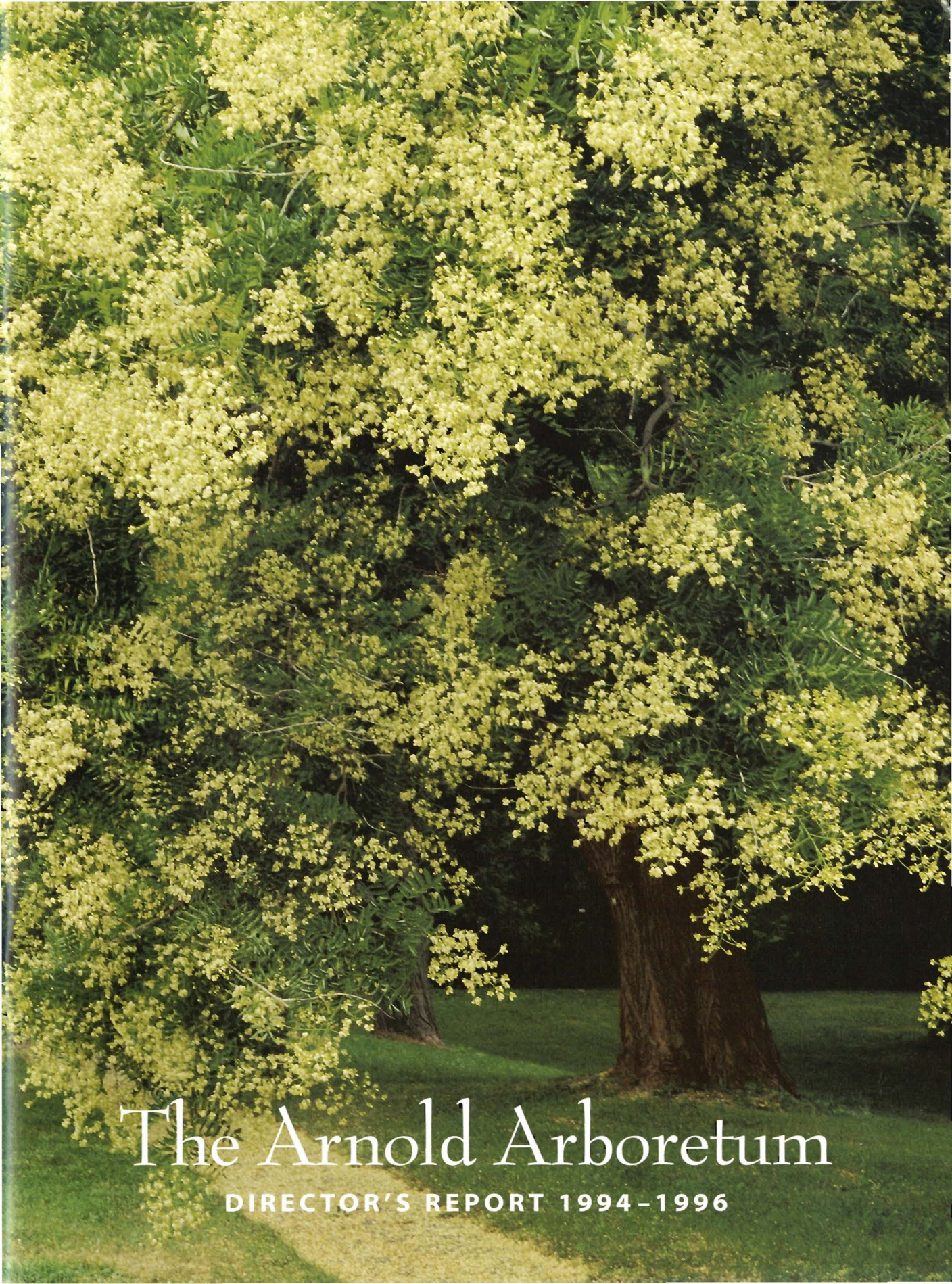


# The Arnold Arboretum

## DIRECTOR'S REPORT 1994–1996

Cover photograph of *Sophora japonica* in late-summer flower by Pamela Harper.

*Cornus,* the genus of the dogwoods and cornels, is especially well represented at the Arnold Arboretum. Among the 62 taxa grown here (28 species, as many varieties, and 6 hybrids), this planting of *C. kousa* on Bussey Hill, above, is especially lovely. Photograph by Rácz & Debreczy.

On the inside back cover, the director, photographing Hemlock Hill, is photographed by Karen Madsen.

# The Arnold Arboretum

## DIRECTOR'S REPORT 1994–1996

*Robert E. Cook, Director*

The Arnold Arboretum of Harvard University
125 Arborway, Jamaica Plain, Massachusetts 02130

Peter Del Tredici



Peter Del Tredici

In the autumn of 1877, five years after becoming director of the Arnold Arboretum, Charles Sprague Sargent faced his first fundraising challenge. His colleague Frederick Law Olmsted, the architect of Central Park, had agreed to create a conceptual design of the Arnold Arboretum for free, but first he would require an accurate survey and topographic map of the grounds of the Bussey Farm. The cost would be two thousand dollars, or about twenty thousand today—well beyond the limits of the Arboretum's operating budget. Legend has it that Sargent threw a dinner party for friends and passed the hat over dessert. But the written record reveals simply the following words in a letter to Olmsted in New York:

> I started yesterday a subscription among some of the neighbors to raise the two thousand dollars for a plan of the Arboretum. My appeal has already met with such good success that the whole sum is as good as secured.

If only it were that easy today! Compared with similar nonprofit and public institutions, the annual financial needs of the Arnold Arboretum depend upon a very limited set of income sources. For instance, we receive no income from the gate, nor any subsidy from city, state, or national government, nor from the university. As part of the Boston park system, the grounds and collections are open free to the public at all times. At best our educational programs and publications bring in funds barely sufficient to cover their production expenses. Similarly, grants and contracts cover just the costs of the programs for which they are awarded. Our enterprise operations, such as the bookstore and property rentals, net very small amounts of actual income once expenses are subtracted. Annual giving by our members brings in less than ten percent of our operating budget.

So, you may ask, how do we pay for the care and curation of our grounds and collections? The largest source of income for the Arboretum, over seventy percent of the total, comes as an annual earning from our endowment. The size of this endowment reflects the generosity of Arboretum friends past who long ago believed in the perpetual importance of its work. It is their legacy that supports our mission today.

**Kirsten Ganshaw, Julie Coop, and 1995 summer intern Angela Ingerle at work stabilizing the banks of Dawson Pond. Coconut husk wrap sheathed in polypropylene lines its edge.**

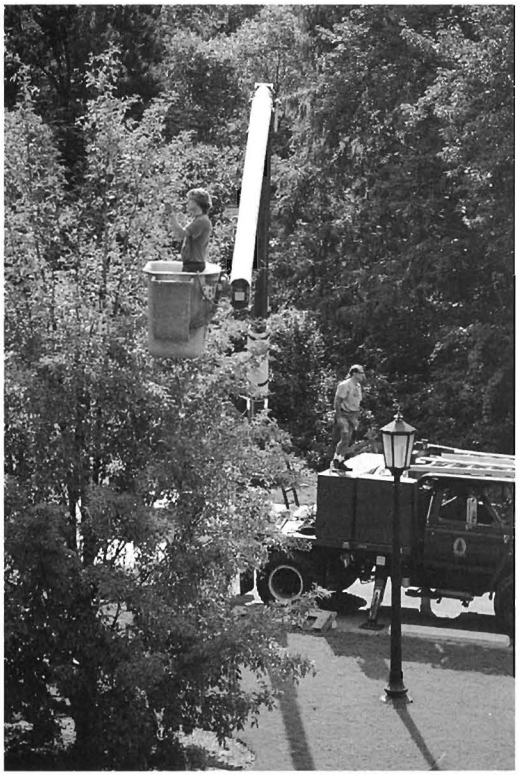
This "annual" report actually represents a summary of activities for two fiscal years, 1994–1995 and 1995–1996. As will become clear, the Arboretum has been very busy with several new initiatives. The accomplishments I will set forth in the course of this report would not have been possible without the security provided by our endowment income, and I shall emphasize our need to continue building that endowment in the future. As the Arboretum faces this challenge today, the spirit of Sargent's confidence, so critical to our creation, convinces me that our subscription will surely be secured.

## LIVING COLLECTIONS

### *Curation*

A total of 261 accessions representing 527 woody plants were added to the permanent collection in the fall of 1994 and spring of 1995; 65 of these accessions were new to the collection. Comparable numbers for 1996 are 253 accessions representing 547 plants of which 82 are new to the collection.

Karen Madsen



The spring and summer months of 1995 were unusually dry, with a forty-day period without measurable precipitation from early August to the middle of September. The impact of this drought can be seen in the changes to the permanent collection. In June of 1995 the collection consisted of 17,116 individual plants constituting 5,049 different taxa. By July of 1996, attrition had reduced the collection to 15,963 plants of 4,736 taxa. Within these taxa, 1,870 are cultivars, 299 are hybrids, 549 are infraspecific taxa, and 2,018 are species.

At any other institution, a sudden loss of over 1,100 plants might be considered a disaster. At the Arboretum, where our mission is to grow "all the plants hardy in the Boston area," hardy is interpreted literally; and the 16,000 survivors, many of which have endured a century of weather extremes, indicate which plants can or cannot meet this measure.

**John Olmsted prunes the forty-year-old *Stewartia pseudocamellia* that was moved to the front of the Hunnewell Building in 1993. Fellow arborist John Del Rosso is at right.**

## *New Landscapes*

For a number of years, the attention of the staff of the Living Collections department has been focused on the care and curation of our existing collections. The Arboretum is now entering a period when major new landscape projects will improve the grounds and add new collections. Some projects will be entirely executed by our own staff; others will require landscape architects and outside contractors. The result will be the creation of several beautiful new landscapes with enhanced educational value for the visitor and expanded research material for scholars.

In 1995 our grounds crew and curation staff initiated a renovation of the collections in the area known as Chinese Path. Located on the south slope of Bussey Hill, this grass pathway is lined with shrubs and trees native to Asia that were first introduced to North American soils by Ernest H. "Chinese" Wilson and other Arboretum plant collectors. Examples include the dove tree *(Davidia involucrata)*, the sand pear *(Pyrus pyrifolia)*, the Chinese zelkova *(Zelkova sinica)*, and the paperbark maple *(Acer griseum)*.

