Oak Leaf from Nature.

3 Lessons—Finished Nov. 24, 1875.

C.E.
Volume 59 Number 2 1999

Arnoldia (ISSN 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 of most issues are $5.00; the exceptions are 58/4-59/1 (Metasequoia After Fifty Years) and 54/4 (A Sourcebook of Cultivar Names), which are $10.00. Remittances may be made in U.S. dollars, by check drawn on a U.S. bank; by international money order; or by Visa or Mastercard. Send orders, remittances, change-of-address notices, and all other subscription-related communications to Circulation Manager, Arnoldia, The Arnold Arboretum, 125 Arborway, Jamaica Plain, Massachusetts 02130-3500. Telephone 617/524-1718; facsimile 617/524-1418; e-mail arnoldia@arnarb.harvard.edu.

Postmaster: Send address changes to
Arnoldia Circulation Manager
The Arnold Arboretum
125 Arborway
Jamaica Plain, MA 02130–3500

Karen Madsen, Editor
Andy Winther, Designer

Editorial Committee
Phyllis Andersen
Ellen S. Bennett
Robert E. Cook
Peter Del Tredici
Gary Koller
Stephen A. Spongberg
Kim E. Tripp

Copyright © 1999. The President and Fellows of Harvard College

Page
2. Charles Eliot, Landscape Architect: An Introduction to His Life and Work
   Keith N. Morgan

22. Arboriculture in Its Relations to Landscape: “All That Would Be Fair Must Be Fit”
   Charles Eliot

26. Austral Weeks: Botanizing in the Southern Hemisphere
   Rob Nicholson

35. Soil as a Living System
   Leslie Jones Sauer

44. Arnold Arboretum Weather Station Data—1998

Front cover: London planes (Platanus x acerifolia) on Memorial Drive, Cambridge, Massachusetts. Charles Eliot’s inspiration for this roadway and embankment was the Thames Embankment at Kew, near London. Photograph by A. E. Bye.


Inside back cover: Beaver Brook Reservation in Belmont and Waltham, Massachusetts, was “reserved” for the people of metropolitan Boston by the Preliminary Park Commission of 1893. At top is the lower dam and below, the brook, photographed for the 1897 and 1895 Reports of the Metropolitan Park Commission, respectively

Back cover: Memorial Drive’s plane trees
Photograph by John Furlong.
Charles Eliot, Landscape Architect: An Introduction to His Life and Work

Keith N. Morgan

Just five days after Charles Eliot died in 1897 at the age of 37, Charles Sprague Sargent published his obituary in Garden and Forest, his weekly journal. As an apprentice to Frederick Law Olmsted, Eliot had prepared planting plans for the Arnold Arboretum, and thereafter Sargent followed his career, first in solo practice and later as partner to Olmsted. Sargent wrote, “in a great variety of work he has proved himself one of the most accomplished of designers. He had an intense appreciation of nature, but he always kept up his student habits, examining the outdoor world critically, and reasoning upon what he saw to establish principles which could be applied in practice.”

Sargent also knew Eliot as a frequent contributor to Garden and Forest; he would be missed for his “gift of expression in a singularly effective style . . . his writings embody such an amount of sound doctrine, effectively stated, that one regrets that he has not left more of this kind of work behind him . . . it is no exaggeration to say that his untimely death is an almost irreparable loss to rural art in America . . . .”

In 1902 Eliot’s father, President Charles W. Eliot of Harvard University, compiled and annotated the son’s writings, which he published as Charles Eliot, Landscape Architect. Nearly a century later, it remains one of our most valuable collections of landscape writing and a necessary resource for those interested in the history of landscape architecture or city and regional planning. The following essay is excerpted from the introduction to a new edition.

Recently returned to Boston from a year-long study tour of Europe, the young Charles Eliot set up a landscape architecture practice on Park Street in December 1886. Over the next decade he would make an indelible mark on the physical form of the metropolitan region and beyond. In Eliot’s solo practice, and later as a partner in Olmsted, Olmsted and Eliot, he developed many fine public parks and private estates. He became one of the country’s most prolific and influential landscape critics and historians, and provided the creative and political impetus for the Trustees of Public Reservations, the first statewide preservation and conservation organization in the country and the precursor to Britain’s National Trust. Finally, and most importantly, Eliot directed the early development of the Boston Metropolitan

Five images of Charles Eliot (1859–1897), clockwise from top left, c. 1863; c. 1869; Harvard College graduation photograph, 1882; at age 35; at center, age 37. Courtesy of Alexander Y. Goriansky.
Park System, one of the first and most successful American experiments in regional landscape planning. It is astounding that all this was accomplished in less than eleven years. Eliot's death from spinal meningitis in 1897, at the age of thirty-seven, robbed the country of one of its most talented landscape architects ever.

**Early Years**

When Charles Eliot was born in 1859, his father was a professor of mathematics and chemistry at Harvard College. His mother, Ellen Peabody Eliot, was an amateur artist and lover of nature. She died when he was ten years old. Charles had one younger brother, Samuel Atkins Eliot, who became an important Unitarian minister, presiding over the Arlington Street Church, Boston, and president of the Unitarian Association. The Eliots' home life was characterized by cultural and social prestige and by intellectual stimulation.

In 1863, after losing a promotion battle at Harvard, Eliot senior took his family abroad so that he could study in French and German laboratories. From August of that year, when young Charles was three, through the summer of 1865, the family traveled between Paris, London, Heidelberg, Marberg, Vienna, Berlin, Switzerland, and Italy. Late in 1864 Ellen Eliot wrote to her mother of the family's life abroad:

> I keep regular school for Charly every morning & it is a pleasure & an interest to him & to me. He learns readily & enjoys it highly—I really sometimes fear the chicks may be spoiled by the entire devotion of their parents to them. They are necessarily with me all day & Charly sews with me & studies with me & paints with me and they generally walk with me, and it is rarely that I can catch Charles—Every day C harles gives Charly a regular gymnastic exercise—the child has improved much in the use of his arms & legs.²

The exercises were intended to counteract the lingering effects of a bout of typhoid fever that little Charles had suffered during the winter of 1863–1864. He was ill for more than a year but eventually recovered fully.³

An invitation to teach chemistry at the Massachusetts Institute of Technology brought the senior Eliot and his family back to Cambridge in the fall of 1865, but his wife's lung and throat congestion prompted them to return to Europe in June 1867 through the following June. Mrs. Eliot died a year later.

Young Charles had loved learning at his mother's knee, but he found formal education onerous. In 1876 he wrote of the school he attended between ages twelve and sixteen: "To my dismay was sent to Kendall's School, Appian Way! . . . Disliked most of the boys but liked Kendall. Often dissolved in tears even in schoolroom; much to my despair."⁴ Fortunately, his education was supplemented by drawing lessons from Charles H. Moore, which he liked. He made lifelong friends at Kendall's, however, especially Roland Thaxter and John H. Storer, and his preparation there helped him pass the entrance examination for Harvard College in June 1877.

Charles was a fragile boy, diffident and often given to melancholic moods, while Sam
This extraordinary volume, 770 pages in length, is the record of a developing landscape philosophy, the story of a remarkable career, and a landmark in American writing on landscape architecture. Originally published in 1902 and reprinted in 1999, it is a rare example of filial biography, the story of a son’s life by his father. Charles’s father, President Charles W. Eliot of Harvard University, did not sign the title page because he considered his role to be that of editor and organizer of his son’s writings and record.

Charles Eliot, Landscape Architect is really three books intertwined. The first is an intimate life story, told as a loving tribute by a devoted father. The second is a species of superb travel literature, written by young Charles from the perspective of a landscape analyst. The third is an annotated, chronological anthology of professional correspondence and public reports. President Eliot’s format places these elements in the context of his understanding of his son’s life and career.

While his name does not appear on the title page, there is no question of President Eliot’s role as helmsman on this journey of reconstruction. He not only wrote but financed the publication of this book. For the publisher’s spring catalogue of 1902, the senior Eliot provided Houghton Mifflin with a statement of the contents and purposes of the volume:

It describes [1] the short but fruitful life of a well-born and well-trained American; [2] how he got his training as landscape architect; [3] the enjoyment of landscape at home and in travel; [4] the physical features of enjoyable landscape; [5] the landscape art—what it can do, and what it should aim to do; [6] the means of promoting and carrying on public landscape works; and [7] as illustrations of (6) the methods and achievements of the Metropolitan Park Commission (Boston) to which he was landscape advisor during its first five years.
correspondence, and diaries from which he drew this manuscript. The speed at which the book was written and published reflects its author’s determination, especially given his other responsibilities as president of Harvard.

The father presented a very different biography from the one his son would have written about himself. By today’s standards, the book is hagiographic; Eliot emerges as the perfect model for the young profession, receiving credit for ideas and projects that were actually the work of many minds and hands. The overstatement of Eliot’s achievements is particularly evident in the description of his role at the Metropolitan Park Commission. President Eliot presents his son as the sole creator, but it is clear that the journalist Sylvester Baxter played a seminal role in conceiving of the metropolitan Boston ideal.  

Also, President Eliot’s narrative emphasizes the importance of heredity and the influential background from which his son had emerged. The Eliots belonged to what Oliver Wendell Holmes had dubbed “the Brahmin caste of Boston.” “In their eyes,” observed Charles senior’s biographer, “their wealth obliged them to strive for personal achievement and social usefulness.” So we are treated to glimpses of many family members including President Eliot’s first wife and young Charles’s mother, Ellen Peabody Eliot. Thus the book is an intimate family portrait. Not all of the nearly 750 pages of text will prove interesting to a modern reader. For example, the chapter on the Metropolitan Park Commission projects of 1894 is excessively detailed, of concern only to those thoroughly familiar with the topography of the Boston area parks. But certain sections of the text are true gems of landscape literature. Anyone interested in the history of landscape architecture, regional planning, or city planning will want to read them.

Despite the book’s being privately produced and only moderately distributed, it has become a classic in the literature of American landscape architecture and city planning, just as President Eliot had hoped that the example of his son’s brief career would be a standard and a model for the profession.

Notes

3 Baxter certainly wrote about the idea of a metropolitan park system before Eliot, but the landscape architect had been thinking about issues of regional planning for many years and would prove to have the staying power and political acumen necessary to make it possible to realize Baxter’s dream. Sylvester Baxter, Greater Boston: A Study for a Federated Metropolis (Boston, 1891), and “Greater Boston’s Metropolitan Park System,” Boston Evening Transcript, Part 5, 29 September 1923, p. 8.
resembled his father. As President Eliot wrote: “His father and brother had very different temperaments from his. They were sanguine, confident, content with present action, and little given to contemplation of either the past or the future; Charles was reticent, self-distrustful, speculative, and dissatisfied with his actual work, though faithful and patient in studies which did not interest him or open to him intellectual pleasures.” Charles Eliot seems to have inherited his mother’s talents and interests in art and nature. Unfortunately, her death in 1869 coincided with his father’s appointment to the presidency of Harvard College: the emotional gulf widened between the busy father and his awkward, shy elder son.

When his father remarried in 1877, the young man resented the intrusion of a stepmother. He recorded his reactions to a new union in his diary: “Heard rumors of father’s wooing a Miss Hopkinson and one day after Sam had gone East was told by father of his engagement.” After President Eliot married Grace Mellen Hopkinson in October, Charles reported that he “tried hard to be pleasant, but felt awkward and ‘queer’.” The distance between father and son continued to grow. Charles secretly complained that he was “distressed by father never telling Sam & me of his plans & doings as he once did. Also much annoyed by many things at ‘home’.”

Nonetheless, within a few years it was his stepmother who became an anchor in his emotional life.

President Eliot hoped to improve his firstborn’s sense of self and increase his physical strength by involving him in the “strenuous life,” camping and sailing along the coast of New England. Young Charles enjoyed these rigorous forays into nature. During the summers of his second and third years at Harvard, he organized and led a small band of classmates known as the Champlain Society in scientific exploration of Mount Desert Island in Maine. Like Theodore Roosevelt, his near-contemporary at Harvard, young Charles Eliot embraced life in the out-of-doors, but he was inspired primarily by a delight in viewing nature.

President Eliot had consistently reinforced the benefits of physical activity and knowledge of the wilderness, emphasizing this experience as a way of counteracting his elder son’s melancholic withdrawals.

Beginning in 1871, Charles, his father and brother, and the family of his uncle pursued the open-air life on Calf Island, near Mount Desert, Maine. With one exception, they continued to camp and yacht there every summer through 1878. Charles made this drawing of the camp in 1875.
The Education of a Landscape Architect

Charles Eliot's preparation for a career in landscape architecture began long before his Harvard years. During the family's travels in Europe, his parents showed him the beauties of many natural and manmade landscapes. After the death of his mother, his father and other family members continued this tradition. In the summer of 1871 the Eliots spent their first summer on Mount Desert, and the following year they acquired a forty-three-and-a-half-foot sloop, The Sunshine. Maine would remain a central and important part of Charles Eliot's life thereafter.

In spring 1874 Charles, then fourteen, accompanied his aunt Anna Peabody on a trip through South Carolina, Georgia, and Florida. A notebook in which he recorded his impressions of the landscape, people, and local customs provides us early evidence of his response to landscapes. At this time he was sketching frequently, exhibiting the natural talent that would later encourage him to consider a career in landscape architecture.

In shaping his education, Charles had the advantage (or disadvantage) of being the son of one of the era's major educational reformers. Parent and child frequently discussed Charles Eliot's future vocation, although it was Charles's own decision to pursue a career in landscape architecture. Since no professional programs existed at the time, the two men together devised a postgraduate course of study at Harvard's Bussey Institute, a professional apprenticeship with Frederick Law Olmsted, and a period of professional travel in the United States and abroad.

“You See I Am a Wanderer”

Charles Eliot was a landscape wanderer, constant but attentive, and a connoisseur of landscape forms. While still a young teenager, he began in 1875 to take a series of walking tours, often tied to public transportation routes, which allowed him to visit natural areas throughout the greater Boston basin in a methodical manner. In his diary for 1878, he provides a “Partial List of Saturday Walks before 1878.” Eliot would later recommend many of the sites as additions to the metropolitan park system. He also meticulously recorded a short trip that he took with his father in 1875, to a “small manufacturing village” (of which he drew a plan), where there was “a very large woolen mill” and also “a tannery and a stream below the mill.”

Charles's penchant for landscape description and analysis was further nurtured by keeping the log for The Sunshine.

