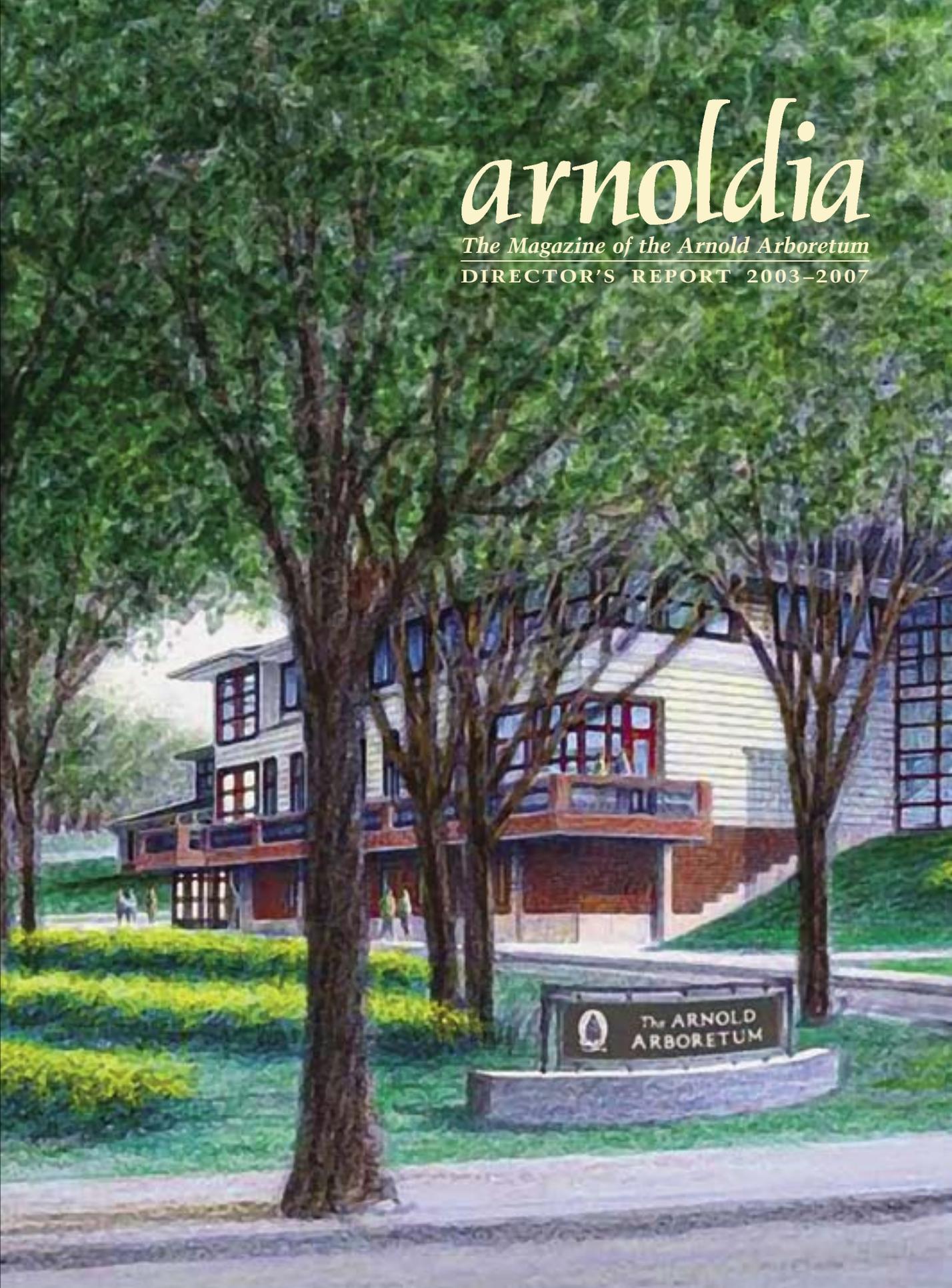


arnoldia

The Magazine of the Arnold Arboretum

DIRECTOR'S REPORT 2003-2007





Zelkova serrata (AA 1813-77) by Michael Dosmann



Richard Schulhof



Richard Schulhof

Between 1 July 2002 and 30 June 2007, 1,011 accessions comprising 2,075 plants were added to the Living Collections, bringing the total number of accessions and plants to 10,176 and 15,665, respectively. Of the new accessions, 53% were of wild origin and 42% were of garden origin, and 103 additions were of taxa new to the collection.

Below, the taxonomic profile of the Living Collections as of 30 June 2007. Numbers for infraspecific ranks correspond only to those accessions where rank is known.

RANK	NUMBER
Families	97
Genera	351
Species	2254
Subspecies	75
Varieties	401
Formae	84
Cultivars	1552
Interspecific hybrids	456
Intergeneric hybrids	19



Jon Hetman

THE ARNOLD ARBORETUM OF HARVARD UNIVERSITY

DIRECTOR'S REPORT: 2003-2007

Robert E. Cook, Director

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FRONT COVER: Weld Hill research facility, design sketch of
Centre Street view (detail); KlingStubbins. BACK COVER: Model of
Weld Hill research facility by GPI Models; photographs by Desroches Photography.
Top main entrance and laboratory wing on the north side of the building;
Bottom courtyard and greenhouses on the south side of the building.



Introduction

Early this spring, the Arnold Arboretum began construction of a new research and administration building at Weld Hill, a fourteen-acre parcel of land adjacent to the grounds of the Arboretum (see Figure 1). It will be the first major building added in nearly half a century. The Weld Hill facility, as we are calling it for now, will have nearly 44,000 square feet of floor area and cost approximately \$42,000,000. Its greenhouses, growth chambers, and modern laboratories will provide state-of-the-art facilities for plant research.

The construction of the building marks a major milestone in the history of the Arboretum and a reaffirmation of our mission as a research institution at Harvard University. In this Director's Report, I will focus on a physical description of the building and its location, the decisions that led to its construction, and the implications of its

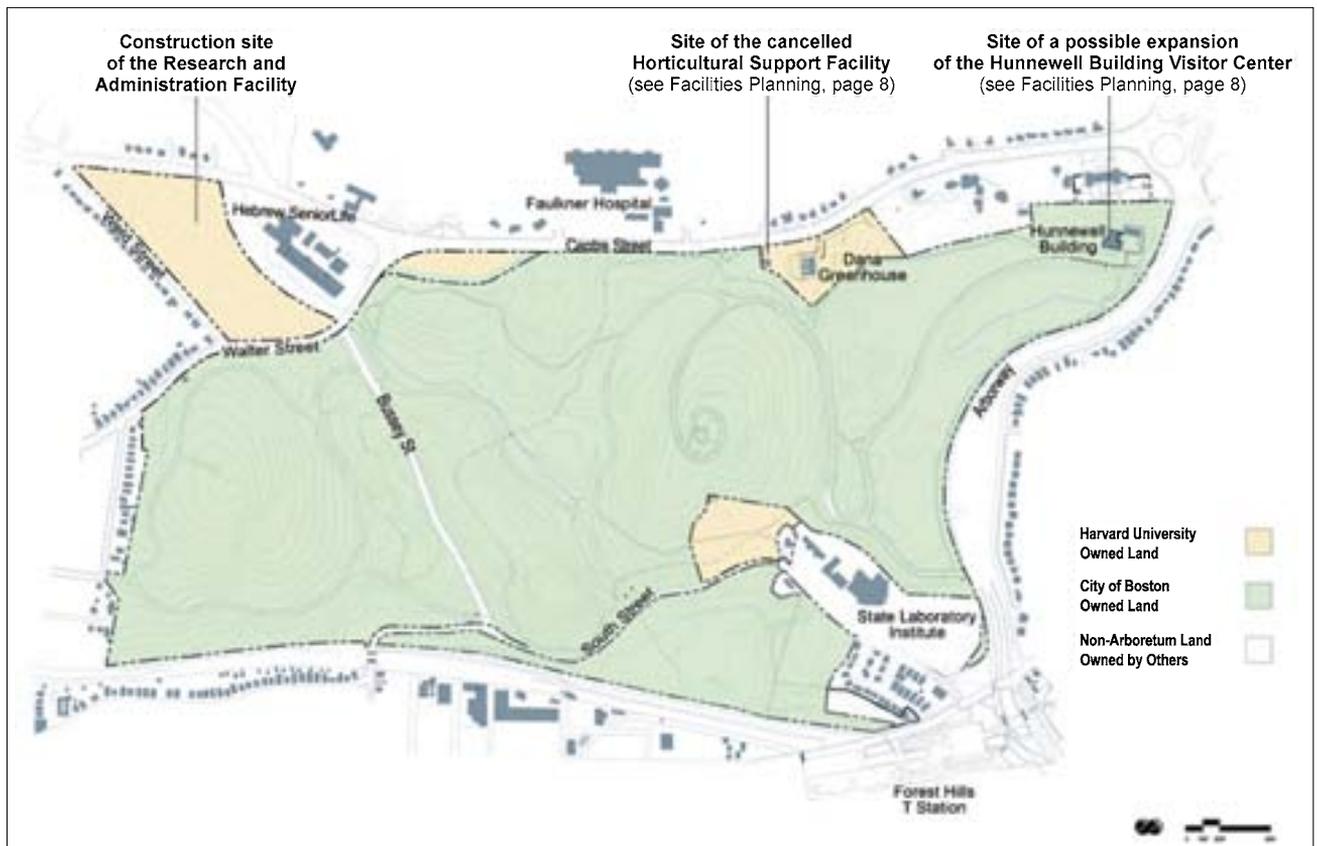


Figure 1. Map of the Arnold Arboretum, showing Harvard-owned land, City of Boston-owned land leased to Harvard, and the proposed facility additions (see Facilities Planning, page 8), by KlingStubbins.

operation on the future programs of the Arboretum. At the end of the report, I will return to the critical role that all the friends of the Arboretum have had in reaching this milestone.

A Building in its Landscape

As is well known, most of the land of the Arboretum is owned by the City of Boston and open to the public as part of the Boston park system; however it did not begin this way. Through the generosity of James Arnold, and on land donated by Benjamin Bussey, Harvard University created the Arboretum as a private research department dedicated to the study of trees. Within a decade the first director, Charles Sprague Sargent, had developed a unique partnership with the City that captured his vision for the institution. It was to become both a non-public research station and a public museum. A decade later, in 1882, the Arboretum's land was given to the City to be operated as a park open to the public for education and enjoyment. At the same time, the land was leased back to the University, for a fee of one dollar a year and a renewable term of 1,000 years, to allow faculty and students to conduct research on the biology of trees. This partnership between Harvard and the City has successfully endured up to the present day. The Weld Hill building is simultaneously an affirmation of the partnership and the embodiment of Sargent's original vision.

Several considerations determined the choice of location for the facility. First, it was highly desirable that a new facility not subtract from the parkland available to the public; a location on the grounds would have had this effect. At the same time, however, researchers would highly value close proximity to the collection of trees upon which their research is conducted. Finally, in consideration of both cost and formal control of the facility's operation and construction, we preferred to site the building on land already owned outright by the University, close to but not within the historic public park.

In 1922 Charles Sargent, in his fiftieth year as director, purchased from a neighbor a fourteen-acre parcel of land lying across Walter Street and adjacent to the southwest boundary of the Arboretum (see Figure 2). The parcel displays significant topographic variation, from the drainage swale feeding Bussey Brook to a large



Lilac Sunday visitors
by Eric Roth.

hilltop that reaches 172 feet above sea level. Over the subsequent eighty years, it was variously used for nurseries, tree plantations, and the planting of some specimen trees.

By 2002 Weld Hill's pastures and woodlots were no longer home to any significant collections and horticultural care had been reduced to an annual mowing of its meadows. To the north of Weld Hill, a major teaching and research hospital for the elderly, called Hebrew SeniorLife, had become an important partner of the Harvard Medical School. Following completion of our strategic plan in 2002 (see Director's Report 1999–2002), we decided that this parcel of land would become the home for a laboratory facility representing a major expansion of our capacity to conduct research.

The functional requirements were developed collaboratively with botanical faculty members in Harvard's Department of Organismic and Evolutionary Biology (OEB), with which the Arboretum has worked for more than a century. These requirements grew out of the Arboretum's commitment, described in the 2002 Director's Report, to make a strategic investment in scientific research.¹ Our goal for

¹ R. E. Cook. "The Future of Research at the Arnold Arboretum," *Arnoldia* 65(2): 23–39 (2007).