After conducting a curatorial review of these collections, the Arboretum worked with graduate student Gail Wittwer of Harvard's Graduate School of Design to develop a plan to restore the path and to renovate the collections. Plants in poor condition or of uncertain provenance were removed, and several large specimen trees of *Stewartia, Cornus,* and *Corylopsis* were relocated to this area from other parts of the grounds using a mechanical tree spade. The resulting removals and additions strengthened the circulation pattern and prepared the Path as a major destination for visitors.

As part of this project, the southwest slope near the summit of Bussey Hill was re-landscaped with extensive plantings of *Kalmia latifolia, Fothergilla major, Leucothoe fontanesiana,* and *Pieris floribunda,* lending the hillside an appearance typical of the southern Appalachian mountains.

A second area that is receiving increased attention is Peters Hill, at the far western end of the Arboretum. In 1994 the staff completed a curatorial review followed by de-accessioning of numerous plants of poor quality. In 1995 we completed a major planting of crabapples, including seventy cultivars donated by the Schmidt Nursery in Oregon, which will reinforce the orchard-like qualities that have long character-

ized the landscape of the Hill. Additional plantings of deciduous gymnosperms included *Metasequoia, Taxodium, Ginkgo,* and *Pseudolarix.*

For a location with a stunning view of the Arboretum and the Boston skyline, the summit of Peters Hill is singularly unattractive. In the 1960s, the top of the hill was graded flat and a macadam road and turnaround of sufficient size to accomodate tourist buses were installed. The circle was ringed with a series of large granite blocks recovered from a nearby bridge demolition. The resulting acre of hard surface projects a most unwelcoming setting to the pedestrian in search of a quiet country hilltop with a clear view to the city.

In 1996 we initiated the restoration of a more pastoral setting for the summit by hiring Carol R. Johnson Associates to develop a new plan for the landscape. The plan calls for removal of the paving in the area, restoration of the original hilltop by adding six feet of new land, establishment of a pedestrian circulation path with seating, and appropriate planting for the new summit to create shade and pleasure. We anticipate completion of this project in 1997.

Plans for two other large areas of the Arboretum are being developed. On March 13, 1996, twenty-four acres of derelict wetland were formally added to the land of the Arboretum owned by the City of Boston and leased to the University for research and education. This was accomplished through the good efforts of a local support group, the Arboretum Park Conservancy. Known as the Stony Brook Marsh, this "urban wild" lies between our southern boundary and the Forest Hills subway and train station. Development of a master plan will be under the direction of the design firm Brown & Rowe and will include a vegetation and habitat inventory, establishment of pedestrian circulation and access to the Arboretum, ecological restoration of the native wetland vegetation, and a plan for interpretation and educational programming.

A final major landscape project will lead to development of a four-acre site northeast of the Dana Greenhouses, incorporating a large group of older dwarf conifers and the Larz Anderson Bonsai collection. In this lowland area we hope to establish extensive new plantings of woody vines and sun-loving shrubs not found elsewhere in the Arboretum. In 1996, we received a $45,000 conservation grant from the Institute of Museum and Library Services to support a complete curatorial review of prospective taxa for this new collection. We will initiate planning with

a landscape architect to be chosen in 1997. We will be identifying construction funds and the necessary permanent endowment as part of the Arboretum's participation in the University Campaign.

During the Campaign, we also hope to increase our endowment for our current collections by offering donors an opportunity to name a collection, as in the Eleanor Cabot Bradley Garden of Rosaceous Plants. The income from each endowment will secure the future care and curation of the named collection. The table on page 24 provides a list of opportunities and the size of gift we hope to receive.

Over the past five years, gifts generously provided by the Putnam family have supported a series of research appointments known as the Katherine H. Putnam Fellowships. Kim Tripp, our most recent Putnam Fellow, came to the Arboretum early in 1995. She has been conducting research on a variety of horticultural problems ranging from root growth in gymnosperms and *Ilex*, propagation and evaluation in alders *(Alnus)*, and the effects of the bacteria *Agrobacterium rhizogenes* on woody-plant stem cuttings. In addition to giving invited lectures and teaching in our adult education program, Dr. Tripp has written for publications on popular and technical horticulture. She is also senior author of the recently published book, *A Year in Trees: Superb Woody Plants for Four-Season Gardens*, a collaboration with the late J. C. Raulston.

Karen Madsen

Peter Del Tredici

**Dawn redwoods *(Metasequoia glyptostroboides)* propagated at the Dana Greenhouses were planted on Bussey Hill in the fall of 1995. The grove defines the southern edge of Chinese Path.**

Along with Peter Del Tredici, director of Living Collections, and Tom Ward, manager of the Dana Greenhouses, Dr. Tripp has also been

Phyllis Andersen

**Tom Ward and Kirsten Thorton move plants propagated for the National Park Service into the NPS section of the Arboretum nursery.**

instrumental in launching a new plant introduction program at the Arboretum. Its goal is to get unusual and exceptional woody plants now in the collections out into the nursery trade. Through a modest subscription made available to nursery professionals nationwide, the Arboretum is providing rooted cuttings and seedlings, related botanical and horticultural information, as well as training in appropriate methods of propagation. During the first year the Arboretum offered three woody selections to over forty participating nurseries: King Boris fir *(Abies borisii-regis); Magnolia grandiflora* 'Tulsa'; and cyclamen cherry *(Prunus cyclamina).* In the coming year, we anticipate introducing the incense cedar *(Calocedrus decurrens),* the pink yellowwood *(Cladrastis kentukea* 'Perkins Pink'), and the Chinese sweetgum *(Liquidambar acalycina).*

Over the past two years, plant material in the Living Collections has supported 39 separate research projects at other institutions. These include: virus screening in *Prunus* under the supervision of Howard Waterworth at the USDA Germplasm Laboratory; breeding studies of lindens *(Tilia)* by George Ayers at Michigan State University; isozyme analysis of witch hazel *(Hamamelis)* species and cultivars by Charlotte Chen at the Holden Arboretum; broad-spectrum cold hardiness studies by Paul Cappiello of the University of Maine; and hybridization studies of maples by Susan Wiegrefe at the University of Minnesota.

Through the Olmsted Center for Landscape Preservation, our collaboration with the National Park Service also achieved some solid accomplishments in 1995 and 1996. Staff horticulturists from the Arboretum worked on six NPS historic sites (St. Gaudens NHS; Longfellow NHS; Adams NHS; Roosevelt/Vanderbilt NHS; Edison NHS; and Sagamore Hills NHS) to complete historic plant inventories that document existing woody plants and to provide the necessary condition assessments for management or replacement.

The Arboretum also established a plant nursery adjacent to the Dana Greenhouses to support the propagation of plants with historic significance, such as the Olmsted elm, the linden at Henry Wadsworth Longfellow's house, and the apple cultivars associated with the home of Franklin Delano Roosevelt at Hyde Park. The Arboretum also held a forum in August 1995 on vegetation management for historic sites. It brought together ten national specialists to discuss case histories with another eighty professional landscape managers. During the past year we have been assembling and editing the individual papers to be published in 1997.

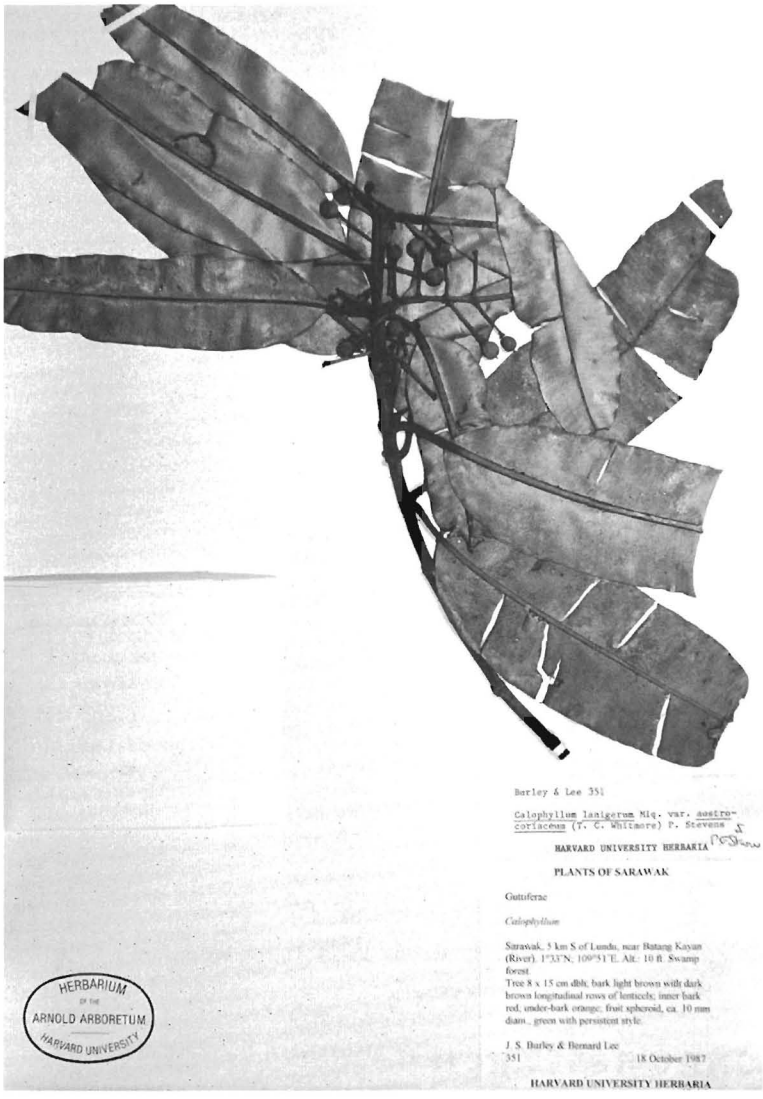
Finally, over the past four years, staff from the Arboretum have been working closely with staff from the Frederick Law Olmsted National Historic Site in Brookline, Massachusetts, to assist in the restoration of its landscape to its appearance in 1930, when the Olmsted Brothers firm was most prominent throughout the nation. During the coming year this work will culminate in the publication of a cultural landscape report authored by historian Cynthia Zaitzevsky, with a concluding essay by garden historian Mac Griswold.

In 1995 Jack Alexander, our senior propagator, was awarded the Jackson Dawson medal by the Massachusetts Horticultural Society. Early in 1997, Stephen Spongberg, our horticultural taxonomist, was given the Gold Veitch Memorial Medal by the Royal Horticultural Society of London, the highest award given by the Society to foreigners. In receiving this award, rarely given outside the United Kingdom, Dr. Spongberg follows in the footsteps of plant explorer E. H. Wilson, propagator William Judd, and horticulturist Donald Wyman.

