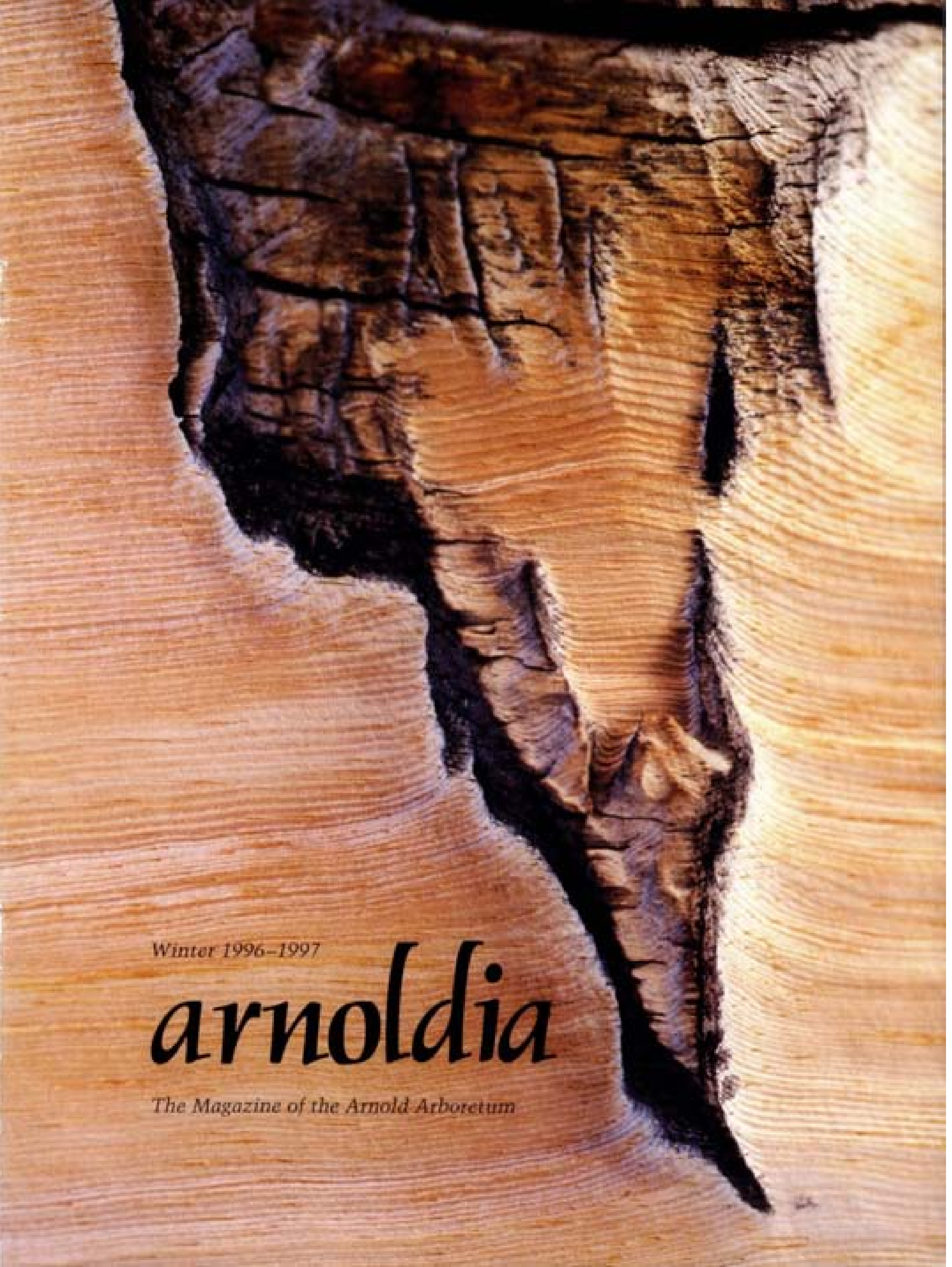

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Front cover: An irregular pattern in a radial section of weathered wood from an ancient bristlecone pine, caused by the juncture of a large branch with the trunk. Photograph by Peter Del Tredici

Back cover: Annual growth rings—100 per inch—in the naturally weathered wood of an ancient specimen of *Pinus aristata*, growing at 9,000 feet on a mountaintop outside Denver, Colorado. There are about 250 growth rings in this radial section. Photograph by Peter Del Tredici

Inside front cover: An ancient savanna at Yegua Creek, Texas. These post oaks *(Quercus stellata)* are 250 to 300 years old. Photograph by David W. Stahle

Inside back cover: *Taxodium distichum* (baldcypress) in the 400-to-600-year age class are protected at Wakulla Springs State Park, Florida. Photograph by David W. Stahle

Tree Rings and Ancient Forest Relics

David W. Stahle

Centuries-old trees persist in thousands of forest remnants across the United States. Small and weathered, they preserve, in a fragmentary pattern, one stratum of our presettlement forest ecology and biodiversity.

It is widely believed that the ancient forests of the eastern United States have been completely destroyed by successive waves of European settlement, commercial logging, agricultural development, and urban sprawl. However, the search for presettlement forests in North America by specialists in tree-ring analysis has produced surprising findings. Tree-ring research suggests that literally thousands of ancient forests survive throughout the United States. These forest relics are often small and unimpressive but nevertheless preserve centuries-old trees.

Forest distribution and productivity in presettlement North America was dictated by climate, topography, and soil fertility, and included marginal stands as well as the majestic. Marion Clawson has estimated that the contiguous United States were covered with some 950 million acres of forest just prior to European settlement, but that this total included an estimated 100 million acres of noncommercial forests. Dendrochronologists have dated thousands of trees in more than four-hundred ancient forest sites located in all forty-eight contiguous states except Delaware and Rhode Island (Cook et al. 1996). These records of tree growth extend hundreds to thousands of years into prehistory and are particularly useful for estimating past climate change. These relics emphasize that the disturbance waves unleashed following European settlement were largely driven by economic motives, and the commercially valuable stands of ancient timber were indeed decimated. For the few surviving examples of magnificent marketable timber, we owe a debt of gratitude to individual landowners and to the early state and federal preserves such as Adirondack State Park and Great Smoky Mountains National Park. But forest disturbance often bypassed stands of remarkably old trees found on noncommercial sites. These for-

This map locates most of the tree-ring chronologies developed from ancient forest sites in the United States. Undisturbed or relatively undisturbed ancient forests with trees dating from at least A.D.1700 to 1979 were present at most of these locations at the time of sampling (mainly from the 1970s through the 1990s), but the size of these forests varies tremendously from less than one acre to thousands of acres. The true distribution of surviving ancient forests in the United States is of course much greater because only a small fraction of the ancient forests actually known have been sampled for tree-ring analysis ests, sometimes described as "decrepit" and "overmature," do not fit the stereotype of "the forest primeval" as cathedral forest and have largely failed to interest forest scientists, managers, or advocates. Nonetheless these are authentic examples of one part of the primeval forest mosaic and deserve to endure.

Tree-Ring Study of Ancient American Forests

For nearly a century, tree-ring experts have specialized in the location of ancient forests and in the biological and ecological processes that drive their growth, longevity, and sensitivity to climatic variations. American work began with Andrew E. Douglass in the semiarid Southwest. Douglass discovered that the width of annual growth rings in living Ponderosa pines *(Pinus ponderosa)* could be synchronized for centuries across the entire Colorado Plateau. Douglass developed the technique of crossdating, the fundamental tool for tree-ring dating. In many species, annual ring series form unique, nonrepetitive patterns of wide and narrow rings that can be compared and synchronized among hundreds of trees in a given region. Using the outermost ring in living trees as the known datum in time, exact calendar years can be assigned to every cross-synchronized growth ring, whether in living or long-dead trees.

The exact age of trees can be readily and harmlessly determined by using a Swedish increment borer to extract a small-diameter core from bark to pith and then carefully polishing the core to reveal the minute anatomy of the annual growth rings The author is seen here coring a 300-year-old eastern red cedar (Juniperus virginiana) *in Elk River, Kansas. In most cases, tree-ring data provide the best information on the maximum longevity for tree species.*

GRAHAM HAWKS

Douglass also demonstrated that climatic fluctuations were responsible for most of the interannual variations in tree growth quantified in these tree-ring chronologies. Today, tree-ring analysis is widely used to date the construction of ancient buildings, prehistoric volcanic eruptions and earthquakes, to document the presettlement fire ecology of forests, to recon-

DAVID W. STAHLE

This canopy of a pondcypress (Taxodium distichum *var.* nutans) *at Topsail Hills, Florida, typifies the flat-topped crowns reduced to a few heavy, craggy limbs often found in cypress trees of great age.*

struct past climate fluctuations, and to study the carbon budget of the earth. With a remarkable degree of precision, it can test theories of anthropogenic climate change.

It was A. E. Douglass' longtime colleague Edmund Schulman who suggested the concept of "longevity under adversity," used by dendrochronologists to locate ancient trees worldwide. He had found that the oldest conifers tend to grow under the most adverse ecological conditions, such as the arid lower forest border in the western United States or the cold windswept forests at the subalpine treeline. For instance, the oldest known continuously living organisms on earth, the bristlecone pine *(Pinus longaeva)* of California's Inyo National Forest, are found at 9,000 feet above Death Valley in the rainshadow of the Sierra Nevada, one of the most hyperarid forest sites on earth. The steep dolomite slopes receive an average of only five to ten inches of precipitation annually. Bristlecone growth can be as slow as one radial inch per century and individuals as old as 5,000 years have been identified.

External Attributes of Ancient Trees

Based on analysis of thousands of ancient trees throughout the world, dendrochronologists have described a suite of external physical attributes often associated with ancient conifers and hardwoods (Schulman 1956, Stahle and Hehr 1984, Swetnam and Brown 1992). Experienced dendrochronologists can often identify ancient trees visually and can readily segregate individuals into approximate age categories. These external attributes are not precise or infallible, of course, and microscopic analysis of the annual growth rings is the only way to obtain certain age evidence.

Perhaps the most reliable attribute associated with great age in trees is a pronounced longitudinal twist to the stem, which is also evident as spiral grain in the wood of ancient trees. Other attributes include crown dieback (also referred to as a spike top, stag top, or dead top); a reduced canopy often restricted to a few heavy, craggy limbs; branch stubs and other bark-covered knobs on the stem; hollow voids or heart rot; partial exposure of massive roots and root collar; leaning stems; heavy lichen and moss growth on stems; thin and patchy bark; strip bark in conifers; wind-sculpted bark or exposed wood; flat-topped crowns; fire or lightning scars; and size—not absolute size, but size relative to other trees of the same species growing on similar sites.

Tree-ring analysis demonstrates that this post oak near Keystone Lake, Oklahoma, began growth well before 1610 and is the oldest post oak known However, there are literally thousands of acres of ancient post oak throughout the Cross Timbers and elsewhere in the oak-hickory forest, and older individuals no doubt survive.

The Network of Long Tree-Ring Chronologies in the United States

On my first collecting trip in northwest Arkansas, I was surprised at how easily ancient forest remnants could be located in the heavily cutover eastern United States. We found 250-to-300-year-old post oak *(Quercus stellata)* dominating a narrow, but largely undisturbed corridor of forest winding around the dry upper slopes of Wedington Mountain. At first I believed that this was just a lucky find, but the hundreds of ancient post oak discoveries we have made since in Arkansas, Missouri, southeastern Kansas, Oklahoma, and Texas clearly demonstrate that this particular forest type has often been left uncut.

Ancient hardwood stands have been found on steep and dry upland sites throughout the eastern deciduous forest, among them chestnut oak *(Quercus prinus)* along the Blue Ridge Parkway and white oak *(Q. alba)* on ravine slopes near the western limit of upland deciduous forests in Illinois and Iowa. A variety of ancient conifers have also been found, including northern white cedar *(Thuja occidentalis)* over 1,000 years old on the Niagara Escarpment and pitch pine *(Pinus rigida)* up to 450 years old in the Schawangunk Mountains only sixty-five miles from Manhattan.

Noncommercial stands are not restricted to dry upland sites; they include an interesting variety of bottomland and swamp forests. Relatively undisturbed old-growth timber in the East includes the pine pocosins of the Carolinas,

DAVID W STAHLE

This Pinus rigida *near Mohonk Lake, New York, is in the 450-year age range and is the oldest pitch pine yet discovered*

the pitch pine bogs of New Jersey, and a few scattered northern white cedar bogs and wetlands. None of these wetland forests support particularly large trees, but some are surprisingly old and undisturbed in spite of their unimpressive size.

