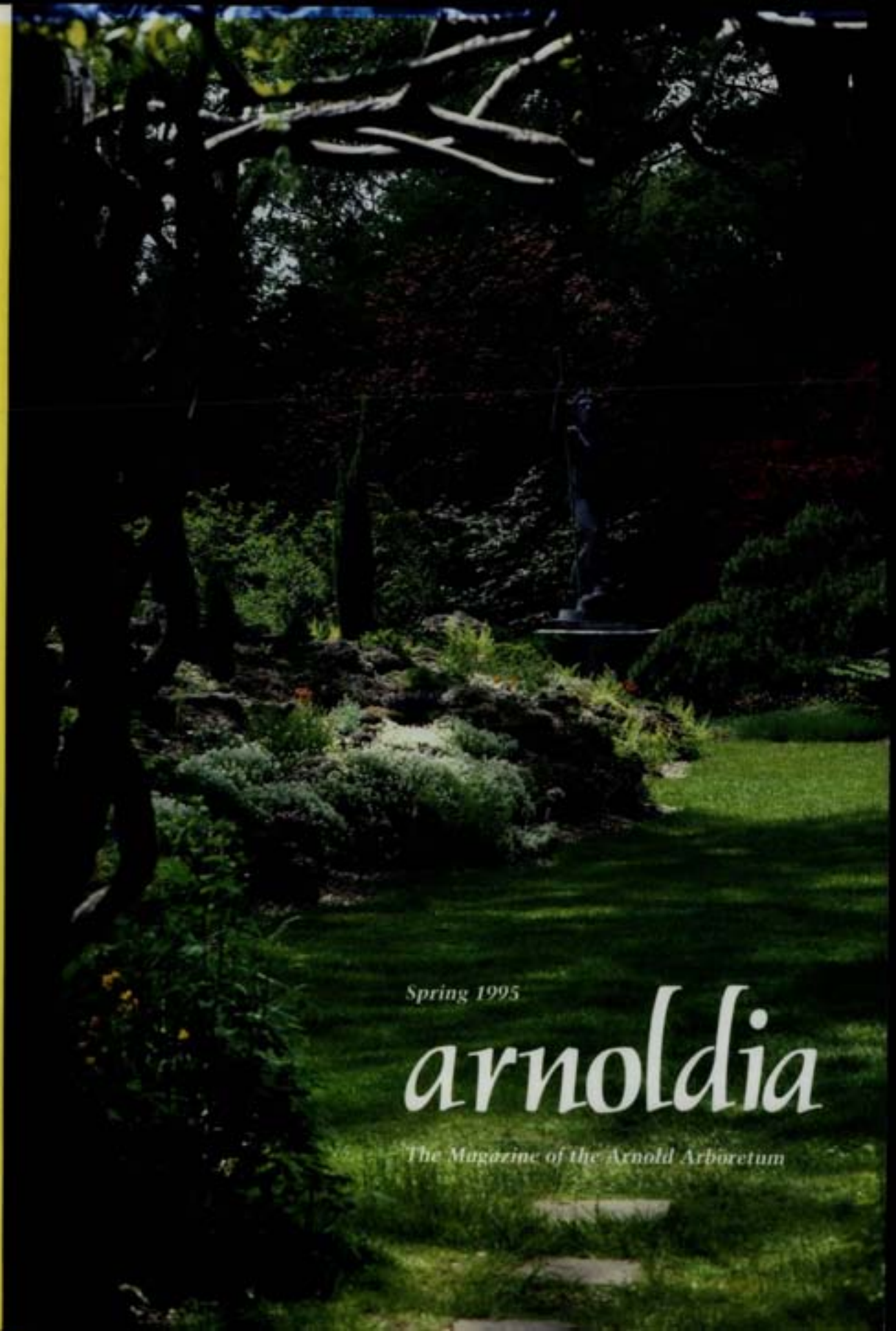
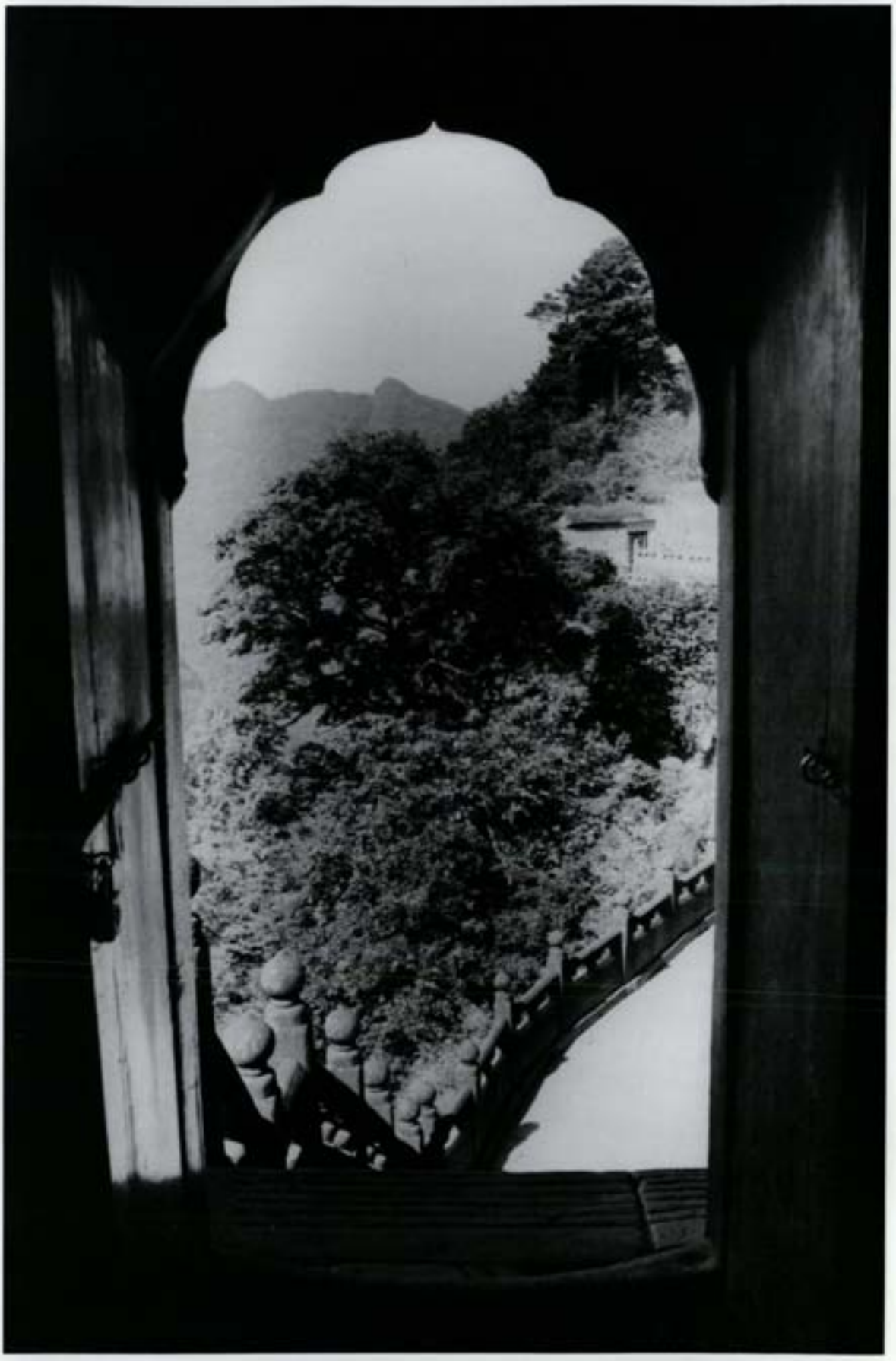


Spring 1995

# arnoldia

The Magazine of the Arnold Arboretum



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**Cover:** Uplands. The wisteria arbor frames the tufa bed and statue of Neptune. Photograph by Saxon Holt.

**Inside front cover:** Richly diverse forests are often found around Buddhist temples on Wudang Shan, China. Photograph by Paul Meyer.

**Inside back cover:** The reflecting pool designed by Fletcher Steele at Uplands. Photograph by Karen Madsen.

**Back cover:** Guanshan, China, and a rice field beyond, is seen from the slopes of Wudang Shan. A China fir, *Cunninghamia lanceolata*, stands to the right. Photograph by Peter Del Tredici.

# Uplands: Life Among the Alpines

*Catherine Hull*

**Rock gardening is a spell—if you succumb to it there is seldom any turning aside from the passionate love of small wild things. There is no point pontificating or preaching—it swoops you up or it leaves you cold.**

Do you choose gardening or does it choose you? I thought I had chosen to make a perennial garden, first in a suburb of Washington, D.C., and later in a small town north of Boston. Then one day I saw from a friend's window a wild mountain poppy growing in a crevice of rock, the orange flower moving gracefully with every breath of air, no bigger than a small butterfly. Instantly I dropped the idea of a lush herbaceous border and began a love affair with wild things, especially those that grow high in the mountains, called alpines. Soon I joined the North American Rock Garden Society. At my very first meeting, which was held at the foot of Mt. Washington, the principal speaker was Lincoln Foster, the guru of all rock gardeners. Then and there my gardening life changed forever. A very strenuous future stretched before me.

Happily, my conversion followed closely the purchase of our new home. The property is on a hill a hundred feet above sea level looking out to Massachusetts Bay. The landscape architect Fletcher Steele had designed a small upland garden here in the 1930s. He made a wisteria arbor with stone columns, a border of hybrid tea rose and clematis along a narrow lawn, a goldfish pool with a full-size statue of Neptune presiding at one end, and a long border of rhododendron and laurel.

My only previous gardening experience had been in backyards, where I had struggled with double digging to incorporate better soil and compost. But here, one thrust of a shovel and CLANG!—a rock! It was soon obvious that the hill was literally solid granite with only a thin skin of soil. No hole deeper than four inches could be dug except in the middle of the lawn. (We later learned that Steele had had to import truckloads of loam to create that lawn.) But at last there was a reason for rock—a wonderful reason—rock plants.

My first efforts began on an island in the driveway where a granite ledge underlies a rather thick growth of trees—pines, hemlocks, oaks, and some Japanese maples planted in Steele's time. By clearing a section of ledge and filling depressions and pockets with the basic rock garden mix of leaf mold, topsoil, and sharp sand, I made a setting for a small rock garden. It was intensely satisfying to have my first love, alpine poppies, grow from seed and do well in the company of some other easy-to-please low plants such as *Dianthus* and *Iberis*.