During his thirteen-month tour of England and the Continent in 1885-1886, Eliot continued to record scenery through detailed narratives and sketches. In a richly annotated collection of excerpts from his diaries and journals, Eliot assesses the design, horticulture, and topography of the sites on his self-generated itinerary and offers sharp opinions about the defining characteristics of cultural landscapes—admiring the Scandinavian countryside, expressing contempt for French landscape fashion and suspicion toward the “nabobry” of the aristocratic English landscape. Eliot often used his extensive knowledge of the New England landscape as a touchstone, describing an island near Stockholm, for example, as “roughly, wildly beautiful in a wholly New Englandish manner.”
Of all the private estates, public parks, and natural sites that Eliot methodically visited in Europe, he was most affected by the former estate of Prince Hermann Pückler at Muskau in Silesia. In one of his last letters to Olmsted before returning in October 1887, Eliot effused about the lessons that Muskau could teach:

His park is probably the finest work of real landscape gardening on a large scale that this century has seen carried out in Europe. It is a work that has made one very proud of the profession—for here was a river valley in great part very barren, fringed by monstrous woods of p. sylvestris and in no way remarkable for beauty or interest—but now one of the loveliest vales on earth—and full to the brim, so to speak, of variety or pleasant change, of quieting and often touching beauty.13

In many ways, Muskau served as a prototype for all that Charles Eliot would do in America. Every element of the landscape—the pleasure grounds near the Schloss, the village and the alum factory, the river valley and the surrounding woodlands—was carefully “improved” with native plants. Pückler presented Eliot with a lasting lesson on how to capitalize on the inherent qualities of site and celebrate the ability of man to enhance nature.

No landscape architect before Eliot had combined so thorough a grounding in the literature of the profession with such close observation of the practice of landscape architecture. Eliot’s call slips from the British Library are evidence of his voracious literary appetite and the methodical manner in which he read everything on the topic in English, French, and German from the seventeenth century on.14 Thus Eliot returned to the United States with a uniquely profound knowledge of the history of his profession. In the December 1887 issue of Garden and Forest, he included a recommended list of books on landscape architecture, based on his readings in Europe.

Eliot also actively pursued the individuals who could help him grow professionally.15 His journals recount his critical reaction to many of the leading landscape gardeners and nurserymen of Europe. One of the most hospitable of his English contacts was James Bryce, with whom Eliot stayed in both London and Oxford. Bryce was an avid mountaineer, secretary of the Commons Preservation Society, and the author of the Scottish Mountains bill and other open space legislation in Parliament. Thus, he could share with young Charles Eliot his direct
knowledge of efforts to legislate landscape preservation in Britain. Eliot also visited the secretary of the Lake District Defense Society, Canon Hardwicke D. Rawnsley, an activist who advocated protection of the Lake District, especially from the potential intrusion of railroad lines and urban reservoirs. Later, he was one of the founders of the National Trust for Places of Scenic and Natural Beauty in Great Britain. From their meeting, Eliot learned about landscape preservation strategies in England and was able to share his knowledge of parallel American efforts. It could not have been a better preparation for the work that lay ahead.

“Mr. Olmsted’s Profession”

Charles Eliot inherited the mantle of Frederick Law Olmsted Sr., who defined the post-Civil War profession of landscape architecture in the United States. After pursuing careers as a farmer, journalist, publisher, and traveler, Olmsted had established himself as the country’s leading landscape architect with his 1858 design for Central Park in New York City. He moved his highly successful practice to Brookline, Massachusetts, in 1883. One of Olmsted’s neighbors in that suburb was Charles Eliot’s uncle, the architect Robert Swain Peabody. It was he who suggested Olmsted as a potential role model to the young man in search of a vocation. After a period of self-designed study at Harvard’s Bussey Institute, in 1883 Eliot gladly accepted the invitation to become the first official unpaid apprentice in the Olmsted office.

Olmsted soon recognized Charles Eliot’s multiple talents and encouraged their development. While Eliot was in Europe in 1885–1886, he wrote frequently to Olmsted about the sites he visited and people he met, many of them through his mentor. Olmsted responded, “I have seen no such justly critical notes as yours on landscape architecture matters from any traveler for a generation past. You ought to make it a part of your scheme to write for the public, a little at a time if you please, but methodically, systematically. It is part of your professional duty to do so.” Eliot heeded

In 1885, as apprentice to Frederick Law Olmsted, Charles Eliot worked on planting plans for the Arnold Arboretum. He also worked at the Arboretum, staking out shrub beds from plans he had helped to prepare. This photograph of the collection was taken in May 1931.

Olmsted's advice and became one of the most productive and effective landscape critics of his generation.

Gradually, the professional relationship achieved more equal footing. While Eliot was in Europe, Olmsted asked him to return home and join the firm. Olmsted was currently developing plans for the Stanford University campus in California and was eager to capitalize on Eliot's fresh knowledge of Mediterranean plant material and design. President Eliot's opinion of the offer was characteristically firm: "You can make an excursion to California whenever it is your interest to do so for $300 & I shall be happy to pay for it. I see no inducement whatever in Mr. O's offer of $50 a month. You had better start for yourself in my opinion. . . . My impression is in favor of refusal by cable—'Decline' & by effusive letter."\(^\text{19}\) In the end, Eliot took his father's advice, finishing his trip as planned and setting up his own office on his return. Instead of working for Olmsted, Eliot asked his former mentor to provide a reference for an advertisement announcing his new business.\(^\text{20}\)

Three years later, Eliot asked Henry Codman, who had followed him as an apprentice in the Olmsted office, to join his firm as a partner, but Codman declined. Then, in July 1889, in a letter to Olmsted, Eliot proposed yet another plan:

My talk with Codman has led me to imagine a possible general union of forces in which all three of us young men [Eliot, Codman, and John Charles Olmsted] might serve as more or less independent captains under you as general. We could perhaps have offices in N.Y. and Phila. as well as in Boston and Brookline . . . and while we should manage all small jobs ourselves we should refer all weighty matters and all persons who distinctly desired your opinion to you.\(^\text{21}\)

But his idea never materialized. Codman accepted a position with Olmsted, and Eliot continued to pursue his independent practice.
until January 1893, when Codman suddenly died from appendicitis while supervising the landscape development of the World’s Columbian Exposition in Chicago. Once again, Olmsted, especially eager for help with the Chicago Fair, begged Eliot to become a partner, not just a junior employee; this time the younger man saw a more dynamic role for himself and agreed. In March 1893, the office of Olmsted, Olmsted and Eliot was officially announced.

By the time Eliot had joined the firm in 1893, Olmsted’s health had begun to fail, and one of the burdens Eliot could take on for his elder partner was the writing of reports and articles. Much of the younger man’s writings was cast in his mold, including one article that defended his former mentor. Realizing that Olmsted’s work for the Boston Municipal Park Commission was frequently attacked for its “unnaturalness,” Eliot responded with an article titled “The Gentle Art of Defeating Nature,” in which he stated his (and Olmsted’s) belief that landscape architects must alter natural conditions to meet the needs of the public.22

On one occasion, Eliot actually wrote an article that was published under Olmsted’s name. The senior Eliot states that “Parks, Parkways, and Pleasure Grounds” in Engineering Magazine was “a concise statement—with some new illustrations—of doctrines which Mr. Olmsted had been teaching all his life. It was prepared however by Charles . . . Mr. Olmsted being unable at the time to write it himself.”23

Eliot had thoroughly absorbed every lesson on landscape aesthetics and professional practice that Olmsted taught. In addition to the standard Olmsted agenda, the article includes new ideas that Eliot was then pursuing and for which he uses new language—for instance, “reservations of scenery,” “Board of Trustees.”

As an ultimate indication of mentor-student closeness, Eliot was invited to draft an obituary...
for Olmsted in 1896 (several years before Olmsted’s death). He submitted the draft “with great diffidence,” he wrote in the accompanying letter, having “been too near him to write it rightly.” Eliot began the piece: “It is seldom that the death of one man removes a whole profession, but, excepting for a few associates personally inspired by him, this is really what has happened in the case of the death of Frederick Law Olmsted.”

Eliot was certainly one of those “associates personally inspired by him” and provided a rich and elegant account of his mentor’s life and work.

From his apprenticeship days on, when Eliot wrote to his family and friends about Olmsted, he expressed a mixture of both respect and criticism in his letters. He happily told his close friend Roland Thaxter in October 1883 that he had “become apprentice to the leading man in my proposed profession—namely Mr. Fred. Law Olmsted . . . the man who has had a hand in almost every great Park work that has been attempted in this country.”

But in six years of private practice, Eliot had formed his own distinct opinions and was highly critical of many things that Olmsted did. Eliot also maintained many of his earlier, independent jobs—such as positions on the Metropolitan Park and the Cambridge Park commissions—after he joined the firm. Eliot was neither an extension nor pale reflection of Olmsted; he was his own man, facing important new issues in the profession of landscape architecture.

Olmsted was delighted to have his former apprentice in the firm and the added income from major projects on which Charles was working. In an 1893 letter to his partners, Olmsted effused about the importance of the work currently in the office:

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 in our profession now in hand anywhere in the world. . . . In your probable life-time, Muddy River, Blue Hills, the Fells, Waverley Oaks, Charles River, the Beaches will be points to date from in the history of American Land-
Charles Eliot’s “scientific ‘park system’” for metropolitan Boston included reclaiming the riverbanks and beaches, which were occupied by tenements and industry. In 1896, word spread that the Metropolitan Parks Commission had “reserved” three miles of Revere Beach for the use of the public. With warm weather, multitudes began to visit, as seen in the photograph at the top. On one Sunday in July the number mounted to 45,000, convincing the Commissioners that large-scale constructions were needed to accommodate visitors. Charles Eliot spent the rest of that year preparing plans.

By 1900, streets and railroads had been relocated, shanties and saloons razed, and sidewalk, driveway, and promenade built. Those constructions can scarcely be seen in the photograph at bottom, taken during “the carnival”, for one week in August, local business people were permitted to use part of the beach for sports and amusements, including balloon ascensions and diving horses.
ral retreats as places in which modern city dwellers could find spiritual replenishment through passive contemplation of nature, Eliot discussed reservations, trusteeships, and rural landscape preservation that would provide settings for active enjoyment of nature. In contrast to Olmsted's retreat into a private contemplation of nature, Eliot compared scenery or landscape to other advantages of urban culture, especially books and art. While Olmsted's parks were created through design, Eliot's reservations were products of choice, preservation, and improvement.

Eliot used the word "reservation" often in his articles and lectures. Indeed, he even thought that the Boston Metropolitan Park Commission should really be called the Metropolitan Reservations Commission. He realized that the term "park" had a specific and limited meaning for his contemporaries, so Eliot took a different word—"scenery"—to distinguish his ideas from common assumptions. He had three basic goals: to preserve scenery, make it accessible, and improve it. By Eliot's definition, scenery was land that had been "resumed" or reclaimed for the public benefit. Reservations, Eliot believed, should be "held in trust," and those who preserved and improved scenery were therefore "trustees" of that heritage. Eliot's use of the term "trustee" invoked a legal process by which individuals were designated as the guardians of landscape, as in the Trustees of Public Reservations. It is interesting that he also referred to park users as "trustees." He was convinced that "ordinary people," as trustees, had the potential to appreciate and the right to expect the merits of public reservations.

Eliot's highly effective and original landscape ideas were especially apparent in his work for the Metropolitan Park Commission, where he envisioned a new regional approach to planning. In his first letter to Charles Francis Adams, chairman of the temporary commission, Eliot outlined the landscape types he wished to incorporate into the system:

As I conceive it the scientific "park system" for a district such as ours would include:

1st Space upon the Ocean front.

2nd As much as possible of the shores and islands of the Bay.

3rd The courses of the larger Tidal estuaries (above their commercial usefulness) because of the value of these courses as pleasant routes to the heart of the City and to the Sea.

4th Two or three large areas of wild forest on the outer rim of the inhabited area.

5th Numerous small squares in the midst of dense populations.

Local and private action can do as much under the 5th head but the four others call loudly for action by the whole metropolitan community. With your approval I shall make my study for the Commission on these lines.

This broad scheme represented a larger landscape analysis than had ever been attempted in America.

To explain these concepts and others, Eliot invoked a landscape language that had not previously been employed. His arena was the physical world at large. In a lecture to a farmer's association in New York State, he explained that he meant "by the term 'landscape' the visible surroundings of men's lives on the surface of the earth." Eliot considered himself an architect and repeatedly referred to a definition of architecture borrowed from the English socialist and art critic William Morris: "Architecture, a great subject truly, for it embraces the consideration of the whole of the external world, for it means the moulding and the altering to human needs the very face of the earth." This broad environmental consciousness is rooted in the lessons he drew from Prince Pückler, a topic about which Eliot frequently both spoke and wrote.

Eliot's proto-environmentalist viewpoint grew naturally out of his contact with the Transcendentalist writers of New England. Ralph Waldo Emerson, for example, is frequently quoted in both Eliot's commonplace book and in the selections his father incorporated in the biography. An uneasy product of Unitarianism, Eliot had been attracted early to the Transcendentalist belief in nature as an allegory for the divinity. In essence, however, Eliot practiced an applied Transcendentalism, actively securing
for the general public the advantages of active engagement with nature, not just urging its passive contemplation.

Onto this literary-philosophical base, Eliot grafted other ideals. He was a democrat and an environmentalist, long before the term had been coined. He wrote that reservations, parks, and parkways must "be placed, without regard to local pressure, solely with a view to securing the greatest good of the greatest number," following the principles of English political philosopher John Stuart Mill. And he opposed commercial intrusion into this scenery of beauty; he argued against the exploitation of the landscape with giant advertising signs and proposed that telegraph lines be sunk below ground to remove another modern irritant from the reservations. His concern transcended the needs of his contemporary generation. He wrote about hopes for improved water quality in the Charles River and celebrated the increase of "wild birds and animals" that had resulted from improvement in the Stony Brook Reservation.35 Recently, Ian McHarg, a leader in landscape architecture education, commented in his autobiography: "I have been described as the inventor of ecological planning, the incorporation of natural science within the planning process. Yet Charles Eliot, son of Harvard's president, a landscape architect at Harvard, preceded me by half a century. . . . He invented a new and vastly more comprehensive planning method than any pre-existing, but it was not emulated."36 McHarg believed that his own education as a landscape architect at Harvard had been deficient because the school had forgotten the planning vision of Charles Eliot in the 1890s.