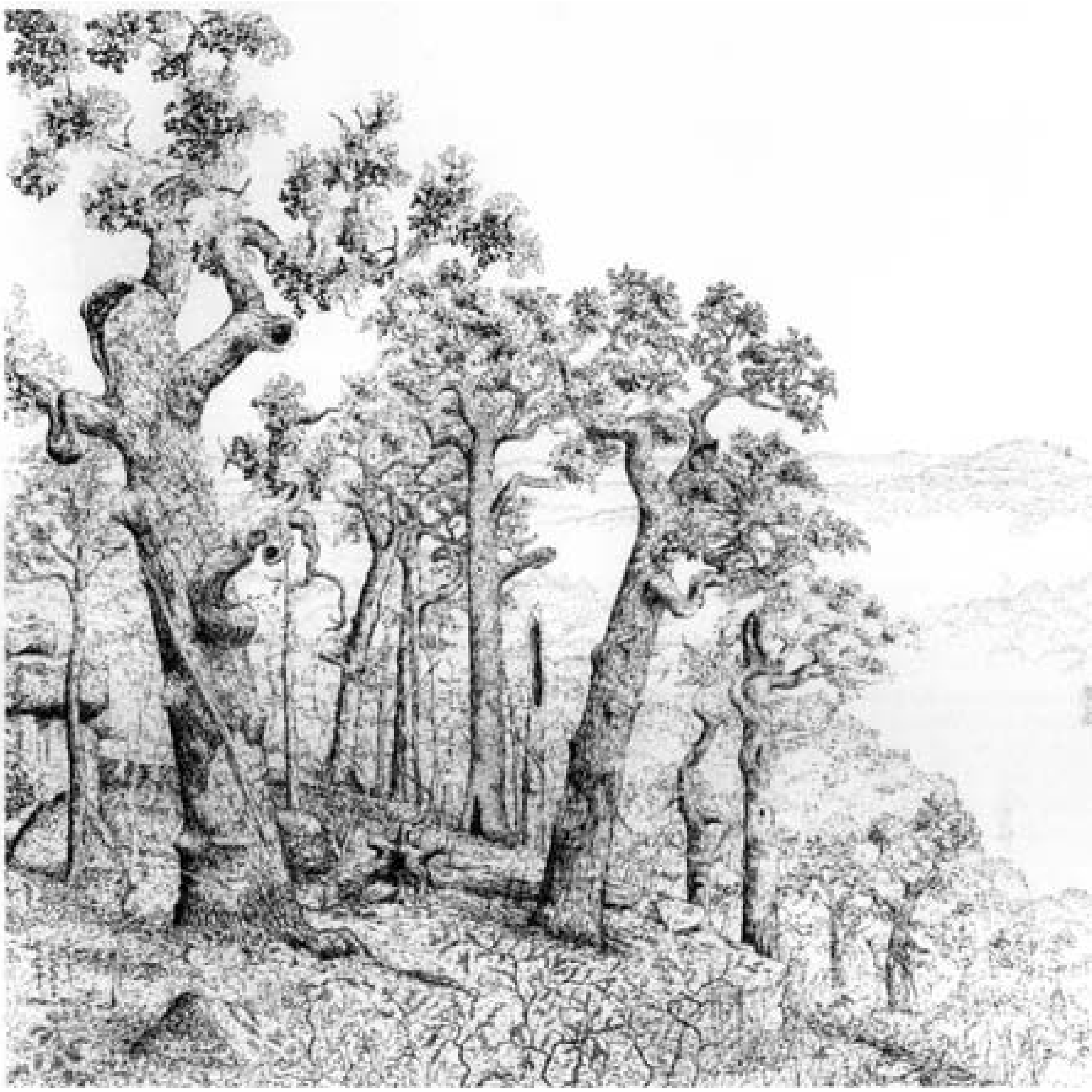
The many baldcypress *(Taxodium distichum)* swamps with trees from 500 to over 1,500 years old are certainly among the most notable ancient forests left in eastern North America. The natural range of baldcypress was restricted to excessively wet forests and swamps in the southeastern United States. This habitat contrasts vividly with the adverse upland sites usually associated with longevity in trees, but the specific environmental stresses responsible for slow growth and longevity can vary dramatically among species and forest types. For baldcypress and other wet-site species, these environmental stresses include excessive moisture and acidic, nutrient-poor swamp waters.

Bottomland hardwood forests along many southern streams have also been heavily exploited for timber and cleared for farmland, but again not all bottomland hardwood species produce quality lumber and some species tend to be restricted to the lowest and wettest positions, which are poorly suited for agriculture. The best example might be overcup oak *(Quercus lyrata)*, which can achieve impressive size, but its lumber is often twisted, defective, and prone to rot. We have occasionally found 200-to-350-year-old overcup oak growing on slightly higher positions in or adjacent to ancient cypress swamps. Small tracts of marketable timber of a variety of species have also survived in a few areas surrounded by noncommercial forests or rough, inaccessible terrain.*

(continued on page 10)

* These can include beech *(Fagus grandifolia)*, post oak, white oak, chestnut oak, chinkapin oak *(Quercus muehlenbergii)*, blackjack oak *(Q. marilandica)*, Texas live oak *(Q. virginiana* var. *fusiformis)*, shin oak *(Q mohriana)*, overcup oak, swamp chestnut oak *(Q. michauxii)*, black gum *(Nyssa sylvatica)*, tupelo gum *(N aquatica)*, ashe juniper *(Juniperus ashei)*, eastern red cedar *(J. virginiana)*, pitch pine *(Pinus rigida)*, table mountain pine *(P. pungens)*, jack pine *(P. banksiana)*, yellow poplar *(Liriodendron tulipifera)*, eastern hemlock *(Tsuga canadensis)*, baldcypress, and pondcypress *(Taxodium distichum* var. *nutans)*.

A Portfolio of Ancient Trees



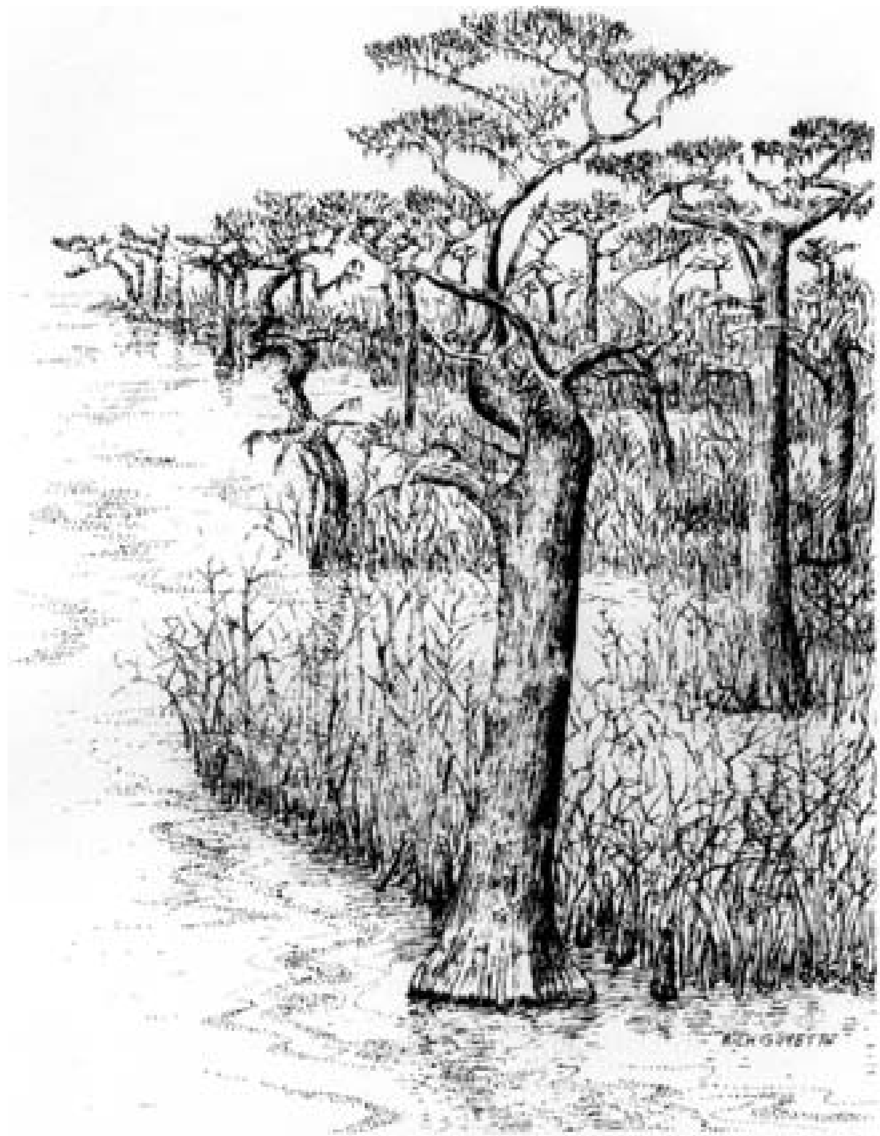
An ancient *Quercus stellata* forest of the Ozark Plateau drawn by Richard P. Guyette, an accomplished artist and dendrochronologist. This drawing illustrates many of the external attributes typical of ancient hardwoods and gives some impression of the aesthetic qualities that distinguish these authentic presettlement forest survivors. Richard has illustrated the details of a post oak-dominated forest on the Ozark Plateau, including twisted stems, dead tops and branches, exposed root collar, hollow voids, and canopies restricted to a few heavy muscular limbs. Leaning trees, branch stubs, irregular bark texture, fire and lightning scars, and fallen logs in various stages of decay are also evident.

These weathered relics are found on steep slopes and poor soils broken by small glades and picturesque blufflines. Post oak tends to dominate these dry infertile positions in the Ozarks, but blackjack oak, black oak, northern red oak, white oak, winged elm, white ash, bitternut and mockernut hickory, serviceberry, dogwood, dryland blueberry, little bluestem, and a variety of mosses and lichens are variously present in these forest remnants. Although stunted by the adverse environment, these noble post oak trees often exceed 300 years in age.

Ancient spike-top and strip-bark *Juniperus virginiana* on a bluffline in the Missouri Ozarks drawn by R. P. Guyette. The old-growth attributes illustrated here are typical of ancient *Juniperus* trees worldwide. The classic spike top of these red cedars, particularly the massive twisted spike top at right, are virtually a universal indicator of old-growth conifers and can often be identified from a considerable distance. Notice that this spike top is free of delicate branching, which was broken off after years of exposure to wind, ice storms, perching birds, and climbing animals. The mildly intoxicating fragrance of cedarene can permeate these bluff-edge red cedar, making the collection of tree-ring samples from these high blufflines a precarious experience.

In strip-bark trees only thin filaments of living cambium connect the canopy and root systems. Strip-bark growth is a hallmark of the ancient bristlecone pine forest along Methuselah Walk in California's Inyo National Forest and is common in many other high-elevation and drought-stressed conifers. However, strip-bark growth is not common in old pines of the eastern or southern United States

The oldest red cedars on the Ozark Plateau are often found growing on rocky pinnacles detached from the main cliff escarpment, where they may have enjoyed a measure of protection from the occasional ground fires that swept the hardwood forest floor. The oldest red cedars are 600 to over 900 years old and have been found by Richard Guyette on dolomite-derived soils along the Jack's Fork and other scenic streams in Missouri. In fact, a number of the oldest known trees of several species have been discovered on dolomite or gypsum-derived soils. Other very ancient dolomite- or gypsum-grown trees include bristlecone pine at Methuselah Walk, California (up to 5,000 years old); ancient Rocky Mountain Douglas fir at Eagle, Colorado (up to 900 years old); and northern white cedar on the Niagara Escarpment, Ontario (up to 1,000 years old).



Ancient *Taxodium distichum* typical of blackwater streams in the Carolinas, Georgia, and Florida, drawn by R. P. Guyette. Note the blunt and bent silhouette on the stout cypress in the foreground, which would be in the 800-year age class. The mature tree in the middle distance on the right would be in the 400-year age class, and the stunted and twisted tree at the right margin resembles a specific tree at Black River that is over 1,500 years old.