## INTERNATIONAL RESEARCH

In 1995 the Arboretum concluded an eight-year program to collect and identify plants from the tropical forests of the Indonesian region that exhibit potential anticancer and anti-HIV properties. Supported by grants from the National Cancer Institute (NCI), Arboretum scientists conducted numerous expeditions to the remote islands of Indonesia to gather samples of leaves, twigs, and fruits for testing. Their extracts were screened in NCI's laboratories in Maryland, and promising candidates were re-collected for further testing.

A key component of this inventory process is the creation of a voucher specimen for each sampled plant. This voucher records its




**Herbarium specimen Burley and Lee 351 from Sarawak, Borneo, documents the original plant of *Callophylum lanigerum* var. *austrocoriaceum*, which contains a compound that inhibits the growth of the AIDS virus.**

correct taxonomic identity as well as the location and date of sampling and any related information. For extracts that demonstrate inhibitory activity, it is the voucher specimen that ensures successful re-collection of a known species. These specimens make up the herbarium collections of the Arboretum, where the critical expertise of Arboretum scientists permits a correct taxonomic assignment.

The essential importance of this ability to place the correct name on a plant of vital interest can be seen in the emerging story of *Calophyllum*, a group of trees in the mangosteen family (Guttiferae) found throughout the Malaysian region. In the autumn of 1987, John Burley, director of our Indonesian program, accompanied a Dyak tree climber into a peat-swamp forest near Lundu in the state of Sarawak on the northern side of Borneo. They sampled fruit and twigs from a small tree of eight meters that they suspected to be a *Calophyllum* species and sent the sample to NCI for testing. They also created a voucher specimen (Burley and Lee 351) and brought it back to the Arboretum for determination. In 1991, an extract from the sample sent to NCI proved to display "100 percent protection against the cytopathic effects of HIV-1 infection and essentially halted HIV-1 replication."

NCI soon launched an expedition to re-collect material from the original plant. To their dismay, researchers discovered that the peat-

swamp tree near Lundu had been cut down several years earlier, perhaps by local people for fuel or building material. Samples taken from other specimens of what appeared to be the same species produced only very low activity against HIV. With the original plant gone, researchers wondered whether they had re-collected the right species. This put a critical premium on the accurate identification of the original tree.

Professor Peter Stevens, on the staff of the Arnold Arboretum, is the world's expert on the genus *Calophyllum.* He identified Burley and Lee 351 as *Calophyllum lanigerum,* but of a variety called *austrocoriaceum* that is rare in the forests of northern Borneo. He subsequently confirmed that the re-collected samples were of a different species, *Calophyllum teysmannii* var. *inophylloide.*

With the correct identification now verified by the voucher specimen at Harvard, researchers were able to locate trees of *Calophyllum lanigerum* var. *austrocoriaceum* in the Singapore Botanic Garden. Soon organic chemists at NCI identified the anti-HIV substance from the original tree as (+)-calanolide A. It inhibits reverse transcriptase, a substance required by the HIV virus for replication. In 1993, scientists at SmithKline Beecham Pharmaceuticals synthesized (+)-calanolide A. In 1995, NCI issued to MediChem Research Inc. of Lamont, Illinois, an exclusive, worldwide license to develop this chemical as a treatment for AIDS. It is scheduled to enter human clinical trials in 1997.

## *Biodiversity Research*

Indonesia, an archipelago nation of 200 million people living on 14,000 islands, is a country rich in biodiversity. Although its area is only 1.3 percent of the earth's land surface, it contains 25 percent of the world's fishes, 17 percent of all bird species, 16 percent of reptile and amphibian species, 12 percent of mammal species, 10 percent of plant species, and unknown numbers of invertebrate, fungal, and microorganismal species. Of these, perhaps 30 percent of the flora and 90 percent of the fauna are not yet fully described and scientifically documented. Yet many sectors of the growing Indonesian economy (agriculture, forestry, fisheries, nontimber forest products, tourism, watershed conservation) are dependent, directly or indirectly, on the diversity of natural ecosystems and the environmental functions they protect. The conservation of

biodiversity in Indonesia, and the scientific information required for sustainable management of natural resources, will be critical for the future economic development of the country.

Toward the end of 1995, the National Science Foundation awarded Dr. Burley, director of our programs in Indonesia, a grant for a two-year extension to his existing grant for botanical inventory in West Kalimantan (Indonesian Borneo), bringing the total funding to $785,000 for this five-year project. Funds were included to upgrade our computer database system for managing botanical information and to integrate this new database into existing geographical information systems (GIS) technology. GIS is software that organizes geographically based data, such as the distribution of species or variation in topography, in a way that permits electronic analyses and compilations to be performed.

To facilitate this database/GIS integration, the Arboretum has received generous technical assistance from ESRI (Environmental Systems Research Institute, Inc.), a company that developed the widely used GIS system called ArcInfo. We have also received extensive software support from Microsoft. During the past year, the core database model was created by staff member Liz Kolster using a software development tool called ERWin. Currently the model is being tested with data sets, collecting records, and maps entered into the system during the past year. We anticipate publication of the model in early 1997.

A related development has been the creation of an interactive computer key (called INTKEY) for the woody plants found in the Bukit Baka-Bukit Raya National Park in Kalimantan. James Jarvie, who returned in 1995 from a four-year research stint in Indonesia, is now developing this key to allow rapid identification of plants to genera based on simple characters that minimize the need for technical terminology. By the end of 1996, the key will be expanded to cover the approximately 400 genera of woody plants (excluding lianas) present in the whole of Borneo. This electronic key now facilitates the training of academic, forestry, and conservation students in Indonesia and Malaysia. Copies of the key can be obtained at the web site of the Harvard University Herbaria (www.herbaria.harvard.edu).

In September 1994, the Biodiversity Collections Project was awarded funding of $2,375,000 from the World Bank to provide technical assistance to the Government of Indonesia for a program to restore

John Burley

**Field workers conducting botanical inventories for the Flora of West Kalimantan project in Indonesian Borneo.**

the country's botanical and zoological collections and to establish modern information management systems for its natural resources. The Arboretum is collaborating with the Natural History Museum, London, and the Commonwealth Scientific and Industrial Research Organization (CSIRO) of Australia to support this project. In 1995 we conducted studies and international workshops to define immediate taxonomic priorities and to develop guidelines and protocols for collections and archival restorations consistent with modern standards of environmental health and safety. Twelve new Indonesian collections managers received training through study tours to nine countries.

The Program has also begun to design a national biodiversity database for Indonesia that will consolidate information about the natural resources of the country's forests and waters into a single system called IBIS (Indonesian Biodiversity Information System). A detailed study has been completed that outlines the information needs of Indonesian government agencies and nongovernment organizations. This study has also created a basic data dictionary to establish common technical standards and functional requirements for successful implementation of the system.

In 1996, the Arboretum reached agreement with the Government of Indonesia to use the core database model from the NSF project as the foundation for IBIS. Last spring four Indonesian scientists spent six

weeks on a study tour at the Herbaria in Cambridge, learning network, database and GIS skills to facilitate the export of the database model to Indonesia in 1997.

This work in support of the international conservation of biodiversity occupies a prominent place in our fundraising goals. While we have successfully secured government grants and contracts to fund our programs, there is no guarantee that such support will be available in the future. Yet the Arnold Arboretum possesses unique library and herbarium resources that will be critical to future conservation efforts. Consequently we are seeking to establish an endowment fund of $2,000,000 at the Arboretum, the income of which will support continuing work in international research and conservation.

## PUBLIC PROGRAMS

Educational programs for the public have expanded dramatically at the Arboretum over the past decade. We have continued delivering our traditional offerings to increasingly large audiences: *Arnoldia* to our membership, adult education in botany and horticulture to a wide range of amateur and professional students, and guided tours of the grounds to visiting groups of tourists. In recent years, we have developed a growing program of science education for children and interpretive exhibitry for the visiting public.

Our education program in botany and horticulture, largely serving adults in evening classes and on weekends, averages about 150 courses annually. In 1995, for instance, nearly 1,900 students registered for offerings in botany (29 courses), horticultural practice (58), garden design and history (39), plant materials and propagation (45), and garden tours (13). Our program often features lectures by well-known landscape architects such as Susan Child, Carol Johnson, Dan Kiley, Michael Van Valkenburgh, and Morgan Wheelock. Many organizations sponsor their employees' or clients' participation in our educational courses, including the Boston Housing Authority, Federal Reserve Bank of Boston, National Park Service, The Trustees of Reservations, and the University of Massachusetts Cooperative Extension Service.

*Arnoldia,* our quarterly magazine, exemplifies the kind of traditional program that changes from year to year by slow evolution. Nineteen ninety-five saw the publication of fifteen articles and book

reviews, of which ten were authored or coauthored by Arboretum staff. The winter issue was entirely devoted to "A Sourcebook of Cultivar Names." While not an issue that one would read straight through, its up-to-date listing of cultivar checklists gathered in one location the widely dispersed literature on cultivar names, descriptions, and illustrations, all of great value to horticulturists, nursery professionals, garden historians, and landscape designers. In 1996, twelve of nineteen articles were authored by Arboretum staff.

