In the Shadow of Red Cedar

Wade Davis

In the shadow of red cedar, along a stream colored by salmon, in a place where plants draw food from the air and small creatures living on dew never touch the forest floor, it is difficult to imagine a time when the coastal temperate rainforests of North America did not exist. Today, these immense and mysterious forests, which in scale and wonder dwarf anything to be found in the tropics, extend in a vast arc from northern California 2,000 miles north and west to the Copper River and the Gulf of Alaska. Home to myriad species of plants and animals, a constellation of life unique on earth, they spread between sea and mountain peak, reaching across and defying national boundaries as they envelop all who live within their influence in an unrivaled frontier of the spirit.

It is a world anchored in the south by giant sequoias (Sequoiadendron giganteum), the most massive of living beings, and coast redwoods (Sequoia sempervirens) that soar 300 feet above the fogbanks of Mendocino. In the north, two trees flourish: western hemlock (Tsuga heterophylla), with its delicate foliage and finely furrowed bark; and Sitka spruce (Picea sitchensis), most majestic of all, a stunningly beautiful species with blue-green needles that are salt tolerant and capable of extracting minerals and nutrients from sea spray. In between, along the silent reaches of the midcoast of British Columbia, behind a protective veil of Sitka spruce, rise enormous stands of Douglas fir (Pseudotsuga menziesii). Intermingled with hemlock and fir, growing wherever the land is moist and the rains abundant, is perhaps the most important denizen of the Pacific slope, the western red cedar (Thuja plicata), the tree that made possible the florescence of the great and ancient cultures of the coast.

To walk through these forests in the depths of winter, when the rain turns to mist and settles softly on the moss, is to step back in time. Two hundred million years ago vast coniferous forests formed a mantle across the entire planet. Dinosaurs evolved long supple necks to browse high among their branches. Then evolution took a great leap, and flowers were born. What made them remarkable was a mechanism of pollination and fertilization that changed the course of life on earth. In the more primitive conifers, the plant must produce the basic food for the seed with no certainty that it will be fertilized. In the flowering plants, by contrast, fertilization itself sparks the creation of the seed's food reserves. In other words, unlike the conifers, the flowering plants make no investment without the assurance that a viable seed will be produced. As a result of this and other evolutionary advances, the flowering plants came to dominate the earth in an astonishingly short time. Most conifers went extinct, and those that survived retreated to the margins of the world, where a small number of species maintained a foothold by adapting to particularly harsh conditions. Today, at a conservative estimate, there are over 250,000 species of flowering plants. The conifers have been reduced to a mere 700 species, and in the tropics, the hotbed of evolution, they have been almost completely displaced.

On all the earth, there is only one region of any size and significance where, because of particular climatic conditions, the conifers retain their former glory. Along the northwest coast of North America the summers are hot and dry, the winters cold and wet. Plants need water and light to create food. Here in the summer there is ample light for photosynthesis but not enough water for most deciduous trees, except in low-lying areas where broadleafed species such as red alder (Alnus rubra), cottonwood (Populus balsamifera ssp. trichocarpa), and vine maple (Acer circinatum) flourish. In the winter, when
both water and light are sufficient, the low temperatures cause the flowering plants to lose their leaves and become dormant. The evergreen conifers, by contrast, are able to grow throughout the long winters, and since they use water more efficiently than broadleafed plants, they also thrive during the dry summer months. The result is an ecosystem so rich and so productive that the biomass in the best sites is easily four times as great as that of any comparable area of the tropics.

Indeed it is the scale and abundance of the coastal rainforests that overwhelm the visitor. White pine (Pinus strobus), the tallest tree of the eastern deciduous forests, barely reaches two hundred feet; in the coastal rainforests there are thirteen species that grow higher, with the redwoods reaching nearly four hundred feet, taller than a twenty-five-story building. Red cedars can be twenty feet or more across at the base. The footprint of a Douglas fir would crush a small cabin. The trunk of a western hemlock, a miracle of biological engineering, stores thousands of gallons of water and supports branches festooned with as many as 70 million needles, all capturing the light of the sun. Spread out on the ground, the needles of a single tree would create a photosynthetic surface ten times the size of a football field.

These giant trees delight, but the real wonder of the forest lies in the details, in the astonishingly complex relationships: a pileated woodpecker living in the hollow of a snag, tiny seabirds laying their eggs among the roots of an ancient cedar, marbled murrelets nesting in a depression in the moss in the fork of a canopy tree, rufous hummingbirds returning each spring, their migrations timed to coincide with the flowering of salmonberries (Rubus spectabilis). In forest streams dwell frogs with tails and lungless salamanders that live by absorbing oxygen through their skin. Strange amphibians, they lay their eggs not in water but on land, in moist debris and fallen logs.

Invertebrate life is remarkably diverse. The first survey to explore systematically the forest
Mossy branches of bigleaf maple, Acer macrophyllum, Olympic Peninsula, Washington.

canopy in the Carmanah Valley of Vancouver Island yielded 15,000 species, a third of the invertebrates known to exist in all of Canada. Among the survey's collections were 500 species previously unknown to science. Life is equally rich and abundant on the forest floor. There are 12 species of slugs, slimy herbivores that in some areas account for as much as seventy percent of the animal biomass. A square meter of soil may support 2,000 earthworms, 40,000 insects, 120,000 mites, 120,000,000 nematodes, and millions upon millions of protozoa and bacteria, all alive, moving through the earth, feeding, digesting, reproducing, and dying.

None of these creatures, of course, lives in isolation. In nature, no event stands alone. Every biological process, each chemical reaction, leads to the unfolding of other possibilities for life. Tracking these strands through an ecosystem is as complex as untangling the distant threads of memory from a myth. For years, even as industrial logging created clearcuts the size of small nations, the coastal rainforests were among the least studied ecosystems on the planet. Only within the last decade or two have biologists begun to understand and chart the dynamic forces and complex ecological relationships that allow these magnificent forests to exist.

One begins with wind and rain, the open expanse of the Pacific and the steep escarpment of mountains that makes possible the constant cycling of water between land and sea. Autumn rains last until those of spring, and months pass without a sign of the sun. Sometimes the rain falls as mist, and moisture is raked from the air by the canopy of the forest. At other times the storms are torrential, and daily precipitation is measured in inches. The rains draw nutrients from the soil, carrying vital food into rivers and streams that fall away to the sea and support the greatest coastal marine diversity on earth. In the estuaries and tidal flats of British Columbia, in shallows that merge with the wetlands, are six hundred types of seaweed, seventy species of sea stars. Farther offshore, vast, underwater kelp forests shelter hundreds of forms of life, which in turn support a food chain that reaches into the sky to nourish dozens of species of seabirds.

The land provides for life in the sea, but the sea in turn nurtures the land. Birds deposit
excrement in the moss, yielding tons of nitrogen and phosphorus that are washed into the soil by winter rains. Salmon return by the millions to their native streams, providing food for eagles and ravens, grizzly and black bears, killer whales, river otters, and more than twenty other mammals of the sea and forest. Their journey complete, the sockeye and coho, chinook, chums, and pinks drift downstream in death and are slowly absorbed back into the nutrient cycle of life. In the end there is no separation between forest and ocean, between the creatures of the land and those of the sea. Every living thing on the raincoast ultimately responds to the same ecological rhythm. All are interdependent.

The plants that dwell on land nevertheless face particular challenges, especially that of securing nutrients from thin soils leached by rain throughout much of the year. The tangle of ecological adaptations that has evolved in response is nothing short of miraculous. As much as a fifth of the biomass in the foliage of an old-growth Douglas fir, for example, is an epiphytic lichen, Lobaria oregana, which fixes nitrogen directly from the air and passes it into the ecosystem. The needles of Sitka spruce absorb phosphorus, calcium, and magnesium, and their high rate of transpiration releases moisture to the canopy, allowing the lichens to flourish.

On the forest floor thick mats of sphagnum and other mosses filter rainwater and protect the mycelia of hundreds of species of fungi; these elements form one of the richest mushroom floras on earth. Mycelia are the vegetative phase of a fungus, small hairlike filaments that spread through the organic layer at the surface of the soil, absorbing food and precipitating decay. A mushroom is simply the fruiting structure, the reproductive body. As the mycelia grow, they constantly encounter tree roots. If the species combination is the right one, a remarkable biological event unfolds. Fungus and tree come together to form mycorrhizae, a symbiotic partnership that allows both to benefit. The tree provides the fungus with sugars created from sunlight. The mycelia in turn enhance the tree’s ability to absorb nutrients and water from the soil. They also produce growth-regulating chemicals that promote the production of new roots and enhance the immune system. Without this union, no tree could thrive. Western hemlocks are so dependent on mycorrhizal fungi that their roots barely pierce the surface of the earth, even as their trunks soar into the canopy.

The story only gets better. All life requires nitrogen for the creation of proteins. Nitrates, a basic source, are virtually absent from the acidic, heavily leached soils of the rainforest. The mycorrhizae, however, contain not only nitrogen-fixing bacteria that produce this vital raw material but also a yeast culture that promotes the growth of both the bacteria and the fungus. There are scores of different mycorrhizae—the roots of a single Douglas fir may have as many as forty types—and, like any other form of life, the fungus must compete, reproduce, and find a means to disperse its spore. The fruiting body in many cases is an underground mushroom or a truffle. When mature, it emits a pungent odor that seeps through the soil to attract rodents, flying squirrels, and red-backed voles, delicate creatures that live exclusively on a refined diet of truffles. As the voles move about the forest, they scatter droppings, neat little bundles of feces that contain yeast culture, fungal spores, and nitrogen-fixing bacteria—in short, all that is required to inoculate roots and prompt the creation of new mycorrhizae.