These nutrient-limited blackwater swamps are frequently dominated by slow-growing baldcypress in an open canopy and by Carolina ash in the understory, often to the near exclusion of other species of trees and shrubs. The canopy cypress are rarely over 60 feet tall or over 36 inches in diameter above the buttress; we have measured radial growth in some ancient blackwater cypress at less than one inch per century. The frequently broken main stem, flat-topped crowns, and recently sprouted fine branches on the stem and broken branches seen in the foreground all bear mute testimony to the pruning effects of past hurricanes in these near-coastal cypress swamps.

(continued from page 6)

Ancient noncommercial forest remnants are sometimes discounted in the debate over eastern old growth because they do not answer our desire for large as well as old trees. These relics are not our lost cathedral forests, but they are the authentic remains of our oldest forests; they represent an important part of the presettlement forest mosaic that once graced eastern North America. Their growth rings faithfully record a natural history of the virgin forest and may hold the answers to questions of environmental change we have yet to pose.

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David W. Stahle is associate professor of geography and director of the Tree-Ring Laboratory at the University of Arkansas He documented the oldest known trees in eastern North America, the baldcypress at Black River, North Carolina, which are over 1,600 years old. Currently he is conducting tree-ring research in the United States, Mexico, and Africa.

Tree Transplanting and Establishment

Gary W. Watson

Both experience and research make it clear that almost any size tree of any species can be transplanted. Success depends on the reestablishment of a normal spreading root system. An understanding of how roots grow and take up water can aid the process, even on difficult sites.

Many aspects of transplanting change over time. Modern equipment has made it possible to transplant larger trees with "soil balls" more affordably. Containerized production has grown in popularity for many reasons, including the ability to plant in any season. One thing remains the same—plants must quickly establish or reestablish a normal, spreading root system on the new site to minimize susceptibility to stress and assure survival.

Stress after transplanting, often called transplanting shock, is caused primarily by drought stress. Field-grown trees can lose up to 95 percent of their roots when they are dug from the field. This small portion of the root system has difficulty absorbing enough water to meet the needs of the tree. Plants grown in containers are also subjected to drought stress after planting, not because of root loss, but because water drains out of the light soilless container media much faster after it is planted in the ground than when it was in the pot. To compound the problem, irrigation is typically less frequent than it was in the container nursery. All newly planted trees will be subjected to stress until a normal spreading root system has developed.

GARY W. WATSON

When the root ball is planted high to improve drainage, the soil should slope from the existing grade to the top of the root ball.

Planting Site Preparation

Not every site requires extensive preparation before planting. The soil in undisturbed sites and landscapes in older neighborhoods is often of very good quality. Site preparation must be more intensive on disturbed sites or sites with naturally poor quality soils. Soil conditions on urban planting sites can be very difficult for root growth.

Planting site preparation can provide an optimum environment for root growth for only a limited time. Considering that the roots of a tree can normally spread two to three times as far as the branches, the long-term needs of even a small tree cannot be completely provided for at planting time. Long-term survival will depend more on selecting a species that will be able to survive, and thrive, under the existing site conditions.

Planting site preparations should focus on providing the highest quality environment possible for initial root growth during the first year or two after transplanting—possibly longer for trees over 4 inches (10 cm) in caliper. Even in cool northern climates, tree roots with average growth rates may extend 3 feet (1 m) or more from the root ball after two years. Though it would be desirable to prepare a larger area, in most cases it would be impractical.

Planting Hole Size and Shape

Trees are expensive. Planting the tree properly and maintaining it until it is established will protect the substantial investment in the tree. To emphasize the need for adequate site preparation, gardeners often advocate preparing a five-dollar planting hole for every fifty-cent tree.

The primary objective of planting site preparation is to provide a quantity of backfill soil that promotes rapid initial root development and does not restrict root spread beyond the planting hole. Ideally, these objectives should be achieved with a minimum of cost and effort. To prevent settling, the root ball must be supported by undisturbed soil. Since most new roots will grow horizontally from the sides of the root ball, compacted soil at the bottom will not substantially affect overall root growth.

When a deeper planting hole is not an option, widening the planting hole is the only way to increase its size. Most tree roots are concentrated within the top foot of soil. Since the most vigorous root growth is likely to occur near the surface, efforts should be concentrated there. In many compacted urban soils, root growth from the bottom half of a 12-to-18-inch (30-45 cm) deep root ball will be inhibited by inadequate drainage and aeration. In these soil conditions, a wide hole for the entire depth of the root ball may not be as useful or efficient as a hole with sloped, or stepped, sides. With this configuration, the majority of the effort is directed towards surface soils where the new roots will grow most vigorously. A hole with sloped sides will not restrict root spread. Deeper roots will grow towards the surface soils and continue to spread if they are unable to grow into the compacted subsoil (Figure 1).

A planting hole that is two to three times the width of the root ball at the surface, with sides sloping towards the base of the root ball, is optimum for most situations. The root ball can hold less than 5 percent of the original root system. A hole only 25 percent greater in diameter than the root ball will allow the root system to reach less than 10 percent of its original size before poor-quality site soils slow root growth. A hole three times the width of the root ball with sloped sides will allow the root system to grow rapidly to 25 percent of its original size before being slowed by the poorer quality site soil. The well-aerated surface soil is increased up to tenfold by the wide, shallow configuration. This increased volume of high quality backfill soil promotes rapid root growth and will make the tree less subject to severe drought stress than the tree in a smaller hole. Trees transplanted with a tree spade also benefit from a larger planting hole. The tree spade's metal blades dig cone-shaped holes whether extracting a tree or creating its new home. In this situation, cultivation around the root ball after planting may be the only practical method.

Backfill Soil Modifications

The change in soil type at the interface between backfill soil and the surrounding undisturbed soil is often blamed for poor root development in the undisturbed soil, but this stems from a confusion between inability of roots to cross the

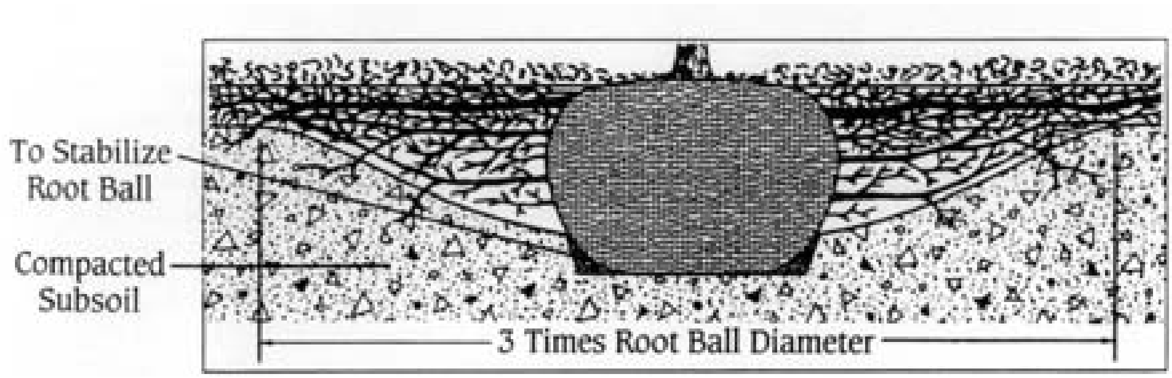

Figure 1. Where roots have difficulty penetrating compacted site soils, sloped sides allow roots to continue to grow vigorously towards the better soils near the surface. Roots that do penetrate the site soil along the sloping interface will probably grow more slowly

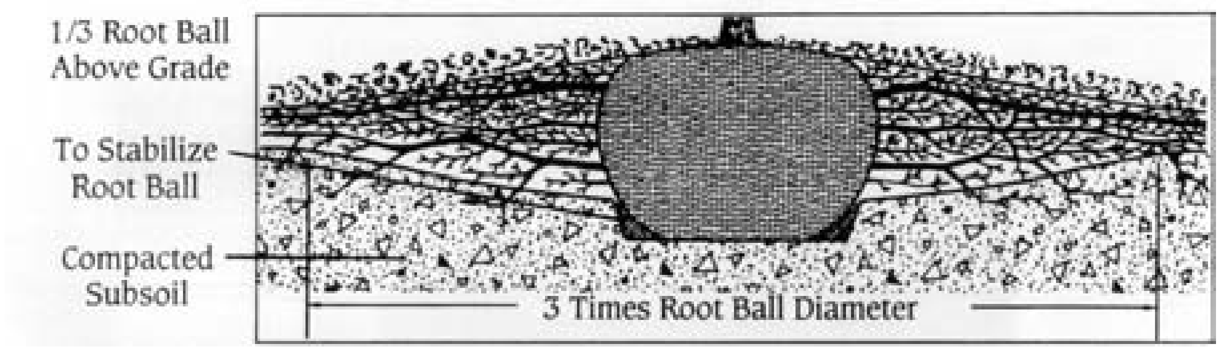

Figure 2. Planting the root ball so that approximately one-third of it is above grade can help to provide better drainage and aeration for roots.

interface and inability of roots to grow vigorously in the soil material on the other side. While the interface can have a major effect on soil water movement, it usually does not affect roots. If the backfill soil has been amended, the abrupt change in soil texture can affect soil properties such as water movement but probably not root growth.

When three types of backfill soils were used on a compacted urban planting site, including unamended soil, there was no difference in root development in any of the backfills. (Note that unamended soil is not the same as unaltered soil.) Root development in the soils outside of the planting hole was lower than in any of the backfill soils, but this appeared to be due to the overall reduced root growth in the compacted clay site soil, rather than an inability of the roots to grow across the interface between the soils.

On moderate sites, amending the soil may be unnecessary, but not harmful. On extremely poor quality sites, soil amendments may be more important, but still probably not as important as digging a large planting hole.

Drainage

Adequate drainage from the bottom of the planting hole is very important for root regeneration. Gravel in the bottom of the planting hole can make drainage worse. Water will not move from the finer textured soil above to the layer of coarse gravel below until the fine-textured soil is completely saturated. This results in waterlogged soil above the gravel.

Drainage tubing may be used to drain water from the bottom of the planting hole if the water can be discharged at a lower level nearby. Planting with the top of the root ball slightly above grade can also increase survival on poorly drained sites. No more than one-third of the root ball should be above grade, and the soil should be gradually sloped between the top of the root ball and the original grade (Figure 2).

Establishment After Transplanting

The establishment period can be defined as the period required for a plant to grow a normal root system. During this period the plant is susceptible to extreme stress. The length of the establishment period is affected by many environmental and cultural factors. Growth rate also provides an indication of stress (Figure 3). Growth will slow immediately after transplanting and recover to pre-transplanting levels as the root system regenerates and stress is reduced.

Plant growth is always limited by something—temperature, light, nutrients, genetics—but after transplanting, water is usually the most limiting factor. Transplanted trees rely heavily on moisture in the root ball throughout the first growing season. For balled-and-burlapped trees, the moisture contained within the root ball represents only a small fraction of the water that was available to the tree before transplanting, and it is small relative to the transpiration demands of the tree. Root ball soil moisture can be depleted very quickly, even while backfill soil just outside the root ball stays very moist, because there are few roots to absorb the water there. The water from the backfill soils is not able to move into the root ball quickly enough to effectively replace what is being removed by the tree. Just two days after watering, the root ball soil can become dry enough to stop new root growth and to reduce the capacity of the existing root tips to absorb water. (In experiments with trees of two-inch caliper transplanted into backfill soil, it took four to five months to develop roots just outside the root ball that were sufficiently dense to allow significant amounts of soil moisture.) It may take several days for growth to resume after watering. With frequent, repeated soil drying, root growth may be halted for long periods.