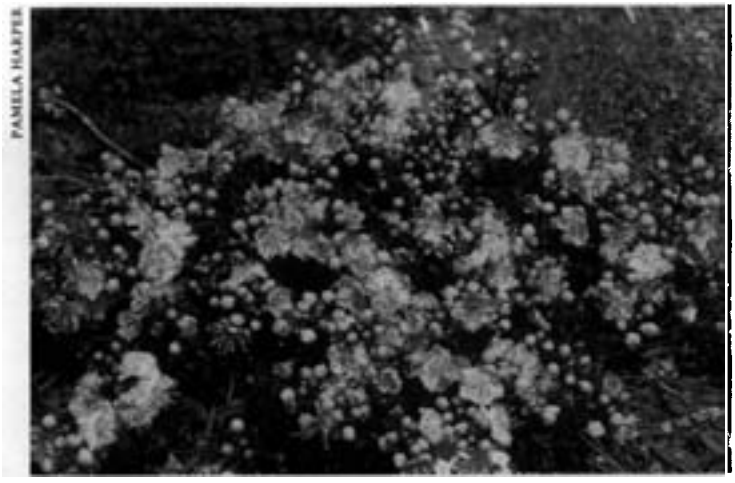
This early success led me next to the long-overgrown border of rhododendron and laurel near the lawn. Lincoln Foster had said that if he had to create a space to grow rock plants, nothing could compare to the planted wall. It seemed wise to follow his advice, all the more because a rock wall was available: it supported the rhododendron bed that lay along a walk Steele had planted with flowering dogwood. The trees could provide the high dappled shade needed for the wall's southern exposure. I felt no compunction about removing the old laurel and rhododendron; they had been aging unhappily for reasons that became evident when they were dug. The soil they lived in was desiccated and pale, with no possibility of moisture retention, hardly deserving the name of earth.

*Neptune, rescued from a water tower in Needham by Fletcher Steele, stands over the reflecting pool at Uplands. Two colonies of Steele's signature plant, the large-leaved butterbur,* Petasites hybridus, *can be seen to the right of the pool; the Atlantic Ocean is beyond.*

The stones in the existing wall were round and unattractive; it was a bonanza to find a tumbling wall of well-weathered granite fieldstones at the foot of the hill. I must have been the despair of the skilled masons doing the job, insisting as I did that the lichened side of any rock be turned outward and that they pack between the stones the special mix I had prepared. They were able to fill the whole depth of the old laurel-rhododendron bed with newly mixed soil suitable, we hoped, for a stony scree for mountain plants. In nature, scree is the loose rock debris found at the base of large rock masses or left behind on slopes by the movement of glaciers. To create it artificially in a raised bed one needs deep underpinnings of small stones or rubble. We put in well over a foot, then sandwiched in some leaves or hay to prevent the finer soil mix on top from sifting down.

I had been gathering small plants from specialist nurseries and from friends' coldframes, and I had also grown some from seed. Many of the smallest were inserted between the stones on the face of the wall; others were placed on top in the prepared scree bed. The plants were mulched with at least two inches of gravel or stone chips to keep the roots cool and protect the leaves from soil spattering.

Soon after the granite wall and raised bed were completed, plants were flourishing. The backbone was provided by small conifers and shrubs, such as *Daphne,* both *cneorum* 'Eximia' and *alpina, Leiophyllum buxifolium* var. *prostratum,* and the nearly prostrate *Vaccinium macrocarpon* 'Hamilton'. The loveliest of all was *Kalmiopsis leachiana* 'Umpqua Valley' propagated by Alfred Fordham at the Arnold Arboretum. *Lewisia* were soon thriving, as were small saxifrages and an *Asperula nitida* ssp. *hirtella* (or *A. n. puberula,* as it is often known) recently collected by an explorer in Turkey; *Androsace* sowed themselves—in short, it was




**Kal**miopsis leachiana *'Umpqua Valley'*


Glaucidium palmatum


Primula x *'Frances P. K.'*


Dodecatheon maedia *'Album'*

gorgeous. So much so that I wanted more wild plants, not only from mountain peaks but from bogs and woodlands as well.

With a book in one hand and shovel in the other, I tried to dig a bog, succeeding in getting down only about four or five inches before striking granite. I dutifully followed the book's instructions to line the designated bog space with several layers of plastic and to fill it with dampened peat laced with a small amount of sand, although as the years go on I realize that the layer of ledge alone would undoubtedly have kept the moisture in. Not everything in that spot is a bog plant, but *Helonias bullata, Saxifraga pensylvanica, Primula denticulata,* and *Cardamine pentaphyllos* do well.

Along paths Fletcher Steele must have planned many years ago, we added woodland plants, among them both the single and double *Trillium* and *Sanguinaria, Clintonia, Primula, Erythronium, Arisaema,* and ferns. In a fairly


Trillium recurvatum


Trillium grandiflorum 'Flore Plenum'

open area near an old hemlock we planted *Glaucidium palmatum*, which has become one of the showiest early spring bloomers and an enormous favorite. Below a low rocky cliff by the lawn we planted one of my best-loved ferns, a maidenhair, *Adiantum venustum*, and above on the level shelf of rock a single *Dodecatheon maedia* 'Album', which has selfsown and created a community. *Gentiana scabra*, the Japanese fall gentian, behaved the same way, colonizing the cliff. A few *Claytonia virginica* planted early on have made a wonderful white spring carpet for the shooting stars—a serendipitous result.

Euonymus and ivy groundcovers, thoroughly entrenched, had been planted by Steele as "maintenance free" for his client in the 1930s. When we pulled them away, some good natives appeared as if released from jail. The most exciting was *Erythronium americanum*, which continues to spread, with considerable bloom in early spring. A few patches of *Anemone quinquefolia* came to life and have been hopping about ever since.

Little by little, the garden was being extended. We made a dwarf rhododendron collection on raised islands—homes for cuttings from Polly Hill's North Tisbury hybrid azaleas and for a few crosses made by Lincoln Foster at his garden, Millstream, in Falls Village, Connecticut. Other ericaceous plants came back with us from trips to England and Scotland, along with many plants for the rock garden's scree.

Not all the effort was expended on the upland garden. We had been in the house only a few weeks in the fall of 1967 when one night we heard the sound of rushing water outside. Early the next day we thrashed our way downhill through the dense growth of brush and trees and found a stream struggling through thickets of alders. Had the gods read my wish list? A stream had always been near the top, but neither the real estate agent nor the former owner had ever mentioned one. Our discovery triggered vast effort to clear the alders, deepen the channel, accentuate the rocky waterfalls, and create a few pockets to hold water even in summer.

The desire to see the stream from the house helped us confront the forty years' growth of briars, poison ivy, nettles, wild grape, and unwanted trees on the hillside—the growth that comes after land has once been cleared and is reverting to its natural woodland state. Oak, beech, and ash had been strangled and stunted by the competition. In these days of raised ecological consciousness, it is considered wicked to call any natural state a horticultural nightmare,

but we had to come to terms with this tangled wilderness in order to let in more air and light, to widen the view of the ocean at the upper level, and to make paths down the hill and up again.

For several years, my husband and a succession of college students pulled and cut. I followed with salt-marsh hay and piles of newspapers (we haven't thrown one out for twenty-eight years). There may be better ways to discourage unwanted vegetation, but I can only report on what we did here. The biodegradable paper and hay are adding a richer, deeper soil quite rapidly. Of course, much that is unwanted gladly seeds in, but so do more welcome volunteers.

I still needed more space for my growing collection of alpines. Where could I make another bed with sufficient light, away from the shade and the drip of trees, preferably with a northern exposure? The answer was the ailing rose and clematis border. My attempts to make those plants happy had been a complete failure. The roses were leggy and had blackspot. The clematis were supposed to climb only sixteen inches to the top of the dressed-slate retaining wall, then lie down flat and show glad faces to an admiring audience sipping tea on the terrace above. But it didn't work that way for me. In spite of my teasing and training the vines along a horizontal trellis on top of the wall, there was more wilt than bloom. Once again, plants were dug out for anyone wishing to take them.

I had been hearing more and more about tufa—that calcareous rock, very porous, pocked with holes and narrow tubes. It was our great good fortune to learn of an estate where a cache of tufa—treasure to rock gardeners—was unwanted by the owners. They let several of us take away all we could carry. With that unexpected windfall we soon had an Aladdin's supply in all shapes and sizes.

Fortunately the rose and clematis bed was at the edge of the long lawn Fletcher Steele had made with imported soil, so it was possible to dig. At about two feet down we poured in bags of vermiculite, as I had read of its ability to hold moisture under a large raised bed. Next we added lavish loads of gravel and sand; then assorted-sized pieces of tufa were embedded in a long series of mounds of prepared soil. Soon after this pudding was completed and some plants put in, the elements took a hand. The result was a sunken soufflé: I had made the mix too humus-y, with too much peat and leaf mold. So I began again and belatedly listened to advice from others. We buried cinder blocks along the edge near the lawn to support the largest, base pieces of tufa and instead of a soil mixture used only coarse sand to position the other pieces, with occasional chunks of granite wedged underneath to hold them in place. A four-inch layer of the regular rock garden soil mix was topped with two inches of stone mulch to give the plants a start. They responded with the usual euphoria of young plants in fresh soil in settings to their liking.

Soon alpine poppies blazed over the long bed, *Saxifraga* settled in, *Androsace, Hutchinsia alpina, Aethionema oppositifolium,* some *Penstemon, Dianthus,* and *Erinus*—a pleasant mosaic of small plants colorful in May and early June. Many of the small ferns took gladly to the tufa, and I have had much better luck with *Adiantum pedatum* var. *subpumilum* (often known as *A. p.* var. *aleuticum)* and *Asplenium trichomanes* in that porous rock than in the granite. *Cystopteris bulbifera* f. *crispa* has taken a very determined and welcome hold. The happiest combination may have been a small pink *Erigeron compositus* endemic to the Wallawa Mountains in Oregon and *Gentiana acaulis* grown from seed. The past tense applies to that companionship as the large gentian gave up after a season of twenty-four blossoms; young gentians have been planted to see if they can recreate the good years. There are small shrubs: *Salix arbuscula* and *S. hylematica, Tsusiophyllum tanakae, Daphne arbuscula* indigenous to the Tatra Mountains, *Ulmus parviflora, Ptilotrichum spinosum* 'Purpureum', and others to provide a different interest and change of texture. Certainly some plants selfsow too vigorously and others fade quietly away, but on the whole the tufa bed still gives us great pleasure.

You seldom see a rock garden without dwarf conifers. The high mountains have only occasional windbent stems or twisted trunks above


*Drifts of the white* Hutchinsia alpinum, *the ever-faithful of the tufa bed, remain constant while other plants come and go. In the upland garden, spring's color gives way in summer to various greens and the interest of differing textures while meadow plants flower on the lower hill. Notwithstanding the blaze of the New England woods, fall in the garden is a quieter season, when the plants begin to collect themselves and prepare to return to their beginnings.*

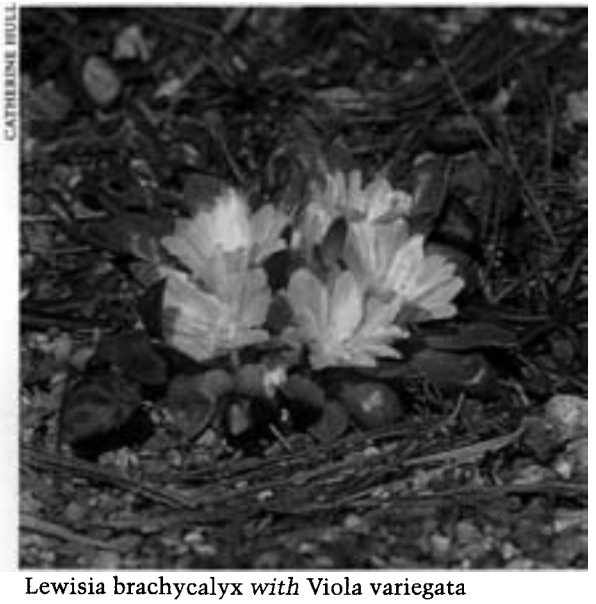
the treeline, but in a garden landscape more persistent punctuation is needed, some backbone for small plants. A little difference in eye level is welcome as one looks at the scree, raised bed, or wall, and a conifer's dark green shape helps accentuate the plants around it. *Juniperus, Abies, Picea, Tsuga, Chamaecyparis,* all are useful and present in various sizes in our tufa and granite beds. Many of these so-called dwarf conifers proved eager to become giants and had to be moved down the hill, where they are now anchors of dark green or steel blue in all seasons.

