their bozoms." Garden first referred to it as *Buereria,* or *Frutex cornifoliis,* the sweet shrub. This last name was used by Mark Catesby, the English naturalist, collector, and artist, to accompany the illustration of calycanthus that he included in the first volume of his *Natural History of Carolina, Florida, and the Bahama Islands.*

John Ellis, an Englishman who corresponded with Garden and received new plants from him, wrote to Linnaeus suggesting the plant be called *Gardenia,* but Linnaeus declined. He

Calycanthus floridus, *Carolina allspice, drawn by Sydenham T. Edwards.* Curtis's Botanical Magazine *1801. By courtesy of the Gray Herbarium Library, Harvard University.*

did, however, suggest that Garden send him a new genus from North America so that he could name it *Gardenia.* This request went unheeded at the time.

Calycanthus also escaped being called *Basteria,* which Phillip Miller of the Chelsea Physic Garden wanted to name it in 1753, "in honor of his worthy friend, Dr. John Baster." Eventually Linnaeus gave it the botanical description *Calycanthus*, which means calyx flower, "because the sepals and petals are indistinguishable."

Fothergilla

The first recorded collection of *Fothergilla*, the witch alder, was made by Alexander Garden. He found it in the Carolinas and thought it was a new genus, which he called *Anemelis*. He sent information concerning it to Linnaeus in 1765 and later dispatched specimens both dried and pickled "in spirits of wine."

Linnaeus thought it was a species of *Hamamelis*, and a series of letters passed between the two men between 1765 and 1773 in which they argued over the classification of the witch alder. Garden finally prevailed in establishing it as a new genus, but it was named *Fothergilla* by Linnaeus after Dr. John Fothergill (1712-1780), an English philanthropist with a lifelong interest in natural history. In 1773 Garden wrote to Linnaeus, "I am very glad that the most elegant shrub, called by me *Amemalis*, has at length obtained its proper place, for I was much afraid that it must have submitted to range under the banner of another."

Linnaeus never published a formal description of the witch alder. The founding of the genus and the formal description is attributed to J. A. Murray (1740-1791), a pupil of Linnaeus, who revised a portion of Linnaeus' work. Garden's name, however, was given to the species *Fothergilla gardenii* Murray. Fothergilla was grown in the Bartram's garden under the name of *Gardenia* about the year 1785, the first fothergilla recorded in cultivation in North America.

Hypericum

Hypericum, St. Johnswort, was briefly another candidate for the name *Gardenia*. After a stay with Dr. Cadwallader Colden on the Hudson River, near Newburg, New York, Alexander Garden travelled south to continue his observations and acquisitions of new plants. About a mile from New York City on his way to Pennsylvania, Garden found a plant he thought to be a *Hypericum*. He sent a description of it to Jane Colder, the daughter of Cadwallader and herself a collector and documenter of plants. She was familiar with it but had it filed in her collection only under the identification "Number 152." She told Garden that, "using the privilege of a first discoverer," she would name the plant *Gardenia* in his honor. The plant was demonstrated not to be a new genus and was indeed a *Hypericum*.

Garden's name was finally attached to a plant that was unfamiliar to him—the "Bay leaved Jasemin," acquired by a Captain Hutchinson who found it at the Cape of Good Hope, a plant with "the most wonderfull fine smell and large double white flowers."

This naming process was an experience in part shared by Bartram. He, too, was unfamiliar with the *Bartramia* named for him. It was a native of Florida and was subsequently placed in another genus, one species of which retained *bartramia* as a specific name. The genus name was later revived and applied to a genus of mosses. Bartram originally regarded mosses "as a cow looks upon a pair of new barn doors," but eventually he "made good progress in that branch of Botany, which really is a very curious part."

Kalmia latifolia L.

In 1748 Peter Kalm (1715-1779), Finnish botanist and pupil of Linnaeus, came to North America to collect plants that might be suitable for cultivation in the Scandinavian climate. He found and admired an evergreen plant whose flowers "rival that of most of the known trees in nature." Its most common name is mountain laurel, but it is also known as spoonwood, a name linked to the Indian practice of making spoons and trowels from the wood of the root. When dug, the root was easily worked but became hard and smooth when dry. In spite of its beauty, the plant is said to be so toxic that even the nectar secreted by the flowers is suspect. One wonders with what consequences mountain laurel spoons were used, and

Kalmia latifolia, *mountain laurel.* Curtis's Botanical Magazine *1792. By courtesy of the Gray Herbarium Library, Harvard University.*

whether a connection was ever established between their use and the longevity of their users.

Mark Catesby had seen this plant during his travels in Carolina and in 1726 imported both seeds and plants to England where it initially proved difficult to propagate. However, Peter Collinson had success with plants he requested of Colonel John Curtis of Virginia in 1736. Apparently his plants came from a more northerly part of America than Catesby's. It is possible that Kalm, having visited Collinson's garden on his way to America in 1748, saw mountain laurel in cultivation before he collected it in the wild.

Kalm met Bartram on his travels and recorded in his notebook his impressions: "We owe to him the knowledge of many rare plants which he first found and which were never known before. I also owe him much, for he possessed that great quality of communicating everything he knew. I shall therefore in this work, frequently mention this gentleman." On Kalm's return to England Bartram continued to supply him with seeds, but Kalm, when he catalogued his collection of new plants, failed to acknowledge the great help he had received from Bartram, who was justifiably disappointed.

Stewartia

In 1687 the Reverend John Clayton located the first plants of stewartia near Williamsburg, Virginia. The population from which he gathered specimens is still in existence. This species, *S. ovata* (Cavanilles) Weatherby, was also observed in the Carolinas by Andre Michaux (1766-1803), botanist to Louis XVI. He had come to North America in search of plants and was especially interested in American trees to replenish the French forests and birds to populate them.

In 1742 another John Clayton (1686-1773), whom Jefferson called "the first American botanist," sent to Mark Catesby in England plants of another stewartia, *S. malacodendron* L., a native of the coastal plain from Virginia to northern Florida. Catesby reported, "For this elegant plant I am obliged to my good friend, Mr. Clayton, and three months after its arrival it blossomed in my garden at Fulham." Dried herbarium specimens of Clayton's stewartia ultimately reached Linnaeus, who founded the genus *Stewartia.* He named it for John Stuart, Earl of Bute, acknowledging his efforts to establish a botanic garden at Kew.

The most commonly cultivated species of stewartia grown in North American gardens is *S. pseudocamellia* Maximowicz probably because of all the stewartias its exfoliating bark is considered the most attractive. It was introduced by Thomas Hogg (1820-1892), a first-generation American who was sent to Japan on a diplomatic mission by Abraham Lincoln. Like many of his collecting predecessors, Hogg man-

Botanical Illustration

Perhaps next winter's diversion will be the history of botanical illustration, a wonderful and vast subject scarcely touched upon in this essay. The art as we know it appeared in the West in the early Christian era, in the form of illustrated manuscripts on the medicinal use of plants. John Gerard (1545-1612), a practicing surgeon, gardener, plant collector, and herbalist, published his *Herball or Generall Historie of Plants* in 1597. It contains eighteen hundred woodcut illustrations, printed mostly from blocks used in previous herbals. In 1633 a second edition was published, "corrected and amplified" by Thomas Johnson (1604-1644), an apothecary, botanist, and publisher. This edition included three hundred newly discovered plants from the New World and is the edition most frequently cited. It was one of three herbals, Culpeper's and Parkinson's being the others, that seventeenth-century settlers in New England consulted.

Curtis's Botanical Magazine was the creation of William Curtis (1746-1788), an apothecary who forsook that business to follow his interest in botany. Aiming to describe and illustrate the great eighteenth-century influx of plants to Europe, Curtis established his magazine in 1787 and remained its editor until his death in 1799. William Jackson Hooker (1785-1865) took over the direction and illustration of the magazine in 1826. When he became Director of the Royal Botanical Gardens at Kew, a connection between the two institutions was forged. In 1904 the text of the magazine began to be written by a number of writers instead of solely by the editor. When in 1922 the magazine fell into financial trouble, it was taken over by the Royal Horticultural Society. In 1970 the copyright was transferred back to the Royal Botanical Gardens at Kew, and since 1984 it has been incorporated into *Kew Magazine.*

The earliest plates in Curtis's Botanical Magazine were hand-colored engravings. This method was replaced by lithography in 1845, and hand coloring, surprisingly, ceased as recently as 1948, to be replaced by offset lithography. Among the most notable of the artists whose work appeared in the magazine is Sydenham Teast Edwards (1769?-1819). Son of a Welsh schoolmaster, Edwards was brought to London for further instruction in art by William Curtis after he was introduced to some of Edwards' drawings. They became companions on botanical expeditions, and in 1788 Edwards' first plate for the *Botanical Magazine* was published in the second volume. In the next twenty-seven years almost all the drawings in the magazine were his. In 1815 Edwards left the *Botanical Magazine* to establish a rival publication, *The Botanical Register.*

Walter Hood Fitch (1817-1892), a young apprentice to a firm of Glasgow calico designers whose first plate was published in 1834, became the magazine's sole artist, illustrating it until 1877. Sir Joseph Hooker described him as "an incomparable botanical artist" with "unrivalled skill in seizing the natural character of a plant." Walter's nephew, John Nugent Fitch, lithographed nearly twenty-five hundred drawings for the magazine. He also illustrated *The Orchid Album* (1882-1897), now in London's Natural History Museum.

aged to combine his political and horticultural interests. On the death of his father, he and his brother had taken over his nursery in New York City, and it was to add to their increasing collection of Japanese plants that Thomas Hogg introduced the Japanese stewartia.

Stewartia ovata (then S. pentagyna) drawn by Walter Hood Fitch. Curtis's Botanical Magazine 1842. By courtesy of the Gray Herbarium Library, Harvard University.

Stewartia pseudocamellia leads me out of the nineteenth century into the present, out of the safety of winter history into the horticultural reality of spring. Has my stewartia survived the winter? Will it outgrow the problems that threatened it last fall?

It has been an enlightening sojourn in the company of people I was inclined to romanticize, for the names summoned up visions of benevolent gardeners in smocks and of gallant and intrepid collectors, all sharing their common interest and plants in harmony. In reality, of course, they partook of the full range of human attributes and frailties: The generous and dedicated are easily exploited; the arrogant complacently ignore those they have depended on; one-upmanship and political contrivance abound. But the delight in the enterprise is none the less for that. Among them were writers able to convey the excitement of their discoveries and artists who documented, often with exquisite skill, their observations in a language universally understood. Through them it is possible to appreciate the long journey many plants have taken before settling comfortably in our gardens among representatives of other times and other continents.

Bibliography

Bailey, L. H. 1976. *Hortus Third: A Concise Dictionary of Plants Cultivated in the United States and Canada.* New York: Macmillan Publishing Co.

Berkeley, E., and D. S. Berkeley. 1969. *Dr. Alexander Garden of Charles Town.* Chapel Hill: University of North Carolina Press.

——— 1982. *The Life and Travels of John Bartram: From Lake Ontario to the River St. John.* Tallahassee: University Presses of Florida.

Blunt, W. 1950. *The Art of Botanical Illustration.* London: Collins.

——— 1971. *The Compleat Naturalist: A Life of Linnaeus.* New York: The Viking Press.

Brickell, C., and F. Sharman. 1986. *The Vanishing Garden: A Conservation Guide to Plants.* London: John Murray.

Brickell, C. 1989. *The Royal Horticultural Society Gardeners' Encyclopedia.* London: Dorling Kindersley.

Coats, A. M. 1956. *Flowers and Their History.* London: Hulton Press Ltd.

——— 1992. *Garden Shrubs and Their Histories.* New York: Simon and Schuster.

Coombes, A. J. 1985. *Dictionary of Plant Names.* Portland, OR: Timber Press.

Desmond, R. 1977. *British and Irish Botanists and Horticulturalists.* London: Taylor & Francis Ltd.

Dirr, M. A. 1990. *Manual of Woody Landscape Plants.* 4th rev. ed. Champaign, IL: Stipes Publishing Co.

Downe, M. A., and M. Hamilton. 1980. *And Some Brought Flowers: Plants in a New World.* Toronto: University of Toronto Press.

Fisher, J. 1982. *The Origin of Garden Plants.* London: Constable and Co., Ltd.

Gerard, J. 1633; 1979, rev. ed. *The Herball or Generall Historie of Plants.* New York: Dover Press.

Heywood, V. H. 1985. *Flowering Plants of the World.* Englewood, NJ: Prentice-Hall, Inc.

Hooker, W. J. 1831. Browallia Grandiflora, Large-Flowered Browallia (3069).*Curtis's Botanical Magazine.* Vol. V, New Series (or Vol. LXVIII).

Leighton, A. 1976. *American Gardens of the Eighteenth Century.* Boston: Houghton Mifflin Co.

——— 1970. *Early American Gardens.* Boston: Houghton Mifflin Co.

Leith-Ross, P. 1984. *The John Tradescants, Gardeners to the Rose and the Lily Queen.* London: Peter Owen.

Loudon, J. C. 1854. *Arboretum et Fruticum.* Vol. I. London

McClintock, D. 1966. *Companion to Flowers.* London: G. Bell & Sons, Ltd.

Olmsted, F. L., F. V. Coville, H. P. Kelsey. 1923. *Standardized Plant Names.* American Joint Committee on Horticultural Nomenclature. Salem, MA.

Smith, A. W. 1963. *A Gardener's Book of Plant Names.* New York: Harper and Row

Spongberg, S. A. 1990. *A Reunion of Trees.* Cambridge, MA: Harvard University Press.

——— and A. Fordham. 1975. "Stewartia—Small Trees and Shrubs for All Seasons." *Arnoldia* 35 (4): 163-180.

Stafleu, F. A. 1971. *Linnaeus and the Linnaeans: The Spreading of Their Ideas in Systematic Botany, 1735-1789.* Utrecht: A. Oosthoek's Uitgeversmaatschappij N.V.

Stearn, W. T. 1990. *Botanical Latin.* 3rd rev. ed. North Pomfret, VT: David and Charles

Still, C. 1975. *Classical Plants.* London: Hamlyn Publishing House.

Stuart, D., and J. Sutherland. 1987. *Plants From the Past.* New York: Viking Penguin Inc.

Trehane, P. 1989. *Index Hortensis: Vol. 1. Perennials.* Wimborne, GB: Quarterjack Publishing.

Wright, M. 1984. *The Complete Handbook of Garden Plants.* New York: Facts on File Publications.

Wyman, D. 1987. *Wyman's Gardening Encyclopedia.* New York: The Macmillan Company.

Mary Harrison is a volunteer in the herbarium of the Arnold Arboretum. Since her retirement from teaching, she has devoted full time to her lifelong interest in horticulture.

NEWS

from the Arnold Arboretum

Endowment for Endangered Plants

Robert E. Cook, Director

Nearly a decade ago the Arnold Arboretum was home to the birth of the Center for Plant Conservation (CPC). This organization was conceived to facilitate a collaboration between selected botanic gardens around the country for the preservation of endangered plant species. It was a simple idea. Each participating garden would bring into cultivation a genetic sampling of endangered species capable of growing in its region. This collection would preserve the germplasm of each species and provide the basis for reintroduction into the wild, should the species become extinct in its native habitats. The Center would raise funds to support the maintenance of the national collection and to establish an endowment for future maintenance.

Prunus alleghaniensis by C. E. Faxon.

In the Hunnewell Visitor Center, the Arnold Arboretum provided a home for the administrative operations of the national headquarters of CPC for the early years of its operations and growth. Over the years the Arboretum has brought into its collection a total of twenty-one species.

When administrative space at the Arboretum became a critical resource for the Center in 1991, it reached a decision to relocate to the Missouri Botanical Garden to receive direct administrative support as part of the Garden. The Center also launched a nationwide fundraising campaign to endow its national collections, and it encouraged participating gardens to support this effort.

With this endowment need in mind, I approached a group of our volunteers, known as the Arnold Arboretum Associates, to solicit their support for endowing the collection of endangered plants at the Arboretum. In December they made a magnificent gift to us which,

Continued on page 2

Endangered Plants at the Arnold Arboretum

Abies fraseri	Fraser fir
Amelanchier nantucketensis	Nantucket shadblow
Buckleya distichophylla	Piratebush
Clematis viticaulis	
Conradina verticillata	Cumberland rosemary
Corema conradii	Broom crowberry
Diervilla rivularis	Bush honeysuckle
D. sessilifolia	Southern bush honeysuckle
Fothergilla major	Mountain witch alder
Galussacia brachycera	Box huckleberry
Ilex collina	Holly
Leiophyllum buxifolium	Sand myrtle
Magnolia pyramidata	Pyramidal magnolia
Paxistima canbyi	Canby paxistima
Prunus alleghaniensis	Allegheny cherry
Rhododendron austrinum	
R. prunifolium	Plum-leaf azalea
R. vaseyi	Pinkshell azalea
Spiraea virginiana	Bridal-wreath
Torreya taxifolia	
Viburnum bracteatum	Bracted viburnum

A Fund-Raiser for the Children's Field Study Program

On March the Boston Junior League Garden Club hosted two events to benefit the Children's Field Study Program. On both occasions Gerald Allan Doell and M. Christine Klim Doell, garden historians and landscape preservation planners, presented a slide lecture, A Garden in Good Order, Two Centuries of Garden-Making at the White House, that traced the evolution of the "President's Square" from rubble-strewn expanse to romantic landscape. The Boston Junior League Garden Club has worked to support children's field studies at the Arnold Arboretum since 1984. Coordinated with the Boston Public School Science Curriculum, the program serves more than 3,000 elementary schoolchildren and teachers each year. Thanks to the efforts of the Boston Junior League Garden Club, the Arboretum Committee, and other local organizations, the program is now entering its tenth year of operation.

Endowment for Endangered Plants

Continued from page 1

when matched by grant funds at CPC, will completely endow the Arboretum's collection for the future. We are immensely pleased, and deeply appreciative, of the generosity of the Associates. This gift, and the endowment it creates, ensures a future for these critically endangered plants.

Al Fordham

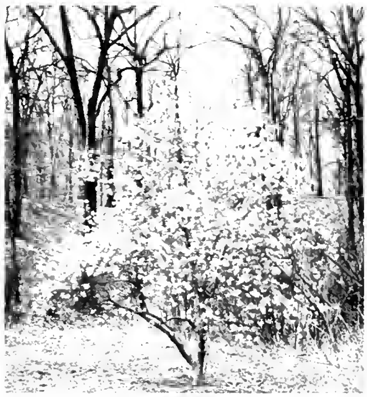
Al Fordham Named Fellow of IPPS

Alfred J. Fordham, Arnold Arboretum Research Horticulturist, retired, whose career at the Arnold Arboretum began in 1929 as a student trainee, has been named by the Eastern Region of the International Plant Propagator's Society to their second class of Fellows. During twenty of his nearly fifty years at the Arboretum Al carried the title of Plant Propagator. He continues to pursue research interests, especially seed dispersal mechanisms and abnormal growth in trees.

Spring Plant Dividend

Each year the Friends of the Arnold Arboretum are invited to enhance their own gardens with a membership benefit, the Spring Plant Dividend. This year more than 2,500 bare-rooted cuttings of *Magnolia* x *loebneri* 'Leonard Messel' were carefully packaged and shipped, thanks to the efforts of volunteers Frank and Doris Ahearn, Richard Brooks, Louise Cies, Dorick Corbo, Charles Doherty, Helen and Lillian Hagopian, George Hibben, Isabel Horan, Sophie Kulik, Dan Linehan, Nod Meyer, Eileen McNeil, Abby Nelson, Pauline Perkins, Joan Poser, Bob Reed, Bob Reynolds, Robert Siegel, Doris Smith, and Loretta Wilson; Arnold Arboretum interns Joan Mullins and Jason Diauto; and staff members Jim Gorman, Mike Gormley, Jim Papargiris, Richard Schulhof, and David Seiks.

A fragrant and beautifully flowering tree, visitors to the Arboretum can see a mature specimen by Meadow Road. It should be in bloom in early May, and it will be featured at our Annual Plant Sale in September.



Magnolia x loebneri 'Leonard Messel', the Spring Plant Dividend, photographed at the Arnold Arboretum by Rácz and Debreczy.

(photo top left) Recipients of the Certificate in Gardening Arts and their advisors. (photo bottom right) Richard Schulhof presents Elizabeth Ann Fagan with her Certificate in Gardening Arts as Jack Alexander looks on.

Photo by Marcia Mitchell.

Certificate in Gardening Arts Ceremony Held at Faculty Club

On November 12, twenty-one students received Certificates in Gardening Arts from the Arboretum. A luncheon and graduation ceremony was held in their honor at the Harvard Faculty Club, with remarks by Gary Koller, Senior Horticulturist at the Arboretum, and Richard Schulhof, Assistant Director for Education and Public Affairs.

Photo by Marcia Mitchell.

Certificate recipients were James M. Bilderback, Mary Buscher, Judith Lang Day, Judith Dembsey, Diana Demuth, Caroline G. Donnelly, Frances Doyle, Elizabeth Ann Fagan, Matthew P. Giroux, Mary Harrison, Roberta Jean Hodson, Keith Kurman, Mary DeBlasi Mady, Margaret W. Millar, Madeleine Messina, William Noble, Christine O'Connor, Linda O.-Finer, Catherine Schwenk, Denise Stiller, and Mary Faith Wilson. The Arboretum thanks student advisors Paul Martin Brown, Laura Eisener, Darrell Probst, and Ruthanne Rogers.

This spring National Park Service Rangers (from left to right) Alan Banks, Chris Lamond, and Tim Maguire will lead tours of the Arboretum landscape. Sponsored by the Frederick Law Olmsted National Historic Site in Brookline, the program will explore the Arboretum's rich design history with a focus on the contributions of Olmsted and Charles Sprague Sargent. The tours are part of the Arboretum's ongoing collaboration with the Olmsted Site and will be offered, free of charge, beginning at 2:00 PM on May 1, 8, 15, and at 5:00 PM on May 29 and June 5. For more information, call 566-1689.

Celebrate Roses in the Bradley Rose Garden

Each year since its installation in 1985, the Bradley Rose Garden has become more beautiful, the species roses more graceful and floriferous. On June 13, from 10:00 AM to 3:30 PM, the Education Department will offer talks, slide presentations, and walks among the roses with rose experts from the Arboretum, who will be joined by Stephen Scanniello, Rosarian of the Brooklyn Botanic Garden. Mr. Scanniello joins us just prior to his departure to serve as chairman of judges at the rose trials in Bagatelle, France.

Luncheon will be served in the Rose Garden following the morning of talks, after which the Arboretum's own rose care specialist will provide a demonstration of proper pruning techniques for species roses. The afternoon will end with a stroll among the roses, an informal discussion of the species roses in the garden and the other members of the rose family that grow nearby.

Among the roses that are expected to be at their best at this time are *Rosa gallica, R. multiflora, R. pimpinellifolia, R. roxburghii, and R. hugonis.* The speakers will describe the hybrid descendants of these and other species that thrive in the New England climate, providing outstanding bloom with little of the chemicals and work that roses often require. *Sunday, June 13, from 10:00 AM-3:30 PM. Call the Education Department, 524-1718, ext. 162, to register. Preregistration required.*

Rosa gallica 'Versicolor'.

Why Are Bonsai Leaves Small?

Robert E. Cook

The Japanese term *bonsai* translates literally as "planted in a container," but in popular usage it also denotes any ornamental plant that is dwarfed by means of pruning.

It seems obvious that plants, unlike most animals, do not have a brain. But it is not so clear where they make those critical decisions that govern their lives. You who garden certainly know that plants have a mind of their own. Given that humans, and the majority of animals, solve many of their stressful problems (say, hunger) with a change in behavior (foraging for food), where are these decisions made in plants?

An intriguing, and visually pleasing, example of such decision-making can be seen in bonsai. These dwarfed trees, which have suffered severe pruning, bondage by wire, and permanent confinement in a small ceramic pot, respond by forming a canopy of miniature leaves that are essential to the aesthetic of this Asian art.

It need not be this way. One could imagine a tiny tree, rooted in shallow soil, with its slender limbs sprouting foliage of normal or nearly normal size, as though someone had planted a well-shaped branch. It would hardly qualify as the elegant and delicate creation characteristic of a refined horticultural sensibility.

In fact, the bonsai leaves of deciduous species may be thirty to fifty times smaller, while conifer leaves or needles are one-fifth or one-eighth the size of those on trees growing unconstrained in the ground. So why are the leaves of bonsai plants so small?

The compact Hinoki cypress, Chamaecyparis obtusa *'Chabo-hiba', in the "octopus" shape, started in Japan in 1787, part of the Larz Anderson Bonsai Collection at the Arnold Arboretum. Often grown in containers and intensively pruned, this cultivar responds by producing congested, planar foliage and contorted, horizontal branches. Photo by Rácz and Debreczy.*

The Modular Organism

The answer can be sought in an understanding of how leaf size in general is determined. Like most living organisms, the body of a plant consists of different kinds of very small cells arrayed in combinations of types to form organs such as roots or leaves. Plants, however, grow and develop in a way fundamentally different from animals, especially higher vertebrates. In a population of rabbits, for instance, one can determine the size of the population by counting the total number of ears and dividing by two. In general each individual has a very predictable number of any kind of organ: one liver, two eyes, ten toes. That number is determined in the embryo and remains the same throughout growth and maturation.

Plants, on the other hand, are modular organisms. The basic unit of construction, so to speak, is the leaf, with an associated bud capable of growing as a branch and a section of stem connecting the leaf and bud to the other units of the plant. Similarly the root is really an interconnected network of branched, growing root tips. New modules are continually produced by growing shoot tips where decisions about size and shape are made at the time of module construction.

Unlike many animals, plants have no fixed adult size and can continue increasing their stature throughout life through the generation of more modules, each of which is more or less the same size whether produced at the age of twelve or one hundred and twelve. The number of such organs, however, depends upon the history of growing conditions experienced by the individual. It can potentially increase throughout the life of the plant.

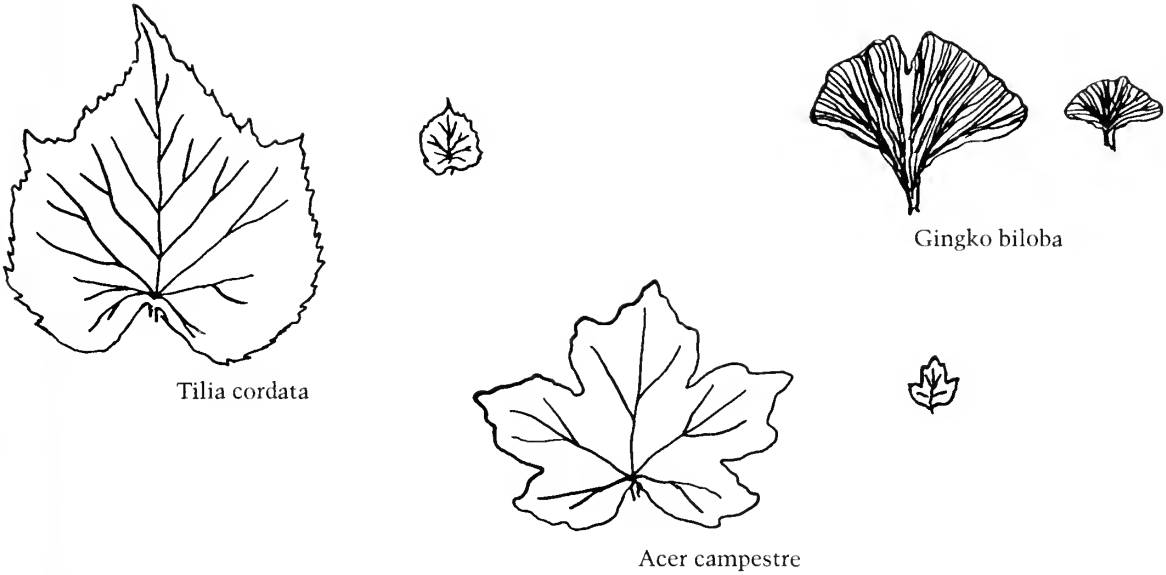
Given that individual leaves live only for a year or two, the ability to continue leaf production must also be retained throughout life. How do plants do this? The answer lies in the behavior of the growing tip at the end of each twig or branch. Here, where all the decisions regarding the number, size, and shape of organs are made, the annual production of leaves, stems, and buds (new modules) will, when repeated by multiple growing tips each season, give trees the shapes so distinctive of different species. The growing shoot tip, called the *meristem,* is the most intriguing plant organ of all.

The Growing Shoot

When I lecture students in introductory biology about plant development, I bring in a looseleaf head of lettuce with which to search for its meristem. A head of lettuce is really just a growing shoot with lots of green leaves, compact in some varieties and loose in others. With a good deal of dramatic flourish, I hold up the head and proceed to strip away the largest leaves, one by one. Try this sometime. It quickly demonstrates that successively younger leaves toward the center of the head are smaller and smaller, that this sequence of leaves is arrayed in a spiralling geometrical pattern around the center, and that the last identifiable leaf, now sitting atop a tapered stem base, is exceedingly small to the unaided eye. There at its tip, too small to see without a microscope, lies the shoot meristem. It is less than one one-hundredth of an inch across.

This meristem, from which all the lettuce leaves have been formed, consists of a small population of proliferating cells that retain the ability to form daughter cells through cell division. Both parent and daughter cells may continue dividing for several generations until a subset of the descendents stop dividing, begin to expand, and subsequently specialize as a form of functioning tissue for photosynthesis or the transport of nutrients. Newly formed descendent cells remain unspecialized as part of the meristem for a number of division cycles before making the decision to specialize. Thus plant cells in the growing meristem cannot continue dividing and specialize at the same time.

The meristem as a whole has a distinctive dome shape, sometimes broad or narrow, depending upon the species; and the cell divisions occur in such a way that this overall shape is maintained through the life of the shoot. In a sense, the meristem functions like the principal of an endowment in the bank: it generates income (specialized cells in plant organs) to support the whole while remaining more or less the same size over time.



Leaf size differences between normal and bonsai individuals of the same plant species. Redrawn from Körner 1989 by Susan Hardy Brown.

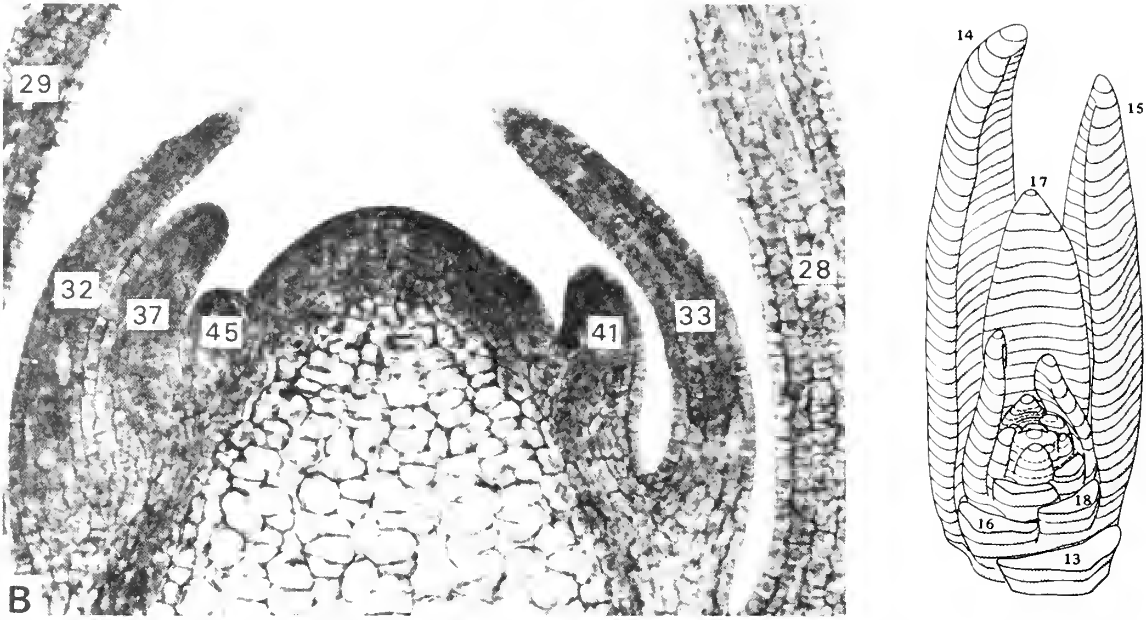
Leaf Formation

Leaves are formed from the meristem when a clump of cells on the side of the dome divide in a different direction such that a bump begins to emerge from the surface. This bump continues growing away from the meristem tip and gradually takes on the shape of a leaf. Within a short time, another bump appears on the opposite side of the meristem, followed by another to form the characteristic spiral sequence of leaves around the stem. Each of these young leaves also develops a small bud at its base. Initially this bud will remain dormant and later it may begin growing away from the stem to form a new branch with its own shoot tip generating new leaves.

While it still lies wrapped within the protection of older leaves, a newly formed leaf will increase in size very slowly because growth consists primarily of continuous cell divisions; each cell appears to divide a certain number of times before specializing and individual cells remain relatively small. After multiple generations this period of cell division gradually declines and the leaf enters a phase of cell expansion, coincident with tissue specialization, which greatly increases its size until the mature leaf size is reached. For many species that are dormant during the winter season, the overwintering bud contains a number of small leaves that have formed most of their cells but have yet to enter the expansion phase. With the coming of warm temperatures and rising sap, these leaves quickly begin expanding to rapidly approach maturity.

Thus the size of a leaf is determined by the average size of its mature plant cells and the number of such cells that are produced in the cell division phase early in the life of the leaf. Returning to our bonsai plant, we can ask whether its miniature leaves are smaller because the average leaf cell is smaller or because there are fewer cells in each leaf.

To answer this question, Professor Ch. Körner, a European botanist working at the University of Innsbruck in Austria, selected six



The photomicrograph on the left shows a slice through the middle of the shoot tip of an 18-day-old flax plant. The developing leaves are shown numbered on each side of the domed meristem. The 45th leaf has just emerged from the side of the dome. Leaves not shown (44, 43, and 42, for instance) are on parts of the dome not captured in the slice. The drawing on the right of a 15-day-old flax shoot tip was reconstructed from a sequence of slices starting at the tip of the longest leaf (#14) and slicing across at very small intervals. Using a microscope, each slice in sequence is drawn to create the 3-dimensional form. Leaves #13, 16, and 18 have been omitted to permit the shoot tip to be seen. Note the spiral arrangement of successively smaller leaves around the shoot tip. Reprinted from The Shoot Apex and Leaf Growth, *R. F. Williams, by permission of Cambridge University Press.*

species of trees—Carambola, *Averrhoa carambola;* Japanese zelkova, *Zelkova serrata;* hedge maple, *Acer campestre;* European linden, *Tilia cordata;* gingko, *Ginkgo biloba;* and European larch, *Larix decidua*—to conduct a comparative study of leaves in samples from normal trees and trees that had been grown as bonsai for six to seventeen years. Five individual leaves per plant were cut and examined with a light microscope to measure the length and width of individual cells, and the thickness of the leaf as a whole. Any differences found between the normal plants and the bonsai were statistically tested for significance.

In four out of the six species, the average size of the cells in the bonsai were *larger* than normally grown plants; cells of the remaining two species appeared to be the same size in normal and bonsai leaves. However Körner did find that bonsai leaves are about twenty percent thinner than normal leaves because there are only four cell layers instead of the usual five. Still, this difference cannot account for the much smaller overall size of the leaves in bonsai; clearly each layer has many fewer cells, each of which is normal in size or even somewhat enlarged. Körner concluded that the dwarfed leaves of bonsai result from reduction in the production of cells, not from any shrinkage in average cell size.

Based on evidence from studies of other plants that produce dwarf or miniature leaves under stressful conditions, Körner also concluded that the greatly reduced number of cells in bonsai leaves is not due to a reduction in the rate of cell division; during development such cells divide as frequently in normal and dwarfed leaves. The decision to form a miniature leaf appears to be made at the time a leaf is first initiated on the surface of the meristem. Körner believes that the bump itself starts smaller (that is, many fewer cells decide to alter the direction of division to form the bump). Consequently, although the future leaf grows at the normal rate and specializes on schedule, its size at maturation is greatly reduced because it commenced growth with a smaller starting capital of cells.

I should mention one note of caution with Körner's interpretation. It is a practice of some bonsai growers to strip off the first set of leaves produced in spring to stimulate the production of a second set. Körner's paper gives no indication that the bonsai he examined were so treated, but such spring pruning might have contributed to the very small sizes seen by Körner.

The Magic of the Meristem

What remains unclear is how the conditions of growth characteristic of a bonsai cause the many meristems at branch tips to make these decisions for each new leaf. The stressful environment surrounding a bonsai plant is due to the constrained nature of root growth in a very small pot, coupled with occasional, but severe, root pruning. In some way the roots of the plant, restricted in their ability to absorb water and minerals, communicate this stress to the arborescent parts of the plant growing above the soil. At the level of individual growing shoots, each tiny meristem responds by allocating many fewer cells to the initiation of a new leaf and this leads to leaves which, when fully mature, are in a decidedly dwarfed size appropriate for a miniature tree.

At one level, therefore, the bonsai plant responds to stressful growing conditions by reducing the size of its modular building blocks (leaves); but at a second level, each meristem responds to the same conditions by maintaining, or even increasing, the size of the building blocks (cells) and producing fewer of them to form a leaf. Cell size, unlike leaf size, is highly conserved under stress.

Perhaps the larger lesson for the botanist and gardener lies in the magic of the meristem itself. This organ, which sits hidden amidst the packed layers of expanding leaves in the growing shoot, is never seen by the naked human eye. Yet it is here that the critical decisions are made each season that will come to form the final size and shape of the leaves and stems of each individual. Such sequential decisions, made by the entire network of connected branch tips can, carried over the lifetime of the plant, create the characteristic architecture of trees that is so pleasing to our human sense of nature.

How all of this is coordinated, and how such coordination reaches from the deepest root tips to the tallest growing shoots on the tree, is unknown. But it is remarkable that, despite the harsh treatment we humans sometimes impose on bonsai, such coordination survives this mutilation intact, leading to the elegantly miniaturized leaves so essential to the beauty of these plants.

References

Dale, J. E. 1992. How Do Leaves Grow? *BioScience* 42 (6): 423-432.

Körner, C., S. P. Menendez-Riedl, and P. C. L. John. 1989. Why Are Bonsai Plants Small? A Consideration of Cell Size. *Australian Journal of Plant Physiology* 16: 443-448

Lyndon, R. F. 1990. *Plant Development: The Cellular Basis*. London: Unwin Hyman.

Bob Cook is Director of the Arnold Arboretum and lectures in introductory biology at Harvard University

The Upright White Pine

Peter Del Tredici

What's in a name? In the case of *Pinus strobus* 'Fastigiata', the fate of an excellent tree. All too often the acceptance or rejection of a plant lies not in its physical attributes but in the aptness of its common name. The so-called fastigiate white pine deserves a new one.

The white pine (*Pinus strobus*) was once the most important timber tree in North America. Its tall, straight trunk and lightweight wood were perfectly suited for all types of building projects. So valuable were large pines for ship masts that in 1711 Queen Anne of England, through an act of Parliament, took possession of all the white pines in her colonies that were larger than twenty-four inches in diameter and were not the property of any private person. She justified her action on grounds of national security, the trees being needed "for the Masting of her Majesties Navy." This peremptory seizure outraged entrepreneurial New England lumbermen, who considered the trees their private property even though they held no legal title to the land on which the trees were growing. Their outrage found an eventual outlet, some sixty years later, in the American Revolution.

In the period following the Civil War, New England white pines became less important as the white pine forests of the Great Lakes states and the extensive softwood forests of the Far West began to be cut. Around 1890, however, there was a reawakening of interest in white pine, when the New England farmland that had been abandoned during the Civil War started producing a marketable crop of white pine lumber. As this crop was being cut, the newly founded forestry departments of several universities as well as the United States Bureau of Forestry initiated programs of scientific silviculture directed at cultivating white pine on a commercial scale. However, the unpredictability of weather, the wide variation in soil types, and the competition from fast-growing deciduous trees frustrated most of these efforts.

In the few white pine plantations that were successfully established, the young trees still had to face the infamous white pine weevil (*Pinnodes strobi*). This native insect destroys the leading shoots of vigorous young white pines. Unfortunately for the forester, once the leader is destroyed, the basic shape of the tree is damaged and its utility diminished. At its worst, what was intended to be a straight-growing, single-stemmed tree is reduced by the weevil to a multistemmed bush. When weeviled trees reach harvestable size, many are either too crooked or too branched to be used for lumber. In addition to the white pine weevil, early foresters had to contend with the white pine blister rust, a fungus disease that was inadvertently imported from Europe around the turn of the century.

These two pests also adversely affected the use of white pines in landscape design. In the 1880s, the white pine was a widely planted

Anno Nono

Annæ Reginæ.

An Act for the Preſervation of White and other Pine-Trees growing in Her Majeſties Colonies of *New-Hampſhire*, the *Maſſachuſets-Bay*, and Province of *Main*, *Rhode-Iſland*, and *Providence-Plantation*, the *Narraganſet* Country, or *Kings-Province*, and *Connecticut* in *New-England*, and *New-York*, and *New-Jerſey*, in *America*, for the Maſting Her Majeſties Navy.

Whereas there are great Numbers of White or other Sort of Pine-Trees, fit for Maſts, growing in Her Majeſties Colonies of New-Hampſhire the Maſſachuſets Bay, and Province of Main, Rhode-Iſland, and Providence-Plantation, the Narraganſet Country, or Kings-Province, and Connecticut in New-England, and New-York, and New-Jerſey, fit for the Maſting Her Majeſties Royal Navy: And whereas the ſame growing near the Sea, and on Navigable Rivers, may commodiouſly be brought into this Kingdom for the Service aforeſaid: Wherefore, for the better Preſervation thereof, Be it Enacted by the Queens moſt Excellent Majeſty, by and with the Advice and Conſent of the Lords Spiritual and Temporal, and Commons, in this preſent Parliament Aſſembled, and by the Authority of the ſame, That from and after the Twenty fourth Day of September, which ſhall be in the Year of our Lord, One thouſand ſeven hundred and eleven, no Perſon or Perſons within the ſaid Colonies of New-Hampſhire, the Maſſachuſets-Bay, and Province of Main, Rhode Iſland, and Providence-Plantation, the Narraganſet Country, or Kings-Province, Connecticut in New-England, and New-York, and New-Jerſey, or any of them, do or ſhall preſume to Cut, Fell, or Deſtroy any White or other ſort of Pine-Tree

Eeeee 2 fit

An Act for the Preservation of White and other Pine Trees in Her Majesties Colonies of New Hampshire, Massachusets-Bay . . . . for the Masting of Her Majesties Navy. A facsimile of the 1711 decree of appropriation of all white pines greater than twenty-four inches in diameter.

ornamental, grown both in groups and as single specimen trees. Writing in 1841 in *The Theory and Practice of Landscape Gardening,* Andrew Jackson Downing summarized the position that the tree occupied in landscape gardening:

> This species—the White Pine—seldom becomes flattened or rounded on the summit in old age, like many other sorts, but preserves its graceful and tapering form entire. From its pleasing growth and color, we consider it by far the most desirable kind for planting in the proximity of buildings, and its growth, for an evergreen, is also quite rapid.