Calculating the amount of water held in the root zone in relation to usage by the plant is another way to estimate the water needs of new plantings. The supply of soil moisture available to the expanding root system of a recently planted shrub increases more rapidly than does water use by the slower growing crown. Twenty-one weeks after planting, the soil water

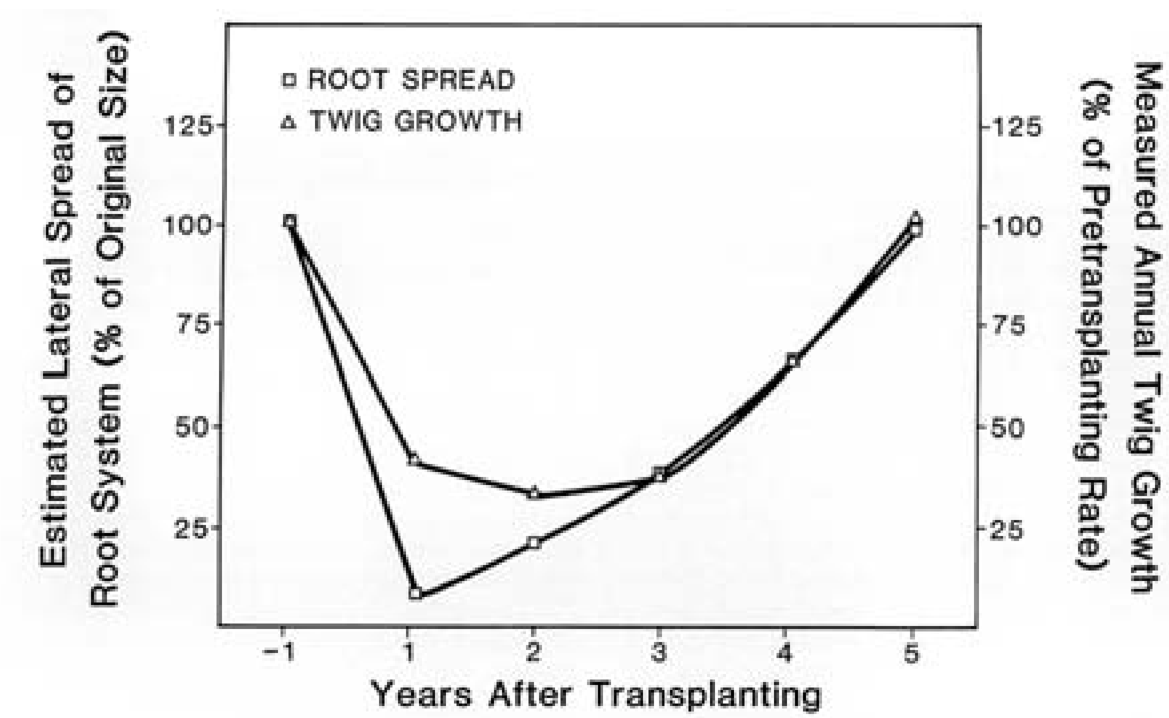

Figure 3. Root loss as a result of transplanting causes a corresponding decrease in twig growth Recovery of twig growth rate is closely related to regeneration of the root system.

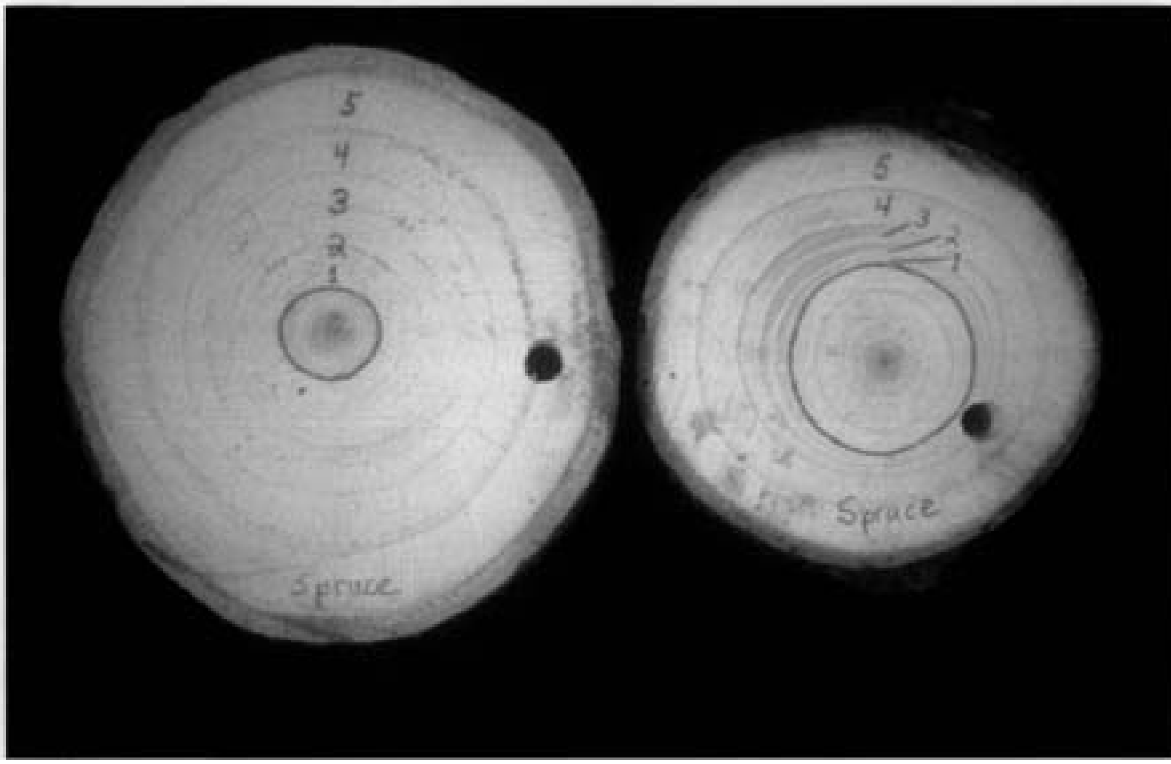

*Figure 4 Trunk sections of transplanted spruces (*Picea *sp.) show that growth of the larger transplanted tree (size at the time of transplanting is shown by the circle) is slowed for several years, while normal growth of the smaller tree resumes more quickly. By the time both of the trees are established, the relative size of the two trees may be equal or reversed.*

supply of small shrubs was only eleven days. Two-inch caliper trees may require two growing seasons before attaining a large enough root system for a similar soil water supply.

Duration of Transplanting Stress

To be considered fully established after transplanting, the tree must develop a full root system on the new site. The partial root system in the root ball, or the confined root system of the container, must develop into a normal spreading root system that can utilize soil moisture and nutrient resources from a large soil volume. This will take several years.

Root establishment takes longer for large trees than for small trees. When standard specifications are followed, the size of the root ball or container is proportional to the size of the plant. Regardless of size, the root ball holds only this same small percentage (4 to 18) of the root system. The root system in container plants is likewise confined to a proportionately small soil volume. Moreover, root growth rates are similar for large and small trees. What is very different is the distance that roots must grow to develop the full spreading root system necessary for complete establishment. A smaller tree requires fewer increments in annual root growth after transplanting than a large tree in order to replace the original root system. Since the smaller tree recovers vigor faster, it may one day be nearly the same size as a larger tree transplanted at the same time (Figure 4).

Soil temperature also affects root growth after transplanting. In climates where the soils are warm year round, roots will grow faster and plants will become established sooner. In the north temperate climate of the upper midwestern United States, twig growth of a four-inch caliper tree is reduced for four years after transplanting. In other words, the establishment period is approximately one year per caliper inch. In the subtropical climate of northern Florida, where roots grow much faster, trees reestablish at a rate of approximately three months per caliper inch.

During the second half of the establishment period, stress may not be as apparent. Nevertheless, the reduction in growth can be measured. At this time, monitoring should be continued, but it may be possible to limit supplemental watering to periods of drought.

Comparisons Among Growing Methods

Researchers have compared the establishment of traditional field-grown trees with conventional root balls to that of container-grown trees and of trees grown in in-ground fabric bags. Based on data on water stress, trees that were transplanted from field soil or from fabric bags establish more quickly than trees planted from plastic containers. Container plants were smaller and sustained very little root loss at transplanting and yet took longer to establish. Although measurable, the differences were not great enough to warrant avoiding container-grown plants. Adequate irrigation will easily overcome the difference, and container plants have many other advantages. The need for regular watering of all trees cannot be overemphasized. As long as the roots stay primarily confined to the root ball soil, they will be susceptible to rapid drying when irrigation or rainfall is absent for even a short period.

Both periodic and chronic stress can reduce growth in any plant. If a high level of care and a consistent environment is maintained above and below ground, the plant will establish faster. Water stress reduces photosynthesis and root growth and also increases susceptibility to certain disease and insect problems. Adequate site preparation and judicious watering throughout the growing season will do more to assure survival and maximize vigor than anything else, with the possible exception of high-quality, site-appropriate plant material.

The successful establishment of transplanted trees is dependent primarily on the reestablishment of a normal spreading root system on the new site. This process can be slowed by inadequate site preparation and difficult sites. Root growth is naturally slower in colder climates. Larger trees have larger root systems and take longer to regenerate after transplanting. Both experience and research make it clear that almost any size tree of any species can be transplanted. Large and small trees transplanted at the same time may eventually be similar in size. The choice may depend on size of budget and willingness to wait for a small tree to grow.

For Further Reading

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A Kind of Botanic Mania

Joan W. Goodwin

The simplicity of Linnaeus' classification system opened the field of botany to amateurs and its study was soon seen as "peculiarly adapted to females."

"I have this summer paid some attention to Botany," wrote seventeen-year-old Sarah Alden Bradford (1793–1867) to fourteen-year-old Abigail Bradford Allyn (1796–1860). "It is not a very useful study, although a very pleasing one," she continued. "It is however an innocent amusement, and enables us to discover Divine Wisdom, even in the construction of the smallest flower." Anticipating her family's move later that year of 1810 from Boston to Duxbury, where her third cousin Abigail lived, Sarah added her intention "to try to persuade you to join with me, in examining plants, and arranging them under their respective classes."[1]

Apparently she succeeded. Soon Sarah's father was writing to her brother at Harvard that "Sarah & Abba are studying Botany and one would think they hold converse only with the flowers for they in a manner seclude themselves from human observation & from communication with animal nature. I dont know what flower they affect to emulate but I dare say they are known to each other under some order or class of the Lin[na]ean system." If the Harvard student should write to his sister, Bradford advised him to "talk about calyx, corolla, & petals & I will engage you will be read."[2]

Without realizing it, Sarah and Abba were part of a fashionable trend that was drawing many young women into the study of botany. The simplicity of the new binomial system of classification devised by Swedish botanist Carolus Linnaeus (1707–1778)—which categorized plants according to the number and position of the stamens and pistils of their flowers—opened the field of botany to amateurs, many of whom made major contributions in describing and classifying plants. Wives and daughters were introduced to the study as helpers of botanist husbands and fathers. Linnaeus's daughter Elizabeth Christina saw her report on phosphorescence in nasturtiums published in the *Transactions* of the Royal Swedish Academy of Sciences in 1762.[3] In this country, Jane Colden (1724–1766) was introduced to botany by her father, Cadwallader Colden, who wrote the first local flora of New York based on the Linnaean system. Jane corresponded with experts in the field on both sides of the Atlantic, was widely praised for her botanical drawings, and was commended to Linnaeus himself.[4]

From the mid-eighteenth century on into the nineteenth, the study of botany was considered especially appropriate for young women who, it was assumed, liked flowers, were nurturing by virtue of their gender, and would benefit from healthful but not strenuous outdoor exercise. As Almira Phelps wrote in her *Familiar Lectures on Botany* (1829), "the study of Botany seems peculiarly adapted to females; the objects of its investigation are beautiful and delicate; its pursuits, leading to exercise in the open air, are conducive to health and cheerfulness."[5] However, there was some concern that since the Linnaean system was based on the sexual characteristics of plants, it might offend delicate sensibilities. In Britain, "desexualized" texts were created for female audiences, and in France Jean Jacques Rousseau omitted the Linnaean system in his 1771 *Lettres élémentaires sur la botanique*, written for a mother to use with her daughter. Thomas Martyn's English translation, *Letters on the Elements of Botany, addressed to a lady*, on the other hand, suggested that the Linnaean system be used for classification.[6]

Though much has been written about botany as "the female science," the letters of Sarah Alden Bradford provide a rare record of the

This portrait of Sarah Alden Bradford Ripley at fifty-three, drawn by Cheney in 1846, now hangs in the Old Manse in Concord, Massachusetts.

observations of a particular young woman caught up in the general excitement during those years. Sarah read French as well as English, and Gamaliel Bradford, her broad-minded sea captain father, had even permitted her to learn Latin along with her brothers. When Sarah and Abba were not botanizing, their heads would be close together over the *Aeneid,* for John Allyn, Abba's father and Duxbury's minister and schoolteacher, also believed in educating daughters as well as sons. Sarah found another mentor in Judge John Davis, a Boston neighbor whose avocation was natural history. He welcomed Sarah to his library and his extensive natural history collections. It may well have been Judge Davis who first interested her in botany. Martyn's version of Rousseau was available to Sarah in Judge Davis's library, along with Linnaeus's own *Genera Plantarum* (1754), *Philosophia Botanica* (1790), and *Flora Lapponica* (edited by J. E. Smith, 1792), and James Lee's popular exposition of the Linnaean system, *Introduction to Botany* (Edinburgh, 1797).[7]