Fungi bring life to the forest both by their ability to draw nutrients to the living and by their capacity to transform the dead. In old-growth forests twenty percent of the biomass—as much as six hundred tons per hectare—is retained in fallen debris and snags. There is as much nutrition on the ground as there is within it. The moss on the forest floor is so dense that virtually all seedlings sprout from the surface of rotting stumps and logs, which may take several hundred years to decay.

When a tree falls in the forest, it is immediately attacked by fungi and a multitude of insects. The wood provides a solid diet of carbohydrates. To secure proteins and other nutrients, the fungi deploy natural antibiotics to kill nitrogen-fixing bacteria. Chemical attractants emitted by the fungi draw in other prey, such as nematode worms, which are dispatched with exploding poison sacs and an astonishing arse-
Western red cedar near Port Angeles, Washington.
Douglas firs at sunrise.

nal of microscopic weapons. The assault on the log comes from many quarters. Certain insects, incapable of digesting wood directly, exploit fungi to do the work. Ambrosia beetles, for example, deposit fungal spores in tunnels bored into the wood. After the spores germinate, the tiny insects cultivate the mushrooms on miniature farms that flourish in the dark.

In time other creatures appear—mites and termites, carpenter ants that chew long galleries in the wood and establish captive colonies of aphids that produce honeydew from the sap of plants. Eventually, as the log progresses through various stages of decay, other scavengers join the fray, including those that consume white cellulose, turning wood blood-red and reducing the heartwood to dust. An inch of soil may take a thousand years to accumulate. Organic debris may persist for centuries. Dead trees are the life of the forest, but their potential is realized only slowly and with great patience.

This observation leads to perhaps the most extraordinary mystery of all. Lush and astonishingly prolific, the coastal temperate rainforests are richer in their capacity to produce the raw material of life than any other terrestrial ecosystem on earth. The generation of this immense natural wealth is made possible by a vast array of biological interactions so complex and sophisticated as to suggest an evolutionary lineage drifting back to the dawn of time. Yet all evidence indicates that these forests emerged only within the last few thousand years. In aspect and species composition they may invoke the great coniferous forests of the distant geologic past, but as a discrete and evolving ecosystem the coastal temperate rainforests are still wet with the innocence of birth.

Some twenty thousand years ago, what is today British Columbia was a place of turmoil and ice. The land was young, unstable, given to explosive eruptions that burst over the shore. A glacial sheet more than 6,000 feet deep covered the interior of the province, forging mountains and grinding away valleys as it moved over the land, determining for all time the fate of rivers. On the coast, giant tongues of ice carved deep fjords beneath the sea. The sea levels fell by 300 feet, and the sheer weight of ice depressed the shoreline to some 750 feet below its current level. Fourteen thousand years ago, an instant in geologic time, the ice began to melt, and the glaciers retreated for the last time. The ocean invaded the shore, inundating coastal valleys and islands. But the land, freed at last of the weight of eons, literally sprang up. Within a mere one thousand years, the water drained
back into the sea, and the coastline became established more or less as it is today.

Only in the wake of these staggering geological events did the forests come into being. At first the land was dry and cold, an open landscape of aspen and lodgepole pine (Pinus contorta). Around ten thousand years ago, even as the first humans appeared on the coast, the air became more moist and Douglas fir slowly began to displace the pine. Sitka spruce flourished, though hemlock and red cedar remained rare. Gradually the climate became warmer, with long seasons without frost. As more and more rain fell, endless banks of clouds sheltered the trees from the radiant sun. Western hemlock and red cedar expanded their hold on the south coast, working their way north at the expense of both fir and Sitka spruce.

For the first people of the raincoast, this ecological transition became an image from the dawn of time, a memory of an era when Raven slipped from the shadow of cedar to steal sunlight and cast the moon and stars into the heavens. Mythology enshrined natural history, for it was the diffusion of red cedar that allowed the great cultures of the Pacific Northwest to emerge. The nomadic hunters and gatherers who for centuries had drifted with the seas along the western shores of North America were highly adaptive, capable of taking advantage of every new opportunity for life. Although humans had inhabited the coast for at least five thousand years, specialized tools first appear in the archaeological record around 3000 B.C., roughly the period when red cedar came into its present dominance in the forests. Over the next millennium, a dramatic shift in technology and culture occurred. Large cedar structures were in use a thousand years before the Christian era. A highly distinct art form developed by 500 B.C. Stone mauls and wooden wedges, obsidian blades and shells honed to a razor’s edge allowed the highly durable wood to be worked into an astonishing array of objects, which in turn expanded the potential of the environment.

* * *

In Oregon and Washington only ten percent of the original coastal rainforest remains. In California only four percent of the redwoods have been set aside. In British Columbia, roughly sixty percent has been logged, largely since 1950. In the last two decades, over half of all timber ever extracted from the public forests of British Columbia has been taken. At current rates of harvest, roughly 1.5 square miles of old growth per day, the next twenty years will see the destruction of every unprotected valley of ancient rainforest in the province.

In truth, no one really knows what will happen to these lands once they are logged. Forests are extraordinarily complex ecosystems. Biologists have yet to identify all of the species, let alone understand the relationships among them. Although we speak with unbridled confidence of our ability to reproduce the ecological conditions of a forest and to grow wood indefinitely, there is no place on earth that is currently cutting a fourth generation of timber on an industrial scale. The more imprecise a science, the more dogmatically its proponents cling to their ability to anticipate and predict phenomena.

Forestry as traditionally practiced in the Pacific Northwest is less a science than an ideology, a set of ideas reflecting not empirical truths, but the social needs and aspirations of a closed group of professionals with a vested interest in validating its practices and existence. The very language of the discipline is disingenuous, as if conceived to mislead. The “annual allowable cut” is not a limit never to be exceeded but a quota to be met. The “fall down effect,” the planned decline in timber production as the old growth is depleted, is promoted as if it were a natural phenomenon when it is in fact a stunning admission that the forests have been drastically overcut every year since modern forestry was implemented in the 1940s. “Multiple-use forestry”—which implies that the forests are managed for a variety of purposes, including recreation, tourism, and wildlife—begins with a clearcut. Old growth is “harvested,” though it was never planted and no one expects it to grow back. Ancient forests are “decadent” and “overmature,” when by any ecological definition they are at their richest and most biologically diverse state.

The most misleading of these terms is “sustained yield,” for it has led the public to believe that the trees are growing back as fast as they are being cut. But they are not. In British
Columbia alone there are 8.7 million acres of insufficiently restocked lands. We continue to cut at a rate of 650,000 acres per year. Every year 2.5 million logging-truck loads roll down the highways of the province. Lined up bumper to bumper, they would encircle the earth twice. In practice, sustained-yield forestry remains an untested hypothesis: after three generations we are still cutting into our biological capital, the irreplaceable old-growth forests. As a scientific concept, sustained yield loses all relevance when applied to an ecological situation the basic parameters of which remain unknown. At best, sustained yield is a theoretical possibility; at worst, a semantic sleight of hand, intended only to deceive.

Anyone who has flown over Vancouver Island, or seen the endless clearcuts of the interior of the province, grows wary of the rhetoric and empty promises of the forest industry. Fishermen and women become skeptical when they learn that logging has driven 142 salmon stocks to extinction and left 624 others on the brink. Timber for British Columbia mills now comes from Manitoba. Truck drivers from Quesnel, a pulp-and-paper town in the center of the province, haul loads hundreds of miles south from Yukon. Just one of the clearcuts southeast of Prince George covers five hundred square kilometers, five times the area of the city of Toronto. This, after sixty years of official commitment to sustained-yield forestry. The lament of the old-time foresters—that if only the public understood, it would appreciate what we do—falls flat. The public understands but does not like what it sees.

Fortunately, this orthodoxy is now being challenged. Many in the Pacific Northwest, including the best and brightest of professional foresters, recognize the need to move beyond, to an era in which resource decisions are truly based on ecological imperatives, in which the goal of economic sustainability is transformed from a cliché into an article of faith. To make this transition will not be easy, and it will involve much more than tinkering with the edges of an industry that generates $15.9 billion a year in the province of British Columbia alone. Dispatching delegations to Europe to reassure customers, or devising new regulations that if implemented may mitigate some of the worst ecological impacts, will neither restore the public’s confidence and trust nor address the underlying challenge of transforming the economy.

Any worker who has wielded a saw or ripped logs from a setting knows that in the end it all comes down to production. The enormous wealth generated over the last fifty years has been possible only because we have been willing to indulge egregious practices in the woods that have little to do with the actual promise of forestry. Spreading clearcuts ever deeper into the hinterland is a policy of the past, crude and anachronistic, certain to lead to a dramatic decline in the forestry sector and to bitterness and disappointment in the communities that rely upon the forests for both spiritual and material well-being. Revitalizing cutover lands with vibrant tree plantations, implementing intensive silviculture to increase yields, establishing the finest model of forest management on a finite land base—these are initiatives that will both allow communities to prosper and enable them to fulfill a moral obligation to leave to the future as healthy an environment as the one they inherited.

There is no better place to pursue a new way of thinking than in the temperate rainforests of the coast. At the moment, less than six percent has been protected; the remainder is slated to be logged. If anything, this ratio should be reversed. We live at the edge of the clearcut; our hands will determine the fate of these forests. If we do nothing, they will be lost within our lifetimes, and we will be left to explain our inaction. If we preserve these ancient forests, they will stand for all generations and for all time as symbols of the geography of hope. They are called old growth not because they are frail but because they shelter all of our history and embrace all of our dreams.