But the weevil epidemic of the early 1900s and the introduction of the blister rust changed all this. A single tree planted in a lawn could not be counted on to produce the desired effect. More often than not, the tapering form never materialized. In its place, a bushy "cabbage" pine arose. True enough, many old pines that have been weeviled develop a certain picturesque appearance, but this is the result of many years of searching for a leader. Many modern landscapers suggest that the white pine be used in group plantings, where competition from neighboring trees will force it to grow straight in spite of repeated leader loss.

A Matter of Branch Angles

Happily, nature has provided gardeners with a way out of this unfortunate situation in the form of the so-called fastigiate (or, as I prefer, upright) white pine, *Pinus strobus* 'Fastigiata', which is distinguished from the normal white pine by the more vertical angle at which the lateral branches are carried. In order to appreciate the implications of this seemingly trivial difference, it is necessary to understand how a normal white pine grows. In the spring, when the terminal cluster of buds breaks, the laterals and the terminal all begin growing vertically. As the season progresses, however, the laterals slowly move downward, away from the terminal, under the influence of hormones produced by the terminal. This process continues through the year until, by the following spring, they are at angles of between fifty and seventy degrees to the main stem. By the end of the second year, the laterals are at angles of about seventy to ninety degrees to the main stem. By the end of the third year, almost all of the laterals are at right angles to the trunk. This is the normal, genetically controlled pattern of growth for undamaged white pines.

In the upright pine, the laterals and the terminal start out the way they do in the normal pine, but for some reason the laterals fail to move down into the horizontal position. The downward migration stops prematurely at an angle of about thirty degrees to the main stem.

The weeviled crown of a white pine.

It is only with increasing age (after ten years) that the laterals begin to sag down to angles greater than thirty degrees. When they do, it is the result of the weight of the limbs rather than of a predetermined genetic pattern, as it is in the normal pine. In other words, in the upright white pine the branches stay in a position alongside the main axis for a good ten years, while in the normal pine the laterals are alongside the leader for less than a year before moving down into a horizontal position.

This discussion of branch angles has implications that go beyond mere academic interest. Because its branches remain alongside the main axis for a longer time, the upright white pine is better able to replace a dead leader than the normal pine is. When the leader of a young tree is destroyed by either the white pine weevil or the blister rust fungus, there is already a lateral branch in position to replace it immediately. In the same season that the attack occurs, the most vigorous lateral assumes dominance and becomes the newly anointed leader. By virtue of this rapid leader replacement, the upright white pine will maintain its shape in spite of repeated losses of its leader. In contrast, when the leader of a normal white pine is killed, there are no ready replacements, and the re-erection of horizontal branches results in several laterals competing with one another, ultimately producing a multileadered specimen that looks more like a bush than a tree.

As well as preadapting the tree for rapid leader replacement, the ascending branches of the upright white pine give it a greater ability to shed snow; hence, it suffers less winter damage than does the normal pine with its horizontal branches. In addition, because the lower branches grow upward and not outward there is less of a tendency for them to be shaded out by the upper branches. Both of these factors contribute to the creation of a tree that, if given full sun, is green from top to bottom for many, many years. At maturity the tree has an imposing presence—a broad column of green that seems to reach out directly at the viewer to create a unique ascending appearance.

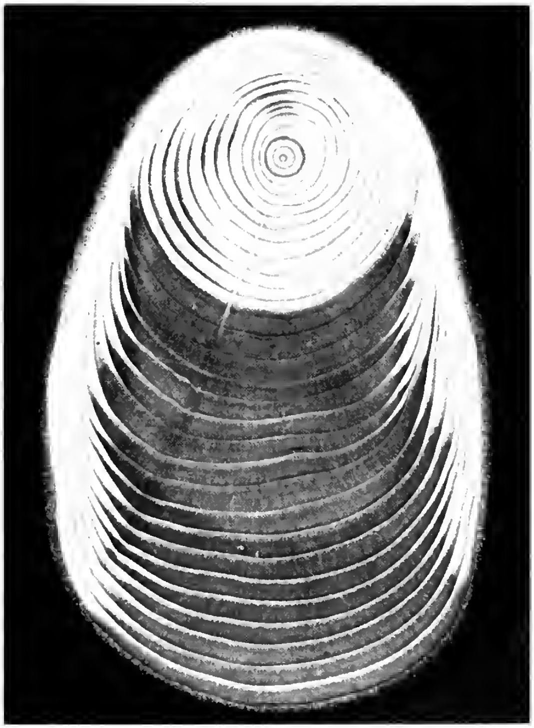
A Proposed Change of Name

You might ask why, if this tree is so superior for landscaping, its use has not been suggested before. One part of the answer is simple: the tree is not very well known. From time to time people have tried to popularize it but generally to no avail. In 1920, for example, when yards were big and landscaping grand, E. H. Wilson predicted that the upright white pine was "destined to be of great importance." Unfortunately, the tree planters of the day ignored this prophecy. This excellent tree has been planted here and there, but not nearly in the abundance it deserves.

A second part of the answer is that the plant does not live up to its common name. Certainly a change in the tree's common name from fastigiate white pine to upright white pine would not only be more accurate but

Compression Wood

In the white pine, as in most conifers, the production of a specialized type of wood known as compression wood plays an integral part in the development of a tree's shape. A cross section of the lateral branch of a white pine reveals the compression wood as a crescent-shaped, red blotch on the lower side of the branch. This "red wood," as it is called, is most conspicuously formed when the leader of a straight-growing conifer is destroyed and a lateral branch grows upward to become the new leader. Large amounts of compression wood are formed along the underside of the branch, forcing it upward. In an undamaged conifer the situation is more complicated. The innate tendency of the laterals to erect themselves is countered by hormones produced by the leader, which are aimed at pushing them down. The balance between these two opposing forces results in a specific amount of compression wood being laid down, which in turn results in branches being carried at angles that are specific for each species. In the white pine, this angle is nearly ninety degrees, or horizontal, to the main stem. This process was first described by the great German tree physiologist Ernst Münch, who called it "delayed epinasty." In a classic article, "Investigations on the Harmony of Tree Shape" (1938), he makes an analogy comparing "the terminal shoot with a tyrant who suppresses his subjects and prevents them from development. As soon as the tyrant is removed or weakened, the vassals fight for the leadership until one of them has reached the top and in his turn suppresses the others."



Compression wood in Abies balsamea, *the balsam fir, produced along the underside of a leaning trunk, pushing it up into a vertical position. Note the eccentric radial growth caused by the production of darkly stained compression wood on the lower portion of the cross section. Photo by T. E. Timell.*

would probably stimulate a greater appreciation of this distinctive cultivar.

While this may seem a trivial distinction, the fact of the matter is that people expect a plant to live up to its name, and when it doesn't they blame the plant and not the name. When I first saw the tree, I thought it was a perfect example of another useless horticultural selection. True, it was narrower than a normal white pine, but fastigiate? Never. When I first became interested in the plant in the early 1980s, I asked knowledgeable people about the plant and found that there is general agreement that the tree, although fastigiate when young, should be cut down when it fills out. When I started looking more closely at some of the old

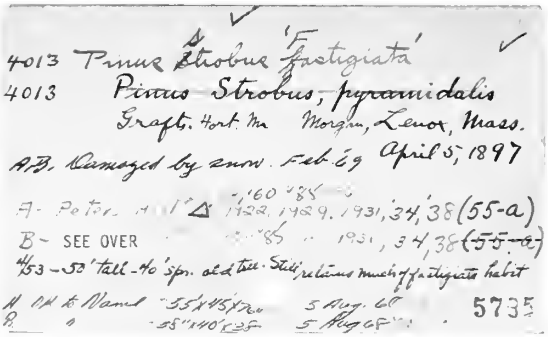
Pinus strobus, *the normal white pine, growing along Route 2 in Acton, Massachusetts.*

The upright white pine, Pinus strobus *'Fastigiata', at the Arnold Arboretum.*

trees in the Arnold Arboretum, however, I realized that they were indeed quite different from the normal white pine and that they were beautiful in their own right. Indeed, like many other plants, the upright white pine seemed to be condemned to oblivion more for what it is not than for what it is.

The Origin of the Upright White Pine

The history of *Pinus strobus* 'Fastigiata', while not quite as revolutionary as that of the normal white pine, is an interesting one. According to E. H. Wilson, in *Aristocrats of Trees*, "the original tree was discovered about 1895 in a garden at Lenox, Massachusetts, and the trees now growing at the Arnold Arboretum are grafts from this." Arboretum records reveal that, indeed, *Pinus strobus pyramidalis* (the


4013 Pinus Strobus 'Fastigiata'
4013 Pinus Strobus, pyramidalis
Grafts. Hort. Mr Morgan, Lenox, Mass.
A.B. Damaged by snow. Feb. 69 April 5, 1897
A- 1922, 1929, 1931, 34, 38 (55-a)
B- SEE OVER 1931, 34, 38 (55-a)
4/53 - 50' tall - 40' spr. old tree. Still retains much of fastigiate habit
5735

The index card record of Arnold Arboretum accession #4013, Pinus strobus *'Fastigiata', originally* Pinus Strobus pyramidalis, *a scion of Mr. Morgan's original tree.*

name was later changed to 'Fastigiata') scions were received from a Mr. Morgan of Lenox on April 5, 1897, and that two of these original propagations are still alive. On a hunch I called the Lenox town assessor and discovered that, yes, J. P. Morgan's brother, George H. Morgan, once lived in the town and was a great lover of trees. And yes, his old estate, Ventfort Hall Villa, is still standing. I went out to Lenox as soon as I could to try to locate the original upright white pine from which the Arnold

At center is the original Pinus strobus *'Fastigiata' photographed by the author in Lenox, Massachusetts, in 1980.*

Arboretum scions had come. After much searching, which involved climbing onto the roof of the old mansion, I finally spotted the tree's distinctively pointed crown.

The tree was about a hundred and twenty feet tall and at four feet from the ground was twenty-seven inches in diameter, a perfect ship-mast pine. The spread from branch tip to branch tip was about thirty-two feet. There was no sign of any graft union near the base, and the straight trunk (devoid of branches for its first fifty feet) showed no evidence of weevil or blister-rust damage. The fact that the tree was growing close to other, equally large, normal pines suggests that several trees were planted as a group before Morgan recognized that one of them was different. Fortunately, he had the good judgment to send scions to the Arnold Arboretum, whence the tree eventually made its way into the nursery trade.

The upright white pine is easily propagated by grafting and is available from several nurseries, particularly those specializing in conifers. It grows best in the natural range of the normal white pine: Newfoundland to Manitoba, south to Georgia (in the higher elevations), and west to Minnesota. It grows as quickly and as tall as the normal white pine (one hundred to one hundred and fifty feet after a century), so it needs lots of room. It does best when planted in a sandy loam with good drainage, but it is tolerant of thin, stony soil as well. If grown in full sun, the upright white pine will keep its lower branches for as long as it lives. This tendency, together with its narrow growth habit, makes the tree a perfect choice for a tall hedge or a screen. As a specimen plant, the upright white pine presents a fuller, neater appearance than the normal white pine. It is striking enough to be used in a position of prominence, either close to a house or at the edge of a deciduous wood.

References

Albion, R. G. 1926. *Forests and sea power: the timber problem of the royal navy, 1652-1862.* Cambridge, Mass: Harvard University Press.

Del Tredici, P. 1982. Resurrecting the white pine. *Horticulture* 55 (5): 17-20.

Downing, A. J. [1841] 1977. *A treatise on the theory and practice of landscape gardening.* Reprint. Little Compton, Rhode Island: Theophrastus Books.

Malone, J. J. 1964. *Pine Trees and Politics.* Seattle: University of Washington Press.

McKinnon, F. S., G. R. Hyde, and A. C. Cline. 1935. *Cutover old field pine lands in central New England.* Harvard Forest Bulletin No. 18.

Münch, E. 1938. *Untersuchungen uber die Harmonie der Baumgestalt. Jahrbucher fur Wissenschaftliche Botanik* 86: 581-673 (English translation available from Translation Center, John Crerar Library, 35 West 33rd St., Chicago, IL 60616).

Sinnott, E. W. 1952. Reaction wood and the regulation of tree form. *American Journal of Botany* 39: 69-78.

Timell, T. E. 1986. *Compression Wood in Gymnosperms,* 3 vols. New York: Springer-Verlag.

Wilson, E. H. [1930] 1974. *Aristocrats of the trees.* Reprint. New York: Dover Books.

Zimmerman, M. H., and C. L. Brown. 1974. *Trees: structure and function.* New York: Springer-Verlag.

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

Trees as Urban Infrastructure: Book Review

Phyllis Andersen

Trees in Urban Design. Second Edition. Henry F. Arnold. Van Nostrand Reinhold, 1993. 197 pages. Hardcover. $39.95

When the first edition of this book was published in 1980, it was called a classic—an intelligent and complete proposal for the transformation of cities through structured tree planting. Arnold, a landscape architect based in Princeton, New Jersey, views trees as an integral part of urban infrastructure rather than as a decorative palliative. He feels that tree planting structured by architectural principles of scale, massing, and perspective can transform American cities from barren, eroded landscapes to rich human environments enhanced by shade, pattern, texture, and enclosure. It was a simple proposal—large caliper specimens of a single species planted at closely spaced intervals would, if properly maintained, create a continuous canopy of branches and foliage that would unify the unrelated elements of streets and create a system of linked green spaces of the kind so admired in European cities.

Arnold's conviction of the power of geometry, his insistence on single species planting and close spacing, was seen as a powerful affront to the caretakers of city trees, the arborists, horticulturalists, and municipal tree superintendents who were exhausted after battling years of deferred maintenance and the devastation of Dutch elm disease. Classic confrontations occurred in meetings and conferences across the country, pitting landscape architects inspired by the spatial manipulation of LeNôtre against the arborists, who were newly aligned with the proponents of biological diversity and environmental responsibility. The dispute resurrected the age-old suspicion that designers, remote from the day-to-day care of a vulnerable and disrespected tree population spun out ideas remote from reality.

Arnold held his position, criticizing municipal arborists as shortsighted, willing to sacrifice the profound aesthetic effect of designed tree planting in an overreaction to the loss of the American elm and to the inevitable maintenance demands of trees in cities. Principles of forest ecology cannot be transported to cities where plants grow under artificially controlled conditions. Through planned growth and change, cities can be biologically "fit" communities—healthy and stimulating places in which to live. Arnold emphasizes that species diversity has meaning only at a regional level. Mandating that four or five species be planted on each street, as has been done recently in New York City, does not affect a regional ecosystem and contributes to the chaos of city streets. European tree managers look with bemusement on American planting methods. Several years ago I met with Tristan Pauley, Chief of Paris Plantations. A recent inventory of Paris street trees had revealed too strong a reliance on the London plane (43% of the total tree population). Paris is now implementing a ten-year plan to diversify species. This new plan continues to emphasize single species planting on all streets and boulevards to reinforce the strong spatial order that is such a powerful characteristic of that city.

The early chapters of the second edition of *Trees in Urban Design* largely repeat those of the first, describing the value of geometry in

Platanus occidentalis, *the American sycamore, along Memorial Drive in Cambridge, Massachusetts. Photo by A. E. Bye.*

urban planting, the details of spatial composition, and the characteristics of growth and form of species recommended for urban planting. The excellent photographs and diagrams of the earlier edition have been updated with projects from the 1980s. References and the comprehensive bibliography have been expanded to reflect the broad spectrum of new ideas that Arnold draws on to expand his closely reasoned argument—from Mandelbrot's fractal geometry to Edward O. Wilson's ideas on biodiversity. In the first edition, which coincided with the beginning of the resurrection of the reputation of Frederick Law Olmsted, Arnold, while respectful of the significant contribution of Olmsted, offered a critical analysis of the limitations of the pastoral park in the modern city. In this new edition Arnold carries these ideas further by pointing out the fallacy of appropriating emotionally charged ideas about agrarian nature or, worse, concepts of wilderness ecology for urban situations. Arnold does not want to define cities by what they are not. He has, with some fortitude, tried to define what constitutes the character of urbanity so admired in the capitals of Europe and so valued

Carretera de Miramar, Montjuic, Barcelona. Photo by Karen Madsen.

in the successfully planted areas of American cities.

In this second edition Arnold clearly sets out to defend his position as a realist and a practitioner. He offers a new chapter with detailed technical instructions on how to deal with urban environmental problems. He rejects the standard "suburban" tree planting method, which assumes soil suitable for plant growth. New techniques that deal with improved soil mixtures, subsurface drainage, drip irrigation systems, and venting systems for root aeration are described and illustrated. Substantial information on ground-surface treatment from permeable pavers to the standard European detail of stabilized crushed stone are offered as alternatives to mounds of mulch. He describes the technique of planting at grade over underground structures, an increasingly popular method of providing new green space within the density of central cities. Boston's Post Office Square, built over an underground parking garage, is an excellent example of good design and new technology.

This section also describes the pervasive shortsightedness of government agencies. These "new" techniques have been around for a number of years but have been rejected by municipalities because of their increased cost. Cities refuse to provide adequate underground conditions for trees but will replace a single specimen three or four times in as many years, claiming the demise to be a sign of the hopelessness of planting in cities. New tree planting techniques is hampered by a lack of knowlege. Only recently have biologists begun to seriously study tree roots and as a consequence we have substantially altered our view of growth patterns and growth requirements. It is clear from recent projects documented by Arnold that trees with adequate conditions for healthy root growth can withstand the standard litany of urban stresses, sustain growth, and become low-maintenance additions to the fabric of the city.

In a final chapter titled "A Longer View," which addresses the inseparable issues of trees and governance, Arnold discusses the financial aspects of tree planting in the context of cost-benefit analysis. He compares the cost of urban planting with the benefits accrued as a result. While admitting that this is an imprecise exercise, he describes how his accounting method can help increase municipal tree budgets. The seamless integration of trees into the pattern of a city involves master planning: a tree inventory, a municipal tree policy, a tree plan, and detailed standards and regulations. This is not a new idea. Haussmann's plan for Paris included tree planting schemes still admired today. L'Enfant's plan for Washington, D.C., and turn-of-the-century plans for sections of New York City have resulted in communities of great character and livability.

The value of trees in cities has received a great deal of attention since the first edition of this book. Urban forestry, an odd term that satisfies no one but persists for lack of a better one, has received full professional status with the strong promotional efforts of the American Forestry Association. The advantage of this high visibility is offset by the profession's insistence on applying principles of forest ecology and silviculture to city streets and by its all-too-obvious bias toward suburban settings. The fact that trees create beneficial local climate conditions has been well documented in the popular media. Yet few authors have taken on the integration of physical benefit, emotional effect, and urban design. Trees in their evolving form (Arnold's term) can contribute a unique sense of order within the dynamics of city life. A study completed in 1987 by the American Forestry Association indicated that American cities have half the number of street trees that they can accomodate. Civic design, a term with visionary appeal, could be the discipline to lead the planting effort. By setting aside conflicting agendas, professionals and community tree advocates can come together to integrate successful tree planting into the complex organization of cities.

Phyllis Andersen, Landscape Historian at the Arnold Arboretum, has served as consultant to a number of government agencies including the Boston Parks Department and the Massachusetts Department of Environmental Management.

Arnold Arboretum Weather Station Data — 1992

	Avg. Max. Temp. (°F)	Avg. Min. Temp. (°F)	Avg. Temp. (°F)	Max. Temp. (°F)	Min. Temp. (°F)	Precipi-tation (in.)	Snow-fall (in.)
JAN	37	18	28	59	4	1.04	0
FEB	39	20	29	55	6	1.4	1.8
MAR	43	25	34	60	10	2.77	1.7
APRIL	55	35	45	76	25	2.88	0
MAY	69	45	57	94	32	1.28	0
JUNE	79	57	68	88	48	4.87	0
JULY	85	59	72	89	52	5.18	0
AUG	79	59	69	93	51	4.98	0
SEPT	74	53	64	86	38	2.73	0
OCT	60	39	50	72	30	2.0	0
NOV	47	31	39	61	20	4.82	0.1
DEC	38	24	31	53	8	7.58	2.6

Average Maximum Temperature	59°
Average Minimum Temperature	39°
Average Temperature	49°
Total Precipitation	41.53 inches
Total Snowfall	6.2 inches
Warmest Temperature	94° on May 23
Coldest Temperature	3° on January 17
Date of Last Spring Frost	28° on April 29
Date of First Fall Frost	31° on October 1
Growing Season	154 days

Note: According to the state climatologist, R. Lautzenheiser, 1992 averaged 1.3° per day below normal, with the average temperature being 50.2°. This was a great contrast to 1991, at 53.4°, the third warmest on record. There were two days with temperatures in the 90's and the low was a fairly mild 3°. Precipitation at 41.53 inches was just .09 inches less than normal. This is with snowfall still 13.7 inches less than normal.

Summer 1993

arnoldia

The Magazine of the Arnold Arboretum

arnoldia

Volume 53 Number 2 1993

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

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

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

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

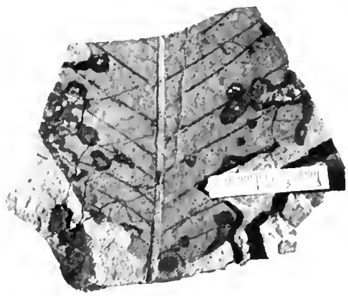
Page

Front cover: A dawn redwood (*Metasequoia glyptostroboides*) seen from the Willow Path on a hot summer day at the Arnold Arboretum. Photo by David Akiba.

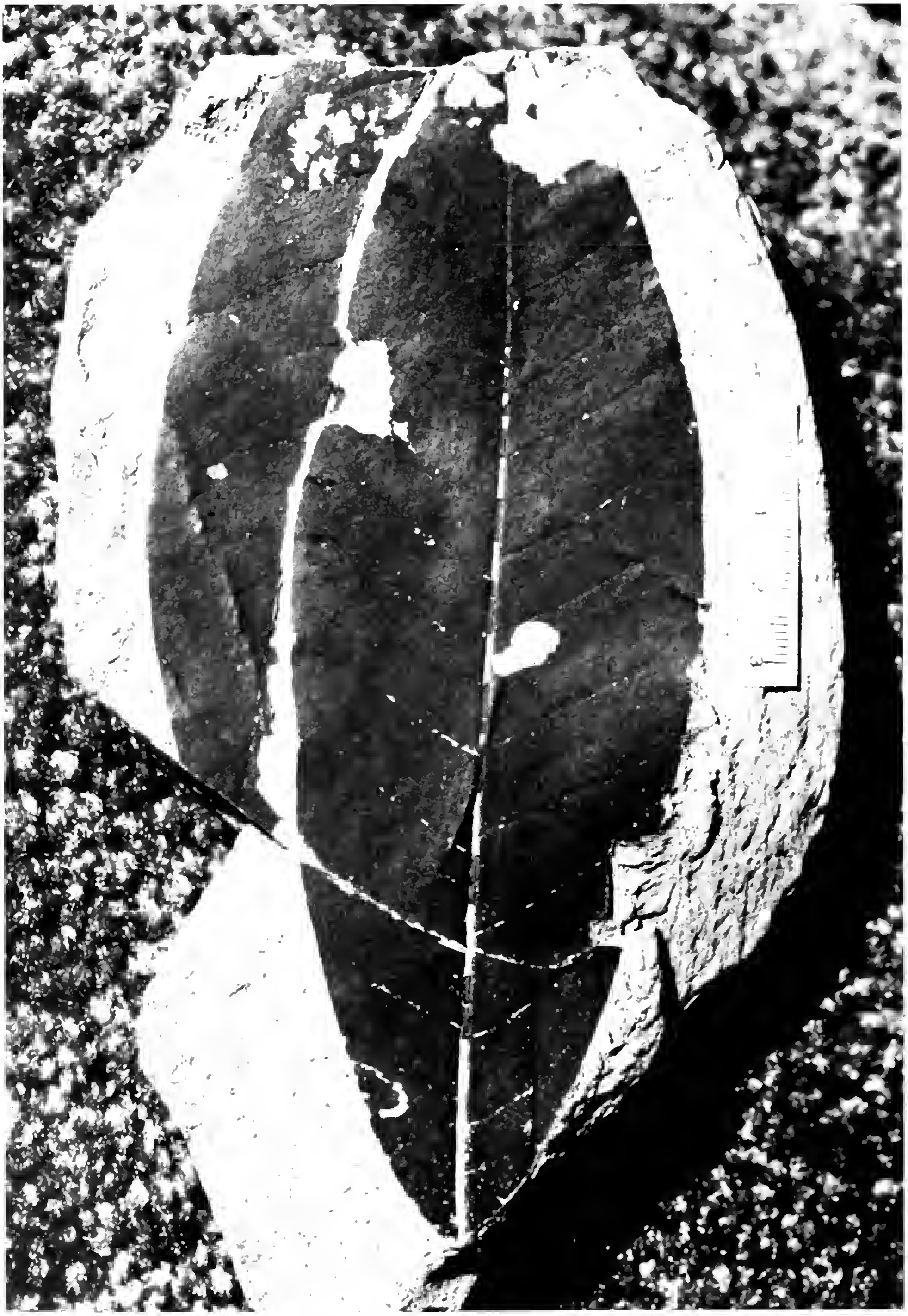
Inside front cover: The cucumber magnolia (*Magnolia acuminata*), drawn by C. E. Faxon. From *The Silva of North America* by C. S. Sargent.

Back cover: A fossil leaf of a Miocene tulip tree (*Liriodendron hesperia*) from Clarkia, Idaho. Photo by R. B. Figlar.

Inside back cover: The American chestnut (*Castanea dentata*), drawn by C. E. Faxon. From *The Silva of North America* by C. S. Sargent.



Fossil leaf of the so-called slope magnolia. Photo by R. B. Figlar.



Fossil Magnolia latahensis *leaves preserved on two separate bedding surfaces.*

Stone Magnolias

R. B. Figlar

At an extraordinary fossil site in Idaho, seventeen-million-year-old leaves look remarkably like present-day leaves—in many cases, in better condition than autumn's windfalls.

It was April of 1990 and I had just walked into my kitchen after a look at my magnolias, several of which were in full bloom. Suddenly my attention was riveted on the evening news: Dan Rather was describing the successful extraction of DNA from a seventeen- to twenty-million-year-old *Magnolia* leaf found in Idaho. As a certified magnoliaphile I was immediately captivated and had to learn more. My quest led me to Charles J. Smiley of the University of Idaho in Moscow, manager of the Clarkia fossil site for many years and author or co-author of several papers on it since its discovery in 1971. With his help I was able to obtain much of what had been published on Clarkia. Later, in 1991, he invited me and my wife, Anita, to visit and collect at the site.

History of the Site

The fossil beds are located about fifty miles northeast of Moscow, Idaho, in the valley of the St. Maries River near the town of Clarkia. The principal fossil find there, called the P-33 site, is located on the property of Francis Kienbaum. In September 1971, while Mr. Kienbaum was grading a portion of his land for use as a snowmobile racetrack, he noticed that the bulldozer was turning up a lot of black leaves, some even blowing around in the wind. Fortunately, it aroused his curiosity. Noticing that most of these leaves appeared to be from broadleaf trees not common in that part of Idaho, Kienbaum telephoned the University and eventually contacted Dr. Smiley. What Kienbaum had uncovered is now regarded as the best preserved Miocene plant fossil site in the world. Those black leaves were the organic remains of leaves that fell there at least seventeen million years ago.

In the ensuing years Dr. Smiley and his team of researchers discovered more than 130 different plant species in the nine-meter-thick sediments, including fossil *Magnolia latahensis* (Berry) Brown and perhaps one or two other species of *Magnolia* as well as fossil equivalents of many of its present-day associates (Golenberg et al. 1990). These include tulip tree (*Liriodendron*), sweet gum (*Liquidambar*), baldcypress (*Taxodium*), oak (*Quercus*), persimmon (*Diospyros*), red bay (*Persea*), tupelo (*Nyssa*), beech (*Fagus*). Also present in the fossil record are several genera now confined to eastern Asia, such as dawn redwood (*Metasequoia*), China fir (*Cunninghamia*), katsura (*Cercidiphyllum*), *Zelkova*, and princess tree (*Paulownia*) (Smiley and Rember 1985). Though the assemblage of plants matches the present flora of southeastern North America more closely than that of any other region, it appears that the Miocene Clarkia flora was more diverse than any existing flora of temperate North America.

The author in the St. Maries River valley near the Clarkia, Idaho, P-33 site. Photo by Anita Figlar.

Origin of the Clarkia Flossil Beds

About twenty million years ago, during early Miocene time, widespread volcanic activity was underway in the Pacific Northwest. One of the largest known lava flows overspread eastern Washington and is manifest today as the Columbia River basalts. Farther east, in the proto-St. Maries River valley, similar volcanic activity occurred; one of the lava flows suddenly dammed the valley, creating a deep, narrow lake (Smiley and Rember 1979). The lake must have been cold-bottomed and limited in oxygen with very little microbial or scavenger activity, thus favoring the preservation of any plant parts deposited from the nearby shore. The lake silted in fast, probably from airfall ash, clays, silt, and other products of erosion, perhaps filling in completely within a thousand years or less. This gentle but rapid infilling of sediment on the lake bottom entombed the leaves and fruits in finely laminated sediments where they remained, saturated with water. Untouched by weather or erosion, running water, glaciers, or any of the other geological processes that have modified most of the earth's surface, they survived the past seventeen million years virtually unaltered. Everything had to go right and it did.

Exploring Clarkia

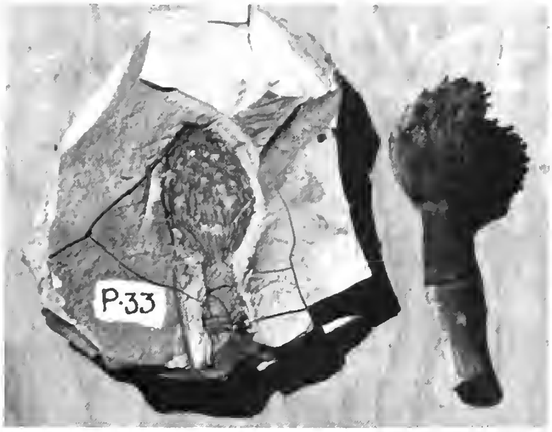
We arrived in the Clarkia area by way of the University of Idaho in Moscow in early July 1991. Though it was nearly midsummer, northern Idaho looked oddly spring-like as black locust trees (*Robinia pseudoacaccia*), widely planted as ornamentals, were still in bloom. On the hourlong drive to the fossil site, Dr. Smiley provided a detailed geological and botanical narration as accompaniment to the roadside scenery. Basaltic extrusions give evidence of the Miocene lava flows in the roadcuts. These are often interbedded with clay-like layers known to geologists as the Latah sediments, which are sometimes fossil bearing. As we traversed the gently rolling topography, the existing flora—grand fir (*Abies grandis*), douglas fir (*Pseudotsuga mensiesii*), western white pine (*Pinus monticola*), western larch (*Larix occidentalis*), subalpine fir (*Abies lasiocarpa*), quaking aspen (*Populus tremuloides*)—contrasted markedly with my mental image of the rich magnolia-beech-baldcypress forest that existed in Miocene time.

A sign that read "Fossil Bowl," the name of Mr. Kienbaum's racetrack, signaled that we had arrived at site P-33. Bill Rember, Yang Hong, and other researchers were taking core samples of stream and lake sediment. As Rember told us about some of his recent discoveries, including "a really big leaf" believed to be a *Magnolia*, possibly belonging to section Rytidospermum (a group of closely related *Magnolia* species often called big leaf or umbrella magnolias), I kept looking at the ground. Leaves, black leaves, mostly baldcypress, were all over the place. Within minutes I had picked up pieces of shale containing dawn redwood, sweet gum, chestnut (*Castanea*), and yes, even *Magnolia*. Dr. Smiley suggested that we could get better specimens if we chopped them fresh from the sediment.

Chopping Fossils

This method calls for a pulaski, a kind of pickax, to chop out small blocks of the soft shale sediment. Individual bedding surfaces are then split off with a pocket knife. Each bedding surface usually reveals one or more fossil leaf compressions, many of which still show original green or red pigmentation for a short time before turning black. Sometimes fruits and twigs are also present.

This is how we explored this ancient forest: I would chop and Dr. Smiley would split and identify while our wives, Peg Smiley and Anita



An unusually well preserved Miocene fossil, an immature Clarkia Magnolia *fruit aggregate, next to its present-day counterpart,* Magnolia grandiflora.

Figlar, wrapped and labelled specimens. As we lifted the leaves from the ancient sediments, my sense of time often became confused; for all intents and purposes, these seventeen-million-year-old leaves looked like present-day leaves, and in most cases, better than those that fell into my own pond last fall. We had time to dig for only an hour or so, but in that short time we collected fossil leaves of numerous Miocene species, including the *Magnolia latahensis* and what appears to be a second species of *Magnolia*, one that resembles the extant cucumber magnolia (*M. acuminata*) of section Tulipastrum.

Later, we visited the main fossil collection at the Tertiary Research Center of the University of Idaho. There, Dr. Smiley showed us many of the better specimens of Magnoliaceae from Clarkia. Most impressive in this collection was an exceptionally well preserved fossil of an immature *Magnolia* fruit aggregate. Even more remarkable is the extraordinary resemblance of this fossil fruit aggregate to that of the present-day southern magnolia (*M. grandiflora*) of the section Theorhodon. Close examination of the fossil showed nine tepals, approximately 250 stamens, and some 120 carpels—all of these being well within the ranges for *M. grandiflora*.

Also impressive among Dr. Smiley's collection were the quality and quantity of fossil tulip tree leaves and fruits.

Looking for Modern Analogues

Back home in New York State, I determined to pursue the questions raised at Clarkia. Did more than one *Magnolia* species exist in the Miocene Clarkia flora? Do these fossil *Magnolias* have modern analogues? Which extant species do they most resemble? The possibility of more than one *Magnolia* species in the Miocene Clarkia flora was raised by Smiley and Rember (1981) in the course of a stratigraphic analysis of a column of sediment 7.6 meters deep. In this study the researchers selected a one-meter-square area at the P-33 site, then painstakingly peeled off layer after layer of sediment, each usually less than one centimeter thick. All plant fossils in each layer were collected, identified, quantified, and tabulated for the entire 7.6-meter depth of the column. The resulting data suggested that different plant communities occurred at different levels of the column. Some layers of the column revealed fossil evidence of a swamp assemblage species such as baldcypress, tupelo, and *Magnolia latahensis,* whereas other layers reflected a slope assemblage dominated by oak, beech, and dawn redwood. In this latter assemblage Smiley and Rember found fossils of a species of *Magnolia* whose leaf morphology was suggestive of present-day *M. acuminata.* Smiley told us that unlike those of *M. latahensis,* fossils of this species occurred rarely and were typically found in a more fragmented, abraided condition, indicative of long-distance transport by running water.

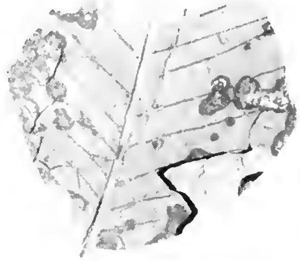
Using both close-up photographs and actual fossil material, I compared leaf structures and venation patterns of the two fossil *Magnolias* to each other and to numerous species of living *Magnolias.* While the sample size of fossil material was small, the specimens were in excellent condition and showed leaf venation down to the smallest details. Comparative analysis of these characters indicated that the two fossil species, *M. latahensis* and the slope magnolia, showed a closer resemblance to living *M. grandiflora* and *M. acuminata,* respectively, than to each other or to any other living *Magnolia* species studied. In fact, the structural details and venation parameters for both fossil species were well within the ranges for each of their proposed living analogues. Smiley's comment that the abraided leaves of the slope magnolia suggest thin, fragile deciduous leaves, further supports the affinity between the slope magnolia and living *M. acuminata.*

In the case of *M. latahensis,* both the leaf structure and the stratigraphic evidence of a swamp assemblage suggest an affinity with living *M. grandiflora,* a conclusion that is bolstered by the extraordinary morphological similarity of the fossil fruit aggregate to those of *M. grandiflora.* An even more convincing case for the *latahensis/grandiflora* affinity would be made if it could be demonstrated that the fossil fruit aggregate did in fact belong to *M. latahensis* and not to the slope species. Probability suggests that since only one type of *Magnolia* fruit was found at Clarkia, it came from the species that produced the most leaves—that is, *M. latahensis.* Unfortunately, the fossil fruit did not have any leaves associated with it, making it impossible to prove that it was produced by *M. latahensis.*

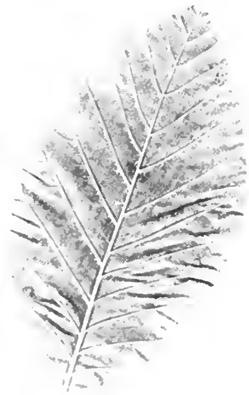
A Change in Climate

Some time after sediment had filled the lake at the Clarkia site—in the middle and later parts of the Miocene epoch—the Cascade Range formed, producing a rainshadow effect over Clarkia and surrounding areas. Not only did the Cascades rising to the west cause precipitation and humidity to decrease, but this climatic barrier also allowed more frequent invasions of arctic air masses from the north. These combined effects would eventually doom *Magnolia latahensis* and the rest of the moisture-loving Miocene Clarkia flora in favor

Paleobotanical Detection: Leaf Structure of *Magnolia acuminata* Compared to a Miocene Fossil



Fossil leaf of the so-called slope magnolia.



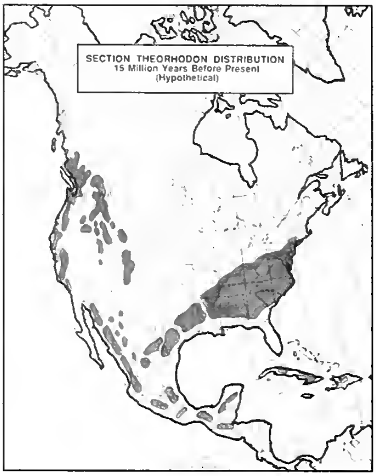
Leaf of extant Magnolia acuminata.

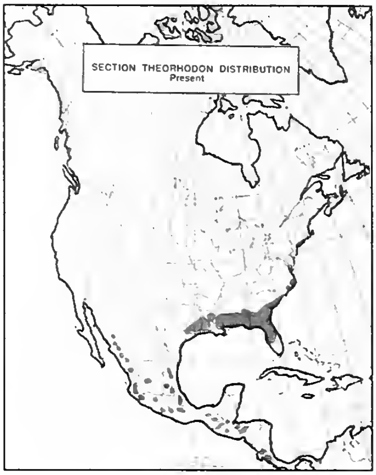
In contrast to conventional botany, paleobotany requires one to deal with fragmentary evidence. The fossil leaf may be nearly pristine, but the paleobotanist does not have the luxury of examining parts of the plant that would have been attached to the leaf, nor the habitat in which it grew. This presents a special problem with *Magnolia* since its leaves can easily be confused with those of other genera such as the tupelo and pawpaw (*Asimina*) whose leaves are of similar size and shape and, like *Magnolia*, are entire margined (that is, without lobes).

To address this issue, we studied leaf venation patterns of most of the modern equivalents of the entire-margined Miocene Clarkia genera and found that even when the leaves were similar in size and shape, most could be distinguished from *Magnolia* by the number of secondary veins on either side of the primary vein. *Magnolias* typically have ten to fourteen of these secondary veins (except for section Rytidospermum, which ordinarily have twenty or more), while the leaves of most other entire-margined genera have fewer than ten. In two genera, *Nyssa* and *Asimina*, the number of secondary veins did not differ from those in *Magnolia*, but other characteristics (for example, the behavior of loop-forming branches of secondary veins) were used to differentiate them (Dilcher 1974).

Having found a way to distinguish *Magnolia* from other genera using leaf evidence only, we still needed to distinguish among the various species of *Magnolia*. In *M. acuminata* the angle of divergence of the secondaries from the midrib is usually between 45 and 65 degrees, with the angle tending to be more acute near the leaf apex. Frequently, the secondaries in the basal half of the leaf are recurvate (curving down before curving back up again), especially in proximity to the midrib. These and other venation characteristics peculiar to *M. acuminata* were also found to be present on fossil leaf specimens of the slope magnolia. Other extant *Magnolia* species with leaf shapes comparable to *M. acuminata*, however, show less acute or more acute angles of divergence of the secondaries from the midrib: *M. grandiflora*, 60 to 70 degrees; *M. campbellii* and *M. delavayi*, up to 90 degrees; *M. denudata*, less than 45 degrees.

Further evidence of the close relationship between *M. acuminata* and the fossil slope magnolia was found when we compared ultimate venation structures such as areoles and veinlets under forty-times magnification. Areoles are usually pentagonal or quadrangular shapes formed by the lower order veins. In *M. acuminata* these areoles are usually 0.5 to 1.0 millimeters across. Typically more than half of these areoles contain veinlets that "dead end" inside the areoles. These features are clearly visible in the fossil and appear to closely match those of extant *M. acuminata*. Other extant magnolias (*M. campbellii*, *M. sprengeri*, and *M. delavayi*), however, have larger (2 to 3 mm) areoles, while in *M. grandiflora* and in fossil *M. latahensis* veinlets are rarely present or are indiscernible, possibly because of the leathery leaves.





of the more drought-tolerant and boreal flora found today throughout interior western North America.

Other Miocene fossil records, though less well preserved, indicate that many Clarkia-type floras existed throughout western North America, including the Miocene Latah flora near Spokane, Washington, and the Miocene Puente flora in the Los Angeles area (Axelrod 1939). Fossil *Magnolia corrallina* Chaney, from the Miocene San Pablo (Neroly) flora of west central California, is said to resemble present-day *M. grandiflora* just as the Clarkia *latahensis* does (Condit 1938; Chaney and Axelrod 1959).

More recently, in a report on fossil *Magnolia* seeds found in Brandon lignite of the Oligocene epoch (twenty-five to forty million years ago) in west-central Vermont, Tiffney describes two fossil *Magnolia* species, *M. septentrionalis* and *M. waltonii,* whose seed morphologies suggest affinity to living species of section Theorhodon and section Tulipastrum, curiously similar to the affinities described here for Clarkia fossil *Magnolias.*

The Clarkia evidence, which shows close morphological similarity in the leaves of the Miocene *M. latahensis* and present-day *M. grandiflora* as well as other section Theorhodron species, supports the view proposed by Parks and Wendel that species that persist in the same moist habitats as their Miocene counterparts tend to retain their ancestor's morphological characteristics. In contrast, species found in more xeric habitats today generally show greater morphological divergence from their Miocene ancestors.

Grounds for Speculation

The fragmentary nature of paleobotanical evidence allows, even encourages, speculation. For instance, one can speculate that some twenty-five million years before the present—during the late Oligocene/early Miocene—a species resembling *M. grandiflora* was distributed continuously from what is now far western Canada southward through the Great Basin into Mexico and Central America, then back up through south-central United States into New England and perhaps beyond.

Later, in middle Miocene time—fifteen million years before the present—a large gap in the distribution might have developed in the American Southwest as that region became more arid. At the same time, mountains rising along the western coast of North and Central America would begin starving other Theorhodon populations of moisture, resulting in many disjunctions. And finally, the New England leg of the distribution would shrink southward as the Miocene and Pleistocene climates cooled.