Back in Boston after a happy year in Duxbury, Sarah continued her literary and botanical correspondence with Abba. From Judge Davis she borrowed *The Botanic Garden* (1789–1791), in which Charles Darwin's grandfather Erasmus Darwin combined mythic and scientific elements in verse. The first part, "The Economy of Vegetation," depicts the goddess Flora and numerous spirits as directing the vegetable kingdom. The second part, "The Loves of Plants," dealt with the Linnaean system in metaphors of courtship and marriage. Sarah described the first part to Abba as "very beautiful" though "highly figurative" and "splendid perhaps even to a fault." She did not expect to like the second part so well because "[i]t is founded on the sexual system of Linnaeus, that the dust of the anthers is absorbed by the pistil, and is absolutely necessary to the production of perfect seed, which system has since been exploded, and proved to have been but a fanciful idea of that great botanist."[8]

She praised Linnaeus for "making the number and situation of the stamens and pistils the ground of distinction between the classes, orders, &c" and for reducing the number of classes, "which were before very numerous depending on differences in the leaves &c of vegetables." However, she thought that "[t]he idea of sexual distinction in plants, forming so striking an analogy between the animal and vegetable kingdoms, giving so important a part in the economy of vegetation, to the dust of the anthers, which otherwise appears entirely useless to the plant, so caught the imagination of Linnaeus, that he overlooked difficulties in the way of his favorite system, which have since been proved conclusive arguments against it."[9]

Indeed, the Scottish professor Charles Alston, among others, disputed Linnaeus's claim that the "dust of the anthers" was essential to reproduction in plants and instead likened pollen to excrement, thrown off by the plant as superfluous.[10] Sarah would soon learn, however, that Linnaeus's system had not been "exploded." In this instance and in others that follow, it is interesting to see the scientific controversies of the time from the viewpoint of this young devotee.

In 1813, though longing to return to the woods and fields of Duxbury, Sarah was reconciled to spending the summer in Boston by her father's offer to take her to a series of botanical lectures by William Dandridge Peck. "[T]hey commence next week," she wrote excitedly to Abba, "and we are besides to have the privilege of visiting the Botanic garden as often as we please."[11]

Professor Peck, appointed to Harvard's newly created chair in natural history, was also director of the Botanic Garden, bounded by the present Linnaean, Garden, and Raymond Streets and augmented by a gift of land from the adjoining Andrew Craigie estate.[12] According to Peck, the garden was "intended for the cultivation of plants from various parts of the world, to facilitate the acquisition of botanical knowledge. It was also intended to receive all such indigenous trees, shrubs, and herbaceous plants, as are worthy of attention, as being useful in domestic economy, in the arts, or in medicine." Begun with contributions from nearby greenhouses, it was gradually enlarged by travelers to the East and West Indies and Africa.[13]

Soon Abba was treated to a secondhand version of the Peck lectures. In fact, Sarah's letters over the next few years offer a striking parallel to contemporary botanical texts written for young people in epistolary form. The British author Priscilla Wakefield, for example, used the device of letters between two teenage sisters, Felicia and Constance, one of whom is learning botany and explaining her lessons to the other.[14] Whether or not Sarah had read the American edition of Wakefield (1811), she was as eager as the young woman in the book to share her discoveries.

"I warn you before you begin you will hear nothing except de classe et ordine et genere, for there prevaileth hereabouts a kind of Botanic mania," Sarah wrote. She had obtained "our great desideratum a work almost wholly confined to Genera and species, so that if I find a flower whose name is unknown to me, I have only to turn to the page where its particular class and order (whatever they may be) are written above after the manner of a dictionary, and compare it with the descriptions of the several Genera under that class, which are so exact that it is almost impossible to mistake them, and when I find one agreeing with it exactly, I have its Generic name, I then turn to that Genus in another volume on species and find its common or trivial name as botanists say, its properties, the places where it usually grows &c."[15]

Sarah shared her new knowledge of willow trees ("which you know are of the class Dioecia"), giving a meticulous description of the blossoms, including "a nectarium scarcely discernable to the naked eye but very plainly seen with the help of that microscope we had last summer." She urged Abba to examine the willows in Duxbury and instructed her further about the nectarium "which varies very much in different flowers and in some makes almost their whole bulk, as in the Columbine, which you will find in the swamp at the back of your house, those four hollow tubes resembling horns are the nectaria which I know by experience for I have sucked the honey out of them many a time."[16]

She also learned about Cryptogamia when "Mr. Peck, our lecturer gave us a curious plant called Equisetum or horsetail, it bears its fructifications in a spike, which is composed of little plates in the form of shields supported on short foot stalks, their edges hung round with bags which when viewed with the microscope resemble the fingers of a glove, when they are ripe they burst open and drop out balls which are supposed to be the seeds, to which are affixed four strings resembling and supposed to be antherae."[17]

Another friend of Sarah's to receive accounts of the lectures was Mary Moody Emerson, one of whose young nephews would later become famous. "We have been attending a course of Botanical lectures, and have found them numerously frequented by the beau-monde," Sarah informed Mary, adding archly that "we are pleased to see so rational an amusement in fashion; by exciting a taste for nature it may perhaps render the country supportable to some of our fine ladies." "Linnaeus was the lady's man," she observed later, "and the ladies have just found it out."[18]

For Mary, Sarah described henbane: "Its lurid and disagreeable aspect and foetid smell would repel all but the botanist. The whole plant is covered with a fine kind of glutinous hair. The colour of its blossom is a dirty yellow striped with dark purple. It is a most deadly poison, but as is generally the case with plants of its affinity has been discovered to possess great medicinal virtue." Knowing that Mary was more interested in the state of her soul than in her newly acquired knowledge, Sarah added a religious note. "Instances like these daily multiplied are unspeakably delightful," she wrote. "They vindicate the ways of God to man. What a world of wonders the vegetable creation unfolds to the enquiring eye! If the grand, magnificent, stupendous frame of some parts of the Divine scheme have oft compelled the exclamation 'what is man that thou art mindful of him' how instantly is the doubt relieved when we behold the admirable and complicated provision for the preservation, multiplication, and disperson of the most minute and to limited human knowledge apparently most useless species of vegetation!" She went on with a poetic description of the variety of seed dispersal: "those furnished with silken wings soar aloft wafted by some propitious breeze to their destined spot. Those armed with hooks avail themselves of passing travellers' aid for conveyance. Some confined in an elastic case, when ripe burst their prison, and are propelled abroad with amazing force; others borne as it were in a light balloon cut the liquid air, or skim the surface of the wave!"[19]

As the lectures came to an end, Sarah was bursting with things to tell Abba. She was particularly struck with Professor Peck's account of Linnaeus's discovery of the sleep of plants. "He [Linnaeus] was presented with some unknown plants in blossom, and not having time to examine them, he ordered the gardener to set them out, and take particular care of the blossom. At evening being at leisure he visited them and to his chagrin and disappointment the flowers were not to be found. The gardener was reprimanded and promised to be more careful in future. The next morning they were visible and Linnaeus engaged again deferred visiting them till evening when the flowers had disappeared as before. This was done thrice, and at length examining them more closely, he found the floral leaves at the base of the blossoms had risen and completely enveloped them. Struck with the idea that some such change might take place in all plants, at midnight with a lantern he visits his greenhouse, and there sure enough he finds his dear family all <u>sound</u> [asleep]. The solemn hour of night combined with the silence and novelty of the scene affected Linnaeus even to <u>tears</u>. They were the tears of admiration and gratitude we may suppose a parent might shed at the development of some new faculty in a beloved offspring." As a demonstration to his class, "Mr Peck brought a plant asleep one morning, which was very carefully wrapped up in cotton wool to keep it from the light; the leaves were curiously folded together, but by exposing it to the influence of the sun's rays, before lecture was over it had begun to recover."[20]

When Professor Peck lectured on Linnaeus's experiment with the fig tree, Sarah was convinced, if she had not been before, of the sexual function of flowers. She described for Abba "an exhibition with the solar microscope of the flowers of the fig tree which grow within the fruit, and are curious also as being an example of the 23 class. The fig was quoted and termed <u>fructussine</u> flore in contradiction to an assertion of Linnaeus that flowers were absolutely necessary to the production of fruit. [However, Linnaeus] discovered the hiding place of the blossoms and taught his opponents that in many cases, in order to form an accurate judgment it is necessary to look beyond the surface."[21]

The following summer found Sarah still enthusiastic about botany. She encouraged Abba to visit her, writing, "Craigie's swamp will be full of flowers, Smith's botany will be published, and we will enjoy ourselves finely together."[22] In 1814, Jacob Bigelow, founder and president of Boston's Linnean Society, brought out the American edition of James Edward Smith's popular English botany text, trusting that "the present edition will not be unacceptable to the public, particularly to students attending the botanical lectures in this place, for whose use it was originally undertaken."[23] He added notes on American plants and an expanded glossary of botanical terms. In Smith Sarah could read the full account of the "luminous experiment" in which Linnaeus removed the anthers from a flower, destroying the rest of the day's blossoms, and another day repeating the process but sprinkling pollen from another flower on the stigma of one from which he had removed the anthers. When the first flower produced no fruit while the second produced perfect seed, Linnaeus had proved his point, according to Smith.[24]

GRAY HERBARIUM ARCHIVES OF HARVARD UNIVERSITY

William Dandridge Peck, professor of natural history and founding director of the Harvard Botanic Garden in Cambridge (1805–1822), credited his interest in natural history to an "imperfect" copy of Linnaeus's Systema Naturae *that he retrieved from a ship wrecked near his home in Newbury, Massachusetts. Almost immediately on being named director of the yet-to-be-created Harvard Botanic Garden in 1805, William Peck set sail for Europe, where for three years he visited the great gardens, collecting seeds, plants, books, and ideas.*

In Smith's eyes, the facts of plant life did not detract from the delight of botanical study. "The natural history of animals, in many respects even more interesting to man as an animated being, and more striking in some of the phenomena which it displays, is in other points less pleasing to a tender and delicate mind," he wrote in his preface, while "[i]n botany all is elegance and delight. No painful, disgusting, unhealthy experiments or inquiries are to be made. Its pleasures spring up under our feet, and, as we pursue them, reward us with health and serene satisfaction. . . . The more we study the works of the Creator, the more wisdom, beauty and harmony become manifest, even to our limited apprehensions; and while we admire, it is impossible not to adore."[25]

As we have seen, Sarah, with her Unitarian upbringing, had already found botany to be a religiously illuminating experience. "If you have never examined a dandelion flower," she wrote Abba, "you will find it very curious, the

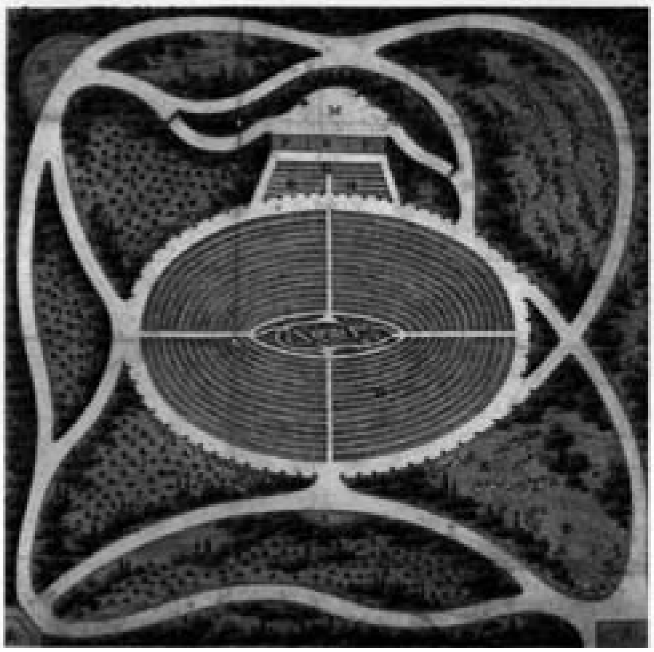
A Plan for the Botanic Garden at Cambridge

The idea for "a large well-sheltered garden and orchard for students addicted to planting" was broached at Harvard as early as 1672, and in 1784 the King of France offered "to furnish such [botanic] garden with every species of seeds and plants which may be requested from his royal garden, at his own expense." Finally, in 1805, a collaboration between the College and the Massachusetts Society for Promoting Agriculture provided for a professorship of natural history; among the duties of the professor was the formation of a "Botanic Garden on the grounds that shall be provided for that purpose."* William Dandridge Peck promptly set sail for a lengthy tour of western Europe.