Wade Davis is an ethnobotanist and prolific writer. This article is excerpted from his most recent book, Shadows in the Sun: Travels to Landscapes of Spirit and Desire, published by Island Press/Shearwater Books [1.800.828.1302 or www.islandpress.org]. Photographer Graham Osborne specializes in alpine and coast subjects. The photographs in this article and on the covers have been published in his book Rainforest, published by Chelsea Green, Vermont.
The First and Final Flowering of Muriel’s Bamboo

_Peter Del Tredici_

Regular readers of _Arnoldia_ can appreciate the many satisfactions that come from working at the Arnold Arboretum, with its endless opportunities for studying plants. Even after twenty years of daily contact, there’s always something new and exciting. Some days it is the first flowers on a recently planted specimen; on others, it is stumbling, sometimes quite literally, across an amazing old plant never before noticed. The highlight of the 1998 season was definitely the discovery of flowers on Muriel’s bamboo, _Fargesia murielae_, which appeared at the Arnold Arboretum for the first—and last—time.

The Flowering

_Fargesia murielae_ is native to the mountains of central China, where it grows at elevations between two and three thousand meters. The species is one of the principal foods of the giant panda bear and arguably one of the most ornamental of the hardy species of bamboo. Its graceful, arching stems reach two to three meters in height and add a measure of exotic elegance to any garden. As a clump-forming species it expands slowly, in stark contrast to bamboos that spread by long, underground stems—the “running bamboos”—which are often the bane of unwary gardeners. Experienced bamboo growers are universal in their praise of _Fargesia murielae_, not only for the above-mentioned traits, but also because Muriel’s bamboo is among the hardiest of the entire family, growing well in USDA zone 5 and, with protection, into zone 4.

For all of its attractiveness, however, the most interesting feature of Muriel’s bamboo is its monocarpic life cycle—it flowers once in its life and then dies. Gardeners are used to seeing sunflowers germinate, grow, and die in a single season, and foxgloves die after two years, but the idea of a plant flowering after eighty to one hundred years and then dying seems more than a little strange. And strange indeed it is, being found only among the “woody” monocots, such as the well-known century plant (_Agave sp._), Minel's bamboo, _Fargesia murielae_, in the full flush of its spring growth.
a few genera of palms (most notably in the genus Corypha), and an Andean bromeliad of tree-sized proportions (Puya raymondii), which tend to come into flower when they reach a critical size.

Monocarpic bamboos are unique even among this unusual group because they do not flower according to their size, but according to a predetermined maturation cycle, the length of which appears to be genetically fixed for each species. The eighty-to-one-hundred-year flowering cycle of Muriel's bamboo, while certainly not the longest on record, is among the most widely known and well documented. Indeed, it was the widespread flowering and subsequent death of the umbrella bamboo in China in 1971, along with that of several closely related species, that created worldwide concern about the survival of the giant panda. The panda population in central China, it was found, had become overly dependent on the high-elevation species of Fargesia after bamboo species growing at lower elevations were eliminated by land clearance for agriculture.

Even more remarkable than their long flowering cycle, many bamboos are also synchronous in their flowering behavior. This term refers to the tendency of most or all of the individuals of a given species to come into flower at more or less the same time. This unusual behavior has led some authors to postulate that flowering in these bamboos is controlled not by climatic factors but by some sort of internal clock. In reality, however, the synchronicity is less precise than generally believed, particularly when plants in their native habitat are compared with same-aged cohorts in cultivation that have been repeatedly propagated by division. It may be propagation by subdivision that affects cultivated bamboos, but in any case their flowering cycle occurs as much as twenty years later.

While many authors have speculated on the possible evolutionary and ecological significance of the monocarpic habit in bamboos, nothing has been proved. One theory, proposed by Daniel Janzen, is that the long delay in flowering is a strategy for preventing a buildup of predators that would feed on the highly nutritious seeds if they were produced on a predictable schedule. However, this idea does not explain why the flowering intervals of many bamboos greatly exceed the lifespans of most animals that would feed on their seeds. More likely, the real reason is inextricably embedded in a complex matrix of physiological, ecological, and evolutionary factors.

The Introduction
The history of the plant's introduction into cultivation in the West, like that of so many other plants, is cloaked in mystery and confusion. It was first collected by the Arnold Arboretum's most famous plant collector, E. H. Wilson, who assigned it number 1462. The Arboretum has most of Wilson's field books in its archives, and those for his first Arboretum expedition, from February 1907 through April 1909, contains the following entry: “1462. Bamboo, 12 ft., stems golden, thickets, 7000-9000 ft, Fang. Plants, __ __ __.” Unfortunately, the last three words of the passage are unintelligible, but one important piece of information is unequivocal: living plants, along with the usual herbarium specimens, were part of this collection.

With the help of Alfred Rehder, Wilson reworked his field notes and published them in Plantae Wilsonianae, a work in three volumes that appeared in sequence in 1913, 1916, and 1917. The reference to the umbrella bamboo occurs on page 64 of volume II:

*Arundinaria* sp. Western Hupch: Fang Hsien, uplands, alt. 2000–3000 m., April 17, 1907 (No. 1462, 2–4 m. tall, stems golden). Without flowers. This plant is in cultivation. It forms on the mountains of north-western Hupch dense thickets and with its clear golden slender stems is one of the most beautiful of Chinese Bamboos. A picture will be found under No. 0111 of the collection of my photographs. E.H.W.”

The photograph that Wilson referred to is found in a bound volume entitled “Arnold Arboretum Second Expedition to China: 1910–1911.”
Photographs by E. H. Wilson." Photograph #0111 clearly shows a clump-forming bamboo growing below a group of fir trees (*Abies fargesii*). According to the notes on the accompanying label, the photograph was taken on June 19, 1910, and the plant, Wilson’s #1462, is seen growing “behind Fang Hsien” at an altitude of 8,000 feet. Wilson’s diary for this day includes the following entry:

The rain had ceased when we woke at 5 am & though dark mist obscured everything from a hundred yards above & around us I prophesied a fine day. It remained fine for about two hours & then commenced to rain steadily. It increased as the day advanced & we had a fine soake. All were soon drenched to the skin & everything became sodden. We hurried on as fast as possible & reached the head of the pass at 10 am . . . Much of the Bamboo has been burned and cut away from the path which is considerable improved since our last visit . . . This bamboo is the handsomest I know with its bright golden yellow culms some 10–15 ft high shrubs and with arching plume. It must be very hardy for the climate here is very rigorous. Patches of original forest remain here and there & especially near water-course silver fir & many Birch with willows and Rhod. are practically the sole constituents.

The final reference to bamboo #1462 in the Arboretum archives comes from an undated notebook in Wilson’s own handwriting entitled: “Numerical list of seeds [no. 1–1474, 4000–4462], collected on his Arnold Arboretum expeditions to eastern Asia, 1907–09, 1910, which were planted in the arboretum nurseries.” Under #1462, a single bamboo plant is listed as being located in the “Greenhouse & Frames” area of the nurseries. Unfortunately, the Arboretum’s permanent records of plants growing on the grounds do not contain any mention of #1462, strongly suggesting that the plant was never cultivated out-of-doors.

---

*Fargesia murielae* photographed by E H Wilson in its native habitat, Fang Hsien, China, at 8,000 feet. The plants are ten to fifteen feet high with yellow culms *Abies fargesii* stand in the background. Below is Wilson’s field book entry for collection #1462.
The first scientific description of Wilson’s #1462 did not appear until 1920, in an article in *Kew Bulletin of Miscellaneous Information*, under the name *Arundaria murielae* Gamble. In the notes following J. S. Gamble’s Latin description, W. J. Bean, Kew horticulturist, noted that, “By Mr. Wilson’s special wish the species is dedicated to his daughter, Muriel Wilson.” Bean went on to detail the plant’s history:

This Bamboo was presented to Kew from the Arnold Arboretum in the autumn of 1913. A single plant came in a pot, and this was divided up into about half a dozen pieces, which were repotted and grown for a few months in a greenhouse. They were then planted out in the collection of Bamboos near the Rhododendron Dell where they have grown luxuriantly and promise to be as ornamental as any hardy species. They are at present (October 1920) about 8 ft. high forming dense masses of culms, the outer ones of which arch outwards towards the top and give the plants a very graceful appearance… On the whole *A. murielae* is a distinct and most attractive addition to hardy bamboos.

At the Royal Botanic Garden, Kew, the only record of Wilson’s #1462 is in the accession books, which noted its arrival on December 12, 1913.

Wilson’s only other reference to #1462 is in *A Naturalist in Western China*, published in London in 1913 and New York in 1914. On page 49 he describes the vegetation behind Fang Xian by paraphrasing his journal entry of June 19, 1910:

The summit is of hard limestone with rare outcroppings of red sandstone. Stunted wind-swept Silver Fir and various kinds of Currant extend to the summit. Rhododendron and a dwarf Juniper (*J. squamata*) are also common. The descent was through woods of Birch and Bamboo to an open, grassy, scrub-clad, sloping moorland, through which a considerable torrent flows. The Bamboo, so common hereabouts, is very beautiful, forming clumps 3 to 10 feet through. The culms are 5 to 12 feet tall, golden yellow, with dark, feathery foliage; the young culms have broad sheathing bracts protecting the branchlets. Taken all in all, this is the handsomest Bamboo I have seen.