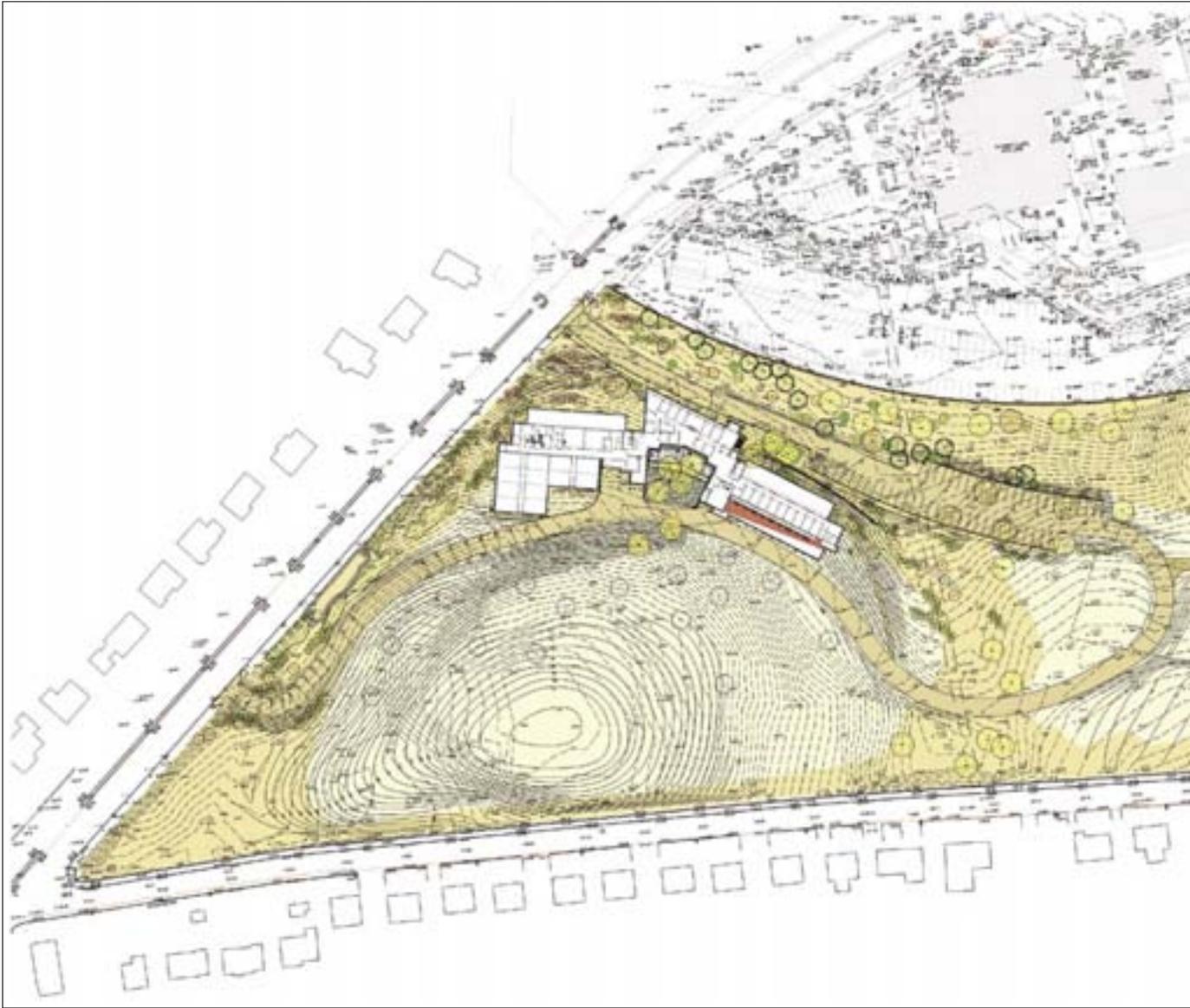
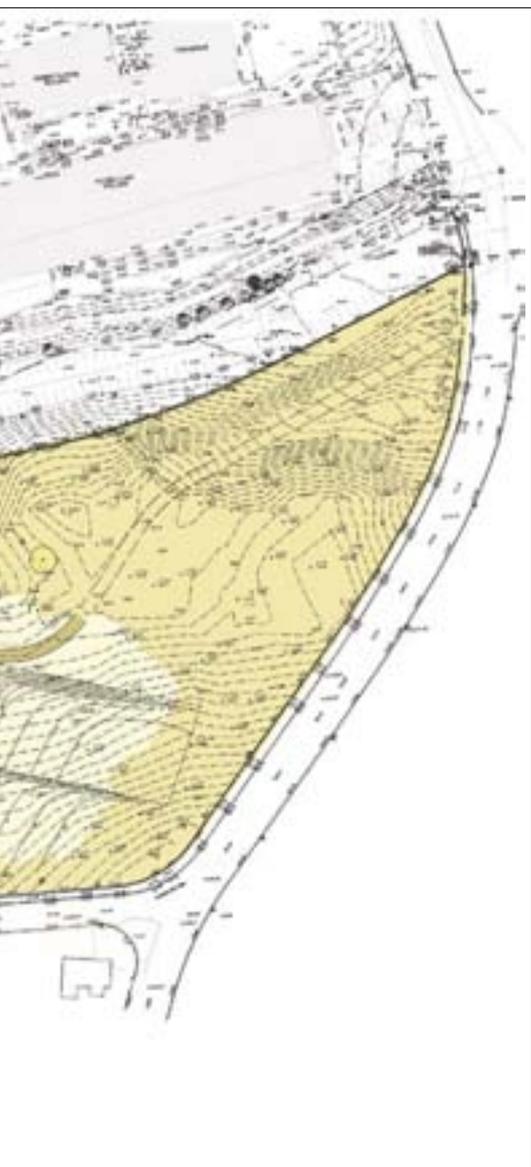


Figure 2. Site plan with topographic detail and building footprint for the Weld Hill facility, by Reed|Hilderbrand.

this investment was to match other major research units at Harvard University in providing the physical and financial capacity to support researchers of the highest quality. Nothing pleases high-quality researchers more than first-class research facilities. For plant scientists, this means the finest growing facilities (controlled climate greenhouses; growth chambers; nurseries and experimental gardens). And, if at all possible, it also means access to a broadly diverse collection of living



tree species of great maturity and known provenance from all over the world.

The scientific program of the building must support a sufficient number of scientists to form an intellectual community that interacts and collaborates closely. Toward that end we specified enough laboratory space to house eight senior researchers or faculty members, along with their post-doctoral trainees, their graduate students, their laboratory technicians, assorted undergraduates just getting started, and visiting scientists. We estimated the total to be about 40 full-time researchers.

In addition, as part of a larger facilities plan to address other needs at the Arboretum (see Facilities Planning, page 8), the new building would also accommodate the relocation of the Arboretum's administrative offices, presently housed in the Hunnewell Building. These offices include the director's and those of such functions as finance, facilities management, personnel, and research administration.

The space required for these purposes, together with the mechanical systems to heat and cool the facility, comes to approximately 43,500 square feet. Taking

into account site conditions (topography, wetlands, utility easements, rock) and the necessary road and parking infrastructure, we envisioned that the facility would require less than a quarter of the entire fourteen acres of the Weld Hill site.

In collaboration with the architectural firm of Stubbins Associates (now KlingStubbins, Inc.), located in Cambridge, MA, we defined a set of principles for siting the building that would be consistent with the pastoral nature of the Weld Hill land and with the Olmsted

FACILITIES PLANNING

In 2004 the Arboretum developed a comprehensive facilities plan. At its center was the creation of the research facility that is described in this director's report. But the plan also projected the construction of facilities that would address two other needs. First, our primary maintenance facility, which houses grounds equipment adjacent to the Hunnewell Building, has reached the end of its useful life. In the plan we proposed a new facility that would be more centrally located in the vicinity of the Dana Greenhouse, thereby separating the traffic in tractors and trucks from the movement of pedestrians around the Hunnewell Building Visitor Center. Second, we wanted to expand our service to the public adding a new wing to the Hunnewell Building that would house our educational programs and visitor services and provide greater access to the horticultural library.

Thus the larger facilities plan envisioned three centers (see Figure 1). A new research and administration complex would be located at Weld Hill. The horticultural support facility would include a new maintenance building combined with the Dana Greenhouse. Finally, the Hunnewell Building, with a newly constructed public wing, would be the "public museum," dedicated to education and service.

However, late in 2005, after developing schematic designs for the maintenance facility at the Dana Greenhouse, we suspended any further work on it and, consequently, on any expansion of public programs at the Hunnewell Building as well. Our plan called for the removal of an 1820 farmhouse, in dilapidated condition and of no further use to the Arboretum, because its location precluded the construction of a maintenance facility on land owned outright by Harvard University rather than on land under lease from the City and historically part of the public realm. A small group of neighbors objected to our proposed removal for reasons of historic preservation. We made the strategic decision to focus our immediate energies on the construction of the Weld Hill facility.

design of the adjacent Arboretum landscape. These principles are: 1) to locate buildings on edges and in corners; 2) to concentrate buildings and circulation infrastructure near other buildings and infrastructure; and, 3) to reserve the higher elevations for pedestrians and use the lower, level land for nurseries. These principles, combined with the concern expressed by neighbors that they not "see" the building, led to its current planned location in the parcel's northwest corner on the lower slope of Weld Hill (see Figure 2).

Here the building will lie close to the existing hospital facility (Hebrew SeniorLife) and be terraced into the lower hillside such that the mass and height of the hill will screen the building from its neighbors to the south. The service road will enter the site from Centre Street and curve across and around the rising topography to meet the rear of the building at its highest floor, adjacent to the greenhouses, before descending to an exit on Centre Street. This siting effectively leaves the hill itself open for pedestrian enjoyment and reserves the eastern half of the parcel for woodlands, pastures, and gardens.



Acer palmatum f. atropurpureum (AA 22717-A),
photo by Jim Harrison.

Thus the overall landscape will be characterized by its four quadrants. The northwest quadrant will hold the building and its circulation infrastructure; the pastures and distant views of the hilltop will continue to occupy the southwest quadrant; mature woodlands will remain throughout the northeast quadrant; and the southeast quadrant will display terraced nursery beds.

A Home for Research

The facility itself will be a large, three-story central building with two wings to the east and west (see Figure 3). The basement

floor of the central building will consist of a large room for mechanical equipment adjacent to the main entrance and the stairway leading to the administrative offices, computational facilities, and a large auditorium for meetings and lectures on the first and second floors.

The first floor of the east wing will have a large, open laboratory conducive to collaborative research, with individual work stations on the north side and specialized equipment rooms tucked into the hillside on the south. Above this, on the second floor, a series of offices will house senior researchers and faculty.

The west wing will be devoted to growing plants. On the first floor, several large rooms will be equipped with reach-in and walk-in growth chambers, as well as related laboratory support spaces. The second floor will have a large head house and loading dock to support twelve adjacent greenhouse modules.

My simple description of these spaces with their highly specialized equipment and technical capacity does not evoke the

ambiance of the building—the way it will look and feel as it sits in its landscape. I wanted the building’s occupants to feel very much at home despite the essentially institutional nature of their work. This is a challenge for a fairly large facility that one might initially envision as a steel and glass box like most laboratories being built today. The configuration of the interior spaces will be largely dictated by functional needs; any domestic qualities must evolve from the ingenuity of their occupants. Nevertheless, we have tried to communicate in the design of the building’s exterior—its appearance and surface qualities—a sense of arriving at home as one approaches the front door.

The façade of the building will be constructed of basic, traditional, residential materials: stone, brick, and wood. The lowest level of the central building will be clad in light Kasota stone of a lemon hue. This stone base will rise to meet horizontal shiplap cedar siding covering the first and second floors, both of which will display horizontal bands of vertical windows (see Figure 3). The base of each wing will be articulated in brick that rises to meet cedar-clad walls and rows of windows. At the end of each wing and at the junctures with the central building will be large vertical brick “chimneys” to house mechanical ducts and other equipment. Most important, the roofs of the entire building will slope gently down to create substantial overhangs. They will be shingled with a dark synthetic slate, and the gutters, downspouts, and building accents will be made of copper.

The overall appearance of the building will recall the early prairie houses of Frank Lloyd Wright, particularly Taliesin East, his first studio and home in Wisconsin. With its central mass flanked by two recessed wings that recede into the slope of the hill; its strong horizontal lines defined by roof, windows, and base; and its cladding of natural materials, the building will be fully integrated with and defer to the surrounding pastoral landscape. The immediacy of the landscape will be reinforced on the south side of the central building by a courtyard sanctuary that visually connects the first-floor reception area to the summit of the hill (see Figure 3).

The design and engineering of the facility and its site will fully incorporate current principles of sustainable architecture. The roof shingles, for instance, will be made of recycled tires, and other materials



Figure 3. Architectural rendering of the north (top) and south views of the Weld Hill facility, by KlingStubbins.

throughout the building have been chosen to minimize their negative impact on the environment. Water flow from rain falling on the building and land will be managed to minimize any change to the hydrological conditions that prevailed prior to construction. Rooms will have ceiling fans and all windows will be operable to maximize natural circulation and encourage energy conservation. Finally, and most significantly, the building will be heated and cooled by a geothermal exchange system buried deep below the ground. This system—essentially a network of connected pipes buried in deep bore holes—will work like a very large radiator drawing heat from the earth in the winter and returning it in summer. There will be no basement furnaces or rooftop air conditioners.

Building Research Capacity

Because of the challenges presented by the building's hillside location and its environmentally sensitive architecture, the Weld Hill facility is relatively expensive on a cost-per-square-foot basis. Can such an investment in research at the Arnold Arboretum be justified?