We were pleased to discover an admiring reference to our magazine in *The Plant Explorer's Guide to New England* (1994): "If by any chance you're moved to become a member of the [Arnold] Arboretum. . . . you will soon be receiving *Arnoldia,* a delightful quarterly magazine that always manages to hit upon some fascinating topic or other, from the plant-collecting habits of Henry David Thoreau to the life and times of the dawn redwood . . . "

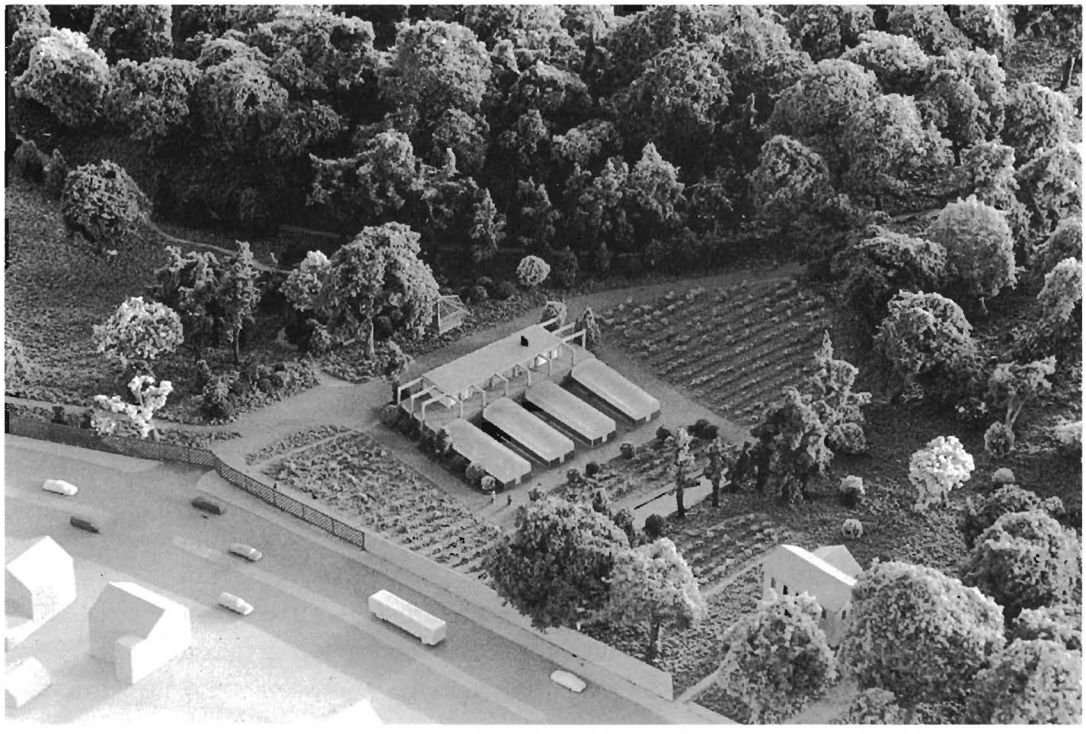
Equally important to the work of the Arboretum are the many volunteers who contribute numerous hours of their time in the greenhouse, in the herbarium, and in our education programs. The number of volunteers increased in 1995 from 114 to 166. One hundred and five tours of the grounds and collections, often led by a volunteer, served nearly 2,600 individuals. Sadly, one of our most beloved volunteer guides, Al Bussewitz, died on August 8, 1995; he will be greatly missed by his many friends.

## *Science in the Pleasure Ground*

The opening of "Science in the Pleasure Ground" in the fall of 1996 brought to a culmination a five-year project to plan and construct a permanent exhibit in the Hunnewell Building that introduces visitors to the landscape of the Arboretum and traces the many uses to which the land has been put. Funded by grants from the National Endowment for the Humanities, the exhibit features five themes of importance in the history of the Arboretum: the design of the land and its changing landscape over the past hundred years; the introduction of plants from distant lands; the development of suburban horticulture for American homes in the middle years of this century; the economic uses of wood in our culture; and the Arboretum's involvement in forest conservation in America and abroad.

Janet Stearns

Janet Stearns



The centerpiece of the exhibit is a 40-to-1 scale model of the Arboretum measuring sixteen by eight feet and displaying over 10,000 individual shrubs and trees. Depicted as vignettes in the landscape, and illuminated by small spotlights, are historical structures and events such as the 1938 hurricane that brought down over 1,500 trees in four hours; the mid-19th-century estate of Benjamin Bussey, complete with grazing sheep; and an archaeological dig that documented the habitation on the land by native Americans centuries ago. The model exhibits a comprehensive overview of the landscape for first-time visitors and clear evidence of the cultural and botanical richness to be found on the grounds.

The opening of the exhibit on October 18, 1996, provided a fitting, if somewhat early, occasion to kick off the celebration of our 125th anniversary in 1997.

## *Children's Education*

Another project reached completion in the spring of 1996 with the publication of an educational CD-ROM in collaboration with a commercial software company called Tom Snyder Productions. Partially funded by a grant from the National Science Foundation, "Rainforest Researchers," as the curriculum package is called, challenges middle-school classes to divide into teams of four experts (taxonomist, ecologist, plant chemist, ethnobotanist) for an expedition to help Indonesian scientists find solutions to pressing environmental problems facing their tropical forests.

As students shuttle between the computer and field workbooks, the team structure strongly encourages shared decision-making and cooperative learning. To insure a high level of visual authenticity for the CD-ROM narrative, the Arboretum led a group of filmmakers on a journey to the Mentawai people of Siberut Island off the coast of Indonesian Sumatra, where extensive footage was shot to document the intimate relationship between these people and the plants of the forest. This footage was then incorporated into the software.

"Rainforest Researchers" promises to be a model for the use of technology to support genuine science learning in the classroom. It has

**Details from the new 8-by-16-foot model of the Arboretum grounds show the Hunnewell Building near the Arborway at top and the Dana Greenhouses and nursery complex at bottom.**

already received many favorable reviews and garnered two software awards for its exceptional educational quality.

### *Community Science Connection*

Nineteen ninety-six marked the second year of a four-year program funded by a grant from the National Science Foundation called Community Science Connection. This program employs educational telecommunications (computers, network software, telephone lines) to link elementary teachers and their classrooms to the Arboretum and to each other in support of the teaching of science. Schoolteachers from our surrounding communities (Boston, Brookline, Newton) participate in a two-week summer workshop and a year-long series of meetings to familiarize themselves with the educational resources of the Arboretum and to develop a new model for teaching science using trees. During the school year, they lead expeditions to the Arboretum to guide their students in the collection of data that is later shared and compared with other classes. The program also encourages parents to support the science activities and learning of their children, both in school and out.

Underlying the Community Science Connection program is an idea about the way science works and how teachers can come to understand and communicate the power of a scientific approach to learning. Science usually begins with curiosity, when a question is formed by an individual about some pattern seen in nature. Why do maple seeds have wings and oak seeds not? A scientific approach suggests a possible explanation: the size and shape of seeds has something to do with the way they are dispersed from the parent plant. The scientist then asks what observations or data can be collected, in a nonbiased way, that would be consistent with or in conflict with this hypothetical explanation. The data are collected and compared with other data. The pattern that emerges either strengthens or weakens the original explanation and, at some point, an alternative explanation may make more sense. Among practicing scientists, this process of scientific investigation is frequently a collaborative and social activity, often accompanied by much discussion and debate. Teaching science, therefore, needs to encourage student interaction and cooperative learning.

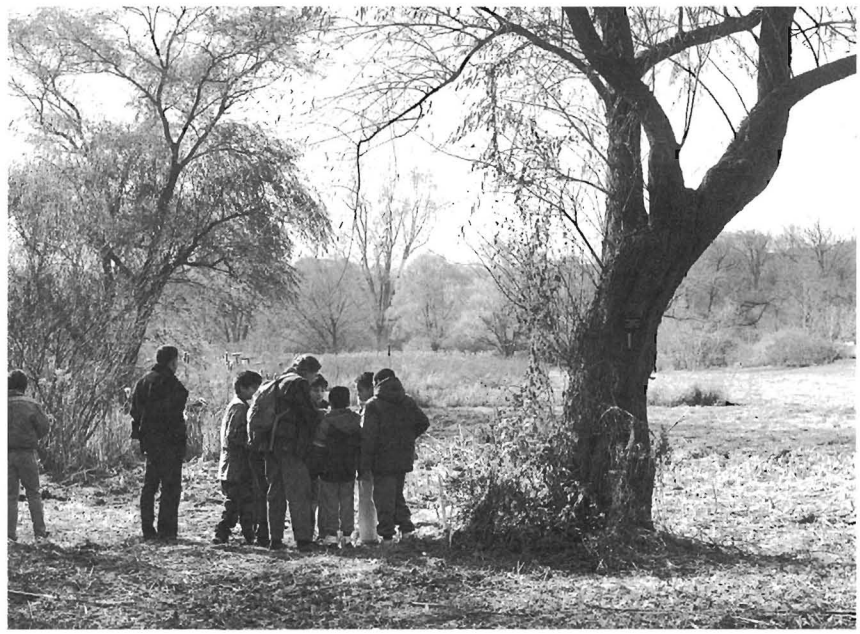
We believe that teachers are better able to teach the skills that shape this scientific process (close observation, question formation, creative

Istvan Rácz

Many programs at the Arboretum depend on the time and talents of volunteers. Each year approximately 3,000 schoolchildren accompanied by more than 300 teachers, teachers' aides, and parents participate in the Arboretum's Field Study Experiences. Here, guides are trained to lead the outdoor investigations that are a part of the program.

explanations, data collection and comparison) if they themselves have engaged it personally and seen its power. Therefore much of our training encourages teachers to abandon the security of the textbook or the nearby expert with the "answer"; instead it encourages them to engage directly in questioning, data sharing, and discussion. Then, through activities conducted with their students, we help them translate their own understanding of, and excitement about, the scientific process to the kind of problem-solving skills that will serve individuals throughout their lives.

Institutions like the Arnold Arboretum can play a special role in helping teachers to understand science and encouraging them to change the textbook-bound way they currently teach to a more activity-based approach. With our dual mission for research and public education, we are in an ideal position to mediate between the scholarship of the university and the practical needs of our community. The physical



Istvan Racz

The Community Science Connection supports year-long studies of trees in schoolyards, supplemented by visits to the Arboretum's collections.

resources of land and collections provide a neutral and friendly setting for addressing difficult subject areas and the changes needed to establish new patterns of teaching. The Arboretum, like many cultural institutions, is a symbol for the entire community of an organization that appeals to the whole family and reinforces the critical role of parents in the support of their children's learning.

Although the technology in Community Science Connection gives the program a progressive image, in fact computers and networks are a minor part of the program, simply a set of tools that facilitate communications and deeper understandings. In the coming years we will continue to explore ways in which technological advances (the World Wide Web and sophisticated information browsers) can further close the distance between the expertise of the Arboretum and the needs of teachers and their students.

Because we believe the model of science education we are creating at the Arboretum is so important for the environmental challenges of the coming century, we wish to ensure a permanent future for this critical role in our community. Thus, in the University Campaign, we seek an endowment of $2,250,000 to sustain the core of this program for generations to come.

## ADMINISTRATION

### *Facilities and Finances*

Our five-year program to bring our facilities to a modern standard of operation was completed in the past year with the expenditure of approximately $200,000 for improvements to our service garage (conversion to gas heating, new lighting, interior painting, roof replacement), our greenhouse complex (roof replacement, bonsai pavilion repair), and the schoolhouse at the Case Estates in Weston (handicap ramp, downstairs bathroom). Thus all our facilities are now in excellent condition and we anticipate no major capital expenditures for deferred maintenance in the near future.