My education as a rock gardener has proceeded slowly over the years. It is curious to see what remains constant in one's affections and what begins to pall. And startling how hard some lessons are to learn. It is painful to realize that not all the plants you love will stay with you long. Enormous help came to me from courses at the Arnold Arboretum, and I wish I could have taken others at the New England Wild Flower Society. One acquires books along the way—I started out reading them like detective stories—and there are answers from the experts who lecture at seminars, clubs, and plant societies. For a rock gardener the North American Rock Garden Society is a constant source of help, of plant sales and swaps, and of seeds. The contagious zeal of all plantspeople is a never-ending propellant.

One of the ABC lessons I have been shamefully slow in absorbing is the continually changing nature of a garden. Some plants have a tendency to move out from the place where they have performed beautifully and seek new ground. I am thinking, for instance, of *Primula kisoana,* the special color form that Dr. Rokujo


Papaver alpina


Saxifraga longifolia




Lewisia brachycalyx *with* Viola variegata


Adiantum pedatum

in Japan sent to Lincoln Foster. It made a striking splash over a yard wide by a woodland path for several years, then began to meander all over, leaving a blank space behind. Many plants that don't wander away or die simply become weak images of their former selves.

The scree bed in the granite wall has been in need of rejuvenation for several years, and piecemeal efforts have not produced much improvement. I am seeking solutions to avoid the upheaval a total rebuilding would require. I have allowed some biennials too much license: *Symphyandra hofmannii* has been a lusty invader, *Scabiosa lucida* another. For a while *Phyteuma orbiculare* was a threat. Honesty and rocket are all over the place. After battling briars and poison ivy, such comely takeovers seemed almost welcome, but the day of reckon-


*The author down the hill in her "wilderness."*

ing comes relentlessly: digging and renewing the soil and replanting are urgently needed.

When I tire of working with tiny seedlings in a small corner of the granite scree or tufa bed, I plunge downhill. There I can thrash around, cutting back dock, overzealous daisies, and exuberant goldenrod; plant some of the taller *Penstemon, Perovskia, Anemone,* different forms of *Digitalis,* varieties of *Cimicifuga* and *Rodgersia,* and other plants I like. I am not sure yet whether I regret introducing some of the ornamental grasses. Many of them can become monstrously large and difficult to move.

Scattered over the hillside are shrubs such as *Fothergilla,* both *major* and *gardenii, Viburnum, Daphne, Syringa meyeri* 'Palibin', *Heptacodium miconioides, Vaccinium, Lespedeza thunbergii,* and others. We are planting only small trees and individual specimens, among them *Acer triflorum, A. griseum, Cornus kousa,* various forms of *Stewartia,* and a *Chionanthus retusus* collected by members of the Arnold Arboretum staff on the Sino-American Expedition in 1980.

In spite of the clearing and cutting of our early years here, only about one-third of the hill is in full sunshine. The most shaded areas are being encouraged to grow different species of ferns as well as lots of *Cimicifuga, Epimedium, Vancouveria hexandra, Alchemilla mollis, Aruncus,* and much else. Some of the ferns—the ostrich *(Matteucia struthiopteris)* is one—are adopting a belligerent tone and marching fiercely up the hill. *Asarum europaeum* and *Waldsteinia ternata* are taking hold along the edges of paths, and many other plants have been moved down from the woodland garden where they had multiplied beyond their space.

Schools of thought on gardening are continually changing, just as gardens themselves do. One of the most observant writers, Mac Griswold, has said that gardeners want to know if it's possible to restore the environment and have a garden, too. There is even an outcry in some places against doing battle with slugs, chipmunks, and woodchucks. It takes a tremendous mental wrench to perceive their presence as anything but invasive; in fact, it is more than I can do in parts of the garden. Is a favorite plant


Symphyandra wanneri *with* Anemonella thalictroides.


*Korean stone lantern obscured by* Trillium grandiflorum *and* Arisaema sikokianum.

to be lost because it is caviar to a chipmunk or just what the slug was waiting for? Is it to be struck from our list because it is not native? I am sorry that the ecological crisis has thrust guilt on some gardeners. Can it be lifted where plants are concerned and channeled instead onto overspraying with pesticides and herbicides and the overuse of chemical fertilizers?

One ecological theme can hardly be contested—the one praising compost. For lack of loam and soil on our property we have turned compost-making into a homescale industry with cinder block bins in an out-of-the-way spot and a shredder to speed up the process when there is time to use it. Every fall and spring the shredder is in heavy use chopping up the autumn crop of leaves and coping with those left behind in spring as well. These leaves are used for surfacing the paths, for mulch, for compost. The bins are like the cannisters on a kitchen shelf in which flour, sugar, and salt are stored; here there are bins for leaves, horse manure, sand, gravel, weeds, seaweed, and sheep and cow manure when we can get it. When shredding time or strength runs out in the fall, we pile unshredded leaves in a large wire bin, the first of three, so that in three years there is compost of a rough sort for general use in the woodland and on the hillside. This has been done unscientifically, without additional inoculants, letting nature do the work.

Wheelbarrows and trash barrels are indispensable parts of our gardening efforts—a wheelbarrow is taken to the various bins and individual ingredients put in by the bucketful, the choice of which bin and how much depending on whether the mix is for woodland plants in shade or for plants on the open hillside. For the rock garden the mix is made more fastidiously with only leaf mold (mainly oak since that is our principal tree) and helpings of peat, occasionally manure, and ample amounts of sand and bags of granite chick grit to provide good drainage.

Why do gardeners garden? Especially, why try so hard to grow temperamental plants with fussy requirements and unpredictable personalities? And what makes a plant a favorite? Summon the poets—let me count the ways. It is as irrational, personal, and idiosyncratic as the gardener's genes. Often I think I would give up a large section of a rock bed if I could have one perfect specimen of *Androsace* 'Millstream' or *Physoplexis comosa,* or have a fern return and flourish as *Asplenium ceterach* once did. For rock gardeners it has to do with delicacy, the structure of leaf and flower fitting together with a clock's perfection of parts, far too rigid a com-

parison for shapes so fragile. But contradiction leaps with every word: there is nothing visibly fragile about the cushion of a saxifrage—often a sturdy community of minute rosettes—but the flowers that open on the nearly invisible stems above that cushion are as thin in petal as silk, their very stature and texture speak of crystal air, high places, freedom, uniqueness. Nothing humdrum, nothing overdone or blowsy, or repeated too often. We wait for the blossoms, are enraptured by them, and then wait again for another season—fleeting, evanescent—all the qualities that are hard to capture or tame.

Plants from all the wild places—meadows, swamps, bogs, woodlands, as well as alpines—are there to satisfy the yearning for flowers that are slender rather than fat; unusual rather than commonplace; elegant and graceful rather than bulky. When an alpine is well grown, it is said to be "in character," conforming to the ideal in the wild. Fertilizers, overwatering, too much cosseting, can change the height, the size of the flowers, the very look of the plant. An alpine generally needs to be only a few inches high; a woodland plant graceful, not heavy.

Plants from the wild are my weakness, it's true, but I also garden just for the feel and the smell of it. Mere earth in spring can summon the heart as imperatively as the fragrance of any familiar flower. But the moment is at hand to reconcile the urge to grow plants with the need to spend more hours on other pursuits. Adjusting expectations, refocusing goals, coming to terms with what *is* rather than what is wished for—these are lessons I need to learn. No sooner said than the thought of a new planting of *Arisaema sikokianum* pops up or a bank of species azaleas to transform a boring corner. How not answer the challenge of convincing *Primula japonica* to settle in permanently by the stream? Who would willingly shun the prospect of more shrubs whose fragrance in season can suffuse the whole garden, or forego a recently discovered plant that quickens the blood? Did I just imply *moderation?* Or use the word *reconcile?* As long as there's life, let spring come and let me at the trowel!

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# Plant Collecting on Wudang Shan

*Peter Del Tredici, Paul Meyer, Hao Riming, Mao Cailiang, Kevin Conrad, and R. William Thomas*

**American and Chinese botanists describe the locales and vegetation encountered during a few key days of their expedition to China's Northern Hubei Province.**

From September 4 to October 11, 1994, representatives from four botanical gardens in the United States, together with botanists from the Nanjing Botanical Garden, participated in a collecting expedition on Wudang Shan *(shan=mountain)* in Northern Hubei Province, China. The American participants were from member institutions of the North American-China Plant Exploration Consortium (NACPEC), a group established in 1991 to facilitate the exchange of both plant germplasm and scientific information between Chinese and North American botanical institutions.

Paul Meyer, director of the Morris Arboretum, led the expedition. He was joined by Kevin Conrad from the U.S. National Arboretum, Peter Del Tredici from the Arnold Arboretum, and Bill Thomas from Longwood Gardens. The Nanjing Botanical Garden was represented by two botanists, Mao Cailiang and Hao Riming, assisted by Lü Yi and Zang Qifa. Deng Zhidong, director of the Science and Technology Committee of Dang Jiang Kou City, was in charge of logistical arrangements, assisted by Zen Jiafu.

Wudang Shan was selected for its exceptionally diverse flora, among the richest in the temperate world. Ernest Henry Wilson, the English plant explorer who collected in China first for the Veitch Nursery and later for the Arnold Arboretum, spent considerable time in Hubei Province (then known as Hupeh) in the late 1800s and early 1900s but never went as far north as Wudang Shan. He did, however, visit the town of Fang Xian, about fifty kilometers to the southwest.* The first systematic study of the flora of Wudang Shan was done in 1980 by a team of botanists from Wuhan University, who made extensive herbarium collections. In the spring of 1983, the British plant collector Roy Lancaster visited the region with a group of tourists, making him the first Western botanist to explore the mountain (Lancaster, 1983, 1989).

Wudang Shan is famous throughout China as an important center of Ming Dynasty Taoism. Over five hundred years ago, about three hundred thousand workers were employed on the mountain building some forty-six temples, seventy-two shrines, thirty-nine bridges, and twelve pavilions, many of which are still standing. A modern paved road takes visitors up to about 900 meters, where a hotel and several small inns are located. Beyond this point a steep stone path leads up to the summit, the Pillar-of-Heaven Peak, which is crowned with the small but spectacular Golden Temple. Hundreds of thousands of Chinese tourists and pilgrims visit the mountain throughout the year, but their impact is generally confined to the immediate vicinity of this main path. While the vegetation adjacent to the path shows signs of wear and tear, one finds well-preserved forest very close by as well as on all the secondary trails.

Remnants of ancient forest in China are typically found only in the vicinity of Buddhist or

* The old *Acer griseum* (paperbark maple) growing along Chinese Path at the Arnold Arboretum (AA# 12488-B) was collected by Wilson at Fang Xian in 1907 (EHW # 719).