At Uppsala Peck acquired seeds of 150 species of plants and 500 herbarium specimens that "are such as are rare and valuable, especially as they are from persons of the most correct information." He was told there "that the arrangement of plants in a garden according to Classes and orders in the [Linnaean] System is both difficult and inconvenient; but the disposition of them according to their natural orders in concentric circles is much more commodious."

In 1808 he sent a plan (top right) from Paris that grew out of several conversations at the Jardin des Plantes with M. Thouin, "a gentleman of eminence in the profession of ornamental gardening." It provided for various trees and flowering shrubs; small lawns with flowers and shrubs; hothouse, greenhouses, cold frames, and hotbeds. The "garden of Arrangement or Botanic School" forms the large central oval *(D)*. From Kew Peck had written, "A reservoir of water fed and kept sweet by a small spring is the best situation for aquatic plants." Accordingly, "Bason or reserves with running and stagnant waters" are designated at center *(C)*.

Peck had seen the Garden's site only briefly before his European trip, and although he remembered the wetland, he did not recall the shape of the grounds. In the 1888 plan (bottom right) some of the elements of the 1808 scheme can be seen, including a pool for aquatic plants at the center of the concentric planting beds. Native and exotic trees and shrubs were planted at once, and later came a conservatory; native herbs around a spring in the southwest corner; seedplots, cold frames, and hotbeds screened by a hedge of European beech; a gardener's cottage.



GRAY HERBARIUM ARCHIVES OF HARVARD UNIVERSITY

GRAY HERBARIUM ARCHIVES OF HARVARD UNIVERSITY

* Goodale, George L. 1991 The Botanic Garden at Cambridge. *Harvard Register,* Vol. 3 (Jan.).

downy wings of the seeds by which they are scattered far and wide. The perfect uniformity of the little flowers, each with its pistil and five stamens united by the anthers, the filaments separate, almost too small to be distinguished with the naked eye. The same order, regularity and beauty are as visible in the least as in the greatest of the works of creation. Do you think a dandelion could have been the work of chance? Surely that study cannot be entirely useless which can make even this most despised of flowers a source of admiration and entertainment, a demonstration of the hand of a Creator."[26]

Two years after the lecture series, Sarah wondered if Abba was reading Smith and recommended the sixteenth chapter on the functions of leaves. "It is amusing," she wrote, "to trace the striking analogies between the animal and vegetable kingdoms in respiration, secretion & all the similar and diversified effects of the vital principle in each. Theories which pretend to explain these effects in vegetation on chemical or mechanical principles are unsatisfactory." Smith had mentioned heat and wind as possible causes for the flow of sap from root to branch.[27] It seemed to Sarah that "[t]he attraction of cohesion may account for the ascent of fluids to small heights, but not for the propulsion of the sap from the spreading roots of the oak throughout the unnumbered ramifications of its towering limbs; that this most important function should depend on the agitation of the inconstant breeze is equally inconceivable; if you ascribe it to the vital energy and suppose some action of the spiral coated sap vessells similar to the pulsation of the arteries, a distinction sufficiently broad is marked between organic and inorganic bodies, and the operations of animal and vegetable organs analogous in their curious structure and combinations, are explained from similar causes. How regular the gradation too from species to species in the long series of organized existance!"[28]

Continuing her line of thought, she confronted Abba with a botanical extension of the popular philosophical idea of the Great Chain of Being supposed to link deity and the hierarchy of heavenly spirits with humans and the lower animals. "I suppose your ladyship would not feel her dignity much impaired by kindred with the majestic elm or delicate sensitive plant," she wrote, "but how would you receive the hand of fraternity extended by a potato or toadstool? Distinctions which appear so striking and marked when extremes are compared blend insensibly into each other as we descend, and genus is linked with genus in a chain which the delighted philosopher cannot nor does not wish to dissolve. Nature never disturbs us with abrupt transitions in any of her operations; broad day softens into twilight, twilight deepens into the shades of evening; the process of vegetation, from the first swelling of the seed till the perfect plant appears in all the luxuriancy of foliage and beauty of fructification, is so imperceptible that we are affected with no wonder or admiration at the secret agency of Divine power in the successive stages of its progress and are astonished only when we compare what it is with what it was."[29]

Sarah continued botanical study throughout her life. Three years after she wrote the letter just quoted, she married the Rev. Samuel Ripley, the Unitarian minister in Waltham who also kept a boarding school to prepare boys for Harvard. In addition to teaching Latin, Greek, and mathematics in the school, Sarah raised her own seven children and an adopted niece and managed the large household with only sporadic help. Collecting excursions to Prospect Hill and visits from an expert amateur botanist, the Rev. John Russell, provided much-needed recreation during those busy years.

When Asa Gray was appointed Fisher Professor of Natural History at Harvard in 1842, he was told about "a learned lady in these parts, who assists her husband in his school, and who hears the boys' recitations in Greek and geometry at the ironing-board, while she is smoothing their shirts and jackets! . . . reads German authors while she is stirring her pudding, and has a Hebrew book before her, when knitting. . . . Even my own occupation may soon be gone; for I am told that Mrs. Ripley (the learned lady aforesaid) is the best botanist in the country round."[30]

Soon Gray was sharing his books with this learned lady. One, "a beautiful edition of a french work on botany," gave Sarah "great pleasure in getting at the mind of a man of genius through his scientific method." She found it "much more satisfactory to begin from the root and study upwards, than to pick open a flower, count the stamens refer it to a class and give it a name."[31] When a book on European mosses came to the botanical library, Gray promised to loan it to her as soon as he had finished with it himself.[32]

Sarah spent her last years in retirement at the Old Manse in Concord, Massachusetts, where some of her mounted specimens may be seen. In her seventies, she was still teaching botany, writing to a young grandson, "I long to have the bright days of summer come for you and dear little Ezra to gather flowers of all kinds. . . . And poor old GrandMa will tell him all she knows, and put them in a book that has pretty flowers, which have been pressed and kept a great while, and are still bright and beautiful."[33]

Endnotes

[1] SAB to ABA, n.d (1810?), Sarah Alden Bradford Ripley Papers, MC 180, Schlesinger Library, Radcliffe College, hereafter cited as SABR.

[2] Gamaliel Bradford to Gamaliel Bradford, Jr., "Thursday" (1810?), Bradford Papers, bMS Am 1183.32, by permission of the Houghton Library, Harvard University

[3] Ann B. Shteir, "Linnaeus's Daughters. Women and British Botany," in Barbara J. Harris and Jo Ann K. McNamara, eds., *Women and the Structure of Society* (Durham, NC: Duke University Press, 1984), 69.

[4] See Mary Harrison, "Jane Colden: Colonial American Botanist," *Arnoldia* (Summer, 1995) 55(2): 19–26.

[5] Quoted in Vera Norwood, *Made From This Earth. American Women and Nature* (Chapel Hill: University of North Carolina Press, 1993)

[6] Ann B. Shteir, *Cultivating Women, Cultivating Science. Flora's Daughters and Botany in England, 1760–1860* (Baltimore: Johns Hopkins University Press, 1996), 19–20, 23.

[7] *Catalogue of the Private Library of the Late Judge Davis* (Boston: Alfred Mudge, 1847), 17, 20, 43.

[8] SAB to ABA, Nov 3 (1812?), SABR.

[9] Ibid.

[10] Shteir, *Cultivating Women, Cultivating Science,* 17. James Edward Smith, *An Introduction to Physiological and Systematical Botany,* First American, from the Second English Edition, with notes by Jacob Bigelow, M.D. (Boston: Bradford & Read, 1814), 253. Smith names Tournefort and Pontedera as being of the same opinion.

[11] SAB to ABA, n.d. (1813), SABR.

[12] Jeannette E. Graustein, Harvard's Only Massachusetts Professor of Natural History, *Harvard Alumni Bulletin* (December 13, 1958), 243.

[13] William Dandridge Peck, *A Catalogue of American and Foreign Plants Cultivated in the Botanic Garden, Cambridge, Massachusetts* (Cambridge: University Press, 1818).

[14] Priscilla Wakefield, *An Introduction to Botany, in a Series of Familiar Letters* (1st British ed., 1796, 6th ed., Philadelphia: Kimber & Conrad, 1811).

[15] SAB to ABA, n d. (1813), SABR. Sarah offers no authors or titles for the books she was using prior to the publication of the American edition of Smith.

[16] Ibid.

[17] Ibid

[18] SAB to MME, n.d (1813); Sept 5 (1817?), SABR

[19] SAB to MME, n.d. (1813), SABR.

[20] SAB to ABA, n.d. (1813), SABR.

[21] Ibid.

[22] SAB to ABA, n.d. (1814), SABR.

[23] Jacob Bigelow, "Advertisement to the American Edition," Smith, v.

[24] Smith, 253.

[25] Ibid., 18–20.

[26] SAB to ABA, n.d. (1812?), SABR.

[27] Smith, 54–55.

[28] SAB to ABA, Sept. 30 (1815), SABR.

[29] Ibid.

[30] Jane Loring Gray, ed., *Letters of Asa Gray* (Boston: Houghton, Mifflin, 1893), I· 289

[31] SAR to George F. Simmons, June 26, 1844, SABR. Unfortunately, Sarah failed to mention the name of this "man of genius" or the title of his book.

[32] Ibid , Dec. 12, 1844.

[33] SAR to William Sydney Thayer, n.d. (winter, spring, 1867?), MS Storage 296 (#51), by permission of the Houghton Library, Harvard University

Acknowledgments

The author wishes to thank Peter Stevens of the Harvard University Botany Department and Mary Harrison, Arnold Arboretum volunteer, as well as *Arnoldia* editor Karen Madsen for their helpful comments.

Joan W Goodwin, who lives in Brookline, Massachusetts, is an independent scholar now completing a biography of Sarah Alden Bradford Ripley.

A Multitude of Botanies: Book Essay

Peter Stevens

Cultivating Women, Cultivating Science: Flora's Daughters and Botany in England 1760 to 1860. Anne B. Shteir. Baltimore: Johns Hopkins University Press, 1996. Hardcover, 312 pages

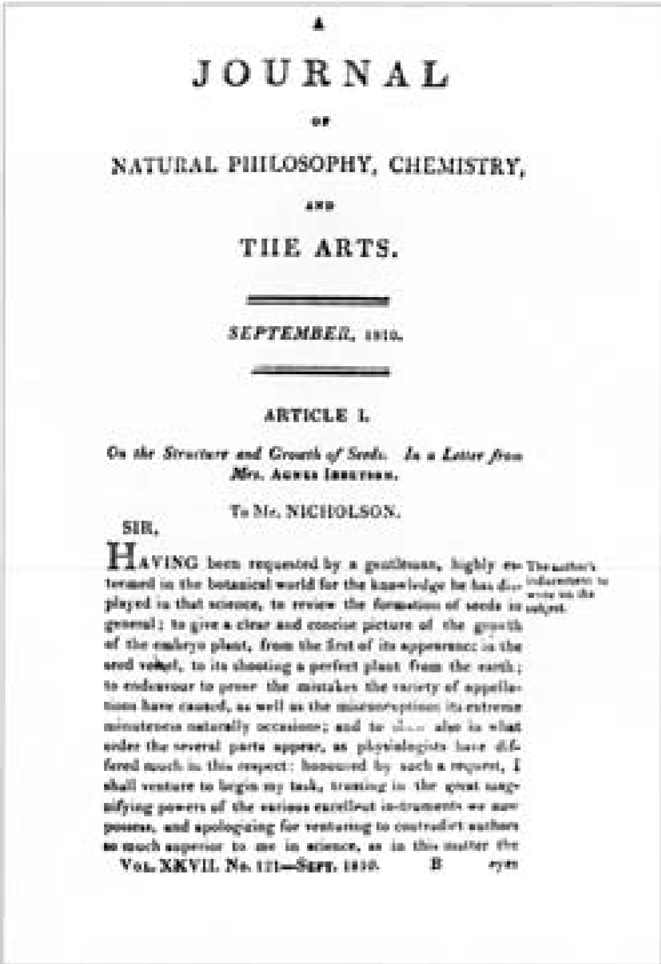
What does the word *botany* bring to mind? A nosegay held by a young girl? Field studies by amateurs that result in finds of new plants subsequently reported in the proceedings of botanical clubs using sesquipedalian words with Latin and Greek roots? Classificatory studies carried out in the cavernous halls of a large herbarium? Physiological and ecological studies of a prairie grass? In the nineteenth century these were seen by many as being competing ideas, and what we call botany in the twentieth century—and different people still define it in different ways—owes much to debates in the late eighteenth and nineteenth centuries. These were between professional botanists promoting very different visions of their discipline, and between what we might call amateurs and professionals, both men and women, as they, too, strove to shape public interest in a particular area of botany, or simply responded to what they saw as a market for particular kinds of botanical works.