A persistent theme in Eliot's public writings and professional reports is the principle "what would be fair must be fit." In an article for Garden and Forest by that title, Eliot first warned his readers about the three types of landscape designers to avoid: commercial nurserymen who would think only in terms of the plants they could sell, landscape gardeners who laid out everything in curving lines, and former students of the Ecole des Beaux-Arts in Paris, who saw garden design in lockstep geometry. Eliot's distance from these dominant trends reflected his sense that function, or "fitness," should be the guiding principle of design. He was not a proponent of either side of the great debate between the natural and the formal style of landscape design. In his review of Italian Gardens by Charles A. Platt, a leader of the formal garden revival, Eliot was enthusiastic about the lessons that the Renaissance garden could teach but warned that the conditions of climate, topography, and needs of the client must all justify this choice of landscape mode.37 In his essay "Anglomania in Park Making," he similarly cautioned against the mindless popularity of the English or natural landscape style as the only correct manner for public park design. Eliot's philosophy resembles a landscape theory variation on the theme of "form follows function"—the battle cry of the Chicago architect Louis Sullivan at that time.38

To achieve his broad aims for landscape design preservation, Eliot lobbied ceaselessly through prolific letter writing, frequent public speaking, appearances before legislative committees, and regular contributions to popular magazines and professional journals. His major written contribution to a philosophy of scenery preservation and enhancement was his report, posthumously published in 1898, Vegetation and Scenery in the Metropolitan Reservations of Boston. Although specific in its definition of the basic types of landscapes found in the Boston metropolitan reservations and the appropriate methods for their management and development, Eliot's report has generic implications as well.

One important message conveyed in the report is that all of the landscapes of the metropolitan reservations are "artificial" in that they have been changed through human interaction with them. Eliot wanted to counter the popular assumption that the reservations were "wild" and therefore should not be altered in any way. "Before and after" drawings of specific sites emphasized the importance of improving the scenery through careful analysis of natural systems and well-conceived plans of action. Much of this analysis had already begun with the surveys of geology, topography, and history of use in the reservations. The next step would have been the development of general plans for each of the reservations, blueprints for improv-
From Charles Eliot’s *Vegetation and Scenery in the Metropolitan Reservations of Boston*, one of the sets of before-and-after drawings in the manner of English landscape gardener Humphry Repton made by Arthur A. Shurtleff. The first— with overleaf— was captioned “Tree-clogged notch, near the southeastern escarpment of the Middlesex Fells, which might command the Malden-Melrose valley and the Saugus hills.” The second—with overleaf removed— illustrates the sweeping view of valley and hills that will appear when the notch is unclogged.
The "Civic Pride Monument" erected in memory of Charles Eliot at the St Louis Exposition, 1902.

The "Civic Pride Monument" erected in memory of Charles Eliot at the St Louis Exposition, 1902.

Political and social action were two of the tools Eliot wielded brilliantly to achieve his evolving goals. He worked from the bases of power and influence that were his birthright. As the son of the highly visible president of Harvard University and the descendant of well connected and powerful families, Eliot had learned how to inform and influence his contemporaries, even contributing portions of speeches to powerful friends, such as his Harvard contemporary Governor William Russell, who appointed Eliot to various commissions. Eliot's network involved a core group of fellow travelers who could understand and appreciate his ideas. For example, Dr. H. P. Walcott, whom Eliot invited to chair the initial meeting in the formation of the Trustees of Public Reservations, was also the chair of the state board of health and would become the chair of the Joint Commission on the Improvement of the Charles River, for which Eliot served as secretary. And Eliot could rely on Frederick Law Olmsted Sr., Charles Sprague Sargent—director of the Arnold Arboretum—and a host of literary and political lions to come forth in support of many of his efforts.

But he did not work primarily for the benefit of an economic and political elite; he deeply appreciated the involvement of an informed public. In 1897, when Warren Manning wrote to him about the possible formation of a professional society for landscape architects, Eliot responded that it was more timely and important to establish a broad-based support group for public landscape causes. The American Park and Outdoor Art Association, founded in 1897, was the result.

Eliot's Legacy

Despite, or perhaps because of, his early death, Eliot inspired others to perpetuate his ideals. He had not only expanded the parameters and concerns of the profession of landscape architecture, he had also laid the foundations for the environmental movement and for the professions of city and regional planning. A model village erected at the St. Louis World's Fair of 1902 included a "Civic Pride Monument," one
of many such testimonials to his importance and influence. (Ironically, Eliot would have preferred to be remembered for his belief in metropolitan or regional, rather than civic or municipal, pride.)

Eliot’s father became a vocal advocate for the issues his son had embraced. Indeed, President Eliot showed the zeal of a convert. Not only did he write and edit *Charles Eliot, Landscape Architect*, he also began to write articles and speak in public about landscape preservation. From 1905 until 1926, he served on the Standing Committee, the central governing board of the Trustees of Public Reservations. President Eliot carried forward his son’s vision of a forest reservation on Mount Desert Island, Maine, now Acadia National Park. Perhaps Charles Eliot’s finest legacy was his father’s commitment to establishing a professional program in landscape architecture at Harvard, which was inaugurated in 1900 under the direction of Frederick Law Olmsted Jr., Eliot’s former colleague, and Arthur Shurcliff, his former protégé. President Eliot’s program today maintains his son’s name in the Charles Eliot Professorship in Landscape Architecture and the Charles Eliot Traveling Fellowship, which enables promising young landscape architects to benefit from travel study as its namesake had.

After his retirement from Harvard University, Charles W. Eliot moved to a house on Fresh Pond Parkway, a green corridor designed by his son. The Parkway, in turn, connects the Fresh Pond Reservation, his son’s design for the Cambridge Park Commission, to the Memorial Drive Reservation on the Cambridge side of the Charles River, another of the younger Eliot’s early projects for the Cambridge Park Commission. Today the Eliot Bridge (dedicated in 1955 to both father and son) connects the Fresh Pond Parkway to the Soldiers Field Road Reservation on the Boston side of the Charles River.

Even more directly perpetuating the ideals of Charles Eliot was the work of his nephew, Charles W. Eliot II. Born in 1900, three years after his uncle’s death, but named for his grandfather, this Eliot was destined from birth to adopt his uncle’s profession. “At the time I was born,” he reported late in life, “my grandfather came to the house and asked if it was a boy or a girl. When he was told it was a boy, he said: ‘That’s good! His name will be Charles like his uncle. He will be a landscape architect like his uncle. He will go on with his uncle’s work.’”

Trained in landscape architecture and regional planning at Harvard, this Charles became the first field secretary of the Trustees of Public Reservations in 1925. In May of that year, the Trustees sponsored a conference, “The Needs and Uses of Open Spaces in Massachusetts,” in which he took a leading role. One result of the conference was a renewed effort to coordinate the activities of private and public conservation organizations in the state. Equally significant was the proposed “Bay Circuit,” a new and larger greenbelt for the Greater Boston Basin. The idea for the Bay Circuit may not have been Eliot’s alone, but he became its strongest long-term supporter. Like his uncle, Eliot soon saw an opportunity to advance the cause of landscape architecture and regional planning by moving into the public sector. He became the director of the National Capitol Park and Planning Commission under the Roosevelt administration, a position he maintained until 1955. Eliot then returned to Harvard to become the Charles Eliot Professor of Landscape Architecture. He retired in 1968 but remained an active supporter of land conservation and became the conscience of both The Trustees of Reservations and the Metropolitan District Commission until his death in 1992.

The early growth of the Trustees was modest, in part, because Eliot turned his attention so quickly to the Metropolitan Park Commission. By 1897, the year of Charles Eliot’s death, only two properties, Rocky Narrows on the Charles River in Canton and Mount Anne Park in Gloucester, had been given to the Trustees. Together they totaled fewer than one hundred acres. Today, the Trustees are stewards of more than twenty thousand acres, “the best of the Massachusetts landscape in all its diversity.”

The organization has been the inspiration for land trusts both in the United States and abroad, and Eliot’s early writings also inspired the formation of other organizations. Most notably, the National Trust for Places of Historic Interest or Natural Beauty in Great Britain was modeled on the Trustees, as was, ultimately, the
National Trust for Historic Preservation in the United States.

Soon after his success in forming the Trustees, Eliot turned his attention to the creation of a public authority, the Metropolitan Park Commission. Celebrating its centennial in 1993, the commission now "embraces almost twenty thousand acres of parklands ranging from dense woodlands and wetlands to intensely developed and managed urban parks." One of the most important potential benefits of the centennial celebration was the appointment of the Green Ribbon Commission to suggest improvements to the organization. At the top of its list of priorities was the issue that Charles Eliot had fought hard but unsuccessfully to impress on the early commissioners—the need for careful and persistent maintenance, or what is today called stewardship. The responsibility now rests with the commission's current administration—and with all of us who are "trustees" of the Eliot legacy—to ensure that these resources receive the care and the use they merit.

Despite the enormous challenges posed by increasing traffic and neglected maintenance, the metropolitan park system that Eliot envisioned remains his greatest achievement. In a chapter titled "Growth Invincible" in his 1906 book, The Future in America, H. G. Wells contrasted his recent visits to New York and to Boston:

If possible it is more impressive, even, than the crowded largeness of New York, to trace the serene preparation Boston has made through this [Metropolitan Park] Commission to be widely and easily vast. New York’s humanity has the curious air of being carried along upon a wave of irresistible prosperity, but Boston confesses design. I suppose no city in all the world . . . has ever produced so complete and ample a forecast of its own future as this commission’s plan for Boston.

Today, Charles Eliot’s ideas "confess design” as clearly as they did a century ago, just as they attempted to forecast a future not only for Boston but for the whole of American landscape architecture.

Notes


2 Ellen Peabody Eliot to her mother, Marberg, 17 November 1864, Charles W. Eliot Papers, Pusey Library, Harvard University (hereafter cited as CWE Papers).

3 Charles W. Eliot to his mother, Marberg, 5 January 1865, CWE Papers.

4 Commonplace Book, October 1876. Charles Eliot Collection, Frances Loeb Library, Graduate School of Design, Harvard University. Hereafter cited as CEC.


6 Commonplace Book, July 1877. CEC

7 Ibid., 30 October 1877 and December 1878.


9 The quotation is from a letter Charles Eliot wrote to his wife, Sunday, 20 July 1895, CELA, 515.

10 Diary of 1875, 14 May 1875, Princeton, Mass. Charles Eliot Papers, Goriantsky Collection, Boston. Hereafter cited as GC.

11 For his comments on “nabobry,” see CELA, 176–177; his assessments of landscapes are chiefly found in chapters 9 and 10.

12 Charles Eliot to Frederick Law Olmsted, Sunday, 10 October [1887], GC.

13 Ibid.

14 CEC.

15 He was greatly assisted in this process by the letters of introduction he brought from his father, Frederick Law Olmsted, Charles Sprague Sargent, and Asa Gray, among others.

16 CELA, 32.


18 CELA, 207.

19 Charles W. Eliot to Charles Eliot, 11 June 1886, GC.

20 Charles Eliot to Frederick Law Olmsted, 10 October 1887, GC.

21 Charles Eliot to Frederick Law Olmsted, 20 July 1889, Eliot Correspondence File, 141–142, CEC.

22 CELA, 554–556, 543–545.

23 Ibid., 441.

24 Charles Eliot to Mr. Garrison, 2 November 1896, Manuscript Letters, vol. 2, nos 164 & 165, CEC. Ironically, Eliot died before this obituary could be used for Olmsted.

25 Charles Eliot to Roland Thaxter, 13 May 1883, GC.
26 Frederick Law Olmsted to his partners, Biltmore, N.C., 28 October 1893, Frederick Law Olmsted Collection, Manuscript Division, Library of Congress, Washington, D.C.


29 CELA, 600.

30 Ibid., 492.

31 Ibid., 517, 230.

32 CELA, 381.

33 Ibid., 367, 662.

34 Eliot contributed "Muskau—A German Country Park," the fullest statement of his understanding of and admiration for this site (which he had visited on 22–23 September 1886), to the 28 January 1891 issue of Garden and Forest.


37 CELA, 547–549.

38 Eliot and Sullivan were developing parallel philosophies at the same moment. Eliot published "What Would Be Fair Must First Be Fit" in Garden and Forest on 1 April 1896. Sullivan published the clearest expression of his ideas in "The Tall Building Artistically Considered," Lippincott’s 57 [March 1896], 403–409.

39 CELA, 650.


41 Nan Lincoln, "The Champlain Society," Bar Harbor Times, 1 August 1996, B5. Eliot first described his vision in an article for Garden and Forest in 1889. The dream was realized in 1916 with the establishment of Mount Desert National Park.


44 The papers of Charles W. Eliot II are held in the Special Collections of the Frances Loeb Library, Graduate School of Design, Harvard University.


46 Abbott, 310, 319.

47 Enhancing the Future of the Metropolitan Park System. Final Report and Recommendations of the Green Ribbon Commission (Boston: Metropolitan District Commission, 1996), 9. Nineteen thousand of these acres were acquired in the commission’s first ten years. The Metropolitan Park Commission merged with the Metropolitan Water and Sewer Commission to become the Metropolitan District Commission in 1919.

48 Ibid., 47–49. The Green Ribbon Commission focused on three general areas for improvement: building effective stewardship, linking the parks and the public, and managing, planning, and supporting the public trust. The concerns Eliot expressed in his letters to the commission about general plans are identical. See CELA, chapter 34.


Acknowledgments
For a research and writing grant that supported the preparation of this introduction, I am deeply grateful to the Graham Foundation for Advanced Studies in the Fine Arts. Robin Karson, executive director of the Library of American Landscape History, and Karl Haglund, senior planner for the Metropolitan District Commission, read, critiqued, and improved the manuscript. I am indebted to Mary Daniels, curator of Special Collections, Frances Loeb Library, Graduate School of Design, and the staff of Pusey Library, both at Harvard University, for their assistance. My deepest debt is to Alexander Y. Goriensky, grandson of Charles Eliot, for access to the family manuscripts in his possession.