The western North American populations would vanish by the end of the Miocene.

Eventually, in Quarternary time—perhaps as recently as ten thousand years ago—climatic change would force another separation of the Theorhodon distribution between Texas and the disjunctions in Mexico. These Central American disjuncts, having been genetically isolated for so long, have evolved into separate species (Vasquez-G 1990). *M. grandiflora,* which still has a sizable continuous distribution in southeastern United States, is all that remains of the original continental distribution of *M. latahensis.*

A similar migration could be posited for the ancestor of the cucumber magnolia (*M. acuminata*) except that, being a more temperate species, its range may have extended farther north, perhaps originally as far as coastal Alaska during the early Miocene epoch. The fact that the closest living relative to the cucumber magnolia, *M. liliflora,* is found in Asia suggests that the ancestral species could still have been genetically "communicating" across the continents via the Alaska land bridge to Asia during or shortly before the early Miocene. This relatively short period of isolation, about twenty-five million years, might have resulted in the morphological similarity that exists between the two extant section Tulipastrum species, *M. acuminata* and *M. liliflora.*

These scenarios seem plausible, but for now they are largely conjectural, given the fragmentary fossil evidence. But just as the amazing findings at Clarkia have brought us much closer to understanding *Magnolia's* past in North America, future studies there might someday unlock still more secrets.

Acknowledgments

While this manuscript was being prepared, my mother, Adelene Greenwood Figlar, passed away. She was a kind and loving lady and, probably because of me, developed a great fondness for magnolias. This article is dedicated to her memory.

Literature Cited

Axelrod, D. I. 1938. Miocene floras from the western Mohave Desert. *Contributions to Paleobotany,* 55-56. Carnegie Institute of Washington, Publication 516.

Chaney, R. W., and D. I. Axelrod. 1959. *Miocene Floras of the Columbia Plateau.* Carnegie Institute of Washington, Publication 617.

Condit, C. 1938. The San Pablo flora of west central California. In R. W. Chaney et al., *Contributions to Paleobotany.* Carnegie Institute of Washington, Publication 476.

Dilcher, D. L. 1974. Approaches to the identification of angiosperm leaf remains. *Botanical Review* 40(1): 1-157.

Golenberg, E. M., D. E. Giannasi, M. T. Clegg, C. J. Smiley, M. Durbin, D. Henderson, and G. Zurawski. 1990. Chloroplast DNA sequence from a Miocene *Magnolia* species. *Nature* 344: 656-658

Parks, C. R., and J. F. Wendel. 1990. Molecular divergence between Asian and North American species of *Liriodendron* (Magnoliaceae) and implications for interpretation of fossil floras. *American Journal of Botany* 77(10): 1243-1256.

Smiley, C. J., and W. C. Rember. 1979. *Guidebook and Roadlog to the St. Maries River (Clarkia) Area of Northern Idaho.* Moscow: Idaho Bureau of Mines and Geology Information Circular 33: 1-45.

Smiley, C. J., and W. C. Rember. 1981. Paleoecology of the Miocene Clarkia lake (northern Idaho) and its environs. In A. J. Borecot, J. Gray, and W. B. N. Berry (eds.), *Communities of the Past.* Stroudsburg, PA: Dowden, Hutchinson, and Ross, 551-590.

Smiley, C. J., and W. C. Rember. 1985. Composition of the Miocene Clarkia flora. In C. J. Smiley (ed.), *Late Cenozoic History of the Pacific Northwest.* San Francisco, CA: American Association for the Advancement of Science, Pacific Division, 95-112.

Tiffney, B. H. 1977. Fruits and seeds of the Brandon lignite: Magnoliaceae. *Botanical Journal of the Linnaean Society* 75: 299-323.

Vazquez-G., J. A. 1990. Taxonomy of the genus *Magnolia* in Mexico and Central America. Madison, WI: University of Wisconsin M.S. Thesis.

Dick Figlar is a past president of the Magnolia Society who grows more than thirty kinds of *Magnolia* in his own garden in Pomona, New York. He is developing a personal arboretum of *Magnolia* in the foothills of the Blue Ridge Mountains of South Carolina.


Flora Danica Tab. DCLXI.

Notes on Transatlantic Migrants

Stephen A. Spongberg

Records of the early colonial period in New England illustrate the multidirectional plant exchanges that followed the discovery of the New World.

Populations of plant species have been migrating from one part of the world to another for millennia. It has long been known that some plants considered "native" to one region were actually carried by man or his domesticated animals from another region, sometimes continents away. For instance, the chestnut, the filbert, and the "English" walnut trees—all considered thoroughly at home in England—were actually brought there by the Romans in relatively recent times. But the most significant of all floral transmigrations may have been the one begun by Columbus. As early as his second voyage to the New World, Columbus inaugurated a biological exchange of plants, animals, and pathogens between the New and Old Worlds that laid the foundations for colonization of the New World by Europeans in the early seventeenth century and has continued to the present day. From the first, this exchange had tremendous consequences for the aboriginal peoples of the New World as well as for its floras and faunas.

Consequences of equal magnitude were to follow in Europe and throughout the Old World. The exchange fueled the European economy through the exploitation of the New World's abundant natural resources. Equally important, it hastened development of the "new science," which had slowly begun to replace the medieval perception of the world that was rooted in the classical writings of the ancient Greek and Roman scholars.

Columbus' Second Voyage

On that second voyage in 1493, Columbus sailed with twelve hundred men in seventeen ships to Hispaniola. Included in the ships' cargo were seeds and cuttings of common Eastern Hemisphere crops including chickpeas, melons, radishes, onions, salad greens, grapevines, and sugar cane, as well as the stones and seeds of European orchard trees. Later explorers continued to introduce plant species from the Old World to the New. By 1516 the banana had been introduced to the Caribbean region from the Canary Islands. Ginger and garlic—the latter quickly adopted into the diets of the native Americas—were early transplants, and coffee, an Old World plant, was to flourish in the New World where climatic conditions suited its growth. American production of the coffee bean was soon helping to satisfy the Europeans' seemingly unquenchable thirst for the brew, a thirst that initiated the birth of the coffeehouse in England and on the continent.

By the year 1600, twenty years before the Pilgrims landed at Plymouth, all the major food plants of the Old World had been introduced and were being grown in the Americas, doubling or even tripling the number of species that were known as food plants. But scores of

Viburnum opulus, *the guelder rose or snowball, from* Flora Danica, *Volume 4, published in Copenhagen, 1770. By courtesy of the Gray Herbarium Library, Harvard University.*

new plants had in turn been carried back to the Old World in the holds of the caravels and galleons. Peanuts, sweet potatoes, white or "Irish" potatoes, squashes, pumpkins, chile peppers in infinite variety, the tomato, manioc (sometimes known as cassava or tapioca), and beans of many sorts—including the lima, pole, kidney, snap, haricot, and French—all attested to the agricultural prowess of the aboriginal Americans. Most important of all were the numerous varieties of maize or Indian corn—vegetable gold—that were adapted to growing conditions from sea level to well over eight or ten thousand feet in the mountains. While maize was not widely accepted as a human comestible in northern Europe, it quickly found a use as feed for livestock.

Many other New World crops helped to revolutionize Old World cuisines and to provide new crop plants adapted to a wide variety of growing conditions, among them the pineapple, the avocado, cacao (the source of chocolate, which Linnaeus later gave the name *Theobroma*, "food of the Gods"), the papaya and guava, and cashews and Brazil nuts, all of which began to reach European markets in the seventeenth century. In fact, so successful were American food plants in the Old World that the population increase experienced in Europe and elsewhere throughout the Eastern Hemisphere during the sixteenth and seventeenth centuries has been tied to the availability and acceptance of increased food supplies from American crop plants.

Plants the Pilgrims Brought

Specific illustrations of these migrations between the Old World and the New—and back again—can be drawn from surviving records of the early colonial period in New England. When the Pilgrims came ashore on Cape Cod to establish the Plymouth Plantation in 1620, they arrived fully resolved to reestablish their ordered European lifestyle in the new colony. Despite the vegetable abundance of the territory they were colonizing, they came prepared for the worst, not intending to depend upon unknown plants in order to subsist. Therefore, the Pilgrims as well as other colonists who soon followed brought with them seeds of all the vegetables and salad greens familiar in European fields and gardens at that time. Even melons, squashes, cucumbers, and maize, which had been brought to the Old World from the New shortly after Columbus's maiden voyage, returned with the settlers to help them establish in the new colonies gardens similar to those they had left behind in Europe. The pattern of plant introduction established by the Spanish in New Spain was repeated by the English in New England. They too cultivated familiar foodstuffs in order to transplant their version of European society and culture to the wilderness.

Thus history records that on the unusually warm morning of Monday, the nineteenth of March 1621, the Pilgrims set about the task of allotting garden plots to the various families comprising the Plymouth Plantation. Six acres of barley and peas were planted while twenty acres were sown to Indian corn. In their work they were assisted by the kindly Indian Squanto, who, legend has it, instructed them in the Indian technique of planting the kernels in hills that had been fertilized with fish. Familiar with Europeans by virtue of having been kidnapped and taken to Europe but returned to New England before the arrival of the Pilgrims, Squanto was one of the few survivors of the Patuxet group of the Wampanoag tribe, which had been devastated by an epidemic of the plague a few years before 1620.

Soon after 1629, when Governor Endicott arrived at Naumkeag (Salem) and established the Massachusetts Bay Company settlement, the Reverend Francis Higginson, who led the second emigration to the colony, observed the following in a letter carried back to England.

> Our Governor hath already planted a vineyard with great hopes of increase. Also mulberries, plums, raspberries, currants, chestnuts, filberts, walnuts, small nuts, hurtleberries, and haws of white thorn. . . . They have tried our English

> corn [wheat] at New Plymouth Plantation, so that all our several grains will grow here very well, and have a fitting soil for their nature. (Slade 1895)

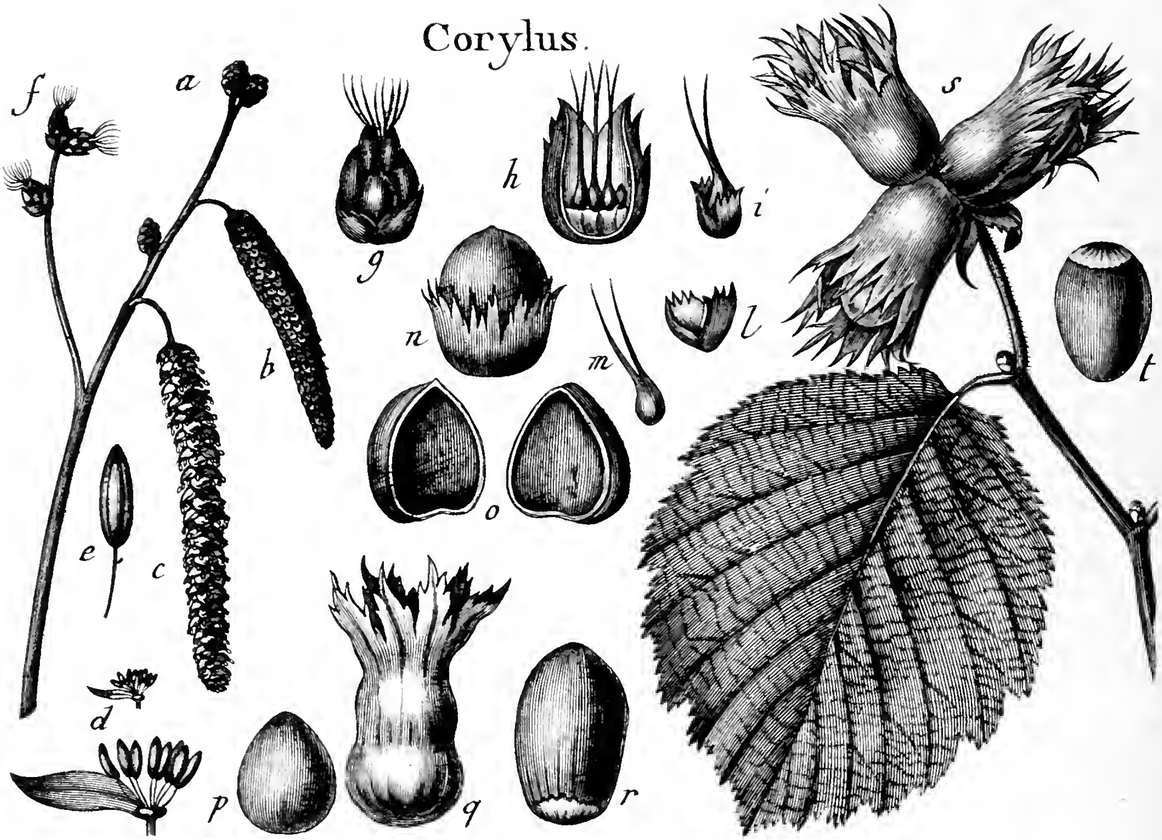
In fact, included in the list of stores that were to be sent to the Massachusetts Bay Colony in 1629 were the following plants and seeds: "vine-planters, wheat, rye barley, oats, a hogshead of each in the ear: beans, pease, stones of all sorts of fruits, as peaches, plums, filberts, cherries: pear, apple, quince kernels: pomegranates, woad seed, saffron heads, liquorice seed, madder roots, potatoes, hop-roots, hemp seed, flax seed, currant plants, and madder seeds" (Slade 1895). Domesticated animals, chickens, pigs, and goats rounded out the biological cargo. Cattle had arrived earlier, by 1624. Not finding suitable species for forage in the native flora, the ineptly named Kentucky bluegrass (*Poa pratensis* L.), white and red clover (*Trifolium repens* L. and *T. pratense* L., respectively), and probably alfalfa (*Medicago sativa* L.) were brought from English meadows and pastures and over the years have become completely naturalized across eastern North America.

Of course, this was not the first migration for many of these species. Of the woody plants listed in Higginson's letter, the chestnut (*Castanea sativa* Miller), sometimes known as the Spanish or sweet chestnut, is native to southeastern Europe, western Asia, and northern Africa, and was probably introduced into England during Roman times. Valued for the sweet meat of its nuts as well as for its timber, the tree was widely planted in England. The nuts were sometimes roasted before open fires or ground with oats or barley to make a kind of bread by the poorer classes. Likewise the filbert (*Corylus maxima* Miller) and "small nuts" (probably *Corylus avellana* L., European hazelnut, and *C. colurna* L., Turkish hazelnut) were valued for their nutmeats and for their extremely tough and flexible shoots that were used to make a variety of objects from hoops and wattles to fasteners for roof thatch. Both the filbert and Turkish hazel are native to

Crataegus oxycantha, *the white thorn or common hawthorn, from* Flora Danica, *Volume 4, published in 1770. By courtesy of the Gray Herbarium Library, Harvard University.*

southeastern Europe and western Asia and had been introduced into Britain, again probably by the Romans, while the European hazel is indigenous to all of Europe including England.

The "English," "Persian," or "royal" walnut (*Juglans regia* L.), native to an area extending from southeastern Europe to the Himalayan region and China, was also widely cultivated throughout Europe by the early seventeenth century, and like the chestnut, filbert, and Turkish hazelnut, had probably been carried to the British Isles in Roman times. Its chief value lay in its edible nuts as well as its fine-

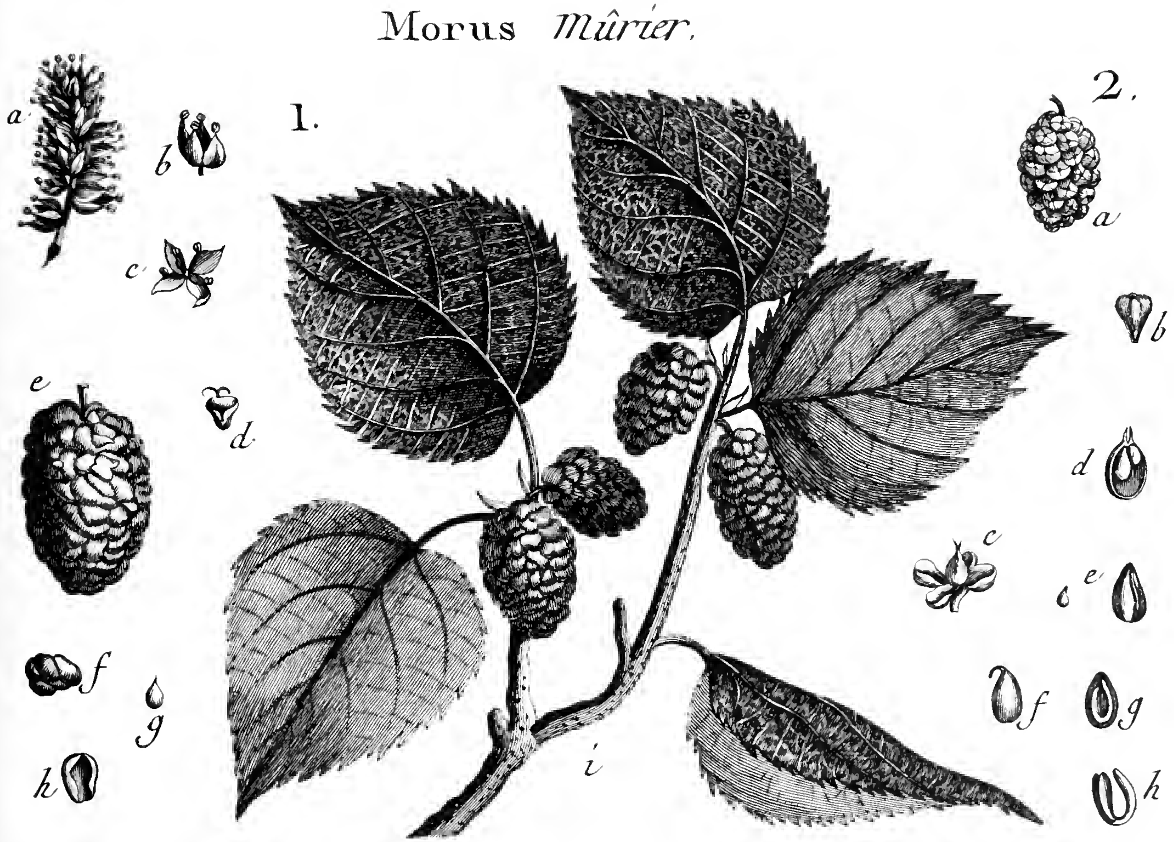


Corylus avellana, *the European hazelnut, from* Recueil de Planches de Botanique de l'Encyclopédie, *Volume 4, 1823. By courtesy of the Gray Herbarium Library, Harvard University.*

grained timber, which was utilized, as it is today, for cabinets and particularly for gunstocks.

White thorn or common hawthorn (*Crataegus oxycantha* L. or, perhaps more correctly, *Crataegus laevigata* (Poiret) De Candolle) is a widely distributed European species that was well known to New England's first settlers. Plants of this small thorny tree were among the first used to create the hedgerows, living fences that remain a characteristic and prominent feature of the English countryside. When planning for the new colony in New England, the Pilgrims doubtless considered the white thorn necessary to protect their garden plots from freely roaming livestock as well as from wild marauding animals. The development of horticulture in the new colony would depend on the settlers' ability to establish enclosures that animals could not penetrate, which may seem strange to us today, living in an era when animals are fenced in rather than out.

But beyond the anticipated need for garden enclosures, the Pilgrims had a variety of other reasons for bringing the hawthorn along on their first voyage to New England. It had long been associated with folk customs and rituals welcoming the spring season. Since Greek and Roman times, the first of May had been a day of celebration that centered on gathering the flowering boughs of the hawthorn. In addition,



Morus alba, *the white mulberry of the Orient, from* Recueil de Planches de Botanique de l'Encyclopédie, *Volume 4, 1823, Paris, which accompanied Lamarck's* Encyclopédie Méthodique. *By courtesy of the Gray Herbarium Library, Harvard University.*

the hawthorn's small, applelike fruits had a history of medicinal use, and many legends tell of the power of its flowers' scent to revive the spirits and counteract poisons. Other legends tell of the use of hawthorn branches to form Christ's crown of thorns or of the plant's miraculous appearance (apparently out of nowhere) to signify a favorable omen of religious import. In all probability, the first colonists carried along to New England not only the hawthorn itself, but all the European traditions, legends, and superstitions associated with it as well.

The mulberries referred to by Higginson could have been either the white mulberry of the Orient (*Morus alba* L.) or the common European or black mulberry (*Morus nigra* L.). Perhaps both species were represented since both were cultivated in England. Governor Endicott of the Massachusetts Bay Company was not the first European to attempt their cultivation in New World soils. As early as 1548 the Spanish had introduced plants of the black mulberry into Mexico, and English settlers had established mulberries in the Jamestown region as early as 1619. An earlier attempt to establish the trees in 1609 had failed when the ship on which the plants were being transported from England was lost at sea.

While the Pilgrims occasionally ate the seedy mulberries, sometimes directly from the tree, it is unlikely that they brought these trees to New England for their fruit. More likely, they included them in their gardens for their milky-sapped leaves, the major food of the silkworm, the larval stage of the silkworm moth (*Bombyx mori*). The trees are therefore prerequisites for sericulture, an industry that Endicott may have intended to establish in New England. Given the enormous demand for silk in England and in other parts of Europe, sericulture might have proved very lucrative for the colonists.

Silk from China was known in Europe from Greek times, and the craze for the luxurious fabric, the "queen of textiles," had resulted in the establishment of trade routes, the so-called silk road, between Europe and Cathay during Greek and Roman times. The closely guarded Chinese technique of sericulture had been brought to Europe at about the beginning of the sixth century by monks who had also carried the precious eggs of the moths concealed in the hollows of their canes; seeds of the white mulberry tree were introduced at about the same time. The industry (including both the animal and plant component) spread through southern Europe and became firmly established in Italy. But by the beginning of the seventeenth century the increasing demand for silk in Europe, particularly by the nobility, prompted James I to issue an edict promoting the planting of mulberry trees in England in order that the industry might be established there. Mulberry seeds were distributed to anyone who would sow them, and steps were taken to encourage the colonists in Virginia to abandon the profitable cultivation of tobacco and replace it with sericulture.

No one has yet succeeded in establishing a silk industry in New England, but the desire to do so gave rise to sporadic experimentation long after the colonial period. In one of these experiments, in 1869, the gypsy moth was introduced from Europe into Medford, Massachusetts, for cross-breeding with the silkworm. The goal was a hybrid that would feed on oak leaves, like the voracious gypsy moth larvae, while possessing the silkworm's unique capacity to produce silk. The desired hybrid was never produced, but the effects of this experiment are still visible in the damage to northeastern forests that began when gypsy moths were accidentally released from their cages.

A Living Apothecary

The early colonial gardens also included many imported nonedible plants, some of which have become naturalized in New England, but the seeds for these plants were not given space in the settlers' tightly packed chests for their ornamental value. Just as today's travelers invariably include aspirin and any required prescription drugs in their luggage, so did the Pilgrims include medicine chests in the form of seeds with their other essential belongings. The colonists' ability to survive and establish themselves permanently across the Atlantic would depend on their success in growing medicinal herbs, since medical practice of the time still relied on these "simples," or their lookalikes, the bulk of which had been listed by Dioscorides, Pliny, and Theophrastus in Greek and Roman times.

In the summer of 1631, the *Lyon* dropped anchor in Agawam (Ipswich) harbor, bringing to John Winthrop, Junior, an assortment of seeds from England, perhaps to reestablish plants that had not survived the previous winter. A list of the species represented has survived, showing not only a variety of vegetable seeds but numerous medicinal herbs as well. Ann Leighton, in her *Early American Gardens: "For Meate or Medicine,"* made the following observations about the plants on the list.

> The list of seeds could have belonged to any distinguished Pompeian householder, except for a few additions of hardier plants culled from the English countryside and brought into garden cultivation before the colonizers of William the Conqueror arrived with a few reliable herbs of their own. There is no concrete example of the many thrilling new discoveries which suddenly burst upon gardeners and willing experimenters in the art of physic from the Spanish conquests in South America—even to tobacco. On the

NEWS

from the Arnold Arboretum

The Renovation Nears Completion

Robert E. Cook, Director

The essence of the Arboretum is nowhere captured more fully than in the design of the new entrance to our just-renovated Hunnewell Building. The challenge here was to develop a means of surmounting our original set of eight slate steps with a wheelchair ramp that was consistent with both the spirit of the 1992 Americans with Disabilities Act (ADA) and the mission of the Arboretum. Through a creative design by landscape architect Carol Johnson, our new entrance seamlessly weaves a gently rising and accessible sidewalk into the historical character of our 1892 building.

The effective solution lay in the use of earth for elevation. Now as you look at the entrance from the road out front, you see a set of new, bluestone steps, straddled on each side by black, wrought-iron railings. They rise up nearly eight feet to an elevated plaza edged with elegant wooden benches. Behind this platform stand our historical oak doors, newly restored with their oversized iron hinges and black metal grills. To each side of the seating area a grassy berm drops gently to the ground.

Climbing the steps, you realize that accessibility has been achieved with a branch in the sidewalk that splits from its beginning at the road to follow the berm of earth along its ridge, rising to enter the seating arena at its edge. A slightly sloping bluestone bridge carries the visitor past the massive wooden doors into the building.

The entire landscape has been planted with mature woody specimens that have been chosen to illustrate the long historical interest of the Arboretum in the flora of Asia and its close relationship to the flora of eastern North America. This provides an exceptional opportunity to conduct an excursion into the collections within one hundred feet of the entrance.

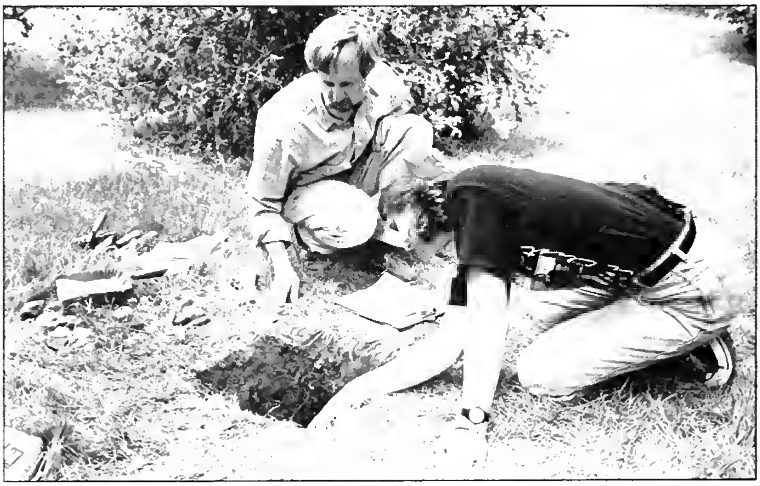
The renovation, as beautifully captured in this new entrance, has sucessfully integrated the regulatory requirements of a modern research and educational facility serving the public interest while preserving the historical integrity of our landmark building. It is a fitting symbol for an institution committed to the highest quality in its programs consistent with the preservation of its traditional mission to advance our knowledge and understanding of trees.

Japanese Delegation Tours Arboretum

On June 30 the Arboretum was honored with a visit by the Japanese Association of Botanical Gardens. Comprised of directors of Japanese Botanical Institutions, the delegation is touring major American gardens to learn about our methods of curation and management.

Archaeologists Dig the Arboretum

Richard Schulhof,
Assistant Director for
External Relations



Thousands of years before Charles Sprague Sargent began planting the Arboretum, the landscape was home to a number of prehistoric settlements. This past spring City Archaeologist Steven Pendery of the Boston Landmarks Commission (seen on the left in the photo) investigated this history with a dig conducted in the vicinity of Bussey Brook valley.

Working with a grant from the National Park Service and support from the Arnold Arboretum, Dr. Pendery uncovered evidence that the area has been inhabited repeatedly over the past six to eight thousand years. Of the site and its significance he reports, "The Spring Village site appears to have been occupied periodically over thousands of years precisely because of its strategic setting with ready access to food and water resources. Its relationship to other natural resources and sites within the surrounding 265 acres can still be studied. This type of site probably survives nowhere else so close to Boston."

The project was greatly assisted by an energetic group of volunteers that included thirty Boston teachers who participated through a collaboration between the Boston Public Schools and the National Faculty Program.

Chris Strand Joins Arboretum Staff

The Arboretum is pleased to announce that Chris Strand has joined the staff as Outreach Horticulturist. Chris is a graduate of the University of Delaware's Longwood Program and previously served as an interpretive horticulturist at Callaway Gardens in Georgia. At the Arboretum, he will work with visitor education, orientation, and public services programs, and pursue his special interest in the interpretation of botanical collections.

As always, summer brought interns to the Arnold Arboretum. Their training here includes hands-on experience in grounds maintenance, labelling and mapping, and plant propagation. They also participate in plant identification classes and join Arboretum staff members for tours and talks. 1993 interns are, from left to right, Angela Cerruti, Jochen Martz, Sandra Chuck, Joan Mullins, Alana Dudley, Keith LeBlanc, Tracey Goldberg, Jason Diauto, Mark Dugan, and John Evers. David Giblin is missing from the photo.

Choice and Unusual Plants for New England Gardens

Annual Plant Sale, Auction and Members' Bonus

of

The Arnold Arboretum of Harvard University

Sunday, September 19, 1993

TO BE HELD AT THE

CASE ESTATES

135 Wellesley Street, Weston, Massachusetts
For more information and plant sale catalogues, call (617) 524-1718.

Plant Information ***Lunch***

EVENTS OPEN TO THE PUBLIC

Plant Sale
10:30 AM - 2:00 PM

Annual Silent Auction of Selected Plants
9:00 AM - 1:00 PM
TABLES CLOSE SEQUENTIALLY BEGINNING AT 11:00 AM

Specialty Plant Societies Sales and Information
9:00 AM - 2:00 PM

Members receive bonus plants and discounts beginning at 9:00 AM. Become a member today.

whole Winthrop's seed list is a very old and reliable one indeed, well tried for more than a thousand years.

Plants for Beauty

Unlike medicinal and culinary herbs, ornamental plants were not essential to the establishment of European settlement in New England, but no doubt a few were brought from English and Dutch gardens if only for sentimental reasons. The common lilac (*Syringa vulgaris* L.), native to mountainous regions of eastern Europe, had been introduced into western Europe in the middle of the sixteenth century. Although no documentation has been located, it was probably one of the first exotic shrubs to be carried from Old World gardens to newly established ones across the Atlantic. It has become as characteristic of New England gardens as it is of English villages, and in New England its longevity and persistence in fields and woodlands often signal the site of a now abandoned homestead.

Circumstantial evidence suggests that the common barberry (*Berberis vulgaris* L.) was also an early introduction into New England. The alternate host of black stem rust disease of grain, the barberry provides an essential link in the life cycle of the microscopic rust plant. Without the barberry as alternate host the rust cannot infest wheat, oats, barley, and rye, and without these grains, barberries are likewise apt to be free of the rust. But if barberries and grains grow near one another the conditions are satisfied for the growth and reproduction of the rust, and grain plants in the vicinity will become infected by its airborne spores. Damage to the grain plant ensues, reducing considerably the amount and quality of the crop yield. Apart from small, orange, circular pustules that appear on the upper surfaces of its leaves, infected barberry plants show few if any effects from the rust.

Wheat or "English corn," rye, barley, and oats were among the staple crop plants brought to New England by the earliest settlers, and damage to these grains was noted at an early

Berberis vulgaris, *the common barberry, from* Icones Plantarum Medicinalium *by Joseph Jacob Plenck, published in Vienna, 1790. By courtesy of the Gray Herbarium Library, Harvard University.*

date. While the relationship between the rust disease of cereal grains and the barberry shrub was not proven scientifically until early in the nineteenth century, the cause and effect relationship must have been fully suspected by the middle of the eighteenth century. In 1726 the Connecticut colony, followed by Massachusetts in 1755, enacted legislation forbidding the planting of barberries and promoting their eradication. Presumably, large enough populations of barberries were present in those two colonies to support the rust and cause widespread damage to the grain crops, prompting concern and legislation.

Like the white thorn, the spiny barberry shrubs were undoubtedly imported primarily as hedging plants; their dense habit of growth coupled with their sharp spines formed an imposing barrier to both man and animal. Barberries offered an expedient substitute for the more labor-intensive process of fence or stockade building when a low enclosure was desired. The plant was also useful in other ways. The bark of the roots and stems provided a yellow dye, and the pleasingly acidic leaves served as seasoning for meat and as a salad green. The small red fruits were frequently used for syrups and jellies, and—because of their astringency—as a purgative and all-purpose tonic. Tolerant of shade as well as full sun, seedlings had probably become established in the woodlands surrounding settlements by the early eighteenth century, where, despite attempts to eradicate them, survivors can still be found today.

Another imported shrub that may have been among the first woody ornamentals cultivated in New England is the guelder rose or snowball, not a rose at all but a form of the European cranberry bush (*Viburnum opulus* L.). Known from European gardens since the sixteenth century, its large, snowball-like inflorescences formed by numerous double, sterile flowers made the guelder rose an immediate favorite as a decorative shrub. Not known as a wild plant, this garden form is reputed to have originated in the Netherlands, in Guelderland.

The numerous fruit trees introduced into New England by the first colonists not only yielded essential and valuable harvests of

Malus sylvestris, *a parent of apple cultivars, from* Flora Danica, *Volume 7, 1799. By courtesy of the Gray Herbarium Library, Harvard University.*

apples (cultivars selected from complex hybrids probably involving *Malus sylvestris* Miller, *Malus dasyphylla* Borkhausen, and *Malus praecox* (Pallas) Borkhausen), pears (cultivars of *Pyrus communis* L., another complex hybrid involving several species), peaches (*Prunus persica* (L.) Batsch), and plums (cultivars of *Prunus domestica* L., a probable hybrid between *Prunus spinosa* L., the sloe, and *Prunus cerasifera* Ehrhart), but also added to the beauty of the landscape when in flower. Until the middle of the eighteenth century the

Prunus domestica, *the common plum, from* **Medical Botany** *by William Woodville, M.D., Second Edition, Volume 3, published in London, 1810. By courtesy of the Gray Herbarium Library, Harvard University.*

few written accounts that document horticultural and agricultural activities in New England focus primarily on the development of orchards throughout the settled areas, recording the yields of particular harvests and commenting on the sporadic origin and attributes of new varieties of apples, pears, and other orchard fruits.

At the same time that the first settlers in the wilderness of New England were trying to establish an agrarian society based on the traditional European model, gardening in Europe was experiencing a minor revolution. For centuries the only plants cultivated other than staple food crops had been the simples required for practicing the type of medicine brought by the Pilgrims to New England. Largely confined within the walls of monasteries during the Middle Ages, the "physic gardens" that provided simples slowly became linked with universities and the teaching of medicine. In 1542 the first botanical garden in Europe was established at Padua, west of Venice in northern Italy. Soon after, botanical gardens were established in Montpellier, in Paris, and in Germany, and plants became the focus of experimentation and close observation as well as the objects of increasingly accurate illustrations. Botanical knowledge was documented in the great illustrated herbals that were produced from the late fifteenth century well into the late seventeenth century, primarily serving the medical community and only secondarily the broader botanical community.

But by the middle of the sixteenth century, with the increasing number of new plants that were introduced into Europe from the Levant, Asia, and the Americas and with the increased awareness of the natural world that had been thrust upon European society by the discoveries of their navigators, gardening and the cultivation of curiosities became pastimes of royalty and the wealthy. Even the flora of Europe itself was scrutinized for the first time since the Greeks and Romans. Plants were placed in the landscape for architectural effect; flowers were arranged to beautify banquet tables, and gardens became pleasure grounds.

All of North and South America contributed to the gardens of Europe, and dried specimens of botanical novelties from the Americas as well as Africa and Asia accumulated in the European centers of botanical study, which were in an embryonic stage when the first settlers brought their familiar food plants and medicinal herbs to the New World. The immigrants to New England left Europe at a time when plants were just beginning to be studied and appreciated in their own right, over and above their economic potential or their real or imagined medicinal value. Slowly and then with a quickened pace, in gardens, in "cabinets" of natural history, and in libraries, the materials—dried specimens, the living plants themselves, and increasingly detailed publications about plants—began to accumulate. These materials would enable botany to emerge as a branch of science distinct from medicine. Botanical and horticultural exploration would follow, the two alternating in emphasis, but always closely linked.

The Pilgrims and other early settlers cannot be given credit for bringing a multitude of horticultural treasures to New England, but they did play a part in the biological exchange that followed the discovery of the New World by establishing in New England the basic food plants we still rely on. Each succeeding generation of New Englanders would produce individuals who played increasingly active and important roles in the development of botany, horticulture, and plant introduction in the "newe founde world."

Sources and Suggested Reading

Arciniegas, G. 1986. *America in Europe: A History of the New World in Reverse.* San Diego: Harcourt Brace Jovanovich.

Crosby, A. W., Jr. 1972. *The Columbian Exchange: Biological and Cultural Consequences of 1492.* Contributions in American Studies No. 2. Westport, CT: Greenwood Press.

Dodge, B. S. 1959. *Plants That Changed the World.* Boston: Little, Brown and Company.

Ewan, J. 1968. Traffic in seeds and plants between continental North America, England, and France during the seventeenth century. *Résumés des Communications/Sommaires, XII Congrès International d'Histoire des Sciences,* Paris, August 25-31

——— 1969. Silk culture in the colonies, with particular reference to the Ebenezer Colony and the first local flora of Georgia. *Agricultural History* 43: 129-141.

——— 1971. Traffic in seeds and plants between continental North America, England, and the Continent during the 16th and 17th centuries. *Actes: Histoire des Sciences Naturelles et de la Biologie* 8: 47-49.

Hamilton, E. J. 1976. What the New World gave the economy of the Old. In: *First Images of America: The Impact of the New World on the Old,* Vol. II. Berkeley: University of California Press.

Heald, F. D. 1926. *Manual of Plant Diseases.* New York: McGraw-Hill Book Company.

Heath, D. B., ed. 1986. *Mourt's Relation: A Journal of the Pilgrims at Plymouth.* Cambridge: Applewood Books.

Hedrick, U. P. 1950. *A History of Horticulture in America to 1860.* New York: Oxford University Press.

Jones, E. L. 1974. Creative disruptions in American agriculture, 1620-1820. *Agricultural History* 48: 510-528.

Leighton, A. 1970. *Early American Gardens: "For Meate or Medicine."* Boston: Houghton Mifflin Co.

McManis, D. R. 1975. *Colonial New England: A Historical Geography.* New York: Oxford University Press.

Rahn, J. E. 1982. *Plants That Changed History.* New York: Atheneum.

Sauer, C. O. 1941. The settlement of the humid East. In: *Climate and Man: Yearbook of Agriculture.* Washington, D.C.: United States Department of Agriculture.

——— 1971. *Sixteenth Century North America: The Land and the People as Seen by the Europeans.* Berkeley: University of California.

Slade, D. D. 1895. *The Evolution of Horticulture in New England.* New Rochelle, New York: The Knickerbocker Press, O. P. Putnam's Son's.

Tuckerman, E, ed. 1865. Introduction and Notes. In: *J. Josselyn: New England's Rarities.* Boston: William Veazie, 1865.

Stephen Spongberg is horticultural taxonomist at the Arnold Arboretum and author of *A Reunion of Trees: The Discovery of Exotic Plants and Their Introduction into North American and European Landscapes.*

A Habit to Cultivate

Gary Koller

Securinega suffruticosa, a plant that's both tough and graceful, deserves some recognition.

Visually and spatially unsatisfactory landscapes often result from the need to keep the size and scale of plants within bounds. To control them people tend to get out their shears and execute a crewcut no matter what the plant or the time of year or how the pruning will affect growth or flowering next year. The only thought is to keep the plant at bay with as little time, effort, and expense as possible. The shears appear and the disfigurement of the plant begins.

Plants that were meant to grow together as a mass or thicket end up as tight little gumdrops. Whatever the plant's innate grace and beauty, it is lost, maybe forever, and as added injury its maintenance needs have just escalated. Keeping the plant frozen as an awkward caricature raises the chore level considerably.

As often as not, the fault lies in the initial selection. The plant may simply be too big for its location, and this is where the workings of the market come in. The nursery industry seeks plants that propagate easily, in cost-effective percentages. They must grow rapidly, ideally reaching a marketable size in eighteen to thirty-six months. But plants that grow that fast in the nursery almost always continue at the same rate once they're established in the home garden. They quickly outgrow the space allotted them.

Enter the buying habits of the too-typical gardener. At one time or another we've all succumbed to the attractions of a plant in full, glorious flower and thrown to the winds any consideration of how much and how quickly that plant will grow. (As a general rule of thumb most shrubs grow as wide as they are tall—a six-foot tall shrub will be six-foot wide.) Just as in the long run the overall composition of plants is more important than the effect of any one individual, so a cohesive, billowy, free-flowing effect is more important than an ephemeral floral or seasonal effect. This is where the plant's habit, or form, comes into play. In plant selection habit often takes precedence over any other characteristic, such as flower color or size. Plants that play their part without constant restraint become very valuable, and some of those plants may well lack major ornamental qualities as we generally think of them. Such a plant is *Securinega suffruticosa*, the fountain hardhack, which does not merit its almost total anonymity. It deserves to be known and used, especially for its graceful form and size.

A Cascade of Foliage

Securinega suffruticosa matures from upright branching into a gradual outward arch that in summer is a bright yellowish green. In autumn the cascading effect is enhanced when the foliage turns a clear, bright, buttery yellow. Its saturated color and delicate, airy texture combine to form a golden waterfall.

In winter the plant presents another pleasing effect when its colony of twiggy stems mimic a

A group of four sixteen-year-old Securinega suffruticosa *plants grow on a dry bank near the top of Bussey Hill at the Arnold Arboretum. They were propagated from seeds collected in South Korea on the Arnold Arboretum expedition of 1977. Photo by Margot Balboni.*

miniature woodland. Whereas in summer the new stems are a bright green, in fall they turn a light tan that contrasts with the darker browns and blacks of most shrubs and trees.

The foliage is alternate with a simple, ovate shape. In late summer the plant bears a multitude of small greenish yellow flowers in the leaf axils, but the blossoms will be missed by all but the most observant. The fruit, the size of a small peppercorn, is divided into three sections with three to six seeds and adds an interesting beading effect to the branches. It ripens from pale green to brown at maturity. At some point in the ripening process the capsules burst open and fling out their contents, reaching distances of three to five feet or more. Germination trials indicate that optimum results occur after three months of cold stratification.

A member of the spurge family (Euphorbiaceae) that is native to northeast Asia, *Securinega suffruticosa* was introduced to cultivation in North America by the Arnold Arboretum in 1881. In *The Flora of Japan* Jisaburo Ohwi reports that it is a common native that grows in thickets and on grassy slopes in the lowlands of Honshu, Shikoku, and Kyushu. Cultivations of *Securinega* in the Arboretum landscape represent several wild populations. In the autumn of 1977 Stephen Spongberg and Richard Weaver brought back wild-collected seeds from South Korea. In 1984 botanists from the Research Institute of Ecology and Botany, Vacratot, Hungary, collected seeds from a mixed, rocky, broad-leaved forest and pinewood on granite hills at three hundred meters altitude in North Korea, and shared these seeds with us, helping to further expand the genetic diversity of our living collections.