I believe the answer is yes. Elsewhere I have written extensively on the revolution sweeping the botanical sciences and the critical

importance of the Arboretum's participation in this revolution.² Let me briefly review the reasons for our investment at this time.

In 2001 a landmark goal was reached in biomedical science when the Human Genome Project completed the sequencing of all human genes. Out of this work and related efforts with other species' genomes have come whole new approaches to basic research that are fundamentally transforming our understanding of biological organisms and their evolution. A new field of science, evolutionary developmental biology, has emerged that embodies many of the elements of this revolution. It seeks to understand how a sequence of genes inherited from two parents leads to the creation of a new organism and how this system of reproduction evolved over time. The methods of research in this new field, while drawing deeply on the sciences of molecular biology and biochemistry, have also given renewed importance to comparative biology, which analyzes the differences between species and studies their evolutionary history in order to bring insight to discoveries in developmental biology and genetics. All of these new approaches and their highly technical methodologies apply to the biology of plants as well as that of animals.

This has three major implications for the Arnold Arboretum. First, if the Arboretum is to maintain its scientific reputation for the long-term future, it must invest in the capacity to conduct this kind of research. The original trustees who created the Arboretum at Harvard University and the Arboretum's first director, Charles Sprague Sargent, would have surely agreed. Second, with its collections and endowment, the Arboretum has an exceptional opportunity to advance our understanding of plant biology, particularly that of trees. The herbarium and living collections, in addition to our incredible library collections, can only become more valuable as tools to further our understanding of comparative biology and the evolutionary history of botanical diversity. And, as noted earlier, the Arboretum needs research facilities of the highest caliber to preserve and enhance our future scientific reputation.

Should the Arboretum conduct applied research with more targeted goals typical at agricultural colleges and land-grant universities? I believe the answer is no, because the highest-quality research,

² Ibid.

CURRENT INTERNATIONAL RESEARCH

Although the Arboretum is investing in a major research expansion at Weld Hill, it continues its international research in Asia through projects in southwest China, Kalimantan (Indonesian Borneo), and Papua New Guinea. Also of critical importance is our growing collaboration with the Smithsonian Institution. It was Charles Sprague Sargent, the Arboretum's first director, who first recommended an expansion of the Arboretum's mission to the tropical forests of Asia.¹ This tradition reached its apex in the spring of 2007 when Peter Ashton, Bullard Professor Emeritus and director of the Arboretum from 1979–1987, was awarded the Japan Prize for his lifetime devotion to research on the biology of Asian tropical forests (see Director's Report 1997–1999 for a full description of this work).

In 1983 Peter initiated a collaboration between the Smithsonian Institution's Tropical Research Institute (STRI) and the Arnold Arboretum which has since evolved into the Center for Tropical Forest Science (CTFS), a network of international partners around the world. This program supports long-term tropical forest research through a set of permanent, large-scale plots established in forests that differ in climatic conditions, soil types, and disturbance regimes. These research plots, located at twenty sites in fifteen different tropical countries in Asia, Africa, and Latin America, are united in maintaining a standardized monitoring methodology involving a complete census every five years of all trees larger than one centimeter in diameter, with each individual being mapped, tagged, measured, and identified to species. The first plot was estab-

lished on Barro Colorado Island in Panama in 1980. In recent years the number of permanent plots has been expanding through support from the Arnold Arboretum, particularly in tropical Asia.

Recently the Center received grants to create a global earth observatory system for research on forest dynamics in response to climate change. This system will be based on the already existing permanent tropical forest plots and expanded to include new plots in temperate regions of the world. The grants will support measurement and monitoring of carbon flows and watershed dynamics in forests that are experiencing the impact of changes in global climate. The Center also maintains programs of field training, research grant support, and applied research into sustainable policies for the management and restoration of tropical forests.

In June of 2007 the headquarters of CTFS, and its director, Dr. Stuart Davies, relocated to the Harvard University Herbaria, with the Arnold Arboretum assuming full support for the twelve permanent plots in Asia. The CTFS program will continue to maintain the core of its operations at STRI in Panama.



CTFS director Stuart Davies and Harvard biology professor Naomi Pierce at the CTFS tropical forest plot at Lambir National Park, Malaysia, photo by Christian Ziegler.

¹ C. S. Sargent. "The First Fifty Years of the Arnold Arboretum," *Journal of the Arnold Arboretum* 3(3): 127–171 (January 1922).

of greatest long-term value to society, emerges out of the passions and interests of the highest-quality scientists asking basic research questions. Rather than defining a particular problem and hiring a scientist who will conduct prescribed research to solve it, I favor identifying the best scientists in very broad areas of endeavor—as defined by their previous research and their publications—and giving them the freedom to define their own research problems and priorities. Restricting individuals of this sort to a narrow specific problem usually leads to narrow findings and less valuable science. Open-ended research by very creative scientists is a better long-term investment strategy.

In fact, the Arboretum's capacity to make major advances in our basic understanding of plant biology is unique. There are many insti-



Senior research scientist David E. Boufford collects herbarium specimens with the help of local Tibetans at an elevation of 3,780 meters, in Daofu Xian county of western Sichuan, China. In 2007, Arboretum researchers joined an international team for the fourth of five expeditions to China's Hengduan Mountain region, home to 30 to 40 percent of China's estimated 30,000 plant species. The group made 2,652 collections of vascular plants for a total of 17,861 herbarium sheets, and 752 collections of tissue samples for molecular analysis. In addition, members of the team photographed the plants and their habitats for the project's biodiversity website (<http://hengduan.huh.harvard.edu>), the largest collection of such documented and vouchered images of Chinese plants, photo by Susan Kelley.

tutions with strong agricultural missions (Cornell comes to mind) that are much better positioned to apply massive scientific resources, underwritten by the Department of Agriculture, to the resolution of agricultural or horticultural problems by developing drought- or pest-resistant varieties of crop species, for example. Today, however, the distinction between applied and basic research has become increasingly blurred by the impact of the genomics revolution on our understanding of plant physiology and development. These days basic research in plant biology promises to contribute directly to imme-

diate societal problems in ways, and in a time frame, that are very hard to predict.

Let me cite as examples three major problems that currently confront us and suggest how basic research on woody plants might point to solutions: global climate change, remediation of severely polluted land, and energy independence. Early each year, as the days of spring grow longer, a magical phenomenon sweeps across vast tracts of land in the temperate regions of the world. The branch tips of a wide diversity of deciduous trees develop a covering of carbon-sequestering machines called leaves. Over time, this greening of a large part of the earth's surface has a huge impact on the overall carbon budget of the planet and, therefore, on its climate. Curiously, though, maple trees develop their leaves very early in spring, while for unknown reasons the leaves of oak trees emerge much later. Could basic research on the biology of leaf emergence and canopy development, particularly on the difference in the timing of these phenomena in oaks and maples, contribute to a greater understanding of global climate and how humans are changing it?

Consider the second example, remediation of land pollution. There are natural populations of plant species whose roots have adapted to growing in soils that have been severely contaminated by heavy metals, such as mercury. Could an investigation of the basic biology of root growth under these conditions suggest ways that this capacity might be introduced into a fast growing tree such as aspen, thereby allowing the mercury to accumulate in its wood for safe disposal?

Finally, the search for renewable energy has increasingly focused on potential fuels from plants (biofuels). Unfortunately, the strong and resilient structure of wood, with which any carpenter is quite familiar, resists the efficient extraction of energy to create a liquid form of fuel able to compete with gasoline. Could a better understanding of the biology of wood lead to a crop that efficiently yields its energy in a highly concentrated form of fuel?

In sum, I believe the Arboretum must seize the opportunity before it. We can become an international leader in the type of basic research that will be required to resolve fundamental problems facing today's world. Through the construction of research facilities on Weld Hill, we are taking a giant step toward achieving this goal.

MANAGEMENT INITIATIVES FOR COLLECTIONS AND LANDSCAPE

The past five years have brought significant progress in strengthening operations at the Arnold Arboretum. Signaling an increased commitment to excellence in the care of the living collections as well as the landscape in which they grow, staff members completed a strategic plan with the explicit goal of attaining an exemplary level of quality in arboretum management.

To define excellence in the care and development of a botanical collection and landscape, Arboretum managers investigated four sister institutions that share our mission as centers of knowledge and investigation relating to woody plants: Holden Arboretum in Kirtland, Ohio; Morris Arboretum of the University of Pennsylvania, Philadelphia; Morton Arboretum, Lisle, Illinois; and the U.S. National Arboretum, Washington, DC. These investigations included interviews with staff, reviews of policies and management practices, and tours of facilities, equipment, and landscapes to explore common challenges and identify best practices across our profession.

In assessing the accomplishments and aspirations of our peer institutions, we identified three key initiatives that will significantly enhance the work of the Arnold Arboretum: Landscape Management, Collections Development, and Plant Health Management.

Landscape Management

Our careful review of how landscape work is accomplished at sister arboreta underscored the benefits of assigning to each horticulturist the responsibility for specific collections and landscapes. As our professional peers have found, this site-specific focus yields substantial cumulative knowledge, enabling staff to provide increasingly effective horticultural care and to serve as “local” experts on soils, pests and disease, collections development, hardscape maintenance, and visitor needs and impacts.

In June 2006, following a history of more broadly deploying staff, Arboretum managers implemented this approach through a new Landscape Management Plan. After organizing our 265-acre landscape into 62 management zones composed of contiguous areas that share similar challenges, collections themes, and management priorities, we placed each zone under the care of a staff horticulturist. Now entering its second year of implementation, the new system is yielding substantial improvements, which will be amplified as horticulture manager Steve Schneider collaborates with our dedicated horticulturists to further refine care plans for collections, natural areas, and historic features.

In a second phase, to be completed in 2009, the Landscape Management Plan will expand to include curatorial initiatives, cultural resource management goals, and longer-term capital projects. The end result will be a comprehensive vision for the Arnold Arboretum landscape.



Arborist Robert Ervin gets a lift to collect seed from the upper branches of an *Abies* accession for use in the Arboretum's 'Tree of Life' investigations of gymnosperms, funded by the National Science Foundation, photo by Kathryn Richardson.

Collections Development

Our assessments also identified a strong need to develop a highly systematic approach to collections development. As we enter our 137th year, the Arboretum collections are distinguished by their maturity, with over 500 accessions that exceed 100 years in age. Through careful planning, the coming decades can bring a significant strengthening of our collections.

Priorities for future development include expansion of our national collections in *Acer*, *Carya*, *Fagus*, *Syringa*, *Stewartia*, and *Tsuga*, along with the acquisition of documented, wild-collected accessions to fill critical gaps, or augment specimens of lesser-known provenance. We will also create new research opportunities through increased representation of the disjunct genera of eastern Asia and North America and other taxa that can directly support the work of Arboretum scientists. Additional tasks include assessing space-constrained collections, particularly our plantings of shrubs, as well as implementing new curatorial policies for potentially invasive accessions.

In January 2007, Michael Dosmann, a recent graduate of Cornell University's doctoral program in horticultural science, joined the Arboretum staff in the new position of curator of living collections. A former Arnold Arboretum Putnam Fellow, Michael brings strong expertise in both hardy woody plants and collections management. In 2008, he will complete a collections development plan to guide the acquisition of new accessions and to set curatorial priorities for the next five years.

Plant Health Management

Not surprisingly, the larger environmental changes altering our world have affected the work of the Arnold Arboretum. Most notably,



Horticultural staff relocates *Syringa* 'Purple Haze' (AA 36-2002) on Bussey Hill from its testing location at the Dana Greenhouse, photo by Steve Schneider.

the human-mediated transport of organisms has made the management of hemlock woolly adelgid, winter moth, and other invasive species a challenge of expanding scope. At the same time, we have sought to more effectively manage the complex and changing ecosystem within which our diverse botanical collections grow. To address these and other needs, the strategic vision for horticulture called for a staff position dedicated to overseeing plant health.

In the fall of 2007, Julie Coop, former grounds superintendent, was appointed plant health manager. Charged with implementing a comprehensive approach, Julie will coordinate integrated pest management activities and increased monitoring of critical environmental factors over time, including pest populations, soil pH, and soil moisture. This work will provide important opportunities to better understand the impacts of introduced organisms, climatic shifts, and other forces of long-term ecological change in the Arboretum environment.

These initiatives promise to bring the Arnold Arboretum to the forefront of professional practice, requiring significant investment but achieving the standards of excellence and innovation befitting an internationally respected botanical institution.

—Richard Schulhof, deputy director

Sargent Fellows

Equally important as creating new facilities for research is the development of personnel policies to support the hiring of senior scientists at the Arboretum. Ordinarily at Harvard University faculty members are hired by academic departments to teach while also pursuing scholarly activities. Since the Arboretum is not an academic department—it is administered by the Vice President for Administration rather than being part of an academic school such as the Faculty of Arts and Sciences—we needed to create a new type of position that would attract highly qualified scientists. At the same time, a set of recruitment and retention policies different from those ordinarily associated with our administrative positions would be required. Scientists in a university setting usually have remarkable freedom to define their work schedules and to develop their research programs. The quality of their research is judged according to exactly high standards set by the larger community of scientists rather than by the administrator who “supervises” them. Therefore the Arboretum’s personnel policies must be crafted to encourage creativity rather than constrain it.