Shteir's *Cultivating Women, Cultivating Science*—clearly written and well-illustrated—helps us understand the issues involved. Her subject is women in both popular and more scientific cultures of botany in the period 1760–1860, and she summarizes some of the topics that will engage her as she outlines how Linnaeus's classification, all the rage in the 1760s, came to be perceived at the beginning of the nineteenth century: "Teachers continued to explicate Linnaean botany for students, but increasingly it was seen as the gateway, or the lower rung of the ladder of botanical knowledge, associated with children, beginners, and women. During the 1790s commentators began distinguishing between the 'botanist' and 'botanophile', between the scientist and enthusiast . . . the botanist was male and masculine and the botanophile usually female and feminine. As a result, during the 1820s some botanists began to generate strategies to 'defeminize' the public image of the science."[1]

Botany proper, these male botanists thought, was not simply the Linnaean system; botany was not a subject that interested women alone; botany was an exciting science worthy of attention by men. Much ink was to be used in defining what botany was all about, yet the same arguments were being made at the end of the century, as we will see.

Shteir first summarizes how Linnaean botany—the identification and naming of plants using Linnaeus's system—became part of the social culture of women by the early nineteenth century. This was despite criticism by those who found the Linnaean sexual system offensive, and by some Romantic poets who felt that the rigidity of Linnaeus's approach was antithetical to their artistic concerns. Shteir then focuses on two groups of women writers responsible for the integration of Linnaean botany with popular middle- and upper-class culture. A group of these women wrote botanical books that specifically addressed mothers and governesses of children, especially girls. Such books were much in demand, judging by the numbers of times many of them were reprinted.

She then discusses the work of three women, Maria Jacson, Agnes Ibbotson, and Elizabeth Kent, who made careers in botanical writing, whether or not they made a living by their work. Agnes Ibbotson, who died in 1823, is particularly interesting. Her interests were in more "philosophical" botany, that is, botany that



A

JOURNAL

OF

NATURAL PHILOSOPHY, CHEMISTRY,

AND

THE ARTS.

SEPTEMBER, 1810.

ARTICLE I.

On the Structure and Growth of Seeds. In a Letter from Mrs. Agnes Ibbetson.

To Mr. NICHOLSON.

SIR,

HAVING been requested by a gentleman, highly esteemed in the botanical world for the knowledge he has displayed in that science, to review the formation of seeds in general; to give a clear and concise picture of the growth of the embryo plant, from the first of its appearance in the seed vessel, to its shooting a perfect plant from the earth; to endeavour to prove the mistakes the variety of appellations have caused, as well as the misconceptions its extreme minuteness naturally occasions; and to [illegible] also in what order the several parts appear, as physiologists have differed much in this respect: honoured by such a request, I shall venture to begin my task, trusting in the great magnifying powers of the various excellent instruments we now possess, and apologizing for venturing to contradict authors so much superior to me in science, as in this matter the

The author's inducement to write on the subject.

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included physiology, anatomy, and work with microscope, and they engrossed her energies for over twenty years at her home near Exeter, in the southwest of England. Largely without contact with metropolitan botanical colleagues, she nevertheless contributed to periodicals such as *The Philosophical Magazine* and *Annals of Philosophy.* However, when she sent a summary of her life's work to the doyen of British botanists, Sir J. E. Smith, president of the Linnean Society and owner of Linnaeus's collections, she received no encouragement. I would love to know more about Ibbotson's work and to see some of the illustrations she drew and to find out about Smith's own ideas about philosophical botany. (Staunch upholder of the Linnaean system though Smith was, Shteir notes he wrote *An Introduction to Physiological* [philosophical] *and Systematical Botany.*) Without such information, it seems premature to suggest that Smith felt challenged by Ibbotson's work, or to compare her work with that of the Nobel Prize winner Barbara McClintock.

John Lindley is the next to figure in Shteir's narrative. More than any other botanist in Britain in the first half of the nineteenth century, Lindley linked what might be called professional botany, polite middle- and upper-class amateur botany, and gardeners and horticulturists. He is still remembered for his work on orchids (the recently founded orchid journal, *Lindleyana,* attests to this), and he was closely associated with the Horticultural Society for almost his entire working life. However, his activities seem almost contradictory. Shteir notes both that Lindley attempted to rescue professional botany from women yet at the same time in his copious writings, perhaps most notably his *Ladies' Botany, or a Familiar Introduction to the Study of the Natural System in Botany* of 1834–1837, he introduced the natural system to popular audiences in general and women in particular. Furthermore, David Mabberley, in his recent biography of the great botanist Robert Brown, tends to dismiss Lindley's efforts, suggesting that Lindley "tamed" botany, making it palatable to Victorian England—"Floras had to be written, Science left by the back door."[2] Robert Brown had taken the lead in the introduction of a classification system that reflected ideas of nature to British professional circles barely a generation before Lindley wrote his book, and Brown's achievements inform Mabberley's judgment. But in an anecdote recounted by Shteir, we find Lindley, holed up in his summer house on a rainy day with family and visitors, forced to play indoor games, and indisposed to start botanical conversations with the botanical author Mary Kirby. The author of *Ladies' Botany* is here not even a popularizer of botany, although the conditions for any sort of botanical tête-a-tête on that occasion would seem hardly ideal.

The place of women in society was not static, and Jane Loudon changed the title of *Botany for*

Ladies (1842) to *Modern Botany* (1851). Shteir suggests that in the middle of the nineteenth century "women's spaces disappeared as the site of [botanical] science" with the disappearance of books written specifically for them. Shteir links this change to changing ideas of education—women's and men's education should not differ. However, even by Shteir's own telling, women had never been more than marginal contributors to the masculine, professional world of botanical science, however defined; they did contribute to a broader science culture, but very little to then-current classification systems. And in the last two chapters we find women later in the nineteenth century still very active in botany, as illustrators, collectors, and writers, but mostly of juvenile or general popular literature.

Shteir shows clearly that there were several groups of people interested in botany in the middle of the nineteenth century. (She also mentions the work of Anne Secord on British artisan botanists—another semi-independent community of botanical devotees with their own particular interests and customs.) We can relate these groups to the equally diverse ways in which zoology, natural history, and in particular, botany were perceived. Lindley wasn't jumping into a field dominated by women; professional botany, which at that time in England was largely synonymous with systematic studies, was dominated by men. But there is guilt by association—women and plants, especially flowers, were connected in the public mind[3]—and thus he wanted to disassociate women from the *philosophical* botany that he considered most exciting. Yet philosophical botany itself was not botany *toute courte*, as Sir J. E. Smith himself acknowledged in his opening address to the fledgling Linnean Society in 1798 and as Smith's and Lindley's contemporaries such as Lamarck and the great Swiss botanist Alphonse de Candolle also made clear. Similarly, the Victorians for whom Lindley "tamed" botany were a rather different group of people from those for whom Brown wrote earlier in the century, and both are different from Secord's artisan botanists. Some of the contradictions noted above disappear.

Indeed, throughout the century, botany as a science remained almost synonymous with classification studies, and botany in the eyes of the public remained associated with women and flowers. In 1895 John Merle Coulter, a major figure in the introduction of Lindley's philosophical botany (in its late nineteenth-century garb) into the United States wrote, "recommended especially to ladies as a harmless pastime . . . it [botany] was an emasculated science, which regarded merely the cut of the clothes rather than the man beneath. In spite of the subsequent revelation of the botanical man, the capacity of plants for usefulness in the domain of aestheticism still brands botany in certain quarters as an emotion rather than a study . . . But the botanical man has been liberated, and his virile strength is becoming daily more evident."[4]

Coulter may have thought the virility of botany (and he did not mean classificatory botany) was self-evident; he certainly acknowledged, albeit unwittingly, "the pervasive factor of gender in shaping the scientist, science education, and science writing," to quote Ann Shteir in the Epilogue.

If in this review I have taken a rather narrower view of botany-as-science, and of botany itself, than Shteir does in her admirable book, it is because I find this the easiest way to work towards the much-needed "broader conversation about the culture of botany"—again quoting the Epilogue—by emphasizing its subcultures. Both views are essential if we are to understand where botany stands at the end of the twentieth century.

Endnotes

1 Shteir, 30–31

2 D. Mabberley, Jupiter botanicus: *Robert Brown of the British Musuem* (Braunschweig: J. Cramer, 1985), 399

3 Jack Goody's recent *The Culture of Flowers* (Cambridge: Cambridge University Press, 1993) discusses this.

4 *The Botanical Outlook* (Lincoln: University of Nebraska Press), 4.

Peter Stevens is professor of botany at Harvard University and author of *The Development of Biological Systematics Antoine-Laurent de Jussieu, Nature, and the Natural System*, published by Columbia University Press in 1994.

Arnold Arboretum Weather Station Data — 1996

	Avg. Max. Temp. (°F)	Avg. Min. Temp. (°F)	Avg. Temp. (°F)	Max. Temp. (°F)	Min. Temp. (°F)	Precipi-tation (in.)	Snow-fall (in.)
JAN	35	18	**27**	**58**	–2	7.51	39.6
FEB	37	20	**29**	**58**	–6	3.05	17.3
MAR	44	24	**34**	**63**	4	3.78	20
APRIL	57	38	**48**	**83**	29	5.93	8
MAY	69	46	**58**	**93**	31	3.96	0
JUNE	81	58	**70**	**92**	45	1.87	0
JULY	83	61	**72**	**93**	54	5.45	0
AUG	83	62	**73**	**97**	56	2.17	0
SEPT	72	54	**63**	**90**	41	9.05	0
OCT	64	40	**52**	**77**	29	13.18	0
NOV	47	30	**39**	**71**	16	2.68	2.3
DEC	45	30	**38**	**61**	17	4.35	2.7

Average Maximum Temperature	60°
Average Minimum Temperature	40°
Average Temperature	50°
Total Precipitation	62.98 inches
Total Snowfall	89.9 inches
Warmest Temperature	97° on August 7
Coldest Temperature	–6° on February 5
Date of Last Spring Frost	31° on May 13
Date of First Fall Frost	32° on October 5
Growing Season	144 days

Note: According to state climatologist R. Lautzenheiser, 1996 was an extremely wet year with temperatures slightly below normal and sunshine well below normal. This was the ninth wettest year on record. January, July, and September were double the norm for precipitation, while October was triple the norm. The 9.99 inches that accumulated in October from the 19th to the 22nd was the second greatest rainfall on record and is considered a hundred-year storm.

The snowfall totaled 89.9 inches, which is more than double the past average for the year This was due to the glut of snow that fell early in the year. At year's end, the new snow season had brought less than normal snow. January broke the snow record for that month, and it was the second snowiest month recorded in 106 years. Only fifty percent of possible sunshine was measured, down four percentage points from the average.

Index to Volume 56 (1996)

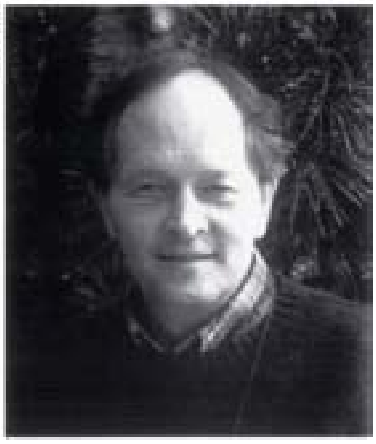
Numbers in parentheses refer to issues, those in ***boldface*** *to illustrations of the entries*

The Arnold Arboretum

WINTER • NEWS • 1996–1997

Spongberg Is Awarded the RHS Gold Veitch Memorial Medal

Sheila Connor, Horticultural Research Archivist



Stephen A. Spongberg, Arboretum horticultural taxonomist, recently traveled to London to receive the Gold Veitch Memorial Medal, one of the foremost honors of the horticultural world. Recipients of the medal are selected by England's Royal Horticultural Society for their outstanding contributions to the field and are deemed "persons who have helped the advancement of the science and practice of horticulture." Presented annually since 1873, the medal commemorates James Veitch (1792–1869) of the famous and influential family of British nurserymen.