A Variable Habit

The plant's habit varies with age and vigor. At the Arnold Arboretum a planting approximately five years old grows in full sun at the top of a dry bank. Here the plants range in height from five to eight feet tall, and they remain upright overall. Elsewhere on the grounds a ten-year-old planting that stands in dappled shade has grown three to four feet tall and has acquired a strongly arching habit. Much older plantings also share this size and shape.

At the Arnold Arboretum these plants thrive in full sun to light shade, and they seem exceptionally tolerant of dry conditions. To my knowledge there is no history of dieback from either winter damage or summer heat and drought. Indications are that the plants will not tolerate heavy or poorly drained soils nor an exposure of more than moderate shade. The plants are hardy to at least USDA Zone 4. The occasional occurrence of spontaneous seedlings suggest that the plant may prove invasive, a potential that should be guarded against.

The bright yellowish green of the summer foliage mixes well with other plants to create compositions of shape, texture, and form. For autumn and winter viewing *Securinega* makes an excellent thicket for border plants, useful in parks and smaller-scale residential landscapes. Its drought and cold tolerance as well as its graceful habit make it an excellent candidate for difficult conditions such as rooftops and other situations requiring large containers. It might even serve as a delicate barrier in highway median strips.

In 1992 I featured this plant in *American Nurseryman,* a publication of the nursery trade, but response was limited to one or two requests for seed. This reflects the trade's need to stay with proven winners, which in turn contributes to landscape plantings that are tried, true, and boring. Nurseries will not produce this plant—and we will not discover the full potential of this quiet but beautiful Asian shrub of tough character and graceful habit—until innovative gardeners and landscape designers are willing to experiment with it.

The Andersen Horticultural Library's *Source List of Plants and Seeds,* which lists commercial sources for over 47,000 plants, includes one for *Securinega suffruticosa:* Sheffield's Tree and Shrub Seed, 273 Auburn Road, Route 34, Locke, New York 13092. We have collected seeds from established plantings at the Arnold Arboretum and will be happy to supply a packet to anyone who asks. You need only send to my attention a self-addressed, stamped envelope and a donation of $5 to help defray our expense in supplying the seeds.

Gary Koller is Senior Horticulturist at the Arnold Arboretum and Lecturer in the Department of Landscape Architecture at the Harvard Graduate School of Design.

Faith in a Seed and a Squirrel: Book Review and Excerpt

Peter Del Tredici

Faith in a Seed: The Dispersion of Seeds and Other Late Natural History Writings. Henry David Thoreau, edited by Bradley P. Dean. Island Press/Shearwater Books, 1993. 283 pages with line drawings by Abigail Rorer. Hardcover. $25

For most Americans, especially those who were assigned *Walden* in college, Thoreau sticks in the mind as a homespun philosopher-hermit who willingly went to jail for his beliefs. But students who dig a little deeper find another Thoreau, a naturalist tramping the fields and forests of Concord, recording minute observations, and trying to tie them together in a unified natural philosophy.

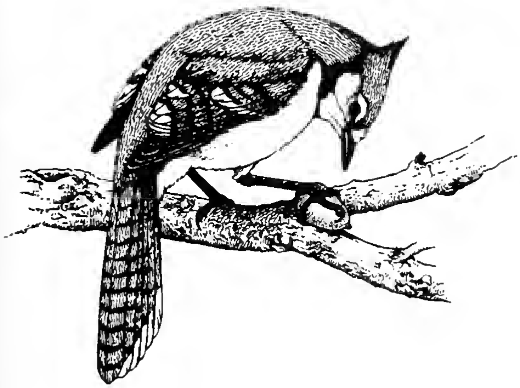
Until now, this other Thoreau was visible only in his journal—some three thousand pages of it—which, while fascinating to browse, cannot be considered a finished literary work. In the later part of his life Thoreau undertook to organize his natural history observations into a coherent work of science. He died before the task was complete, leaving behind two unpublished manuscripts, "The Dispersion of Seeds," published in its entirety in this volume (154 pages), and "Wild Fruit," only a small part of which is published here (27 pages).

The main body of "Dispersion" consists of a description of the various mechanisms by which seeds of common New England trees are dispersed—wind, water, and animals—along with a painstaking discussion of his theories on the relationship between seed dispersal and forest succession. For those who have read the essay entitled "The Succession of Forest Trees," published in 1860, much of the information on forest succession will not be new. That essay can be viewed as a preamble to "Dispersion," which covers the same ideas but with many more details to support the theories. Indeed, it is precisely these details that form the heart of "Dispersion," just as they form the heart of all natural history studies.

Had "Dispersion" been published at the time Thoreau wrote it, the book would most certainly be considered a seminal volume, significant for its groundbreaking treatment of interrelationships between plants and animals—a field that has recently become fashionable under the name *coevolution.* Because "Dispersion" did not appear in print until 1993, one hundred and thirty-one years after it was written, the book is primarily valuable for the light it sheds on Thoreau's mind and for its descriptions of New England natural history.

For this reviewer the most interesting parts of the book are those that deal with Thoreau's concept of forest succession, incomplete and somewhat skewed though it is. The core of this idea, as he saw it, is that forests are in a continual state of flux and the dominant species of today will be replaced by others tomorrow. A key ingredient in Thoreau's theory is that birds and small rodents play a crucial role in this process by "planting" the seeds of the replacement generation. Indeed, the idea expressed most frequently in "Dispersion" is that squirrels are the ones who are responsible for making the New England forests look the way they do. To a certain extent, possibly in reaction to the creationist view of nature then prevailing, Thoreau portrays the homely gray squirrel as the driving force behind forest succession, exaggerating its role and going so far as to attribute to the creature a small measure of consciousness about its forest-planting activities.

In the following passages Thoreau's customary brilliant attention to detail is accompanied by a less customary use of scientific method. Note, too, that he proposes that the earth itself is a living organism, presaging James Lovelock's "Gaia" hypothesis by at least a hundred and ten years.



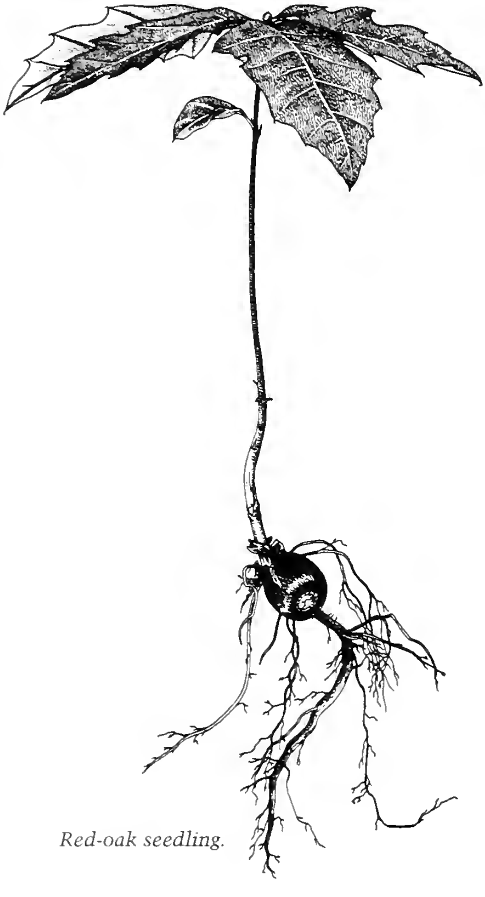
Yes, these dense and stretching oak forests, whose withered leaves now redden and rustle on the hills for many a New England mile, were all planted by the labor of animals. For after some weeks of close scrutiny I cannot avoid the conclusion that our modern oak woods sooner or later spring up from an acorn, not where it has fallen from the tree, for that is the exception, but where it has been dropped or placed by an animal.

Consider what a vast work these forest planters are doing! So far as our noblest hardwood forests are concerned, the animals, especially squirrels and jays, are our greatest and almost only benefactors. It is to them that we owe this gift. It is not in vain that a squirrel lives in almost every forest tree or hollow log or wall or heap of stones.

Thus, one would say that our oak forests, vast and indispensable as they are, were produced by a kind of accident, that is, by the failure of animals to reap the fruits of their labors. Yet who shall say that they have not a dim knowledge of the value of their labors?—that the squirrel when it plants an acorn, and the jay when it lets one slip from under its foot, has not sometimes a transient thought for its posterity, which at least consoles it for its loss?

But what is the character of our gratitude to these squirrels—to say nothing of the others—these planters of forests, these exported dukes of Athol of many generations, which have found out how high the oak will grow on many a mountain, how low in many a valley, and how far and wide on all our plains? Are they on our pension list? Have we in any way recognized their services? We regard them as vermin. The farmer knows only that they get his seed corn occasionally in the fields adjacent to his woodlot, and perchance encourages his boys to shoot them every May, furnishing powder and shot for this purpose, while perhaps they are planting the nobler oak-corn (acorn) in its place—while up-country they have squirrel hunts on a large scale every fall and kill many thousands in a few hours, and all the neighborhood rejoices. We should be more civilized as well as humane if we recognized once in a year by some symbolical ceremony the part which the squirrel plays in the economy of Nature.

. . .



Red-oak seedling.

On entering the wood I began at once to look about carefully for oak seedlings or anything else of the kind, and directly, in a part of it almost exclusively oak, I was surprised to see a cluster of little chestnuts six inches high and close together. Working my hand underneath, I easily lifted them up with all their roots—four chestnut trees two years old, which had partially died down the first year, yet were quite flourishing, with the four great chestnuts from which they sprang still attached, but not the burr; and also four small acorns which had sent up puny little trees of the same age beneath the chestnuts, but it is remarkable that these were either dead or dying. These eight nuts all lay within a diameter of two inches, about an inch and a half beneath the present leafy surface, in a very loose soil of but half-decayed leaves. I have no doubt that they were buried there two falls ago by a squirrel, or possibly a mouse.

Burr of the American chestnut (Castanea dentata).

It is very rare that you distinguish a seedling chestnut in this neighborhood, and I do not *remember* that I had ever met with any of *this age* before, though it is very likely that I have. I had come forth on purpose to look for them, but did not expect to find them so soon. Such is the difference between looking for a thing and waiting for it to attract your attention. In the last case you are not interested at all about it, and probably will never see it.

Nevertheless, I was surprised at the sight of these chestnuts, for these are not to my knowledge, and I am thoroughly acquainted with that wood, any seed-bearing chestnut trees within about half a mile of that spot, and I should almost as soon have expected to find chestnuts in the artificial pine grove in my yard.

• • •

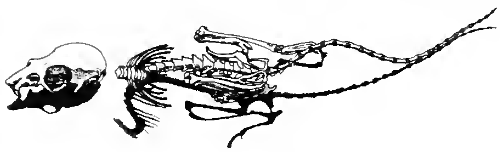
As I proceeded onward over hill and dale through the mixed pine and oak woods toward Lincoln, with my eyes more widely open than ever, now *looking for* chestnuts and not waiting for them to call to me, I found many chestnut seedlings two or three years old, and some older and even ten feet high, scattered here and there but more numerous as I approached the chestnut woods. I should say that on an average there was one every half-dozen rods, made more distinct by their yellow leaves on the brown ground, which was the more surprising to me because I had not attended to the spread of the chestnut before, and every one of these came from a chestnut placed there by a quadruped or bird, which had brought it from further east, where alone it grew.

• • •

Exploring one of the old limestone quarries in the north part of Concord in November, I noticed in the side of an upright sliver of rock, where the limestone had formerly been blasted off, the bottom of the nearly perpendicular hole which had been drilled for that purpose, two or three inches deep and about two and a half feet from the ground, and in this I found two fresh chestnuts, a dozen or more peavine (*Amphicarpaea*) seeds, as many apparently of winterberry seeds, and several fresh barberry seeds, all bare seeds or without the pericarp, mixed with a little earth and rubbish.

What placed them there—squirrel, mouse, jay, or crow? At first I thought that a quadruped could hardly have reached this hole in the perpendicular side of a rock, but probably some rude kinds could easily; and it was a very snug place for such a deposit. I brought them all home in order to ascertain what the seeds were, and how they came there. Examining the chestnuts carefully in the evening, and wondering if so small a bird as a chickadee could transport one, I observed near the larger end of one some very fine scratches, which it seemed to me might have been made by the teeth of a very small animal while carrying it—certainly not by the bill of a bird, since they had pricked sharply into the shell, sucking it up one way. I then looked to see where the teeth of the other jaw had scratched it, but could discover no marks and was therefore still somewhat in doubt about it.

But an hour afterward I examined these scratches with a microscope, and then I saw plainly that they had been made by some fine and sharp cutting instrument like a pin, which was a little concave and had plowed under the surface of the shell a little, toward the larger end of the nut, raising it up. And, looking further, I now discovered on the same end at least two corresponding marks made by the lower incisors, plowing toward the first and about a quarter of an inch distant. These were scarcely obvious to the naked eye, but quite plain through the glass. I now had no doubt that they were made by the incisors of a mouse, and comparing them with the incisors of the common wild or deer mouse (*Mus leucopus*, whose skeleton I chanced to have), I found that one or two of the marks were exactly the middle of its two incisors combined, or about a twentieth of an inch, and that the others, though finer, might have been made by them; and the natural gape of the jaws corresponded. On one side at least it had taken fresh hold once or twice. I have but little doubt that these seeds were placed there by a deer mouse, our most common wood mouse.



*Skeleton of a deer mouse (*Mus leucopus*).*

The other chestnut, which had no marks on it, I suppose was carried by the stem end, which was now gone from both. There was no chestnut tree within twenty rods.

These seeds thus placed in this recess will help to account for chestnut trees, barberry bushes, and so on growing in chinks and clefts, where we do not see how the seeds could have fallen. There was earth enough even in this little hole to keep some very small plant alive.

• • •

The consequence of all this activity of the animals and of the element in transporting seeds is that almost every part of the earth's surface is filled with seeds or vivacious roots of seedlings of various kinds, and in some cases probably seeds are dug up from far below the surface which still retain their vitality. The very earth itself is a granary and a seminary, so that to some minds its surface is regarded as the cuticle of one great living creature.

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

Ecology for Your Backyard: Book Review

Edward Stashko

Noah's Garden: Restoring the Ecology of Our Own Backyards. Sara Stein. Houghton Mifflin Company, 1993. 294 pages. Hardcover. $21.95

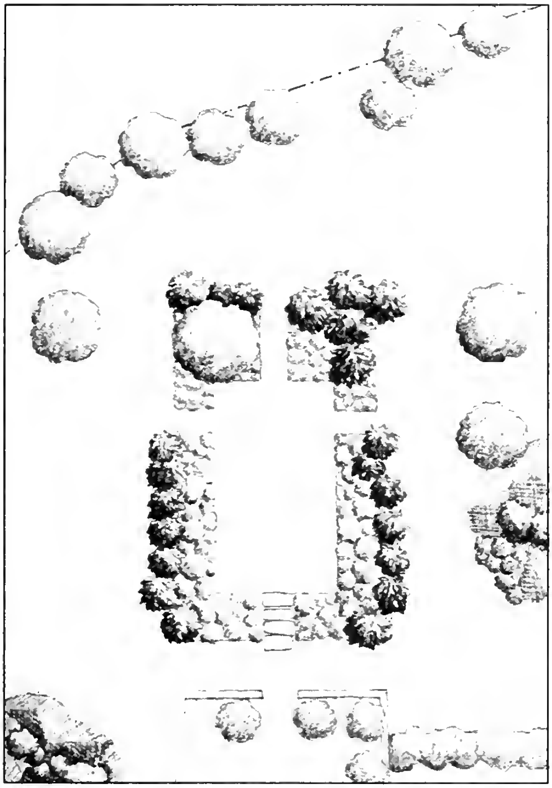
The axiom "Think globally, act locally" urges us to preserve our wetlands and protect endangered species, but nonetheless it has often been easy to miss the ecological opportunities that exist in our own backyards. Sara Stein's new book tells a fascinating story of her personal discovery of the magical ecological processes that unfold in her backyard garden or, better said, the portion of the ecosystem that is found within her backyard.

The design of landscapes has for too long been overly concerned with form and structure at the expense of the functions of the landscape, both within itself and its relationship to surrounding areas, as Stein began to recognize just as she and her husband Marty finished creating what has become the epitome of the suburban landscape—great expanses of rolling lawns, liberal use of yews as foundation plantings, exotic specimen trees, and flower beds neatly confined in rectangular beds, raked and weeded free of any untidiness. Her uneasiness with the results of their hard labors coincided with the completion of her previous book, *My Weeds: A Gardener's Botany,* which documented the taming of their New England garden. After clearing brush, removing rocks, cutting down trees, repairing stone walls, establishing lawns, and digging flower beds, they quickly realized that by opening their landscape for themselves they had closed it to all manner of animals.

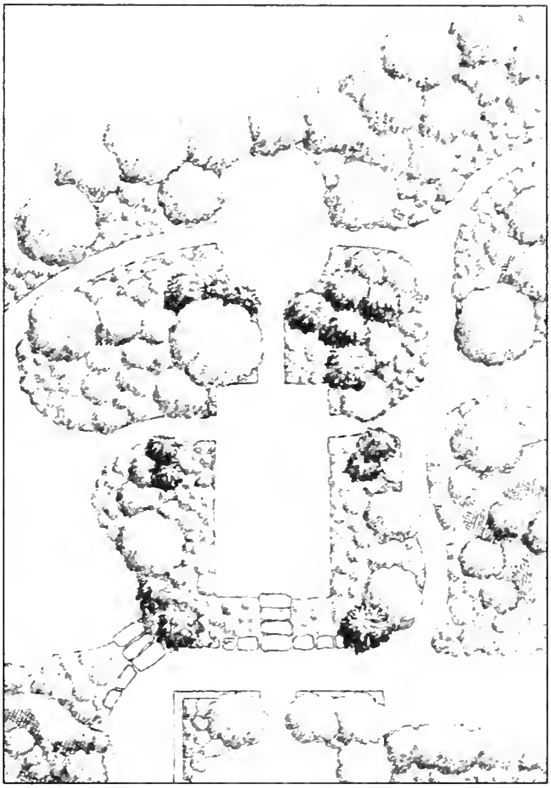
Stein's discomfort arises when she compares the sterility of her typical suburban garden with the richness of the landscapes of her childhood. Where had all the fireflies and frogs gone? Why didn't the pheasants patrol the backyard anymore? Stein lamented that the rich pleasures of nature that she enjoyed as a child are now largely missing from our daily lives and can only be relived in brief visits to preserves established to house remnant ecosystems.

As her tale of restoration unfolds, Stein relies on her memories, mental snapshots, and an intrepid sense of exploration to guide her efforts. She draws an analogy between inviting guests to a party and planting a mix of trees and shrubs to see what dialogue results. When it comes to conversing with her plants, Stein proves to be an excellent listener. After wading through the botanical section of the Cornell University Library, she fashioned a landscape that is greater than the sum of its parts. Function rules over form in her backyard.

Noah's Garden provides a wealth of insights into the complexities of landscapes as ecosystems that will enlighten both gardener and student of ecology alike. The book explores the intricacies of creating diverse natural systems as it delves into predator-prey relationships, succession, competitive interactions, symbiosis, pollination, and seed dispersal systems. Stein demonstrates an uncommon ability to present these often eye-glazing topics in a way that lets the reader not only understand but use these concepts to create and maintain healthy landscapes. The book would make an excellent companion reading for any student of ecology wading through the usual dry texts espousing theoretical ecology. For example, her explanation of nutrient cycling falls under the head-



The Steins' rectangular perennial garden originally stood alone in a sea of lawn, isolated from two rock gardens.



Now the gardens are continuous, cut through by mower-width paths and occasional clearings. The area shown is about half an acre.

ing of "Where the gone goose went," in which she relates how she left the School of the Neat and Clean for the messier but more efficient system of letting leaves, stones, earthworms, and the plants themselves provide essential nutrients.

Stein envisions a day where a property might be valued as much for its plant and animal carrying capacity as it now is for the number of bedrooms and expanse of lawn. A tax abatement for a frog pond? She does a very convincing job of selling the advantages of reducing labor-intensive chores such as double-digging beds and endless lawn cutting as not only saving time and sore backs but providing ecological benefit. Her meadow and forest restoration projects provide habitat for a broad variety of wildlife, improve soils for the future, and yet require less labor and expense.

She continually searches for connections—links between plants and soils, pollinators and flowers, fruits and seed dispersers, plants and other plants. The most important connection made is the larger one between her six acres in Pound Ridge, New York, and all the land that surrounds it. Cities and suburbs have become vast deserts. The few patches of green that serve as refuges for wildlife are scattered in an ever-increasing archipelago of islands with dispersal distances that many plants and animals cannot conquer. Ecologists have only recently recognized that so much damage has been rendered to natural systems that nature's capacity to restore itself has often been surpassed.

Our attempt to actively direct natural processes to restore landscapes has been termed biocultural restoration. *Noah's Garden* is a handbook for a careful tread-lightly, think-twice strategy for achieving this end.

Stein proposes a plan (with credit to Michael McKeag) that uses plantings to link personal landscapes: groves of trees at the back of the lot are tied to the front yard with hedgerows, which in turn blend into the front yard with native grasses and wildflowers. The focus is always on establishing connections, the most important linkage being the restoration of key interactions between species. Whether done for reasons of ecology, economy, or style, she urges both individual and community responsibility in creating a new tradition in which land is valued for the life that it harbors.

The book holds a treasure trove of advice to gardeners that is often laced with a wry humor. Referring to exotic plants that require plenty of help to survive, she suggests, "I learned at least to avoid anything that comes with a full paragraph of instructions for its care." In taking on such popular techniques as integrated pest management, biological controls, and grassland restoration, she points to the many pitfalls involved. "A meadow in a can is a misnomer; the can we bought was real enough, but no meadow could have come from it. An essential ingredient was missing: grass. The mix was flavored with empty calories—slim-bodied, shallow-rooted annuals alien to meadow ecology but included to satisfy the same consumer impatience that demands instant soups." We quickly learn that there are few shortcuts to succession.

The book is delightfully illustrated by the author and filled with valuable references. The appendices include useful lists of plants important to butterflies, berrying plants for hedgerows, botanical names, and helpful books. Despite the latter, a bibliography with full citations for the many books and authors mentioned in the text would have been helpful. Given the book's focus, some references to key ecological texts might also have been useful.

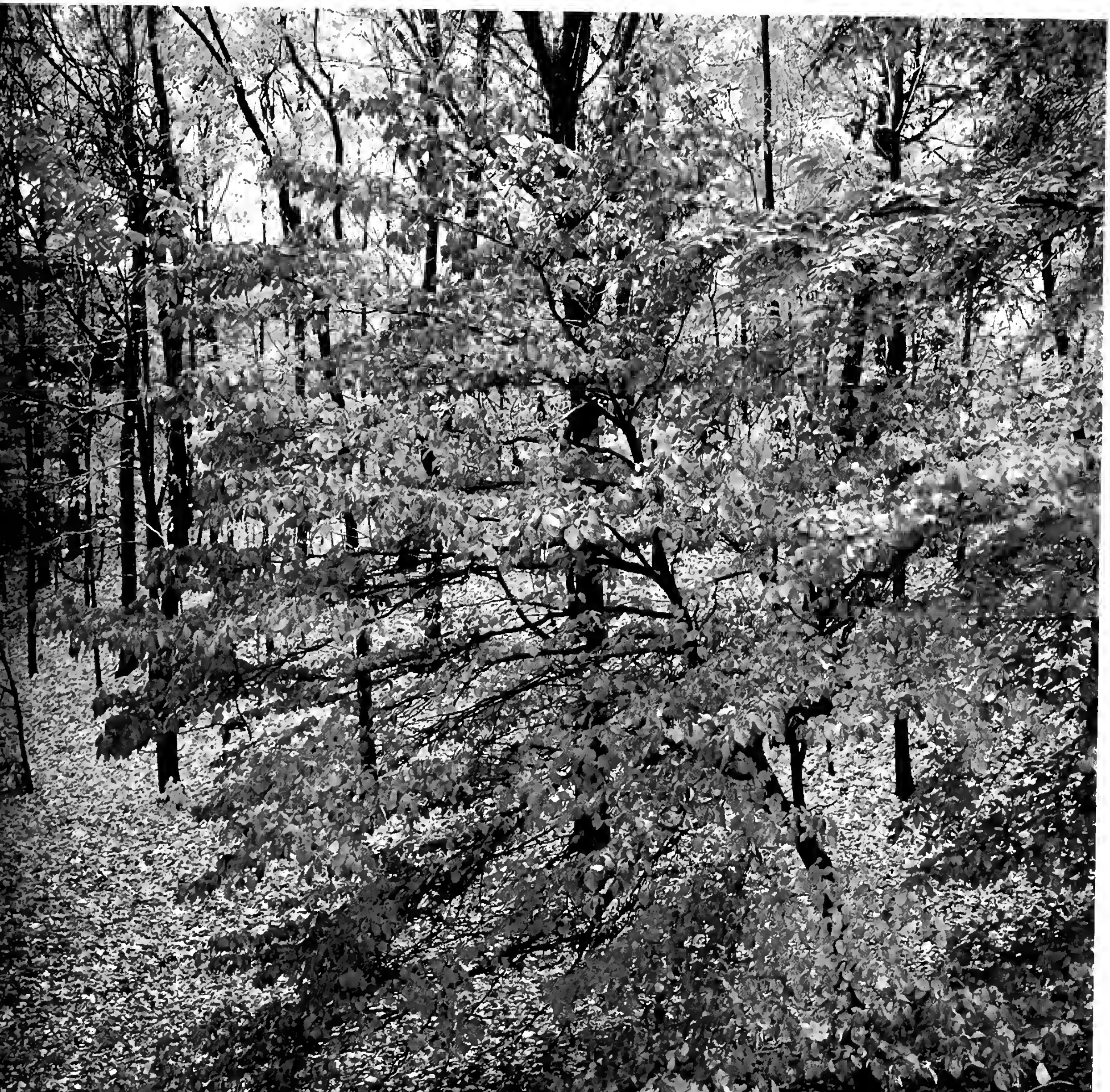
Noah's Garden is a bold reexamination of many of the basic traditions of gardening and will certainly generate a great deal of discussion as we take a new look at our backyards and how they relate to our neighbors' backyards. It is a peculiarity of how we perceive time that many old ideas seem new and radical when scrutinized by a new generation. Rarely is the case for reexamination made as eloquently and clearly as Sara Stein has done in this book.

Edward Stashko, Ph.D., is Director of Conservation and Tropical Programs for the School for Field Studies and is an instructor in the ecology of landscapes and ecological restoration at the Radcliffe Seminars Graduate Program in Landscape Design.

Fall 1993

arnoldia

The Magazine of the Arnold Arboretum



arnoldia

Volume 53 Number 3 1993

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

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

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

Karen Madsen, *Editor*

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

Page

Front cover: Autumn foliage of the flowering dogwood *(Cornus florida)* at the Arnold Arboretum. Photo by David Akiba.

Inside front cover: *Viburnum sieboldii*, a favorite of Donald Wyman's for its splendid six-inch leaves, its attractive branching habit, and its colorful fruits. Photo by Rácz & Debreczy.

Back cover: *Malus* 'Donald Wyman', the flowering crabapple that honors the late horticulturist. It is notable for its vigor, its reliable bloom (pink buds opening to single white flowers), and its bright red, glossy fruit that persists unfading well into winter. Photo by Peter Del Tredici.

Inside back cover: The charred stump of *Eucalyptus* sp. showing renewal growth, located at the site of Hiroshima Castle, 600 meters from the hypocenter of the atomic bomb blast. Photograph by Hiromi Tsuchida, 1979.

Donald Wyman at the Arnold Arboretum in 1952 evaluating Cytisus x praecox *(Warminster broom), a plant he first selected for distribution in 1940. He valued it for its abundant, pale lemon-yellow flowers in mid-May, its hardiness, and the dense green stems that give it an effect akin to an evergreen.*

Remembering Donald Wyman

1904–1993

Donald Wyman, for thirty-five years Horticulturist of the Arnold Arboretum, died on September 6. From 1935 to 1970, Dr. Wyman was largely responsible for the care and maintenance of the living collections of the Arboretum. He grew up in Philadelphia and later described himself as a city boy who became interested in growing things in his room. He took a bachelor's degree in horticulture at Pennsylvania State College in 1926 and received a master's in forestry in 1933. On receiving a Ph.D. in horticulture at Cornell University in 1935, he joined the Arnold Arboretum, without pay for six months, and in 1936 was named Horticulturist. Richard Howard, director emeritus, commented that when Wyman came to the Arboretum as a young Cornell graduate, he undertook major responsibility for one of the principal arboretums in the world—at one of the worst times. Charles Sargent, the founding director, had died in 1927, and E. H. Wilson—thereafter Keeper of the Arboretum—met an untimely accidental death in 1930.

As Horticulturist, Dr. Wyman reinstituted a comprehensive plant labeling and mapping program and initiated a judicious thinning of old and declining specimens. He also departed from the original method of planting only in botanical sequence, making exceptions when valued ornamental plants would be displayed well at a turn of the road or as the focal point of a vista. He saw his primary responsibility as the introduction of new plants. In 1960–1961 alone, he located seeds or plants of 586 species and varieties not then in the Arboretum. A trip to Europe in 1965 netted 930 species and varieties, many of them first-time introductions into the United States.

Wyman viewed arboreta as the best places to evaluate the ornamental qualities of trees and shrubs. It was in fulfilling this mission that Wyman established his reputation and for which he will long be remembered. More, perhaps, than any other single person, certainly of his era, he advanced the knowledge and appreciation of hardy woody plants through his articles (numbering in the hundreds), published in *Arnoldia* and elsewhere, and his seven books, which included the acclaimed *Shrubs and Vines for American Gardens, Trees for American Gardens,* and the bible of horticulturists, *Wyman's Gardening Encyclopedia.* With a personable style and a willingness to make unequivocal recommendations, he published comprehensive lists and then subdivided them into practical groupings recommended for special uses—shady spots, urban environments, seaside landscapes. A synthesizer and popularizer, he translated a great deal of technical information into a form nonprofessionals could understand. His work may now seem familiar, but only because it's been so often imitated.

His achievements did not go unrecognized. He was president, director, and trustee of the American Horticultural Society and trustee of the Massachusetts Horticultural Society. He was awarded the Liberty Hyde Bailey Medal, the foremost honor of the American Horticultural Society; the George Robert White Medal, the top honor of the Massachusetts Horticultural Society; and the Veitch Memorial Gold Medal, the highest award available to a foreigner, from the Royal Horticultural Society of London.

In an interview at age eighty-seven he remembered, "At a certain point in my studies, I had to choose which area of horticulture to devote myself to, and I chose to concentrate on ornamental woody plants. When I came to the Arboretum, there they all were, needing loving care and attention. I enjoyed working at the Arboretum. I loved every bit of it."

Sustainable Trees for Sustainable Cities

Henry Arnold

Large shade trees make an enormous contribution to sustainable cities, but all too many of the trees planted every year will not survive long enough to attain effective size. Many factors are involved, but certainly an important one is the relationship between longevity and planting methods.

The idea of *sustainable cities* is linked to an older concept of *sustainable plant communities.* The theoretical basis for both is a closed system where everything is continuously recycled. Natural resources are renewed rather than depleted. In undisturbed natural areas a kind of sustainability is achieved through the natural cycles of the biosphere. However, this kind of sustainability for trees in the city cannot be achieved because the natural cycles have been interrupted there. Continuity of urban trees depends on human intervention.

Making Cities Sustainable

Sustainability in the broader sense for cities involves human populations and all of their activities. A major concern, in considering what makes cities sustainable in this social sense, is their desirability as places to live. The city has the great advantage of compactness, which makes possible human interaction and cultural enrichment. Today the city suffers many ills that counter these advantages, not the least of which are incompatible transportation and deteriorating infrastructure. To a great extent these problems are interwoven and cannot be successfully resolved independently. If, however, one were to pick a logical starting place, retrofitting the city for trees has appeal on several levels. It could be done more independently than most other major changes, and it would show results sooner.

Trees have enormous appeal not only aesthetically but also for their air-conditioning value; they are beautiful utilities. A large tree in the city is ten to twenty times more beneficial to the environment than a rural forest tree (Akbari et al. 1992). This is a result of the combined effects of trees on air conditioning and atmospheric carbon reduction in the urban "heat islands." They not only cool the city but they save energy used to air condition buildings. Hence they reduce atmospheric carbon produced by burning fossil fuels to generate electricity. The enhanced benefit of urban trees depends on this multiple effect when planted in urban spaces, as "infrastructure."

Present Deficiencies

With the increasing awareness of the danger of global warming there have been scores of national, state, and local efforts to increase the number of trees growing in urban areas, especially in large cities. Many tree planting programs blossomed during the 1980s, but without the crucial component of coordinated interagency planning. Each program follows its own course of action in deciding where to plant, what to plant, and how to plant trees resulting in loss of visual continuity and less

Trees in downtown Brooklyn, NY, planted in paving using a soil mixture with expanded slate aggregate to prevent loss of pore space under compaction from heavy pedestrian use.

durable tree plantings. This is usually a consequence of not making tree planting part of the city's comprehensive planning. Trees are not looked upon with the same seriousness as utilities, streets, and building heights.

This may be one reason for failing to effectively plant the "hard-core" areas. By this term I mean those precincts of every city where there are no large trees and where it does not appear that large healthy trees could grow. These are the zones of continuous paving supporting intensive pedestrian and vehicular activity. These hard-core areas include central boulevards, traffic islands, crowded sidewalks, pavement over structures, urban squares, commercial plazas, and building roofs. They constitute a significant part of the city center, possibly sixty to eighty percent of the open space. Such urban areas can support and would greatly benefit from large healthy trees.

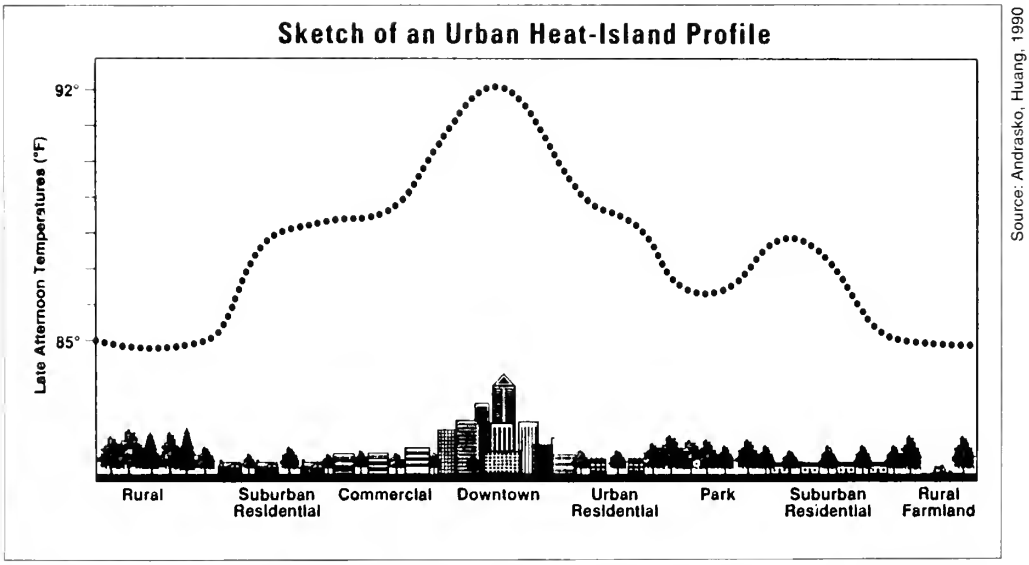
Understanding These Deficiencies

An obstacle to effectively planting American cities is the continuation of three widespread cultural biases inherited from the nineteenth century. These notions about the city still operate against the bountiful use of trees. Without reconsidering these issues there is little chance of establishing an effective urban forest in the downtown areas of our cities.

The first is the popular belief that greater diversity of tree species creates a more durable and healthy forest. Diversity of plant species does not *produce* stable plant communities (Wilson 1989). Rather, species diversity occurs as a result of long periods of stable habitat conditions. Old plant communities that have developed species diversity are very fragile. Any disturbance to their habitat is likely to greatly reduce the number of species that can survive. This certainly applies to forests, especially in the city where the harsh habitat is so unsuited for most tree types. Therefore we cannot expect to create a suitable urban habitat for trees by simply planting many different tree types. The appropriate habitat conditions are required first to support species diversity.

Many urban sites will not support tree species diversity because of the biological limitations of the space. For example, poor air quality, disturbed water cycle, chemical pollutants, and soil restrictions prohibit all but a very few adaptable tree types to grow in these disturbed locations. Well-meaning but ill-informed efforts to create variety by planting many tree types on a single block or street are counterproductive. The best principle to follow on urban sites such as city streets is to plant desirable tree types that are growing in and have survived similar conditions for many years. Diversity of age is likely to be far more important in creating sustainable urban tree plantings than varying species. If all of the trees in a particular urban location become old at the same time, there is greater likelihood of a catastrophic loss. A continual replanting program that staggers the ages of the street trees could prevent possible extensive periodic tree losses (Richards 1982/1983).

At the very least we should avoid the now common practice of seeking species diversity as an end in itself. This is not to discourage testing other tree types on a limited basis. Yet misguided imposition of species diversity is being mandated by new tree planting regulations in almost every urban community. This can have serious negative consequences for urban tree sustainability. I believe this is the wrong reaction to the widespread loss of American elm trees. Planting more tree species, most of which are poorly adapted to urban locations, will not result in greater longevity of urban trees. Selecting the best adapted tree type for each specific habitat will allow city-wide diversity adequate to provide insurance against major tree epidemics. We do not need to install five or more species of trees in every block of every street.



Sketch of an urban heat island profile shows how summer temperatures can vary from a rural area to center city by as much as 7 degrees Fahrenheit on a summer day. From Akbari 1992.

The Champs Elysée in Paris, where trees define the streets and spaces of the city.

The second bias concerns *deployment* of trees in the city. There is a predisposition for the open-grown tree form with broad, low spreading crown. Trees are placed far apart to develop individual symmetrical crowns, decreasing their effectiveness as urban forests.

Alternatively, consider trees as *infrastructure*, that is, as a whole system. In this recommended approach, trees are used as groves, arcades, connectors, buffers, canopies, and colonnades. As strong geometric compositions they unify chaotic streets and tie the urban spaces together. The resulting network of vegetation conditions the air, light, and sound of the city, shaping a habitat that is unifying and soul satisfying. Used this way trees are a connecting tissue that is a part of the fabric of the city, not just decorative trim.

The use of trees as infrastructure maximizes their architectural values. Our best examples are European cities, most notably Paris. Large trees line every street forming shaded arcades that echo the rhythms of the building architecture. They are as much a part of the city as buildings and streetlights and roads. In the modern cities of temperate North America trees can be a welcome visual contrast to our often less distinguished architecture. Tree shadow patterns enrich the walls and pavement, compensating for lack of architectural richness.

The third bias is a preference for the use of suburban planting techniques in urban areas regardless of the specific site conditions. The planting methods still being used in the city were developed for rural or suburban sites.

Street Tree Planting

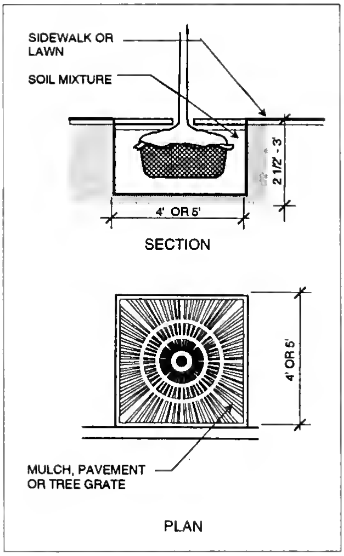


Figure A. Standard tree planting detail. Conventional planting technique showing typical tree pit used for planting street trees containing about fifty cubic feet of prepared soil. This detail is effective in suburban areas where there is good growing soil surrounding the planting pit, but not in most dense urban areas.

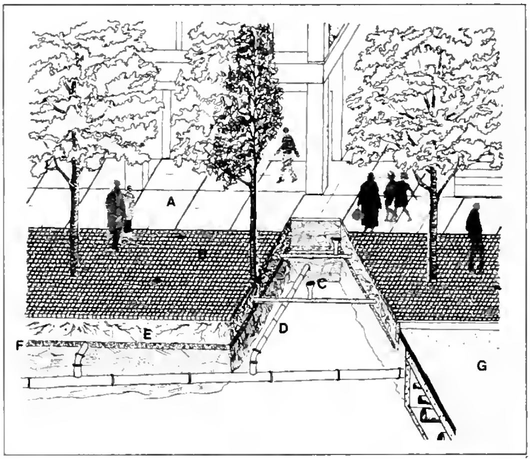


Figure B. Isometric cut-away drawing showing how root space is prepared to grow large street trees on an intensively used site. Street trees planted this way can become part of the urban infrastructure.

- **A.** IMPERVIOUS SIDEWALK PAVEMENT
- **B.** PAVING BLOCK WITH OPEN JOINTS
- **C.** AIR VENT PIPES FOR TREE ROOTS
- **D.** SUBDRAIN PIPES BENEATH ROOT ZONE
- **E.** SPECIAL POROUS SOIL MIXTURE
- **F.** POROUS DRAINAGE LAYER UNDER SOIL
- **G.** ROADWAY PAVEMENT OVER UTILITY TUNNEL

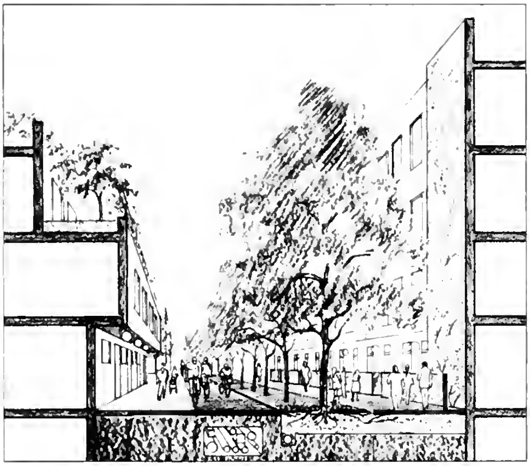


Figure C. Section perspective showing how tree roots can be accommodated on a narrow street retrofitted for pedestrians, bicyclists, and trees. Note large volume of special soil and subsurface drainage.

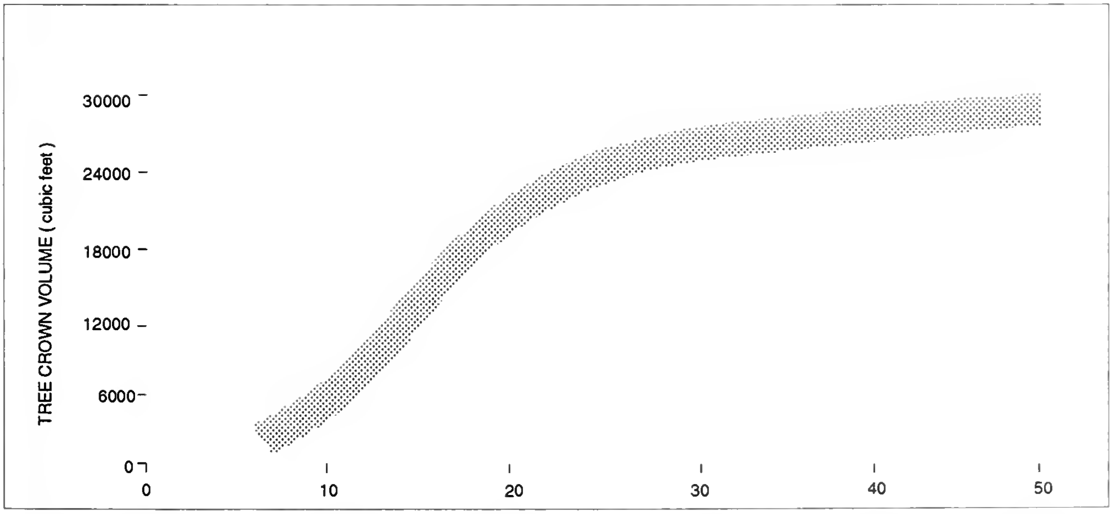
One approach to solving the problem of supporting paving around trees while preserving pore space for the roots is to use a mixture of expanded aggregate and topsoil. Open-jointed paving blocks are then set directly on the compacted soil mixture. Other methods involve supporting the pavement on a layer of coarse aggregate that retains air or bridging the pavement over the planting soil to prevent compaction. Each of these methods has its advantages and limitations and must be designed to meet the constraints of site and budget.