The footnote at the bottom of the page reads: “In 1910 I successfully introduced it into cultivation.” In the revised edition of the book, published in 1929 under a new title, *China, Mother of Gardens*, Wilson makes clear that the nameless bamboo mentioned in the 1913 edition was collection #1462 by removing the footnote and adding the following to the end of the above-quoted paragraph: “In 1910, I successfully introduced it into cultivation. It has been named Arundinaria Murielae in compliment to my daughter.”

From all this information, it appears that only one plant of Wilson’s #1462, collected on May 17, 1907, survived the long journey from Fang Xian in China to the Arnold Arboretum, where it was observed growing in the greenhouse in 1910. In December 1913, without ever being cultivated out-of-doors here, the plant was sent to Kew Gardens where it was divided—it must have been quite large—and planted out in the bamboo collection. Although *Fargesia murielae* was widely distributed throughout Europe during the first part of the century, the Arnold Arboretum did not get another plant until 1960, when the U.S. National Arboretum in Washington, D.C., sent one (under the name *Sinarundinaria murielae*) that had been imported in 1959 from the Royal Moerheim Nurseries in Dedemsvaart, Holland.

**Flowers at Last**

The first flowers of *Fargesia murielae* in the West appeared in Denmark in 1975. While these plants were clearly representative of the species, it is not certain that they were part of Wilson’s #1462 clone. The plants were said to be smaller than Wilson’s, and they came into bloom several years earlier than plants known to be divisions of #1462.

While the origin of the Danish plants will never be determined with certainty, the fact remains that in 1998 the flowering of known clones of Wilson’s *Fargesia murielae* appears to be virtually complete, more than ninety years after it was collected from the wild. Some of the plants of #1462 have produced seed, but it is important to remember that they are the result of self-pollination, and as such they are likely to suffer from the deleterious effects of inbreeding depression. Only by re-collecting the species in central China—from seedlings that germinated following the widespread flowering that
History of *Fargesia murielae* in the West

1892: The French missionary P. Farges collects a herbarium specimen of an unknown flowering bamboo in Szechuan Province, China. In 1893, the French taxonomist A. Franchet assigns it to a new genus, *Fargesia*, with the specific name *spathacea*.

17 May 1907: On his first expedition to China for the Arnold Arboretum, E. H. Wilson collects plants and three sterile herbarium specimens of an unknown bamboo at Fang Xian, Hubei, under collection #1462.

[1910]: Wilson makes note of a single plant from his collection #1462 growing in the “greenhouses and frames” area of the Arnold Arboretum.

10 June 1910: On his second Arboretum expedition to China, Wilson revisits Fang Xian and photographs #1462, labelling the photograph #0111.

12 December 1913: One plant of Wilson’s #1462 is received by Kew Gardens from the Arnold Arboretum. The plant is divided into six pieces that are planted out in the bamboo area.

1916: Wilson labels #1462 as *Arundinaria* sp. in volume II of *Plantae Wilsonianae*, but lists the wrong collection date.

1920: Wilson’s #1462 is given the name *Arundinaria murielae* by J. S. Gamble.

1935: T. Nakai of Japan reclassifies *Arundinaria murielae* as *Sinarundinaria murielae*.

23 December 1959: U.S. National Arboretum botanist F. Meyer arranges for the importation of plants of *Sinarundinaria murielae* (PI #262266) from the Royal Moerheim Nurseries, Dedemsvaart, Holland. The plants are probably divisions of Wilson’s #1462. One of them is received by the Arnold Arboretum on 8 November 1960, under accession #1239-60.

1975: Plants of *Sinarundinaria murielae* in Denmark, possibly divisions of Wilson’s #1462, come into flower.

1979: Based on the flowering specimens of the Danish plants, T. Soderstrom proposes the name *Thamnocalamus spathaceus*, for the umbrella bamboo. Based on the same specimens, other botanists argue that the species should be classified as either *Fargesia murielae* (Gamble) or *F. spathacea* (Franchet).

1988: At Kew Gardens, the original plants of Wilson’s #1462 come into flower for the first time.

1995: C. Stapleton makes the case for preserving the name *Fargesia murielae*, but proposes correcting the spelling of the specific to *murielae*.

May 1998: Arnold Arboretum plants of *Fargesia murielae*, received from the U.S. National Arboretum in 1960, come into flower for the first time.
The flowers of Fargesia murielae are inconspicuous occurred there during the 1970s—can we hope to obtain material comparable in quality to the original Wilson #1462.

The story of the introduction of Muriel’s bamboo is typical of the interplay between meticulousness and confusion that often surrounds the introduction of a new plant. That we can follow the Fargesia story as well as we can bears witness to the care and effort that the Arnold Arboretum in general, and Wilson in particular, put into the process of collection and documentation. The story illustrates another point as well: the importance of sharing plants among botanical gardens. Kew Gardens, and especially its horticulturist W. J. Bean, deserve credit for propagating and eventually distributing the plant throughout Europe. Distributing rare plants is an act both of generosity and of self-preservation: if you have two plants and give one away, you can get it back when you lose the one you kept. Such losses happen frequently, but the tradition of sharing plants provides an important safety net that greatly increases the chances of successful introduction. Given the rate at which the forests of the world are disappearing, failure to thoroughly document collections—and to share them—can represent the loss of a resource that can never be recaptured.

Endnotes


4 Renvoize, op cit.


8 Wilson’s diary entry for April 17, 1907, makes no mention of any bamboo, but when I checked the herbarium specimens that document #1462, I found all of them dated “17/5/07” in Wilson’s handwriting. In the absence of any journal for the month of May 1907, this discrepancy in dates was resolved by checking Wilson’s other herbarium specimens collected at Fang Xian According to former Arboretum director R. A. Howard, in his 1980 article “E. H. Wilson as Botanist” (part I, *Arnoldia* 40(3): 102–138; part II, 40(4): 154–193), the Fang Xian material all had collection dates in May 1907. This clearly suggests that the date of April 17 published in *Plantae Wilsonianae* is an error, and that May 17, 1907, noted on the specimen, was the actual date for the collection of Fargesia murielae.

9 E. H. Wilson, AA Manuscript #39611: Numerical list of seeds [no. 1–1474, 4000–4462], collected on his Arnold Arboretum expeditions to eastern Asia, 1907–08, 1910, which were planted in the arboretum nurseries (undated, probably 1910–1911).

10 J. S. Gamble, in Anon, *Decades Kewenses; Plantarum novarum in Herbario Horti Regii*
Perhaps Wilson used 1910 as the date for “successfully” introducing *Fargesia muheiae* because it was then that he inventoried his collections for those that were actually alive “in the arboretum nurseries.” An alternative, and rather unlikely, interpretation is that Wilson recollected the bamboo in 1910 and simply recycled #1462 from the 1907 expedition. Of course, one can not discount the possibility that Wilson just made a mistake in giving 1910 as the date for the introduction of *F. muheiae*.

At the National Arboretum the plant was given inventory number 262266; at the Arnold Arboretum, it became accession number 1239–60.


Acknowledgments

The author would like to express his thanks to Dr. Chris Stapleton, consulting taxonomist at Kew Gardens, for his help in sorting out the complex history of the introduction of *Fargesia muheiae*, and to Keiko Satoh, Putnam Research Fellow at the Arnold Arboretum, for help in sifting through the Wilson Archives, housed at the Arnold Arboretum.

Peter Del Tredici is Director of Living Collections at the Arnold Arboretum.
Nature Study Moves into the Twenty-First Century

Candace L. Julyan

The veining of the leaves and the construction of the stalks . . . are as interesting to me as the construction of a locomotive is to an engineer. When you get to know the plants, you feel as though you ought to have a garden where you can take care of real plants and study them.

Plants move, though many people do not know it. It is true that they do not move with a jerk, but they move very slowly. When the corn gets beaten down by a heavy rain or hail storm, it gradually works itself up again, although it never gets perfectly straight as before. When we move, we bend our joints. That is the way also with the corn. It bends at the nodes.

—Reports from fourth-grade students at the Francis Parker School, Chicago, 1915.

In many respects these reports could be more readily attributed to students today than to those at the beginning of this century. The study of plants is now considered a routine part of the elementary curriculum, and reports are a standard form of communication between teacher and student. However, classroom practice that encourages students’ observations of nature, considered laudable today, was much more controversial at the beginning of the century. At the Arnold Arboretum, education for children has been shaped by our strong belief that the most powerful learning happens out in the landscape, a belief that was articulated at the turn of the century by participants in the “nature-study movement.” The fourth-graders quoted above, students at a school founded on the principles of this movement, had studied plants by observing corn growing in their schoolyard, rather than by reading about it in a textbook. A closer
look at the tenets of nature-study serves to identify the roots of our beliefs and to illuminate new ways to approach the study of nature.

The nature-study movement, which peaked between 1890 to 1920, was part of a progressive education philosophy that proposed a child-centered approach to learning by encouraging engagement and play in contrast to more traditional, text-driven practices. Nature-study educators (who used the hyphen to signify that their nature study included a pedagogical approach) proposed that learning about the natural world was as important as studies of reading, writing, arithmetic, and grammar. The key precepts of the nature-study movement can be summarized briefly:

- The objects of study can be ordinary, seasonal phenomena.
- Direct observation is central to learning; drawing can be a useful, complementary tool.
- The teacher guides the students’ exploration; fostering discussions is considered more critical than memorization.
- Truly significant learning about nature takes place outdoors, “in nature.”
- Education should instill a love of nature in the child.