Keith N. Morgan is professor and chairman of art history at Boston University. A former national president of the Society of Architectural Historians, he has written on a range of topics in nineteenth and twentieth century American architectural and landscape history. In addition to his work on Charles Eliot, he is the author of Charles A. Platt, The Artist as Architect and Shaping an American Landscape, The Art and Architecture of Charles A. Platt. With Naomi Miller, he wrote Boston Architecture, 1975–1990. He is currently one of the principal authors of Buildings of Metropolitan Boston, one of two Massachusetts volumes being prepared for the Buildings of the United States series, published by Oxford University Press for the Society of Architectural Historians.

The new edition of Charles Eliot, Landscape Architect, is being published by the University of Massachusetts Press in association with the Library of American Landscape History. To purchase copies, phone 413.545.2219, fax 800.488.1144, or e-mail order@umpress.umass.edu.
Approach to an estate of six-and-a-half acres in Irvington-on-Hudson, New York, designed by Charles Eliot, 1889–1890. To conceal the boundaries of the estate, plant out undesirable objects, and visually connect the plantings with those of neighboring estates, sixty-two kinds of trees and shrubs were planted in spring 1890. Eliot sent another list of 725 plants (52 kinds) that fall, and yet another list of 520 the following spring. The photograph shows the approach as seen from the highway; the sketch looks down to the highway from the property. From Charles Eliot, Landscape Architect (1902).
Arboriculture in Its Relations to Landscape: “All That Would Be Fair Must Be Fit”

Charles Eliot

Charles Eliot had been told repeatedly by his father and Frederick Law Olmsted that he possessed a gift for expression that should be used, and so he made writing for the press a part of his profession. At a meeting of the New York Farmers, 19 January 1892, the evening’s subject was arboriculture for the farm, the village, and the highway. The paper that Eliot read on that occasion encapsulates several of his chief principles for landscape design as applied to the use of trees.

Mr. President and Gentlemen,—Arboriculture is a long word and a long subject. I suppose it is the whole science and art of growing trees for timber, for firewood, for shelter, for the prevention of destructive erosion, and last but not least, for the beauty of trees individually and in masses. I must, of course, choose some one section of this wide field; and so I shall, by your leave, give my time to a brief discussion of arboriculture in its relations with landscape—meaning by the term “landscape” the visible surroundings of men’s lives on the surface of the earth.

It sometimes seems as if beauty in the surroundings of life were not appreciated, or even desired, here in our America. The man who goes so far as to paint his house and to “fix up” his place is reviled as a “dude” in many parts of our country. A certain brave scorn of beauty seems to characterize most of the people of our new West.

On the other hand we see, when we come to study the matter, that if the experience of the past counts for anything, there is a power in beauty which works for joy and for good as nothing else in this naughty world does or can. And when we come to see this clearly, we are at once compelled to abandon our indifference and to substitute therefor the eager desire of old Plato, “that our youth might dwell in a land of health amid fair sights and sounds.” Alas, that “fair sights” do not spring up spontaneously around our modern lives as they seem to have done in the Old World. In the long settled corners of Europe, men’s fields, lanes, roads, houses, churches, and even whole villages and towns, seem to combine with nature to produce scenery of a more lovable type than nature working alone can offer us. With us the contrary is too often the fact. Our buildings, fences, highways, and railroads, not to speak of our towns, are often scars which mar the face of nature without possessing any compensating beauty of their own. It is evident that beauty in the surroundings of life is not to be had in this modern day without taking thought, and exercising vigilance. And our thought and our vigilance must be rightly directed, or it will defeat our purpose. Many a man, becoming suddenly conscious of a desire for beauty, has attempted to attain his heart’s wish by forbidden and impossible ways. Thus country roadsides have been “slicked up” until all beauty has been “slicked” out of them. Noble growths of native trees have fallen victims to the desire for the beauty of exotics. Village mansions of the dignified old style have given place to the frivolities which are named for Queen Anne. Trim formal flower gardens have been rooted up to make way for the modern gardener’s curves and scattered beds. Men seem slow to learn the truth of the old saying, “All’s fair that’s fit,” or that corollary thereof which best expresses the truth of my subject, “All that would be fair must be fit.”
This is the principle which ought to govern us in our tree-planting as well as in all else which affects the scenery of our lives. Fields, lanes, and roads should be laid out so as to fulfil the requirements of convenience, while conforming to the facts of topography. Buildings should be designed so as to fulfil and express their several purposes. Ground about buildings should be similarly and straightforwardly adapted to the uses and enjoyments of real life, with no regard to any fanciful or a priori notions of what such ground should look like or contain. So when we come to the most effective means of modifying the scenery about us, the felling, preserving, or planting of trees, our principle will constrain us to cut, and save, and plant for good reasons only, and not from consideration for mere passing fashion or foolish love of display.

Let me illustrate this fundamental principle by briefly noting the main points in regard to the way in which trees and shrubs have been used in a typical New England valley where the eyes of the inhabitants have been opened. I shall describe nothing imaginary, although I may put together things which are to be seen in two or three separate places.

Of course we arrive at our valley by the railroad; and the railroad banks themselves herald the approach to our station, for behold, they are actually planted! Not with Forsythias and Japan Quinces,—how absurd such plants would look upon these gravel banks,—but with shrubby Cinquefoil, Dyer's Greenweed, Bayberry, Sweet Fern, and other humble, but tough and hardy plants. When we reach the station, we find not only a decent unpretentious building with substantial platforms, and neat driveways and gravel spaces, but also a fair spread of grass with three or four great Sugar Maples for shade—a contrast, indeed, to the usual North American station-yard, which commonly resembles a cattle-pen more than anything else; a contrast also to that other type of station ground in which the station master sets out Geraniums supplied by the company, although the fundamental separation of grass-land from gravel space has not yet been made.

From the railroad platform we at once command a view of our valley. The village, with a mill or two, lies below us at the mouth of a gap in the northern hills. Southward the valley widens to contain a fresh green intervale. Opposite us the west wall of the valley is an irregular steep slope of rising woods with numerous hill farms scattered along the more level heights above. The eastern wall upon which we stand consists below the railroad of a long and dense wood, and, above the tracks, of rolling and airy uplands which have been occupied by city men for country houses. The central intervale, the flanking woods, the village gathered at the valley's head, the whole scene before us possesses unity and beauty to a degree which interests us at once. And how was this delightful general effect produced? Simply by intelligent obedience to the requirements of human life in this valley. The village was placed where it is for the sake of using the great water power which rushes from the gap in the hills. The intervale was cleared and smoothed for raising perfect hay. The steep side-hills have been maintained in woods because they are too steep for agriculture, and because if they were cleared of trees, their sands and gravels would be washed down upon the fertile land of the intervale. It is in such ways as these that the every-day forces of convenience, use, and economy conspire to produce beauty, and beauty of a higher and more satisfying type than that which founds itself upon caprice, or pomp, or fashion.

The truth of all this is well illustrated by the details as well as by the total effect of the valley before us. If we descend towards the village, we find the footpath leaving the highway, and following a swift brook down through the wood, while the road, in order to find an easier grade, makes a long zigzag through the woods to the south. Trees and bushes crowd the sides of the road thus freed from the stiff accompanying sidewalk, while the footpath gains exemption from the dust of the road, and has all the beauty of the brookside in addition. We learn incidentally that all this wooded slope is the property of the township, that it is called the Town Wood, and that it was the gift of some of the men who live above the railroad.

At the foot of the slope, footpath and highway join again, and proceed across the level valley as
a straight village street, adorned with rows of trees, and broad grass strips, and sidewalks which conform themselves to the slight ups and downs of the ground. Here is just as much stiffness and straightness as is necessary and fitting, and not a bit more. Here is no mimicking of the curbing, and the strict grades which are necessities only in city streets. Here, also, the street trees are neither Gingkoes, nor Koelreuterias, nor Magnolias, but American Elms.

In the heart of the village we find a town square planted with Elms in symmetrical rows. Fronting on the square is the town hall,—a respectable building,—and back of it rises a steep rocky slope with a high rock at the top, where a bonfire burns every 4th of July. The rocky bank has recently been planted with Pines and Hemlocks, which in a few years will make a dense, dark background for the town hall. Then straight away south from the hall and the square runs the broad main street of the town, an avenue of Rock Maples, young as yet, but promising a noble vista in twenty years or less; for the southern end of the long avenue opens upon the sunny meadows of the intervale; so that a man standing in the public square will look under the boughs of the trees away to the south for miles. Until lately there was a barn standing in the line of this vista and hiding the open intervale. The removal of the barn by a public-spirited man has established the permanence of the outlook, because the lands beyond are so moist that they can never be built upon.

I should like to speak of the generally sensible and simple planting of the house grounds, of the good specimen trees in the yard of the principal school, of the fine gorge above the gap in the hills, where the mill company has preserved the woods for the protection they afford to the canal and its retaining-banks, of the way in which the intelligent preservation of trees along even the tiniest brooks of the neighboring hill farms has resulted in unusual beauty of farm scenery, as well as in the prevention of that extravagant washing away of soil which results from carrying ploughing to the edges of watercourses. All through this district it is most interesting to note how beauty has resulted from the exercise of common sense and intelligence.

When we turn the other way, and climb the hill above the railroad station, we find a charming winding road, the sides of which are irregularly overgrown with trees, shrubs, climbers, and herbaceous plants. The footpath is there, but it dodges in and out, and goes here below a knoll and there on top, and does not stick to the roadside like a city sidewalk by any manner of means. Every now and then we pass the entrance of some city man's country estate,—there must be a dozen or twenty such estates in this fine hillside,—and in the course of a summer afternoon we make the round of them. Presumably all these gentlemen have distinctly intended to preserve or create beauty in the surroundings of their country homes. It is very interesting to see the several methods they have followed, and the various results obtained. Some of these estates seem very beautiful to us, while others are far less interesting. After allowing for all differences of natural opportunity, can any general reason for this contrast in results be found? It is obvious at once that the most beautiful of these places are not those upon which the most money has been spent, not those in which natural conditions have been most completely revolutionized, not those which display the greatest number of kinds of trees, shrubs, and herbs, not those in which the gardener has scattered flower beds in all directions. After studying these places it is plain that the most beautiful are those in which the general arrangement, and the saving and planting of trees, have been made to depend upon those same considerations of convenience, easiness, and fitness which we found produced the beauty of the valley. Arboriculture, when it is practised to produce timber, to prevent erosion, or to form collections of all growable species, is an interesting and noble occupation for mind and for capital; but when it is practised to enhance the beauty of the scenery of every-day life, it must consent to be guided by that keen feeling for fitness which is the essence of what is called good taste.

Austral Weeks: Botanizing in the Southern Hemisphere

Rob Nicholson

Among the amazing plants of Chile’s temperate rainforests, two conifers stand out, both unique to their region and both of great beauty—the alerce and the monkey puzzle tree.

A favorite childhood excursion for my brother and me involved a visit to Yale University’s Peabody Museum of Natural History, where we would stand transfixed in front of the magnificent skeleton of a full-sized apatosaurus in the massive Hall of Dinosaurs. Equally favorite was Rudolph Zallinger’s stunning 110-foot mural depicting groups of vertebrates arranged chronologically over a 300-million-year period. It was a viscerally potent image, one that still triggers memories instantly whenever I see a picture of the mural.

I recently returned to the Peabody, this time with my own children in tow. They too were enamored of the apatosaurus skeleton and ran eagerly around the exhibits prattling about sharptooths and bumpyheads. As I stood before Zallinger’s mural, I realized how thoroughly my own interests had changed in the thirty years since I had last seen it. Only now did I notice that in the interest of historical accuracy, the artist had included in his painting the flora that was associated geologically with the dinosaurs; under ginkgo boughs, tyrannosaurus scouted for victims, while triceratops and ankylosaurus warily grazed in arbors bordered by magnolia and palmetto palm. It was a vivid reminder that these plants, the forebearers of today’s flora, existed over one hundred million years before their modern descendants.

One tree that I seized on, a member of the taxonomic order Coniferales, was the progenitor of the conifer genus known scientifically as Araucaria and by such common names as bunya-bunya or the monkey puzzle tree. Once again the mural triggered memories. I had recently returned from a seed-collecting expedition to southern Chile with Michael Burggren of the Jatun Satcha Biological Preserve of Ecuador, a field station sponsored by the Missouri

Araucaria araucana, the monkey puzzle tree of Chile, a relict amid volcanic lava flows.
Botanic Garden. We had seen this peculiar relict on the flanks of two of Chile’s numerous volcanoes. We were collecting seeds for a consortium of North American and European botanical gardens and arboreta that hoped to increase their representation of Chilean species as a possible safeguard against eventual extinction. Of the fifty species of trees found in forests of southern Chile, forty-seven are found in no other country, and thirty-eight are listed as rare or endangered because of excessive exploitation.

Chile’s flora, rich in endemic species, even boasts endemic families, such as the primitive Gomortegaceae and the parasitic Misodendraceae. Other taxa show odd distribution patterns that are vivid illustrations of how a plant’s range and the continents’ positions can change over the eons. Eucryphia is a sumptuous flowering tree genus found only in Chile and Australia, having migrated across a former Antarctic land bridge. A relative of beech, Nothofagus, shows a similar distribution pattern while Empetrum, a heather-like shrub, is found throughout the coldest regions of the Northern Hemisphere but also in a few locales in Chile. This genus migrated from north to south along the mountain peaks, dispersed by migratory birds.

In the course of our expedition, we traversed unique forests ranging from supersaturated temperate rainforests to mediterranean assemblages of drought-tolerant trees and shrubs. Given that Chile extends along more than 3,000 miles of latitude, with altitudes ranging from sea level to 22,834 feet, it’s easy to understand why its borders encompass a wide array of ecosystems. We were targeting two trees in particular, both of them conifers, both unique to the temperate rainforests of Chile, and both of outstanding beauty: the alerce and the monkey puzzle tree.

**Temperate Rainforests**

While the soggy forests of our own Pacific Northwest are familiar to many, few people realize that other nontropical countries—Australia, Japan, Norway, Chile, and even Iran—also have rainforests. These temperate rainforests are rare jewels, covering only two-tenths of a percent of the earth’s land surface.

The term “rainforest” is only a century old, having been coined by the German botanist Otto Schimper in 1898 to describe a forest that grows in perennially wet conditions. According to today’s common definition, a tropical rainforest has a closed overhead canopy and receives eighty or more inches of rain annually, with precipitation fairly evenly spaced throughout the year. Various subcategories are defined...
by altitude, canopy height, leaf size and shape, and even mossiness. Most tropical rainforests are quite warm, of course, but the category also includes such high-altitude areas as the Mossy Forest of the Philippines and the cloud forests of Central America, where temperatures can fall below freezing.