They don't work in the city's hard-core spaces. These unnatural sites require planting methods that are very different from those used on suburban sites. The value of trees, especially in the city, is dependent on their longevity, which depends in turn on how the root space is prepared when the trees are planted. Special soil mixtures are required to maintain porosity to supply roots with essential air. Tree roots need air, but urban trees cannot usually find suitable growing space under the pavement. A medium to large urban tree, with a branch spread of eighteen to twenty feet, needs at least one thousand cubic feet of well-aerated, well-drained soil to survive and be healthy (Bassuk et al. 1991). Unless these special provisions are built into the typical city site when it is planted, there is very little chance that the tree will last long enough to provide significant benefit.

The Effect of Current Tree Planting Practices

Our cultural attitudes and their influence on the way we plant trees help to explain why there are millions of trees planted every year in our cities that will not survive to a beneficial age—that is, they will not grow to be large shade trees. It is not only a result of improper species selection and planting methods, but also a failure to ask questions about our objectives. Are we most concerned with quantity as opposed to size or longevity? One tree that lasts fifty years is worth more than twenty trees that last only ten years. The benefit of an urban tree is directly proportional to its crown size or volume. Therefore, average crown volume multiplied by longevity gives the truest picture of a tree's worth. This is further explained by the accelerated rate of growth of the crown after the first ten years. Considering the economics, wouldn't it be more effective to trade fewer trees that grow large for a larger quantity of trees that last less than ten years? This is not meant to suggest planting trees further apart, a practice that compromises the visual continuity and shade effectiveness of urban trees. Rather, it suggests reallocating resources used to reforest cities so that they will become more effective over time.

It is especially important that the large number of recently established tree planting programs be guided by a long-term approach, recognizing the relationships between the benefits of tree longevity and effective urban tree



Urban tree canopy size measured as cubic feet of crown volume showing estimated size increase with age for a hypothetical urban street tree planted correctly. Crown growth accelerates after the first ten years, later declining as branch spread fills the space. Adapted from Arnold 1993.

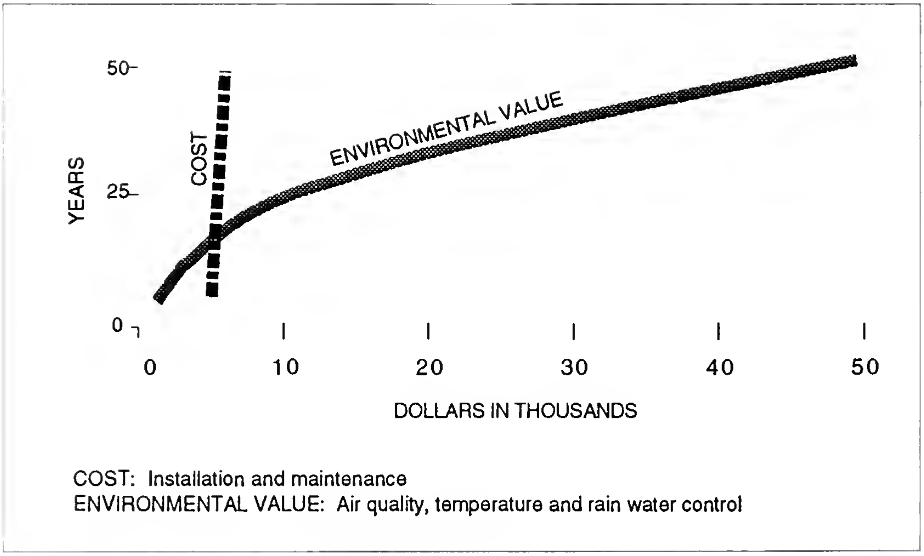
planting methods. Most urban trees are still being planted using outdated installation practices. Unfortunately the success of these planting programs is being measured ten years too soon, that is, before the tree roots outgrow the site. Preparing a difficult city street site for a tree so it will grow for many years requires three things: a specially designed soil mixture, an underdrainage system, and an appropriate ground surface material. The site preparation alone may be three to four times as expensive as a good-sized nursery grown tree. However, the measurable benefits exceed the higher planting cost by a factor of ten (see graph below). A tree costing five thousand dollars to plant would yield fifty thousand dollars in accumulated benefits, using estimated values from a U.S. Forest Service study (Ebenreck 1988). While such estimates are bound to be imprecise, they yield plausible figures without even counting intangible benefits. From this perspective, trees are our most economical urban utilities.

A More Effective Approach

The specialized planting techniques recommended here are not meant to supplant the tree planting methods successful at less cost on less disrupted sites. The new methods have been developed for hard-core urban sites where only trees over four inches in caliper when planted can survive the characteristic abuse (Nowak et al. 1990). Such areas require complete replacement of the existing urban soil with a special growing medium to allow the development of mature trees. Trees planted over structures, in manufactured soil recessed below the pavement, illustrate one such condition.

If more knowledgeable practices for urban trees are widely adopted, the success of city trees will improve dramatically. The three most critical of these practices are:

- The use of special installation techniques where they are required to accommodate tree roots.
- Selecting the tree type on the basis of



Comparison of cost and benefit of urban street tree. Using a dollar value comparison, it will take ten years from the time a five-inch caliper street tree is installed until the cumulative costs equal the cumulative benefits. However, the benefits will greatly exceed the costs for the remaining thirty-five years of a fifty-year tree cycle. From Arnold 1993.

Bauhinia trees planted on a rooftop plaza in Singapore near a large shopping complex. Trees are recessed into the structure so that there are no raised planters.

experienced survivability under the specific site conditions in that locality.

- Planting and dealing with trees as urban infrastructure, not as individual specimens.

This discussion deliberately concentrates on planting practices for sustainable urban trees because these issues are still being ignored or overlooked. Other issues such as *maintenance* of trees, many will argue, are just as important. However, these concerns have received much greater attention. The experience of some arborists and landscape architects suggests that incorrect installation of trees on hard-core urban sites is the number one obstacle to making our cities tree-shaded havens (Perry 1982; Urban 1989). Trees that are incorrectly installed so that they last less than ten years are an unfortunate waste of resources. No amount of maintenance can make trees that are planted this way sustainable.

There is an exceptional opportunity to make unimagined changes to cities, conferring benefits that multiply with time. Trees can have a major role in recreating cities that are biologically fit for human enjoyment. It requires installing a whole new utility system consisting of branches and roots and leaves, utilizing sustainable planting methods. The planting sites of central city streets and plazas will challenge our technical ingenuity to reshape the open spaces of the city. Artistry and scientific skill can combine to convert old cities into places of delight and culture, with trees that outlive people. Now may be the moment in history to capture this great opportunity. Making cities livable by installing trees that last will contribute to regional and global sustainability.

Literature Cited

Akbari, Hashem, Susan Davis, Sofia Dorsono, Joe Huang, Steven Winnett, editors. 1992. *Cooling Our Communities: A Guidebook on Tree Planting and Light-Colored Surfacing.* Washington, D.C.: U.S. Environmental Protection Agency.

Arnold, Henry. 1993. *Trees in Urban Design.* 2nd ed. New York: Van Nostrand Reinhold.

Bassuk, Nina, Jan Goldstein, Patricia Lindsey, James Urban. 1991. From the ground down. *Landscape Architecture* 8(1): 66-68.

Ebenreck, Sarah. 1988. Measuring the value of trees. *American Forests* 94(7/8): 30-31.

Nowak, David J., Joe R. McBride, Russel A. Beatty. 1990. Newly planted street tree growth and mortality. *Journal of Arboriculture* 16(5): 124-129.

Perry, Thomas O. The ecology of tree roots and the practical significance thereof. *Journal of Arboriculture* 8(8): 197-211.

Richards, N. A. 1982/1983. Diversity and stability in a street tree population. *Urban Ecology* 7:159-171.

Urban, James. 1989. New techniques in urban tree planting. *Journal of Arboriculture* 15(11): 281-284.

Wilson, Edward O. 1989. Threats to biodiversity. *Scientific American* 261(3): 108-116.

Henry Arnold practices landscape architecture as principal of Arnold Associates, based in Princeton, New Jersey. The firm's awarding-winning projects include Constitution Gardens and the Vietnam Veterans Memorial, both in Washington D.C., and the Trenton Marine Terminal Park in New Jersey. His advocacy for urban trees takes many forms, including his book, *Trees in Urban Design* (2nd edition, 1993), urban landscape design projects in the U.S. and S.E. Asia, lectures, and articles.

Taxonomy and Arboretum Design

Scot Medbury

In the second half of the nineteenth century, arboreta joined natural history museums and zoological gardens as archetypal embodiments of the Victorian fascination with the natural world.

Grouping plants by type is a familiar practice in North American gardens where small, separate collections of maples, oaks, or other genera are common features. Although it is now unusual to follow a taxonomic scheme in the layout of an entire garden, such arrangements were the vogue in nineteenth-century botanical gardens and arboreta. The plant collections in these gardens were frequently grouped into families or genera and then planted out along a winding pathway so that visitors encountered specimens in a taxonomic sequence.

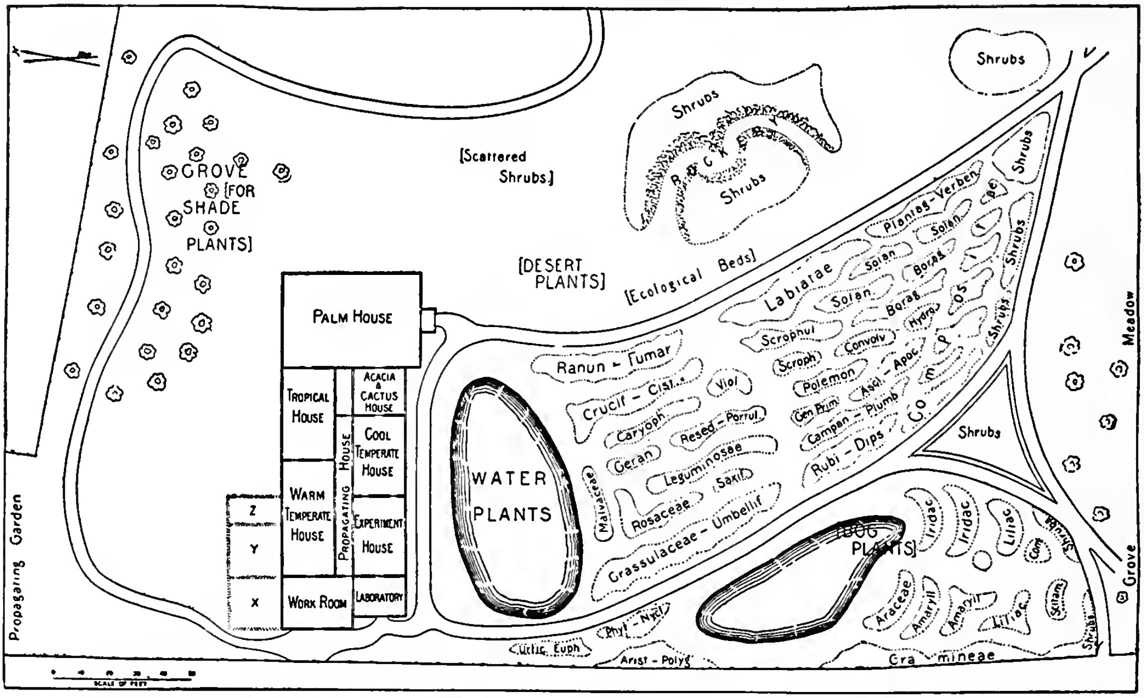
Growing related plants together, in effect, organizes a collection into a living encyclopedia, allowing for comparison of the characteristics of species within a genus or genera within a family. By planting related taxa in an evolutionary progression, the more complicated sequential taxonomic arrangement reveals the ancestral affinities of modern floras. Good examples of this display theme are the "order beds" of herbaceous plants at gardens like Kew and Cambridge, which have long provided botany students with a compact synopsis of the plant kingdom arranged in taxonomic sequence.

Despite the educational advantages, there are significant horticultural and management problems that result from the application of taxonomy to the layout of a garden. Because plant families tend to be ecologically heterogeneous, they require a variety of cultural conditions. This is especially problematic when the concept is applied to a plant collection that strives to be all-inclusive. The arboretum projects of the Olmsted landscape architectural firms illustrate some of these problems and also exhibit how changes in plant taxonomy were expressed in the landscape.

Historical Background

The historical antecedents for arranging plant collections taxonomically include the first European botanical garden, the Orto Botanica, founded in Pisa in 1543. The plants in this garden were grouped according to their medicinal properties and, by the end of the sixteenth century, by morphological characteristics as well (Hill 1915). As the science of botany advanced during the Renaissance, the practice of storing herbarium collections in a taxonomic order developed, and this probably contributed to the practice of arranging living collections in a similar fashion.

Following the publication of Linnaeus' comprehensive plant classification system in 1753, botanical taxonomy changed radically, and taxonomic gardens quickly followed suit. William Aiton used the Linnaean system in laying out the original nine-acre botanical garden at Kew in 1760, as did the Reverend Erasmus Darwin (grandfather of Charles Darwin) when designing his private garden at Litchfield in England (Simo 1988).



Plan of a small botanic garden.—Smith College, Northampton, Mass. Early plan.

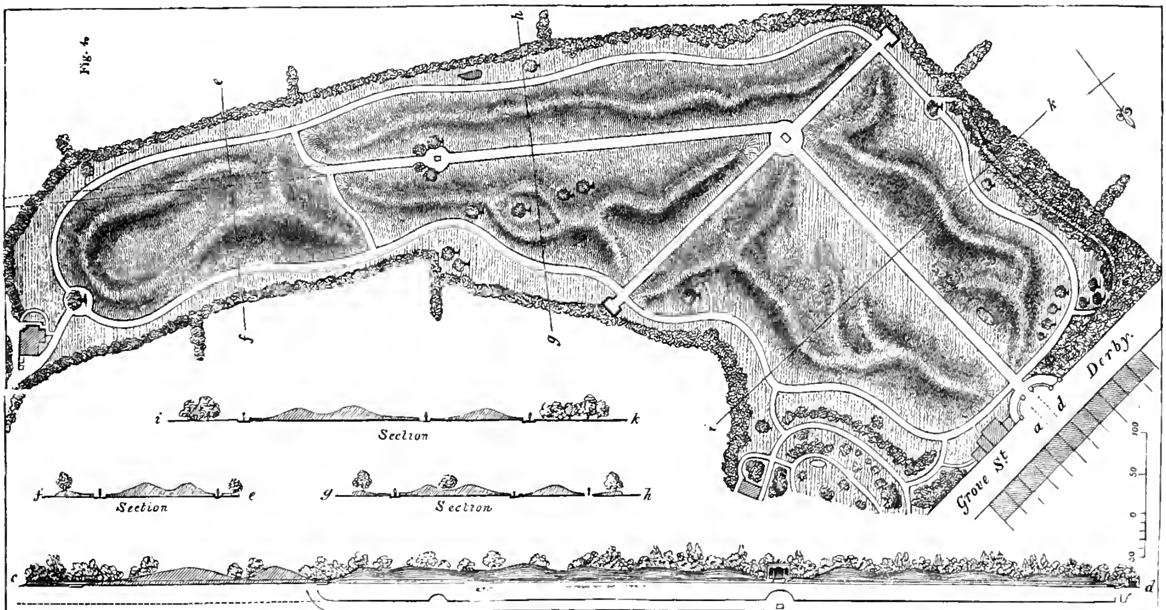
This plan, which illustrates the entry on botanic gardens in Liberty Hyde Bailey's 1914 edition of the Standard Cyclopedia of Horticulture, *reflects taxonomy's role as the standard method of organizing plant collections in botanic gardens.*

In 1759, the French botanist Bernard de Jussieu became dissatisfied with the Linnaean system while laying out a taxonomic garden at Versailles. Jussieu began moving plants around in pots in an attempt to express an arrangement that reflected "genealogical" relationships. Linnaeus himself had allowed that this was the goal of botanists although he had not been able to provide more than outlines for such an arrangement. Bernard's arrangement was further developed by his nephew Antoine Laurent de Jussieu, and his classic *Genera Plantarum* fairly soon gained broad acceptance in Europe and became the basis for taxonomic arrangements in gardens.

Following Jussieu's work, three successive systems of classification have been principally employed in the layout of sequentially ordered taxonomic plant collections. In chronological order, these were (1) the system of the Swiss botanist Augustin Pyramus de Candolle, which was based on rather different principles than that of Jussieu, although the main difference might seem to be in the plant with which the sequence of flowering plants starts—Dutchman's-pipe *(Aristolochia)* for Jussieu, and buttercups *(Rananculus)* for Candolle; (2) the system of George Bentham and Joseph Dalton Hooker, published in England between 1862-1883, and in some ways an elaboration of the Candollean system; and (3) the post-Darwinian system of Adolph Engler and Karl Prantl, published in Germany between 1887-1915 and the first widely accepted system to be based on evolutionary progression.

In order to appreciate the progression of plant families in taxonomic gardens, it is first necessary to understand the placement of the gymnosperms and subdivisions of the angiosperms (i.e., monocotyledons and dicotyledons) within each of these classification systems. The sequence of dicot families is especially important, for although the pre-Darwinian systems of Candolle and Bentham and Hooker began with the polypetalous (many-petalled) buttercups and magnolias, Engler and Prantl's dicot sequence commenced with the willows and birches, whose apetalous (petalless) flowers they considered to be more primitive. Both the Candolles (Augustin as well as his son Alphonse) and Bentham and Hooker placed the gymnosperms between the monocots and dicots because they thought that gymnosperms really were very complex organisms, just like dicotyledonous trees, whereas Engler and Prantl placed them first, as the purported progenitors of the angiosperms.

The sequence of families in Jussieu's, Candolle's, and Bentham and Hooker's systems was not intended to show evolutionary progression. However, they did attempt to reflect their authors' general ideas of the progression of morphological complexity. Jussieu's arrangement, as far as can be ascertained, forms a basically linear sequence, but the Candolles and Bentham and Hooker were adamant that plant relationships did not follow a linear sequence, although the printed page forced such a sequence on them. Most plant classification systems appearing after the work of Charles Darwin and Alfred Russell Wallace have been predicated on an understanding of descent and evolution and, therefore, have tried to establish "evolutionary" relationships among plants. In the first of these phylogenetic systems, such as Engler and Prantl's, plant families were placed in a sequence beginning with the most primitive plants and ending with the most advanced. This is still the case today, although a veritable forest of evolution-



Contour plan of the Derby Arboretum, 1839. The arboretum path that winds around the periphery is concealed from the main walk at the center by thick evergreen shrubbery and six- to ten-foot berms. From J. C. Loudon's catalog, The Derby Arboretum, *published in London, 1840.*

ary "trees" has been produced. Each tree purports to show the complexity of the relationships between plant families that cannot be accomodated by the linear sequence of the printed book.

The Derby Arboretum

It was to the Candollean system that the English author and garden designer John Claudius Loudon looked when laying out the Derby Arboretum in England in 1839, the most influential of the taxonomically arranged British gardens. Early in his career Loudon had become intrigued by the novel marriage of science and landscape beauty that a taxonomic garden presented (Simo 1988). In 1803 he seized upon Jussieu's system as the organizing structure for a large arboretum and flower garden at Scotland's Scone Palace. In 1811 he recommended a similar "living museum" for the city of London, with plantations arranged by the Linnaean system in one area and by Jussieu's system in another. Neither the Scone Palace nor the London garden materialized as envisioned. But with the taxonomic design for Derby, Loudon brought the arboretum into a new era, where it joined the natural history museum and the zoological garden as an archetypal embodiment of the Victorian fascination with the natural world.

The Derby Arboretum was designed to be viewed in a prescribed sequence. This concept drew on the eighteenth-century English tradition of emblematic landscape gardens such as Stourhead, where statuary and classical temples, as they were revealed sequentially to the viewer, were intended to call up specific ideas and allusions, usually from classical history or poetry. At Derby, however, a new paradigm was evoked, that of science. The paths were designed to follow, in sequence, the "natural order" of the plant collections.

The main walk at Derby is on a central axis that brings visitors to a seating area in the middle of the park. The tree collection was planted along a secondary walk that takes a serpentine course around the park's perimeter, allowing visitors to enter the park, experience the entire collection, and then leave by the same gate without retracing their steps. Loudon employed the "gardenesque" style (which he created and advocated) when planting the arboretum, displaying the trees singly with sufficient room for each specimen to develop without touching others. Such careful planning notwithstanding, the arboretum was intended to be torn up and replanted every few decades, in order to remove outsized trees and to permit the addition of new taxa (Loudon 1840).

The Derby Arboretum greatly impressed both the American landscape architect Frederick Law Olmsted, Sr., and his friend and mentor, Andrew Jackson Downing, America's first native-born professional landscape designer and most influential transmitter of contemporary English design for American use. Both men, when given the opportunity to design public parks, included taxonomic arboreta in their proposals, drawing heavily on Loudon's writings and his seminal design for the Derby Arboretum.

North American Examples

North America's first botanical gardens were planted without particular attention to taxonomic or other thematic arrangements. The continent's first proposal for a taxonomically arranged garden appears to have been made in 1839, for Nova Scotia's Halifax Public Garden, followed closely by a design by Downing for a Derby-like arboretum in Boston's Public Garden, probably in 1841 (Zaitzevsky 1982). But it was Olmsted and Calvert Vaux's inclusion of a taxonomic arboretum in their 1858 "Greensward" plan for New York's Central Park that became the most significant early proposal, since it inaugurated eighty years of involvement in taxonomic arboretum design by the Olmsted firms.

As with the Derby Arboretum, the forty-acre Central Park Arboretum was designed to be a self-contained and sequential experience. Also like the Derby, its plan followed Candolle's system of classification. Since the Derby Arboretum had been criticized by

NEWS

from the Arnold Arboretum

New Exhibit Celebrates Reopening of Hunnewell Building

Photo by Warren Patterson

On November 22, the newly renovated Hunnewell Building will reopen to the public with an exhibit entitled "Museum in the Garden: Longfellow, Alden, and Harlow at the Arnold Arboretum." Exploring the building's rich design history as well as its recent renovation, the exhibit will feature archival materials from the Arboretum, original Longfellow drawings, and photographs highlighting the goals of new construction.

Alexander Wadsworth Longfellow designed the Hunnewell Building in 1892. Longfellow, who trained with H. H. Richardson and founded the well-known Boston firm of Longfellow, Alden, and Harlow, went on to design train stations for Boston's Orange Line, several Carnegie libraries, Cambridge City Hall, and a number of commissions for Harvard that were to establish the direction of the University's architecture for over fifty years.

The recent renovation of the Hunnewell Building sought to preserve the integrity of Longfellow's original design while addressing a number of contemporary challenges, including the need to correct structural deficiencies, update utility systems, address code issues, and provide barrier-free access. Project managers Sheila Connor and George Oommen, renovation architects The Primary Group, Inc., and landscape architect Carol Johnson were committed to achieving these changes while also preserving the building's landmark heritage.

We hope you'll soon visit the Hunnewell Building and the new exhibit to discover both the improvements wrought by recent renovation and the beauty revealed in Longfellow's historic design. The exhibit, located in the Hunnewell Building, is open free of charge, 10 a.m. to 4 p.m., Monday through Friday. For more information, please call 524-1718.

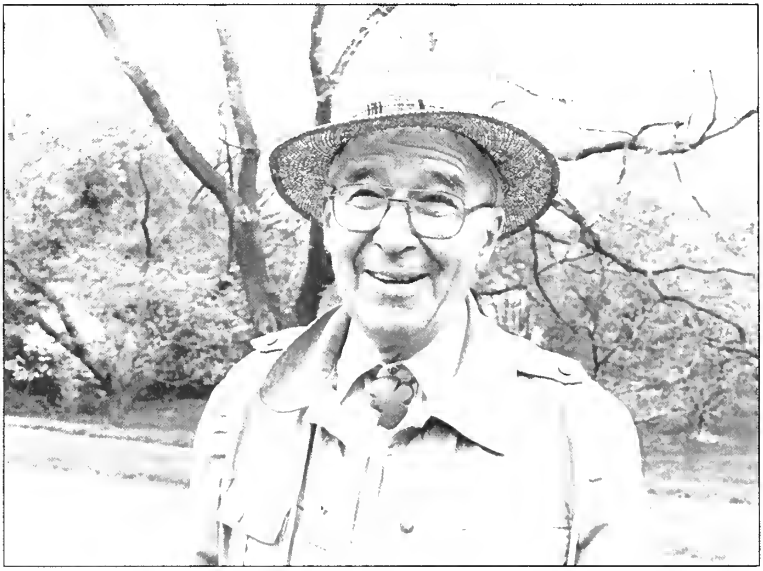
IMS Grant Supports Peters Hill Initiative

The Arnold Arboretum Master Plan, soon to be completed by Sasaki Associates of Watertown, designates Peters Hill as the site for expansion of the Arboretum's collections of crabapples, mountain ash, hawthorn, and other major genera. In support of these expansion plans, the Institute of Museum Services (IMS) has awarded the Arboretum a $25,000 conservation grant to evaluate existing materials and prepare for the integration of new accessions.

(continued on page 4)

Al Bussewitz Honored

Photo by Amy Wilson

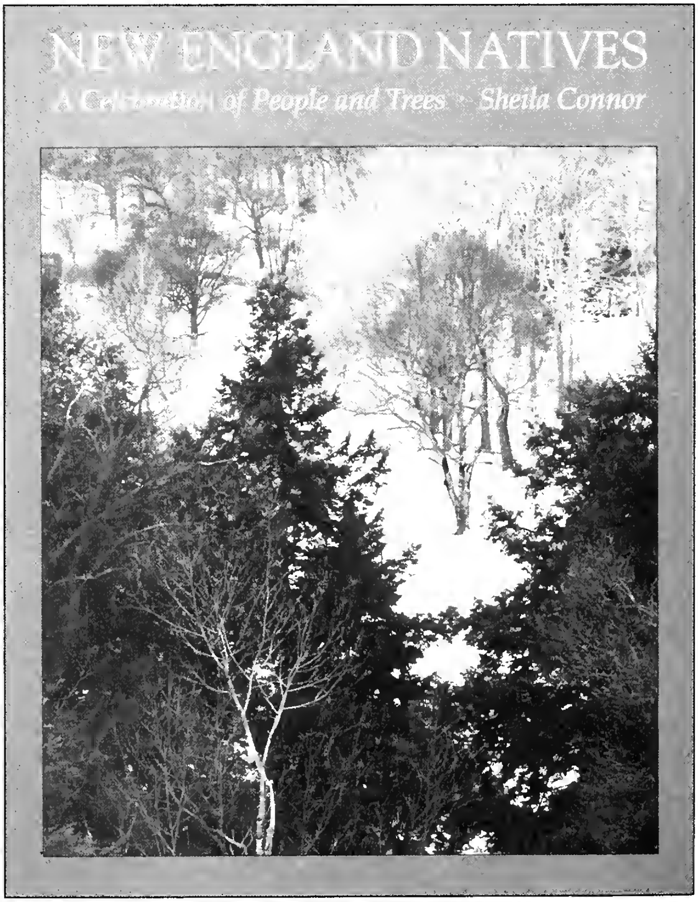


Al Bussewitz, the dean of the Arnold Arboretum's corps of volunteers, is our Volunteer of the Year. Al has been guiding tours of the Arboretum for many years, and his warm smile has introduced thousands of new visitors to the Arboretum's grounds and living collections.

Al is a highly knowledgeable naturalist, now retired after a long career with the Massachusetts Audubon Society. His enthusiasm for the plant world has proved infectious, bringing many new friends back to the Arboretum for repeat visits, always in the hope of encountering Al and his wife, Flora, again.

An Arboretum Guide to New England Trees

This November marks the arrival of *New England Natives: A Celebration of People and Trees*, a new Arboretum guide by Horticultural Research Archivist Sheila Connor. Beginning with the arrival of Native American peoples over 10,000 years ago and extending to the present, *New England Natives* explores how successive human cultures have utilized the region's native trees and forests. It is the second volume in the three-part series of comprehensive Arboretum guides supported by the National Endowment for the Humanities. The first volume, *A Reunion of Trees* (1990) by Horticultural Taxonomist Stephen Spongberg, told the story of plants that came to the Arboretum from around the nation and the world. The third, *Science in the Pleasure Ground* (due next year) by Research Associate Ida Hay, will chronicle the Arboretum's evolving role in botanical and horticultural research. To order, call Harvard University Press at 1-800/448-2242.



Federal Support for Arboretum Teacher Training

Arboretum LEAP teacher training, now in its third year, has been awarded a $36,000 grant by the Dwight D. Eisenhower Math and Science Education Program. Part of a national education initiative, the award provides vital continuing support for the Arboretum's efforts to enhance the teaching of science in the Boston public schools.

This past summer an earlier Eisenhower grant enabled Diane Syverson, Arboretum school science program manager, to conduct a ten-day workshop for twenty-five Boston public school elementary teachers. Led by Arboretum staff and educators from the Harvard Graduate School of Education, the workshop utilized hands-on activities, landscape explorations, and discussions to introduce teachers to the basic plant science concepts and project-based learning strategies of the LEAP curriculum.

The new grant will enable these same teachers to return to the Arboretum in 1994 to expand their knowledge of science and to design new lesson plans for the classroom. In addition, teachers will participate in fifteen teams, each representing a targeted Boston public school. After the workshop, these teacher teams will return to their home schools to disseminate their newly acquired knowledge and skills to additional educators, ultimately bringing LEAP and related Arboretum resources to over fifteen hundred Boston public school students.

Plants for Historic Landscapes

Stephen Spongberg, shown here holding a leaf from the Dutchman's-pipe vine (*Aristolochia*) at the Codman House in Lincoln, is team-teaching a course, Plants for Historic Landscapes, in the Radcliffe College Seminars Graduate Program in Landscape Design with colleagues Gary Koller (seen on the right) and Peter Del Tredici. Phyllis Andersen, Arboretum landscape historian, is coordinating the course.

Photo by Karen Madsen

(continued from page 1)

The sixty-six acres of Peters Hill were not added to the Arboretum until 1895, several years after Charles Sprague Sargent, the Arboretum's first director, and Frederick Law Olmsted had completed their comprehensive plan for the original property. As a consequence, the landscape design and collections of Peters Hill were never fully integrated with those of the original landscape.

The initiation of master planning two years ago provided an opportunity to finally "connect" Peters Hill with the core area of the Arboretum. Arboretum staff worked with the Sasaki design team to create a plan that allows both for much-needed expansion of key collections and the development of a landscape on Peters Hill that is more consistent with the naturalistic character of the original Sargent/Olmsted design.

Work to be conducted under the IMS grant by Arboretum Horticultural Taxonomist Dr. Stephen Spongberg and his team will provide the essential curatorial foundation for the Peters Hill initiative. With respect to the future, their taxonomic review and field assessment of existing specimens, together with the Sasaki design plan and the planting of new accessions, comprises an important chapter in the Arboretum's ongoing efforts to collect and study the woody plants of the North Temperate Zone.

Flora of the Lesser Antilles

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

These six volumes constitute the first comprehensive flora of the area, and the treatments present keys to the genera as well as the species for easy identification. For each genus and species a complete modern description is provided; 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 both 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 USA. (Add $5 for shipping outside the USA.) 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 (other than Orchidaceae)	$35
Volume 4: Dicotyledoneae 1	$75
Volume 5: Dicotyledoneae 2	$85
Volume 6: Dicotyledoneae 3	$85

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

Plant Information Back On Line

The Arboretum's volunteer-run plant information line will resume service this November after a year's hiatus.

Dial 617/524-1718 x127 between 1:00-3:00 p.m. on Mondays.

Downing for its "peculiarity of design," a reference to the use of "scattered single trees and shrubs" (Downing 1850), Olmsted and Vaux's planting plans for the Central Park Arboretum avoided the aesthetic shortcomings of such spotty, gardenesque planting by displaying tree species both as specimens and *en masse* (Zaitzevsky 1982).

Olmsted and Vaux not only attempted to make the taxonomic arrangement appear picturesque but also tried to place families where they would grow best. Thus they attempted to reconcile one of the major problems of taxonomic arrangements. Strict adherence to taxonomic groups and a fixed, linear sequence of families may locate plants on unsuitable sites, where they will not flourish. After all, membership in a botanical genus or family implies little or nothing about a particular species' cultural requirements or preferences in habitat. Species within the same genus may originate in such widely dissimilar habitats as bog and desert, as occurs, for instance, within the genus *Pinus.*

Given this formidable problem, Olmsted and Vaux did their best to bring each family "into a position corresponding to its natural habitats," in some locations winding the paths to achieve this. Nevertheless, in their design they were preoccupied with preserving the botanical sequence rather than concerned with the habitat preferences and performance of individual species.

Olmsted's 1858 plan for the Central Park Arboretum never came to fruition, but fifteen years later he was presented with an even greater opportunity, this time in Boston. The result was the Arnold Arboretum, North America's quintessential taxonomically arranged plant collection. The Arnold has developed out of the collaboration and foresight of a variety of institutions and individuals, among them Charles Sprague Sargent, its first director and, with Olmsted, co-designer.

Olmsted and Sargent chose Bentham and Hooker's classification as the taxonomic guide for their planting plan, which, although Bentham and Hooker's *Genera Plantarum* was published after the appearance of Darwin's *Origin of Species* (1859), did not embrace Darwin's views. The trees were set out by genera, ordered according to Bentham and Hooker's sequence. Every species to be included was planned for in advance, which required modifications later when unanticipated species and subspecific taxa (subspecies, varieties, and formae) were acquired. As with the Candollean system, Bentham and Hooker's classification begins with the magnolias and their relatives, which were assembled at the entrance to the then one-hundred-and-thirty-acre arboretum. The rest of the collection then followed according to sequence, although this time it was to be viewed from a winding carriage road instead of a pedestrian path, a sensible innovation given the size of the property.

The design also arranged species geographically within each generic group. The plants of North America were the first to be encountered, followed by those of Europe, and finally those of Asia. This created considerable complexity in the layout. To add to this complexity, the species within each continental subgroup were placed in the sequence in which they appeared in Bentham and Hooker's book.

Because the main collection was intended to be permanent, specific places for individual specimens and groves were designated on the plan. Early studies for the distribution of plants placed related species on both sides of the road, as Olmsted had done in the Central Park Arboretum plan. But in the final Arnold plan, species groups were assembled on one side only, with the next genus appearing across the road, and so forth, in staggered fashion.

The Bentham and Hooker sequence was followed quite closely in Olmsted and Sargent's plan. Only one major genus, *Salix,* appears to have been placed out of sequence and that was due to cultural necessity. The moisture-loving willows were planted in wet ground near the arboretum entrance, far from their proper place at the end of the dicot sequence. Bentham and Hooker placed the conifers after the dicots; consequently, Olmsted deployed the dicots along winding roads so as to terminate at an

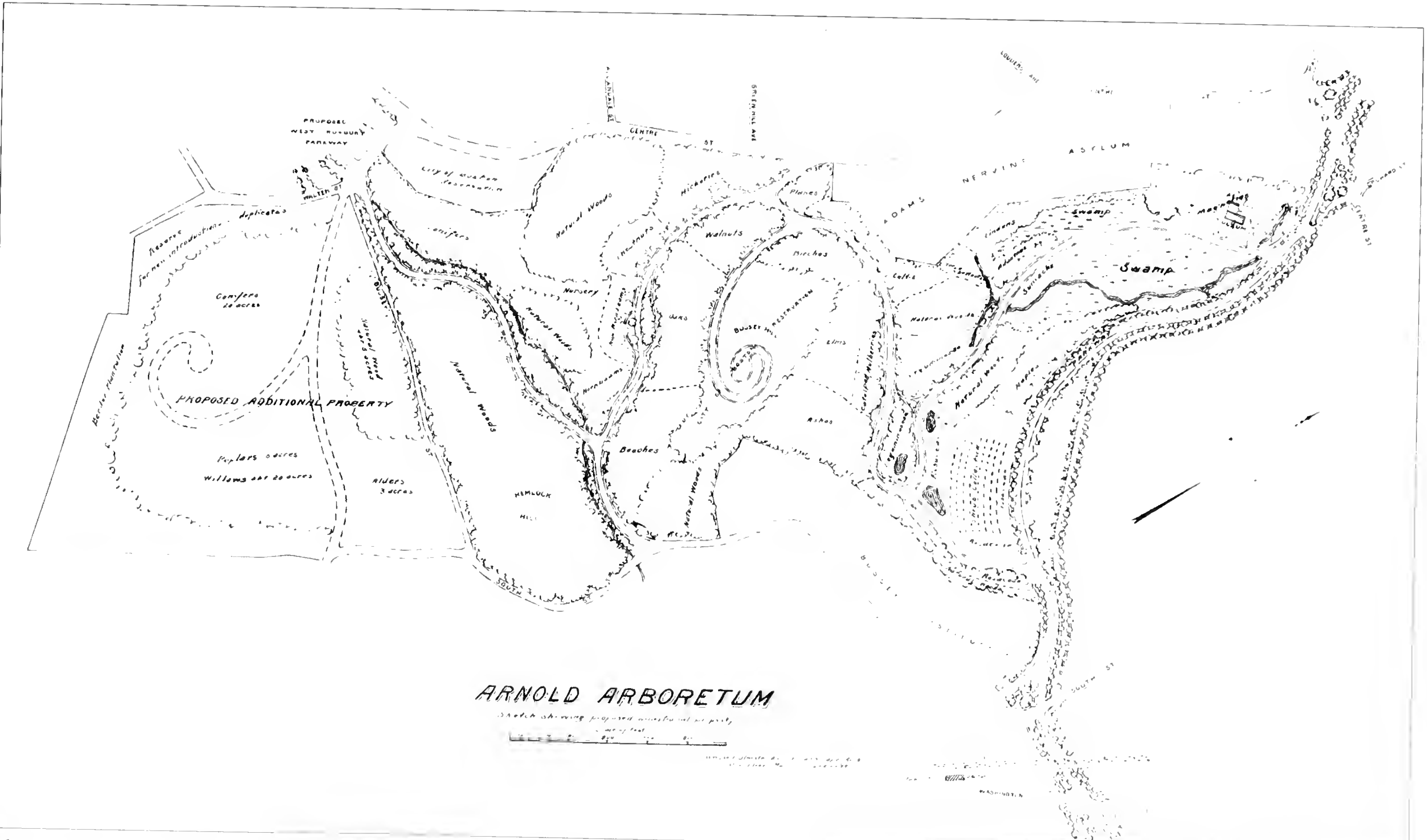
In the Bentham and Hooker sequence, conifers followed the dicotyledons. This 1991 photo by Rácz and Debreczy captures part of the Arnold Arboretum's collection at just over the century mark.

existing stand of native hemlocks. Nearby, he created a pinetum for cultivated conifers.

Unlike the plan for Central Park, where families containing mostly shrubs were interspersed in proper sequence among the tree families, Sargent arranged the shrubs at the Arnold in a separate fruticetum (from the Latin *frutex*, meaning shrub), also arranged in a progressional sequence according to Bentham and Hooker (Gamboni and Hamburg 1983).

In a few cases, strict adherence to the taxonomic scheme resulted in poor performance among various groups of plants. For instance, the plan called for magnolias to be planted near the entrance, but some tender species have had to be sited elsewhere, where warmer microclimates prevail. Similarly, the flowering cherries had been established in one of the coldest areas in the arboretum. In subsequent years, the sequence has been modified when necessary to accomodate the cultural requirements of the plants.

The Arnold Arboretum undoubtedly had an enormous impact on the development of American gardens that followed, including the New York Botanical Garden and the Brooklyn Botanical Garden, where parts of the perma-



This 1894 plan of the Arnold Arboretum shows botanic families arrayed along the roads, with the magnolias at the Arborway entrance and the conifers near Walter Street.

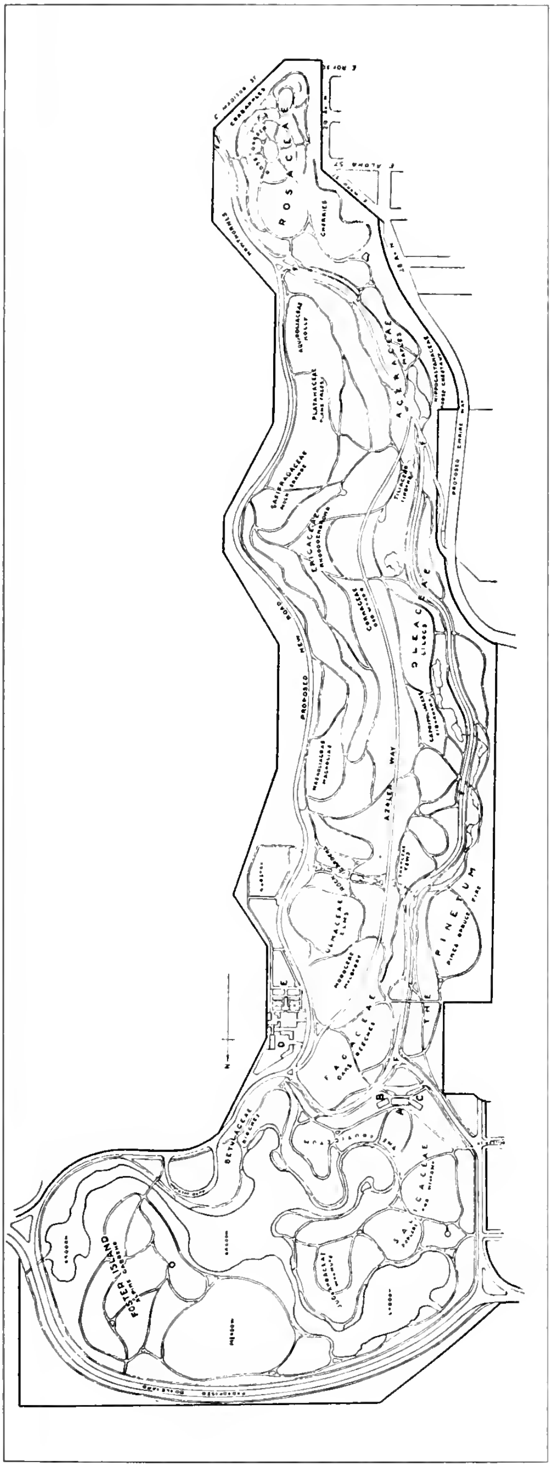
nent collections were laid out taxonomically. Olmsted maintained a profound interest in the creation of arboreta throughout the remainder of his career, producing arboretum plans for the city of Rochester, New York, Stanford University, and other institutions. Olmsted's last commission, the Biltmore estate in North Carolina, included an ambitious proposal for what would have been the world's greatest collection of trees and shrubs, arranged taxonomically along a sinuous nine-mile drive. The collections policy for the Biltmore arboretum was the broadest imaginable: every woody plant from the world that might be hardy, cultivars included, was to be acquired and planted, whether it was currently in cultivation or not. (Throughout much of the Arnold Arboretum's history, its collections policy has focused on hardy *species* of woody plants, bypassing most cultivars.) Such comprehensiveness ultimately proved to be the Biltmore arboretum's undoing. Because the layout of the collection was determined by a plant classification system (in this case, Bentham and Hooker's), it was necessary to know in advance how many hardy tree and shrub species would be represented in each genus so that adequate space could be allocated in the proper sequential location. Due to an incomplete knowledge of temperate floras (especially of Asiatic regions) and widespread synonymy in the nursery trade, compilation of such a master planting list was a daunting task, as it would be today. This impasse no doubt played a part in the collapse of the arboretum project at the turn of the century.