In 2003, working with Harvard botanical faculty members in Cambridge, I defined a new type of position: the Sargent Fellow. Over time, I envision that the Arboretum may have six or eight such Fellows managing their own research programs in the new Weld Hill facility. Initial appointments will be for a fixed term of time (two years, followed after evaluation by another five years). At the end of this time, Fellows will be considered for permanent appointments based on a review of the quality of their research by their peers.

In August 2003, the Arboretum appointed the first Sargent Fellow, Dr. Sarah Mathews. Sarah conducts research on the biology and evolution of systems in plants that sense environmental conditions and control plant development. She currently works in borrowed facilities at the Harvard University Herbaria in Cambridge and eagerly anticipates the construction of the Weld Hill facility. In 2004 I recruited a second Sargent Fellow, Dr. Maciej Zwieniecki, who is a plant physiologist interested in the physical and biological mechanisms that control the acquisition and movement of water and nutrients in very large trees.



As completion of the Weld Hill facility approaches, I will begin searching for a senior research director, who may also be a faculty member at Harvard. For this position I hope to attract an exceptional scientist who will oversee the development of a broad, long-term research program on the biology of trees.

Sargent Fellow Sarah Mathews collects foliage samples of *Thuja plicata* for DNA analysis as part of the 'Tree of Life' project, photo by Mark Beilstein.

Balancing a Dual Mission

In making this major investment in research, does the Arboretum risk overshadowing its traditional mission to serve the public? For the Arboretum, administered as it is by one of the world's leading research universities, what is the proper balance between the scholarly activities that ordinarily define the mission of Harvard and the programs of education and visitor amenity that serve the general public?

During the Arboretum's first half-century, approximately ninety percent of the Arboretum's activity and expenditures would probably have been defined as research by its director, Charles Sprague Sargent. At that time public activities largely consisted of publishing the *Bulletin of Popular Information* (the predecessor of *Arnoldia*) and holding occasional public lectures by staff for local schoolteachers. This was also a time when research itself, especially exotic expeditions securing new species in distant lands and introducing them as landscape plants for the garden, was seen by the Arboretum's public—primarily affluent

Bostonians during that period—as more obviously serving their interests (see *Current International Research*, page 13).

Over the last half-century, botanical research, particularly at Harvard, has become much less accessible to non-specialists, while the Arboretum's public has become much more diverse. When I became director in 1989, research as a percentage of the budget was below twenty percent and declining. As described in my most recent Director's Report, in 2002, the scientific reputation of the Arboretum was coasting on the impact of work done decades earlier, and current research activity was being conducted by a few scientists who were housed in Cambridge and distant from the collections here in Boston. If research at the Arboretum was to avoid extinction, a major investment would be required to modernize facilities, expand the scope of research, and fully engage the intellectual resources of the University in a collaborative effort. The Weld Hill facility and our Sargent Fellows program begin to address this need.

In the 1980s, at the same time that our research effort was contracting, our public service initiatives, including education programs for children and adults, as well as visitor services, were expanding significantly. Over the past decade and a half, we have increased our commitment to improved care for our collections and landscape (see *Management Initiatives for Collections and Landscape*, page 16). Large landscape projects, exemplified by the new Leventritt Shrub and Vine Garden, have richly enhanced the enjoyment of visitors. In 2002, we adopted the Landscape Institute (formerly administered by Radcliffe College as the Radcliffe Seminars Landscape Design Program), adding a major public program to our budget.

Over the next five to ten years, our investment in research is likely to increase to perhaps sixty percent of our budget, with the remaining forty percent supporting programs that serve the public. This seems about right to me. However, these two parts of our dual mission—as research institution and as public museum—have always been in some tension at the Arboretum, and they pose an unusual governance challenge for the University.

In general, research at Harvard is conducted within its schools, with the directors of research organizations reporting to a dean. This is how the Arboretum was governed from about 1930 to 1988 before



LINDEN PATH AND THE LEVENTRITT GARDEN

In 2006, completion of a new path through collections of *Tilia* (linden), *Cercidiphyllum* (katsura), and *Lonicera* (honeysuckle) marked an important addition to the Arboretum's pedestrian circulation system. Linden Path, designed by the landscape architectural firm Reed|Hilderbrand Associates, provides a direct connection between Meadow Road and the Leventritt Garden, guiding visitors along a gently winding passage that features exceptional specimens of *Tilia* and *Cercidiphyllum*.

The Leventritt Garden, also designed by Reed|Hilderbrand, was recognized by the American Society of Landscape Architects with its 2007 Award of Excellence. Completed in 2002 and now a highly popular visitor destination, the Leventritt Garden provides a long-needed home for sun-loving shrubs and vines as well as new interpretive exhibits exploring botanical research, plant conservation, and horticultural introduction.

—Richard Schullhof, deputy director

SEED HERBARIUM IMAGE PROJECT

Beginning in the 1960s, Arboretum propagator Al Fordham created a seed herbarium to facilitate the growing of unfamiliar species. Collecting the seed of several hundred rare and unusual taxa, Fordham envisioned a unique resource for the identification and propagation of woody plants from around the world. In 2004, his vision entered the digital age through the Arboretum's Seed Herbarium Image Project (SHIP). Made possible through the generous support of the J. Frank Schmidt Family Charitable Foundation, the Cabot Family Charitable Trust, and the Stanley Smith Horticultural Trust, SHIP uses high-resolution digital photography to document the morphol-

ogy of seeds and selected fruit structures. The SHIP images, now available on the Arboretum's website, support scientists, horticulturists, and educators, particularly in propagation research and management of rare and endangered species.

The SHIP team is working to finish photographing the Arboretum's six national collections within the North American Plant Collections Consortium: *Acer* (maple), *Carya* (hickory), *Fagus* (beech), *Stewartia*, *Syringa* (lilac), and *Tsuga* (hemlock). Using new protocols and equipment developed for microphotography, SHIP will next document species within the Ericaceae (heath family).

—Richard Schulhof, deputy director



Seed and fruit images of *Stewartia ovata* var. *grandiflora* created as part of the Seed Herbarium Imaging Project (SHIP) include a detail of a single seed, multiple seeds displaying alternate views and morphological variation, seeds shown with fruiting structure, and fruiting detail, photos by Julie McIntosh Shapiro.

it was moved to administration within the Central Administration. At about the same time, other non-research organizations providing public service, like the University Art Museums and the American Repertory Theatre, were also moved to the Central Administration. Today, with the revitalization of our research mission and our major investment in research facilities and staff, we have become something of an anomaly in Central Administration and this creates some specific problems for the Arboretum.

First, there are no personnel policies for research scientists in the Central Administration of the University because research scientists at Harvard ordinarily receive academic appointment in one of the schools. Second, the Arboretum now manages seven federal research grants—another anomalous activity within Central Administration—and the number promises to grow. Finally, because neither the director of the Arboretum nor the researchers on its staff are members of a faculty, there is no link between long-range planning for research at Harvard, which happens in faculty meetings and committees, and long-range planning at the Arboretum which does not involve faculty.

The issue of governance for the Arboretum is further complicated by the administrative position of the Harvard University Herbaria (HUH), located five miles away in Cambridge. Nearly half the herbarium and library collections within this botanical unit are the property of the Arnold Arboretum and we pay for about 40% of the facility's operation. Yet its director reports through a school to the Dean of the Faculty of Arts and Sciences (FAS) and the administrative and personnel policies governing its operation are defined and executed by FAS.³ Despite considerable similarity in their missions, these two botanical units are governed in very different parts of the University.

All of these factors have come together to frame a critical question: Should the Arboretum return to management by the Faculty of Arts and Sciences, consistent with its research mission? Or should it remain under the management of Central Administration, consistent with its public mission?

This matter should be resolved before a new director is chosen for either the Arboretum or HUH, but it presents a thorny challenge. In the case of the Arboretum, a governance structure that is dominated

³ In July, 2005, I accepted a three year term as director of HUH in addition to my duties as director of the Arboretum.

LANDSCAPE INSTITUTE

Since its relocation to the Arnold Arboretum in 2002, the Landscape Institute (formerly the Radcliffe Seminars Landscape Design Program) has undergone several changes that will prove critical to its future success as an educational resource for professionals working in landscape design and management, historic preservation, landscape history, and related fields. In 2006, the Institute moved from the Cronkhite Center, the program's home for more than seven years, to 29 Garden Street in Cambridge, just outside Harvard Square. The new facility, with its strikingly contemporary design, offers increased space and new possibilities for classes and special programs.

An equally significant transition began in early 2007 when Landscape Institute director John Furlong, following twenty-five years of strong leadership, announced his desire to step down to devote more time to private practice and teaching. Following a national search, Heather Heimark assumed full-time duties as director in February 2008. Her background includes a Master in Landscape Architecture from the Harvard Graduate School of Design, work with several accomplished landscape architects, and the founding of Heimark and Foglia, formerly HighMark Land Design, a firm specializing in green design, innovative use of plant materials, and new construction approaches. In keeping with the progressive spirit of the Institute, Heather's extensive practical experience and commitment to innovation promise important new directions in sustainable design, construction, and landscape horticulture. Looking to the future, the Landscape Institute will continue the work of Arboretum founding director Charles Sprague Sargent to strengthen the landscape professions, while also addressing burgeoning societal needs for leadership in environmental design and management.

—Richard Schulhof, deputy director

by either FAS or Central Administration risks undermining one part of our dual mission or the other. Put another way, if the dual mission of the Arboretum is to survive into the future, its governance structure must support integration of its research investment with the traditional mission of the University (research and undergraduate education) while also encouraging the public mission of the Arboretum to thrive.

A New Model for the Arboretum

Thus our sizable investment in research will only succeed for the Arnold Arboretum if it also succeeds for the University. Effectively this means that the conduct of research must be governed as an integrated part of ordinary academic operations and coordinated through members of a school's faculty. In this case, the logical school is FAS, where the Arboretum resided prior to 1988. I believe the decision about how Arboretum research is to be managed will need to recognize this reality. The remaining question about Arboretum governance regards its public mission: what threats might it face in an academic context such as FAS?



Magnolia 'Elizabeth' (AA 120-78), photo by Jim Harrison

Three come to mind. First, a large bureaucracy exists within FAS to manage intelligent and ambitious professors who are powerful through their appointment and their relations with outside sources of funds (donors, government agencies, consultancies). Professors, in turn, are always creative in their efforts to circumvent a constraining bureaucracy. A small public museum governed by this sort of bureaucracy without the protection of a resident professor can suffocate through no one's ill intentions.

Second, public service will never be a high priority at major research universities beyond the normal public relations activity required by proximity to non-university neighbors. Put more positively, universities like Harvard provide "public service" for the long term: they develop tomorrow's leaders and increase our understanding of the world. In such a university, a unit providing direct services to the public can suffer from administrative and financial neglect simply because it is not a priority for senior administrators and deans.

Finally, unprotected public service operations in the midst of large academic schools can suffer financial predation from well-meaning but narrowly focused academics. Funds that are not being used to educate university students or support faculty research look to many professors like money being poured into a hole, money that could be more fruitfully spent on academic activities.

In view of these threats, three elements seem essential to protecting a university unit with a mission of direct public service—what we here call the public museum of the Arboretum. First, the public museum must have a clear identity and sufficient independence to establish its own brand of administrative culture, one that openly acknowledges a commitment to service. This requires real authority, particularly over budgets and personnel, even though in an academic setting this authority is normally vested in the dean and his or her administration.

Second, this independence can only work if the public museum is given a guaranteed base of financial support sufficient to carry on essential activities. This base of support must be ensured a reasonable rate of annual increase to sustain it against inflation in the future. While this will support the core program, special projects that enhance its facilities and programs will also require the public museum to raise money from the public, largely through philan-

ENHANCING VISITOR EXPERIENCE

A *Time for Change*, a strategic vision authored by Bob Cook in 2002, voiced a strong commitment to improving the quality of information and orientation furnished to Arnold Arboretum visitors. After several years of planning, 2007 brought completion of a comprehensive wayfinding signage system that enables visitors to fully explore our 265-acre historic landscape and diverse botanical collection. Created by the environmental graphic design firm Roll Barresi, the system provides “you are here” maps, path markers, and other navigational aides to ensure confident and effective visitor wayfinding. In 2009, the system will be augmented by a new map brochure and temporary interpretive signs focused on seasonal information.

To provide leadership for visitor programs, Julie Warsowe, a graduate of Cornell University’s program in public garden management, was appointed the Arboretum’s first manager of visitor education in 2006. Julie recently completed a survey of Arboretum visitors that provides valuable information about the demographics, motivations, and interests of the broad community that utilizes our landscape. Survey data, compiled and analyzed by visitor research consultants People, Places and Design, will inform development of new interpretive programs, including plans for new exhibits in the Hunnewell Building Visitor Center.