By definition, temperate rainforests also receive at least eighty inches of rainfall a year, but being farther from the equator they have a wider seasonal fluctuation in daylength and usually greater variations in temperature. Since most of them are near oceans or seas, the precipitation may actually begin as fog, which then condenses on leaves and boughs and falls as droplets. Temperatures regularly fall below freezing, and snowfalls can be substantial.

On the Trail of Alerce Seeds

Chile's temperate rainforest generally lies to the south and east of Puerto Montt, a pleasant seaport and major shipping center for wood products bound for overseas markets. On its docks is found the notorious six-story pile of woodchips, a potent symbol of Chile's desire for export revenues. An hour east from Puerto Montt lies Alerce Andino National Park, a preserve for the conifer known to Chileans as alerce and to the botanical world as Fitzroya cupressoides. The common name was given to the tree by Spanish colonizers—alerce is the Spanish name for larch—and was itself the result of Moorish colonization in Spain, having been derived from the Arabic for cedar, al-arzah. Alerce is a tree that under the right conditions can attain massive proportions, as much as 150 feet in height and 25 feet in girth. Age estimates of some trees have gone as high as 4,500 years.

The exploitation of alerce began almost immediately after the arrival in 1540 of the Spaniards, who quickly recognized that its timber was well suited for shipbuilding and construction. By the early 1600s forests were being logged and within three centuries had been drastically reduced in extent. In 1834 the trees fell under the scrutiny of a qualified observer—the young Charles Darwin—when an exploration party was sent ashore from the H.M.S. Beagle, captained by Robert Fitzroy (for whom the tree was named). One can almost sense the damp fatigue in his bones as he writes, "I should think there are few parts of the world, within the temperate region..."
The coastal stands of alerce have by now been decimated, and the species' range is restricted to interior regions. North of Puerto Montt, entire square kilometers of huge alerce stumps left from trees that were cut decades ago give a melancholy demonstration of the species' ability to resist rot but not iron.

The sound of water is a constant in southern Chile, be it from rain, river, or the swamps in your shoes. Alerce Andino is in the floristic zone known as the Valdivian Rainforest—a supersaturated ecosystem with a soggy, mossy floor that receives 150 inches of rain a year. A walk in the southern forest requires a new frame of reference. Unlike Japan, Denmark, or California, where one can recognize a pine for a pine, a maple for a maple, or a beech for a beech, Chile has very few plants that are recognizable as members of genera also found in the Northern Hemisphere. But our sense of confusion was accompanied by the enchantment of discovery, of seeing species we had not known existed on the planet. By the side of a brook we stumbled onto Hooker's crinodendron, *Crinodendron hookerianum*, a small tree hung with sculpted, rose-pink, one-and-a-half-inch, bell-shaped flowers. These surreal blossoms would look more at home on a doily in the shopwindow of a Parisian confectioner. Two climbing shrubs had latched onto the moss-covered tree trunks, *Mitraria* with its glossy green leaves and goldfish-like flowers and *Philesia*, an unusual woody plant of the lily family that boasts striking pink, waxy bellflowers.

The first conifer we saw was *Saxegothaea conspicua*, a rare endemic named in 1851 for Prince Albert of Saxe-Coburg-Gotha, consort of Queen Victoria. Since this species has possible affinities to yew, the source of the anti-cancer agent taxol, we secured a sample for the National Cancer Institute's screening program. [I regret to inform royalists everywhere that it failed the test.] Walking through an unyielding
The volcanic slopes of Conguillio National Park contain a mix of deciduous southern beech and evergreen monkey puzzle trees.

drizzle we also saw trees we had identified in other locales but that reached far larger sizes here. *Eucryphia* on the coastal isle of Chiloé was a 40-foot tree; under the rains of Alerce Andino it grew to 120 feet. The verdant forest was wet to the point of discouraging everything but flora: I do not recall seeing a single insect or bird during the day of our visit.

After a number of miles we rounded a bend and saw our first stand of alerce. The stout 150-foot giants were immediately distinguishable from the surrounding flora. Although they belong to an entirely different family of conifers, they bore an amazing resemblance to the giant sequoia of California’s Sierra Nevada Mountains. They possess a stout trunk and extremely high first branches with cloudlike billows of foliage. Like sequoia, the bark of alerce is reddish-brown and also very thick—possibly a protective adaptation against fire and insects, although both seemed unlikely foes in the constant rain. After a fruitless search for cones on the ground, we realized that they were still in the trees’ branches, one hundred feet over our heads, and concluded we would not be collecting cones. Reports of the number of rings on felled trunks of alerce range from two to four thousand, causing us to wonder whether the wheel had reached South America when this tree began its upward journey.

In 1993 Antonio Lara and Ricardo Villalba published a profile of climatic shifts over a 3,622-year period using tree-ring data from alerce trees and stumps—the longest annually resolved climatic reconstruction ever made from tree rings. The oldest stump they sampled was found to be 3,613 years old when it was cut down in 1975.

Alerce today is at the center of a tug-of-war between environmentalists, who believe that remaining stands should be saved, and their opponents, who maintain that Chile’s need for foreign currency justifies continued exploitation of forest remnants. Unfortunately, the capacity of alerce to reproduce itself is still unknown. Pollen studies indicate that the species was more common in the region 4,500 to 6,000 years ago, when the climate was colder and moister; its original range appears to have shrunk even before Spanish colonization accelerated the process. In his research on the regeneration patterns of many forest species of
The pointed leaves of *Araucaria* present a challenge to climbing primates, but the large seeds provide ample rewards to foraging animals.

south-central Chile, Dr. Thomas Veblen of the University of Colorado found only one seedling of alerce in recent clearcut stands.

Has the plant lost the ability to reproduce? Does it produce sound seed only occasionally? Or does the full sun of a clearcut scorch and kill the young seedlings? Possibly the tree’s germination biology is still attuned to a former climatic regime, requiring a longer cold period for germination. Clearly Veblen’s work highlights the need for further research on alerce in the wild. But in order to decipher the species’ seed biology, researchers may have to use seed from a botanic garden—possibly bred from a cluster of different genotypes—since getting seed from the wild is so difficult.

On the way out of the park we did find a smaller tree and were able to take a number of cuttings. After experimenting with different hormones back in the United States, we successfully propagated these cuttings and distributed the plants worldwide. One recipient was Chris Page of Edinburgh Botanic Garden’s Conifer Conservation Programme, whose mandate is to plant groves of rare conifers of known provenance at “safe sites” in the United Kingdom. With luck these plants will be setting seed within a generation for future botany experiments.

**On the Trail of Araucaria**

Many miles to the north of Alerce Andino Park lies the fragmented range of the monkey puzzle tree, *Araucaria araucana*. Also a coniferous genus, *Araucaria* grows only in the Southern Hemisphere—Australia, the Pacific Islands, Brazil, Chile, and a small section of Argentina—and is best known for *A. heterophylla*, the Norfolk Island pine of the indoor landscaping trade.

Everyone who sees the Chilean monkey puzzle tree is immediately struck by its bizarre otherworldliness. As a young tree it looks like a
The pillar-like trunks of the monkey puzzle tree might have served as scratching posts for dinosaurs shedding their skin.

candelabrum made of concertina wire. With age it assumes a parasol-like habit, its branches cloaked with emerald-green, triangular, sharp-tipped leaves and its trunk an untapered column of interlocking, fissured plates of bark. It is as if the tree evolved to mimic the stegosaurs and ankylosaurs that may once have foraged beneath its boughs. I first saw the tree long ago in San Francisco’s Golden Gate Park and was recently surprised to see a 35-foot specimen growing on New York’s Long Island—as far as I know, the coldest area in which it has been successfully grown.

The species’ common name is misleading, since there are no monkeys living within its range. It owes its origin to that fountainhead of whimsy, the English garden party. It seems that at a planting ceremony in Cornwall in 1834, a guest remarked that the tree’s dangerously armed branches “would be a puzzle for a monkey to climb.” The name was coined, and it stuck. In Chile, the tree is known as pehuen to indigenous peoples, who roast and eat its large seeds. In season, seeds collected in remote villages find their way to the supermarkets of the major cities.

Araucaria has evolved a number of features that may have helped it survive through the ages. Its inch-and-a-half seeds are among the largest of all conifers, providing seed-caching animals with a strong incentive to collect and distribute them. Presently the seeds serve as food for two parrots that inhabit the araucaria forest, but its dispersal agents in the distant past may have been reptiles or early mammals. In addition to size, the seeds have a functional wing; the fossil record is too scanty to be certain, but araucaria may have been among the first seeding genera to evolve a winged seed. Lastly, the trunk of the araucaria enjoys an ability unusual in conifers, that of coppicing, or sprouting another trunk, near its base. This feature may have helped the species persist in a region where volcanism and lava flows still constitute a major disturbance regime.

Araucaria can be found in pure old-growth stands, but it also associates with various species of Nothofagus, the Southern beech, and
Expedition member Michael Burghgren resting in a grove of monkey puzzle trees.

with a variety of understory shrubs. On the still puffing Villarica volcano we visited a stand of fifty trees mixed with dense and intertwining beech. A lava flow had annihilated a section of the forest, but along its edges, on the skim of new soil, we found a few araucaria seedlings already colonizing, along with Pernettya pumila, a low shrub of the rhododendron family. Another colonizer on these lava flows was a plant I had put high on our list of target species, Empetrum rubrum. This low-growing, spreading shrub is a relative of black crowberry, Empetrum nigrum, a plant familiar to mountain climbers throughout the Northern Hemisphere. In our half of the globe E. nigrum is known as a colonizer that establishes itself on ground newly freed by retreating glaciers. Clearly it is a genus that has no fear of fire or ice. E. rubrum has proved hardy in Boston and is now residing in front of the cold storage building at the Dana Greenhouses.

We had worried that the monkey puzzle tree would also prove to be a botanist’s puzzle tree, with its barbed branches preventing us from climbing up to retrieve the six-inch cones. Luckily, however, I was able to climb a beech to within reach of a cone, which I shattered with a few pokes of a pole. Since the huge cones can hold up to 300 seeds, the result was a shower of inch-and-a-half seeds that fell to the forest floor and came to rest on the orange fall foliage of the beech leaves.

At the next site we visited, the stunningly beautiful Conguillio National Park, the araucaria trees had already shed their seed, and we quickly collected more than we could carry. Here we found the species growing in pure stands: darkly shaded forests of hundred-foot giants, their four-foot-thick, blackish-gray trunks rising like pillars to the whorls of branches above. The forest seemed far removed from us in time, primeval in appearance, with no familiar flora to orient ourselves by. If a few dinosaurs had ambled by, we would have seemed more the intruders than they.

At this time, April, it was autumn, and snow had already fallen. The snow grew deeper as we drove across the park and into higher altitudes,
but as self-respecting New Englanders we refused to admit that it was too deep to negotiate. After careening upward for a few miles, we finally stopped at the crest of a steep hill. Ahead of us, at the hill’s base, was a narrow plank bridge slicked with ice, leading to another steep hill that would require a full head of steam to climb. Had it been New England ice we might have given it a try, but instead we made our last collections at the crest of the hill and reversed our course back to the village of Melipueco.

Over the last fifteen years araucaria has passed back and forth between protected and nonprotected status. Logging is allowed at present, but CODEFF, Chile’s first environmental protection group, is pressing for renewed protection. According to a study by the Central Bank of Chile, the pace of the deforestation in the country has doubled since 1984, giving Chile the dubious honor of being the second most deforested Latin American nation, after Brazil. Native trees are being logged primarily for the foreign woodchip market and to clear areas for nonnative tree plantations. Since almost 95 percent of the native woodchips go to the wood pulp factories of Japan, the status of Chile’s forests is closely linked to the vigor of the Japanese economy.

Two opposing images from the expedition have crystallized in my mind. The first was Puerto Montt’s infamous six-story pile of woodchips bound for Japan. The second was a television documentary I saw on the day of my departure. It featured three rare Chilean trees—the Jubea palm, the araucaria, and the alerce—and voiced an appeal for conservation. In the last ten years Chile has begun to re-evaluate its forestry industry and, thanks to the efforts of local and global environmental groups, is becoming aware of the negative consequences of overexploitation. I can only hope that when my children’s children see Zallinger’s mural they will not view alerce and araucaria in the same way as dinosaurs—as fascinating relics of bygone species.

Bibliography


Rob Nicholson manages the conservatories of the Smith College Botanic Garden, Northampton, Massachusetts.
Soil as a Living System

Leslie Jones Sauer

What most struck the woodland manager of New York City’s Central Park when he visited the Adirondacks was a forest floor so soft he could plunge his hand into it. The ground was visibly alive and completely different from the dead, concretized soil of the urban forest in Central Park.

Soil wears its problems on the surface. Where trampling or high rates of decomposition prevail, the litter layer and topsoil are entirely absent. Until recently, the annual leaf fall in the woodlands of Central Park typically did not accumulate or even persist from one year to the next. With no litter layer, there was no nursery for the next generation of the forest.

Nearly a decade of woodland management is rebuilding the ground layer in Central Park’s woodlands at the north end of the park. The site is becoming increasingly stabilized as erosion is controlled and bare areas are replanted. The many small saplings and seedlings that were planted or that volunteered after exotics removal help to hold the ground. During the icebound 1993–1994 winter season, some remains of autumn’s leaves persisted under the blanket of ice until spring. That was a turning point for the woodlands. The following winter was unusually mild, and by spring 1995 there was a relatively continuous litter layer.

In time, the organic litter on the forest floor will create humus, an organic soil horizon. Within it, most of the life of soil occurs. As organic matter is continually broken down into humus, it becomes incorporated into the mineral layers of the ground surface to build topsoil. Soils are forming all the time, and like vegetation, integrate and express all of the ecosystem’s processes. Soil is a reflection of climate, parent material, topography, vegetation, and time. The layers of soil tell a more recent history than the rocks beneath.