As successors to the senior Olmsted's practice, the Olmsted Brothers firm continued a tradition of making taxonomic plans for arboreta and influenced other landscape architects to do the same. The firm was commissioned to generate plans for the Missouri Botanical Garden, the Holden Arboretum in Ohio, the original Rancho Santa Ana Botanic Garden in southern California, and the University of Pennsylvania's Morris Arboretum. Unfortunately, all of these designs either went unexecuted or no longer exist.

The Missouri Botanical Garden project is notable in that it roughly coincided with the publication of Engler and Prantl's classification system, the first system based on Darwinian ideas of evolution to achieve wide use. William Trelease, the garden's first director, decided to make use of both the Bentham and Hooker and the Engler and Prantl systems when engaging the Olmsteds to lay out two new geographic collection areas. The Bentham and Hooker was chosen for the American collection for its familiarity among botanists. A larger garden devoted to the "universal flora" followed the Engler and Prantl system because it illustrates evolutionary affinities among plants. Both gardens were to contain mere synopses of their respective floras. In this way, the designers avoided the horticultural problems that have plagued other taxonomically arranged gardens because representative species from a particular family or genus could be selected based upon their horticultural compatibility. In addition, the designers did not have to wrestle with the planning issues arising from a comprehensive collections policy, such as those that confounded the Biltmore project.

In 1936, the Olmsted Brothers produced the firm's last taxonomic arboretum plan, for the University of Washington Arboretum in Seattle. The Engler and Prantl system was exclusively applied here to a collection intended from the outset to be comprehensive in scope. Following the post-Darwinian system of Engler and Prantl, the taxonomic sequence began with *Gingko biloba*, the most primitive hardy gymnosperm, followed next by the conifers, the woody monocots, and finally by the dicots. The dicot sequence was initiated not by the magnolias as in Bentham and Hooker's system, but with apetalous families like the willow and birch.

Despite the aesthetic and intellectual appeal of their strikingly rendered plans on paper, the Olmsted Brothers' last arboretum design revealed a sharp decline in conceptual quality. The firm appears to have been copying aspects of the Arnold Arboretum plan merely out of



A redrafted version of the Olmsted Brothers' taxonomic plan for the University of Washington Arboretum, which employed the classification system of Engler and Prantl. From the Bulletin *of the University of Washington Arboretum, Volume 1, Number 1, December 1936.*

custom, without reexamining the theoretical basis for arranging plants in a taxonomic sequence. Incredibly, the critical interrelationship between the botanical sequence and the pedestrian circulation was omitted, thereby stripping the design of the educational elements that justify the use of a taxonomic sequence in the first place. Fortunately, the University of Washington Arboretum has since developed independently of the Olmsted Brothers' plan for it, with greater sensitivity given to the physical characteristics of the site and the cultural requirements of the plants.

Disadvantages

With few exceptions, North American botanical gardens founded after the 1930s have eschewed sequential taxonomic arrangements in favor of geographic, ecological, or strictly aesthetic schemes (or combinations thereof). Gardens continue to present small displays organized by evolutionary sequence, such as the Prehistoric Glen at Honolulu's Foster Botanical Garden or the Plant Families garden at the North Carolina Botanical Garden, but the comprehensive application of taxonomy to garden design is virtually forgotten today.

For purposes of comparing related plants, the approach works reasonably well with herbaceous perennials, where the plants are small and the flowers within reach—a substantial amount of diversity can be encompassed within a relatively small area. Woody plants lend themselves less successfully to a sequential taxonomic treatment. The flowers are often out of reach and the plants are spaced farther apart. This makes comparisons of floral characters difficult. However, there remains the advantage of comparison of overall form as, for instance, in the collections of maples and lindens.

A view of the Arnold Arboretum's linden (Tilia) *collection in 1991. A taxonomic scheme offers the opportunity for side-by-side comparisons of overall form. Photo by Rácz and Debreczy.*

New developments in taxonomy also pose problems for sequentially arranged taxonomic collections of woody plants. While a herbaceous garden can be torn out and replanted following acceptance of a new taxonomic system, such a drastic approach is impractical in a mature arboretum. Nevertheless, woody collections that follow an obsolete classification system are anachronisms, worth maintaining for their historical interest but lacking in some of the educational values that originally led to the use of a taxonomic sequence. At the same time, it is clear that no planting sequence can do justice to natural relationships, whether as understood in 1850 or 1993. From the point of view of teaching natural relationships, some means of organizing a collection is better than none.

The most serious drawback to a taxonomic arrangement, however, deals with horticultural issues. The point has already been made that taxonomic groups above the species level often contain plants from widely dissimilar habitats. The varying degrees of sun and shade tolerance as well as the differing nutritional and moisture requirements found among groups of related species cause problems when these plants are grown together under similar conditions. Many plants will simply die when placed in the wrong spot. Others will struggle for years in a sickly or stunted condition and consequently form poor examples of the average size, growth, or appearance of a particular species.

There are ways of avoiding some of the aforementioned problems of sequential taxonomic arrangements. Planning a synoptic collection rather than a complete one affords the opportunity of choosing plants based on ease of culture and other factors. Diversity of terrain also permits greater flexibility, as the linear sequence can be bent to site taxonomic groups in the positions best suited to the majority of their member species. Species clusters composed of the often smaller generic unit rather than of families have also tended to be more successful, since one is most likely to find a tolerable site for a smaller group of species. As at the Arnold Arboretum, curators must make exceptions to a hard-and-fast pursuit of any scheme.

Acknowledgments

This article originated in the author's M.S. thesis at the University of Washington, where he investigated the application of taxonomy to the display of plant collections. An earlier version was published in *The Public Garden*, July 1991. The author thanks Peter Del Tredici, Karen Madsen, Richard Schulhof, Stephen Spongberg, and especially Peter Stevens for their comments and suggestions during the preparation of this version. The assistance of Sheila Connor at the Arnold Arboretum Archives, Joyce Connolly at the Olmsted National Historic Site, and Paul Ledvina at the Manuscripts Division, Library of Congress, is also gratefully acknowledged.

Archives

Arboretum Documents Collection, Miller Library, Center for Urban Horticulture, University of Washington, Seattle.

Archives of the Arnold Arboretum, Jamaica Plain, MA.

Olmsted Associates Records, Manuscripts Division, Library of Congress, Washington, DC.

Olmsted National Historic Site, National Park Service, Brookline, MA.

Sources and Suggested Readings

Connor, Sheila, and B. June Hutchinson. 1979/1981. "The Original Design and Permanent Arrangement of the Arnold Arboretum as Determined by FLO[lmsted] and CSS[argent]: A Chronology." Unpublished paper. Archives of the Arnold Arboretum.

Downing, A. J. 1850. "The Derby Arboretum." *The Horticulturist* 5: 266-267.

Gamboni, J. F., and B. T. Hamburg. 1983. "The Arnold Arboretum and the History of the Shrub Collection." Unpublished paper. Archives of the Arnold Arboretum.

Hill, A. W. 1915. "The History and Functions of Botanic Gardens." *Annals of the Missouri Botanical Garden* 2:185-240.

Loudon, J. C. 1840. *The Derby Arboretum.* London: Longman.

Simo, M. L. 1988. *Loudon and the Landscape.* New Haven: Yale University Press.

Zaitzevsky, C. 1982. *Frederick Law Olmsted and the Boston Park System.* Cambridge, MA: Harvard University Press.

Scot Medbury is a Beatrix Farrand Scholar in the Ph.D. program in environmental planning at the Department of Landscape Architecture, University of California at Berkeley.

Map of Hiroshima. The star marks the hypocenter of the atomic bomb blast. Circles indicate the distances 1 kilometer, 2 kilometers, 3 kilometers from the hypocenter. Adapted from Hiroshima *by Hiromi Tsuchida, Kosei Publishing Co., 1985.*

- **A** *Eucalyptus tree* (Eucalyptus *sp.*)
- **B** *Camphor tree* (Cinnamomum camphora)
- **C** *Ginkgo tree* (Ginkgo biloba)
- **D** *Pine tree* (Pinus thunbergii)
- **E** *Willow tree* (Salix *sp.*)

Hibaku Trees of Hiroshima*

Photographs by Hiromi Tsuchida. Text by Peter Del Tredici

A series of striking photographs presents the trees that survived the atomic bomb blast of August 6, 1945.

In this era of constant global crises, it's easy to forget that it is not the earth that is endangered by human activities so much as humanity itself. Over the course of three and a half billion years of environmental fluctuations and catastrophes, organisms of all types have developed tremendous powers of regeneration. Some species, typically referred to by humans as weeds, seem especially adept at not merely surviving severe disturbance, but of actually flourishing in the face of it. These organisms are all too familiar to most people and, in the temperate world, include such well-known creatures as rats, cockroaches, dandelions, and purple loosestrife.

Regardless of what fate awaits the earth, it is clear that life will go on, with or without people. Nowhere is this truth more evident than in Hiroshima, Japan, the first city on the planet to experience the full force of a nuclear bomb on August 6, 1945. In most people's minds the detonation of an atomic bomb connotes total and absolute destruction, yet this was hardly the case. At the hypocenter of the blast, the devastation was indeed complete, yet just a few hundred meters away many people, as well as many plants and animals, survived, albeit seriously damaged.

I have long wondered about the trees that survived the atomic bomb blast, curious to know which species were most resilient to the shock wave and fireball that were responsible for the most serious damage. My interest in this question was first whetted when I read about a ginkgo tree growing in the Hiroshima "Peace Park," a few hundred meters from the hypocenter, that supposedly had survived the atomic bomb blast (see P. F. Michel, *Ginkgo Biloba: L'Arbre Qui A Vaincu Le Temps*, 1986). While attempting to validate the truth of this report (which I was unable to do), I came across the work of the Japanese photographer Hiromi Tsuchida, who has meticulously documented the existence of many authentic *hibaku* trees.

Hiromi Tsuchida was born in Fukui, Japan, in 1939. He has published a massive three-part photographic work about Hiroshima, produced between 1976 and 1983, that focuses on the history and memory of the atomic bomb. Using hundreds of pictures, he presents a systematic and measured chronicle of the aftermath of the atomic apocalypse. Not only has Tsuchida photographed the trees that survived the bomb, but also the people and their personal belongings. Tsuchida's photographs illustrate the human dimensions of the tragedy and transform everyday objects into horrifying images of a deadly nightmare.

Looking at Tsuchida's photographs of trees, the sense of tragedy gives way to a sense of

* *Hibaku* is a Japanese word meaning "something that has experienced a nuclear bomb." Typically it is used in the form *hibakusha* meaning "people who have survived a nuclear bomb."

wonder at the indomitable vitality of life. These are the true survivors, plants that can withstand the worst humanity has to offer. While it is impossible to say why one particular individual survived while others didn't, studies done by Japanese scientists in the years immediately following the bombing have generated a list of those trees that showed the greatest powers of survival. Most of these reports are written in Japanese and have had very limited distribution, but their content was summarized in English in the remarkable book *Hiroshima and Nagasaki: The Physical, Medical, and Social Effects of the Atomic Bombings*, published in 1981 by Basic Books. Quoted below is the section that deals with the effects on trees:

> The degree of damage [to trees] was quite different by direction. At places far from the hypocenter, only the side of the tree trunk facing the hypocenter was burned, while the opposite side was frequently normal in appearance. In some trees, there were no branches on the side facing the hypocenter, while the other side had many branches.
>
> Damage to plants was found only in the portions exposed aboveground, and portions underground were not directly damaged. Consequently, the root and the underground stalk put forth new buds even in those whose aboveground portion was completely burned. New buds were

Pine tree (Pinus thunbergii), *Sumiyoshi Shrine, 1,400 meters from the hypocenter, photographed in 1985.*

found coming out from the stumps of trees, which were standing burned without any branches. These sights were seen two months after exposure to the atomic bomb at the time of the primary survey. New buds did not sprout from the damaged side of the trees within 700 meters of the hypocenter. Regeneration differed greatly by species of plants: some regenerated rapidly, while others withered. Broad-leaved trees in general regenerated actively, especially *Cinnamomum camphora* (camphor tree), *Melia azedarach* var. *japonica* (chinaberry), willow, *Robinia pseudoacacia* (black locust), Chinese parasol [*Firmiana simplex*], fig tree, hemp palm [*Trachycarpus fortunei*], sago palm [*Cycas revoluta*], ginkgo, eucalyptus, *Euonymus japonica* (spindle tree), *Fatsia japonica* [Japanese aralia], *Celtis sinensis* var. *japonica* (nettle tree), *Nerium indicum* (oleander),* azalea, and bamboo. . . . The poorly resistant herbs were needle-leafed trees such as Japanese cedar [*Cryptomeria japonica*] and pine. Cedar and pine forests far from the hypocenter were frequently reddish in color, and trees apparently normal during the first year sometimes withered the following year. This tendency was especially marked with *Pinus densiflora* (Japanese red pine).

What follows, then, are Hiromi Tsuchida's portraits of trees of indomitable vitality—*hibaku* trees that survived man's inhumanity not only to himself but to the entire living world.

The same tree photographed in 1993.

* The oleander has been designated the official flower of the city of Hiroshima for its remarkable powers of regeneration. Kiyoshi Hashimoto, director of the Hiroshima Botanical Garden, explains that after the disaster, it seemed that nothing could grow for at least three decades. But *Nerium indicum* bloomed the next year! Its flowers encouraged the citizens, and since then, every summer it has consoled the victims in their misfortune.

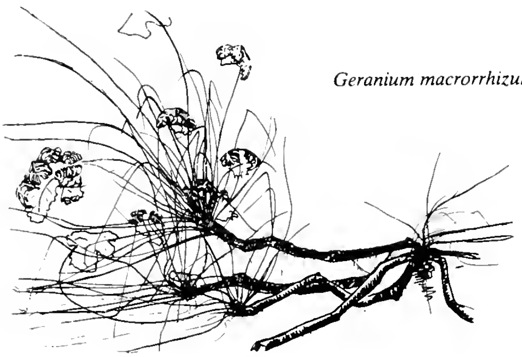
*Above: Camphor tree (*Cinnamomum camphora*), 1,200 meters from the hypocenter, photographed in 1979. Below: The same tree photographed in 1993.*

Above: Willow tree (Salix *sp.*), *Hijigamahoncho, 1,600 meters from the hypocenter, photographed in 1993. Below: Ginkgo tree* (Ginkgo biloba), *Shukukeien garden, 1,400 meters from the hypocenter, photographed in 1993.*

BOOK NOTES

Perennials and Their Garden Habitats, 4th edition. Richard Hansen and Friedrich Stahl. Translated by Richard Ward. Portland, OR: Timber Press, 1993. 450 pages. Hardcover. $49.95

This English translation of a book first published in German in 1981 will be a watershed event for serious perennial gardeners. There is no other book that treats the aesthetic use and cultural care of perennials in such a thorough and organized manner. The senior author was director of the testing and evaluation garden at



Geranium macrorrhizum

Weihenstephan, near Freising, Germany, and as such is a philosophical lineal descendent of the great German horticulturist Karl Foerster. The book is the distillate of information from three decades of objective study of the performance of a wide range of perennials in various aesthetic combinations across many habitats.

The beginning sections describe in a general way the variety of growth forms into which perennials are classified, their propagation, long-term performance, and how the habitat and gardener influence them. Separate sections provide insight into siting, design, planting, and maintenance.

The heart of this book, however, is the classification of garden habitats, each accompanied by an annotated list of plants suitable for the sites described. Such categories as Woodland, Woodland Edge, Open Ground, Rock Garden, Border Perennials, Water's Edge and Marsh, and Water are subdivided into even finer divisions. Thus the section on Woodland Edge has subsections on perennials confined to the woodland edge; perennials more loosely bound to the woodland edge; perennials for special conditions on or near the woodland edge; and spring-flowering bulbs and their allies. A final level of classification breaks each of these down even more specifically. For example, the section on perennials more loosely bound to the woodland edge is subclassified into perennials with border character for garden-type maintenance; invasive perennials; tall perennials with border character for moist soils, and so on. Each of these small categories is associated with a list of perennials, annotated as to their garden characteristics and requirements, and cross-referenced to other lists that, taken together, encompass the breadth of a species' habitat tolerance. The lists also key each species to the aesthetic groupings for which they are best suited (called "sociability").

This is a complex book, and one packed full of information that experienced gardeners will find extremely useful. It comes at an opportune time, when the North European garden idiom is finding wide acceptance in America and when naturalistic gardens are in fashion. I have found it most useful when planning for a new garden area or trouble-shooting in problem areas of the garden. I merely describe the habitat as well as I can and look in Hansen's book for the classification that most closely fits. The plant lists associated with that classification suggest possibilities that I adapt to my specific needs.

This work represents the *magnum opus* of an outstanding plantsman. Its beauty lies in its completeness. It is not simply a copy or update of previous works, but an entirely new and unique treatment of perennials. I find little difficulty in using the book as a guide for American garden conditions and feel that we are fortunate to have this translation available.

Richard W. Lighty

Dick Lighty is Director of the Mt. Cuba Center for the Study of Piedmont Flora in Greenville, Delaware.

• • •

Willows: The Genus Salix. Christopher Newsholme. Portland, OR: Timber Press, 1992. 224 pages, 65 color photos. Hardcover. $34.95

Whether gracing the Charles River or growing in a vacant lot, willows suffer the bane of familiarity. Ubiquitous in many regions, willows are often overlooked by horticulturists who have come to associate the regrettable traits of commonly encountered forms with the entire genus. While many willows are, in fact, troubled by numerous pests and brittle branches, an array of relatively unknown species are fine garden performers and offer a wealth of multiseason ornament. That many of these species have remained undiscovered is more a consequence of ignorance than any lack of merit.

Christopher Newsholme can be credited for doing much to remedy this situation with his new book, *Willows: The Genus Salix*, Mr. Newsholme, who maintains Great Britain's National Willow Collection on his property in Devon, has produced a long-needed treatise that outlines not only the classification and economic uses of *Salix*, but also provides a thorough review of cultivated forms and their culture and use in the landscape.

As Newsholme demonstrates, making a case for willows as worthy landscape plants is not difficult. Numbering over three hundred species, the genus *Salix* is one of the most diverse of temperate woody genera—a fact well illustrated by a visit to the willow collection of the Arnold Arboretum where throughout the year little-known willow species, ranging from stately trees to prostrate shrubs, contribute to the beauty of the landscape. Beginning in early January near the Arboretum meadow, the cottony-white one- to two-inch catkins of the violet willow *(Salix daphnoides)* emerge in abundance on a strongly columnar twenty-five-foot tree. Later, in early spring, a nearby seven-foot shrub of black pussy willow *(Salix gracilistyla* var. *melanostachys)* displays curious black-brown catkins that are soon dotted by orange-red anthers that mature to a pale yellow. On Chinese Path, *Salix fargesii*, introduced by the Arnold Arboretum in 1910, displays lustrous deep green summer foliage followed in the fall and winter by shining red bud scales that are abundant on low, almost horizontal, two- to three-foot branches.

Willows: The Genus Salix illustrates these and many other hardy forms with many line drawings, sixty-five color plates, and well-written descriptions that emphasize ornamental features, seasonal effects, habit, and other information essential to selecting and siting willows in garden settings.

Newsholme's book deserves particular praise for its organization. Rather than describe willows in the typical encyclopedic format, the author has organized the species into four groups based on scale and use in the landscape. Ranging from Ornamental Trees and Shrubs for Large Gardens, Parks and Estates to Tiny Willows for Sink Gardens, these categories allow the willow neophyte to proceed with confidence in sorting out the right plants for particular landscape roles.

If Newsholme's guide has a shortcoming, it is its lack of more precise information about cold hardiness. One can only hope that an American author will eventually provide detailed information about the performance of willows in the extremes of our climate, as well as indicate where many worthy but uncommon species can be located in American nurseries. Until then, *Willows: The Genus Salix* is certainly the best available reference for those gardeners willing to experiment with the unusual forms of a familiar genus.

Richard Schulhof

• • •

Redesigning the American Lawn: A Search for Environmental Harmony. F. Herman Bormann, Diana Balmori, and Gordon T. Gebaille. Lisa Vernegaard, Editor-Researcher. New Haven: Yale University Press, 1993. 166 pages. Hardcover. $19.95

From Frederick Law Olmsted's plan for Riverside, Illinois (that half-town, half-country setting for an idealized life), to the crabgrass suburb of current culture, America has long had a love/hate relationship with the lawn. Is it a pastoral setting for family and community life or an environmental anachronism? This book is neither a guide to the perfect lawn nor a condemnation of a national obsession. It is a carefully measured and highly readable essay on the lawn as a typological phenomenon. It details our devotion to perfecting the type and makes recommendations for an ecologically responsible continuance of this deeply ingrained American landscape tradition.

The readability is a credit to intelligent editing as this book has a complicated authorship. Bormann and Geballe are forest ecologists while Balmori is a landscape architect. All teach at the Yale School of Forestry and Environmental Studies. The book is a product of a graduate seminar with students credited as contributors. The subject was chosen to give focus to the complexity of environmental education. By describing the cost and physical effect of fertilization, water supply depletion and pollution, and waste disposal in relation to lawn care, the subject is tied to the larger issues of global environmental planning. The authors define two types of lawns: the "industrial lawn," carefully limited in grass species, regularly mowed and watered, and dependent on the lawn industry for sustenance; and the "freedom lawn," a diverse mix of drought-tolerant grasses in combination with other plants that are stress resistant and require minimal intervention for survival, and hence are environmentally benign.

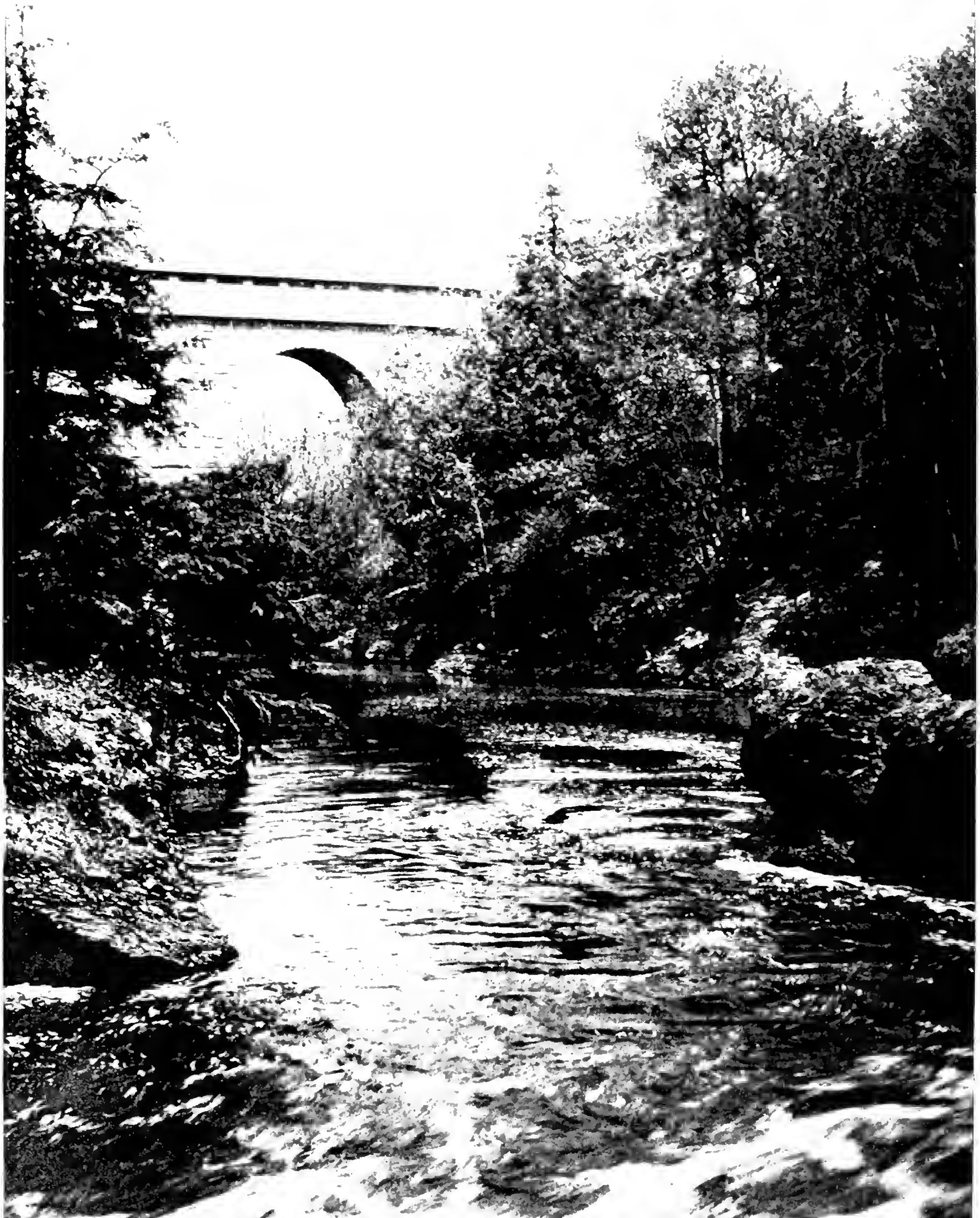
The book offers case studies of homeowners who have developed alternatives to the lawn—wildflower meadows, woodlots, groundcover beds. But the "freedom lawn" allows the traditional greensward with all its attendant pleasures: recreation, community gathering, visual unity. The book's unique contribution is the weaving together of landscape history and ecological theory. The idea of the green lawn as a setting for a detached house is traced from its source in the mild, moist climate of England to its transformation as the matrix for American suburban towns. Frank J. Scott, the chronicler of the birth of the American suburb, wrote in 1886, "an unbroken lawn around the dwelling should typify the unwritten page in the opening book of earnest life." The "freedom lawn" proposed in this book permits the opportunity for the earnest life to be played out on a bed of green while improving the local environment and contributing to a heightened recognition of our collective responsibility for a healthy earth.

Phyllis Andersen

Winter 1993–1994

arnoldia

The Magazine of the Arnold Arboretum



arnoldia

Volume 53 Number 4 1993

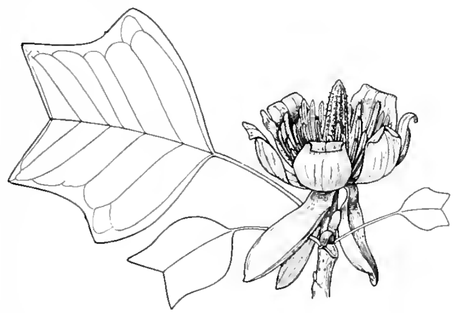
Arnoldia (ISBN 004-2633; USPS 866-100) is published quarterly by the Arnold Arboretum of Harvard University. Second-class postage paid at Boston, Massachusetts.

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

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

Karen Madsen, *Editor*

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



Liriodendron chinense

Page

Front cover: Winter at the Arnold Arboretum, looking down from Hemlock Hill to Valley Road. This photograph, by David Akiba, appears on the jacket of *New England Natives: A Celebration of People and Trees* written by Sheila Connor, librarian of the Arnold Arboretum, and published by Harvard University Press, 1994.

Inside front cover: The Hemlock Gorge Reservation, near the juncture of Wellesley, Needham, and Newton, was acquired by the Boston Metropolitan Park Commission (now the Metropolitan District Commission) in 1895. From *Report of the Board of Metropolitan Park Commissioners*, 1896.

Back cover: The Arboretum's thirty-five-foot *Liriodendron tulipifera* x *chinense* (a hybrid tulip tree) is moved to its permanent location in the landscape of the Hunnewell Building. Photograph by Peter Del Tredici.

Inside back cover: "The Museum," the Hunnewell Building, as designed by Longfellow, Alden & Harlow, Architects, in 1892. Pen-and-ink watercolor by Harry Fenn for "The Tree Museum" by M. C. Robbins, which appeared in the April 1893 issue of *Century* Magazine.

Emerald Metropolis

Karl Haglund

One hundred years ago the founders of Boston's Metropolitan Park Commission realized a transcendentalist vision by reserving as public open space "the rock hills, the stream banks, and the bay and the sea shores" of the region.

At the height of the Panic of 1893 Charles Francis Adams and his brother Henry "packed up our troubles and made for Chicago" to see the World's Columbian Exposition. Like thousands of others they were captivated and astonished by the fantastic ensemble of images they saw there—neoclassical buildings, all perfectly white, arrayed according to Frederick Law Olmsted's site plan to display "the successful grouping in harmonious relationships of vast and magnificent structures." Employing the talents of America's best architects, the fair's "White City" generated enormous enthusiasm for what soon came to be called the City Beautiful movement.[1]

In his autobiography, Henry Adams puzzled over the exhibits and the architecture of the exposition. Given that these extraordinary white structures had been "artistically induced to pass the summer on the shore of Lake Michigan," the question was, did they seem at home there? More than that, Adams wondered whether Americans were at home in the fair's idealized New World city. But neither of the Adamses, in their published works or private writings, connected what they saw in Chicago with Charles' work as chairman of the Metropolitan Park Commission in Boston.

In January 1893 the six-month-old park commission had published its report, written by Sylvester Baxter and Charles Eliot, the commission's secretary and landscape architect; Adams wrote the introduction. Their report addressed the urban environment, but not by focusing on the city center as Chicago's White City had done. Nor did they advocate taking control of suburban development—street plans and public transportation as well as parks—an approach that Olmsted and others had unsuccessfully urged in New York City in the 1870s. Looking instead to the margins and the in-between spaces of the region, they envisioned an "Emerald Metropolis." More than a city in a park, more than a second Emerald Necklace, more, even, than a *system* of parks, it was a visual definition of the region's structure that could be sustained, they were convinced, even in the face of unimagined growth. The Emerald Metropolis would help Bostonians feel at home by preserving what Eliot called "the rock-hills, the stream banks, and the bay and the sea shores" of greater Boston—the natural edges, paths, and landmarks of the region.[2]

The Idea Defined

Eliot and Baxter moved to shape the region by reserving as open space large tracts hitherto unbuildable but now on the verge of development; the shores of rivers and beaches still marshy or shabbily built up; and the most picturesque remaining fragments of the aboriginal New England landscape. The *natural* features of the region should establish the armature for urban development, not the existing haphazard assemblage of streets, lots, railroads, and

By the 1890s the Middlesex Fells was entirely surrounded by rapidly growing towns whose boundaries met in the middle of the woods. The towns had already begun to purchase land around the ponds to protect their water supply when the reservation was created in 1894, expanding the protection of the watershed. This view looks across Spot Pond toward Pickerel Rock. From Report of the Board of Metropolitan Park Commissioners, *1895.*

streetcar lines. Once set aside, these reservations would forever enhance the city's fitness for human habitation, joining unique and characteristic landscapes to the placemaking power of the city's historic landmarks. The park commission's plan offered the citizenry of Boston an opportunity to see the metropolis in an entirely new way; the figure and ground of the region's topographical features would be transposed.

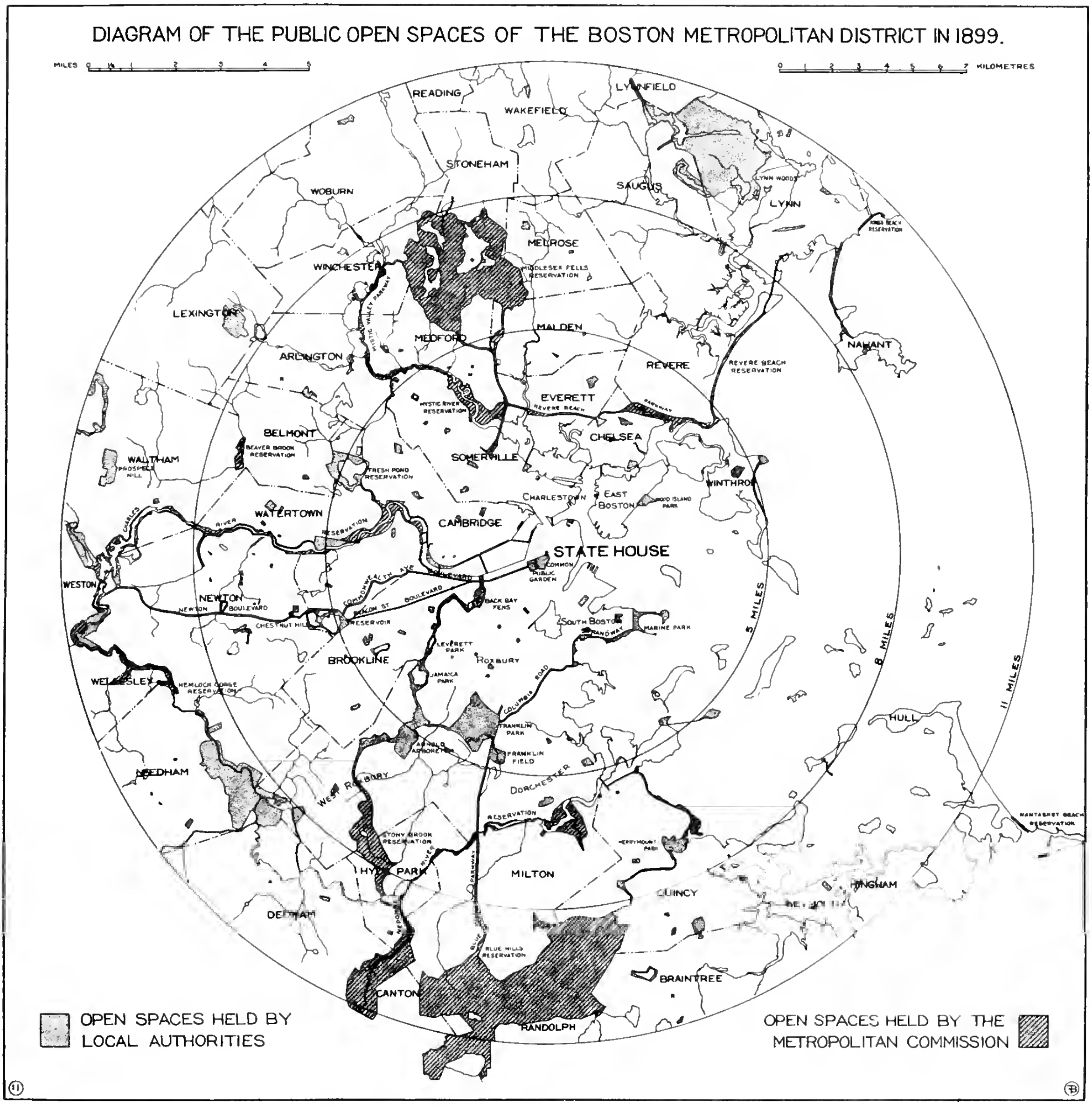
Baxter and Eliot had begun formulating these ideas several years earlier. In February 1890, Eliot responded to an editorial by Charles Sprague Sargent in his new periodical *Garden and Forest* that since the cities and towns around Boston had failed to act, the provision of "well-distributed open spaces" for public squares and playgrounds would have to wait for the establishment of a commission by the legislature. Eliot, however, was concerned with another sort of open space. He looked out from the State House and saw, within a ten-mile radius, many still-surviving remnants of the New England wilderness. There were half a dozen scenes of uncommon beauty, "well known to all lovers of nature near Boston . . . in daily danger of utter destruction." He urged the immediate creation of an association to hold "small and well-distributed parcels of land . . . just as the Public Library holds books and the Art Museum pictures—for the use and enjoyment of the public." Generous men and women would bequeath these irreplaceable properties to such a group, just as others give works of art to the city's museums. Eliot helped organize a standing committee of twenty-five, which set to work in the spring of 1890. As an energetic member of the committee, Baxter drew on his ties to newspaper editors and writers across the state and to other veterans of the twenty-year-old campaign to preserve the Middlesex Fells. The legislation to create a privately endowed Trustees of Public Reservations was signed in May of 1891.[3]

Though Eliot did not note the distinction in his letter, the analogy with the art museum and the public library suggested *two* approaches to preserving open space, one private and the other public. Even before the campaign to organize the Trustees was completed, Eliot and Baxter moved—first separately and then jointly—to promote a public regional park authority. Eliot wrote a letter to his boyhood friend Governor William Russell in December 1890, recommending that the State Board of Health develop a plan for metropolitan reservations. Three months later, Baxter wrote a series of articles in the *Boston Herald* about what he called "Greater Boston." He too scanned the ten-mile view from the State House, but he described an image that was the very inverse of Eliot's fast-disappearing landscapes. From that height he observed "a billowy sea of buildings stretching away in nearly every direction, apparently without interruption, as far as the feet of the chain of hills that encircles the borders of the bay from Lynn around to Milton." The pattern of construction paid little heed to town boundaries, and the limits of Boston covered only a fraction of the true city. The proper management of this Greater Boston would be a regional commission with authority over all the major public services—water supply, sewerage, fire, police, schools, highways, transit, parks. Here Baxter's perspective joined with Eliot's. Of all these functions, Baxter reserved his lengthiest description for a chain of pleasure grounds extending (under regional administration) from Lynn Beach and the Lynn Woods to the "mountain-like" Blue Hills range. Taken together with the recently completed parks in the City of Boston, these large woodland reservations would constitute one of the grandest park systems in the world.[4]

Olmsted urged Baxter to publish the *Herald* articles in book form, and soon after *Greater Boston* appeared, Eliot read it and proposed that they work together to realize the metropolitan park system. At their urging the newly organized Trustees of Public Reservations agreed to convene a meeting of park commissioners from across Greater Boston in December 1891. After public hearings the following spring, a temporary Metropolitan Park Commission was authorized by the legislature in June 1892.[5]

Baxter's concerns were the administrative inefficiencies and parochial jealousies of the myriad cities and towns in the Boston basin, and Eliot knew firsthand how the wariness of town officials affected the development of public open space. From his extensive explorations on the region's fringes, he knew that town boundaries often bisected the most scenic areas, especially along ponds and river valleys. It would be senseless, he said, for one town to act without the other, but too often one city had refused to spend money for fear that the adjoining city would enjoy what it had paid for.[6]

So when the park commissioners planned a series of daytrips through the district in September and October of 1892, they invited city officials and prominent residents of the towns to join them. The secretary's minutes recount the itinerary of these ten excursions, which took the commissioners and their guests throughout the metropolitan district. Several required transit by train, carriage, barge, and steam launch, all in the same day. The places they visited were unfamiliar to most of the members, and Baxter wrote later that the outings "were like voyages of discovery about home." Again and again the minutes of these journeys underline the fascination with obtaining grand and scenic views. On Milton Hill they found "one of the noblest prospects in the neighborhood of Boston." The outlook down the valley of the Saugus River toward the meadowland, the serpentine stream, and the uplands "formed a picture of exceptional charm." The view from the twin summits of Prospect Hill in Waltham was "wide and glorious." On their inspection tours the travelers



The park plan was bounded by the rock hills—the forest reservations laid out along the ring of hills that surround Boston about ten miles from the State House. The radial spokes of the park system were the three rivers—the Mystic, the Charles, and the Neponset. The beaches of the bay and seashores comprised the third element of the plan. Parks and parkways were proposed along the rivers, and parkways also linked Revere Beach with the Mystic River and the Middlesex Fells, the Charles River with Fresh Pond, Stony Brook with the Arnold Arboretum, and the Blue Hills with Franklin Park. By 1899, over nine thousand acres of reservations and parkways had been acquired. Cartography by Olmsted Brothers; from Report of the Board of Metropolitan Park Commissioners, *1899.*

Plans and Planners

What we now know as the Emerald Necklace was conceived and executed as a single, unified work by Frederick Law Olmsted. By contrast, it is impossible to attribute the authorship of the metropolitan park system to a single author. Except for relatively small parcels within the larger reservations—for example, Revere Beach (1895) and the Charles River Esplanade (1936)—MPC lands have been largely untouched by "design." They represent the first metropolitan application of the idea of "reserving" natural landmarks that began with Yellowstone, Yosemite, and Niagara Falls.

In the second half of the nineteenth century, many people campaigned to preserve various woodlands and undeveloped areas around Boston—including the Lynn Woods, the Middlesex Fells, Beaver Brook, and the Blue Hills. Among the park advocates who took a comprehensive, metropolitan view, the most influential included Robert Morris Copeland, Sylvester Baxter, and Charles Eliot.

Robert Morris Copeland

A landscape gardener listed in Boston city directories from 1855 to 1872, Copeland prepared the plan for the village of Oak Bluffs on Martha's Vineyard and wrote the popular book *Country Life: A Handbook of Agriculture, Horticulture, and Landscape Gardening.* During the park debates of post-Civil War Boston, Copeland wrote a remarkable editorial proposing a system of parks as well as a grand circular boulevard around Boston that would follow the its encircling ring of hills; bridges and ferries across the harbor islands were to complete the loop. Copeland suggested that the surrounding towns "were now Boston," but their citizens "come here to earn money, and go home to enjoy it." It should be possible, he thought, to choose park improvements that would benefit Boston as well as the surrounding suburbs, but this task was beyond the means of individual cities and towns. He appears to have been the first to suggest a "metropolitan commission" as the vehicle for this parkmaking.[1]

When Copeland moved to Vermont, his ideas for a metropolitan system were advanced by his former associate, the engineer Nathaniel Bowditch. In 1874 Bowditch published a metropolitan park plan that included many of Copeland's ideas and anticipated Eliot's proposal of two decades later. For almost fifteen years Copeland had lived in a house along Beaver Brook in Belmont, near the famous Waverly Oaks, an area he included in his metropolitan system. When the MPC was organized in 1893, Beaver Brook was its first acquisition.

Sylvester Baxter

Having determined that he could not afford to attend the recently opened architecture school of the Massachusetts Institute of Technology (the first in America), Baxter went to work for the *Boston Daily Advertiser* in 1871. It seems likely that he would have read Bowditch's 1874 proposal for a metropolitan park system in the *Advertiser.*

From 1875 to 1877 Baxter studied at the universities of Leipzig and Berlin and was especially interested in German municipal

Sylvester Baxter (above) and Charles Eliot (facing page). Photographs by Elmer Chickering, ca. 1893, courtesy of MDC Archives.

administration. On his return to Boston he became involved with Elizur Wright in the campaign to preserve "Stone's Woods" in Malden, Medford, and Winchester. (He also promoted renaming the area "the Middlesex Fells.") In 1880 he wrote Olmsted, who had not yet moved to Boston, about the Fells.