*Members of the Wudang Shan expedition pose for a group photo at the summit of the Pillar-of-Heaven Peak. From left are Mr. Zeng, Lu Yi, Zen Jiafu, Kevin Conrad, Peter Del Tredici, Mao Cailiang, Paul Meyer, Hao Riming, Zang Qifa. Not shown are Bill Thomas and Deng Zhidong.*

*All supplies must be carried on foot up an ancient stone path to the summit of Wudang Shan.*

Taoist temples, a fact that explains the relatively good condition of the forests surrounding the main peak of Wudang Shan. At lower elevations, below about 600 meters, the forests have either been replaced by field crops or are being intensively managed for fuelwood production. The only relatively undisturbed forest that we found was above 900 meters on slopes punctuated by inaccessible peaks, steep cliff faces, and boulder-strewn valleys.

The Wudang Shan Range, which is located in the northwestern corner of Hubei Province, extends for a distance of about 400 kilometers along a southeast/northwest axis (from 110°57' to 111°14' east longitude and 32°23' to 33' north latitude). It is bordered by two large rivers: the Han, which flows about 30 kilometers to the north, and the Yangtse, about 150 kilometers to the south. The upper slopes of Wudang Shan consist of a series of seventy-two jagged peaks, the highest being 1,612 meters in elevation. Above 1,000 meters, the terrain is dominated by steep cliffs and deep, moist ravines. The soil is well-drained, having been formed mainly by erosion of sedimentary limestone and sandstone, and is classified by the Chinese as "mountain yellow-sandy loam." Soil pH ranges between 5.5 and 7.5, with the top of the mountain more acid, between 4.5 and 6. The mean annual temperature is 8.5 degrees Centigrade; the mean annual precipitation of 963 millimeters is quite evenly distributed throughout the year.

Our goal in this article is not to describe all the plants encountered on Wudang Shan but rather to give the reader a sense of the locale and its vegetation, as well as of the plant-hunting process, by outlining the observations we made during a few key days of the expedition.

*An ancient specimen of* Quercus variabilis *that has been repeatedly cut back for firewood production. Farmers have coppiced most of the trees on the lower slopes of Wudang Shan in similar fashion.*

### September 21: Hubei Horticultural Heaven

The weather was alternately foggy and rainy, creating a mysterious mood in the forest. Shortly after leaving the main trail leading to the summit, we entered a forest dominated by large specimens of pine and oak, *Pinus tabulaeformis*, the tabletop pine, and *Quercus aliena*, an oak similar to our native chestnut oak. Continuing along the path, we came upon a rustic stone house built into the side of a vertical cliff. A little way beyond this cottage, a bend in the road looped back on itself as it followed the contours of a ravine. The conditions were moist, shady, and steep, with an oak overstory. Our guide, Mr. Zeng, a collector of medicinal plants, pointed out two specimens of *Stewartia sinensis*, the Chinese stewartia, both with beautiful, smooth cinnamon-red bark, a wonder to behold and to touch. Growing nearby were several kousa dogwoods, *Cornus kousa*, and a small specimen of the paperbark maple, *Acer griseum*. The Americans in the group could hardly contain their excitement, as though they had died and gone to horticultural heaven. The only thing missing, sadly, was seed on any of the plants, probably due to the previous summer's drought. The understory of this exquisite tableau consisted of the beautiful

Epimedium *sp. growing on the slopes of Wudang Shan. Because it was lacking both fruit and flowers, its identity is uncertain Based on a newly published report by Roy Lancaster, it could well be* Epimedium stellatum.

evergreen holly, *Ilex pernyi;* the ubiquitous Chinese spicebush, *Lindera glauca;* and *Lyonia ovalifolia.* As on much of Wudang Shan, the forest floor was carpeted with a bewildering array of ferns and herbaceous perennials, including species of *Aconitum, Ligularia,* and *Cimicifuga,* all in flower. Jack-in-the-pulpits *(Arisaema)* were everywhere, their stalks heavy with seed, along with unidentified species of *Epimedium* and *Rodgersia.*

Shortly after passing through the *Stewartia* ravine, we stopped for lunch in a small cave where Mr. Zeng, who had gone on ahead of us, had built a fire to warm us. Just outside the mouth of the cave was a large specimen of the somewhat weedy glory bower, *Clerodendrum trichotomum.* After lunch we continued on, collecting seeds of *Zanthoxylum molle, Acer mono,* and a snake-barked maple, *Acer davidii.* As we emerged from the dense forest into a more open area, we came across a straggling specimen of *Decaisnea fargesii,* bearing several of its unusual long, blue fruits, and several multistemmed specimens of a maple, *Acer henryi,* that resembles our native box elder.

We also saw an ancient specimen of *Zelkova sinica* growing on a cliff face that may once have housed some kind of shrine. Its exfoliating orange bark made it stand out clearly in the thick mist. As noted earlier, *Cornus kousa* was quite common in the woods, represented by several old specimens a third of a meter or more in diameter, along with large specimens of *Cornus controversa,* the Chinese pagoda dogwood. A little way beyond the *Zelkova* shrine, we found several plants of Chinese witch hazel, *Hamamelis mollis,* loaded with unopened seed capsules. We were particularly pleased to collect this winter-blooming species, which has recently been gaining popularity in American gardens. After seeing so many plants without seed, it was a treat to find one in fruit, and we greedily collected every seed capsule we could find. The plants were growing on a dry, shady hillside near another plant in the witch hazel family, *Sinowilsonia henryi;* a large specimen of the beautiful broadleaf evergreen tree, *Phoebe bournei* (Lauraceae); and a few small plants of *Cephalotaxus sinensis,* growing in dense shade. As the path became more open, we found ourselves surrounded by flowering specimens of *Elaeagnus pungens* in full fragrancy, growing together with *Forsythia giraldiana,* in seed.

**September 30: The Paperbark Maple**

At about 900 meters on a steep northwest-facing slope, we found two large specimens of *Acer griseum,* covered with seed. One specimen was about 6 meters tall and had three large trunks emerging from a swollen base; the other, about 7 meters tall, had a single trunk about 15 centimeters in diameter. Throughout this area of mature forest, we saw numerous saplings and seedlings of this species growing in dense shade on very steep, well-drained terrain. Ecologically speaking, *A. griseum* appears to be late successional, clearly able to persist under conditions of deep shade, periodic drought, and intense root

competition. When a gap in the forest canopy develops, the tree is perfectly positioned to expand into the newly available space.

Our excitement at finding *Acer griseum* was exceeded only when we noticed two trees with bright orange bark farther up the slope. More *Stewartia sinensis,* we thought at first, but on closer examination we discovered them to be specimens of *Zelkova sinica.* This outstanding tree is rare in cultivation in North America and deserves thorough testing to determine whether its potential as a street tree matches that of its more common cousin, *Z. serrata.* On the slopes of Wudang Shan, the orange bark of *Z. sinica,* which exfoliates in discrete plates like pieces of a jigsaw puzzle, was every bit as spectacular as that of *Acer griseum.*

In this area alone we found five large paperbark maples with diameters of 10 centimeters or more and ten smaller trees with diameters between 3 and 6 centimeters. There were ten juveniles between 30 and 200 centimeters tall, and about fifteen seedlings less than 30 centimeters tall. This makes for a mixed-age population of approximately forty plants. The three largest trees were situated at the base of a steep cliff, and we nearly killed ourselves trying to reach them.


PETER DEL TREDICI

*Kevin Conrad reloading his camera at the end of a long day of collecting.*

Some horticulturists have suggested that the slow growth of *Acer griseum* in cultivation might be symptomatic of inbreeding that has occurred as a result of its genetically limited introduction by Wilson at the turn of the century. However, our field observations suggested that its slow growth is probably an adaptation to the ecological niche it occupies in the forest understory. Most of the specimens we saw were spindly and gnarled, with light, airy crowns.

About 95% of the *Acer griseum* seed we collected was hollow. Why this should occur within a healthy, mixed-aged population is not readily apparent, but the scant rainfall in the area since late spring may be one explanation. The fact that fertility problems have been widely reported in cultivated paperbark maples suggests a possible biological cause: it may be that the broad, green wings of the seeds are performing a photosynthetic function in addition to their more obvious dispersal function. If this is the case, the "seeds" may be persisting on the tree in order to produce carbohydrates, regardless of whether or not they contain an embryo. However, we found numerous paperbark maple seedlings growing in the understory, clearly indicating that not all *A. griseum* seeds are hollow and that the species is capable of reproducing even in dense shade.

**October 1: The Ravine Trail**

Leaving the main tourist trail behind, we started climbing a steep, moist ravine. In the distance we could hear the loud cries of a troop of rhesus monkeys *(Macac mulatta)* as they moved through the forest on the slopes across the valley. Almost immediately we were in the midst of numerous herbaceous plants, many in full flower. They included two species of annual *Impatiens,* one yellow, the other pink; the Chinese bugbane, *Cimicifuga simplex,* with its meter-long flowering spike; the toad lily, *Tricertis macropoda;* the stately, yellow-flowered *Ligularia dentata;* and three species

of monkshood (*Aconitum* spp.). In addition, a large number of perennials in the seedpod stage were present, including *Cardiocrinum cathayanum*, the giant lily, with fruiting stems up to a meter tall; two jack-in-the-pulpits, *Arisaema consanguinium* and another as yet unidentified; and a second bugbane, *Cimicifuga acerina*. We also collected spores from at least four different species of ferns that abounded in the moist, shady understory. We can only imagine how spectacular this area is in the spring.

Climbing farther up the moist ravine, to about 1,000 meters, we came upon a cluster of stone terraces. According to Mr. Zeng, they were built around 1962, during the Cultural Revolution. They had been planted with corn and soybeans, but were abandoned five years later because they were too far from people's homes. Numerous sun-loving plants had invaded the terraces, chief among them *Pueraria lobata*, the dreaded kudzu vine. It was amazing to see this plant behaving in its homeland much the way it does as an introduced species in North America—that is, swarming up and over everything in its path. Indeed, large areas on the lower slopes of Wudang Shan were completely covered with kudzu.

The Chinese kiwi vine, *Actinidia chinensis*, was also common throughout the woods, easily recognized by its coiling stems hanging languidly from the branches of canopy trees. The fruits of this species, which is a parent of most commercially available varieties, are moderately sized, about 3 to 5 centimeters long, and very tasty. The local residents do a brisk business selling them to tourists setting out for the top of the mountain. As in the case of kudzu, the kiwi vine seemed to require some form of disturbance (usually human) in order to establish itself. Rounding out a triumvirate of weedy vines that sprawled over the lower slopes of Wudang Shan was *Akebia quinata*, with its clusters of banana-shaped, purple fruits filled with a sweet, white pulp and numerous hard, black seeds. More than once these fruits proved a pleasant snack for the collecting team.

Farther up the slope, at about 1,200 meters in elevation, we came upon a particularly exciting find—a giant specimen of *Emmenopterys henryi* (Rubiaceae, or madder family), some 18 to 20 meters tall and 48 centimeters in diameter. The tree is listed in the Chinese *Red Data Book* (1992) of endangered plants and is classified as "vulnerable." It produces showy, white flower clusters with subtending bracts that persist into mid-autumn, taking on a rose-to-tan color as the small fruits ripen. Mr. Zeng showed no hesitation about climbing the tree barefoot in order to collect some seed. For the Americans, it was a thrill to find what E. H. Wilson considered "one of the most strikingly beautiful trees of the Chinese forests" (Sargent, 1917). Growing nearby was a large specimen of *Acer mono*, along with numerous specimens of *Pteroceltis tartinowii*, literally clinging to a rocky cliff face. A beautiful shrub, *Mahonia bealii*, was also common in the understory; Mr. Zeng, a practitioner of traditional Chinese medicine, collected a fair number of its stems, which when taken internally "put out the fire within the body."