DIGITAL RESOURCES

Plant Collections

- ♦ **Plant Inventory:** Search the Arboretum's living collections database by common or scientific name; <http://arboretum.harvard.edu/plants/inventory.html>
- ♦ **Interactive Map of the Arboretum:** Explore 31 plant collections and 76 featured plants; <http://www.arboretum.harvard.edu/visitors/map.html?myURL=/visitors/visitors.html&myLayer=collections>
- ♦ **Multisite Plant Inventories:** Search 24 living collections and conservation databases for participating botanical institutions, hosted by the Royal Botanic Garden, Edinburgh, Scotland, UK; <http://rbg-web2.rbge.org.uk/multisite/multisite3.php>

Herbarium Collections

- ♦ **Cultivated Herbarium:** Search the Arboretum's herbarium collections by common or scientific name; <http://arboretum.harvard.edu/plants/herbarium.html>
- ♦ **Seed Herbarium:** Browse images from the Arboretum's seed herbarium; <http://arboretum.harvard.edu/plants/herbarium.html>
- ♦ **Joseph Rock's Type Specimens:** Access to 197 type specimens collected by Joseph Rock between 1923–1932 in western China and Tibet; <http://www.arboretum.harvard.edu/library/tibet/herbarium.html>
- ♦ **Maps of Joseph Rock:** Navigate 10 individual hand-drawn maps and related gazetteer illustrating plant explorer Joseph Rock's travels (1924–1927) in China;
Maps: www.arboretum.harvard.edu/library/tibet/zoom/rock_maps.html
Gazetteer: www.arboretum.harvard.edu/library/tibet/map.html

Photographic Collections

- ♦ **The Arboretum Through Time:** Historical photographs of the Arboretum's landscape and collections; www.arboretum.harvard.edu/programs/views/intro.html
- ♦ **Botanical and Cultural Images of Eastern Asia, 1907–1927:** Archival images of Arboretum plant explorers and their field photographs from their exhibitions; www.arboretum.harvard.edu/programs/eastern_asia/overview.html
- ♦ **South Central China and Tibet: Hotspot of Diversity:** Images of natural history and ethnographic collections from Arnold Arboretum expeditions to China and Tibet between 1924 and the present; <http://www.arboretum.harvard.edu/library/tibet/expeditions.html>
- ♦ **Cienfuegos Botanical Garden, Cuba:** Archival and contemporary photographs of the former Atkins Institution, administered by the Arnold Arboretum from 1946 to 1959; <http://www.arboretum.harvard.edu/programs/cuba/intro.html>

Other Resources

- ♦ **Arnoldia:** Searchable database of all volumes published during the last hundred years of the Arboretum's journal *Arnoldia* and its antecedent, *The Bulletin of Popular Information*; <http://arnoldia.arboretum.harvard.edu>
- ♦ **Silva:** All issues of the Arboretum's news magazine since its inception in 2005; <http://arboretum.harvard.edu/aboutus/silva/current.html>
- ♦ **Correspondence Index:** A work in progress referencing institutional correspondence from the 1880s to 1940; http://www.arboretum.harvard.edu/library/about_arc.html
- ♦ **OASIS:** Harvard's Online Archival Search Information System includes 42 finding aids to archival and manuscript records at the Arnold Arboretum Archives; <http://oasis.harvard.edu>
- ♦ **Hollis:** Searchable database containing more than 9 million records for more than 15 million items in the Harvard University Libraries; <http://lib.harvard.edu/>
- ♦ **Google Book Search:** Search the full text of all books available in Google Book Search, including some 3,000 titles from the Arnold Arboretum Library; <http://books.google.com>

thropy rather than earned revenue which usually creates too many conflicts in an academic culture.

Finally, a public museum in academia needs deeply committed leadership with a strong belief in its public mission, not only within its internal operation but also at more senior levels of the university. For the Arboretum, this certainly includes the director, who may be primarily focused on the health of the research mission. But it must also extend to the supervising administrator, whether in FAS (the dean) or in Central Administration (the provost or a vice president).

These governance issues are now being addressed in two ways. First, the provost has formally assigned them for deliberation to the University's senior committee for long-range planning for science and engineering. I anticipate resolution of the matter by the end of the fiscal year in June. Second, at the Arboretum we have begun to develop a new model of operation that more explicitly acknowledges the identity of our public museum functions traditionally serving our visitors and students.

The Public Museum

Defining the programs at the Arnold Arboretum that provide public service is relatively easy in the case of educational programs and visitor services. Our educational programs are of two kinds. Children's education serves about 2,000 individuals under the age of ten each year. Adult programs include lectures and classes for the dedicated amateur and the more formal programs of the Landscape Institute, which can lead to a certificate indicating professional-level achievement.

The services for visitors might be characterized as providing access to information. They include the traditional functions of our horticultural library and our visitor's center, both of which serve people walking in through the door. But they have also been expanded to include the vast amount of information we are now making available through the Internet (see Digital Resources, page 28). Because digital access provides valuable information to anyone anywhere in the world at any time, these efforts promise to continue growing in the years to come.

SCHOOL PROGRAMS

Over the course of several years, Arboretum friends Henry and Nod Meyer have generously supported explorations of the natural environment for urban children. Thanks to their encouragement, Arboretum field study programs have grown significantly in depth and focus, now hosting over 2,000

A second initiative serves pre-schoolers attending neighborhood Head Start centers. Over the past three years, visiting children from Hyde Park, Jamaica Plain, and Roslindale were led by trained volunteers in exploring flowers, fruit, bark, soil, and other aspects of plants and landscape. Designed in collaboration with specialists in early



Kris Snibbe/Harvard News Office, ©2007 President and Fellows of Harvard College

children annually with a special commitment to elementary schools in Boston and Chelsea, and to local Head Start centers. Among these initiatives is a new field study that invites Boston students to investigate the dramatic changes caused by hemlock woolly adelgid on the Arboretum's Hemlock Hill. The new program, developed in collaboration with Boston teachers and titled "A Changing Ecosystem," supports the fifth-grade science curriculum through a case study in biological invasion that powerfully conveys the dynamics of ecological change.

childhood education, the program provides children with a range of new outdoor experiences, builds vocabulary, and encourages curiosity about the natural world. In coming years, we will increase our training for Head Start instructors in inquiry-based teaching methods and also offer family activities that foster parental participation in pre-school education. In addition to supporting public education, these efforts seek to strengthen neighborhood connections and promote greater enjoyment of the Arboretum by the diverse communities of Boston.

—Richard Schulhof, deputy director

One might ask, does the Arboretum's program in horticulture also provide "public service"? While the living collections are of great value for research, they and the grounds are given a much higher level of care than would be the case if they were grown solely for the use of scientists. A planting for purely scientific use would look like an agricultural field, with long rows of trees enclosed by a tall fence, rather than an open, beautiful landscape inviting the visitor to linger. I therefore see



our strong commitment to horticultural excellence on the grounds as a public service, though that commitment is shared with our obligation to serve the needs of researchers today and tomorrow. This dual function of the living collections is the essence of Charles Sprague Sargent's original vision for the Arboretum.

Last summer we reorganized the Arboretum into two programmatic entities, research and public museum, supported by a central administration consisting of the director's office and the functions of finance, information technology, and facilities (see Organizational Chart, page 32). As noted earlier, the research program will be headed by a director of research and will include all senior research staff, as well as the post-doctoral fellows and technicians in their laboratories. The public museum will include the functions of horticulture, education, and information access for visitors. It is now headed by my deputy director, Richard Schulhof.

Anticipating its need for financial security, we have identified a core budget for the public museum that for the current fiscal year amounts to \$9,375,000 (out of a total Arboretum budget of \$13,770,000; see Summary of Operations, page 33). We have also projected a four-percent rate of budget increase for future years. Finally we have transferred the Arboretum's membership and development program from administration (reporting to the director) to the public museum (reporting to the deputy director).

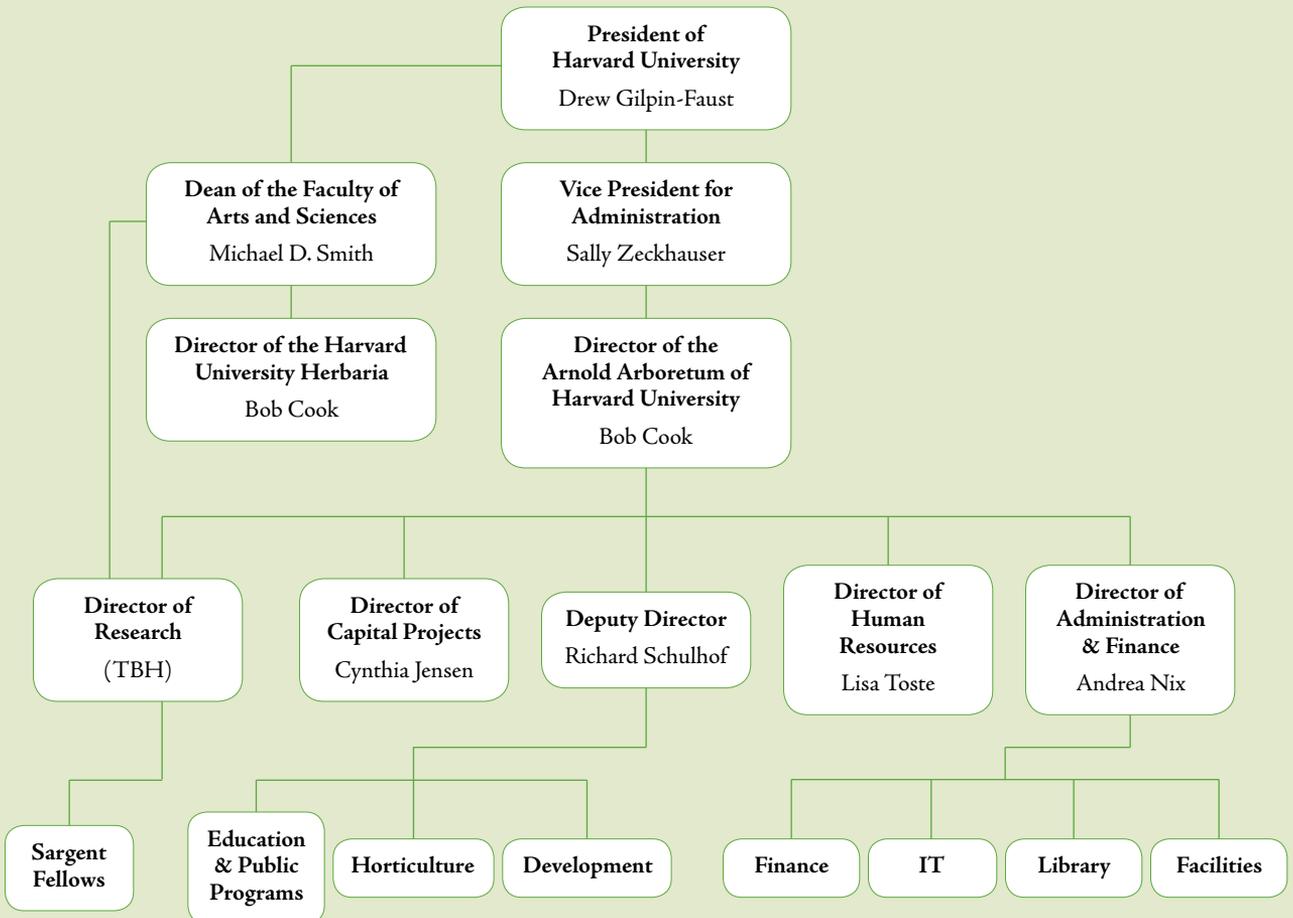
Horticultural technologist Scott Grimshaw cuts invasive undergrowth of *Rubus* spp. growing along Oak Path, photo by Richard Schulhof.

The Arboretum and its Friends

One may question the change in the reporting relationship of the development department. Shouldn't it support the entire institution, not solely the public museum?

Ever since its creation in 1872, the Arboretum has benefited from very generous friends and their generosity has arrived with remarkably few restrictions beyond a specification that their gifts should support the Arboretum (as opposed to Harvard University). I believe this pattern of giving reflects unusual trust on the part of our friends in the wisdom of past directors.

ARNOLD ARBORETUM OF HARVARD UNIVERSITY ORGANIZATIONAL CHART



SUMMARY OF OPERATIONS

This chart indicates our overall financial performance for the past six years. As we have taken on new capital projects and invested in research, our overall budget has moved from overall surpluses to deficits in the past two years which have been covered by reserves. With respect to income trends, the appointment of Sargent Fellows after 2003 has led to increases in research grants, and renewed efforts in membership have brought in increasing numbers of gifts. The large jump in education income in 2003 represents the assumption of administrative responsibility for the Landscape Institute and its educational programming; it is offset by equal increases in expenditures. With respect to expenses, salaries and services are the major categories increasing, along with debt service reflecting the completion of the Leventritt Garden in 2005. Expenses will continue to increase in coming years as we expand our investment in research.