Our budget for the past two fiscal years experienced the full impact of our annual mortgage payment of $312,416. In 1995 we ended the year with an operating deficit (including this new debt payment) of $294,572, which was offset with a transfer from reserves of $217,630 to leave a final deficit of $75,942, approximately the same size as the deficit in the previous year (see the table on page 22). Despite this negative result, however, we also transferred over one million dollars to endowment earlier in the year.

In 1996 our financial performance improved dramatically. At year's end the operating surplus (including debt payment) was $113,386; no transfer from reserves was necessary and no deficit was experienced despite the burden of our mortgage payment.

Several factors account for this result. First, on the income side, our receipt of grant funds doubled in 1995 to $1.3 million, but this was offset by significant increases in program-related expenses for services and travel. In 1996, however, grant income remained the same and gift income increased by one-third. In addition, we were able to constrain the growth in salary expenses (the number of full-time employees declined from 60.5 to 58.8) and significantly reduce expenses for both equipment (by deferring major purchases to the future) and facilities (completion of capital improvements program in 1995).

In short, over the past three years, significant increases in grants (and their capture of staff salaries that released endowment income) has permitted the Arboretum's operating budget to absorb the annual debt payment resulting from a $4,000,000 renovation. We will need to be

vigilant to ensure that this accomplishment in the third year of our 20-year mortgage is not undermined by accelerating expenses in the future.

A fifth of our annual budget partially pays for the cost of operations in the Harvard University Herbaria where the bulk of the herbarium and library collections of the Arboretum are managed collaboratively with the Faculty of Arts and Sciences. These funds support research awards (Mercer and Putnam Fellowships, Arnold Arboretum Associates, Deland Awards for students), direct research, and facility and staff costs for management of the collections. The table on page 23 provides the data on such expenditures for the past eight years.

### *Membership and Development*

Unlike most of our institutional peers, the Arnold Arboretum receives no operating funds from either our parent institution (Harvard Univer-

*Summary of Operations*

| | FY 1993 | FY 1994 | FY 1995 | FY 1996 |
|---|---|---|---|---|
| **Income** | | | | |
| Endowments | 3,039,819 | 3,210,133 | 3,433,102 | 3,587,450 |
| Transfer from Reserves | 0 | 0 | 217,630 | 0 |
| Membership/Gifts | 240,611 | 260,043 | 282,360 | 401,906 |
| Enterprise | 178,155 | 195,096 | 237,167 | 225,387 |
| Grants | 540,760 | 669,367 | 1,272,503 | 1,315,466 |
| Education/Publications | 103,784 | 114,058 | 106,351 | 81,732 |
| **Total Income** | **4,103,129** | **4,448,697** | **5,549,113** | **5,611,941** |
| **Expenses** | | | | |
| Salaries | 2,240,783 | 2,593,398 | 2,962,629 | 3,172,682 |
| Supplies/Equipment | 442,558 | 587,524 | 539,027 | 409,127 |
| Facilities/Operations | 516,796 | 478,220 | 473,291 | 313,567 |
| Services | 689,467 | 695,373 | 1,129,778 | 1,110,375 |
| Travel | 158,837 | 118,947 | 207,913 | 180,386 |
| **Total Expenses** | **4,048,441** | **4,473,462** | **5,312,638** | **5,186,137** |
| **Excesses (Losses)** | | | | |
| Unrestricted Excess (Loss) | 82,762 | 15,045 | 312,351 | 312,482 |
| Restricted Excess (Loss) | (28,074) | (39,810) | (75,877) | 113,320 |
| Operating Excess (Loss) | 54,688 | (24,765) | 236,474 | 425,802 |
| Debt Payment | 0 | 52,069 | 312,416 | 312,416 |
| **Total Excess (Loss)** | **54,688** | **(76,834)** | **(75,942)** | **113,386** |
| **Total Fund Balances** | **1,650,630** | **1,761,322** | **408,670** | **519,789** |

*Arnold Arboretum Expenditures in Dollars for Operations and Research in the Harvard University Herbaria*

| | FY 1989 | FY 1990 | FY 1991 | FY 1992 | FY 1993 | FY 1994 | FY 1995 | FY 1996 | Totals |
|---|---|---|---|---|---|---|---|---|---|
| Facilities and Personnel | 521,785 | 485,445 | 558,316 | 663,372 | 693,177 | 768,666 | 885,641 | 791,919 | 5,368,322 |
| Fellowships | 39,621 | 12,004 | 17,167 | 48,221 | 0 | 31,897 | 42,257 | 55,222 | 246,390 |
| Research Support | 0 | 1,500 | 16,996 | 40,403 | 60,336 | 53,871 | 57,235 | 9,724 | 240,065 |
| **Totals** | 561,406 | 498,949 | 592,479 | 751,996 | 753,513 | 854,434 | 985,133 | 856,865 | 5,854,777 |

sity) or our government partner (the City of Boston). Nearly all of our operating income has traditionally come from past (endowment) and present (membership and annual fund) giving by friends who believe in the work of the institution. In recent years grants have provided funds for special programs, but grants cannot pay for ongoing operations that support the development and curation of the collections. While the Arboretum has benefited from the generosity of past philanthropists, it must continue to build its endowment to sustain its collections and the research and educational programs that use these collections.

In 1993 I established a new position at the Arboretum for a director of development, thereby recognizing our ongoing need to raise money for our programs. The following year we joined the University Campaign with a formal goal of raising $8,200,000, largely to enhance our endowment. To guide us in this new endeavor, Steve Nelson came from the Business School for two years as development director, leaving in 1995 for the Law School. He has been ably replaced by Lisa Hastings, who assumed his responsibilities in 1996.

In 1993 the number of members supporting the Arboretum had fallen to 2,700, and we initiated steps to increase membership in subsequent years. In the spring of 1995 we used direct mail to send a membership brochure to target lists of individuals, and we increased our solicitation efforts in our immediate neighborhood and at Arboretum events. The membership is now approaching 3,100, and we hope to continue increasing this number during the coming year.

As we entered the University Campaign in 1994, it quickly became clear that we could not secure the kind of gifts necessary to achieve our

*Funding Priorities*

| | |
|---|---|
| **Endowment** | |
| Living Collections | $2,500,000 |
| Children's Science Education | $2,250,000 |
| International Conservation of Biodiversity | $2,000,000 |
| Research Fellowships | $1,000,000 |
| **Capital Improvements** | |
| Restoration of Peters Hill Summit | $125,000 |
| Development of Stony Brook Marsh | $200,000 |
| Development of Vine and Sun-Adapted Shrub Garden | $500,000 |

goal without the dedicated help of a set of volunteers who believe in the long-term mission of the institution. We soon began planning for the creation of two new volunteer groups to work closely with the director on long-range planning and the identification of future resources needed to implement the mission.

The Director's Advisory Board of the Arnold Arboretum held its inaugural meeting in the autumn of 1996. Consisting of a group of fifteen to twenty-five volunteers, this group will meet four times annually to provide the director with guidance and counsel on strategic planning, community relations, and fundraising. Committees of the Board will focus on volunteer recruitment, cultivation events, and Campaign goals.

Supplementing this Board will be a larger body of volunteers called the Arboretum Council made up of individuals who are interested in a closer relationship with the Arboretum but who are not yet in a position to commit the time required by participation on the Board. The Council will provide a means for them to learn directly about the Arboretum's work, and it will facilitate the recruitment of a new generation of friends for the future. The first meeting of the Council will take place in the spring of 1997.

During the coming year, the Arboretum will celebrate its 125th birthday and will launch its own Campaign for the New Century. Our goal is to increase our endowment by nearly $8,000,000, thereby securing the future for many of the ongoing programs described in this report. The table above lists our priorities for achieving this goal by the end of the century.

As of this writing, our Campaign is more than a third of the way to accomplishing its objective. We have been heartened and inspired by a pledge of $1,000,000 from the Hunnewell family and a commitment by the Putnam family to endow the Katherine H. Putnam Fellowships at the Arboretum.

## A CONTINUING VISION

The trustees of James Arnold's estate believed that an arboretum, the first established in this country, should first and foremost be an institution devoted to scientific research; they entrusted the funds as an endowment at Harvard University. The Arboretum's first director, Charles Sprague Sargent, had a greater vision: such a research institution could also directly benefit the public through education.

As the words of this report testify, that vision is very much the mission of the Arboretum today. But Sargent also knew that such a vision was not possible without the continuing commitment of dedicated and able friends. He passed the hat over dessert often.

You, the readers, are the friends we need today if we are to sustain Sargent's vision into the future. I look to you for leadership in facing the challenges before us.

Bob Cook

*Robert E. Cook, Director*
1 March 1997

Rácz & Debreczy

The foliage and fruit of *Cornus controversa*.

# PUBLISHED WRITINGS OF THE ARNOLD ARBORETUM STAFF

## J. H. ALEXANDER

1995. *Lilacs: Plants of History—Plants for Tomorrow.* Spencer, OH: International Lilac Society (with N. Sinton).

1996. Would a Lilac By Any Other Name Smell So Sweet? A Search for Fragrance. *Arnoldia* 56(1): 25-28.

## P. ANDERSEN

1994. Review of *The Planters of the English Landscape Garden* by Douglas D. C. Chambers. *Arnoldia* 54(3): 35-36.

1995. Partners in Landscape Preservation. *Land and History* 5(2): 3-5.

1996. Art and Nature in a Garden. Review of *The Muses of Gwinn* by Robin Karson. *Arnoldia* 56(1): 29-32.

## P. S. ASHTON

1994. Towards a Regional Forest Classification for the Humid Tropics of Asia. In *Vegetation Science in Forestry*, ed. E. O. Box et al., 457-468. Dordrecht: Kluwer.

1994. Research Strategy for Optimal Use of Indonesian Flora. In *The Role of Flora in the World Economy and its Conservation*, ed. Suhirman and J. Pfeiffer. Kebun Raya, Indonesia: International Conference, July 1994.

1995. The Contrasting Role of *in situ* Conservation of Biodiversity in the Wild and *ex situ* Conservation of Biodiversity in Botanical Gardens and Zoos. In *Community Development and Conservation of Forest Biodiversity through Community Forestry*, ed. H. Wood, M. McDaniel, and K. Warner. Bangkok: Proceedings of Conference at Regional Community Forestry Training Center, Kasetsart University.

1995. Towards a Regional Forest Classification for the Humid Tropics of Asia. In *Vegetation Science in Forestry*, ed. E. O. Box et al., 453-464. Dordrecht: Kluwer.

1995. What Can Be Learned from a 50 ha Plot Which Cannot Be Learned Any Other Way? *Studies of Global Environmental Change with Special Reference to Asia and Pacific Regions* 2(3): 207-214.