**Other Highlights of the Forest**

Not more than 20 meters from the main path, at about 1,100 meters in elevation, we found an absolutely spectacular specimen of *Stewartia sinensis*, 15 meters tall and 55 centimeters in diameter at breast height. The bark was perfectly smooth and a cream-pink in color, unlike the reddish bark of younger plants. W. J. Bean captured the essence of the tree when he described the bark as being "smooth as alabaster and the colour of weathered sandstone" (1981). Our specimen had no branches below 8 meters, making it impossible to collect either seeds or specimens. According to local legends, this is a sacred tree; Taoist pilgrims typically burn sacred paper, symbolizing money, as an offering at its base. Unfortunately, the area around the tree is used as a refuse dump, spoiling an otherwise sublime setting. Growing in the shady understory near the giant *Stewartia*, we found a peony in fruit, *Paeonia obovata* var. *willmottiae*. The three-valved pod was reddish-purple on the inside and filled with a mixture of viable steel-blue seeds and red, aril-like structures. The species produces beautiful white flowers in the spring. It was originally collected by E. H. Wilson in Fang Xian.

At higher elevations we collected seed of *Sinowilsonia henryi* and *Fortunaria sinensis*,

*A spectacular specimen of* Stewartia sinensis, *15 meters tall and 55 centimeters at breast height, growing at an elevation of 1,100 meters on Wudang Shan.*

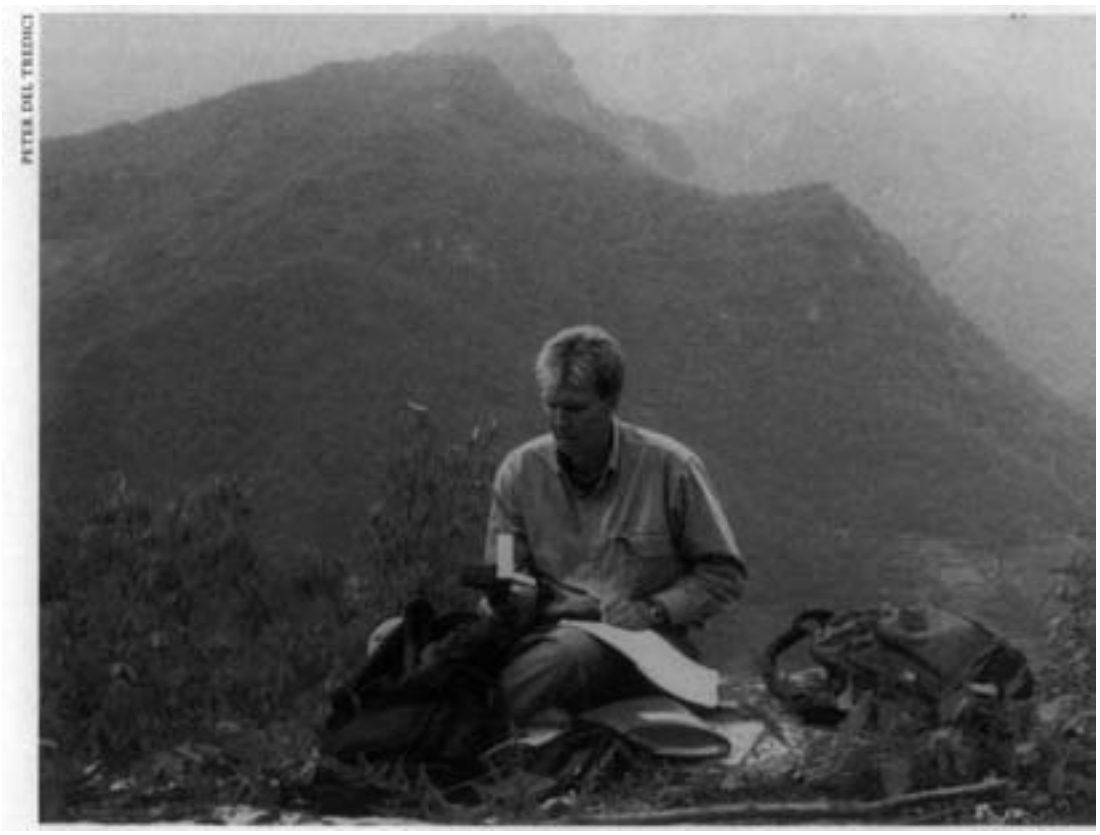
both in the family Hamamelidaceae. The former reached tree-size proportions on Wudang Shan, upwards of 10 meters, while the latter was decidedly shrubby. At lower elevations we encountered the marginally hardy but very beautiful *Loropetalum chinense,* growing up to 4 meters tall. This plant produces large masses of beautiful white flowers in late winter, but unfortunately can be grown out-of-doors only in the southern portions of the United States.

Maples were well represented on Wudang Shan, including the aforementioned *Acer henryi, A. davidii,* and *A. mono.* We also came across a small-seeded chestnut, *Castanea henryi;* the wild persimmon, *Diospyros lotus;* and a large tree-form redbud, *Cercis glabra.* The canopy was dominated by several species of oaks, most notably *Quercus variabilis* and *Q. serrata,* remarkable for their ability to thrive in poor, eroded soils and to sprout back after being cut down. At other locations on the mountain, farmers used logs of both these species as substrates for cultivating a wide variety of woodear-type fungi.

Among the shrubs, the genus *Euonymus* was particularly well represented on Wudang Shan. We found at least five different species, including the aptly named *E. elegantissima,* with gracefully pendant four-angled fruits. We were particularly pleased to find seeds of the beauty bush, *Kolkwitzia amabilis,* growing in moist ravines. This species, which has beautiful pink and white flowers and a graceful growth habit, was first collected by Wilson in 1901. It achieved great popularity in the 1920s and 1930s but is now, sadly, out of fashion. Other shrubs of note included three species of small-leafed *Rhododendron;* the beauty berry, *Callicarpa japonica;* and the Chinese sweetleaf, *Symplocos chinensis.* The evergreen spicebush, *Lindera glauca,* was ubiquitous in the understory, reaching heights of 4 to 5 meters. We also found species in the familiar genera *Lonicera, Hypericum, Photinia,* and *Spiraea.*

## Conclusions

All told, the Wudang Shan expedition yielded 185 collections of seeds and cuttings. For each collection the exact location (latitude, longitude, elevation) was determined by a battery-



*Paul Meyer checking latitude and longitude using a Global Positioning Device.*

powered Global Positioning Device and carefully recorded, along with a detailed description of the surrounding habitat. In addition, each collection was documented with five replicate herbarium specimens, to be filed in both Chinese and North American herbaria. These will function as the permanent record of the trip that will allow future generations of botanists to study the nature of vegetation change in the Wudang Shan area. They were also essential to the success of our trip in allowing us to check our field identifications against documented material in the herbarium of the Nanjing Botanical Garden. Indeed, without herbarium vouchers, the scientific value of the expedition would have been minimal.

When recounting the excitement of collecting plants, one often forgets the more mundane aspects of the plant-hunting process, namely seed cleaning and packaging, which occupied almost as much of our time as the plant collecting itself. As tedious as these tasks sometimes seemed, they are necessary in order to ensure that insect and/or microbial pests are not inadvertently introduced into the United States. Short-lived seeds, such as those of oaks, maples, and chestnuts, had to be carefully packed in moist sphagnum moss to keep them from drying out during transit.

Upon our arrival in San Francisco, the seeds were inspected by officials from the U.S. Department of Agriculture before being released for entry. Later, they were divided among the various NACPEC institutions for cultivation. At the Arnold Arboretum, those seeds requiring a chilling period in order to germinate were immediately placed in the refrigerator, while those lacking embryo dormancy were sown directly in the greenhouse. Even as this article is going to press, many of them have already germinated. Surplus seedlings, should there be any, will be distributed to other botanical gardens as well


*One of the many buildings clinging to the cliffs near the top of the Pillar-of-Heaven Peak.*

as to commercial nurseries. Over time, young plants will be put in the ground and evaluated for performance under a variety of field conditions. In the grand scheme of things, seed collection is only the first step of a lengthy process that includes propagation, cultivation, evaluation, and selection.

After all the work is done, the question remains, "Was it worth the effort?" In the case of our Wudang Shan trip, the answer is an unequivocal "Yes." As regards the plants, we have succeeded in bringing in new germplasm of species already in cultivation in North America but represented by only one or two prior collections that may or may not include the hardiest ecotype available. We also made a contribution to the *ex situ* conservation of several rare Chinese plants that are threatened by extinction due to widespread habitat destruction. And finally, we introduced into cultivation several species that have never been grown in the United States. On the human side of the equation, the trip produced lasting friendships among all the expedition participants and strengthened the ties among a number of U.S. and Chinese botanical institutions.

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# Rehder's Ceanothus: *Ceanothus* x *pallidus* 'Roseus'

*Gary Koller*

**Drought resistance in a plant is not only admirable but in many cases a necessity. Add to its profile toughness, persistence with minimal care, longevity, pest resistance, compact size, and adaptability to soils of low fertility, and you have a plant of merit independent of ornamental characteristics.**

*Ceanothus* x *pallidus* 'Roseus' offers all of the above plus ornamental quality. These attributes are common to the entire genus *Ceanothus*, which is well known to West Coast gardeners but is rarely seen in eastern gardens. Muted in color, it is easily integrated with stronger floral colors and is equally suited to formal landscapes as well as the more casual. Its pale rose-colored flowers appear in mid-June, well after the great spring rush of flowers, and remain for several weeks. If spent blossoms are removed immediately, some recurrent flowering will occur. If allowed to mature, flowers give way to light green fruits that mature into small wine-colored spheres scattered throughout the foliar green like small jewels. These fruits provide a strong visual attraction for several weeks in late summer, especially when set against plants with pink flowers or backed by burgundy foliage. With final ripening, the capsules turn beige-brown and split open along three suture lines, remaining on the plant well into the winter months.

Summer foliage is a medium green and, in my experience, entirely pest-free. The leaves remain in good condition until late October, then fall away with no significant color change. The new season's stems remain thin and supple all summer long. Those on the side exposed to the sun take on a dull burgundy color while on the shady or protected side they remain a light green.

The plant forms a mound, flat-topped to dome-shaped. If completely cut to the ground in spring, just as new growth begins, plants achieve a height of three feet and a spread of three to five feet by early June. Unpruned plants will be slightly taller but more open and rangy. Their consistently tight habit makes them useful in restricted spaces; they are not likely to exceed their allocated space. Individual plants spaced thirty inches apart in good light will coalesce into a continuous, dense surface from soil level to the upper tips, with no thinning or dieback where the plants merge. 'Roseus' is therefore useful both as a specimen plant or in a small hedge or mass planting.

*Ceanothus*, a member of the buckthorn family (Rhamnaceae), is exceptionally drought tolerant; indeed, it will not thrive in heavy or wet soils but instead prefers a soil with very good drainage. The ability to thrive with little water makes it ideal for the sandy soils of seacoast areas as well as inland on poorer, rocky soils. In poorly drained or frequently irrigated soils, *Ceanothus* becomes highly susceptible to root rots. They should never be planted where excess moisture is a problem, especially near irrigation systems.