	Actual FY 2002	Actual FY 2003	Actual FY 2004	Actual FY 2005	Actual FY 2006	Actual FY 2007
Income						
Endowments	7,666,661	8,226,848	8,244,215	8,360,913	9,042,906	9,590,265
Membership/Gifts	644,972	497,892	376,947	292,612	307,663	442,613
Enterprise	116,774	115,463	323,496	239,770	334,377	346,373
Grants	112,446	39,422	194,647	410,335	455,040	566,553
Education/Publications	70,799	605,748	607,701	675,098	753,989	636,561
Total Income	8,611,652	9,485,373	9,620,006	9,845,844	10,754,143	11,434,580
Expenses						
Salaries/Benefits	4,162,438	4,393,437	5,000,632	5,801,809	6,219,559	6,526,842
Supplies/Equipment	429,101	460,973	554,039	560,997	600,118	562,473
Facilities/Operations	717,645	881,689	724,302	800,482	1,143,790	1,505,463
Services	771,907	1,058,734	1,296,032	1,131,235	1,931,237	1,990,992
University Subvention	256,483	264,092	292,123	317,134	346,520	378,988
Travel	66,934	107,962	142,577	235,863	182,432	201,637
Total Expenses	6,404,508	7,166,887	7,882,705	8,714,636	10,283,824	11,018,610
Excess (Loss)	2,207,144	2,318,486	1,737,301	1,131,208	470,319	415,970
Debt Payment	312,416	304,434	393,609	609,450	566,729	568,962
Total Excess (Loss)	1,894,728	2,014,052	1,343,692	521,758	(96,410)	(152,992)

The research program of the Arboretum, now and as expanded in the near future, will be fully integrated into the University's overall research endeavors in the botanical sciences. As such it will benefit from the fundraising energies of the University, which are traditionally focused on alumni. Fundraising for the public museum will face the significant challenge of operating nimbly in the shadow of Harvard's larger fundraising program which is unlikely to support public service as a priority. Because most members of the Arboretum are unusually committed to the horticultural and educational work of the institu-

tion, they give their support to ensure the continuing excellence of these programs. Therefore I believe that the work of our development staff should primarily sustain the long-term survival and growth of the public mission.

So a bargain can be struck. The University will commit itself to ensuring the health and well-being of the Arboretum's research mission, at the same time permitting the Arboretum to raise funds for its parallel mission of public service. But the Arboretum will need help achieving this second goal. Our members and friends, who have always been deeply loyal to our public purposes, will be asked to increase their critical support for this equally important part of our mission. It is a bargain that can secure the continuing fulfillment of Charles Sargent's remarkable vision.



Robert E. Cook

1 May 2008



Beech Path, photo by Eric Roth

ARNOLD ARBORETUM WEATHER STATION DATA—2007

	Avg. Max. Temp. (°F)	Avg. Min. Temp. (°F)	Avg. Temp. (°F)	Max. Temp. (°F)	Min. Temp. (°F)	Precipi- tation (in.)	Snow- fall (in.)
Jan.	40.0	23.1	31.55	69	2	2.74	1.5
Feb.	33.0	16.1	24.55	49	7	2.15	7
Mar.	46.4	25.8	36.1	70	4	4.78	7.7
Apr.	52.8	36.4	44.6	87	27	7.91	0
May	71.4	49.5	60.45	93	33	3.16	0
June	77.0	57.4	67.2	95	47	3.1	0
July	81.7	63.6	72.65	91	53	3.44	0
Aug.	81.7	61.2	71.45	95	50	0.4	0
Sep.	76.6	55.9	66.25	94	43	1.67	0
Oct.	66.8	47.9	57.35	87	32	2.59	0
Nov.	50.3	31.5	40.9	68	20	3.11	0
Dec.	36.4	20.5	28.45	54	8	5.93	26.7

Avg. Maximum Temperature	59.5°
Avg. Minimum Temperature	40.7°
Avg. Temperature	50.13°
Total Precipitation	40.98"
Total Snowfall	42.9"
Warmest Temperature	95° on August 4
Coldest Temperature	2° on January 26 and 27
Last Frost Date	32° on April 9
First Frost Date	32° on October 9
Growing Season	183 days

2007 was a year of highly changeable weather at the Arnold Arboretum. The first half of January brought record warmth, even inducing a scattering of cherries into early bloom. But on January 16 winter finally arrived in the Northeast and temperatures plummeted. The first 16 days of January averaged 12 degrees above normal while the second half of the month averaged 5 degrees below normal. The winter cold extended well into March and April and was coupled with heavy rains and street flooding during both months. Spring and early summer precipitation provided adequate levels of moisture for a very good growing season up to the end of July, which began a period of extremely dry weather in the Northeast. Fortunately temperatures did not soar during this dry spell which helped to limit the negative impact of the drought. However it was dry enough to delay and significantly reduce fall planting from Arboretum nurseries to the grounds. September and October were pleasantly mild and quite sunny. Although poor fall color had been predicted (in part because of the drought), the foliage at the Arboretum ended up putting on quite a colorful show. November remained on the dry side and brought the onset of winter with below average temperatures. To close the year, December was very cold and snowy, with snow accumulation coming close to breaking the record for Boston. Unlike the very mild late fall/early winter of 2006, this period in 2007 reminded us how tough our winters can be. Throughout this variable year of weather, visitors and staff continued to appreciate the beauty of the Arnold Arboretum through all the seasons.

STAFF OF THE ARNOLD ARBORETUM*

ADMINISTRATION

Rose Balan, Staff Assistant
 Donna Barrett, Accounting Assistant
 Kenneth Clarke, Horticultural Technologist
 (resigned 9.30.05)
 Robert Cook, Director, Arnold Professor
 Ann Marie Countie, Computer Services Manager
 William Hays, Biological Database Applications
 Programmer (resigned 6.3.06)
 Andrew Hubble, Network Systems Manager
 Cynthia Jensen, Director of Capital Projects
 (hired 1.3.05)
 James Macklin, Director of Collections and Informatics
 (hired 3.20.06)
 Frances Maguire, Director of Administration and
 Finance
 Andrea Nix, Director of Administration and Finance
 (hired 4.30.07)
 Karen Pinto, Staff Assistant
 Christopher Preheim, Executive Assistant
 (hired 9.11.05)
 David Russo, Facilities Manager
 Lisa Toste, Director of Human Resources (hired 7.1.02)
 Sylvia Winter, Landscape Project Manager
 (hired 9.2.03)

DEVELOPMENT/INSTITUTIONAL ADVANCEMENT

Sheila Baskin, Development Assistant
 Anne Jackson Bell, Events Manager (resigned 7.27.06)
 Ronda Brands, Development Assistant (hired 7.1.05 and
 resigned 1.5.07)
 Jon Hetman, Development Manager
 Wendy Krauss, Development Assistant (hired 1.24.07)
 Michele Levy, Director of Communications
 (hired 2.6.07)
 Julie Anne McNary, Senior Development Officer
 (hired 2.6.05 and resigned 8.26.05)
 Heidi Norris, Development Officer (hired 2.7.06)
 Robert Surabian, Director of Development
 (hired 8.9.04)
 Michaela Tally, Events Manager (hired 2.26.07)

PUBLIC & PROFESSIONAL PROGRAMS

Sheryl Barnes, Webmaster
 Kirstin Behn, Staff Assistant (resigned 6.17.05)
 Ellen Bennett, Manager of Horticultural Information
 (resigned 1.10.03)
 Sonia Brenner, Staff Assistant (resigned 6.1.07)
 Lois Brown, Editorial Assistant (hired 9.25.05)
 John Furlong, Director of the Landscape Institute
 (program transferred from Radcliffe 7.1.02)
 Ann-Marie Greaney-Williams, Administrative
 Coordinator (hired 7.1.02)
 Leah Kane, Staff Assistant (hired 5.2.05)
 Karen Madsen, Editor of *Arnoldia*
 Sandra Morgan, Staff Assistant (resigned 5.3.07)
 Caroline Richardson, Manager of Horticultural
 Information (hired 5.19.03 and resigned 12.15.05)
 Nancy Sableski, Manager of Children's Education
 Micah Schatz, Arboretum Assistant (less than half
 time); (hired 3.27.04 and resigned 4.22.07)
 Richard Schulhof, Deputy Director (hired 9.30.02)
 Pamela Thompson, Manager of Adult Education
 Julie Warsowe, Manager of Visitor Education
 (hired 7.5.06)
 Sheryl White, Staff Assistant
 Laura Wilson, Staff Assistant (hired 7.10.02)

HERBARIUM

David Boufford, Senior Research Scientist
 Maria del Carmen Chavez-Ortiz, Curatorial Assistant
 (hired 8.1.05 and resigned 7.31.06)
 Lihong (Wendy) Duan, Curatorial Assistant
 (transferred to J.P. Library 1.2.05); Staff Assistant
 (hired 10.31.05)
 Jennifer Fonda, Curatorial Assistant (hired 11.9.04)
 Susan Hardy Brown, Curatorial Assistant
 Edith Hollender, Arboretum Assistant
 (less than half time)
 Henry Kesner, Curatorial Assistant (hired 10.5.04)
 Walter Kittredge, Curatorial Assistant
 Jude Mulle, Curatorial Assistant (resigned 9.30.02)
 Melanie Schori, Editorial Assistant (resigned 10.10.03)
 Emily Wood, Manager of Systematic Collections

* (1 July 2002 through 30 June 2007)

LIBRARY

Beth Bayley, Library Assistant (hired 5.1.04)
 Sheila Connor, Horticultural Research Archivist
 Carol David, Library Assistant (resigned 6.1.04)
 Lihong (Wendy) Duan, Staff Assistant (transferred from
 Herbarium 1.2.05)
 Marla Gearhart, Library Assistant (hired 11.29.04)
 Judy Green, Project Image Cataloger (hired 4.1.01 and
 resigned 6.30.02)
 Joseph Melanson, Library Assistant (resigned 12.6.04)
 Lisa Pearson, Library Assistant (hired 7.8.02)
 Cathleen Pfister, Library Assistant
 Christy S. Robson, Catalog Librarian
 Gretchen Wade, Reference/Collection Development
 Librarian
 Judith Warnement, Librarian of Harvard University
 Botany Libraries
 Winifred Wilkens, Library Assistant (retired 9.6.03)

LIVING COLLECTIONS

Thomas Akin, Assistant Superintendent of Grounds
 (resigned 10.24.03)
 John Alexander, Plant Propagator
 James Allen, Arboretum Assistant (less than half time)
 Jesse Batty, Grounds Crew Term (9.4.05–9.21.06)
 Stacy Berghammer, Apprentice (resigned 12.2.02)
 Jessica Blohm, Gardener (hired 9.10.04 and resigned
 7.15.06)
 Laura Tenny Brogna, Landscape Project Manager
 (resigned 7.19.04)
 Julie Coop, Manager of Horticulture
 John DelRosso, Head Arborist
 Peter Del Tredici, Director of Living Collections
 (transferred to Research 7.1.03)
 Kristin DeSouza, Apprentice (hired 8.29.04 and
 resigned 9.19.05)
 Michael Dosmann, Curator of Living Collections
 (hired 1.2.07)
 James Doyle, Gardener/Arborist Apprentice (hired
 9.29.03 and resigned 1.5.07)
 Ralph Ebener, Grounds Crew Term (10.3.04–10.21.05)
 Charlotte Enfield, Grounds Crew Term (10.30.05–
 4.29.06)
 Robert Ervin, Arborist (hired 7.8.02)
 David Falk, Horticulture Term (9.5.06–1.5.07)

Robert Famiglietti, Horticultural Technologist
 Kirsten Ganshaw, Horticultural Technologist
 Donald Garrick, Horticultural Technologist
 (resigned 7.8.03)
 Bethany Grasso, Horticultural Technologist
 (resigned 1.14.04)
 Scott Grimshaw, Horticultural Technologist
 (hired 5.17.04)
 Dennis Harris, Horticultural Technologist
 Eric Hsu, Putnam Fellow (hired 10.31.05 and resigned
 9.23.06)
 Irina Kadis, Curatorial Assistant
 Wesley Kalloch, Horticultural Technologist
 (hired 4.24.06)
 Susan Kelley, Curatorial Assistant (transferred to
 Research 1.1.04)
 Jennifer Kettell, Horticultural Technologist
 (hired 11.17.03)
 Alice Kitajima, Apprentice (hired 9.30.02 and resigned
 9.21.03)
 Jianhua Li, Botanical/Horticultural Taxonomist
 (transferred to Research 1.1.04)
 Daniel March, Apprentice (resigned 8.23.02)
 Brendan McCarthy, Horticultural Technologist
 (hired 3.20.07)
 Bruce Munch, Horticultural Technologist
 Chloe Nathan, Grounds Crew Term (9.4.05–3.3.06)
 James Nickerson, Horticultural Technologist
 (resigned 10.8.04)
 James Papargiris, Horticultural Technologist,
 appointment as Working Foreperson
 Thomas Por, Arborist (resigned 9.9.05)
 Kyle Port, Manager of Plant Records
 Chris Rice, Horticultural Technologist (hired 6.1.04 and
 resigned 10.28.05)
 Kathryn Richardson, Curatorial Assistant (hired 6.7.04)
 Kelly Ruth, Horticulture Term (9.3.06–1.26.07)
 Nima Samimi, Gardener (hired 2.16.07)
 Stephen Schneider, Associate Manager of Horticulture
 Rita Schwantes, Grounds Crew Term (10.3.04–
 11.15.04)
 Julie Shapiro, Curatorial Assistant (hired 4.9.06)
 Maurice Sheehan, Horticultural Technologist, Working
 Foreman (retired 10.31.03)