1995. Tree Prosthesis for Crown Access. *Selbyana* 16(2): 174-178 (with S. Appanah and H. T. Chan).

1995. Conservation and Development: What Role Botanic Gardens? In *Proceedings of the XI International Association of Botanic Gardens Conference*, editor with S. A. He and K. Iwatsuki, 16-20. Beijing: China Agriculture Press.

1995. *Proceedings of the XI International Association of Botanic Gardens Conference*, editor with S. A. He and K. Iwatsuki. Beijing: China Agriculture Press.

1995. Population Structure and Canopy Dominance of Two Emergent Dipterocarp Species in a Tropical Rain Forest of Sarawak, East Malaysia. *Tropics* 4(2/3): 133-141 (with A. Itoh et al.).

1995. Relationship between Topography and Distance of Two Emergent Species, *Dryobalanops aromatica* and *D. lanceolata*. *Studies of Global Environmental Change with Special Reference to Asia and Pacific Regions* 2(3): 77-91 (with A. Itoh et al.).

1995. *Species List for the 52-ha Forest Dynamics Research Plot at Lambir Hills National Park, Sarawak, Malaysia.* Center for Tropical Forest Science (with J. V. LaFrankie and S. Tan).

1995. Long Term Ecological Research of Tropical Rain Forest in Sarawak. Proceedings of Conference at Ehime University, March 1995, editor with H. S. Lee and K. Ogino. *Studies of Global Environmental Change with Special Reference to Asia and Pacific Regions* 2(3).

1995. Individual-Based Simulation Models for Forest Succession and Management. *Forest Ecology and Management* 73: 157-175 (with J. Liu).

1995. Damage and Vegetative Regrowth Patterns of Trees in a 52 ha Plot of Mixed Dipterocarp Forest at Lambir Hills National Park, Sarawak. *Studies of Global Environmental Change with Special Reference to Asia and Pacific Regions* 2(3): 185-198 (with T. Ohkubo et al.).

1995. Landslide Scars in Canopy Mosaic Structure as a Large Scale Disturbance to a Mixed Dipterocarp Forest at Lambir Hills National Park, Sarawak. *Studies of Global Environmental Change with Special Reference to Asia and Pacific Regions* 2(3): 172-184 (with T. Ohkubo et al.).

1995. Sustainable Use of Tropical Forests in Asia. In *Biodiversity Conservation*, ed. C. A. Perrings et al., 257-277. Dordrecht: Kluwer (with T. Panayotou).

1995. Forest Architecture of Lambir Rain Forest Revealed by a Large-Scale Research Plot. I. Topography of the Plot. *Studies of Global Environmental Change with Special Reference to Asia and Pacific Regions* 2(3): 2-20 (with T. Yamakura et al.).

1995. Forest Architecture of Lambir Rain Forest Revealed by a Large-Scale Research Plot. II. Physiognomic Dimensions. *Studies of Global Environmental Change with Special Reference to Asia and Pacific Regions* 2(30): 21-41 (with T. Yamakura et al.).

1995. Topography of a Large-Scale Research Plot Established within a Tropical Rain Forest in Lambir, Sarawak. *Tropics* 5(1-2): 41-56 (with T. Yamakura et al.).

1996. Stand Level Concepts and Indicators for Certification of Forest Management. In Anon., Proceedings: *UBC-UPM Conference on the Ecological, Social and Political Issues of the Certification of Forest Management*, 25-58. University of British Columbia, Vancouver, and Universiti Pertanian Malaysia, Serdango.

1996. Species-Area and Species-Individual Relationships for Tropical Trees: A Comparison of Three 50-ha Plots. *Journal of Ecology* 84(4): 549-562 (with R. Condit et al.).

1996. Seedling Growth of *Shorea* (Section *Doona*) Dipterocarpaceae in Soils from Topographically Different Sites of Sinharaja Rain Forest in Sri Lanka. In *The Ecology of Tropical Forest Tree Seedlings*, ed. M. D. Swaine, 245-265. UNESCO. Man and the Biosphere Series 17. Paris: Parthenon (with C.V. S. Gunatilleke, G. A. D. Perera, and I. A. U. N. Gunatilleke).

1996. An Overview of Seed and Seedling Ecology of *Shorea* (Section *Doona*) Dipterocarpacae. In *Biodiversity and the Dynamics of Ecosystems*, ed. I. M. Turner et al., 81-102. DIWPA Series 1, Otsu, Japan: International Network for Diversitas (with I. A. U. N. Gunatilleke and C.V. S. Gunatilleke).

1996. Separating Signal from Noise in Sampling Tropical Forest Structure and Dynamics. In *Measuring and Monitoring Biodiversity: The International Network of Biodiversity Plots*, ed. F. Dallmeier. Washington, DC: Smithsonian Institution (with P. Hall et al.).

1996. The Tree Flora of Lambir Hills National Park. In *Long-Term Ecological Research at Lambir Hills National Park*, ed. H. S. Lee et al., 20-25. Kuching, Malaysia: Sarawak Forest Department (with J. V. LaFrankie and S. Tan)

1996. Forest Structure of a Tropical Rain Forest at Lambir, Sarawak, with Special Reference to the Dependency of Physiognomic Dimensions on Topography. *Tropics* 6: 1-18 (with T. Yamakura et al.).

1996. Turning a Sound Concept into a Practical Reality. In *Global Terrestrial Observing System (GTOS)*. Nairobi: ICSU/UNEP/FAO/UNESCO/WHO. UNEP/EAP.TR 95-08 (with editorial board).

**D. E. BOUFFORD**

1994. Angiosperms. Subclass Hamamelidae. In *The New Encyclopaedia Britannica*, 15th ed., 13 (Macropaedia): 648-661.

1994. Verbenaceae through Solanaceae. In *Flora of China*, Vol. 17, Flora of China Editorial Committee. Beijing: Science Press, and St. Louis: Missouri Botanical Garden (as

member of FOC editorial committee for vascular plants).

1995. Angiospermae, Dicotyledoneae, Sympetalae (b), Vol. IIIb. In *Flora of Japan*, editor with K. Iwatsuki, T. Yamazaki, H. Ohba. Tokyo: Kodansha.

1995. Mizutamaso (*Circaea*). In *Shokubutsu no Sekai* (*World of Plants*), editor with K. Iwatsuki, 43: 201- 203. Tokyo: Asahi Shimbun (in Japanese).

1995. Pteridophyta and Gymnospermae. In *Flora of Japan*, Vol. 1, editor with K. Iwatsuki, T. Yamazaki, H. Ohba. Tokyo: Kodansha.

1995. *Shokubutsu no Sekai.* (*World of Plants*), editor with K. Iwatsuki, 43: 193-224. Tokyo: Asahi Shimbun (in Japanese).

1995. Gentianaceae through Boraginaceae. In *Flora of China*, Vol. 16, Flora of China Editorial Committee. Beijing: Science Press, and St. Louis: Missouri Botanical Garden (as member of FOC editorial committee for vascular plants).

1996. Angiospermae. In *Flora of Taiwan*, Vol. 2, 2nd. ed., editor with C. F. Hsieh et al. Taipei, Taiwan: Editorial Committee of the Flora of Taiwan.

1996. A Contribution to the Moss Flora of Henan Province, China. *Acta Botanica Yunnan* 18: 67-71 (with B. C. Tan et al.).

**J. BURLEY**

1996. Progress in the Floristic Inventory of Kalimantan. In *Borneo in Transition: People, Forests, Conservation and Development.*, ed. C. Padoch and N. L. Peluso, 76-89. Kuala Lumpur and New York: Oxford University Press.

**S. CONNOR**

1995. Mystical, Medicinal Witch Hazel. *Arnoldia* 55(3): 20-21.

**E. CONTI**

1996. Circumscription of Myrtales and Their Relationships to Other Rosids: Evidence from *rbc*L Sequence Data. *American Journal of Botany* 83(2): 221-233 (with A. Litt and K. J. Sytsma).

1996. *mat*K and *rbc*L Gene Sequence Data Indicate That *Saxifraga* (Saxifragaceae) Is Polyphyletic. *American Journal of Botany* 83(3): 371-382 (with D. E. Soltis et al.).

**R. E. COOK**

1995. *The Director's Report of the Arnold Arboretum: 1993-1994.* Jamaica Plain, MA: The Arnold Arboretum.

**N. D. DE ZOYSA**

1994. *Rattans of Sri Lanka: An Illustrated Field Guide.* Battaramulla, Sri Lanka: Sri Lanka Forest Department (with K. Vivekanandan).

1996. Regional Priorities in Asia: Sri Lanka. In *Palms: Their Conservation and Sustained Utilization*, ed. D. Johnson, 53-60. Gland, Switzerland: International Union for Conservation of Nature and Natural Resources.

**P. DEL TREDICI**

1995. A Nitrogen Fixation: The Story of the *Frankia* Symbiosis. *Arnoldia* 55(4): 26-31.

1995. Requiem for a Cork Tree. *Arnoldia* 55(3): 22-24.

1995. Shoots From Roots: A Horticultural Review. *Arnoldia* 55(3): 11-19.

1995. Plant Collecting on Wudang Shan. *Arnoldia* 55(1): 12-20 (with P. Meyer et al.).

1996. The Propagation of Hardy, Woody Plants from Root Cuttings: A Review. *International Plant Propagators' Society Combined Proceedings.* 45: 431-439.

**T. FORREST**

1995. Nature's Vagaries: The Weather of 1995 and the Living Collections of the Arnold Arboretum. *Arnoldia* 55(4): 2-15.

1995. Two Thousand Years of Eating Bark: *Magnolia officinalis* var. *biloba* and *Eucommia ulmoides* in Traditional Chinese Medicine. *Arnoldia* 55(2):12-18.

1996. Dugout Canoes, Arrow Poisons, and the Cure for Cancer: Book Review. Reviews of *Ethnobotany: Evolution of a Discipline*, R. E. Schultes and S. von Reis, eds.; and *Plants, People, and Culture: The Science of Ethnobotany*, M. J. Balick and P. A. Cox. *Arnoldia* 56(2): 38-40.

1996. Nature's Relentless Onslaught, Redux. *Arnoldia* 56(1): 22-24.

**J. V. FREUDENSTEIN**

1994. Character Transformation and Relationships in Corallorhiza (Orchidaceae: Epidendroideae). II. Morphological Variation and Phylogenetic Analysis. *American Journal of Botany* 81: 1458-1467.