*Ceanothus* comes from the Greek, *Keanothus*, and was first applied to prickly plants. Linnaeus reassigned the name to this genus in 1753 when he described *Ceanothus americanus* in the *Species Plantarum*. The genus, which has fifty to sixty species, is entirely North American, with representatives in Canada, the United States, and Mexico. The majority of the species and natural hybrids are native to California. Four species are native east of the Mississippi River: *C. microphyllus* in parts of Florida, Alabama,


Ceanothus x pallidus *'Roseus'*

and Georgia; *C. serpyllifolius* in a few scattered areas of Florida and Georgia; *C. americanus* from Maine to North Dakota, south to Florida and Texas, and in southern Canada from Ontario to Manitoba; and *C. ovatus* in eastern and central states. *C. americanus* was the first species introduced from the American colonies to Europe in 1713, but it never became popular in gardens. A century later, *C. coeruleus*, with its showy panicles of sky blue flowers, was discovered in Mexico, and its introduction to Europe paved the way for a number of garden hybrids developed in French and Belgian nurseries before 1830. *C.* x *pallidus* 'Roseus' was one of these hybrids.

The parentage of *Ceanothus* x *pallidus* 'Roseus' combines stock that thrives in the alkaline soils of the West as well as in the acid soils of the East. (Plants at the Arnold Arboretum grow in an acid pH.) This tolerance of poor soils and salts extends the plant's range to include highway use. Sunlight exposure can range from full sun, which is preferable, to light shade, which causes some reduction of vigor and flowering as well as a more sparse overall effect.

At the Arnold Arboretum this *Ceanothus* dies back when temperatures dip to about zero degrees Fahrenheit with no snow cover. This requires removal of all dead and injured stems just before the new growing season, but at the same time it allows the plant to renew its aboveground parts. Even after dieback, plants with strong well-established root systems will produce a quick new flush of growth that remains full and robust. Annual dieback may in fact contribute to greater longevity. *Ceanothus* is often regarded as short-lived, persisting for no more than ten or twenty years, but the Arboretum's original plant, acquired in 1889 from the nursery of Victor Lemoine in Nancy, France, still thrives after more than a century. In milder climates there is no need to cut back the plant annually, but doing so every few years may help to keep plants tight and bushy. Major

shearing should be limited to once a year to maintain a mound that is relaxed and informal, rather than tight and sheared.

The Arboretum's original plant found its way to the old shrub collection where for the first ninety-five years or so it received no exceptional care or, for that matter, much interest. I remember it in 1976 as a sad little plant with a great deal of old deadwood, invaded and nearly swamped by switch grasses. In 1986, as part of the renovation of the Eleanor Bradley Collection of Rosaceous Plants, it was lifted and divided into five or six parts. A group of four was placed in the Dwarf Conifer Garden just below the Bonsai House, on top of a stone wall in very dry soil with excellent drainage and no irrigation. During 1994, from late June until mid-September, several thousand cuttings were taken from this planting to be propagated for this year's spring distribution to Friends of the Arnold Arboretum. Steve Effner, propagator at Quonset Nursery in South Dartmouth, Massachusetts, where the plants were grown, had the best results with cuttings taken just as the plant begins to harden up. Treated with mormodin #3 and stuck individually into #72 pots, a high proportion rooted within three to four weeks. They seemed to be adversely affected only by excess moisture.

Rehder, in his *Manual of Cultivated Trees and Shrubs*, reports that the hybrid complex known as *Ceanothus* x *pallidus* originated before 1830, thought to be the result of a cross between *C. ovatus*, which is native from New England to Texas, and *Ceanothus* x *delilianus*, itself a hybrid of the eastern *C. americanus* and the Mexican *C. coeruleus*. Thus, *C.* x *pallidus* 'Roseus' represents a mix of plants from warm and cold climates.

On receipt in 1889, our plant carried the name *Ceanothus* "hyb. flore Alba Pleno." It was Alfred Rehder who applied the name *C.* x *pallidus* 'Roseus', a name that appears to be unique to the Arnold Arboretum; I cannot find it listed elsewhere. It may well exist in the European nursery trade under another name. Could it be the same as the plant 'Marie Simon'? Perhaps not, for I suspect that 'Marie Simon' blooms slightly later. Problems of nomenclature aside, *C.* x *pallidus* 'Roseus' has thrived for well over a century at the Arnold Arboretum.


*Terminal panicles of pale rose-colored flowers appear in mid-June, at the end of the current season's growth, well after the great spring rush of flowers, and remain over several weeks.*

The wonderful forms of *Ceanothus* seen in European gardens offer an incentive to further hybridization work. *Ceanothus* x *pallidus* 'Roseus', while among the hardiest, might be improved still more. Recombination with more garden-worthy forms selected for flower and leaf color and other desirable characteristics could enrich the palette of *Ceanothus* cultivars for northern landscapes.

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KIM E. TRIPP

# *Cephalotaxus:* The Plum Yews

*Kim E. Tripp*

***The largest [Japanese plum yews] I saw grow in the rich forests at the foot of Higashi-Kirishima . . . I saw many trees from 8 to 10 m tall with . . . wide-spreading branches forming broad rounded crowns. Such trees, with their dark-green leaves pale or glaucescent on the under side, are very beautiful. . . .*** **E. H. Wilson, *The Conifers and Taxads of Japan,* 1916[1]**

Wilson was describing the surprisingly large specimens of *Cephalotaxus harringtonia* he had seen growing in Kyushu, Japan. Although it was Wilson who introduced the plant into cultivation in the United States, he was not the first Western plant explorer to collect it and extoll its beauties. Long before, around 1829, the prominent plant collector and principal author of *Flora Japonica,* Philipp Franz von Siebold, had sent *Cephalotaxus* to Europe where it was received with interest and appreciation.[2] Siebold grew five different *Cephalotaxus* in his own garden in Japan, along with many other plants he had discovered, cultivating them for their beauty and for evaluation as garden plants.

Today, although plum yews are widely considered some of the most beautiful and useful of evergreen conifers, their potential as ornamental and medicinal plants has yet to be fully explored and utilized. The endangered status of *Cephalotaxus* in the wild—particularly in China, its "distribution center and refuge,"[3] where it is vulnerable to the increasing demands of an exploding human population—lends a sense of urgency to efforts to learn more about this fascinating genus. At the Arnold Arboretum, we are working to help conserve *Cephalotaxus* while continuing to study and propagate the genus for use in cultivation.

### *Cephalotaxus*

The modern natural range of *Cephalotaxus* has diminished considerably from that of its early antecedents. Now the genus is restricted to southern and eastern Asia—Japan, Korea, south, central, and eastern China, Hainan, Taiwan, India, Burma, Laos, and parts of Vietnam.[4] *Cephalotaxus* was also found in Europe and northwestern North America in the Miocene and Pliocene eras; moreover, during the Jurassic era its antecedents extended into what is now Greenland.[5]

Because Japanese plum yew has been in cultivation in Europe and the United States for close to a century, many modern horticulturists are familiar with the Japanese species *Cephalotaxus harringtonia,* named in honor of the Earl of Harrington, one of the first to grow the plant in a European garden. Far fewer are aware of other equally beautiful members of the genus that were not found by Western explorers until the turn of the century. Six to twelve species and botanical varieties, depending on the taxonomist consulted, comprise an elegant genus with an inelegant name.

While today *Cephalotaxus* is most often considered the single genus of the coniferous Cephalotaxaceae, it was earlier included in the Taxaceae with taxads like *Torreya, Taxus,* and *Pseudotaxus.*[6] Distinctive aspects of the embryogeny and development of *Cephalotaxus* set it apart from this group, however, in spite of shared adult morphological characteristics like fleshy seed coats, two-ranked needles of similar shape, and low shrub to small tree habits.[7] A few modern authors include *Amentotaxus* in the

Cephalotaxus sinensis, *seen here "à la mode" in last winter's ice storm, is one of the most cold hardy of the Chinese plum-yew species.*

*The mature fruits of* Cephalotaxus *(*C. sinensis *is shown here) resemble olives or small plums.*

Cephalotaxaceae, resulting in occasional references in the literature to two genera in the Cephalotaxaceae.[8]

Plum yew's botanical name is apt. "Cephalotaxus" means "head-yew," from the Greek "kephale" for head and the botanical name "taxus" for the yew genus. "Head-yew" refers to the flowering structures that are borne in tight clusters or "heads" and to its needles, which resemble those of yew. Another, more appealing common name, plum yew, refers to the plum-like shape and color of the ripened fleshy "cone."

*Cephalotaxus* is most often found growing as shrubs or small trees in soils rich in humus in moist subtropical or warm-temperate forests, generally as understory plants in at least light shade. They are primarily low- to mid-altitude plants, but a few variant types are found at higher elevations and on chalky gravel cliffs. The entire range of the genus, however, extends from tropical to cool temperate climates, and cold hardiness of cultivated taxa corresponds to provenance.

While the foliage of plum yews generally resembles that of true yews, the reproductive strobili are quite distinct. Most of us are familiar with the bright red (or occasionally yellow), fleshy, nonpoisonous "aril" that incompletely surrounds the yew's very poisonous, small, rounded seed. Fewer are likely to be familiar with the seed of plum yew, which is significantly larger than that of yew, being about the size and shape of an olive or very small plum (0.75 to 1.25 inches long and 0.25 to 0.75 inches wide) and completely enclosed by a thin, hard shell and an outer fleshy coat. As the seed ripens, the fleshy coat changes color, maturing from an attractive, glaucous blue-green, through a warm cinnamon-red (hence "plum yew"), and finally to a dull tan or purple-brown before abscission of the entire "cone" and/or degradation of the fleshy tissue.

Male and female plum yew strobili are borne on separate plants. Male strobili develop in flattened heads of numerous small clusters of anthers, about 0.25 inches in diameter, regularly arranged in the axils of the needles along the

length of the branchlets. Female strobili develop as clusters of six to twelve ovules in pairs held on an odd-looking, oval, initially mauve-colored head (or "cone"), that expands from about 0.5 inches in length at first visibility to the mature length of 0.5–1.25 inches (depending on the species). Usually only one seed matures per head.[9] Three to five female heads are borne on stalks at or near the end of the current or previous year's branchlets.[10] Female cones are wind pollinated.

Seeds of *Cephalotaxus* have a relatively long period of development. Depending on species and region, pollen cones require nine to eleven months to mature (from initiation to pollen dispersal), while female cones can take as long as twenty-one months, generally maturing at the end of the second growing season after initiation.[11]

*Cephalotaxus* is now rare and endangered in significant areas of its range.[12] Its lengthy seed maturation period, combined with a dioecious reproductive habit and an often sparse natural distribution throughout much of its range, may contribute to the seemingly low frequency of regeneration for the genus in the wild. According to Huang, animals and birds may also eat the seed.[13] There is also pressure on *Cephalotaxus* from human activity. It is harvested for timber in various parts of its range as well as used for firewood and for medicinal purposes. The female cones are sometimes collected for the oil expressed from the seed.[14]

Ironically, increasing awareness of the endangered status of *Cephalotaxus* comes at a time when its potential value has expanded beyond horticultural uses to include anticancer compounds found in its seed and vegetative tissues. Experimental work with the ester alkaloids cephalotaxine, harringtonine, and allied chemicals has shown promise, although apparently no widespread therapeutic applications have yet been introduced.[15] Sadly, two of the three species that are especially rich sources of these alkaloids, *C. hainanensis* and *C. oliveri*, are currently endangered, although the third, *C. fortunei*, is less vulnerable.[16]

### *Cephalotaxus* as a Garden Plant

The various taxa of *Cephalotaxus* are of interest and value not only as endangered sources of useful materials, but as exquisitely beautiful evergreens for a variety of modern landscapes, combining graceful habits and foliage with the tough stress resistance and ease of maintenance required by modern gardeners and landscape contractors.