- Kyle Stephens, Arborist Apprentice/Arborist (hired 10.2.06)
 Kevin Stevens, Apprentice (hired 9.13.05 and resigned 7.28.06)
 Sara Straate, Curatorial Assistant (resigned 9.16.02)
 Siobhan Sullivan, Horticulture Term (9.3.06–3.3.07)
 Aneiage Van Batenburg, Apprentice (hired 9.29.03 and resigned 8.31.04)
 Mark Walkama, Horticultural Technologist
 Thomas Ward, Manager of the Greenhouse
 Victoria Woodruff, Gardener (hired 9.29.03 and resigned 8.5.04)
- INSTITUTE FOR CULTURAL
 LANDSCAPE STUDIES
 (incorporated into Public and Professional Programs)**
 Phyllis Andersen, Director of the ICLS (retired 6.30.04)
- RESEARCH**
- Kobinah Abdul-Salim, Mercer Fellow (appointed 12.1.02–5.31.03)
 Jennifer L. Baltzer, CTFS-AA Asia Post Doctoral Fellow (appointed 4.4.05–3.31.2007)
 Mark Beilstein, Mercer Fellow (hired 12.18.07)
 Jonathan Bennett, Research Fellow (appointed 8.1.03–7.31.04)
 Tim Brodribb, Putnam Fellow (appointed 6.1.05)
 Zhiduan Chen, Mercer Fellow (appointment ended 8.31.02)
 Stuart Davies, Science Director of the CTFS-AA Asia Program (resigned 9.30.05); Director of Asian Programs (re-hired 7.1.07)
 Peter Del Tredici, Senior Research Scientist (transferred from Living Collections 7.1.03)
 Michael Dosmann, Putnam Fellow (appointment ended 8.31.02)
 Rodger Evans, Mercer Fellow (hired 1.2.07 and resigned 4.30.07)
 Kenneth Feeley, CTFS-AA Asia Post Doctoral Fellow (appointed 6.1.05)
 Margaret Frank, Research Assistant (hired 6.18.07)
 Lianming Gao, Mercer Fellow (hired 6.26.07)
 Phyllis Glass, Staff Assistant (hired 5.27.03 and resigned 6.1.05)
 Anna Gorska, Post Doctoral Fellow (hired 3.1.06)
 Barbara Gravendeel, Mercer Fellow (hired 10.19.05 and resigned 10.18.06)
 Jocelyn Hall, Mercer Fellow (appointed 9.1.03–1.31.06)
 Maria Jaramillo, Mercer Fellow (appointment ended 6.30.03)
 Zhen Jiao, Mercer Fellow (hired 3.20.06) (resigned 9.14.06)
 Susan Kelley, Botanical Project Manager (transferred from Living Collections 1.1.04)
 David King, CTFS-AA Asia Post Doctoral Fellow (appointed 1.1.03–12.31.04)
 Jeremy Ledger, Research Assistant (hired 7.15.02 and resigned 1.23.04)
 Ethan Levesque, Research Assistant (hired 12.2.03 and resigned 5.23.07)
 Jianhua Li, Senior Research Scientist (transferred from Living Collections 1.1.04)
 Wenbo Liao, Mercer Fellow (appointed 3.1.05–8.15.05)
 Stuart Lindsay, Mercer Fellow (appointment ended 9.30.02)
 Tatyana Livshultz, Mercer Fellow (appointed 7.16.03–10.15.05)
 Laura Lukas, Arboretum Assistant (hired 1.7.05, less than half time); Research Assistant (hired 10.9.05 and resigned 1.14.06)
 Andrew Marshall, Mercer Fellow (appointed 8.1.04–8.1.06)
 Sarah Mathews, Sargent Fellow (appointed 8.11.03)
 Joel McNeal, Post Doctoral Fellow (appointed 2.22.05–1.26.07)
 David Middleton, Tropical Plant Systematist (resigned 12.31.04)
 Rebecca Pradhan, Mercer Fellow (appointed 9.1.02–6.30.03)
 Richard Primack, Putnam Fellow (hired 7.1.06)
 Hardeep Rai, Post Doctoral Fellow (hired 5.1.07)
 Sabrina Russo, CTFS-AA Asia Post Doctoral Fellow (appointed 9.1.03–12.31.05)
 Lawrence Sack, Putnam Fellow (appointed 8.1.02–7.31.03)
 Sonali Saha, Putnam Fellow (appointed 10.8.02–8.31.04)
 Mariya Schilz, Research Assistant (hired 8.20.06)
 Suzie Shoup, Research Assistant (hired 3.29.04 and resigned 11.13.06)
 Stephanie Stuart, Research Assistant (hired 11.28.04 and resigned 8.4.05)

Wayne Takeuchi, Tropical Forest Biologist
 Nina Theis, Putnam Fellow (appointed 1.12.04–
 8.31.05)
 Donna Tremonte, Research Assistant (hired 1.5.04 and
 resigned 8.31.06)
 Sonia Uytterhoeven, Putnam Fellow (appointed 1.1.02–
 2.1.03)
 Ellen VanScoyoc, Staff Assistant (resigned 6.30.03)
 James E. Watkins, Mercer Fellow (hired 9.1.06)
 Campbell Webb, Tropical Forest Biologist (hired 9.1.05)
 Kyle Williams, Post Doctoral Fellow (appointed
 1.12.04–1.12.07)
 Qing Ye, Post Doctoral Fellow (hired 3.27.06)
 Jipei Yue, Mercer Fellow (appointed 10.1.04–5.31.05)
 Lihua Zhou, Putnam Fellow (appointed 10.1.02–
 3.31.03)
 Maciej Zwieniecki, Sargent Fellow (appointed 6.6.04)

RESEARCH AFFILIATES

Glenn Steven Adelson, Arnold Arboretum Associate
 (appointed 9.1.06)
 Ihsan Al-Shehbaz, Arnold Arboretum Associate
 (appointed 4.1.05)
 Phyllis Andersen, Arnold Arboretum Associate
 (appointed 8.1.04)
 Peter Ashton, Charles Bullard Professor of Forestry,
 emeritus
 Jennifer Baltzer, Arnold Arboretum Associate
 (appointed 4.1.07)
 Mark Beilstein, Arnold Arboretum Associate
 (appointed 8.8.06–12.17.07)
 Gordon Burleigh, Arnold Arboretum Associate
 (appointed 7.19.06–10.31.06)
 Mabel Cabot, Arnold Arboretum Associate
 (appointed 11.1.05)
 Thomas Campanella, Arnold Arboretum Associate
 (appointment ended 1.31.03)
 Chin-Sung Chang, Arnold Arboretum Associate
 (appointed 9.15.06)
 Chua Siew Chin, Arnold Arboretum Associate
 (appointed 3.1.06)
 Stuart Davies, Arnold Arboretum Associate
 (appointed 10.1.05; hired 7.1.07)
 Michael Dosmann, Arnold Arboretum Associate
 (appointed 4.1.04–3.31.06; hired 1.2.07)

Peter J. Franks, Arnold Arboretum Associate
 (appointed 12.1.02–11.30.03)
 Irwin L. Goldman, Arnold Arboretum Associate
 (appointment ended 1.31.03)
 Jocelyn Hall, Arnold Arboretum Associate
 (appointed 2.1.06–6.30.06)
 Richard Howard, Professor of Dendrology, emeritus
 (died 9.18.03)
 Shiu-Ying Hu Hsu, Botanist, emerita
 Alice Ingerson, Arnold Arboretum Associate
 (appointed 7.1.02–6.30.05)
 Yu Jia, Arnold Arboretum Associate (appointed 1.1.06)
 David King, Arnold Arboretum Associate
 (appointed 1.1.05–9.30.05)
 James LaFrankie, Arnold Arboretum Associate
 (appointed 9.1.02–8.31.05)
 Timothy Laman, Arnold Arboretum Associate
 (appointment ended 6.30.04)
 Tatyana Livshultz, Arnold Arboretum Associate
 (10.16.05–12.31.05; hired 3.1.06)
 Richard H. Ree, Arnold Arboretum Associate
 (appointed 2.1.03)
 Kenichi Shono, Arnold Arboretum Associate
 (appointed 1.1.05–12.31.05)
 Stephen Spongberg, Curator, emeritus
 George Staples, Arnold Arboretum Associate
 (appointed 8.1.03–7.31.04)
 Hang Sun, Arnold Arboretum Associate
 (appointed 1.1.06)
 Kim Tripp, Arnold Arboretum Associate
 (appointment ended 4.30.03)
 Sonia Uytterhoeven, Arnold Arboretum Associate
 (appointed 2.1.03–1.31.05)
 Keith Vanderhuy, Arnold Arboretum Associate
 (appointed 9.1.03–8.31.04)
 Campbell Webb, Arnold Arboretum Associate
 (appointment ended 8.31.05)
 Kyle Williams, Arnold Arboretum Associate
 (appointed 1.13.07)
 Carroll Wood, Jr., Professor of Biology, emeritus
 Zhuliang Yang, Arnold Arboretum Associate
 (appointed 1.1.06)
 Donglin Zhang, Arnold Arboretum Associate
 (appointment ended 8.31.02)

PUBLISHED WRITINGS OF THE ARNOLD ARBORETUM STAFF

J. H. Alexander

2002. Paraphyletic *Syringa*: evidence from sequences of nuclear ribosomal DNA ITS and ETS regions. *Systematic Botany* 27: 592–593 (with J. Li and D. Zhang).
2002. Phylogenetic relationships of Empetraceae inferred from sequences of gene *matK* and nuclear ribosomal DNA ITS region. *Molecular Phylogenetics and Evolution* 25: 306–315 (with J. Li et al.).

P. Andersen

2002. The Institute for Cultural Landscape Studies of the Arnold Arboretum of Harvard University. In *Restoring the Landscape: Policies for a New Sustainable Regional Project*, ed. Francesca Leder. Ferrara, Italy: Facolta di Architettura di Ferrara.
2003. The Arnold Arboretum and the Early Years of Landscape Design Education in America. *Arnoldia* 62(3): 2–9.
2003. Spirit of Place (roundtable discussion). *Architecture Boston* 6(6): 8–17.
2003. Book review: *Sacred Places: American Tourist Attractions in the Nineteenth Century*, J. F. Sears. *Architecture Boston*, 6(6): 61.
2004. Book review: *Becoming Cape Cod: Creating a Seaside Resort*, J. C. O'Connell. *Architecture Boston*, 7(3): 49.

J. L. Balzer

2007. Geographical distributions in tropical trees: can geographic range predict performance and habitat association in co-occurring tree species? *Journal of Biogeography* 34: 1916–1926 (with S. J. Davies et al.).
2007. Determinants of whole-plant light requirements in Bornean rain forest tree saplings. *Journal of Ecology* 95: 1205–1221 (with S. C. Thomas).
2007. Physiological and morphological correlates of whole-plant light compensation point in temperate deciduous tree seedlings. *Oecologia* 153: 209–223 (with S. C. Thomas).

J. R. Bennett

2006. Phylogeny of the parasitic plant family Orobanchaceae inferred from phytochrome A. *American Journal of Botany* 93: 1039–1051 (with S. Mathews).

D. E. Boufford

- 1992–2006. *Harvard University Herbaria Databases: Botanists, Publications, Specimens*. <http://www.huh.harvard.edu/databases> (with K. N. Gandhi).
- 1998–2007. *Biodiversity of the Hengduan Mountains Region, China*. <http://hengduan.huh.harvard.edu/fieldnotes> (with Z. W. Ge et al.).
2002. Plant databases and the study of Asian Plants (1). *Ouroboros* 7(1): 10–13.
2002. Plant databases and the study of Asian Plants (2). *Ouroboros* 7(2): 13–15.
2003. Hengduan Mountains: International Hotspot of Biodiversity. In *Xiuyuanjieying*, ed. H. S. J. Wenji. Hong Kong: Commercial Press.
2003. A checklist of the vascular plants of Taiwan. In *Flora of Taiwan*, 2nd ed. Vol. 6. Taipei: National Taiwan University (with H. Ohashi et al.).
2003. *Flora of Taiwan*, 2nd ed. Vol. 6. Taipei: National Taiwan University (with C. F. Hsieh et al.).
2003. *Rubus Linnaeus*. In *Flora of China*, Vol. 9, eds. C. Y. Wu and P. H. Raven. Beijing: Science Press; St. Louis: Missouri Botanical Garden (with L. D. Lu).
2003. Phylogenetic position of *Schnabelia*, a genus endemic to China: evidence from sequences of cpDNA *matK* gene and nrDNA ITS regions. *Chinese Science Bulletin* 48(15): 1576–1580 (with S. H. Shi et al.).
2004. Mountains of Southwest China. In *Hotspots Revisited: Earth's Biologically Richest and Most Endangered Ecoregions*, 2nd ed., ed. R. A. Mittermeier et al. Mexico City: CEMEX Conservation International (with P. P. van Dijk).