1994. Gynostemium Structure and Relationships of the Corallorhizinae (Orchidaceae: Epidendroideae). *Plant Systematics and Evolution* 193: 1-19.

1994. Character Transformation and Relationships in Corallorhiza (Orchidaceae: Epidendroideae). I. Plastid DNA. *American Journal of Botany* 81: 1449-1457 (with J. J. Doyle).

1994. Plastid DNA, Morphological Variation and the Phylogenetic Species Concept: The Corallorhiza Maculata Complex. *Systematic Botany* 19: 273-290 (with J. J. Doyle).

1996. Pollinium Development and Number in the Orchidaceae. *American Journal of Botany* 83: 813-824 (with F. N. Rasmussen).

**I. HAY**

1995. *Science in the Pleasure Ground: A History of the Arnold Arboretum.* Boston: Northeastern University Press.

1996. George Barrell Emerson and the Establishment of the Arnold Arboretum. *Arnoldia* 54(3): 12-21.

**R. A. HOWARD**

1994. Caroline Kathryn Allen (1904-1975): A Remembrance Long Overdue. *Taxon* 43: 501-504.

1994. The Role of Botanists During World War II in the Pacific Theatre. *Botanical Review* 60: 197-257.

1995. *Ipomoea sphenophylla* Urban Recollected and Neotypified. *Harvard Papers in Botany* 7: 69-72 (with J. A. McDonald).

1995. Recovery Responses of Tropical Trees after Hurricane Andrew. *Harvard Papers in Botany* 6: 37-63 (with L. Schokman).

1996. *An Almanac of Botanical Trivia.* Acton, MA: Richard A. Howard.

1996. Ignatz Urban and the "Symbolae Antillianae." Flora of the Greater Antilles Newsletter 10: 1-7.

1996. Polygonaceae. In *Flora of the Pico das Almas*, ed. B. L. Stannard, 542. Kew, UK: Royal Botanic Garden.

1996. The Roosevelt Campobello International Park. *Wildflower* 12(2): 29-31.

1996. The St. Vincent Botanical Garden—The Early Years. *Harvard Papers in Botany* 8: 1-6.

**J. K. JARVIE**

1994. What Are Tropical Floras for in SE Asia? *Taxon* 43: 444-448 (with P. V. Welzen).

1995. Turning Taxonomic Data into Information at Herbarium Bogoriense. *DELTA Newsletter* 11: 2.

1995. Anatomical Data and Sectional Delimitation in *Syzygium*. *Paper and Poster Abstracts, Flora Malesiana Symposium*: 12 (Paper) and 33 (Poster) (with S. Sunarti).

1996. *Thismia lauriana* (Burmanniaceae), a New Species from Central Kalimantan. *Blumea* 1: 257-259.

**C. JULYAN**

1996. Constructivist Perspective on Teaching and Learning Science. In *Constructivism: Theory, Perspectives, and Practice*, ed. C. Fosnot, 35-72. New York: Teachers College Press (with E. Duckworth).

**W. KITTREDGE**

1996. Nomenclature Reassessment of *Herissantia* (Malvaceae) and its Generic Synonyms. *Harvard Papers in Botany* 8: 57-62 (with K. N. Gandhi).

**G. L. KOLLER**

1994. Gold-Leaved Plants Keep the Hues of Spring. *Fine Gardening* 39: 38-41.

1995. Foundations for a Winter Garden. *Fine Gardening* 46: 24-29.

1995. Rehder's Ceanothus: *Ceanothus* x *Pallidus* 'Roseus'. *Arnoldia* 55(1): 21-23.

**J. V. LAFRANKIE**

1994. Population Dynamics of Some Tropical Trees that Yield Non-Timber Forest Products. *Economic Botany* 48(3): 301-309.

1994. Diversity Pattern and Spatial Scale: A Study of a Tropical Rain Forest of Malaysia. *Environmental and Ecological Statistics* 1: 265-286 (with F. He, P. Legendre, and C. Bellehumeur).

1994. *Pasoh Climatic Summary (1991-1993).* FRIM Research Data No. 3. Kepong, Malaysia: Forest Research Institute Malaysia (with S. Sulaiman and A. Rahim-Nik).

1995. *Species List for the 52-ha Forest Dynamics Research Plot at Lambir Hills National Park, Sarawak, Malaysia.* Center for Tropical Forest Science (with P. S. Ashton and S. Tan).

1996. The Contribution of Large-Scale Forest Dynamic Plots to Theoretical Community Ecology. In *Biodiversity and the Dynamics of Ecosystems*, DWIPA Series Vol. 1, ed. I. M. Turner et al., 63-79. Singapore: Diversitas Western Pacific and Asia (DWIPA).

1996. The Distribution and Abundance of Malaysian Trees: The Significance of Family Characteristics. *Bulletin of the Singapore Botanic Gardens* 48(1): 1-22.

1996. Species-Area and Species-Individual Relationships for Tropical Trees: A Comparison of Three 50- ha Plots. *Journal of Ecology* 84(4): 549-562 (with R. Condit et al.).

1996. The Impact of Climate Change on the Phenology of Asian Tropical Forests. *Climate Change* 3: 226-239 (with R. Corlett).

1996. Separating Signal from Noise in Sampling Tropical Forest Structure and Dynamics. In *Measuring and Monitoring Biodiversity: The International Network of Biodiversity Plots*, ed. F. Dallmeier. Washington, DC: Smithsonian Institution (with P. Hall et al.).

1996. Spatial Pattern of Diversity in a Tropical Rain Forest in Malaysia. *Journal of Biogeography* 23: 57-74 (with F. He and P. Legendre).

1996. Tree Population Structure in a Tropical Forest Fragment in Singapore. *Asian Journal of Tropical Biology* 2(1): 39-48 (with S. K. Lee and A. C. Ercelawn).

1996. *Capparis buwaldae* Jacobs (Capparaceae): A New Mymecophyte from Borneo. *Blumea* 41: 223-230 (with U. Maschwitz et al.).

1996. The Tree Flora of Lambir Hills National Park. In *Long-Term Ecological Research at Lambir Hills National Park*, ed. H. S. Lee et al., 20-25. Kuching, Malaysia: Sarawak Forest Department (with S. Tan and P. S. Ashton)

**T. G. LAMAN**

1995. The Ecology of Strangler Fig Seedling Establishment. *Selbyana* 16(2): 223-229.

1995. *Ficus stupenda* Germination and Seedling Establishment in a Bornean Rain Forest Canopy. *Ecology* 76(8): 2617-2626.

1995. Safety Recommendations for Climbing Rain Forest Trees with "Single Rope Technique." *Biotropica* 27(3): 406-409.

1996. *Ficus* Seed Shadows in a Bornean Rain Forest. *Oecologia* 107(3): 347-355.

1996. The Impact of Seed Harvesting Ants (*Pheidole* sp. nov.) on *Ficus* Establishment in the Canopy. *Biotropica* 28(4b): 777-781.

1996. Specialization for Canopy Position by Hemiepiphytic *Ficus* in a Bornean Rain Forest. *Journal of Tropical Ecology* 12: 789-803.

1996. Distribution and Abundance of Vascular Epiphytes and Hemiepiphytic *Ficus* on Dipterocarps in Gunung Palung National Park, West Kalimantan, Indonesia. *Tropical Biodiversity* 3(3): 181-192 (with H. Azemi and S. Budhi).

1996. Rain Forest Bird Diversity in Gunung Palung National Park, West Kalimantan, Indonesia. *Tropical Biodiversity* 3(3): 281-296 (with D. E. Lukas and J. C. Gaither).

### K. H. MADSEN

1994. *Landscape Journal*. Special Issue: Women, Land, Design (Fall 1994) 12(2) (editor with J. F. Furlong and P. Horrigan).

1994. Women, Land, Design: Considering Connections. *Landscape Journal* (Fall 1994) 12(2): 88-101 (with J. F. Furlong).

### J. A. MCDONALD

1995. Medicinal Plant Exploration—Past and Present. *Arnoldia* 55(2): 2-11.

1995. Revision of *Ipomoea* Section *Leptocallis* (Convolvulaceae). *Harvard Papers in Botany* 6: 97-122.

1995. Two New Species from Borneo: *Anisophyllaea ismailii* (Rhizophoraceae) and *Sonerila verticillata* (Melastomataceae). *Harvard Papers in Botany* 6: 123-127.

1995. *Ipomoea sphenophylla* Urban Recollected and Neotypified. *Harvard Papers in Botany* 7: 69-72 (with R. A. Howard).

1995. *Macadamia erecta* (Proteaceae), a New Species from Southeast Sulawesi. *Harvard Papers in Botany* 7: 7-10 (with Ismail R.).

### T. SANG

1996. Evolution of Chloroplast DNA Intergenic Spacers and Phylogenetic Implications in Peonies (*Paeonia*, Paeoniaceae). *Supplement to the American Journal of Botany*. (Abstracts). 83(6): 189.

### R. SCHULHOF

1995. A Celebration of Crabapples. Review of *Flowering Crabapples: The Genus Malus*. J. L. Fiala. *Arnoldia* 55(4): 34-35.

1995. Preserving Science in a Historic Landscape. *Land and History* 5(2): 17-19.

1996. Public Garden Landscapes: New Stories to Tell. *Public Garden* 11(1): 12-15.

### S. A. SPONGBERG

1994. A Late Summer Ornamental: *Poliothyrsis sinensis*. *Arnoldia* 54(3): 32-34.

1995. Arboreta. In *Encyclopedia of Environmental Biology*, Vol. 1, ed. W. A. Nierenberg, 81-92. San Diego: Academic Press.

1995. A *Davidia* Bibliography. In *International Dendrology Society Yearbook 1994*, 51-54. London: International Dendrology Society.

1995. *Stewartia*. In *The European Garden Flora*, Vol. 4, ed. J. Cullen et al., 29-35. Cambridge, England: Cambridge University Press.

1995. Recent Botanical and Dendrological Publications. In *International Dendrology Society Yearbook 1994*, 153-157. London: International Dendrology Society (with S. Andrews and P. Heenan).

1995. International Code of Nomenclature for Cultivated Plants—1995. In *Regnum Vegetabile*, editor with P. Trehane and members of the editorial committee, 133: 1-175. Wimborne, UK: Quarterjack Publishing.

1996. Cultivar Registration at the Arnold Arboretum 1995. *HortScience* 31(3): 329.

1996. 'Rose Lantern': A New Cultivar of *Koelreuteria paniculata*, the Golden-Rain Tree. *Arnoldia* 56(2): 32-37 (with F. S. Santamour, Jr).