*Cephalotaxus* are slow-growing conifers with dark olive to black-green foliage. Because their habits range from upright and shrubby to low and informally mounding, they can serve as hedges, masses, groundcovers, specimens, and foundation or container plants. They thrive in a variety of soils, including extremely dense clays. They are not only tolerant of shade but—with only one exception—perform well even in heavy shade, an unusual trait for a needled evergreen. Indeed, most *Cephalotaxus* produce the best foliage when given at least some shade, although some maintain excellent foliage color in either full sun or shade.

Plum yews are extraordinarily heat tolerant in humid climates, another unusual trait for a needled evergreen. For this reason, they have been called "the yew of the south," although they can serve as excellent landscape plants in an area extending far beyond the Southeast. Once established, they are tolerant of extended dry periods such as those experienced during most of our eastern summers. However, they are not good choices for hot, dry climates like those in much of the southwestern United States.

*Cephalotaxus* are relatively deer resistant (I have come to believe that no evergreen is totally deerproof). Deer feeding on plum yews have been reported in areas with very heavy deer populations (for example, central New Jersey and Pennsylvania). Even in these cases, however, with only one exception, deer turned to *Cephalotaxus* foliage only as a last resort.

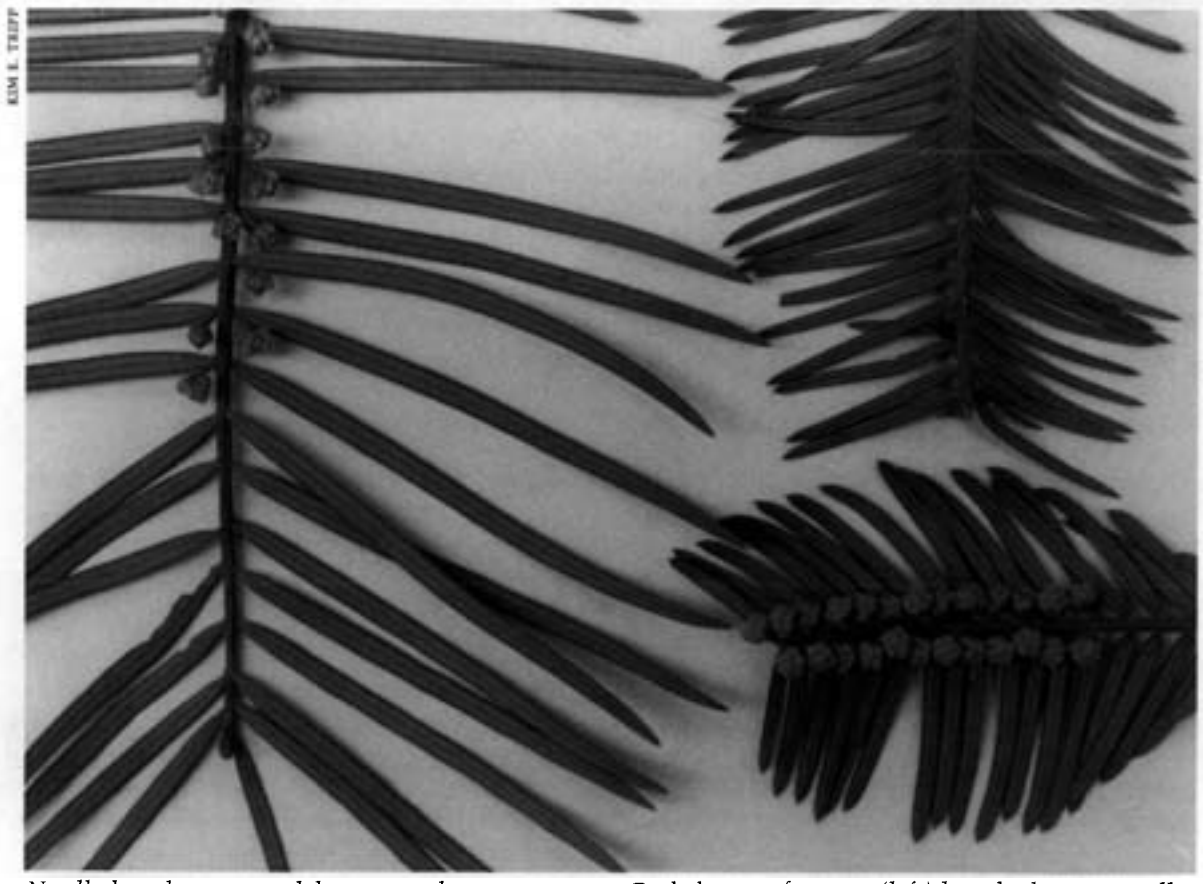
### Nomenclature and Taxonomy

Unfortunately, there is no current monograph on *Cephalotaxus* available. This is especially troublesome since the nomenclature of this genus is particularly confusing and is likely to remain a challenge for the foreseeable future; to the best of my knowledge, no taxonomic monograph of the entire genus is currently underway. Hence, one must simply dive in and make a first

attempt at creating some order out of the chaos.

Key characters listed in the literature have rarely been useful to me when dealing with plum yews. I have observed that widely cited key characters such as stomatal band whiteness, length and shape of needle, and bark color can vary with age of the plant and the microenvironment in which it is grown.[17] Full sun, cool temperatures, and leaf maturity, for example, appear to promote whiteness of the stomatal bands on plants of the four species now grown in North America. In another case, an oft-cited, characteristic V-shaped trough formed by the angle at which needles are held—which has been used to separate what is now called *C. harringtonia* var. *drupaceae* from the rest of the species[18]—can frequently be seen on plants of various species.

What this translates to on a practical basis is that confirmed provenances and commercial sources are critical when working both with species and with cultivars. In the case of species, identifying individual plants is especially challenging because the key characters are mostly morphological intergrades. Therefore, knowledge of geographic origin is important, and even when armed with such knowledge only the morphological extremes of the genus (e.g., *C. fortunei* with very long needles versus the shorter-needled *C. harringtonia*) can be reliably and consistently separated from each other *ex situ*. Judging from what I have observed on diverse live plants and herbarium specimens, a pragmatic taxonomist might argue for including much of the genus in a single species, at least for plants found on the Asian mainland. The fol-



*Needle length varies widely among plum yew species.* Cephalotaxus fortunei *(left) has the longest needles, while* C. harringtonia *(lower right), in general, has the shortest. Other species, like* C. sinensis *(upper right), are intermediate.*

lowing discussion of forms offers a brief introduction to the diversity of plum yews.

### *Cephalotaxus fortunei* Hooker (Fortune's plum yew, San-chien-shan, Lo-han-shu, three-pointed fir)

Fortune's plum yew is native to China, where in addition to wild populations, it is found planted near shrines and temples. This species has a widespread range in central and eastern China south of the Yellow River and has been collected in Shui-sa-pa (the "Water Fir Grove" near the border of Hubei and Sichuan provinces) as part of the *Metasequoia* flora.[19] It was introduced to both Europe (around 1849) and the United States (around 1858) by Robert Fortune, who collected it in China.[20]

The needles of *Cephalotaxus fortunei* are the longest of the genus, varying from two to over four inches; the most dramatically long-needled plants are the most elegant. Needle diameter ranges from extremely slender (1/16th inch) to nearly as wide as that of other species (1/6th inch), with color of the stomatal bands on the undersides of the needles varying from bright white to green. Bark is reddish-brown to dark brown and peels in plates as plants age. Mature female cones are longer (one-and-a-half to two inches) and often narrower than those of other species.

*Cephalotaxus fortunei* is a multistemmed shrub or small tree with an open, loosely rounded habit and slightly pendant branchlets. Height and spread will vary with provenance of seedlings and the climate in which the plants are grown. In China, depending on locale, *C. fortunei* is found as a shrub or as a small to medium-sized, multitrunked tree reaching heights in the range of thirty feet.

In Europe and North America, warmer regions give faster, more upright growth, while cooler temperatures lead to shrubbier, slower-growing plants. All of the *C. fortunei* selections I have seen do best in shade, which results in a more open habit than is found in sunny situations; in North America, full sun usually causes at least some winter burn on the foliage. They prefer moist, loamy soil, but will also stand up to heavy clays if grown in light shade. They are reliably cold hardy through zone 7, and in sheltered, shaded sites, into the warmer parts of zone 6.

*Cephalotaxus fortunei* var. *alpina* Li is a low form found in the mountainous forests of northwestern Yunnan and western Sichuan. *C. fortunei* 'Grandis' is an especially long-needled female form, originally from Hillier Nurseries. *C. fortunei* 'Lion's Plume' is yet another long-needled cultivar, originally received in the 1950s at the Willowwood Arboretum in New Jersey but no longer in the collections there. *C. fortunei* 'Prostrate Spreader' ('Prostrata') is a long-needled, low, mounding form, also from Hillier Nurseries, with lovely dark-green foliage; several other prostrate selections available in the United States may or may not be clones of the Hillier Nurseries plant.

### *Cephalotaxus griffithii* Hooker (Griffith's plum yew)

Griffith's plum yew is one of the species found in India, specifically in the Mishmi Hills of Assam (at about 6000 feet) where it is a small tree fifteen to thirty feet in height. It is also found in western Sichuan, China. Needles are two to three inches long by 1/8th inch wide. Herbarium specimens of this species appear similar to those of the geographically overlapping species *C. mannii*, *C. oliveri*, and *C. sinensis*.[21] In the past, *C. griffithii* was cultivated at Kew, which received specimens from the Calcutta Botanical Garden sometime before 1890,[22] but Kew's inventory does not currently list this species. I have not seen it in cultivation anywhere in the United States. Cold hardiness of this species outside of Asia is unknown.