Much of the impetus for this movement came from a concern that the rigid approach to teaching was not resulting in significant learning by students. Samuel Jackson, an important spokesman for the movement, summarized the dissatisfaction of many with traditional book-centered study:

Instead of providing the child with proper conditions which cause him to grow out of the old into the new, usually, the teacher merely smites him with a definition. The child is finally belabored into saying, “The earth is round like a globe or a ball,” and the matter is dropped; but most of his geography forever conforms to his picture of the old flat earth of his childhood.

Such misgivings were certainly not new. Over two centuries earlier, the Moravian monk John Amos Comenius (1592–1670) wrote a critique of the approach to children’s education at that time:

Hitherto the schools have done nothing with the view of developing children, like young trees, from the growing impulse of their own roots, but only with that of hanging them over with twigs broken off elsewhere. They teach youth to adorn themselves with others’ feathers, like the crow in Aesop’s Fables. They do not show them things as they are, but tell them what one and another, and a third and a tenth, had thought and written about them, so that it is considered a mark of great wisdom for a man to know a great many opinions which contradict each other.

Comenius developed his ideas in the first illustrated children’s book, Orbis Pictus, published in 1658 and focused on topics familiar to young people. The book’s small woodcut graphics are accompanied by short texts that deal with a wide range of topics drawn from both nature and ethics—from clouds, trees, and animals, to honesty, respect, and love.
Another writer influential in the development of the nature-study movement was Jean Jacques Rousseau (1712–1778). Many of his ideas were incorporated into the movement's philosophy: the principles of science are discovered by the child, not learned as facts; learning should begin with observation of common phenomena; the order of learning should be determined by the learner's interests and experiences, not by the organization of science; and the objective should be enthusiasm for the discipline and methods of science, rather than a body of memorized facts.

As the nature-study movement gathered momentum in the late nineteenth century, its leaders built upon these ideas to create an approach to education with careful study of the outdoor environment as its centerpiece. While a growing number of teachers found these ideas exciting and in line with their own thinking, many others were baffled by the idea of teaching without books and using natural objects and phenomena to help children understand the world around them. Ultimately the movement lost strength as educators turned away from the ideas of progressive education in favor of more traditional approaches.

The Relevance of Nature-Study Today

While the philosophy of the nature-study movement could be found in small pockets of schools throughout this century, the ideas gained favor again in the 1960s and 1970s with the growth of environmental education and of science education that focused on experience and, more recently, in the 1980s and 1990s, with a renewed focus on science education. The notion of a compatibility between science and nature-study was not prevalent at the turn of the century. Although exceptions existed, such as Louis Agassiz, a nineteenth-century scientist whose credo was "Study nature, not books," generally, nature-study educators and professors of science held significantly different ideas, as suggested in these passages written by Anna Comstock in 1911:

For a long time botanical science, in the popular mind, consisted chiefly of pulling flowers to pieces and finding their Latin names by the use of the analytical key. All the careful descriptions of the habits of plants in the classic books were viewed solely as conducive to accuracy in placing the proper label on herbarium specimens. Long after the study of botany in the universities had become biological rather than purely systematic, the old regime held sway in our secondary schools; and perhaps some of us today know of high schools still working in the first ray that pierced primeval darkness.

To-day nature-study and science, while they may deal with the same objects, view them from opposite standpoints. The child, through nature-study, learns to know the life history of the violet growing in his own dooryard, and the fascinating story of the robin nesting in the cornice of his own porch.

Comstock explained that nature-study "does not start out with the classification given in books, but in the end it builds up a classification in the child's mind which is based on fundamental knowledge; it is a classification like that evolved by the first naturalists, it is built on careful personal observations of both form and life."

She would, no doubt, be surprised to learn how the teaching of science has shifted in the intervening years. In 1994, the National Academy of Science convened a large group of scientists and educators to consider how and what children should learn about science and the environment. The conclusions of this group, published in 1996 as the National Science Education Standards (NSES), suggest certain "big ideas" to be addressed at each grade level and propose an approach to teaching that in many ways resembles the one endorsed by the nature-study authors at the turn of the century:

Learning science is something students do, not something that is done to them. In learning science, students describe objects and events, ask questions, acquire knowledge, construct explanations of natural phenomena, test those explanations in many different ways, and communicate their ideas to others.

The Arboretum's work with children employs a combination of the nature-study philosophy and scientific practice. Begun in 1984, the Arboretum's Field Studies Experiences are designed for small groups of elementary stu-
Dents who come to the Arboretum to observe closely and make sense of what they see. In the fall, students look for seeds and determine their mode of travel; in the spring, they discover the stages of transformation from flower to fruit. In both of these activities, careful observation is supplemented by conversations with the guides, who help students make sense of what they see. This program is based on a belief that children learn best through experiences in the landscape, guided by attentive adults.

A decade later, we explored ways to add data collection to these observation-based activities. In 1995, with funding from the National Science Foundation (NSF), the Arboretum began the development of a program that could serve as a model for partnerships between elementary schools and institutions involved in science. While based on many of the principles of nature-study, this new project, called Seasonal Investigations, also includes an emphasis on keeping systematic records of observations and sharing those data with others using a computer web site.

**A Design for Nature Study in the Twenty-First Century**

Before I investigated a twig in winter, I just thought that the leaves fell off a tree and gradually grew back. But boy, did I learn a lot about trees from just one little twig!

Maybe I should tell you about some things I learned... I learned the names of the different parts of a twig, like the Terminal Bud, which is the bud at the tip, and the Lateral Buds, the little buds on the sides. I, myself, liked the names our class made up better. Like the name I gave to the Terminal Bud, Kiss-End Tail [an off-spring from the expression "Kiss and Tell"].

Another thing I learned from my twig is that the different colors along the twig signal yearly growth. We also determined the yearly growth for 1995–96 by looking at the first ring from the top. Then we measured from that ring to the very tip of the twig. Get this, my twig grows one centimeter less each year! So next year, if my twig only grew one centimeter since 1995, my twig will probably stop growing. Or maybe it will start a whole new growth. I think that the reason my twig’s health has been declining is because of the harsh winters we’ve been having. Well it’ll sure be a big surprise [this spring]!
color and fall from the tree. In the winter investigation, students learn to “read” a twig and use their new knowledge to determine which was the best recent growing year for the schoolyard trees. The spring investigation revisits the features examined in the winter to learn whether and how those features change in the spring and to determine when the flowers are “open for business.”

The student report quoted above was written as part of the winter twig investigation. The twigs, initially viewed by students as a bag of sticks, constitute the major focus of the class investigation. Each twig soon becomes a treasured resource. Students begin by making careful drawings and identifying features of the twig, later naming the features. These names are often revealing. For example, one student named the annual growth-ring marks “growing up lines.” Many students preferred their own names to those of scientists, but they were fluent in both.

The Role of the Web Site

Now in our final year of NSF funding, we are designing a web site for Seasonal Investigations that we believe will support both the classroom and outdoor work and allow a greater number of teachers to take part in the project. While the program can be (and sometimes is) completed successfully using only the classroom and schoolyard, the on-line environment provides an important support for the four activities central to the project—observation, data collection, communication, and publication—with a web site feature dedicated to each of these activities.

The Spotlight feature changes weekly throughout each seasonal investigation; the topic of each entry is chosen to encourage closer observation. In the fall investigation, students were invited to consider patterns of leaf change, to view other students’ drawings of patterns they found, and to share their observations about leaf patterns with others. Another Spotlight entry asked them to consider how bark accommodates the expansion of a tree’s girth. Three possibilities—fissures, plates, and peels—were illustrated with photos; students were
asked to look at their schoolyard trees and report their findings.

The Tree Talk feature facilitates communication among classes, from initial letters of introduction to later conversations about questions or findings. Contributions to most of these "conversations" can be made and viewed at any time; in addition, there is an option for a live, scheduled chat with either Arboretum staff or other classrooms.

The Activities feature provides the structure for sharing data among classes. Students are asked to provide specific data about their schoolyard trees, changing or adding to the data as the study progresses. The combined data provide opportunities for discussion in the classroom or with other students.

The Publication feature is intended to elicit a creative activity at the end of each investigation, perhaps a report or drawing, that brings together the ideas, surprises, and discoveries from the investigation.

The first three years of the project were spent perfecting the model and developing a set of investigations that could be completed in the schoolyard, with supporting visits to the Arboretum. During this, the last year of the project, the focus is on perfecting the web site to ensure that the program will continue after NSF funding ends.

Even before the project's completion, the framework of Seasonal Investigations has been adopted as a model by other institutions engaged in science education. Descanso Gardens in Los Angeles is replicating the entire program as a pilot project with the Los Angeles Unified School District. The Garden's director, Richard Schulhof, had first-hand experience with the project as a member of the Arboretum staff at the time it began, and is enthusiastic about using the program as a new approach to science teaching for his own staff as well as for the Los Angeles teachers. In addition, the Massachusetts Audubon Society is using the Seasonal Investigations framework to develop both teacher institutes and investigations of vernal pools in three locations across Massachusetts.

**Future Directions**

Many of the ideas of the nature-study movement are alive and in practice in today's programs at the Arboretum, but new issues
are also being raised. What role can the web play, not as an end in itself but as a springboard to investigations outdoors? How might it provide an avenue for sharing our educational ideas, many of which have century-old roots, with interested educators around the globe?