The soil’s abiotic, or nonliving, factors are generally the primary focus of conventional soil assessment. Much of our thinking in the past was oriented toward an “ideal” soil model that balanced sand, silt, clay, pore space, moisture, minerals, and organic matter. These standards determined whether a native soil was judged poor or good, and where soils did not conform to the ideal, soil amendments were used to modify texture, acidity, fertility, or other characteristics. Many early mitigation, stabilization, and restoration projects suffered from this agricultural/horticultural approach. Standard soil specifications, for example, call for routine topsoil stripping, fertilizing, and liming even though many disturbed or made soils are already less acid than in their native condition because of the repeated addition of lime by means of concrete rubble and urban dust. Most regulations related to development sites, highways, landfills, and abandoned mines require from three to six inches of topsoil spread over new soil surfaces before revegetating. That topsoil comes from somewhere, so the restoration of one site frequently means the destruction of another. We need more research on alternatives to topsoil, especially those that reuse waste materials appropriately to amend local soils and that avoid environmentally costly products such as fertilizers and peat. Even where topsoil has been stockpiled on a site before construction, the living organisms it contains die within days.

The Soil Food Web

A food web is the structure of relations among the organisms within an ecosystem based on what each consumes. Primary producers consume water, minerals, carbon dioxide, and a few
other things to produce organic matter, which is consumed by most of the rest of the creatures that are, in turn, consumed by still others. Some organisms have very specialized food requirements while others feed quite omnivorously.

Both soil and water are media in which plants and animals live and grow. And in a very real way, both are living systems. One of the most important contributions to the history of water management occurred with a shift in perspective that originated with Ruth Patrick and others. When one views water as a living system, its quality is measured by the richness of its biota instead of physical and chemical factors such as flood levels or biological oxygen demand. Its biological components are a defining measure of health that reflect a more complex array of factors. This same kind of revolution is happening in our perception of soils.

In 1968 Ruth Patrick wrote about aquatic food webs:

The various pathways in the food web and the various types of interrelationships of species to each other are two of the most promising avenues of research.

Most food webs are composed of at least four stages[1]... the stages tend to be few because so much energy is lost between stages. ... Since the stages of the food web are few, ... diversity is expressed by many species forming each stage or level in the food web.

This strategy of many species at each trophic level has developed a food web of many pathways which seems to give stability to the system . . . [W]e see there are many food webs within systematic groups as well as between groups. It should also be pointed out that the size and the rate of reproduction vary considerably in each of the major systematic groups. These types of variability in food chain, size of organisms, and reproductive rates help to ensure the maintenance of the various systematic groups, and in turn preserve the trophic stages of the food web of the whole community.¹

Soil ecosystems are strikingly similar. Like aquatic systems, they have a great deal of redundancy. Very simple systems with simple food webs can be drastically altered by the appearance or disappearance of one or a few species. In more complex systems there may be multiple ways in which energy flows through the food web. Thus the more complex systems are said to have redundancy and are not so dramatically changed when a few species change. Many soil components even lie dormant until favorable conditions occur. The full soil structure is not required for most basic soil functions.

Rather than focusing simply on the nonliving aspects of soil, restoration should enhance its living components, primarily bacteria, fungi, and microfauna. Most of the work of forming humus is done by plant roots and by animal life in the soil, which depend on a permeable soil crust, stratified soil layers, and appropriate amounts of organic matter. There are up to three thousand arthropods per cubic inch of productive soil. A litter layer of leaves one-and-one-half inches thick and a yard square might contain five thousand miles of fungal filaments.

Plants are the primary producers of organic matter in the forest soil system. Ants and other invertebrates initiate the breakdown of ground-layer litter. Soil microorganisms including fungi, bacteria, protozoa, and actinomycetes continue this process of converting organic matter into soil minerals that in turn become available as nutrients to plants. In food-web nomenclature, these organisms are “consumers.” Primary consumers (herbivores) feed directly on the “producers,” which are the plants; secondary and tertiary consumers are predators and parasites, which feed upon each other as well as upon herbivores. Food webs also contain other decomposers and detritivores that feed on litter, such as mites, woodlice, and earthworms. Woodlands typically support more diverse assemblages of soil organisms than grasslands. If soil organisms are included in the species count, temperate rainforests are richer in biodiversity than tropical rainforests.

The soil food web performs the primary function of the soil, which is to cycle energy and nutrients, including nitrogen, sulfur, and phosphorus. Native soil systems are very efficient and succeed in recycling, for example, upwards of eight percent of the nitrogen in the system. The cycling of nitrogen is intimately associated with the cycling of carbon, which is tied up largely in organic matter. Nitrogen, in part, determines the rate at which carbon is broken
Ancient forests are filled with dead wood. Downed trees can be important assets for re-creating mixed-age, mixed-species forests. Down. Bacteria and fungi take up the nitrogen as they decompose soil organic matter, and some fix atmospheric nitrogen. This nitrogen too is released into the soil to be again available to plants. Nitrogen's slow release from an organic to an inorganic form, which is available to plants, is called “mineralization.”

The microbial community performs three major functions: as discussed above, conversion of organic nitrogen to a plant-available form such as ammonia; nitrification when ammonia is converted to nitrates; and denitrification when nitrogen is recycled into the atmosphere as a gas. The soil microbial community also contributes to soil stability, another vital function. Fungal hyphae knit bits of organic matter together to create a denser, stronger litter layer and upper soil horizon.

Not all soil food webs are the same. Fungi appear to dominate in forest soils, bacteria in agriculture soils. Thus, soil communities change over time as the landscape succeeds to forest. The nature of the vegetation determines the nature of the fuel/food available for soil organisms. Grasslands litter, a relatively easily decomposed herbaceous material, does not typically contribute all of the soil's organic matter. The extensive root systems of grasslands are also a major source of the soil's organic matter. The roots of grasses exude carbon directly into the soil as sugar, amino acids, and other forms to feed soil fungal associates and activate bacteria and other microbes.

As the landscape matures, the litter becomes more difficult to break down. While herbaceous litter is primarily cellulose, the litter of the forest becomes increasingly higher in lignin, the woody component of plants. Tree leaves have more lignin than grasses, and the leaves of late successional species, like beech (Fagus grandifolia) and oak (Quercus spp.), typically have more lignin than ash (Fraxinus spp.), tulip poplar (Liriodendron tulipifera), and other early successional species. In woodlands an important shift occurs as leaf fall and other litter become the most important sources of organic matter, rather than the direct contribution of carbon by the roots, as in the grasslands. There are also larger volumes of wood on the ground in the form of fallen twigs and limbs, which directly foster fungi because bacteria are unable to decompose lignin. The mycorrhizal filaments from tree roots reach up into the old wood to extract the valuable nutrients. Insects such as beetles and ants are also able to break down wood. Wood in contact with the soil and standing dead trunks, “snags,” create many opportunities for various wood and soil invertebrates of the forest.

The soil communities continue to change along with the vegetation communities. Over time, the cycling becomes less rapid. In a humus-rich forest soil, the organic matter that remains the longest is the rather stable organic compounds that degrade much more slowly. By then the humus is important more as a site for important chemical processes and for the physical qualities it gives the soil than as a stockpile of nutrients. The humus, for instance, increases the water-holding capacity of the soil.

Another important role of dead wood is to serve as a water reservoir for the forest in times
of drought. Dead wood, especially larger logs approaching a foot or more in diameter, soaks up water like a sponge and retains it for long periods. Old logs or stumps make great nursery sites by carrying vulnerable seedlings through dry spells. Salamander populations also depend on large logs for needed moisture, which is, in part, why they are absent so long after clearcuts and timbering, although they may number one or two per square yard in old-growth forests. Logs increase local stormwater retention as well by inhibiting overland flow and by absorbing water in place.

Fungi in general foster acid soil conditions, whereas bacteria can increase alkalinity. The bacteria and their predators in grasslands help maintain the soil’s pH and the form in which nitrogen is made available, as well as nutrient cycling rates that work to the advantage of grasses. Where fungi are more abundant, as in natural forests, the nitrogen is converted to ammonium, which is strongly retained in the soil system. In bacteria-dominated systems, the bacteria convert nitrogen to nitrate instead of ammonium. Nitrate leaches more easily from soils than ammonium; however, the growing patterns of grasses tolerate this condition. But when woodland soils become bacteria dominated, rapid leaching may leave most native old-growth species poorly nourished while invasive exotics and some early successional natives are flush with nutrients. Some species are more sensitive than others to soil nutrition. Conifers do not grow in bacteria-dominated soils whereas agricultural crops cannot be grown in fungi-dominated soils. Indeed, in woodlands, a high ratio of bacteria to total biomass is an indicator of disturbance. These factors, which seem to depend on soil organisms, play a greater role in succession than previously recognized.

**Damaged Soil Systems**

Soils are far more damaged and damageable than we realize, but the problem is often hidden. The cumulative effects on forest systems and other environments of acid rain, nitrogen deposition, global warming, ozone thinning, unnecessary grading, and stormwater changes have left a legacy of severely altered soil conditions and totally modified soil food webs. The consequences and remedies are still largely unknown. Many of these changes are so pervasive that we take them for granted. Take earthworms, many nonnative, which now are abundant throughout the urban forest system. In fact, they are not part of the historic community of living creatures in native forests and are typically associated with more disturbed landscapes. Earthworms in general increase soil fertility by initiating the breakdown of organic matter, aerating and mixing the upper soil, and creating a microenvironment that stimulates the bacteria that convert ammonium to nitrate. High earthworm populations also foster nitrification by supplying the oxygen necessary to convert ammonium to nitrates. They take a system already disturbed by added nitrogen and push it farther from normal by consuming the litter layer five times as rapidly as fungi and converting excess food into nitrate. The same kind of

*Logs laid on the ground disappear quickly. Using them as seedbeds for planting avoids soil disturbance while enhancing survival.*
self-reinforcing cycle can be seen when aquatic systems fill with algae. Each shift in the soil character will in turn ripple through the entire system. Unfortunately, in many woodlands that look mature because they have larger trees, there is a lag in the succession of the soil, which may still be dominated by earthworms and bacteria and impoverished in terms of types of fungi, invertebrates, and other, more efficient paths for nutrient cycling.

Building Soil Systems

The object in restoration is to restore the nutrient cycling and energy flow of the historical soil system. First, work to protect existing soil resources and then explore techniques to increase the overall biomass of the soil and to foster the diversity of native soil flora and fauna.

Recommendations

Identify, protect, and monitor areas of native soil that are relatively undisturbed.

Most areas contain places where there is less-disturbed soil that can serve as rough models of local soil conditions. Studying the more natural soils at the same time remediation is being documented in a disturbed landscape will provide a standard for measuring the success of different approaches. The natural sites also serve as propagation sources for locally adapted microorganisms.

Reduce local sources of soil contamination, including added nitrogen.

Evaluate local air pollution impacts, especially that of automobile exhaust. Removing roads wherever possible is of paramount importance, especially in more natural areas. What is convenient, even to the restorer, such as easy access, may be lethal to the most jeopardized species. Educate the community about regional air pollution impacts. Many other management practices, such as pesticide use, also affect the realm of the soil. The most popular herbicide, for example, glyphosate, which is often used to control exotics, enhances conditions for bacteria but makes a poor substrate for the development of forest fungi.

Recognize that the user is inseparable from the solution.

No treatment of soil will make it impervious to compaction, erosion, and other such disturbances. Confine all use in forests and other natural landscape fragments to designated trails to minimize degradation from feet, hooves, and wheels. Prohibition alone never is enough. Users will stay on trails to the extent that trails create the elements of satisfaction that keep them there and provide access to desired destinations. The gradual building of the litter layer and the absence of bare soil off the trail are hallmarks of success.

Minimize “working the soil.”

Despite a lot of knowledge about the damage done to living systems by constant perturbation, there is still a tendency to overwork soil. Beyond the familiar structural damage—such as that caused by working a heavy soil while it is wet or by the erosion that accompanies any soil disturbance—the soil’s level of microorganisms is also severely affected. For example, plowing and any mechanical disturbance to the soil will
Trampling and stormwater runoff prevent reproduction of the next generation of forest in many parks.

Vertical stakes made from cut branches driven into compacted ground in a dense pattern convey water and moisture downward into the root zone. They loosen the surface as they decompose, without disturbing the stability of the surface.

tend to foster the rapid growth of bacteria, which in turn generate exopolysaccharides, which cause the soil to slump in rain. Other substances make soil hard to wet, or hydrophobic. Cultivating soil is almost always deleterious to natural areas and constantly resets the time clock back to disturbance rather than allowing more complex, stable, and diverse soil systems to develop.

We need to try new techniques, such as planting new seedlings in logs or stumps, to avoid soil disturbance while enhancing survival. Another technique is vertical staking, wooden twigs driven vertically into the soil. Vertical staking serves to aerate and loosen the soil without damaging the roots of existing vegetation, and it avoids the need to completely turn the soil. In addition, it favors the development of fungi instead of bacteria because it incorporates wood into the soil.

Reevaluate the usefulness of current methods of stockpiling topsoil.

Harris, Birch, and Short describe the progressive impacts of stockpiling, which is a frequently used method to retain a site's topsoil during construction. The first phase is an instantaneous kill of many of the living creatures in the soil that occurs with the initial removal and stockpiling. During the next few months there is a flush of bacterial growth as well as fungi but only in the upper soil on the outside of the pile, the new "topsoil." During the next half year or so the soil stratifies in layers. The primary distinctions reflect the amount of oxygen in the soil because of its depth in the pile or level of saturation with water. The developing layers consist of both near-surface aerobic and deeper anaerobic zones as well as a shifting tran-
sition area between them. When the soils are restripped and replaced elsewhere, there is another instantaneous kill of most living organisms followed by a flush of bacterial growth.

Experiment with alternative strategies that better preserve native soil food webs when moving soil is necessary.

Experiment with methods that keep soil horizons intact, such as moving blocks of soil. Practitioners are using and modifying equipment like old sod forks and front-end loaders as well as developing new equipment for this purpose, such as the soil-mat lifter devised by John Monro.

Reevaluate the addition of organic matter to enrich disturbed soils.

The continuous rain of airborne nutrients onto soils in the form of acid rain and nitrogen deposition from air pollution raises serious concerns about many traditional management practices with regard to the use of organic matter as a soil additive and our almost automatic addition of nutrients to disturbed soils. Researchers have shown repeatedly that fertilizer benefits weed species. Creating less-hospitable conditions in the conventional sense can actually enhance the performance of native species. Using elemental sulfur on test plots, Jean Marie Hartman and her co-workers at Rutgers University lowered the pH and reduced nutrient availability in a mixed meadow to foster native species over exotics. Many invasives, both native and exotic, are nitrophiles and do poorly under such conditions.

Reevaluate the use of mulch and soil amendments that are harvested from landscape communities other than those native to the site.