**P. F. STEVENS**

1995. George Bentham and the Darwin/Wallace Papers of 1858: More Myths Surrounding the Origin and Acceptance of Evolutionary Ideas. *The Linnean* 11(2): 14-16.

1995. Introduction. In *Ericaceae*, Flora Neotropica Monograph 66, ed. J. Luteyn, 1-12. New York: New York Botanical Garden.

1995. Guttiferae. In *Handbooks of the Flora of Papua New Guinea*, Vol. 3, ed. B. J. Conn, 61-126. Melbourne: Melbourne University Press.

1995. Arfak Mountains, Gunung Lorentz, Maberamo-Pegunungan Jayawijaya. In *Centres of Plant Diversity: A Guide and Strategy for Their Conservation*, ed. S. D. Davis, V. H. Heywood, and A. C. Hamilton, 406-415. Cambridge, UK: World Wide Fund for Nature and International Union of Nature and Natural Resources (with S. D. Davis).

1996. On Phylogenies and Data Bases—Where Are the Data, or Are There Any? *Taxon* 45: 85-98.

1996. Charles Bessey, Evolution, Classification, and the New Botany. *Huntia* 9: 179-213 (with A. Cuerrier and R. W. Kiger).

**K. E. TRIPP**

1994. *Cephalotaxus*: A Plum Yew Primer. *American Nurseryman* 180(9): 28-37.

1994. Considering *Cotinus*. *Arnoldia* 54(2): 20-30.

1994. Exploring the Complexities of Plant Hardiness. *Arnoldia* 54(3): 22-31 (with J. C. Raulston).

1994. Profiles Promote Plants to the Public. *American Nurseryman*. 179(8): 91-92 (with J. C. Raulston).

1995. *Cephalotaxus*: The Plum Yews. *Arnoldia* 55(1): 24-39.

1995. A Fantastic Foursome of Flowering Trees. *Grounds Maintenance* 30(2): G12-G20.

1995. Hardy Asian Alders. *Arnoldia* 55(4): 16-25.

1995. Hardy New Englanders. *Amerian Nurseryman* 181(7): 90-101.

1995. *Picea omorika* Cultivars at the Arnold Arboretum. *American Conifer Society Bulletin* 12(2): 55-56.

1995. Vegetative Propagation of Rare and Unusual Conifers: An Alternative Approach. *International Plant Propagators' Society Combined Proceedings Eastern Region* 45: 472-476.

1995. *The Year in Trees: Superb Woody Plants for Four-Season Gardens*. Portland, OR: Timber Press (with J. C. Raulston).

**T. WARD**

1994. *Pseudolarix amabilis*. *International Plant Propagators' Society Combined Proceedings* 44: 553.

Rácz & Debreczy

The distinctive bracts of *Cornus kousa*.

# STAFF OF THE ARNOLD ARBORETUM*

## ADMINISTRATION

Rose Balan, *Staff Assistant, HUH*
Donna Barrett, *Financial Assistant (upgraded 6/1/95)*
Kenneth Clarke, *Custodian*
Sheila Connor, *Facilities Manager*
Robert Cook, *Director, Arnold Professor*
Kelly Harvey, *Membership Assistant (hired 3/6/96)*
Lisa Hastings, *Senior Development Officer (appointed 11/28/94; upgraded 1/1/96)*
Andrew Hubble, *Network Systems Manager (appointed 6/1/95)*
Frances Maguire, *Director, Finance and Administration*
Steven Nelson, *Development Director (left 1/25/96)*
Deborah Pasternak, *Staff Assistant, Development (hired 12/19/94)*
David Sieks, *Staff Assistant, Membership (left 12/31/95)*
Kara Stepanian, *Development Assistant (hired 3/6/96)*

## HERBARIUM

David Boufford, *Assistant Director for Collections, HUH*
Noel Cross, *Internet Server/Systems Administrator (hired 11/20/95)*
Paul Groff, *Curatorial Assistant (left 3/31/96)*
Susan Hardy Brown, *Curatorial Assistant*
Carolyn Hesterberg, *Secretary*
Walter Kittredge, *Curatorial Assistant (hired 6/1/95)*
Pamela White, *Curatorial Assistant (left 5/16/95)*
Emily Wood, *Manager of Systematic Collections*

## LIBRARY

Jennifer Brown, *Library Assistant (left 8/26/94)*
Sheila Connor, *Horticultural Research Archivist*
Kimberly Crandall, *Library Assistant (left 6/30/95)*
Carol David, *Library Assistant (hired 12/12/94)*
Elzbieta Ekiert, *Librarian*
Carol Mita, *Library Assistant (hired 9/7/95)*
Gretchen Wade, *Library Assistant*
Judith Warnement, *Librarian*

## LIVING COLLECTIONS

John Alexander, *Chief Plant Propagator*
Kristin Claeys, *Landscape Preservation Field Assistant (left 12/31/95)*
Luis Colon, *Grounds Staff*
Julie Coop, *Assistant Superintendent of Grounds*
John DelRosso, *Arborist*
Peter Del Tredici, *Director of Living Collections*
Robert Famiglietti, *Grounds Staff*
Todd Forrest, *Curatorial Assistant (hired 9/6/94)*
Kirsten Ganshaw, *Grounds Staff (hired 4/3/95)*
Donald Garrick, *Grounds Staff*
Michael Gormley, *Grounds Staff (retired 12/22/95)*
Dennis Harris, *Grounds Staff*
Karlton Holmes, *Grounds Staff (left 11/2/94)*
Irina Kadis, *Laboratory Technician (hired 12/12/94, left 2/25/96)*
Susan Kelley, *Curatorial Associate*
Bruce Munch, *Grounds Staff*
James Nickerson, *Grounds Staff*
John Olmsted, *Head Arborist*
James Papargiris, *Grounds Staff*
Maurice Sheehan, *Grounds Staff, Working Foreman*
Stephen Spongberg, *Horticultural Taxonomist*
Kirsten Thornton, *Landscape Preservation Assistant (appointed 1/3/95)*
Mark Walkama, *Grounds Staff*
Thomas Ward, *Greenhouse Manager and Propagator*
Patrick Willoughby, *Superintendent of Grounds*

## PUBLIC PROGRAMS

Phyllis Andersen, *Landscape Historian*
Rebecca Arnoldi, *Mercer Fellow (appointed 9/21/95, ended 12/15/95)*
Sheila Baskin, *Secretary*
Kirstin Behn, *Staff Assistant, CSC (hired 5/6/96)*
James Gorman, *Staff Assistant, Visitor Services*

* 1 July 1994 through 30 June 1996

Annette Huddle, *Children's Program Assistant (left 3/1/96)*
Candace Julyan, *Project Director, CSC (appointed 1/1/95)*
Gary Koller, *Senior Horticulturist*
Karen Madsen, *Editor of* Arnoldia
Marcia Mitchell, *Adult Education Manager (left 9/15/95)*
Lauren Mofford, *Field Study Coordinator (hired 2/21/96)*
Richard Schulhof, *Director of Education and Public Affairs (left 4/5/96)*
Chris Strand, *Outreach Horticulturist*
Diane Syverson, *Manager of School Programs (upgraded 7/1/95)*
Pamela Thompson, *Adult Education Coordinator (upgraded 8/1/95)*

## RESEARCH

Peter Ashton, *Charles Bullard Professor of Forestry*
James Beach, *Manager of Biological Database Systems (left 7/29/94)*
John Burley, *Research Director*
Alison Church, *Research Assistant (left 5/24/96)*
Elena Conti, *Mercer Fellow (appointed 9/1/95)*
Lisa Curran, *Mercer Fellow (appointed 8/1/94, ended 1/31/96)*
John Freudenstein, *Mercer Fellow (ended 6/30/95)*
James Jarvie, *Research Associate*
Cynthia Jensen, *Associate Director for SE Asian Program (hired 1/8/96)*
Elizabeth Kolster, *Information Systems Project Manager (hired 9/15/95)*
James LaFrankie, *Research Coordinator*
Ann-Marie Luciano, *Staff Assistant (hired 9/26/94)*
Jinshuang Ma, *Putnam Fellow (appointed 4/1/96)*
Mark Madison, *Mercer Fellow (appointed 2/1/96)*
J. Andrew McDonald, *Research Associate (ended 12/31/95)*
Cheryl Murphy, *Administrative Assistant (left 3/31/96)*
William Niedzwiecki, *Staff Assistant (hired 2/20/96, left 6/20/96)*
Tao Sang, *Mercer Fellow (appointed 9/1/95)*
Peter Stevens, *Professor of Biology*
Kim Tripp, *Putnam Fellow*

## RESEARCH AFFILIATES

David Burslem, *Arnold Arboretum Associate (appointed 4/1/95, ended 8/31/95)*
Jill Belsky, *Arnold Arboretum Associate (appointed 11/1/95, ended 6/30/96)*
Lisa Curran, *Arnold Arboretum Associate (appointed 2/1/96)*
Niranjala D. De Zoysa, *Arnold Arboretum Associate (ended 3/31/96)*
Ida Hay, *Arnold Arboretum Associate (ended 8/31/94)*
Richard Howard, *Professor of Dendrology, emeritus*
Shiu-Ying Hu Hsu, *Botanist, emerita*
Timothy Laman, *Arnold Arboretum Associate (appointed 9/1/94)*
Jinshuang Ma, *Arnold Arboretum Associate (appointed 8/11/95, ended 12/31/95)*
J. Andrew McDonald, *Arnold Arboretum Associate (appointed 1/1/96)*
Zack Murrell, *Arnold Arboretum Associate (ended 8/31/95)*
Colin Ridsdale, *Mercer Fellow (ended 8/31/94)*
Bernice Schubert, *Curator, emerita*
Stephen Siebert, *Arnold Arboretum Associate (appointed 11/1/95, ended 6/30/96)*
Margaret Stern, *Arnold Arboretum Associate (ended 6/30/95)*
Carroll Wood, Jr., *Professor of Biology, emeritus*
Tsun-shen Ying, *Arnold Arboretum Associate (appointed 10/1/95)*

## VISITING COMMITTEE

Christopher T. Bayley, *Chairman*
Gregory J. Anderson
Robert A. Bartlett, Jr.
Caroline G. Donnelly
Thomas S. Elias
Corliss Knapp Engle
Donna Ford Hartman
Francis Oakes Hunnewell
Joan M. Hutchins
Janine Evnin Luke
Matthew J. Kiefer
Ellen West Lovejoy
Edith N. K. Meyer
Morgan Dix Wheelock, Jr.
Judith D. Zuk