Baxter's interests covered an extraordinary range. In 1881 he joined an archeological expedition to investigate Zuñi ruins in the Southwest, and the following year wrote an article about the visit of several Zuñi chiefs to Washington and Boston, where the Zuñi conducted a sunrise ceremony on the beach at Deer Island. He also wrote several books of poetry as well as a history of Mexican architecture. His abiding interest, however, was his vision for Greater Boston.[2]

Charles Eliot

Periods of elation and tranquility (especially when he was away from Cambridge in nearby countryside or the wilds of Maine) alternated with recurring episodes of self-doubt and depression in Eliot's early life. His mother died when he was nine. By the time he began his studies at Harvard, his father had been president of the college for ten years and was well on his way to Olympian status in American higher education. The burden of family privilege and accomplishment heightened Charles' anxieties when as an upperclassman he realized he "could find no practical bent or ambition anywhere about me." At one point in his senior year he came near to giving up his studies entirely.

Not long after graduation a conversation with his uncle Robert Peabody, an architect who lived near Frederick Law Olmsted in Brookline, persuaded Eliot that he should become a landscape architect. Since there was then no recognized training for the field, he entered Harvard's Bussey Institution, where the Department of Agriculture and Horticulture was located. The following spring Eliot was introduced by Peabody to Olmsted, who offered him an apprenticeship. Within a week he had dropped out of his classes and taken his first inspection tour with Olmsted as a full-time employee of the firm. He soon discovered how well his extracurricular pursuits had prepared him for his profession—the childhood drawing lessons, the long hikes around Boston, the adolescent mapping of imaginary towns and real neighborhoods (like Norton's Woods in Cambridge), the college summers organizing a group of college friends to study the natural sciences on Mt. Desert Island.

After an apprenticeship of two years, Eliot left for a year in Europe. On Olmsted's advice, he ignored the monuments of the "Grand Tour" in favor of public parks, botanical gardens, city streets, and landscape books in the British Museum. He returned with an extraordinary breadth of professional knowledge—from landscape construction to styles and philosophies of design. By 1892, after five years of managing his own office, he was well equipped for his part in the creation of the Metropolitan Park System.[3]

[1] Robert Morris Copeland, "The Park Question," *Boston Daily Advertiser* (December 2, 1869), 2.

[2] [Sylvester Baxter] "Sylvester Baxter," in James Phinney Baxter, *The Baxter Family: A Collection of Genealogies* (N.p. 1921), 94–102.

[3] [Charles W. Eliot] *Charles Eliot, Landscape Architect* (Boston: Houghton Mifflin, 1901), 1–34.

also noted unique and distinctive landscapes. They were deeply impressed with the remarkable beauty of the landscape of the ancient Waverly Oaks in Belmont and with the need to preserve them for the public.[7]

The commissioners were able to see beyond then-current conditions as well. The Charles River shore "was marred by industries merely in search of cheap land" and made ugly by "squalid hovels, dump heaps and other nuisances." Its banks were "inky black" with foul sewage deposits, though they should be "a popular pleasure ground." There were a "number of ugly fish houses and an equally ugly Hotel" on Nahant Beach, but it was nonetheless one of the most beautiful sites on the Massachusetts coast. After their ten outings, all the members presented their views before the board, and then Baxter and Eliot drafted the report.[8]

"Picturing" the Park System

The rationale for the Metropolitan Park System drew on a reservoir of ideas that dated back more than a generation, ideas that had now gained widespread acceptance:

> The life history of humanity has proved nothing more clearly than that crowded populations, if they would live in health and happiness, must have space for air, for light, for exercise, for rest, and for the enjoyment of that peaceful beauty of nature which, because it is the opposite of the noisy ugliness of towns, is so wonderfully refreshing to the tired souls of townspeople.[9]

In Eliot's summation, these general principles gave strong support for the *concept* of the park system. The real genius of the 1893 report, though, was its integration and extension of a series of earlier, less comprehensive proposals for the Boston region.

In 1844 an eccentric Scot named Robert Gourlay, residing in Boston for two years for the treatment of insomnia, had proposed "connecting and exhibiting to the greatest advantage those rare and beautiful features which Nature has here thrown together" so that "the streams, the islands, and the promontories,—all may be made to harmonize in one grand panorama . . ." The landscape gardener Robert Morris Copeland had published a plan in 1869 that encompassed not only the ring of hills from Lynn to Quincy, but a grand circuit that linked the North Shore across harbor bridges and ferries to the southern beaches (though he believed the banks of the Charles would always be needed for wharves and docks). Copeland was probably the first to call specifically for a metropolitan commission to execute this ambitious plan. Separate campaigns had been forwarded for several of the large forests around Boston. Elizur Wright and others had lobbied since the 1870s to create a "forest conservatory" at the Fells, and the Massachusetts Horticultural Society in its reports had urged the reservation of both the Fells and the Waverly Oaks. A "water park" for the Charles River Basin had many advocates in the 1870s and 80s, among them Uriah Crocker and Charles Davenport.[10]

The 1893 metropolitan scheme encompassed the rivers and the shores of Greater Boston in spite of their then-degraded state. Eliot sketched the symmetry of this plan near the end of his "Report of the Landscape Architect":

> As the ocean at Revere Beach was reached by a ten-mile drive from Winchester down the valley of the Mystic River, so now the bay shore at Squaw Rock is reached by a ten-mile drive from Dedham down the lovelier valley of the Neponset. Half-way between these northern and southern riverways we find Charles River, leading, by another course of ten miles, from Waltham through the very centre of the metropolitan district to the basin just west of the State House. Nature appears to have placed these streams just where they can best serve the needs of the crowded populations gathering fast about them.[11]

Here, as throughout the two men's writings, images were crucial to their visionary narratives. During the report's preparation Eliot wrote to the commissioners that his "special work" for the park commission was "the picturing by printed words, photographs, and

The most visionary acts of the park commission were the schemes to reclaim the riverbanks and beaches, which were occupied by tenements and industry. The transformation of Revere Beach required the relocation of streets and railroads and the demolition of numerous shanties and saloons. Photograph by Nathaniel L. Stebbins. From Report of the Board of Metropolitan Park Commissioners, *1898.*

maps of those open spaces which are still obtainable near Boston." The "details of the legal machinery" could all be resolved once this "picturing" aroused the necessary public support.[12] Like others before and since who have projected greater Boston into the future, the two men appealed to the visual as well as the moral imagination.

Eliot divided his report's twenty-five pages of "picturing" into three parts. First was a physical and historical geography of the parks district, followed by a study of "the way in which the peculiar geography of the metropolitan district ought to govern the selection of the sites of public open spaces." Finally, Eliot documented the opportunities still available to acquire open space according to the principles he had outlined.[13]

Those principles reflected widely expressed contemporary concerns for public order and rational structure in American cities. A study of the natural features of the region, Eliot believed, would "bring forth the facts in the case" and result in "the scientific selection of lands for public open space." Such "scientific planning" would proceed from the greater to the lesser, recognizing that the larger spaces could never be had if they were not acquired at the right time. The larger reservations would offer not only the "fresh air and play-room" of smaller spaces but also the "free pleasures of the open world of which small spaces can give no hint." Executing these general principles would require particular attention to the visual and functional logic of the reservations' boundaries. Wherever possible the boundaries should be established on public roads or on lines where roads would likely be built. And the commission should avoid taking "only half a hill, half a pond or half a glen," since fragments of such landscape types would be less satisfying as natural scenery.[14]

The Park Commission was authorized to build parkways in 1894 to create jobs in a time of recession. Primarily intended for "pleasure vehicles," the parkways provided scenic access to the reservations. The Speedway, a departure from the scenic values of the park system, was built near Harvard's Soldiers Field. The tidal flats along the lower Charles offered the only place near Boston for a mile-long course uninterrupted by cross streets. From Report of the Board of Metropolitan Park Commissioners, *1902.*

Picturing the park system also meant citing appropriate administrative models. Though Eliot hinted at the possibilities for parkways, Baxter's "Report of the Secretary" addressed the issue of public roads in a regional context and strongly advocated "Special Pleasure-ways" to link the metropolitan parks and reservations. One precedent was the boulevards of Chicago, created by the Illinois boulevard act, which allowed the park commissioners to seek the consent of municipal authorities and abutting landowners to connect parks with such pleasure roads. Commonwealth Avenue, the parkways of the Emerald Necklace, the planned improvements to Blue Hill Avenue, and the proposed parkway from the Arnold Arboretum to Stony Brook were cited as examples, made possible because the annexation of several adjoining towns had given the City of Boston the necessary geographical range. By contrast, the region north of the Charles River, carved up into many small cities and towns, lacked not only extensive parks but clearly delineated routes to the center of Boston as well.[15]

In Baxter's view, the proper structure for "the peculiar political geography" of the region was not annexation, however; it was the Metropolitan Sewerage Act of 1889. Baxter also saw a fiscal precedent near at hand for the Commission's plans to reclaim degraded natural areas. Olmsted's recreative treatment of the Back Bay Fens was clearly both "the cheapest and most effective" remedy.[16]

Assembling the Reservations

The effort of "picturing" the metropolitan parks in the report, aimed at Boston's "high-handed and liberal" Yankee aristocracy, was completely successful. The "legal machinery" was passed by the legislature and signed by Governor Russell, permanently establishing the Metropolitan Park Commission on June 3, 1893. Charles Dalton, the chairman of the Boston Park Commission, thought the report would be one of the most important contributions to the literature of public parks ever made. Charles Francis Adams observed to the board that "Our work is chiefly educational. We cannot expect to accomplish practical results immediately, but to prepare the public to do something in these directions some years hence."[17]

Eliot, however, had other intentions. He moved with what now seems almost incomprehensible speed to map the reservation boundaries, and the Park Commission acquired almost seven thousand acres of mostly open land in its first eighteen months. Its first taking, in 1893, was Beaver Brook, including the Waverly Oaks. Responding to the depression, the legislature authorized funding for the development of parkways the next year. By 1899, only six years after the park commission was established, the park system comprised eleven reservations and seven parkways, totalling over nine thousand acres.[18]

At the heart of Eliot's vision for the derelict spaces along the rivers and shores was the Charles River Basin, extending upstream from the western slope of Beacon Hill. The basin, he predicted, would become the central "court of honor" of the metropolitan district. Gourlay's visionary drawings in 1844 had already imagined the basin as a single, designed space, but in 1893, the river was still a noisome expanse of sewage-laden tidal flats, unfit for the central role in any story of park design or civic foresightedness. The river's frontage was occupied by two prisons, three coal-burning power plants, and numerous shabby commercial and industrial structures. Two large slaughterhouses, one near the harbor and the other downstream from Watertown Square, dumped offal into the shallow waters. Even in the elegant Back Bay, said Richard Henry Dana, where a public roadway should face the river, there was instead "a contemptible scavenger's street, thirty feet wide, backing up against the unmentionable parts of private houses."[19]

No single reservation took more of Eliot's time than the Charles. Before and during his tenure as consultant to the MPC, he served on several state commissions organized to study the river's sanitary problems, and was also the landscape architect for the new (1893) Cambridge Park Commission. Cambridge acted first, and at Eliot's direction the city acquired and began filling more than four miles of salt marsh, almost the entire length of the city's southern boundary. Though Eliot hoped that some of the region's riverine marshes would be preserved, he told the MPC that the ten miles of Charles River salt marsh below Watertown "must sooner or later be made usable." Like many others, Eliot was persuaded that damming the Charles near the harbor to create a water park would return annually increasing profits to the community. A separate MPC appropriation for land acquisition along the river was passed in 1894, and over five hundred acres were purchased during the next three years. In spite of these extensive investments, the opposition—led by residents on the water side of Beacon Street—successfully resisted the construction of a dam until 1903. (The Esplanade was completed in 1936.)[20]

Reservations and Natural Scenery

For the forest lands, Eliot pressed vigorously to acquire as much of the identified reservations as possible, but he struggled in vain to educate the park board on the need for what he called "general plans" for each reservation before roads and structures were built. When the pace of acquisition slowed in 1896, he organized a project to classify the broad categories of vegetation throughout the park system. Published in 1898, a year after Eliot's untimely death, *Vegetation and Scenery* is a detailed complement to his planning principles outlined in the 1893 report. Though in the earlier document he had advocated a "scientific" selection of lands, the vegetation study would merely record the existing conditions in the reservations; it was neither "an historical or even a scientific inquiry."[21]

Here we are left to puzzle over what Eliot meant by "historical" and "scientific." Certainly the *Vegetation* report corroborated his earlier statements that both the beauty and ugliness of the existing vegetation were primarily the work of men, "chopped over, or completely cleared, or pastured, or burnt over, time and time again." While the reservations differed sharply from each other topographically, recent human action had rendered the vegetation of the woodlands very much alike and "remarkably uninteresting."[22]

Then why—apart from a few scattered natural and geologic oddities—had these forests been acquired? Natural reservations, Eliot had said, "were the cathedrals of the modern world," and the metropolitan reservations had been acquired as a "treasure of scenery." The beaches and the river shores offered expansive water views, but the scenery of the rock hills was problematic. Only on the rocky summits and in the swamps was the vegetation "natural." The opportunity of the park system's stewards was to "control, guide, and modify" the forest growth so that the reservations would be "slowly but surely induced to present the greatest possible variety, interest, and beauty of the landscape." Eliot encouraged his protegé Arthur Shurcliff to sketch before-and-after scenes in the reservations, and Shurcliff's drawings were included in the printed report to "picture" the enhancement of the landscape through the judicious use of the axe.[23]

Standing in the way of such landscape improvements, Eliot wrote, was a "small but influential body of refined persons" who opposed these efforts to adapt parks and reservations to new requirements. He observed that these people could live in a little bower and read Thoreau with delight, but they could not understand a whole landscape. They "talk of 'letting Nature alone' or 'keeping nature natural', as if such a thing were possible in a world which was made for man." The idea that it might be "sacrilegious" to control or modify the existing verdure was nonsense. Even the six thousand acres of the Blue Hills, situated as it was on the rim of the metropolis, did not constitute a wilderness—in fact, the vegetation was "really artificial in a high degree." Eliot's priorities for both the large and small reservations were clear: first, to safeguard the scenery of these natural areas before it was too late; second, to make that scenery accessible to the public; and finally, to enrich and enhance the beauty of the reservations.[24]

Even if there should be sufficient public support to accomplish the first and second of these tasks, could the enhancement of scenery ever be justified at public expense, when "ordinary people will never appreciate the difference"? Eliot answered emphatically in the affirmative. Following Olmsted, he argued that in the presence of "unaccustomed beauty or grandeur," even the average person experienced "sensations and emotions, the causes of which are unrecognized and even unknown." This principle, he thought, was the basis for the public commitment to schools, libraries, and art museums. It was well exemplified in many already completed public parks, and in Eliot's mind it was the foundation for the metropolitan reservations.[25]

The Park System Acclaimed

The significance of the metropolitan parks was widely acclaimed in Boston, in other American cities, and especially in Europe. In November 1893, after Eliot and Olmsted's son John had became his partners, Olmsted wrote to them:

> . . . nothing else compares in importance to us with the Boston work, meaning the Metropolitan quite equally with the city work. The two together will be the most important work of our profession now in hand anywhere in the world. . . . In your probable life-time, Muddy River [part of the Emerald Necklace], Blue Hills, the Fells, Waverly Oaks, Charles River, the Beaches *will be points to date from* in the history of American Landscape Architecture, as much as Central Park. They will be the opening of new chapters in the art.[26]

The popularity of canoeing on the Charles River peaked during the two decades after the construction of Norumbega Park and the Riverside Recreation Grounds in Newton and Weston in the 1890s. More than four thousand canoes were said to be moored along the middle Charles. The regatta shown here was held at the Waltham Canoe Club about 1912. Just downstream of the canoe club is the smokestack of the American Waltham Watch Company, and on the west side of the river is Mt. Feake Cemetery. Farther downstream, below the Watertown Dam, the riverbanks were lined with slaughterhouses, power plants, and other polluting industries, and boating was dominated by the colleges and the rowing clubs. Courtesy of the MDC Archives.

The endeavor of "picturing" the parks did not end with the first report, nor was the audience limited to Bostonians. The metropolitan park commissioners prepared a one-ton plaster topographical model of the metropolitan area for the Paris Exposition of 1900 that was later exhibited at the Pan-American Exhibition in Buffalo (1901), at the Louisiana Purchase Exposition at St. Louis (1904), and at the Lewis and Clark Centennial Exposition in Portland (1905). A 1905 article by the secretary of the City Parks Association on "The Development of Park Systems in American Cities" included a lengthy description of the Boston metropolitan parks, and suggested that "readers have doubtless so identified the park movement with Boston as to be almost totally ignorant that anything of a similar nature has been undertaken elsewhere."[27]

In 1910 the international competition for the planning of Greater Berlin resulted in an influential exhibition and a widely circulated two-volume catalog. A lavishly illustrated chapter on American park systems described their significance as the basis for city plans and their importance in relieving urban congestion. Several pages were devoted to the Boston city and metropolitan parks, with a full-page map of the metropolitan park system and photographs of the Blue Hills and Revere Beach.

The section of the exhibit on American parks was later mounted separately in several German cities.[28]

The judgment of planners and civic officials at the turn of the century has been echoed by modern urban historians. In their view, it was in America that "open space first emerged as a potential structural element for the entire city." The work of Baxter and Eliot has been called "the most notable scheme of comprehensive metropolitan park planning" in the United States and "the first such organization of land in the world." Closer to home, an eloquent study of the Back Bay Fens authenticates the reservations' importance: "If Mount Auburn Cemetery was the forerunner of the Fens, the Metropolitan Park System represented its evolutionary glory."[29]

The Fate of the Idea

In 1919, the Park Commission merged with the Metropolitan Water and Sewerage Board to create the Metropolitan District Commission (MDC). More than a dozen new parkways were constructed in the next decade. The passage of open space bonds in the 1980s funded significant additions to the reservations, and today the park system comprises more than 16,000 acres. After a hundred years' experience with this regional pattern of open space, it is fair to ask what these reservations now mean in our urban lives.

Working double shifts for eight months, twenty-one people built this model under the direction of the "geographic sculptor" George Carroll Curtis. It took six months to make a wax model, then plaster casts were made in ten sections. The finished model was almost eleven feet in diameter and weighed one ton. Its handpainted surface was "planted" with 200,000 evergreen and deciduous trees and depicted 250 miles of railroads, 300 miles of streams, 2,750 miles of streets, and 157,000 dwellings. Even the Frog Pond on Boston

The founders of the park system were practical enough to see that the water edges of rivers and shores could provide open space without taking large tracts off the tax rolls. The city's ponds and rivers, as Eliot told the Cambridge park commissioners, offered "permanently open spaces provided by nature without cost"; capturing their edges for the public opened "these now unused and inaccessible spaces with their ample air, light, and outlook." But behind these matter-of-fact statements was a transcendentalist vision of the mystical power at the edges and margins of the natural world. The human craving for landscapes is most deeply realized where earth connects with water and sky. Emerson, whose writings these park advocates knew well, declared that "in every landscape the point of astonishment is the meeting of the sky and the earth." The New England teacher Horace Mann put it more plainly: "Water is to the landscape what the eye is to the face."[30]

A hundred years ago Eliot was convinced that reservations of scenery had become the cathedrals of the modern world. Are they now? The historian Sam Bass Warner has argued that at the end of the twentieth century "we are escaping a different city; we are in search of a different Mother Nature." It is not just the highways everywhere, splitting the Blue Hills and the Fells, and separating the Esplanade from its neighborhood. Across the

Common and the bridge over the lake in the Public Garden were shown in scale. The model was exhibited first at the Paris Exposition of 1900, then at international expositions in Buffalo, St. Louis, and Portland. For almost eighty years the model was displayed at Harvard University museums. In 1980 it was moved to the Boston Museum of Science, at the geographical center of the Metropolitan Park System. From G. C. Curtis, A Description of the Topographical Model of Metropolitan Boston, *1900.*

country "greenways" are created on former railroad beds, along canals, and in other once-unimaginable "public open spaces," and Olmsted is acclaimed as the "father of the greenways." Greenways, however, are no longer peaceful byways for "restoring the tired souls of townspeople." We now jog, sunbathe, cycle, and skate in many reservations where, until recently, such activities were forbidden. Scenic reserves for many people have become landscapes of speed and motion.[31]

The incursion of structures, highways, and wheels of all kinds notwithstanding, the natural landmarks of Greater Boston, drawn into the public domain according to the park system's visionary scheme, have shown surprising steadfastness. Perhaps the past hundred years have vindicated the definition of stewardship that Baxter and Eliot propounded: first, secure open spaces that reinforce the park system at every opportunity, even if they cannot be developed immediately (remembering the lesson of the reclaimed rivers and shores—that it is never too late to acquire or recover public spaces); next, offer access for people without destroying what has been reserved; and then when the means permit, improve the natural domain—the hills, the rivers, and the shores—of the Emerald Metropolis.

Notes

1 Jack Shepherd, *The Adams Chronicles: Four Generations of Greatness* (Boston: Little, Brown, 1975), 424. Thomas S. Hines, *Burnham of Chicago: Architect and Planner* (New York: Oxford University Press, 1974), quotes Daniel Burnham, the chief architect of the Chicago Fair, on the color of the buildings, 101; and Charles Eliot Norton, Harvard professor of fine arts, on their arrangement, 115.

2 Walter Creese unnecessarily simplifies the Metropolitan Park System by mapping it as "Eliot's Emerald Necklace" in "The Boston Fens," *The Crowning of the American Landscape: Eight Great Spaces and Their Buildings* (Princeton: Princeton University Press, 1985). Henry Adams, *The Education of Henry Adams* (Boston: Houghton Mifflin, 1974), 340. For a discussion of Olmsted and J. J. R. Croes' 1876–77 plans for the Bronx, see David Schuyler, *The New Urban Landscape: The Redefinition of City Form in Nineteenth-Century America* (Baltimore: Johns Hopkins University Press, 1986), 174–79. Charles Eliot, "Report of the Landscape Architect," *Report of the Board of Metropolitan Park Commissioners* (Boston: Wright & Potter, 1893), 91, cited below as *MPC Report* (1893).

3 Charles Eliot, "The Waverly Oaks," *Garden and Forest* (March 5, 1890), 117–18. Eliot first proposed that the association be called "The Trustees of Massachusetts Scenery." The name chosen, "The Trustees of Public Reservations," was the source of some confusion since the organization was privately organized and funded. In 1954 it became "The Trustees of Reservations." Its history is described in Gordon Abbott, Jr., *Saving Special Places: A Centennial History of the Trustees of Reservations: Pioneer of the Land Trust Movement* (Ipswich, MA: Ipswich Press, 1993).

4 Charles Eliot to Governor William Russell, December 19, 1890, in [Charles W. Eliot] *Charles Eliot, Landscape Architect* (Boston: Houghton Mifflin, 1901), 356–57, hereafter cited as *Charles Eliot*. Sylvester Baxter, *Greater Boston: A Study for a Federalized Metropolis Comprising the City of Boston and Surrounding Cities and Towns* (Boston: Philpott, 1891), 8 (reprinted from the *Boston Herald*).

5 Baxter's recollection that Eliot proposed a joint effort to realize the park system is found in his "Wonderful Progress During the Past Seven Years of Work on the Great Metropolitan Park System," *Boston Sunday Herald* (May 20, 1900), 41; and in Baxter, "Greater Boston's Metropolitan Park System," *Boston Evening Transcript*, Part Five (September 29, 1923), 1.

6 Eliot to Russell, quoted in *Charles Eliot*, 356.

7 Minutes of the temporary Metropolitan Park Commission, 1892.

8 Ibid.

9 *MPC Report* (1893), 82

10 Robert Fleming Gourlay, *Plans for Beautifying New York and For Enlarging and Improving the City of Boston* (Boston: Crocker & Brewster, 1844), 17; Robert Morris Copeland, "The Park Question," *Boston Daily Advertiser* (December 2, 1869), 2; "The Waverly Oaks," *Transactions of the Massachusetts Horticultural Society for the Year 1884, Part II* (Boston: Massachusetts Horticultural Society, 1884), 272–73. According to Baxter, painters connected with the Boston Art Club had suggested that the club purchase the Waverly Oaks in the 1870s; "By Bicycle to the Waverly Oaks—II," *Garden and Forest* (August 17, 1892) 3(234): 387. Beginning in the 1870s, the Charles was frequently compared with rivers in European cities, especially Hamburg's Alster Basin, which served in a general way as the model for the development of the Esplanade in the 1930s. See City of Boston, *City Document No. 128* (1869), 7, 264.

11 *MPC Report* (1893), 106. Baxter considered Eliot's

"comprehensive reservation of the banks of the three rivers" unique in a system of park development; see Baxter, "Wonderful Progress," 40.

[12] *Charles Eliot*, 383.

[13] *MPC Report* (1893), 82–110.

[14] *MPC Report* (1893), 83, 92; *MPC Report* (1894), 14. For a broad view of the period, see Robert Wiebe, *The Search for Order, 1877–1920* (New York: Hill & Wang, 1967).

[15] Baxter included a draft "General Parkway Law" in his part of the report. *MPC Report* (1893), Appendix B, 62–66.

[16] *MPC Report* (1893), 3–19.

[17] The characterization of Boston politics in this period as "both high-handed and liberal" is from Martin Meyerson and Edward C. Banfield, *Boston: The Job Ahead* (Cambridge, MA: Harvard University Press, 1966), 106; Dalton's comment is cited in Baxter, "Wonderful Progress," 41.

[18] Two decades later, Adams was still startled by the speed of the Commission's progress: "Wholly opposed to the policy of rapid growth and what I could not but regard as premature development, I found myself powerless to check it. I was, in fact, frightened at our success in the work we had to do." By June 1895 Adams was "bored to death and fast getting cross" with week-to-week administrative matters, and resigned from the board. Writing at the end of his life, however, he doubted "whether at any period of my life, or in any way, I have done work more useful or so permanent in character . . . as saving to the people of Massachusetts the Blue Hills and the Middlesex Fells." Charles Francis Adams, Diary, June 10, 11, 1895; *Charles Francis Adams, 1835–1915, An Autobiography* (Boston: Houghton Mifflin, 1916), 185.

[19] Charles Eliot, "The Boston Metropolitan Reservations," *New England Magazine* 15: 1 (September 1896), 117–118. Richard Henry Dana, letter to the editor, *Boston Daily Advertiser*, June 13, 1874.

[20] *MPC Report* (1897), 43.

[21] Charles Eliot, *Vegetation and Scenery in the Metropolitan Reservations of Boston* (Boston: Lamson, Wolffe, 1898), 8 (hereafter cited as *Vegetation and Scenery*).

[22] *Vegetation and Scenery*, 9; *MPC Report* (1895), 31.

[23] Olmsted, Olmsted & Eliot to the Metropolitan Park Commission, June 22, 1896, quoted in *Charles Eliot*, 655; Eliot, *Vegetation and Scenery*, 9, 22.

[24] Charles Eliot, "The Necessity of Planning," *Garden and Forest* (August 26, 1896), 342; Arthur A. Shurcliff, "What Mr. Eliot Said," 1897 ms. Houghton Library, Harvard University; Eliot, *Vegetation and Scenery*, 9, 22; *MPC Report* (1895), 32. For the cultural roots of urban landscape improvement, see Richard Bushman, *The Refinement of America: Persons, Houses, Cities* (New York: Knopf, 1992).

[25] *MPC Report* (1897), 51.

[26] Olmsted to Partners (John Olmsted and Charles Eliot), October 28 and November 1, 1893, Olmsted Papers, Library of Congress. As Keith Morgan has pointed out, all but the first of these parks were initiated and directed by Eliot; Keith Morgan, "Held In Trust: Charles Eliot's Vision for the New England Landscape" (Bethesda, MD: National Association for Olmsted Parks, 1991), 1.

[27] *MPC Annual Report* (1905), 30–31; Andrew Wright Crawford, "The Development of Park Systems in American Cities," *Annals of the American Academy* (1905), 223.

[28] Christiane Crasemann Collins, "A Visionary Discipline: Werner Hegemann and the Quest for the Pragmatic Ideal," *Center: A Journal for Architecture in America* 5 (1989), 79–80.

[29] Jon C. Teaford, *The Unheralded Triumph: City Government in America, 1870–1900* (Baltimore: Johns Hopkins University Press, 1984), 256–257; Creese, 168; Anthony Sutcliffe, *Toward the Planned City: Germany, Britain, the United States, and France, 1780–1914* (Oxford: Basil Blackwell, 1981), 197; Creese, 183.

[30] Eliot, *Preliminary Report on the Location of Parks for Cambridge* (October 16, 1893); quoted in *Charles Eliot*, 423–24. George H. Snelling, "Testimonials in Favor of the Modification of the Plan of Building on the Back Bay Territory: April 2, 1860"; Ralph Waldo Emerson, "Nature," in Brooks Atkinson, ed., *The Complete Essays and Other Writings of Ralph Waldo Emerson* (NY: Random House, 1940), 410; Horace Mann is quoted in Creese, 192.

[31] Olmsted, Olmsted & Eliot to the Metropolitan Park Commission, June 22, 1896, quoted in *Charles Eliot*, 655; Sam Bass Warner, Jr., "Open Spaces," *New Republic* 170: 29 (March 23, 1974), 30; Noel Grove, "Greenways: Paths to the Future," *National Geographic* 177: 6 (June 1990), 93.

Acknowledgments

Encouragement for this research was generously extended by the Metropolitan District Commission and by Commissioner M. Ilyas Bhatti. Professor Keith Morgan, Julia O'Brien, MDC Director of Planning, and Sean Fisher, MDC Archivist, offered insightful comments. Special thanks is expressed to Katie and Tony Strike.

Karl Haglund is the project manager of the New Charles River Basin, the extension of the Charles River Reservation from the Esplanade to Boston Harbor. He has written about historic architecture, urban design, and the landscapes of the American West.

The Waverly Oaks

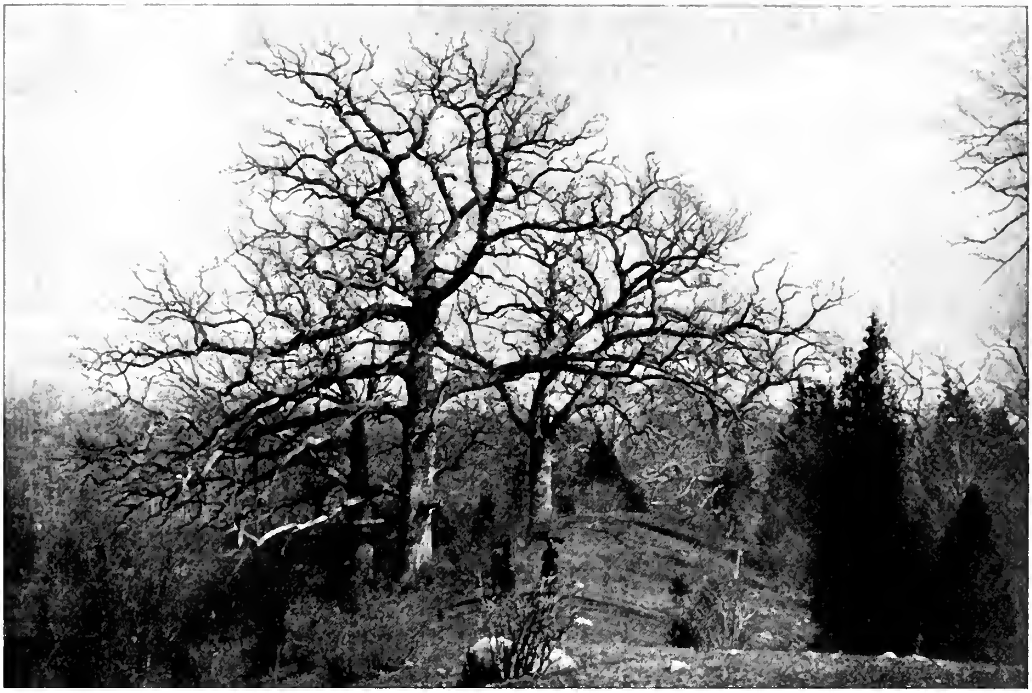
Charles S. Sargent

The impetus to preserve Beaver Brook, which in 1893 became the first of the reservations of the Metropolitan Park Commission, was the desire to save the Waverly Oaks. The founding director of the Arnold Arboretum advocated their preservation in this editorial in *Garden and Forest,* February 19, 1890.

There is in Belmont, one of the suburbs of Boston, and formerly a part of the ancient town of Watertown, a group of Oaks which has come to be known in recent years as the Waverly Oaks, from the village near which they stand. These Waverly Oaks are, all things considered, the most interesting trees in eastern Massachusetts, and although there are larger Oaks in New England and in the Middle States, a group containing so many large trees is not often seen now anywhere in eastern America. There are in this group twenty-three large Oaks and one large Elm growing on an area of two or three acres. The Oaks are all White Oaks, with the exception of a single Swamp White Oak. They occupy mainly the slopes of a terminal moraine, along the base of which flows Beaver Brook, the "Sweet Beaver, child of forest still," sung by Lowell. The Waverly Oaks are well known to all Bostonians interested in nature, and strangers not infrequently make the pilgrimage to Belmont to look upon these venerable products of Massachusetts soil. . . . The Committee on Grounds of the Massachusetts Horticultural Society visited the Waverly Oaks on the 28th of June, 1884, and the chairman, Mr. J. G. Barker, joined to its report printed in the transactions of the society for that year . . . a timely suggestion for their preservation.

This suggestion we desire to repeat and enforce. . . . The age which these trees have attained and the vicissitudes they have survived entitle them to respect, and the people of Massachusetts might wisely secure their preservation through the purchase and dedication to public use of the land on which they stand.

The age of these Oaks can only be surmised. One famous naturalist is said to have declared that the smallest of them had existed through more than a thousand years. It is probable that this statement is greatly exaggerated. The largest tree in the group girths seventeen feet three inches at three and a half feet from the ground. The principal tree in our illustration is smaller, with a girth of only thirteen feet four inches, measured at the same distance from the ground. An actual examination of the wood of this tree shows that it has increased three inches in diameter during the last twenty-four years. Had it made the same rate of growth during the whole period of its existence, it would have been 408 years old, and the largest tree in the group would be, with the same rate of increase, 508 years old. It is probable that they are both younger than these estimates make them. They may have grown less rapidly for several years at the beginning of their life, but there must have been a number of years, probably several hundred, when they increased more rapidly in diameter than they have during the last quarter of a century. The appearance of the trees justifies this supposition. They are still healthy, and are growing with considerable vigor;



In 1892, Sylvester Baxter wrote of the oaks in Garden and Forest, *"The proposition to secure the preservation for public enjoyment dates something like twenty years back. Some of the painters connected with the Boston Art Club then urged their purchase by that institution as a sketching-ground for Boston artists, as Fontainebleau serves for Paris. Fontainebleau, however, is not comparable with the Waverly Oaks in any of the elements of landscape-beauty." Photograph by W. H. Rollins, from* Garden and Forest, *1890.*

but there can be no doubt that their period of most rapid development has passed, or that, while they may continue, with proper care, to live and increase slowly for centuries perhaps, they will grow less rapidly now that they did one or two hundred years ago. But after making all due allowance for differences in the rate of growth at different periods in the existence of these trees, it is safe to surmise that the youngest of them had attained to some size before the Pilgrims landed on the shores of Massachusetts Bay, and that the oldest was at that time a tree of some size. . . .

The Waverly Oaks grow within a few hundred yards of the station at Waverly, on the Boston & Fitchburg Railroad, on a piece of ground directly opposite the property of the trustees of the Massachusetts General Hospital, occupied by the country home of that institution. The whole region is undergoing rapid development, and houses are springing up on every side. The establishment of a small public park at this place, which need not exceed three or four acres in extent to accomplish this object, would protect the trees from the dangers which now threaten them, and would make a valuable and interesting public resort within walking or driving distance of the homes of a very large number of people.

As fate would have it, the oaks survived only a few decades beyond the establishment of the Beaver Brook Reservation. By the 1920s they had succumbed to ice storms and old age.

Historic Plants in a New Setting: The Evolution of the Hunnewell Building Landscape

Stephen A. Spongberg and Peter Del Tredici

The plantings and the landscape in the immediate vicinity of the Arboretum's Hunnewell Building have undergone repeated changes since the construction of the building in 1892. The 1993 renovation of the building called for a landscape renovation as well.

The need for plantings in the newly contoured landscape in front of the Hunnewell Building provided a valuable opportunity. It was a chance to transform the area into a living exhibit that would explore the history of the Arboretum through plants. By planting species relevant to the Arboretum's botanical explorations of eastern Asia, we hoped to introduce visitors to the ancient connections between the floras of Asia and North America that have been the focus of Arboretum research for well over a century.

In 1858 Harvard's Professor Asa Gray, arguably the preeminent botanist of his day, published a benchmark paper in which he hypothesized a close floristic relationship between the floras of eastern North America and eastern Asia. Gray based his theory on some of the first botanical specimens brought to the West after the opening of Japan by Commodore Matthew Perry in 1854. Later in the nineteenth century, Charles Sprague Sargent, the Arnold Arboretum's founding director, inaugurated the Arboretum's exploration of the floras of eastern Asia with a full understanding of Gray's hypothesis and an awareness of the climatic similarities of the two regions. Sargent reasoned that many plants of eastern Asiatic origin would prove hardy when cultivated in the Arnold Arboretum. As a consequence of a continuing series of Arboretum expeditions to China, Japan, and Korea, scores of new woody ornamentals have been introduced into Western gardens and now grow in close association with their eastern North American counterparts in the Arnold Arboretum and elsewhere across North America.

The plants the Arboretum staff have chosen for the new landscape demonstrate these close floristic relationships and simultaneously reinforce the original taxonomic planting established for the Arboretum by Sargent and landscape architect Frederick Law Olmsted. This scheme followed the Bentham and Hooker system of plant classification, which was then current and widely accepted, and arranged the plant families according to their degree of morphological complexity.

The magnolia family falls near the beginning of the Bentham and Hooker sequence, and several existing magnolias have been retained in the Hunnewell landscape, including *Magnolia kobus*, *M. zenii*, a picturesquely multistemmed star magnolia *(M. stellata)*, and several varieties of the saucer magnolia *(M. x soulangeana)*.

For the majority of the new plantings the existing collections of the Arboretum served

#NEWS

from the Arnold Arboretum

Celebrating the Hunnewell Building

Robert E. Cook, Director

In November the Arboretum observed a triple-layered celebration when we were joined by friends and guests at the Hunnewell Building for food and libations. One layer of celebration marked the completed renovation of the building. You have already heard much about this so I shall only say that we celebrated a project that came in on time and under budget. And everyone is delighted with the results.

The second layer brought to light the importance of the architect Alexander Wadsworth Longfellow (nephew to the poet), who designed the original building in 1892. Margaret Henderson Floyd, professor of architectural history at Tufts University, assembled an exhibit that chronicled the career of Longfellow and the extensive work of his firm, Longfellow, Alden & Harlow. The Hunnewell Building was an early commission, influencing many later projects in Boston, Cambridge, and Pittsburgh. We capped the exhibit with a scale model of the renovated building, which will be on display through March.

The third, more subtle celebration acknowledged the historical link between the Hunnewell and

(continued on page 4)

Photo by Amy Wilson

Bob Cook and Walter Hunnewell in the renovated Hunnewell Building.

The Hunnewell Connection

Walter Hunnewell

It was only a short time ago that I became aware of a Hunnewell Building in the Arnold Arboretum. Once I knew this, I began to wonder how much money was needed to build the building and what part of the total my great grandfather had contributed. I was given the figures a few weeks ago, and Oh! for those good old days! H. H. Hunnewell's first gift in 1876 was $300 to form part of a fund of $2,000 for a contour map of the Arboretum land. Then, in 1890 or 1891, he made a gift of $30,000. With a total of $11,000 more from three other men there was enough to build this building. From there on, there was a regular fundraising effort to which Hunnewell continued to contribute modestly.

Irrespective of the size of the gifts that Hunnewell made, there is no doubt that he was vitally interested in the Arnold Arboretum and considered Professor Sargent one of his closest friends. They were forever visiting back and forth. My grandfather's generation used to say that Professor Sargent was always around. Hunnewell was genuinely pleased when Professor Sargent dedicated to him the fourth volume of *The Silva of North America.* Stories still come down to my generation and my children's of how Professor Sargent once while visiting

(continued on page 2)

Photo by Amy Wilson

Jim Gorman, president of the Arnold Arboretum Committee, presents a check for $4000 to Diane Syverson as Bob Cook looks on. The Committee's donation will support the participation of Boston Public School students in the Arboretum's Field Study Experiences program.

(The Hunnewell Connection, continued)

Wellesley jokingly told his friend, "Well, now I know where all my azaleas have gone."

How did these two men, one thirty-one years older than the other, become such good friends, and how did both become so intensely interested in trees and horticulture? I know little about C. S. Sargent. I never met him, but the family always referred to him with great respect as Professor. I am told that Henry Winthrop Sargent, his father's first cousin, was the man who first instilled in the young Charles the interest that was to occupy his attention for the rest of his life. Henry lived on a most beautiful estate, Wodenethe, on the Hudson River. His neighbor across the river was Andrew Jackson Downing, the father of American landscape gardening and the author of the most popular garden books of the day. If these two men were the ones who sparked Professor Sargent's interest, what circumstance or person played a similar role in the case of H. H. Hunnewell?

To give you the background, I have to go back to 1825, sixteen years before C. S. Sargent was born. Hollis Hunnewell's mother had befriended her niece Adeline Fowle in her youth, as Adeline's mother had died shortly after she was born. Adeline later married Samuel Welles, a Paris banker. To show her gratitude to her aunt, Adeline invited her fifteen-year-old cousin, Hollis, to come to Paris to work as an apprentice in her husband's bank. He accepted the invitation and very soon Hollis Hunnewell was writing to the agent of his employer in New York City, Samuel Welles' nephew Henry Winthrop Sargent. It was at the start a purely business relationship, but in time it became more than that. Hollis married Isabella Welles and now it was to his wife's first cousin that he was writing. By the time Hollis moved back to this country to live with his in-laws in what was then Natick, now Wellesley, Henry Sargent had moved to his house on the Hudson River. He often visited the old Welles homestead in Natick for he owned land there and he also liked his old business friend.

Both men began to take an increasing interest in horticulture. In one of Andrew Jackson Downing's books there is a preface by Henry Sargent describing the advantages and disadvantages of starting an estate in a forest versus in an open field, the forest being Wodenethe, the field being Hunnewell's place in Wellesley.

Hunnewell, even in the 1840s, had started planting evergreen trees of different species on the Welles' land. It was not until 1865 that he determined to make a real collection in one place, to form a pinetum. Only a few years later, Professor Sargent started the Arnold Arboretum. How natural it was that the two men should want to compare notes: What tree seemed hardy and what tree had died last winter. They also perhaps wanted to talk about their common relative, who had died in 1882, the man who first encouraged and excited them in what became for both an interest that lasted the rest of their lives.