In many ways, the words of Anna Comstock have as much relevance at the end of this century as they did at the beginning:

When the child has become acquainted with the conditions and necessities of plant life, how different will the world seem to him! Every glance at forest or field will tell him a new story. Every square foot of sod will be revealed to him as a battlefield in which he himself may count the victories in the struggle for existence, and he will walk henceforth in a world of miracle and of beauty,—the miracle of adjustment to circumstances, and the beauty of obedience to law.”9

The young author who wrote about her twig is one of a growing number of students whose science experiences have been shaped, either directly or indirectly, through a connection with the Arboretum and its staff. As we enter the twenty-first century, we continue to seek opportunities for sharing our ideas about the compatibility of nature, science, and technology with teachers and students eager to learn about trees and plants. Our hope is that ideas about children's education, developed and nurtured at the Arboretum, can grow into viable "seeds" locally and around the country.

Endnotes

1 From the Francis Parker School Year Book, vol IV, June 1915 (Archives of Gutman Library, Harvard University).


3 Quoted in Jackman, op. cit., pp. 9–10.


6 Quoted in G. F. Atkinson, First Studies of Plant Life (Boston: Ginn & Co., 1901), p. iii.

7 Comstock, op. cit., p. 5.


9 Atkinson, op. cit., p. v

Candace Julyan is Director of Education at the Arnold Arboretum.
Native vs. Nonnative: A Reprise

Letters to the Editor

To the Editor:

I thoroughly enjoyed the article "An Evolutionary Perspective on Strengths, Fallacies, and Confusions in the Concept of Native Plants" by Stephen Jay Gould (Arnoldia Spring 1998). Gould uses the native plant issue to clarify some of the common misconceptions surrounding the basic theory of natural selection. He also reasserts himself as one of Darwin's prevailing "bulldogs." I do not take issue with anything that Gould includes in his analysis, but rather what he fails to include. Little effort is made to address the evolutionary ecology perspective in the concept of native plants.

Gould touches lightly on the merits of native plants by indicating that they "have generally been present for a long time and have therefore stabilized and adapted" to local conditions. This is for me a key reason, from an evolutionary perspective, for promoting native plants, since natives have presumably coevolved with other local organisms and the chemical and physical environment. An ecological balance has, therefore, generally been struck that prevents the unbridled increase in any one species' numbers. Exotic plant species (i.e., nonnative plants), on the other hand, have a greater propensity for rampant population growth. Darwin even comments on the ecological consequences of invasive exotic plant species and points out in chapter three of On the Origin of Species that:

... cases could be given of introduced plants which have become common throughout whole islands in a period of less than ten years. Several of the plants now most numerous over the wide plains of La Plata, clothing square leagues of surface almost to the exclusion of all other plants, have been introduced from Europe. ... In such cases the geometrical ratio of increase, the result of which never fails to be surprising, simply explains the extraordinarily rapid increase and wide diffusion of naturalized productions in their new homes. ... when a plant or animal is placed in a new country amongst new competitors, though the climate may be exactly the same as in its former home, yet the conditions of its life will generally be changed in an essential manner.

Irruptions of invasive exotic plant and animal species typically occur, as Darwin implies, because they do not generally have the competitor, predator, or pathogen load typically associated with native plants. Exotic species are new players in an environment and do not adhere to the "rules" that govern native species. Admittedly, the vast majority of exotic species are not invasive since they do not seem to compete well with native plants. Those that are invasive, however, have wrought havoc on local and regional ecosystems. Many native plants are maligned as invasive because of their weedy nature, but there is a distinct difference: native weeds do not disrupt natural communities nor do they tend to form monocultures. (I would like to
see the term “invasive” restricted to ecologically disruptive exotic plants and the term “aggressive” adapted for native weeds."

Gould also gives little mention to the ecologically disruptive consequences of invasive exotics to biodiversity other than saying that he “treasures nature’s bounteous diversity of species,” and that “cherishing native plants does allow us to defend and preserve a maximal amount of local variety.” This is precisely why native plants should be the first choice for landscaping among ecologically sensitive individuals. Second choice should be exotic species that are not invasive or those that have a very low potential for becoming invasive. I am not suggesting that we adopt the “Naziesque” approach to plant material choice. I too am awed by our “bounteous” species diversity but it is only diminished by invasive exotic species. And I hope that Gould, by pointing out that the argument for using native plants is evolutionarily fallacious, has not encouraged what he so stridently abhors: a misconstrued Darwinian alibi for depraved behavior—in this case, using ecologically disruptive, invasive plant species.

Organisms, native or otherwise, respond to their environment through the adaptive creativity of natural selection. Theirs is a life without intent. There is no desire among plants to become a garden pest or to disrupt natural communities. Humans, by purposefully homogenizing the world’s flora, have forced the occurrence of unlikely species interactions, some of which we greet with delight (culinary herbs, vegetable crops, and the majority of ornamentals) and some with dread (kudzu, privet, and water hyacinth). Gould weakly dissuades the introduction of invasive exotic plant species by maintaining that there should be “sensitive and respectful mixing of natives and exotics.” From this I read: proceed with caution. I feel that a stronger position needs to be taken on this issue. Invasive exotics are a major threat to biodiversity and the genetic diversity contained within. I therefore challenge botanical gardens and arboreta, plant nurseries, and private gardeners to promote the use of ecologically judicious plant choices in our public and private gardens.

John Randall
Conservation Curator, North Carolina Botanical Garden of the University of North Carolina at Chapel Hill

To the Editor:

Stephen Jay Gould (“An Evolutionary Perspective on Strengths, Fallacies, and Confusions in the Concept of Native Plants,” Arnoldia Spring 1998) offers an excellent argument for his characterization of the concept of native plants as “a remarkable mixture of sound biology, invalid ideas, false extensions, ethical implications, and

Grapevines (Vitus sp.) in northeastern Connecticut.
political usages." It seems worth adding to his commentary, written from an evolutionary perspective, an argument from the perspective of practical horticulture.

But first, I hasten to point out that in 1998, we in the arenas of botanic gardens and horticulture are already working to promote the use of environmentally appropriate plants specific to the requirements and use of the planted site. Plantsmen are not recommending aggressive exotics as landscape plants of preference regardless of environmental consequences. That would not only be irresponsible but would ultimately destroy the green industry and its important contribution to the U.S. economy.

The primary criteria for plant selection in managed environments today is whether a plant is reasonably well adapted to the site and, hence, will survive and thrive without requiring regular use of pesticides, and within that context, whether the plant satisfies the ornamental, agricultural, and/or functional demands of the site and its constituents. Given these criteria, there are many instances when exotic plants are the clear choice for a given landscape—especially when we recall that not all exotics are invasive or aggressive (in fact only a small minority have proven to be so), and that not all natives are nonaggressive (for instance, our native staghorn sumac). The real challenge, of course, is to determine with intelligence and sensitivity to site constraints what are the environmentally appropriate species for a given site that are likely to succeed there. And, I might add, what may be the appropriate cultivars, which are capable of great phenotypic and physiological divergence within one species—in some cases, even greater divergence than the wild-type species can offer within a genus.

We cannot ignore the reason that invasive exotics have been used in the first place, which is: Managed environments (cities, residential neighborhoods, parks, disturbed wetlands, timber production lands, and so on) are already drastically altered and have already been interfered with, resulting in significantly inhibited natural selection and the ability of the prior extant site natives to thrive. For this very reason, a managed environment often requires conscious choice of potentially aggressive plants if there are to be any plants at all that live there.

One of the reasons that botanic gardens, arboreta, and many types of public gardens maintain living collections of plants is to allow for evaluation and comparison of plant growth and development, and landscape performance long-term in real time in a given regional landscape. The ability to carry out these evaluations allows us to select well-adapted plants for an area. The broader the palette of well-adapted plants available, the more effectively an environmentally sound landscape can be built.

All sites, whether managed or wild, including severely disturbed and altered stressful environments [such as urban parks], require plants adapted to the conditions on that site. A well-adapted plant for a managed site may or may not be a regional native, depending on the specific stresses associated with the given managed environment. We cannot effectively plant many of the natives of the humid Northeast United States in, for example, parking lot beds, or even in many new suburban garden sites that have been stripped of topsoil [excepting only such broadly adapted and aggressive natives as, for instance, poison ivy].
Many Asian natives serve as good landscape plants in the Northeast precisely because they are well-adapted to our most common types of “disturbed” landscapes. The climatic and soil similarities between eastern North America and eastern Asia are well documented and widely understood and accepted. Should we, in spite of this natural botanical gift, restrict the plants grown on these sites to a few U.S. natives that will thrive there because they will basically thrive anywhere? Do we want our managed outdoor stressful environments to be planted with only a limited palette of regionally native aggressive plants? Would the residents of Washington, D.C., really want us to replace the flowering Asian cherries with native pin cherries (which are actually more susceptible to tent caterpillars)?

How do we define “regionally native,” in any case?—plants found growing within a 100-mile radius of the site now, 100 years ago, 1000 years ago? Plants found growing within the state now, 50 years ago, 100 years ago? Plants found growing within the region now, 50 years ago, 100 years ago, 1000 years ago?

Much as we may wish to, we cannot turn back the clock and erase the huge disturbances that we have thoughtlessly imposed throughout most of our native habitat. This makes it even more critical that we preserve and protect what small acreages of undisturbed habitat remain, as much as is possible.

Unfortunately, with increasing population and urbanization, the likelihood is that over the next 100 years, these small acreages of undisturbed, or little-disturbed, or restored habitat will become even more fragmented, pressured, and fragile. It is imperative that we learn to manage our expanding areas of managed environments wisely, using a diversity of plants that result in environmentally sound as well as beautiful, productive, and functional landscapes. We cannot achieve that goal by relying solely on “regionally native” plants for every single managed landscape no matter its location or purpose.