Because to a great extent soil organisms are what they eat, bringing in organic material from other sources will not necessarily foster the growth of the same soil organisms as are in the desired native community. In an artificial soil such as made land or a highly contaminated soil, it's not the addition of organic matter but what kind we use that will impact the nature of plant succession on the site. The more indigenous the existing landscape, the more important it is to minimize the use of dissimilar materials.

Reevaluate the conventional management of brush, dead wood, and leaves.

Even where no additional fertilizer is added, it is important to modify our management of dead wood and vegetative debris to more closely mimic natural conditions. This sounds obvious, but how often is organic matter collected from a site, taken to another location to be composted, and then used at still another location when it is "well rotted"? Under more natural forest conditions, however, the major contribution of organic matter is not well-rotted compost but rather wood, twigs, and leaves that slowly break down in the place where they fall. Adding wood and raw, rather than composted, leaves more closely mimics the natural scenario.

Develop new ways of observing and monitoring soil health.

Unfortunately, standard soil tests are of limited assistance to the restorationist. For example, nitrogen levels are poorly evaluated when they are measured only as concentrations at any one time rather than as total flux over time. Conventional tests also ignore the biotic component altogether. A number of researchers are working on new methods. One, Jim Harris of the University of East London in England, who has been monitoring soil changes associated with restora-
tion, has developed a set of techniques for measuring the size, composition, and activity of a soil's microbial community. These measurements can be used for comparison with a less-disturbed target community to assess the level of recovery of the soil system. He and other researchers have developed methods that, at least in England, have increased fungal populations with significant beneficial impacts to soil development and nutrient cycling.

Build populations of soil fungi.

As noted earlier, heavy nitrogen enrichment from air pollution and increased compaction, erosion, and sedimentation have tended to favor the growth of bacteria over fungi and invertebrates. Thoughtful management promoting the development of fungi through appropriate treatment of the soil, soil surface, and litter layer can help restore indigenous food webs in forest soils.

Management to Foster Fungi and Other Forest Organisms

Because only fungi can break down lignin, the woody component of plant matter, allowing dead wood and woody debris to remain on the ground layer is a major component of the effort to rebuild soil fungi. Raw woodchips and small limbs on the soil surface provide an ideal matrix for the rapid development of a dense fungal network in the soil that, unlike bacterial decomposers, also provides surface stabilization. The webby, sticky quality of the mycelia of fungi serve to knit the surface particles and litter to reduce erosion and conserve moisture that is vital to the life of forest soil. While a deep layer of woodchips can create a growth-suppressing mulch that later floods the area with nutrients, a very thin layer of woodchips stimulates the development of more complex soil biota while limiting the overall rate of the addition of nutrients. Wood's slow rate of decomposition is also important where rates of decomposition have accelerated dramatically. Because lignin has a very low decomposition rate, it is a more durable groundcover that promotes the development of a stable litter layer.

Occasionally it may be necessary to inoculate the soil or vegetation with mycorrhizal fungi, although in most cases local sources of inoculum are likely to be available from wind and animal dispersal. Where soils are high in nutrients it may be more important to manage nutrients and foster fungi than directly inoculate, especially if inoculation is not required to establish plant species. Small amounts of soil from analogous sites nearby or woodchips colonized by local mycorrhizae may be used to inoculate sites where natural processes have not been effectual, where there is a substrate limitation, such as thin soil over bedrock, or where plant-specific requirements do not occur.

Jim Harris recommends using thin blankets of fresh woodchips from one-half to one inch thick, which create ideal surface conditions for the development of fungi. Within weeks, a network of fungi colonizes the surface so densely that the woodchip layer can actually be shaken loose from the soil by hand and moved elsewhere to inoculate an area nearby with local fungi. This method, local harvesting and dispersal of indigenous fungi, should become an important part of soil management programs and is preferable to using a mass-produced commercial inoculum for restoration purposes.8

We can also manage blowdowns better than by simply removing fallen trees, as is the current convention. Instead, we can minimize the hazard of a falling tree to area walkers while mimicking more natural processes of decomposition that encourage the growth of fungi and invertebrates in the soil by partially upending the stump. The upended root mass reveals a near-perfect seedbed for native species and maintains enough of the tree's still living roots to maximize the extent to which its nutrients are passed directly to neighboring trees.

Commercially produced mycorrhizae have been very successful in reforesting drastically disturbed lands, such as mine spoils, all over the globe. Sites in Kentucky, for instance, where soils were extremely acid, with pH values as low as 2.8, have produced pulpwood for harvest in just fifteen years from inoculated seedlings.9 When considering such products, however, evaluate their potential impact on native subspecies of mycorrhizae. Like commercial plant propagation, this approach risks hastening the
extinction of local varieties. We still need to
develop appropriate procedures and protocols
for disseminating fungi and other soil organisms
as much as we do for larger plants and animals.
Such techniques are well developed in the west-
ern states but have only recently been applied in
the East.

Fire also acts as a stimulus to many wood
fungi and invertebrates and reduces bacteria,
which in turn fosters the growth of fungi. In a
study of changes in beetle populations following
fire in boreal coniferous forests in Finland, sci-
entists found a sudden appearance of a diverse
group of beetles that feed on wood fungi, which
in turn implies an even more rapid response by
fungi. These wood-fungi-feeding forest beetles
are fire specialists and represent an important
evolutionary adaptation at an ecosystem level
to recurrent fires of the past; they are a side-
benefit of restoring natural patterns of fire to
the forest.

Native soil conditions and biotic communi-
ties and processes need to be the models for our
interventions in restoring native habitats. The
remaining remnants of native soil are, therefore,
biorestores for the richness that once character-
ized our soil heritage. The approach should be
to restore, rather than replace, soils. Soil made
in place is favored over the imported topsoil.
Instead of reintroducing missing components
with inputs from outside the environment,
we should instead focus on fostering the resto-
ration of remnant and indigenous communities
of soil biota, which furthers the general goal of
"restoring-in-place" to the extent feasible. By
doing so, we also minimize the casual dispersal
of local subspecies of soil microorganisms
and exotic soil organisms. In the worst-case
scenarios, such as areas where soil is completely
depleted, some materials from outside will be
needed, but even in these situations the soil-
building resources inherent to the site should be
used to the maximum extent possible.

Endnotes

1 Ruth Patrick, Natural and abnormal communities of
aquatic life in streams. *Via 1. Ecology in Design*
[University of Pennsylvania, Graduate School of Fine
Arts, 1968], 37.

2 M. J. McDonnell, S. T. A. Pickett, and R. V. Pouyat,
Application of the ecological gradient to the study
of urban effects. In *Humans as Components of
Ecosystems, The Ecology of Subtle Effects and
Populated Areas*, ed. G. E. Likens and W. J. Cronon
[New York: Springer-Verlag, 1993], 175–189.

3 E. R. Ingham, Restoration of soil community
structure and function in agriculture, grassland and
forest ecosystems in the Pacific Northwest.
Proceedings, Society for Ecological Restoration
Conference [Seattle, 1995], 31.

4 W. Nixon, As the worm turns. *American Forests*

5 J. A. Harris, P. Burch, and K. C. Short, The impact
of storage of soils during opencast mining on the
microbial community A strategist theory

6 The tool, available for sale in several sizes, was
developed by Monro Ecological Services,
Harleysville, PA, and is available through Bentley
Development Co., P.O. Box 338, Old Route 22,
Blairsville, PA 15717, 412/287-0671.

7 J. M. Hartman, J. F. Thorne, and C. E. Bristow,
Variation in old field succession Proceedings (Design
+ Values) of annual meeting, Council for Educators in
Landscape Architecture [Charlottesville, VA, 1992],
55–62.

8 J. A. Harris, et al., op cit

9 C. E. Cordell, D. H. Marx, and C. Caldwell,
Operational application of specific ectomycorrhizal
fungi in mineland reclamation. Unpublished paper
presented at annual meeting of the American Society
for Surface Mining and Reclamation [Durango, CO,
May 14–17, 1991]

10 J. Muono and I Rutanen, The short-term impact of
fire on the beetle fauna in boreal coniferous forest.
### Arnold Arboretum Weather Station Data — 1998

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>JAN</td>
<td>38</td>
<td>25</td>
<td>32</td>
<td>58</td>
<td>5</td>
<td>6.55</td>
<td>6.3</td>
</tr>
<tr>
<td>FEB</td>
<td>43</td>
<td>27</td>
<td>35</td>
<td>57</td>
<td>7</td>
<td>5.91</td>
<td>.5</td>
</tr>
<tr>
<td>MAR</td>
<td>49</td>
<td>32</td>
<td>41</td>
<td>88</td>
<td>7</td>
<td>5.33</td>
<td>1.1</td>
</tr>
<tr>
<td>APRIL</td>
<td>61</td>
<td>39</td>
<td>50</td>
<td>92</td>
<td>24</td>
<td>4.05</td>
<td>0</td>
</tr>
<tr>
<td>MAY</td>
<td>76</td>
<td>51</td>
<td>64</td>
<td>92</td>
<td>40</td>
<td>8.44</td>
<td>0</td>
</tr>
<tr>
<td>JUNE</td>
<td>79</td>
<td>59</td>
<td>69</td>
<td>96</td>
<td>43</td>
<td>12.7</td>
<td>0</td>
</tr>
<tr>
<td>JULY</td>
<td>88</td>
<td>65</td>
<td>77</td>
<td>98</td>
<td>58</td>
<td>4.01</td>
<td>0</td>
</tr>
<tr>
<td>AUG</td>
<td>86</td>
<td>64</td>
<td>75</td>
<td>95</td>
<td>49</td>
<td>4.69</td>
<td>0</td>
</tr>
<tr>
<td>SEPT</td>
<td>80</td>
<td>56</td>
<td>68</td>
<td>92</td>
<td>37</td>
<td>3.36</td>
<td>0</td>
</tr>
<tr>
<td>OCT</td>
<td>63</td>
<td>43</td>
<td>53</td>
<td>81</td>
<td>31</td>
<td>6.21</td>
<td>0</td>
</tr>
<tr>
<td>NOV</td>
<td>53</td>
<td>34</td>
<td>44</td>
<td>63</td>
<td>24</td>
<td>1.81</td>
<td>0</td>
</tr>
<tr>
<td>DEC</td>
<td>49</td>
<td>30</td>
<td>40</td>
<td>78</td>
<td>5</td>
<td>2.12</td>
<td>0</td>
</tr>
</tbody>
</table>

- Average Maximum Temperature: 64°F
- Average Minimum Temperature: 44°F
- Average Temperature: 54°F
- Total Precipitation: 65.18 inches
- Total Snowfall: 7.9 inches
- Warmest Temperature: 98°F on July 19
- Coldest Temperature: 5°F on January 1 and December 31
- Date of Last Spring Frost: 32°F on April 16
- Date of First Fall Frost: 31°F on October 27
- Growing Season: 193 days

Note: According to state climatologist R. Lautzenheiser, 1998 ties 1973 as the sixth warmest year in 128 years of state weather records; the average temperature for the state was 53 degrees—1.7 degrees above normal. The year was also the seventh wettest year on record, the closest yearly total being 61.65 inches in 1958. Very little of the precipitation fell in the form of snow: 1998 received the lowest amount of snow recorded, breaking the record low of 8.8 inches in 1937.

Relatively frost-free conditions allowed winter rains to penetrate the soil and begin to recharge the ground water, which, after the drought of 1997, was much needed. June was the wettest month of the year with more than 12 inches. Not only was this the second wettest June on record, it was also one of the wettest months ever recorded. The amount of new growth put on by plants on the grounds and in the nursery was astonishing.
New Horticultural Taxonomist Welcomed

Robert E. Cook, Director

In 1997, when Steve Spongberg announced that he would retire after 27 years as the horticultural taxonomist at the Arboretum, we knew he would be hard to replace. The traditional science of taxonomy, especially as applied to the description and naming of horticultural cultivars, had all but disappeared from graduate training programs in American universities. Our preliminary inquiries among colleagues turned up few names of professionals with the experience and stature that Steve had acquired during his career here.

Following his departure, we advertised the availability of the position and received a modest number of resumes expressing interest. Although there were very few senior individuals who could qualify for the position, among the younger scientists who applied, the qualifications of Dr. Jianhua Li stood out due to his unusual background and training and his particular interest in temperate woody plants of Asia and North America.

Jianhua was born in China and received a traditional botanical education emphasizing anatomy, embryology, morphology, physiology, and ecology at Henan Normal University and Central China Normal University. His master's thesis looked at the vegetational ecology of rare Metasequoia populations in southwestern Hubei Province. He taught in several Chinese universities until 1993 when he came to the United States to attend the graduate training program at the University of New Hampshire, where he earned his Ph.D. degree in botany in 1997.

At New Hampshire, Jianhua quickly acquired new skills, using molecular techniques to address questions about genetic relations among plants and what this information tells us about their evolutionary history. His family of choice was Hamamelidaceae, the witch hazels. These newer techniques extract the DNA from plants and compare the sequence of genes along the DNA to infer degrees of relatedness among species. By virtue of his earlier training in China, Jianhua could now compare studies based on traditional morphological approaches with the results of molecular analysis to greatly refine our understanding of plant evolution, particularly the close evolutionary relationship between Asian and North American genera. This relationship has been the basis of plant collecting for the Arboretum for over a century.

With his Chinese heritage and his thorough grasp of modern approaches to plant evolutionary studies, we believe that Jianhua will greatly strengthen our Asian research efforts in collaboration with a wide range of scientists, both here in America and in the countries of eastern Asia.

Jianhua Li's primary area of expertise is the witch hazel family, and his study of genetic differences among its species—of Corylopsis, in particular—continues. His interest in the honeysuckle family (Caprifoliaceae) also continues, and his knowledge of it is growing rapidly, helped by the Arboretum's large representation of that family.

In addition to his work on molecular phylogeny, Jianhua will continue to study the embryonic and floral development of Heptacodium miconioides and Kolkwitzia amabilis. This type of research requires close proximity to the plant material since buds, flowers, and young fruits must be collected often, sometimes every other day. A new laboratory in the Dana Greenhouses will support this more traditional aspect of his taxonomic research.
Fellowship Awarded to Director of Living Collections

Director of Living Collections Peter Del Tredici has recently been awarded Harvard University's Charles Bullard Fellowship in Forest Research. The fellowship is awarded to individuals in the biological, social, physical, or political sciences to promote advanced study, research, or integration of subjects pertaining to forested ecosystems. It provides mid-career scientists with an opportunity to use the resources and interact with personnel in any department within Harvard in order to develop their own professional growth. Peter is one of seven fellows selected for the 1999-2000 fiscal year.