NEH Funds New Exhibit Exploring Arboretum History

The New Year began auspiciously at the Arnold Arboretum with a $150,000 grant from the National Endowment for the Humanities. The award will fund a new exhibit and orientation program to introduce visitors to the history and mission of the Arboretum landscape and collections. The award follows nearly two years of planning by Arboretum staff; by humanities scholars Charles Beveridge, Robert V. Bruce, Blanche Linden-Ward, and Sam Bass Warner; and by exhibit planning consultants The American History Workshop.

The exhibit, entitled "Science in the Pleasure Ground" (the title of Arboretum Associate Ida Hay's upcoming book), is scheduled for completion in the fall of 1995. To be located in the Hunnewell Building, it will include a scale model of the Arboretum landscape, a video exploration of the development of the Arboretum's living collections, and a new brochure providing take-away information on the Arboretum's origins and purpose. The Endowment has further supported the exhibit with the offer of a $50,000 matching grant. We will be working to raise this match when the Arboretum initiates its fund drive later this year.

Thank you! Arnold Arboretum Associates

For over a decade the Arnold Arboretum Associates, a group of dedicated volunteers, have generously supported the Arboretum through the Annual Rare Plant Auction. Managed and organized by the Arboretum Associates, the Auction has become one of New England's premier horticultural events, bringing together plants and people in support of the Arnold Arboretum.

This past January the Associates contributed over $47,000 in auction proceeds to support a variety of Arboretum programs, including the development of new field studies for visiting elementary schoolchildren, the installation of new display labels for the Arboretum living collections, and the conservation of the Arboretum's archival collections of Joseph Rock and Susan McKelvey photographs.

Although many members of the Associates will continue to work with the plant sale and auction, the group recently voted to discontinue the Arboretum Associates as a separate volunteer organization. The Arboretum extends its many thanks and deepest appreciation to the Arnold Arboretum Associates for their many years of support:

Active Members
Mrs. Mario G. Baldini
Mrs. Francis Blake
Mrs. Shepard Brown
Mrs. William Callender
Mrs. Ralph D. Cies
Mrs. Patrick Conley
Mrs. William G. Coughlin
Mrs. Robert G. Crocker
Mrs. Joseph C. Donnelly
Mrs. Ralph Engle
Mrs. John Herweg
Mrs. Shaheen Bossi
Mrs. Ellen McFarland
Mrs. Henry H. Meyer
Mrs. Marlowe A. Sigal
Mrs. Henry S. Streeter
Mrs. David B. Stone

Sustaining Members
Mrs. Oliver F. Ames
Mrs. Peter Ashton
Mrs. Melville Chapin
Mrs. David F. Dalton
Mrs. Edward N. Dane
Mrs. F. Stanton Deland
Mr. Alfred Fordham
Mrs. William Gallagher
Mrs. Theodore Heffenreffer
Mrs. Hugh Hencken
Mrs. Walter Hunnewell
Mr. John Morss
Mrs. Charles G. Rice
Mrs. Hsia Shaw
Mrs. W. Davis Taylor
Mrs. Kennard Wakefield
Mrs. Richard Warren
Mrs. Richard S. West

New Staff at the Arboretum


Photo by Karen Madsen

Jennifer Brown is the new Library Assistant at the Horticultural Library of the Arnold Arboretum. She will mainly be responsible for cataloging, acquisitions, and reference services. She comes to us from Lamont Library where she worked in public services and reference.

Jennifer is currently attending Harvard Extension School where she will complete her Bachelor's degree in August of 1994.


Photo by Karen Madsen

John S. DelRosso brings ten years' experience in arboriculture and horticulture to his new position as arborist at the Arboretum. He holds an associate's degree in forestry from the Essex Agricultural & Technical Institute and has worked for Hartney/Greymont, Lowden Tree, and the Forestry Division of the Metropolitan District Commission. His favorite tree is the Kousa dogwood.

(continued on page 4)

Photo by Karen Madsen

Steve Nelson has joined the Arboretum staff as Chief Development Officer. Steve will be directing the Arboretum's participation in Harvard University's upcoming capital campaign. He also serves as a member of the Arboretum Executive Committee.

Steve joins us from Harvard Business School where he was the Associate Director of Development. He received his MBA from Harvard and his bachelor's degree from Northwestern in chemistry, with a concentration in biochemistry and molecular biology.

Park Endowment Contributes to Arboretum Field Study Experiences

The Arnold Arboretum Park Endowment recently contributed over $6,500 in support of the Arboretum's Field Study Experiences program. The Park Endowment, active since 1985, is an independent, nonprofit organization (with no ties to either Harvard University or the Boston Parks Department) dedicated to supporting public enjoyment of the Arnold Arboretum. Their generous gift funds the participation of several Boston Public School classes in a special series of field study experiences. The Arboretum extends many thanks for the Endowment's continuing support.

(Hunnewell Building, continued)

Sargent families and their roles in the origins of the Arboretum. This history was related at one of our evening events when Walter Hunnewell, great grandson of the original benefactor of the building, presented to the assembled audience a brief discourse on his great grandfather's interest in horticulture (see accompanying article).

It was Horatio Hollis Hunnewell of Wellesley, a close friend of Charles Sprague Sargent, our first director, who provided the bulk of the funds in 1892 for the construction of the new administrative center of the Arboretum in which his great grandson, a century later, recounted this history.

Today we salute a renovated building, a distinguished architect, and the Hunnewell family's long support of horticulture at the Arnold Arboretum.

Arnold Arboretum Committee and City Year Organize Community Clean-Up

Photo by Amy Wilson

Last fall, the Arboretum Committee in cooperation with City Year organized a clean-up of the state-owned parcel that abuts the Arboretum's southeastern boundary, as well as the entire lengths of Bussey, Walter, and Centre Streets. On the neighboring parcel, dense thickets of buckthorn, bramble, sumac, rose, and other woody weeds were completely removed, opening up clear sightlines throughout the site. Over 75 volunteers worked for the better part of a day. All told, they contributed more than 400 person-hours. The Arboretum grounds crew spent several days afterwards chipping the huge piles of brush and trees.

As with many past Committee-organized clean-ups, this project was greatly aided by the generous support of Waste Management, Inc., which donated a disposal truck for the entire day. Thanks go to City Year, Waste Management, Inc., the Arnold Arboretum Committee, and all who made this such a productive and successful effort.

as the source. Large specimens were carefully dug, moved, and incorporated into the site, including three large specimens of *Enkianthus campanulatus* and a solitary specimen of *E. perulatus*, both from Japan. Among the larger trees moved from another Arboretum location was a thirty-five-foot specimen of a hybrid tulip tree *(Liriodendron tulipifera* x *Liriodendron chinensis)* that truly exemplifies the close floristic relationships between China and eastern North America. Only two species of the genus are known, one *(L. tulipifera)* widespread in eastern North America and the other *(L. chinensis)* of scattered and localized distribution in eastern and central China. Separated from one another in nature by thousands of miles on opposite sides of the globe, the two species now grow together in the Arboretum. While the two are distinct in form, they have remained similar enough genetically to produce hybrid progeny when artificially crossed. The hybrid plant now installed in front of the Hunnewell Building has special Arboretum associations. It was raised from seeds obtained from intentional cross-pollinations made by Professors Clifford Parks and Norton G. Miller (a former Arboretum staff member) at the Coker Arboretum on the campus of the University of North Carolina at Chapel Hill. Interestingly, the tree of *Liriodendron chinensis* that was used in these experiments was a gift to the Coker Arboretum from the Arnold Arboretum; it had been grown from the seed originally received from the Lu Shan Arboretum in China. And the hybrid plant itself was a gift from the Coker Arboretum to the Arnold Arboretum, received in 1981.

Each of the plants that shape the newly planted landscape has its own historical associations with the Arboretum. For example, the large specimens of the longstalk holly *(Ilex pendunculosa)* represent a species introduced into Western gardens by Charles Sprague Sargent when he first traveled to Japan in 1892. The Arboretum's most famous plant collector, Ernest H. Wilson (1876–1930), is memorialized

The flower of Liriodendron tulipifera x chinense, *which now grows in the landscape of the Hunnewell Building. Photograph by Rácz & Debreczy.*

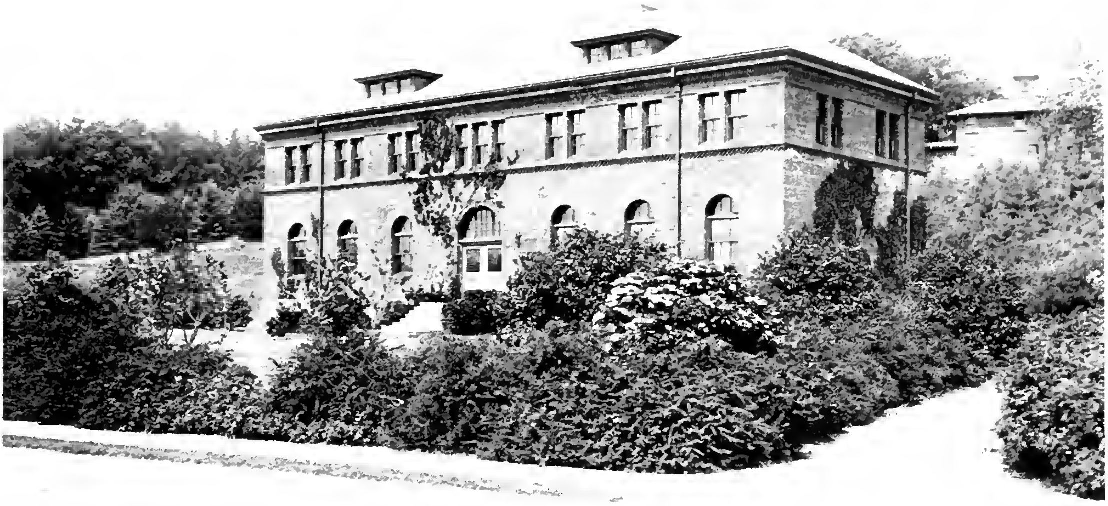
by three individuals of the so-called three-flowered maple, *Acer triflorum*, which constitute a small grove along the curved ramp that facilitates wheelchair access to the building. This maple, introduced into cultivation in the West by Wilson, is a distinctive ornamental tree noted for its loose, papery, reddish- or yellowish-gray bark and for the spectacular golden yellows and pumpkin shades of its leaves in fall. Seeds of this species were collected by Wilson in October 1917 in the forests of Korea and sent to the Arnold Arboretum. So impressed was Wilson by this handsome species in its native habitat that he wrote to Sargent urging that all of the seed be sown. He considered the plant to be the best ornamental located on his last expedition to Asia for the Arboretum. The three young individuals in the new Hunnewell planting will ensure the species' continued presence at the Arboretum for generations to come.

The incorporation of two genera of the Theaceae, or tea family, strengthens the taxonomic sequence that ordered the original planting plan. The genus *Stewartia* is represented by a wonderful thirty-foot specimen of *S. pseudocamellia*, an early summer-flowering tree native to Japan and Korea with a dual ornamental value in its attractive camellia-like flowers and its exfoliating, mottled bark. While two species of *Stewartia* are native to the southeastern United States, they were not included in the Hunnewell landscape for reasons of hardiness and cultural requirements. Instead, a specimen of *Franklinia alatamaha*, the Franklin tree, has been chosen to represent the American branch of the tea family.

Of all the woody plants native to the eastern United States, few, if any, are surrounded by a more interesting history than Franklinia. Briefly told, it was first discovered growing on the banks of the Altamaha River in northeastern Georgia in 1765 by John and William Bartram of Philadelphia, but it was not brought into cultivation until 1773 when William Bartram revisited the area. Like species of *Stewartia*, the Franklin tree produces beautiful camellia-like flowers that appear continuously from late summer until fall, when its leaves turn scarlet. The plant quickly became a horticultural novelty even before 1785, when it was described and named by Humphrey Marshall (John Bartram's cousin) to honor Benjamin Franklin, the foremost American scientist, philosopher, and statesman of the day. As a consequence, it was soon extirpated from its very limited native habitat and was last seen as a naturally occurring plant in 1807. Although now extinct in the wild, *Franklinia* has persisted in cultivation, with the majority of individuals in cultivation today having originated from the plants in the Bartrams' Philadelphia garden.

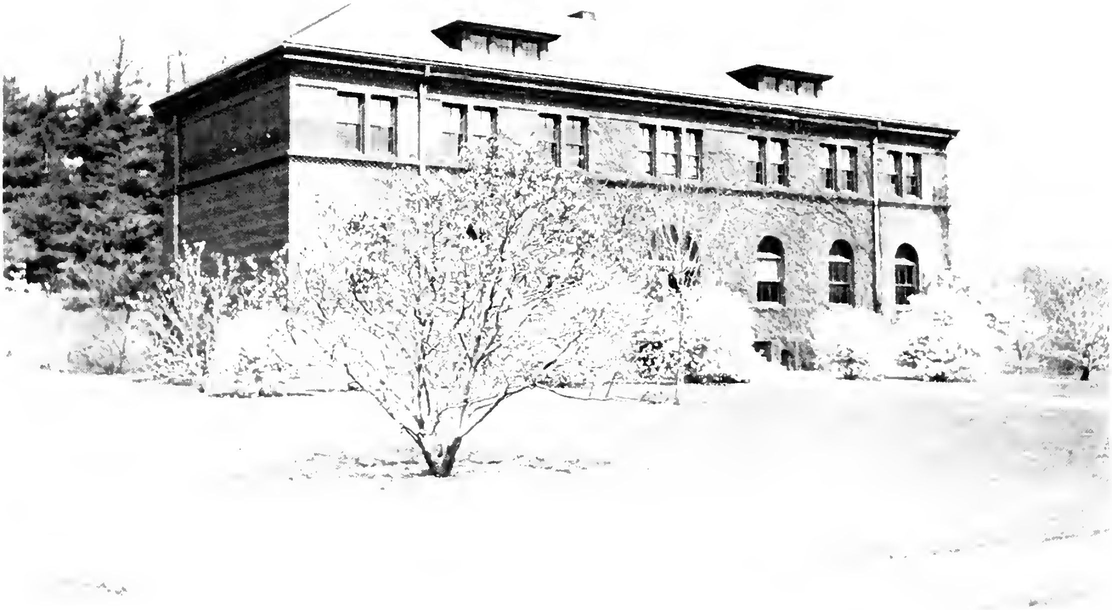
The photos below provide a visual summary of changes in the Hunnewell Building's front yard over the past hundred years.

The Hunnewell Building under construction in 1892. All photos are from the Archives of the Arnold Arboretum.



Shortly after the Hunnewell Building was completed in 1892, Boston ivy (Parthenocissus tricuspidata) *was planted on its walls. By May 1903, when the photo above was taken by T. E. Marr, the vines had reached the roof, and other landscape elements began to assert themselves. The dominant feature in the photograph is a hedge of barberry,* Berberis *sp., clearly intended to separate the building from the public thoroughfare. Note also the large flowering shrubs planted in front of the building and the* Hydrangea *in flower behind the barberry hedge.*

By 1917, when this photograph was taken, the Berberis *hedge had been removed, along with many of the large flowering shrubs, producing a much more open landscape. Two magnolias are clearly visible in the photograph, a specimen of* M. stellata *in the left foreground and a* M. x soulangeana *in the right background. The Boston ivy has been left to ramble freely over the front of the building, creating a dramatic "Olmstedian" effect typical of the period. Photo by G. R. King.*



As the landscape matured, more magnolias were planted in front of the Hunnewell Building. In this photograph, taken in May of 1928, the magnolia theme is well established, with a young, leafless M. acuminata, *in the center of the photo, poised to become a dominant feature in the future. In the left foreground is* M. x soulangeana *'Candolleana' (AA #15160–A), which grows in the same spot today. Photo by Walter Merryman.*

The same view in 1952, with both the M. acuminata *and* M. *'Candolleana' at full maturity.*

The Hunnewell Building in August 1992, a year before renovation. The several specimens of Magnolia stellata *are over twenty feet tall and the* Ilex pedunculosa *over fifteen. The sheer mass of plants creates the impression of an overgrown foundation planting that completely masks the bottom two stories of the building.*

The new look of 1993. Photo by Warren Patterson.

The Asian Connection

Robert E. Cook

While Arboretum horticulturists have tested the hardiness of east Asian plants in the Boston climate, botanists have been theorizing about the causes of their similarities to eastern North American plants, employing a range of methods to investigate their relationships to one another.

Harvard botanists have long been entranced by the flora of east Asia. Although the floristic similarity of eastern Asia and eastern North America was first noted by Linnaeus in the middle of the eighteenth century, it was Harvard's Asa Gray who in 1859 focused scientific attention on the many common or closely related species found in the two regions and nowhere else. This disjunct pattern of distribution seemed to suggest a once more extensive flora now broken up into two smaller regions by geological and climatic causes.

Gray has been followed by numerous students and staff (Sargent, 1894; Fernald, 1931; Hu, 1935; Li, 1952; Wood, 1971; Boufford and Spongberg, 1983; Tiffney, 1985) who have studied and written about the causes of this relationship. Inevitably, alternative explanations have been postulated to account for the similarities of the floras. Perhaps a distinct flora found in one region migrated as a whole across a land bridge connection to the other region. The similarity might also result from the random but repeated dispersal of individual species across great ocean barriers. Or the apparent similarity may not be real at all. Unrelated species could have evolved similar morphologies because the climate and soils of the two regions are similar.

Over the last half century our understanding of past climatic and geological history has deepened. We believe that whole continents, now separated by thousands of miles of ocean, were once connected as a single land mass. We know that major changes in the earth's climate have brought about repeated periods of glaciation in northern regions of the world as well as cycles of wet and dry periods in tropical regions, leading to massive dislocations of flora and fauna. Changes in sea level and the uplifting of mountain ranges have completely altered the shape of terrestrial land and inland seas. Plant fossils discovered in high latitude regions such as Greenland, northern Europe and Asia, and the arctic lands of North America clearly demonstrate that many southern species were once more widely distributed.

Each new piece of evidence about climate, geology, or historical plant distributions has been used by botanists to argue for one over another cause of the striking similarity of the floras on the two continents and the apparent close relations of many of their species. As is so often the case in science, the real explanation for such a complex but distinct pattern is likely to be a combination of several factors interacting over long spans of time. The similarities seen in one group of plants may have its own distinctive history of causes when compared with a different group.

Liriodendron chinense *photographed in Patung Hsein, China, altitude 4,000 feet, by E. H. Wilson in June 1910. At 60 feet in height this individual is at the upper end in stature for its species. From the Archives of the Arnold Arboretum.*

A Common Ancestry

Underlying all of this, and at the heart of the perceived pattern, is the belief that species found in the two regions are indeed closely related and that the pattern represents the remnants of a shared evolutionary history. It could be otherwise. Two species can appear very similar in many characteristics and yet be quite unrelated as in the case of *Acer pseudoplatanus* (Sycamore maple) and *Platanus occidentalis* (Sycamore). This phenomenon has been called convergent evolution by botanists who strive to distinguish this misleading similarity from true relationship.

What does it mean to say that two species are closely related? What constitutes a true relationship? To an evolutionary botanist it means that they share a large number of genes in common because at some time in the past they shared a common ancestor. In essence, the two species were once one species, which subsequently split into two. Our most common definition of a species is a group of interbreeding individuals that do not interbreed with any other such group. The members of a species all share genetic information in a way analogous to the sharing of information among members of a human population who use a

Liriodendron tulipifera, *the American tulip tree, photographed in North Carolina, is a far taller plant than its Chinese relative. For this individual, the height to the first limb alone is 65 feet. From the Archives of the Arnold Arboretum.*

common language or dialect. And just as isolation over time can lead to the development of distinct language dialects, so too can isolation trigger the process of speciation in plants. If parts of a species' population become isolated from each other—perhaps by a geographical barrier such as a mountain range or a river—then the exchange of genetic information is interrupted and the two isolated parts begin to develop genetic differences. If this isolation continues long enough, the two isolated parts may no longer be capable of interbreeding. Speciation has occurred.

The goal of the plant systematist is to organize the diversity of plant species in such a way that their degree of relatedness (in the sense of shared genes due to shared common ancestors) is revealed in the classification. Ideally, then, the names given to species and the way they are placed in genera and families will reflect our understanding of the history of speciational events during evolution that led to the diversity we see today.

Measuring Relatedness

How have systematists tried to measure this degree of relationship among species? The earliest efforts, beginning with Linnaeus two hundred years ago, examined the degree of morphological similarity under the assumption that this accurately revealed the underlying genetic similarity. But we now know that very similar plant morphologies can develop from very different sets of genes. Therefore, morphology may in many cases be misleading.

In their search for the characteristics that more closely represent the genetic identity of species, botanists turned to the proteins that constitute the building blocks of tissues, organs, and mature morphologies. Through biochemical isolation and separation they were able to evaluate a new set of characteristics believed to be the direct products of genes.

In recent years this approach has been further eclipsed by the revolution in molecular biology, which allows one to identify individual genes and compare sequences of genes as they are represented in two presumably related species. Therefore, in theory, one can directly measure the degree of genetic similarity. Molecular systematics, as it is called, promises to bring a higher order of evidence to questions of the relationship between species that may or may not have once shared a common ancestor.

Genes can best be analyzed when they are extracted from living plant tissue that has been quickly frozen in extremely cold temperatures. Researchers use a liquified form of nitrogen to achieve such temperatures. The need for living tissue close at hand from a wide diversity of plant species has greatly increased the importance and value of well-documented collections of trees such as are maintained with great care in the Arnold Arboretum. Samples from these specimens can be supplemented with fresh collections obtained on expeditions to the native habitat of the species under consideration.

History of Two Tulip Trees

The value of this new, molecular approach can be seen in recent work on a classic case of a Chinese–eastern North American disjunct distribution, the tulip tree. *Liriodendron tulipifera*, which ranges from New England to northern Florida, appears closely related to *Liriodendron chinense* of central and eastern China. In addition to sharing a great deal of morphological similarity in leaf, flower, and fruit characteristics, these two species are capable of cross pollination to form viable hybrid offspring. By these criteria, they might almost be judged a single species. Yet the vast geographical distance separating them clearly prevents such hybrids from forming naturally. Based only on morphological evidence, one might conclude that these two species were once part of a large, interbreeding population (that is, sharing a common ancestor) and that the split into two populations had occurred relatively recently.

To obtain new evidence on the true genetic similarity between these species, Clifford Parks and Jonathan Wendel at the University of North Carolina extracted the genetic material (DNA) in leaf tissue from a large number of samples throughout the range of both species, which would directly determine the degree of difference in selected genes. The result of their analysis revealed that approximately one and one-quarter percent of the genetic material differed between the two species. Using statistical models based on the rates at which genetic material changes over time, these botanists were able to estimate how long ago these two species shared a common ancestor. They concluded that *L. tulipifera* and *L. chinense* were part of a single interbreeding population twelve and a half million years ago.

A Confirmation from Fossils

Parks and Wendel then turned to the fossil record to assess the historical evidence for past distributions of *Liriodendron* and other temperate deciduous species found in both Asia and North America. They wished to test their estimate based on genetic analysis against the actual dated presence of the species in particular locations. Reviewing the discovery of fossil plants in western Canada and Alaska, and taking into account the position of the continents ten to twenty million years ago, they concluded that a broadly distributed, temperate forest existed in a band across North America through Alaska and into central Asia at the start of this time period. A global cooling trend around the middle of this time brought the invasion of coniferous forests into Alaska and northeastern Russia, displacing deciduous forests to the south and effectively severing the Asian connection. Fossil dating showed that this disjunction occurred about thirteen million years ago.

Despite the great morphological similarity between *L. tulipifera* and *L. chinense* and their ability to produce hybrid offspring, the molecular and fossil evidence reinforce each other and suggest that they have been separated for more than twelve million years. While their genes have continued to evolve during this separation, their morphologies have remained relatively unchanged, thus giving a false picture of their degree of relatedness.

Parks and Wendel argue the need for similar studies of other genera, such as maples *(Acer)*, silverbells *(Halesia)*, witchhazels *(Hamamelis)*, and ginsengs *(Panax)*, all of which show an Asian–North American disjunct distribution. Clearly molecular systematics, utilizing the rich living collections of institutions such as the Arnold Arboretum, will provide a powerful tool for illuminating our ancient Asian connection.

References

Boufford, D. E., and S. A. Spongberg. 1983. Eastern Asian–North American phytogeographical relationships—A history from the time of Linnaeus to the twentieth century. *Annals of the Missouri Botanical Garden* 70: 423–39.

Fernald, M. L. 1931. Specific segregations and identities in some floras of eastern North America and the Old World. *Rhodora* 33: 25–63.

Hu, H. H. 1935. A comparison of the ligneous flora of China and eastern North America. *Bulletin of the Chinese Botanical Society* I: 79–97.

Li, H. L. 1952. Floristic relationships between eastern Asia and eastern North America. *Transactions of the American Philosophical Society* 42: 371–429.

Parks, C. E., and J. F. Wendel. 1990. Molecular divergence between Asian and North American species of *Liriodendron* (Magnoliaceae) with implications for interpretation of fossil floras. *American Journal of Botany* 77 (10): 1243–56.

Sargent, C. S. 1894. *Forest Flora of Japan: Notes on the Forest Flora of Japan*. Boston: Houghton, Mifflin & Company.

Tiffney, Bruce H. 1985. Perspectives on the origin of the floristic similarity between eastern Asia and eastern North America. *Journal of the Arnold Arboretum* 66: 73–94.

Wood, C. E., Jr. 1971. Some floristic relationships between the Southern Appalachians and western North America. In P. C. Holt [ed.], *The Distributional History of the Biota of the Southern Appalachians. Part II. Flora*, 331–404. Virginia Polytechnical Institute: State University Research Monograph 2.

Bob Cook is Director of the Arnold Arboretum and lectures in introductory biology at Harvard University.

Introducing *Weigela subsessilis*

Stephen A. Spongberg

The Arnold Arboretum is pleased to offer an ornamental shrub of intriguingly variegated color.

Among the seeds collected in Korea on the Arnold Arboretum's 1977 collecting expedition to Japan and Korea (Spongberg and Weaver, 1978; Spongberg, 1978; Weaver, 1978) were two lots representing a species of *Weigela* that had not previously been grown and tested at the Arboretum. At the time the capsules were gathered, the identity of the species was not known. It was not until eleven years later—after plants grown from these seeds in the Arboretum's collection had flowered and fruited, and herbarium voucher specimens had been taken—that the plants were identified as *Weigela subsessilis* (Nakai) Bailey.

When first described by the Japanese botanist Takenoshin Nakai in 1918, this Korean plant was placed in the genus *Diervilla*, a genus of shrubs that is now limited to three North American taxa, while the Asian plants previously included in *Diervilla* have been grouped in the exclusively Asian genus *Weigela* (Bailey, 1929; Hara, 1981). The specific epithet, *subsessilis*, refers to the very short petioles of the opposite leaves, which cause the leaves to appear stalkless, or sessile. The genus *Weigela* is well known for its spring-flowering shrubs, many of which are of considerable ornamental value. About twelve species are native to eastern Asia, with eight of them occurring in Japan, three or four in China, and four in Korea. Most of these species are also cultivated in North American and European gardens, and several interspecific hybrids are known from which many cultivars have been selected, named, and made available in the nursery trade (Howard, 1965; Krüssman, 1986).

Weigela subsessilis is apparently endemic to the Korean peninsula, and the 1977 introduction of the species into the collections of the Arnold Arboretum may, in fact, have represented its first successful introduction into North American gardens. Alfred Rehder included it in his *Manual of Cultivated Trees and Shrubs* (1940), but he questioned whether it had been introduced into cultivation in North America, and the species appears in none of the other standard references on cultivated woody plants, including those by Bean (1980), Krüssman (1986), and Dirr (1990). The *Supplement* to the eighth revised edition of Bean (Clarke, 1988) credits its introduction from South Korea to the Royal Botanical Gardens, Kew, in 1982, five years after the Arnold Arboretum had obtained its two accessions of seeds. One specimen in our herbarium *(S. G. March, s. n.* 5 April 1983) resulted from an earlier introduction by the United States Department of Agriculture (PI 371794), using seed received from Professor T. Bok Lee of the Department of Forestry, Seoul National University, in March of 1972. However, the plant or plants resulting from that introduction and grown at the U.S. National Arboretum (#40580) were apparently never propagated or distributed, except as herbarium specimens.

Weigela subsessilis. *(a) flowering branchlet; (b) detail of maturing capsules; (c) individual leaf; (d) style; (e) open corolla tube and anthers (From Nakai, 1921).*

The Arnold Arboretum collections now include three accessions of *Weigela subsessilis.* Two plants accessioned under #1906–77 were grown from seed collected on the wooded trail to the temple on Yongmun-san in Kyonggi-do Province northeast of Seoul. Another set of plants (#1901–77) was grown from seeds collected from plants growing on the wooded slopes of Kyebang-san in Kangwong-do Province, farther to the east. Plants of the third accession (#587–83) also trace their origin to seed collected on Kyebang-san by Chollipo Arboretum staff and offered in their 1983 *Index Seminum.*

These three sets of plants have had varying results. Plants of the third accession (#587-83) have been incorporated into the Arboretum's collections so recently that their performance has not yet been evaluated. Plants of the second accession (#1901–77) were planted as a group on the slope of Bussey Hill, along Oak Path in a shaded, relatively dry location, but have failed to grow well in this location.

By contrast, two plants of the first accession (#1906–77) that were planted in a sunny location in moist but well-drained soil along Bussey Hill Road near the Dana Greenhouse drive have performed very well. These two shrubs are multiple-stemmed from the base and have grown to about five feet in height with a spread of about three feet. Compact and twiggy, these individuals have been free of disease and insect pests. Moreover, they have proven to flower generously each spring, and the gradual color changes in the flowers make these plants intriguing ornamentals in the spring landscape.

The flowers are produced on new growth from second-year wood as the leaves are expanding. Each inflorescence consists of clusters of three or four, even up to six flowers. When fully open, the flowers measure between 2.5 and 3.5 cm in length. As the flower buds enlarge, they assume a yellowish-green color that gradually changes through various shades of pink to a pale lavender when the flowers are in full bloom. Since inflorescences are profuse and individual flowers represent different stages of maturation, the overall effect of the shrub is a unique combination of pastel colors from pale yellowish-green to lavender.

While these shrubs cannot be considered year-round ornamentals, their profusion of flowers in early May recommend them for trial in New England gardens and elsewhere in North America. The species has proven hardy in the Boston region, but the limits of its hardiness in more northern climates has not been tested. *Weigela subsessilis* may also prove of interest to hybridizers interested in incorporating both its interesting flower color and its floriferous habit in a new generation of hybrid *Weigela* cultivars.

References

Bailey, L. H. 1929. The Case of *Diervilla* and *Weigela*. *Gentes Herbarium* 2: 39–54.

Bean, W. J. 1980. *Trees and Shrubs Hardy in the British Isles*. Vol. 4. 8th ed. (D. L. Clarke, General Ed.). London: John Murray.

Clarke, D. L. 1988. *Trees and Shrubs Hardy in the British Isles. Supplement*. London: John Murray.

Hara, H. 1983. A Revision of Caprifoliaceae of Japan with Referenee to Allied Plants in Other Districts and the Adoxaceae. *Ginkgoana* No. 5 (Tokyo).

Howard, R. A. 1965. A Check-list of Cultivar Names in *Weigela*. *Arnoldia* 25:49-69.

Krüssman, G. 1986. *Manual of Cultivated Broad-leaved Trees & Shrubs*. Vol. 3. Portland, OR: Timber Press.

Nakai, T. 1918. *Botanical Magazine* (Tokyo) 32: 229.

—— 1921. *Flora Sylvatica Koreana* 11: 88. *t. 41*.

Spongberg, S. A. 1978. Korean Adventure. *Arnoldia* 38: 132–53.

—— & R. E. Weaver, Jr. 1978. Notes from the Arnold Arboretum: Colleeting Expedition to Japan and Korea. *Arnoldia* 38: 28-31.

Weaver, R. E., Jr. 1978. Japanese Journal. *Arnoldia* 38: 82-101.

Stephen Spongberg is hortieultural taxonomist at the Arnold Arboretum and author of *A Reunion of Trees: The Discovery of Exotic Plants and Their Introduction into North American and European Landscapes* (Harvard University Press, 1990).

Chaenomeles x *superba* 'Mandarin'

Gary L. Koller

A superior cultivar of a robust, long-time favorite is offered for trial.

The flowering quince is an extremely tough shrub that's available in a wide range of colors. Blooming before its leaves appear, so early in spring that it very nearly has the garden to itself, the plant is also grown for its dense habit. It is a genus of only three species, but they occur in an astonishing number of varieties. In 1963, when Claude Weber undertook to examine and list the cultivars of all species and hybrid groups, she uncovered 550. In aid of the overwhelmed horticulturist, she offered a shorter list of 234, classified by color—white, white-and-pink, pink, orange, and red. These she further narrowed to 41 for special commendation.

From this large company, we have singled out one cultivar, *Chaenomeles* x *superba* 'Mandarin'. Each of its single flowers radiates a saturated reddish-orange, the Mandarin red that gave it its name, but what makes this plant even more distinctive is the disease resistance of its foliage. Many flowering quinces drop their leaves in summer, but 'Mandarin' retains a full complement of lustrous green foliage till frost. Characteristically, the plant takes a nicely rounded shape. Its rich foliage combined with full branching makes it an ideal low-maintenance shrub, useful as a hedge in itself or as a member of a varied group of plants.

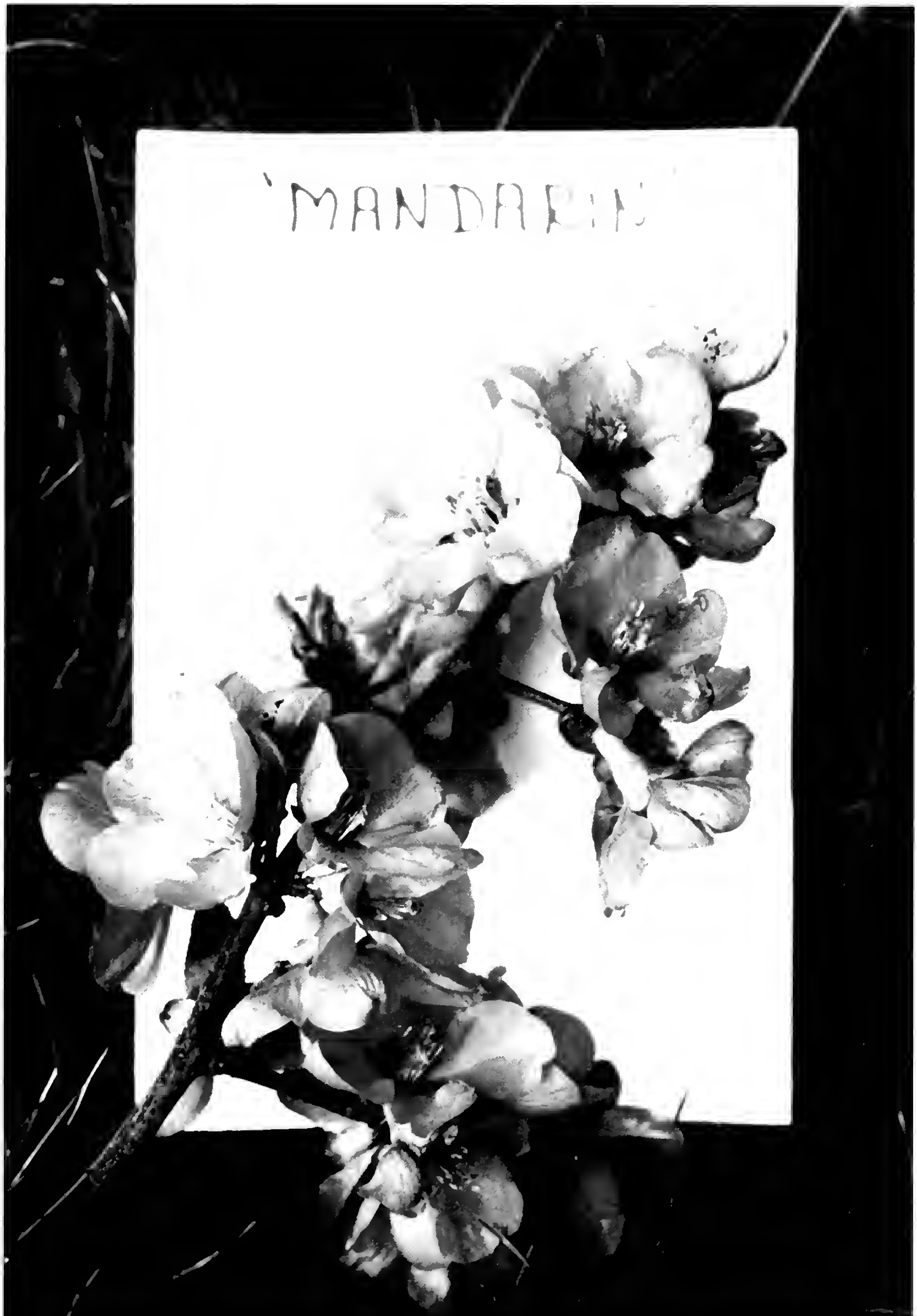
Its yellow-green fruits, which ripen in autumn, are lightly fragrant and ovoid or obovoid in shape, something like a small, gnarled apple. They are edible and can be used to make jams.

'Mandarin' originated as a seedling at the Clarke Nursery Company in San Jose, California, where it was selected for introduction into the trade in 1947. Two small grafted plants arrived at the Arnold Arboretum in 1950. One of these (accession #281–50) has been growing in its present location in the Bradley Collection of Rosaceaous Plants since 1958 at least. This winter, as the plant approaches the age of forty-five, it has grown to about eight feet in height and by the rooting of its ground-level branches has spread to a breadth of fifteen feet.

Size may limit the use of 'Mandarin' in very small gardens, but it should be ideal for larger gardens or for institutional, commercial, and park plantings. 'Mandarin' is quickly established and if planted two or three feet apart, in a few growing seasons it will simulate a thicket that's showy in flower and forms a thorny year-round barrier to direct pedestrian traffic.

Quinces grow well in almost any well-drained, even droughty, acid soil. They will tolerate rocky soils, exposure to moderate amounts of salt spray, and even, it seems, atmospheric pollution. Full sun is required for optimal flowering and fruit production, but moderate shade is tolerated. The northern limit of cold hardiness is not yet fully established, but 'Mandarin' should prove hardy to at least –10 degrees F. Plants damaged in winter storms benefit from renewal pruning immediately following flowering.

At the Arnold Arboretum, we have successfully repropagated 'Mandarin' by cuttings,



Chaenomeles x superba *'Mandarin', photographed by the author. Its flowering season can be extended from late winter to early spring by forcing cut branches for indoor display.*

which avoids the understock suckering that can occur in grafted material. Reproduction from cuttings is vastly more cost efficient from a commercial viewpoint, resulting in less costly plants for gardeners. Softwood cuttings are treated with IBA (indolebutyric acid) or KIBA (potassium salt of indolebutyric acid), stuck in a mixture of equal parts of sand and perlite, and misted intermittently until rooting. The Bradley Collection includes two repropagations from the original plant, one from hardwood cuttings taken in March 1983, the other from softwood cuttings taken in July of the same year. In general, the success rate with softwood cuttings is close to 100 percent while with hardwood it is closer to 10 percent.

'Mandarin' is well worth growing, not only as a brilliant addition to the early spring garden, but for its proven track record of problem-free performance.

Literature

Weber, Claude. 1963. Cultivars in the Genus *Chaenomeles*. *Arnoldia* 23 (3): 17–75.

Wyman, Donald. 1969. *Shrubs and Vines for American Gardens*. New York: Macmillan, 159–162.

Gary Koller is Senior Horticulturist at the Arnold Arboretum and Lecturer in the Department of Landscape Architecture at the Harvard Graduate School of Design.

The Arnold Arboretum is pleased to offer plants of *Chaenomeles* x *superba* 'Mandarin' to our Friends. They were propagated from rooted cuttings and are generally 12 to 18 inches tall. Donation, payable upon receipt of plants, is $20.00 per plant. Shipment will be in the spring of 1994.

Spring Plant Distribution, Dana Greenhouse
The Arnold Arboretum, 125 Arborway, Jamaica Plain, MA 02130

Index to Volume 53 (1993)

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

U.S. POSTAL SERVICE
STATEMENT OF OWNERSHIP, MANAGEMENT, AND CIRCULATION
(Required by 39 U.S.C. 3685)

1A, Title of publication: *Arnoldia.* 1B, Publication number: 00042633. 2, Date of filing: 31 Dec. 1993. 3, Frequency of issue: Quarterly. 3A, Number of issues published annually: 4. 3B, Annual subscription price: $20.00 domestic, $25.00 foreign. 4, Complete mailing address of known office of publication: Arnold Arboretum, 125 Arborway, Jamaica Plain, Suffolk County, MA 02130-2795. 5, Complete mailing address of the headquarters of general business offices of the publisher: Arnold Arboretum, 125 Arborway, Jamaica Plain, Suffolk County, MA 02130-2795. 6, Full names of the publisher: Arnold Arboretum, 125 Arborway, Jamaica Plain, Suffolk County, MA 02130-2795. 6, Full names and complete mailing address of publisher, editor, and managing editor: Arnold Arboretum, 125 Arborway, Jamaica Plain, Suffolk County, MA 02130-3519, publisher; Karen Madsen, Arnold Arboretum, 125 Arborway, Jamaica Plain, MA 02130-3519, editor. 7, Owner: The Arnold Arboretum of Harvard University, 125 Arborway, Jamaica Plain, MA 02130-3519. 8, Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities: none. 9, The purpose, function, and nonprofit status of this organization and the exempt status for federal income tax purposes have not changed during the preceding 12 months. 10, Extent and nature of circulation. A, Total number of copies. Average number of copies of each issue during preceding 12 months: 4,500. Actual number of copies of single issue published nearest to filing date: 4,500. B, Paid and/or requested circulation. 1, Sales through dealers and carriers, street vendors, and counter sales. Average number of copies of each issue during preceding 12 months: none. Actual number of copies of single issue published nearest to filing date: none. 2, Mail subscription. Average number of copies of each issue during preceding 12 months: 3,917. Actual number of copies of single issue published nearest to filing date: 3,910. C, Total paid and/or requested circulation. Average number of copies of each issue during preceding 12 months: 3,917. Actual number of copies of single issue published nearest to filing date: 3,910. D, Free distribution by mail, carrier, or other means (samples, complimentary, and other free copies). Average number of copies of each issue during preceding 12 months: 222. Actual number of copies of single issue published nearest to filing date: 222. E, Total distribution. Average number of copies of each issue during preceding 12 months: 4,139. Actual number of copies of single issue published nearest to filing date: 4,132. F, Copies not distributed. 1, Office use, left over, unaccounted, spoiled after printing. Average number of copies of each issue during preceding 12 months: 361. Actual number of copies of single issue published nearest to filing date: 368. 2, Return from news agents. Average number of copies of each issue during preceding 12 months: none. Actual number of copies of single issue published nearest to filing date: none. G, Total. Average number of copies of each issue during preceding 12 months: 4,500. Actual number of copies of single issue published nearest to filing date: 4.500. 11, I certify that the statements made by me are correct and complete. Karen Madsen, Editor.