By all accounts, the man who inspired the award was not only a skilled plantsman and accomplished cultivator but a generous supporter of horticultural charities. In fact, a medal was selected

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Celebrating 125 Years of Discovery

Mark these events on your calendar and join Arboretum staff and friends for our 125th anniversary celebration.

Yesterday, Today, and Tomorrow
Bonsai at the Arnold Arboretum

An artistic display of three eras of Arboretum bonsai at the New England Spring Flower Show

March 8 through 16, 1997—Bayside Exposition Center, Boston

Harvard University Herbaria Open House

A rare behind-the-scenes view of the work of Herbaria staff in the areas of plant collection, scientific research, and biodiversity conservation, highlighting the historic and current significance of the University's botanical collections

Thursday, May 8, 1997—Harvard University Herbaria, Cambridge

Lilac Sunday

An Arboretum tradition celebrating one of North America's premier lilac collections

Sunday, May 18, 1997—Arnold Arboretum, Jamaica Plain

Annual Fall Plant Sale

Our most popular event for members, this year featuring a new plant introduction—*Syringa* x *chinensis* 'Lilac Sunday'

Sunday, September 21, 1997—Case Estates, Weston

Arboretum Open House & Lecture

Tour the Hunnewell Building, view our new exhibit, meet the staff, and join us for a lecture by renowned British plant hunter, horticulturist, and author Roy Lancaster

Friday, October 17, 1997—Arnold Arboretum, Jamaica Plain

• *from page 1*

as a suitable memorial to Veitch only after the Society's subscribers had considered—and subsequently rejected—the establishment of a club, an almshouse, and pensions for either disabled plant collectors or for aged gardeners. However, James Veitch was also an astute and venturesome businessman. Fiercely competitive in the arena of plant introduction, under his aegis the nursery of Messrs. James Veitch & Sons rose to prominence by being one of the first commercial enterprises to compete with royalty and learned societies in the sponsorship of far-off plant-hunting expeditions.

While the Veitch medal is the highest accolade that the Royal Horticultural Society bestows on a foreign national, half a century would elapse after its inception before the medal would first cross the Atlantic. With Steve's recent honor he has joined a very exclusive group—to date only fifteen medals have gone to North Americans with Steve being the fourth member of the Arboretum staff to be so honored.

In 1926, the Arboretum's famous plant explorer Ernest Henry "Chinese" Wilson, then a British subject, received the Veitch medal inscribed for "his introductions to gardens and his books." On that occasion, newspaper accounts exclaimed, "British Award Won by Boston Horticulturist . . . This medal has never before been given to any person in America!" Almost twenty years later, when the second Arboretum recipient William H. Judd, born in England but a naturalized American citizen, received the medal for "exceptional work in propagation," he wrote in his journal, "I believe that this is the first time by any man other than English to receive it." Donald Wyman, horticulturist extraordinaire, but with no obvious British ties, accepted the coveted award "for his contribution to the science, to the practice, and to the literature of horticulture" upon his retirement from the Arboretum in 1969.

While Steve has won the medal for his "major contribution to horticultural taxonomy at an international level," he could have easily been recognized, like Wilson, for his plant exploration in China. Steve has participated in several plant-collecting expeditions to eastern Asia and was a member of the U.S. team of botanists who took part in the 1980 Sino-American Botanical Expedition to western Hubei Province in the People's Republic of China, the first cooperative venture between Chinese and American scientists after China opened its doors to the West in the late 1970s. The Arboretum's collections and American gardens have been made richer through the introduction of *Magnolia zenii, Heptacodium miconioides,* and *Sorbus yüana,* among other new plants collected during the 1980 expedition. Or like Wilson and Wyman, Steve might have been recognized for his contributions to the field of horticultural and botanical literature. He has written many articles both popular and scientific on north temperate woody plants, and his acclaimed book on the introduction of ornamental plants into North American and European landscapes, *A Reunion of Trees,* has become the standard on the history of plant exploration. On a more personal level, Steve is valued by his colleagues here at the Arboretum for the scholarship, dedication, and love he brings to the herbarium, library, and living collections. We join in congratulations with Roy Lancaster who has written to Steve, "Welcome to the club, one of the horticultural world's most exclusive. I'm sure E. H. Wilson and all those other luminaries will be smiling up there."

Living Collections Apprentice Arrives

Alistair Yeomans has joined the staff as Arboretum apprentice. A native of western Scotland with a bachelor's degree in horticulture from Strathclyde University, Alistair specializes in pathology. In research on *Botrytis cinerea,* a common mold that is destructive to plants, he tested the effectiveness of Dichlofluanid, an ingredient in various commercial treatments for the disease.

Alistair will be working with all the units of the living collections department for a well-rounded view of the maintenance of a scientific collection of woody plants. During his year here he'll study the broad range of host-pathogen interactions that a collection like the Arboretum's can provide.

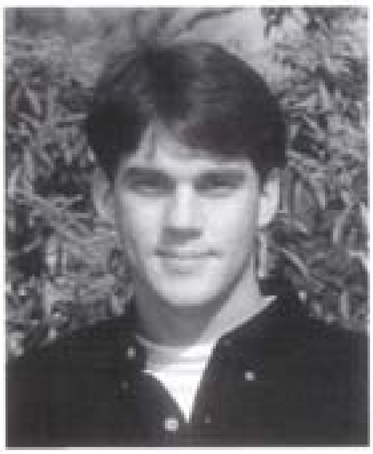
IMLS Conservation Grant for Shrub and Vine Review

With the recent award of an Institute of Museum and Library Services conservation grant, the Arboretum began the first step in a long-range plan to develop a special, synoptic shrub and vine collection to be located near the Dana Greenhouses. The IMLS, a federal agency that strengthens museums to benefit the public, has provided funding for a complete curatorial review of the Arboretum's shrub and woody vine collections over the course of calendar year 1997. Under the supervision of horticultural taxonomist Stephen Spongberg, each shrub and woody vine accession in the Arboretum's living collections will be individually inspected and evaluated, and observations will be recorded in the Arboretum's living collections database (BG-BASE).

For verification of each accession's identity, existing voucher specimens will be located in the herbarium and, if necessary, added to the curatorial database; missing herbarium specimens will be made as required. Lists of species needed for the collections will also be developed, map locations verified for accuracy, and candidates for repropagation identified. In the long term, the results of this survey will ensure that the Arboretum's collections of shrubs and woody climbers will both be accurately identified and comprehensive and that attention will be given to the cultural requirements of these accessions.

Joining Steve Spongberg in this team effort are Andrew C. Bell, curatorial associate; Susan Kelley, curatorial associate for mapping and labeling; Kyle Port, curatorial assistant for plant records; and Patrick Willoughby, grounds superintendent. Additional support will be provided by volunteers Sheila Magullion and Robert Reynolds and this summer's horticultural interns.

Curatorial Associate Rejoins Staff



Andrew C. Bell has returned to the Arnold Arboretum for a third time to join the curatorial staff in its IMLS-supported survey of the shrub and vine collections. Andy served his first stint as a horticultural intern in 1994, helping with mapping and labeling in the curatorial office. Following graduation with a bachelor's degree in ornamental horticulture and botany from the University of Tennessee in 1995, he returned for another summer, as a Putnam Fellow assisting Stephen Spongberg in his taxonomic research.

This time Andy returns after having completed a one-year program for the master's degree in science at the University of Edinburgh and the Royal Botanic Garden, Edinburgh. While his plans for the future after this year at the Arboretum are yet to be finalized, they do focus on plants (particularly woody plants) and either further graduate study or work at a botanical institution.

Arboretum Collaborations

Peter Del Tredici, director of the living collections, recently presented a program at the **Boston Museum of Science** on Leonardo Da Vinci's contributions to botany. His lecture was part of a series presented to the docents who will be interpreting the museum's new exhibit on Leonardo Da Vinci to visitors. Peter pointed out that Leonardo was interested in more than just the accurate depiction of nature—he was concerned with how structure and function were interrelated, and he was a master of deducing function from careful observation of structure.

The Arboretum was a co-sponsor of this year's **New England Grows**, the Northeast's largest green industry trade show, which brings together thousands of participants from the nursery, landscape, and garden design professions. Staff members Peter Del Tredici and Tom Ward, greenhouse manager, presented programs on plant collecting in China and viburnums, respectively. During the course of the

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show the Arboretum distributed more than 1,000 complimentary back issues of *Arnoldia* and answered numerous questions about Arboretum projects and programs.

Stephen Spongberg, Arboretum horticultural taxonomist, hosted a mini-symposium on taxonomic problems in the Maloideae, a subfamily of the Rosaceae. It was held at the Harvard University Herbaria in conjunction with the *Flora of China* translation project, which operates out of the Missouri Botanical Garden. HUH houses one of the *Flora's* editorial centers, which is coordinated by David E. Boufford, assistant director for herbaria collections. The project will publish the first modern English-language account of the vascular plants of China, based on the Chinese language *Flora Republicae Popularis Sinicae.*

For a more complete account, visit HUH's *Flora of China* web site (http://flora.harvard.edu/china/).

1997 American Landscape Lecture Series

READING THE AMERICAN LANDSCAPE

Lectures in memory of John Brinckerhoff Jackson

This fifth year of the American Landscape Lecture Series is dedicated to the memory of the late John Brinckerhoff Jackson, pioneer in the cultural interpretation of landscapes. Each speaker will offer a unique reading of the American landscape. The series is a collaboration among the Arnold Arboretum, Olmsted National Historic Site, the Harvard Graduate School of Design, and other landscape-oriented sponsors. We thank the Massachusetts Foundation for the Humanities for its support.

All lectures are free and begin at 6:30 pm at the Harvard Graduate School of Design, 48 Quincy Street, Cambridge. For information, call the National Park Service at 617/566–1689 x 220.

Thursday, February 13: Social Connections as Clues to Cultural Landscape Health
Paul Groth, Associate Professor of Architecture and Geography, University of California, Berkeley

Thursday, February 27: Prospects Aplenty: Scale, Identity, and Change in Regional Landscapes of America
Michael P. Conzen, Professor of Geography, University of Chicago

Thursday, March 13: The Midwest: America's Homegrown Utopia
Peirce Lewis, Professor Emeritus of Geography, Pennsylvania State University

Thursday, April 3: Reinventing Eden: Landscape as Narrative
Carolyn Merchant, Professor of Environmental History, Philosophy and Ethics, University of California, Berkeley

PROGRAMS & EVENTS

The Arboretum's Education Department offers a wide variety of courses, programs, and lectures in horticulture, botany, and landscape design. A selection of spring courses is shown here. For a complete catalogue of programs and events at the Arboretum, please call 617/524-1718 x 162. Note that fees shown in **boldface** are for Arboretum members. For information about becoming a member, call 617/524-1718 x 165.

ART 120 Botanical Perceptions: Drawing from Plants

Jan Arabas, Artist and Art Instructor

What do the artists Leonardo DaVinci, Claude Monet, and Georgia O'Keeffe have in common? They all turned to the botanical realm for instruction and inspiration. In this course we will emulate these artists and observe plants carefully, working toward good technical skills in a variety of art media, aiming to draw clearly what we see, and to learn about plant structure in so doing.

Fee: $93, $112

6 Mondays, April 7, 14, 21, 28, May 5, 12/ 10:00–noon (DG)

BOT 343 Reading the Forested Landscape: Making Sense of Place

Tom Wessels, Director, Environmental Biology Program, Antioch New England Graduate School

You may know how to identify your neighborhood trees but not know why pines are dominant in one place and maples in another. You may notice fungus growing on a beech trunk but not know the devastating impact of the blights on our forests over the centuries. Unlock the mysteries of the forest in this slide-illustrated lecture by the author of *Reading the Forested Landscape: A Natural History of New England.*

Fee: $12, $15

Tuesday, April 29/ 7:00–8:30 pm (WCC)