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2005. Cornaceae. In *Flora of China*, Vol. 8, ed. D. Y. Hong and P. H. Raven. Beijing: Science Press; St. Louis: Missouri Botanical Garden (with Q. Xiang).
2005. Aucubaceae. In *Flora of China*, Vol. 8, ed. D. Y. Hong and P. H. Raven. Beijing: Science Press; St. Louis: Missouri Botanical Garden (with Q. Xiang).
2005. Helwingiaceae. In *Flora of China*, Vol. 8, ed. D. Y. Hong and P. H. Raven. Beijing: Science Press; St. Louis: Missouri Botanical Garden (with Q. Xiang).
2005. Mastixiaceae. In *Flora of China*, Vol. 8, ed. D. Y. Hong and P. H. Raven. Beijing: Science Press; St. Louis: Missouri Botanical Garden (with Q. Xiang).
2005. Toricelliaceae. In *Flora of China*, Vol. 8, ed. D. Y. Hong and P. H. Raven. Beijing: Science Press; St. Louis: Missouri Botanical Garden (with Q. Xiang).
2005. *Circaea lutetiana* L. sensu lato (Onagraceae) reconsidered. *Harvard Papers in Botany* 9(2): 255–256.
2005. Polyploidy in the flora of the Hengduan Mountains Hotspot, Southwestern China. *Annals of the Missouri Botanical Garden* 92: 275–306 (with Z. L. Nie et al.).
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2006. Angiospermae; Dicotyledoniae; Archichlamideae. *Flora of Japan*, Vol. IIA, ed. K. Iwatsuki et al. Tokyo: Kodansha, Ltd (with K. Iwatsuki and H. Ohba).
2007. Taxonomic note on *Wikstroemia salicina* (Thymelaeaceae). *Acta Phytotaxonomica Sinica* 45: 413–414 (with Y. H. Zhang and H. Sun).
2007. Taxonomic studies of *Saussurea* de Candolle (Asteraceae) in the Hengduan Mountains, China. An annotated list of recently collected specimens. *Newsletter of Himalayan Botany* 39: 13–37 (with K. D. Fujikawa et al.).
2007. Rhizophoraceae. In *Flora of China*, Vol. 13, ed. Z. Y. Wu et al. Beijing: Science Press; St. Louis: Missouri Botanical Garden (with H. N. Qin).
2007. Botanical Expedition to southern Gansu Province, China, May 2007. *Newsletter of Himalayan Botany* 40: 5–14 (with Y. Jia et al.).
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2007. *Meconopsis wilsonii* subsp. *wilsonii* (Papaveraceae) rediscovered. *Acta Botanica Yunnanica* 29: 286–288 (with T. Yoshida and H. Sun).
2007. Atlas of the flora of New England: Cyperaceae. *Rhodora* 109: 237–360 (with R. A. Angelo).
2007. *The Genera of Vascular Plants of Korea*. Seoul: Academy Publishing Company (with C. Park, et al.).
2007. Two New Species of *Wikstroemia* (Thymelaeaceae) from Western Sichuan, China. *Rhodora* 109: 448–455 (with Y. H. Zhang and H. Sun).

Z. Chen

2003. Phylogeny of the Dipsacales s.l. based on chloroplast trnL-F and ndhF sequences. *Molecular Phylogenetics and Evolution* 26: 176–189 (with W. Zhang et al.).
2004. Regional differences in rates of plant speciation and molecular evolution: a comparison between eastern Asia and eastern North America. *Evolution* 58: 2175–2184 (with Q. Xiang et al.).
2004. Phylogenetics and biogeography of *Alnus* (Betulaceae) inferred from sequences of nuclear ribosomal DNA ITS region. *International Journal of Plant Science* 165: 325–335 (with J. Li).
2005. Phylogenetics of *Betula* (Betulaceae) inferred from sequences of nuclear ribosomal DNA. *Rhodora* 107: 69–86 (with J. Li and S. Shoup).
2007. Phylogenetic relationships of diploid species of *Betula* (Betulaceae) inferred from DNA sequences of nuclear nitrate reductase. *Systematic Botany* 32(2): 357–365 (with J. Li and S. Shoup).
2007. Phylogenetic and biogeographic diversification of Berberidaceae in the Northern Hemisphere. *Systematic Botany* 32(4): 731–742 (with W. Wang et al.).

2007. Mitochondrial matR sequences help to resolve deep phylogenetic relationships in rosids. *BMC Evolutionary Biology* 7: 217–231 (with X. Zhu et al.).

S. Connor

2003. Shrubs and Vines at the Arnold Arboretum: A History. *Arnoldia* 62(2): 3–15.

2003. A picture is worth... *The Public Garden* 18(4): 39–41.

2004. In the Library: *Hortus Nitidissimis*. *Arnoldia* 63(1): 32.

2005. The Nature of Eastern Asia: Botanical and Cultural Images from the Arnold Arboretum Archives. *Arnoldia* 63(3): 34–44.

R. E. Cook

2003. *The Director's Report of the Arnold Arboretum: 1999–2002*. *Arnoldia* 62(1).

2006. Botanical collections as a resource for research. *The Public Garden* 21(1): 18–21.

2007. The Future of Research at the Arnold Arboretum. *Arnoldia* 65(2) 23–29.

J. Coop

2003. Sun-loving shrubs and vines for the Leventritt Garden. *Arnoldia* 62(2): 20–26 (with P. Del Tredici et al.).

S. J. Davies

2002. *The 52-Hectare Forest Dynamics Plot at Lambir Hills, Sarawak, Malaysia: Tree Distribution Maps, Diameter Tables, and Species Documentation*. Diliman, Philippines: Center for Integrative and Development Studies, University of the Philippines (with H. S. Lee et al.).

2003. Effects of nutrient addition, mulching and planting-hole size on early performance of *Dryobalanops aromatica* and *Shorea parvifolia* in enrichment plantings in Sarawak, Malaysia. *Forest Ecology and Management* 180: 261–271 (with A. Vincent).

2003. Coadaptation and coevolution of *Macaranga* trees and their symbiotic ants. In *Genes, Behaviours and Evolution of Social Insects*, ed. T. Kikuchi et al. Sapporo, Japan: Hokkaido University Press (with T. Itino and T. Itioka).

2003. The trees of Pasoh Forest: stand structure and floristic composition of the 50-hectare forest research plot. In *Pasoh: Ecology and natural history of a Southeast Asian lowland tropical rain forest*, ed. T. Okuda et al. Tokyo, Japan: Springer (with M. N. Nur Supardi et al.).

2003. Lambir forest dynamics plot, Sarawak, Malaysia. In *Forest Diversity and Dynamism*, ed. E. Losos and E. Leigh. Chicago: The University of Chicago Press (with H. S. Lee et al.).

2003. Book review: *A Manual for Forest Plantation Establishment in Malaysia*, ed. B. Krishnapillay. *Journal of Tropical Forest Science* 15(2): 365–367.

2004. Habitat heterogeneity and niche structure of trees in two tropical rain forests. *Oecologia* 139: 446–453 (with M. D. Potts et al.).

2004. Soil-related habitat specialization in dipterocarp rain forest tree species in Borneo. *Journal of Ecology* 92: 609–623 (with P. Palmiotto et al.).

2004. Evolution of host affiliation in *Creumatogaster* (Formicidae) inhabitants of *Macaranga* (Euphorbiaceae). *Evolution* 58: 554–570 (with S. P. Quek et al.).

2004. Lambir Hills Forest Dynamic Plot, Sarawak, Malaysia. In *Forest Diversity and Dynamism: Findings from a Network of Large-Scale Tropical Forest Plots*, ed. E. Losos and E. G. Leigh. Chicago: University of Chicago Press (with H. S. Lee et al.).

2004. Sinharaja 25-hectare plot: comparisons with other forests in the CTFS network. In *Ecology of Sinharaja Rain Forest and the Forest Dynamics Plot in Sri Lanka's Natural World Heritage Site*, ed. C. V. S. Gunatilleke et al. Columbo, Sri Lanka: WHT Publications.

2004. Palanan forest dynamics plot, Philippines. In *Forest Diversity and Dynamism*, ed. E. Losos and E. G. Leigh. Chicago: The University of Chicago Press (with L. L. Co et al.).

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2005. Tree growth is related to light interception and wood density in two mixed dipterocarp forests of Malaysia. *Functional Ecology* 19: 445–453 (with D. A. King et al.).
2005. Edaphically-associated variation in performance correlates with species' distribution patterns in a Bornean rainforest. *Journal of Ecology* 93: 879–889 (with S. E. Russo et al.).
2005. *Forest Trees of Bukit Timah, Singapore: Population Ecology in a Forest Fragment*. Singapore: Simply Green (with J. V. LaFrankie et al.).
2005. Soil-related floristic variation in a hyperdiverse dipterocarp forest. In *Pollination Ecology and the Rain Forest (Sarawak Studies)*, ed. D. Roubik et al. New York: Springer Science (with S. Tan et al.).
2006. Regeneration of native plant species in restored forests on degraded lands in Singapore. *Forest Ecology and Management* 237: 574–582 (with K. Shono and Y. K. Chua).
2006. Spatial associations of humus, nutrients, and soils in mixed dipterocarp forest at Lambir, Sarawak, Malaysian Borneo. *Journal of Tropical Ecology* 22: 543–553 (with I. C. Baillie et al.).
2006. The role of wood density and stem support costs in the growth and mortality of tropical trees. *Journal of Ecology* 94: 670–680 (with D. A. King et al.).
2006. The importance of demographic niches to tree diversity. *Science* 313: 98–101 (with R. Condit et al.).
2006. Competitive dominance in a secondary successional rain forest community in Borneo. *Journal of Tropical Ecology* 22: 53–64 (with H. Semui).
2006. Contrasting structure and composition of the understory in species-rich tropical rain forests. *Ecology* 87(9): 2298–2305 (with J. V. LaFrankie et al.).
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2006. Testing metabolic ecology theory for allometric scaling of tree size, growth, and mortality in tropical forests. *Ecology Letters* 9: 575–588 (with H. C. Muller-Landau et al.).
2006. Nonrandom processes maintain diversity in tropical forests. *Science* 311: 527–531 (with C. Wills et al.).
2006. Growth and mortality are related to adult tree size in a Malaysian mixed dipterocarp forest. *Forest Ecology and Management* 223: 152–158 (with D. A. King et al.).
2006. *Forest Trees of Palanan, Philippines: A Study in Population Ecology*. Diliman, Philippines: Center for Integrative and Development Studies, University of the Philippines (with L. L. Co et al.).
2007. The role of gap-phase processes in the long-term biomass dynamics of four old-growth tropical forests. *Proceedings of the Royal Society UK* 274: 2857–2864 (with K. J. Feeley et al.).
2007. Geographical distributions in tropical trees: can geographical range predict performance and habitat association in co-occurring tree species? *Journal of Biogeography* 34: 1916–1926 (with J. L. Baltzer et al.).
2007. Decelerating growth in tropical forest trees. *Ecology Letters* 10: 461–469 (with K. J. Feeley et al.).
2007. The geography of diversification in mutualistic ants: a gene's-eye view into the Neogene history of Sundaland rain forests. *Molecular Ecology* 16: 2045–2062 (with S. P. Quek et al.).
2007. Do current stem size distributions predict future population changes? An empirical test of intraspecific patterns in tropical trees at two spatial scales. *Journal of Tropical Ecology* 23: 191–198 (with K. J. Feeley et al.).
2007. Performance of 45 native tree species on degraded lands in Singapore. *Journal of Tropical Forest Science* 19: 25–34 (with K. Shono and Y. K. Chua).
2007. Determinants of tree species distributions: comparing the roles of dispersal, seed size, and soil specialization in a Bornean rain forest. In *Seed Dispersal: Theory and its Application in a Changing World*, ed. A. J. Dennis et al. Wallingford, UK: CAB International (with S. E. Russo et al.).

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Richard Schulhof



Jim Harrison

Adult Education: 2007

Classes Offered: 112
Enrollments: 1040

Visitor Education: 2007

Free Tours: 57
Free Tour Participants: 548
Paid Tours: 35
Paid Tour Participants: 612
Visitor Center Attendance: 27,575



Ann Greaney-Williams



Richard Schulhof

Landscape Institute: Spring/Summer/Fall 2007

Courses Offered: 70
Enrollments: 938
Certificates Granted: 18

Children's Education: Spring/Fall 2007

Programs Offered: 60
Participating Classes: 116
Students Served: 2,098