Clearly, a reasonable, moderate, thoughtful, site-specific, and non-arbitrary approach to plant selection is required for each individual landscape. Known rampant invasives, regardless of provenance, should not be planted. The decision process for what plants to include in a native wetland restoration project should clearly be drastically different from that of choosing plants for an urban pocket park. In all cases, effort to use plants suited to the region and the site must be made.

I write this response to remind us of what we all as plantsmen are already working to achieve, that is, to bring reason, responsibility, knowledge, and moderation to bear on the process of how we choose plants for managed environments, and what choices we make. In the face of the next hundred years of increasing pressure on the land, the future of our flora and the quality of our lives depends on this.

Kim Tripp
Director of the Botanic Garden of Smith College
and Arnold Arboretum Associate
Native Plants: Another View

Harrison L. Flint

To close this circle, for the time being, we reprint very nearly verbatim an article from *Arnoldia*, Winter 1982–1983. When we asked Professor Flint to update it to serve as a companion to the letters to the editor, he found very little, and nothing at all of substance, that he wished to change.

Following the tradition of such great midwestern naturalists as Jens Jensen, Aldo Leopold, and May Theilgaard Watts, contemporary landscape planners have grown in awareness of native plants and their usefulness in designed landscapes. The movement toward landscaping with native plants now has spread widely and has not yet reached its full potential. Its ultimate expression is found in re-creating natural plant communities, a stepwise and time-consuming process now being carried out by relatively few landscape planners. Such planners usually are sophisticated horticulturists and landscape architects who have elected to specialize in this particular area.

Yet, while many landscape planners have developed close familiarity with a great range of plants, carefully selecting those most appropriate for the situation at hand, less-sophisticated members of their profession have eschewed all forms of vegetation that are not “native.” For some this position is taken with a sense of missionary zeal; for others it may simply offer convenience in requiring knowledge of a smaller number of landscape plants.

Yet, while many landscape planners have developed close familiarity with a great range of plants, carefully selecting those most appropriate for the situation at hand, less-sophisticated members of their profession have eschewed all forms of vegetation that are not “native.” For some this position is taken with a sense of missionary zeal; for others it may simply offer convenience in requiring knowledge of a smaller number of landscape plants.

To select landscape plants on the basis of whether or not they are native, one must first determine which species are “native.” In New England, for instance, is it permissible to select black locust (*Robinia pseudoacacia*), a common wild tree in much of the area, yet native only farther south and west? Must redbud (*Cercis canadensis*) be restricted in use to only those few counties where it is indigenous? Any question about species eligibility for use in re-creating or preserving a natural plant association finds its answer in the planner’s knowledge of the association. Clearly, only certain plants “belong.” But in other areas of landscape planning, divisions between native and nonnative species blur—and perhaps are best left blurred, allowing selection decisions to be made according to criteria relating to function.

Exclusion of nonnative plants on principle is based upon several generalized claims, all of which hold at least a grain of truth:

1. **Nonnative plants look out of place in the landscape.**

   If one’s objective is to preserve a natural landscape, ample justification exists for removing nonnative species as weeds. The same is true in re-creating a “natural” landscape, but in other cases the question is not so easily answered. Must a woodland gardener in New England be asked to plant no other species of wild ginger (*Asarum*) than the native *A. canadense*? Must sweetshrub (*Calycanthus floridus*), galax (*Galax urceolata*), box huckleberry (*Gaylussacia brachycera*), and yellowroot (*Xanthorhiza simplicissima*) be left to their more southerly native haunts? And must the New England gardener be sure to omit lily-of-the-valley (*Convallaris majalis*) and English ivy (*Hedera helix*) as European natives? Perhaps, but only as a matter of taste.

2. **Plant species are better adapted to the region in which they are native than**
elsewhere, because this region has "made" them, through distinctive selection pressures.

As logical as this view may seem at first, it has two flaws. First, it excludes the possibility of preadaptation. For example, the climate of northeastern Asia so closely parallels that of similar latitudes in northeastern North America that many Asian species have been preadapted to our climate long before they have seen it, and turn out to be some of our most useful landscape plants.

A second flaw is the tacit presumption that the soil and climate of a particular landscape site are similar to those of the natural region in which it is located. Landscape designers and contractors know that this is not true. Most landscape sites, especially urban ones, are exposed to soil and climatic stresses that seldom exist in wild areas nearby. Soils may be greatly modified by construction and subsequent restoration. Patterns of wind, solar radiation, and temperature fluctuation are modified in developed sites. Perhaps most important of all, patterns of rainfall, runoff, and absorption of water into the soil are drastically altered. In short, developed sites are so greatly changed that they may differ much more from nearby natural areas than do certain natural areas on the other side of the earth.

(3) Nonnative plants are weedy, reproducing freely and invading areas where they are not wanted.

This is a valid criticism of several nonnative species, such as buckthorns (Rhamnus sp.), certain Asian honeysuckles (Lonicera sp.), kudzu vine (Pueraria lobata), some species of Elaeagnus, Euonymus, and others. But it is not a fair generalization. In fact, it seems a contradiction to generalize that nonnative species are not well adapted yet reproduce to the point of being a nuisance. Again, it is necessary to know which species, both native and exotic, are weedy and exclude them in situations in which they might get out of control.

(4) Native plants are less susceptible to insect and disease problems than nonnatives and so need less maintenance.

We as often hear the counterclaim: that nonnative plants separated from their ecosystems are, at least for a time, free of many of their natural enemies, and examples of native species with major problems are easily found. American elm (Ulmus americana) has been decimated in many areas by Dutch elm disease and phloem necrosis. The most promising sources of resistance to Dutch elm disease are Asian species and their hybrids. The majestic American chestnut (Castanea dentata), nearly wiped out by blight in its native habitat decades ago, is finding its closest replacement in the disease-resistant Chinese chestnut (C. mollissima) and its hybrids.

Crabapples native to eastern North America (e.g., Malus angustifolia, M. coronaria, and M. ioensis) are susceptible to cedar-apple rust, a serious enough problem to rule them out as landscape plants in most localities where red cedar (Juniperus virginiana), the alternate host for the disease organism, is present. Asian crabapples are relatively free of this problem. In areas where red cedar does not grow wild, the disease can be largely controlled by substituting junipers of Asian origin for red cedar.

Resistance to insect and disease problems is too important a consideration in selecting landscape plants to be left to generalization. It is better dealt with directly by selecting troublefree plants than indirectly by selecting only native or nonnative plants, in the expectation that they will tend to be more resistant to problems than their opposite numbers.

(5) We need to make better use of the tremendous pool of genetic diversity inherent in native plant species, a pool that has been barely sampled thus far.

Amen! And the same can be said for nonnative species. How often is our knowledge of an Asian species, for instance, limited to a few clones or at best a narrow slice of the germplasm that exists in the natural range? Intrepid plant explorers have introduced to us many new species from remote corners of the world. Notwithstanding the many collections made over the past decade, we have largely failed to follow up on their discoveries by assembling larger samples of those species for evaluation, just as surely as we have neglected to observe fully the variation that exists in native species. As a
result, our narrow knowledge of diversity in plant species confounds the issue of their nativeness.

The U.S. Department of Agriculture has taken an important step to improve this situation with regard to crop species through its network of plant germplasm repositories. It is up to other institutions, including botanical gardens and arboreta, to develop stronger programs relating to preservation and development of germplasm of value to landscape improvement.

There are, of course, landscape situations where nonnative plants are clearly inappropriate and so to be avoided. This includes preservation, restoration, and re-creation of natural areas and plant associations. In many other situations the constraint of using only native plants, intended to produce a natural effect, itself becomes artifact. In such situations it is more sensible to return to the basics of plant selection, considering adaptability and intended function first, then maintenance requirements and seasonal interest. When a pool of plants having the desired requirements has been assembled, final selections can be made on the basis of individual taste.

The search for a broad range of prospective landscape plants, and their thoughtful use, has made our landscape increasingly functional and interesting. Continuing the search will enrich our lives in the process.

Harrison Flint is professor emeritus of horticulture at Purdue University in Lafayette, Indiana. He is the author of The Country Journal Book of Trees and Shrubs and Landscape Plants for Eastern North America, 2nd edition.
Field Studies Are Inspired by the Work of Volunteers

Diane Syverson
Manager of School Programs

A fourth-grade teacher from the Baker School brought her class to the Arboretum this October for a field study called Plants in Autumn: How Seeds Travel. Her response to the question, "What did you like most about your experience at the Arboretum?" was:

I really admire the fact that this program is staffed by volunteers. I think it’s important for kids to see people donating their time and energy because they want to. Additionally the atmosphere was inviting, which made the experience that much better.

Volunteer guides who are personally invested in their work create an invigorating learning environment for school classes that come to the Arboretum for Field Study Experiences. Visiting schoolchildren find themselves in a group facilitated by any one of the 25 men and women who guide children on these fall and spring programs. Each guide is trained to support the children’s science learning, as together they examine the plants and habitats within the Arboretum landscape.

As volunteers, the school program guides are dedicated to enriching children’s connection with science, nature, and the Arboretum through the Field Study Experience. These volunteers are men and women whose commitment might originate from a personal interest in children’s education. They include former teachers, a school librarian, an education graduate student, grandparents, and a person considering a career change to education. Other volunteers come with personal experience and interest in life science: as do a part-time science teacher who saves a day per week to “teach” at the Arboretum, an ex-biology instructor, a retired chemist, a self-employed horticulturist, and many impassioned gardeners. Many of our volunteers know and love the Arboretum from the perspective of neighbor and supporter; it is from this perspective that they invest in sharing its richness with others.