Peter plans to spend most of his “sabbatical” in Petersham, Massachusetts, the site of the Harvard Forest, where he will work on several projects, including vegetative regeneration in trees following catastrophic disturbances and the response of hemlock forests to infestation by the hemlock woolly adelgid. He also hopes to begin writing a book on the growth and cultivation of trees in the human landscape. He will be away from the Arboretum from the first of September through the first of March 2000, but we’re sure that he will pop in at the Arnold periodically.

Welcome to Arboretum Apprentice

Midori Matsuoka arrived at the Arboretum in May to begin her year-long appointment as apprentice. Born and raised in Tokyo, Japan, Midori earned her associate’s degree in horticulture from Kesen Junior College in Tokyo. After graduating, she worked in the floral department of the College, where she propagated herbaceous plant material and taught a number of practical courses related to horticulture. Following her time at Kesen Junior College, she entered the one-year program in practical horticulture at Wisley Gardens in England where she discovered that teaching about plants differs from the Japanese. She found her English instructors to be more open to student inquiries, often responding to questions with multiple answers and ideas. After leaving Wisley she worked for two months at Westonbirt Arboretum in Gloucestershire, which fast became her favorite English garden. She especially enjoyed working with Westonbirt’s many old and very large trees.

An important project in which Midori will be involved over the next year is the restoration of Rhododendron Dell at the base of Hemlock Hill. Re-edging, pruning, weeding, and stream renovation should result in vast improvement. Ultimately, Midori hopes to work in plant conservation.

New Staff

Jon Hetman joined the Arboretum staff in April as assistant to the director and the development staff. Originally from Ohio, Jon graduated from Ohio University with a degree in communications. Since graduating, Jon has held a variety of positions, from public relations at an Ohio art museum to teaching children about composting and beekeeping at a private foundation. He has lived in Boston for nearly six years, and worked most recently at Harvard’s John F. Kennedy School of Government as assistant to the registrar.

Among Jon’s responsibilities are administrative support for the development and membership departments related to special events, the plant sale, and mailings. Jon will also assist the Institute of Cultural Landscape Studies with database management.
1999 Summer Interns

Each year the horticultural trainees of the Arnold Arboretum provide the living collections department with invaluable service. The fourteen interns assisted the full-time staff with the propagation and maintenance of thousands of juvenile plants in the Dana Greenhouses and Nursery and the transplanting of hundreds of plants to the main collection during the spring of 1999. Several tons of weeds were uprooted and replaced with tons of mulch throughout the Arboretum, and records and mapping locations of hundreds of plants have been updated.

Thanks to the hard work of the 1999 interns, the lilac collection was in peak condition for the visiting public this May. Interns braved Lilac Hill, risking life and limb to cut grass with push mowers on the 45-degree slope. The summer has not been all hard, death-defying work; the interns learned a great deal about the propagation, care, and record-keeping of the living collections.


They also ventured out on many field trips, including visits to the Polly Hill Arboretum on Martha’s Vineyard, the Brooklyn Botanic Garden and Prospect Park in New York City, and Boston’s own Emerald Necklace, which they walked from end to end.

Annual Fall Plant Sale

Plans for the 19th Annual Fall Plant Sale, to be held on Sunday, September 26, are well underway. This event attracts expert and amateur gardeners alike and is a wonderful opportunity to take in and play a role in the New England horticultural scene. Over 100 varieties of trees, shrubs, perennials, and vines nurtured at the Dana Greenhouses will be on offer in the barn at the Case Estates in Weston. Arboretum staff and knowledgeable volunteers will be on hand to answer your most challenging questions. Thirty nonprofit plant societies have been invited to participate, adding the twin resources of hard-to-find cultivars and expert advice in a wide assortment of specialties. The liveliest activity of the day is always found under the live and silent auction tents, where the rarest and most choice selections are to be found. Rain or shine, we hope to see you there!
Peters Hill Dedication

Well-wishers gathered in June to view the completed landscape restoration project on Peters Hill, funded by employees of Hill, Holliday, Inc., in honor of founder and chairman Jack Connors. The planting of over 300 trees and shrubs has returned the hilltop to a condition consistent with Frederick Law Olmsted’s vision of scenery in the naturalistic style. Mr. Connors (seen at center) spoke with affection of his visits to the Arnold Arboretum, which began in boyhood, and of the Arboretum’s continuing importance as an urban resource.

A Memorable Spring Gala

Members of the Director’s Advisory Board and the Arboretum Council gathered with friends and contributors to the Arnold Arboretum on a breezy spring evening to celebrate another successful year of fundraising toward the $8.2 million goal of the capital campaign.

Presentations throughout the Dana Greenhouses compared the challenges faced by successive generations in assembling the outstanding landscape of today’s Arnold Arboretum, giving participants a look at how plant collecting, curation, and propagation have changed—or not changed—over the last century. Technological advances have improved efficiency and access to information, but all the same much of the work remains remarkably similar to time-honored methods of acquiring plant material and bringing it into the living collections in Jamaica Plain. In honor of the new millennium, staff developed a self-guided tour of fifteen significant centenarian trees and shrubs to encourage guests to explore the grounds and discover mature examples of the earliest accessions.

Director Bob Cook and Director’s Advisory Board Co-chair David Stone greeted the assembled guests and spoke of the significance of their contributions to the vitality of the institution. John Trexler, director of Tower Hill Botanic Garden, reviewed the Arnold Arboretum’s history of leadership among its peer organizations and remarked that his own fascination with horticulture was fostered at the Arboretum in the earliest stages of his professional career. The remainder of the evening was given over to conversation, music, and renewing acquaintances.
Sheehan Recognized by Fellow Workers

July 16 marked Maurice "Moe" Sheehan's 35th anniversary working on the grounds staff of the Arnold Arboretum. In recognition of this momentous occasion, the staff surprised Moe with a tree dedication ceremony on Peters Hill. The tree, a Fagus sylvatica 'Bornyensis', was the first Moe planted as an Arboretum employee in 1964. A special record label was suspended from the tree during the ceremony. It reads,

In celebration of 35 years of exceptional caring and commitment, as well as hard work, his colleagues at the Arnold Arboretum dedicate this Fagus sylvatica 'Bornyensis'—the first tree he planted—to Maurice "Moe" Sheehan.

July 16, 1999

As the employee with greatest seniority, Moe functions both as the institution's memory and as our working foreman. During his tenure he has literally performed every job related to maintenance of the grounds and has witnessed great change in both the landscape and the institution. Congratulations to Moe for his 35 years of service!

Many back issues of Arnoldia—most of those published since 1990, many published since 1980, and some published since 1970—are available for purchase. With only two exceptions—Sourcebook of Cultivar Names and Metasequoia After Fifty Years, both $10—all are $5 postpaid.

And for gift giving, bear in mind that subscriptions to Arnoldia are just $20 per year domestic and $25 foreign, payable by international money order or by Visa or Mastercard.

Send orders or inquiries to Circulation Manager, Arnoldia, The Arnold Arboretum, 125 Arborway, Jamaica Plain, MA 02130-3500; telephone 617/524-1718 x114; fax 617/524-1418; or e-mail arnoldia@arnarb.harvard.edu.
The Institute for Cultural Landscape Studies of the Arnold Arboretum is pleased to co-sponsor the publication of

**Charles Eliot, Landscape Architect**

_by Charles W. Eliot with a new introduction by Keith N. Morgan_

*University of Massachusetts Press in association with the Library of American Landscape History, 1999*

This biography of Charles Eliot (1859-1897) remains the definitive work on the influential designer and planner whose death at age thirty-seven robbed this country of a practitioner of unusual foresight and deep social conscience. First published in 1902, it was compiled by Eliot’s father, then president of Harvard University, directly from his reports, and published writings. Charles Eliot, Landscape Architect, by Charles W. Eliot with a new introduction by Keith N. Morgan University of Massachusetts Press in association with the Library of American Landscape History, 1999

Charles Eliot laid the groundwork for the creation of the first statewide land conservancy in the country, and the Boston Metropolitan Park System. As a partner on Boston’s Emerald Necklace, including the Arnold Arboretum, Eliot worked on the development of regional open space planning. This reprint series undertaken by the Library of American Landscape History, Amherst, Massachusetts, to honor the centennial of the American Society of Landscape Architects.

In honor of this new publication the Institute for Cultural Landscape Studies is sponsoring a lecture and panel discussion at the Arnold Arboretum to reveal the value of Eliot’s contribution to landscape preservation:

**“The Natural City”: Reclaiming the Legacy of Charles Eliot**

_Catherine Howett, Professor of Landscape Architecture and Historic Preservation, University of Georgia_

Tuesday, November 16, 1999, 7:00–8:30

Professor Morgan will be available at a reception after the lecture to sign copies of the biography and to discuss his work on Charles Eliot.

**Places of Uncommon Beauty: A Panel Discussion on the Lesser Known Parks of Charles Eliot**

_Panelists will include:

_Julita O’Brien, Director of Planning, Metropolitan District Commission_

_Karl Haglund, Project Manager of the New Charles River Basin, Metropolitan District Commission_

Tuesday, December 7, 1999, 7:00–8:30

Charles Eliot, Landscape Architect will be available for purchase at both events. It can also be obtained directly from the University of Massachusetts Press for $50.00 plus postage and handling (e-mail: orders@umpress.umass.edu; fax 800/488-1144; phone 413/545-2219).

Both events will be held at the Hunnewell building of the Arnold Arboretum, 125 Arborway, Jamaica Plain, Massachusetts. They are open to the public free of charge, but advance registration is required. Please call the Institute at 617/524-1718 x175 or e-mail us at icls@arnarb.harvard.edu to reserve a place.

To complement this biography the Institute for Cultural Landscape Studies is publishing _Charles Eliot, Landscape Architect: A Research Guide_. This guide, prepared by Keith Morgan, contains a chronology of Eliot’s life, a list of his projects, and a bibliography of works by and about him. This guide will be available at both of the events listed above as well as directly from the Institute for Cultural Landscape Studies. Call 617/524-1718 x175 or e-mail us at icls@arnarb.harvard.edu.
Johnny Appleseed Commemorated

On April 12, a direct descendant of one of Johnny Appleseed's trees was planted in the Arnold Arboretum in a ceremony that honored him as tree planter of the millenium. The event was co-hosted by American Forests Famous and Historic Trees, and it launched a two-week tour that traced his travels from Massachusetts to Indiana. At each stop, Jeff Meyer of American Forests planted several “Rambo” apple trees, which were propagated from the last surviving apple tree known to have been planted by Johnny Appleseed.

Peter Del Tredici assisted Jeff Meyer (seen above) with the ceremonial planting in the Eleanor Cabot Bradley Collection of Rosaceous Plants. Afterwards, the specimen was removed to the Dana Greenhouses, where it will be sheltered until it attains greater size.

PROGRAMS & EVENTS

The Arnold Arboretum’s education department offers many short courses, lectures, and programs during the winter months. These cold months give gardeners the time to plan their gardening activities for the coming season and to learn about new plant materials and horticultural techniques.

For a complete catalogue of programs and events at the Arboretum, call 617/524-1718 x162. Please note that course fees printed in boldface are for Arboretum members.

SEPTEMBER

HOR 431 Making a Garden: Unusual Plants in a Traditional Design
David Culp, Sales Representative and Researcher and Developer for Sunny Border Nurseries; Instructor for Longwood Gardens

Creating a new garden does not necessarily mean abandoning traditional design, especially in New England. In fact, following tradition may be most appropriate to your garden site. In this slide-illustrated lecture David Culp will provide examples of new ideas joined with standard design techniques to create remarkable and harmonious gardens.

Primarily illustrated with design ideas from his own “four-square” garden in Downingtown, Pennsylvania, this lecture will discuss tried-and-true design elements and suggest innovative ways to bring freshness to old ideas.

Fee: $15, $18

Monday, September 13, 7:00–8:30 pm
Hunnewell Building

Co-sponsored with the Massachusetts Horticultural Society

OCTOBER

HOR 366 Beeches
Dennis Collins, Curator of Plant Collections, Mount Auburn Cemetery

European beeches, Fagus sylvatica, have long been a mainstay in the tree collection at Mount Auburn Cemetery. Many have attained magnificent size and form after more than a century of growth. In addition, the species is known for its vast number of cultivars that display unusual foliage and growth habit. On this walking tour, Dennis Collins will highlight the diversity within this remarkable group of plants and look at the recent outbreak of a serious health threat affecting old beech trees. Wear your best walking shoes. Class meets rain or shine.

Fee: $10, $12

Friday, October 1, 10:00–noon
Mount Auburn Cemetery

(MCA: .5 credits)

Co-sponsored with the Friends of Mount Auburn Cemetery

• continued on page 8
HOR 301 Pruning Basics for Woody Ornamentals

Bob Famiglietti, Gardener Specialist, the Arnold Arboretum, and Massachusetts Certified Arborist

Are you intimidated by overgrown landscapes? Knowing what and when to prune, and how to do so, is essential. This lecture/slide presentation will demonstrate pruning tools and methods that will aid the homeowner in maintaining well-balanced specimens. Learn the basic techniques of structural pruning to enhance the beauty of ornamental shrubs.

Fee: $30, $36
Saturday, October 2, 10:00 am–1:00 pm
Dana Greenhouses
(APLD: 1 unit) (MCA: .5 credits)

HOR 202 Medicinal Uses of Woody Plants

Seija Hälvä, Horticulturist

Enjoy a walk on the grounds of the Arboretum with a focus on its medicinal woody plants. Seija Hälvä will highlight plants from throughout the temperate world that have been used or still are used by various cultures today for healing purposes.

Fee: $16, $19
Tuesday, October 12, 10:00–noon
Dana Greenhouses

Flora of the Lesser Antilles

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

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

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

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

- Volume 1: Orchidaceae .................. $20
- Volume 2: Pteridophyta .................. $25
- Volume 3: Monocots .................. $35
  (other than Orchidaceae)
- Volume 4: Dicotyledoneae 1 .............. $75
- Volume 5: Dicotyledoneae 2 .............. $85
- Volume 6: Dicotyledoneae 3 .............. $85

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