School program guides make a one-year commitment to their job that includes thirty hours of Field Study Experience training; weekly guiding of elementary age children, fall and spring; and attendance at education meetings during the winter months. For more information or to observe a field study program, phone Diane Syverson, manager of school programs, at 617/524-1718 x163.

No Complaints Here

Peter Del Tredici, Director of Living Collections

Gardeners are notorious for their ability to complain endlessly about the weather. If it’s not too wet, then it’s certainly too dry; if it’s not too hot, it’s certainly too cold. The right amount of snow is great, but too little or too much is always a problem. And so on down the line. This tendency in
**Former Intern Returns as Putnam Fellow**

**Laura Brogna, Putnam Fellow**

I've been fortunate, as a child of a foreign service family, to travel in Asia, Europe, and the U.S. and to live in very different kinds of places, including suburban northern Virginia, downtown Tokyo, and the rural Northeast Kingdom of Vermont. Somewhere along the way, noticing my surroundings, I became a student of landscapes and landscape history.

I consider my Putnam fellowship an opportunity to continue my investigations into the workings of New England landscapes, which I began officially as a graduate student in landscape architecture at Harvard’s Graduate School of Design (GSD). One of my projects here will be the study of planning and land management issues, including development and tourism pressures on working farms and forests. I also will investigate how the Arboretum functions within its three increasingly urbanized watersheds in order to prepare a stormwater maintenance plan for the site. Finally, I will research the land-use history of the area proposed for a new sun-loving shrub and vine collection.

During my tenure as Putnam Fellow, I am dividing my time between the Institute for Cultural Landscape Studies (ICLS) and the Department of Living Collections. By straddling departments, I am allowed a wonderful balance in my work. I may spend one day devoted to ICLS in the Widener Library stacks at Harvard, tracking down references to farmland conservation or cultural geography. The next day (after studying USGS topographical maps and poring over city wastewater flow diagrams), I’m out following the course of our own Bussey Brook.

I first joined the Arboretum as a horticultural intern in the summer of 1995. After graduating from the GSD in 1997, I spent one year working in a landscape architecture firm before returning to the Arboretum in September of this year. I’m thrilled to be back and feel happily at home here among the trees.

---

**Farewell to Peter Stevens**

The imminent departure of Peter Stevens, professor of biology and a curator of the Arnold Arboretum and Gray Herbaria, represents a serious loss to the Arboretum’s group of specialists in Asian botany. Peter will be joining his wife, Dr. Elizabeth Kellogg—known to us all as Toby—on the faculty of the University of Missouri at St. Louis. Toby will hold the E. Desmond Lee Chair in Botanical Studies, Peter will be a professor of biology, and both will also hold adjunct positions at the Missouri Botanical Garden.

Peter joined the staff of the Arnold Arboretum as an assistant curator in 1973 after three years as a botanist in the Papua New Guinea Forest Service, and worked his way up through the ranks: quite a feat at Harvard! He has pursued two groups of interests here. One has been in theoretical aspects of the history and practice of systematics, and particularly how botanists use the characters of plants in classification and to interpret evolution. But Peter may well be remembered most for his elegantly crafted systematic treatments, in the St. John’s wort family, Clusiaceae, and especially its large and subtly varying tropical tree genus *Calophyllum*; in the rhododendron family, Ericaceae; and in various other taxa that have presented interesting problems to him.

Peter has played a seminal part in the teaching of plant systematics at Harvard. His undergraduate course Bio 103, Evolution and Diversification of Flowering Plants, and his graduate course Bio 218, The Families of Flowering Plants, have attracted a growing number of students who found them dense and therefore difficult but, thanks to Peter’s ebullient enthusiasm for his subject, immensely stimulating.

We wish Peter and Toby good success in this new phase in their careers and will welcome their future visits here.

*Peter Ashton, Director, 1978–1987*
gardeners has only been exacer-
bated over the course of the last
ten or twenty years, as weather
extremes become the norm and
the so-called hundred-year flood
seems to happen once a decade.

All of which takes me to the
point of this article, namely, that
the living collections department,
which has certainly done its share
of complaining about the weather
in the past, doesn’t have anything
to complain about this year. The
winter was mild and the spring
was cool and moist. Remarkably,
the summer, which was consid-
ered very dry over most of the
East Coast, was no problem in
Boston where we enjoyed adequate
rainfall through the treacherous
months of July and August.
Indeed, nearly every time we
talked about watering our newly
installed plants, it started raining.
And the same is true for the fall.
Two weeks never passed without
substantial rain.

Taking full advantage of this
“anomalous” weather pattern, the
grounds crew planted more than
120 conifers in the collections
from mid-September through
mid-October. It was particularly
gratifying to plant these trees,
given that the Pinetum area was
badly damaged by the blizzard of
April 1, 1997. While it requires a
certain amount of imagination on
the part of the visitor, it is now
possible to envision the appear-
ance of the Arboretum twenty
years into the future, when the
new plantings reach adulthood.

This fall’s planting list was
heavily laden with arborvitae
(Thuja occidentalis and T. plicata),
but we also accessioned many
pine, fir, larch, and spruce. As it
happened, during the long Colum-
bus Day weekend, and just a few
days after we planted our last tree,
it rained more than four inches in
three days, saturating the ground
in a way that no amount of hand
watering or irrigation ever could.
Remarkably, the universal law of
compensation seems to have
worked its mysterious magic at
the Arboretum, making the prob-
lems of the past few years seem
like distant memories. Unfortu-
nately, I’m sure that next year will
be a completely different story.

Dr. Peter Ashton Receives Honorary Medal

On October 15, the Massachusetts
Horticultural Society (MHS)
awarded Peter Ashton the Thomas
Roland Medal of Honor during
the MHS Annual Awards Cer-
emony at the Boston Harbor
Hotel. Dr. Ashton served as direc-
tor of the Arnold Arboretum from
1978 to 1987 and currently is the
Charles Bullard Professor of For-
etry at Harvard University.

First bestowed in 1927, the
Thomas Roland Medal was
awarded in recognition of “excep-
tional skill in horticulture.” In
presenting the award, Dr. John C.
Peterson, president of MHS,
lauded Dr. Ashton “for his exten-
sive work that has ensured a won-
derful public treasure in Boston’s
Arnold Arboretum, and for the
demonstration of what is without
question exemplary skill in the
field of horticulture.”

Arnold Arboretum Council members Wendy
Pearson, Sarah Jolliffe, and Bob Bartlett prepare to
embark on a tour of the living collections following
the fall Arboretum Council meeting. Council
members serve as advocates for the Arboretum,
advise the director in their specialized areas of
expertise, and support the institution in a variety of
ways. Events of the day included presentations on
new initiatives, ongoing projects, and a panel
presentation of landscape maintenance issues.
Two Collaborative Projects of the AA/NPS Win ASLA Awards

Both *Fairsted: A Cultural Landscape Report for the Frederick Law Olmsted National Historic Site, Volume 1: Site History and Landscape Explorers: Uncovering the Power of Place* won 1998 Merit Awards from the American Society of Landscape Architects (ASLA). Both publications are the result of collaborations between the Arnold Arboretum and the National Park Service that began in the early 1990s.

Fairsted, the Frederick Law Olmsted National Historic Site in Brookline, Massachusetts, was the home and professional office of Frederick Law Olmsted and the subsequent firms headed by his sons and others. The National Park Service acquired the site in 1980. The Fairsted Report, produced jointly by the Olmsted Center for Landscape Preservation of the National Park Service and the Arnold Arboretum, includes a detailed history of the landscape of Fairsted by the noted Olmsted scholar Cynthia Zaitzevsky and an afterword that describes the horticultural and cultural context of the Olmsted’s work by the garden historian Mac Gnuswold. Peter Del Tredici, director of living collections of the Arnold Arboretum, participated in the evaluation of historic documentation of the site and provided valuable expertise in plant identification from historic photographs. This report is an integral part of the restoration process for the Fairsted landscape, which began in 1991.

Although the report documents a site of only 1.76 acres, it is (to quote the ASLA) “a fascinating look at Olmsted’s most intimate work: the design, literally, of the master’s own backyard.” Copies of the report have been distributed to libraries nationwide. Individual copies can be purchased through the Eastern National Bookstore at the Frederick Law Olmsted National Historic Site, 99 Warren Street, Brookline, MA 02446. For mail orders, contact Alan Banks at 617/566-1689 x221.

The ASLA calls *Landscape Explorers* “the first—and thus far—the only curriculum designed to teach elementary-school students about the importance of landscape and place in everyone’s lives.” This unit of study invites students to explore the landscape from the perspective of an artist, a historian, or a naturalist. The stated hope that drives the unit is that “children who understand the role of ‘place’ in their evolving sense of self tend to become adults with a commitment to conserving and enhancing their immediate neighborhoods and the larger landscapes of which they are a part.” The authors of this work are Diane Syverson, manager of school programs at the Arboretum, and Liza Stearns, education specialist for the Frederick Law Olmsted National Historic Site. Participating students begin their exploration of place by examining their own schoolyard and learning what it means to “read” a landscape. They then apply those newly learned skills in a visit to the Arboretum, exploring this landscape in one of the three distinct ways described above. For further information about *Landscape Explorers*, contact Diane Syverson at 617/524-1718 x163.

**Give the Gift of Membership**

Membership in the Friends of the Arnold Arboretum makes a unique gift for family and friends at any time of year. The special recipient of your gift will enjoy a year’s worth of exciting benefits.

*Please help support the Arnold Arboretum by purchasing a gift membership today!*

Call the Membership Office at 617/524-1718 x165 for more information.