### *Cephalotaxus hainanensis* Li (Hainan plum yew)

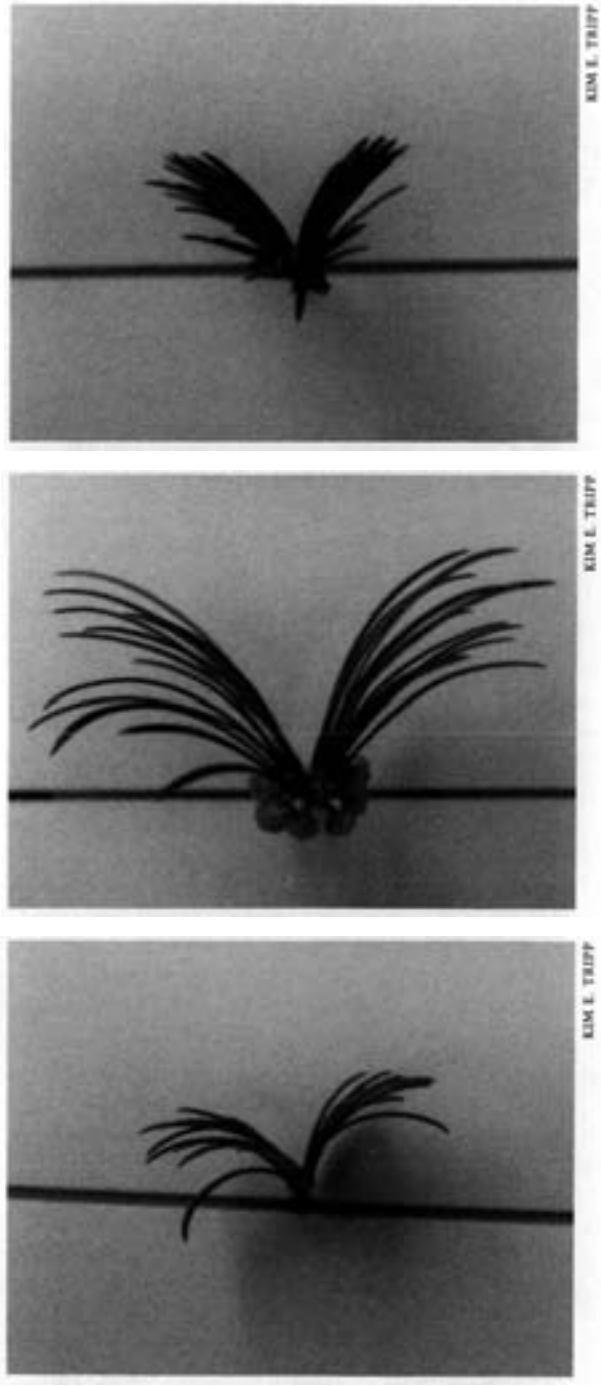
Hainan plum yew is a tropical species found on the island of Hainan, China. Some authors include this taxon as part of *C. mannii*, which appears to be its closest relative. On Hainan, it can grow to tree size, reaching fifty to seventy feet in height. Needles are long and slender (two or three inches by 1/8th inch); most herbarium specimens appear nearly identical to those of *C. mannii* except for a greater variability in needle length. Because of timbering and bark stripping, Hainan plum yew is seriously threatened in its

natural range; it is also one of the species rich in anticarcinogenic alkaloids. It is not in cultivation in this country but is likely to be cold hardy only into zone 9.

***Cephalotaxus harringtonia* (Forbes) Koch (Harrington's plum yew, Japanese plum yew, Inugaya)**

This was the first plum yew to be collected by Westerners and has been longest in Western cultivation. It is widespread in Japan from Kyushu north to Hokkaido and is also found in areas of northeastern China and Korea. In the warmer parts of its range it is usually seen as a small tree; in colder areas it most often appears as a rounded shrub of low to medium height. It is this latter habit that most frequently develops in cultivation in Europe and North America. Its needles are relatively short and often wider than those of mainland taxa (one-to-two inches long and 1/6th inch wide), and its fruits are rounded-ovoid. The numerous cultivars have a variety of shapes, sizes, and foliage variegations.

Siebold first sent this plant to the Leiden Botanical Garden in 1829 as *Cephalotaxus drupaceae*. Most modern authors separate *C. harringtonia* var. *drupaceae* from typical *C. harringtonia*. The primary difference appears to lie in the arrangement of the needles on the stem. In the literature, both historical and modern, the foliage of *C. harringtonia* var. *drupaceae* is repeatedly described as distinctive in its upright V-formation, but I have seen this characteristic on any number of *Cephalotaxus* species and cultivars in diverse sites. In North America (and in a brief survey of southern England), the V-shaped character appears to be more closely related to cultural conditions and to the stage of development of the needles and plants than to any consistent taxon-specific morphological trait. This V-shaped characteristic becomes especially pronounced on the flowering branches of many male *Cephalotaxus*, regardless of species or variety, as pollen-bearing strobili expand in the needle axils and appear to promote "lifting" of the two-ranked needles into a V-shaped trough. The degree of "V" also increases somewhat throughout the season on all plants of various species as leaves mature and in response to dry periods. I have



*The V-shaped foliage that is attributed to* Cephalotaxus harringtonia *var* drupaceae *can actually be seen in other species as well. Seen here in profile, from top to bottom,* C. koreana, C. fortunei, *and* C. sinensis *exhibit varying degrees of this same characteristic*

*A mass of nine* Cephalotaxus koreana *seedlings at the Arnold Arboretum has proven itself to be exceptionally handsome and durable.*

had no success separating what is called *C. harringtonia* var. *drupaceae* from *C. harringtonia* in North America by relying on these morphological characteristics. Cold hardiness and landscape performance of *C. harringtonia* vary with cultivar and botanical variety as noted below.

*Cephalotaxus harringtonia* var. *nana* Nakai (Hai-inugaya) is the variety found growing on seaside cliffs and mountainous areas of Hokkaido and eastern Honshu.[23] Its needles are shorter and more slender than those of *C. harringtonia*, and the plants themselves are shorter, with a more upright, suckering habit. Its fruits are also smaller. In the wild, *C. harringtonia* var. *nana* spreads by layering; it does the same in cultivation, albeit slowly. Overall it is more compact and more finely textured than the species and retains this habit in cultivation. Plants grown from collections made by Spongberg and Weaver have been cold hardy in zone 6 at the Arnold Arboretum where foliage color remains attractive throughout the winter in the shade but bronzes heavily in full sun.[24] *C. harringtonia* var. *nana* has a distinctively demure character in the landscape, and it would make a lovely small evergreen for shaded sites.

*Cephalotaxus harringtonia* 'Duke Gardens' is a broadly rounded, dense shrub reaching about six feet by six feet in about ten years, depending on where it is grown. It was selected at Sarah P. Duke Gardens at Duke University in North Carolina. It makes a beautiful mass in sun or shade in zones 7 to 9 and thrives in soils from sandy loams to clays.

*Cephalotaxus harringtonia* 'Fastigiata' is a distinctive upright cultivar with dark green needles whorled around the stem in a bottlebrush manner. 'Fastigiata' grows even more slowly than the average *Cephalotaxus*, retaining its broad columnar habit for the first ten to twelve years before beginning to spread into a


*The bold foliage of* Cephalotaxus koreana *remains black-green and glossy even in winter.*

multibranched, upright mound. It does best in part shade; full shade causes it to open up and become untidy, while full sun can result in winter burn in severe years. 'Fastigiata' is reliably cold hardy through zone 6 and much of zone 5, especially in walled gardens and other semiprotected areas, but it will suffer from snow and ice damage in severe winters. *C. harringtonia* 'Fastigiata Aurea' is nearly identical to 'Fastigiata' except that its needle margins are gold.

*Cephalotaxus harringtonia* 'Fritz Huber' is a low-spreading cultivar with stiffer branches and a stiffer habit than other low-mounding types. Its needles are a brighter, more emerald green than other selections. *C. harringtonia* 'Gnome' is a dwarf, rounded mound growing to two feet in height, with light green foliage and shorter, stiffer needles than the species. It is a striking, impish little plant from Hillier Nurseries. *C. harringtonia* 'Korean Gold' ['Ogon', 'Ogon Chosen Maki'][25] is identical to 'Fastigiata' except that new growth emerges bright yellow-gold in spring and fades to green in summer. Also, its growth is slower than that of 'Fastigiata'. 'Korean Gold' is very effective in the spring garden.

The name *Cephalotaxus harringtonia* 'Prostrata' is generally applied in this country to any and all selections with a low-spreading, low-mounding habit—plants often have somewhat pendant branchlets as well. However, it should, at this time, be used only for the Hillier Nurseries selection.[26] (See "A Plethora of 'Prostrata's" on page 35.) The true Hillier Nurseries cultivar 'Prostrata' is especially tolerant of full sun and shows no foliar burn in the northeastern United States, where other forms do burn. With its particularly pleasing, informally irregular, cloudlike silhouette, it is one of the most beautiful and useful selections of plum yew available to gardeners. Its quality was recently recognized by the Pennsylvania Horticultural Society with a Gold Medal Award. There is

a reliably named, exceptionally handsome old planting of *C. harringtonia* 'Prostrata' at the Brooklyn Botanic Garden.

### *Cephalotaxus koreana* Nakai (Korean plum yew)

Korean plum yew is found at low to middle elevations in Korea, northern and central Japan, and northeastern China. It is an upright, slow-growing shrub with broad, relatively coarse, black-green needles (about two inches by 1/6th inch). Plants will reach eight to ten feet in as many years, with a narrow spread. Its dense branching and foliage cover make this species one of the most effective for massing. It retains its remarkably beautiful black-green foliage throughout the entire year, even in an exposed winter site at the Arnold Arboretum (zone 6) where other species have bronzed heavily. Cold hardiness will vary with provenance, but *C. koreana* is hardy at least through zone 6 and likely into zone 5. Further collections from the coldest parts of its range would be desirable.

### *Cephalotaxus lanceolata* Feng

*C. lanceolata* is known from only a few places in northwestern Yunnan Province. It closely resembles *C. fortunei;* indeed, the majority of herbarium specimens are practically indistinguishable from those of *C. fortunei.* Its needles are long and slender (about three inches by 1/8th inch) and often with needle edges that are distinctly parallel up to a sharply acute apex (as opposed to tapering more gradually to an acuminate apex). Chinese authors distinguished this species from *C. fortunei* on the basis of its wider, thinner needles with sharper apices (hence its name, *lanceolata*).[27]

### *Cephalotaxus mannii* Hooker (Mann plum yew)

This species grows into a tree of about seventy feet in height. It is the southernmost taxon and can be found at low to middle elevations on moist, shaded slopes and gullies in woodlands in southern China, northeastern Burma, India, Laos, and Vietnam (and Hainan if one includes *C. hainanensis* within *C. mannii*). *C. mannii* is sparsely distributed and seriously endangered by harvesting for timber and for medicinal purposes. Its foliage as seen in illustrations and on herbarium specimens is slender, gracefully tapering, and variable in length;[28] even in a dried state it is strikingly beautiful. *C. mannii* is not in cultivation in the United States and is not likely to be cold hardy north of zone 9. It is exciting to learn that the Royal Botanic Garden at Edinburgh has recently acquired cuttings of this species for propagation.

### *Cephalotaxus oliveri* Masters (Oliver plum yew)

The foliage of this species is among the most distinctive of the genus with short, broad needles (one or one-and-a-half inch by 1/6th

*The distinctive foliage of* Cephalotaxus oliveri *is well illustrated in this figure from* The Gardener's Chronicle *(April 1903), in which "the leaves are disposed, like the teeth of a comb."*

inch) arranged in two militarily precise, nearly overlapping ranks. The needles are pectinate, that is, arranged "like the teeth of a comb";[29] this trait remains distinctive even on diverse herbarium specimens. *C. oliveri* is a large shrub or small tree reaching ten to fifteen feet. It is sometimes found in drier, cooler areas than the other subtropical species of China, but is generally found growing at middle elevations in central, south central, and southwestern China, eastern India, and northern Vietnam. It was once in cultivation at Kew but is no longer listed in their inventory. It is not in cultivation in this country, but it might be a useful horticultural species thanks to its occurrence in somewhat drier and colder areas than other subtropical taxa, as well as because of its distinctive foliage and its moderate size. *C. oliveri* is an endangered species and is rich in anticarcinogenic alkaloids.

***Cephalotaxus sinensis* (Rehder and Wilson) Li (Chinese plum yew)**

Currently also known as *C. harringtonia* var. *sinensis* and historically as *C. drupaceae* var. *sinensis*, this is another very widespread species. It is a medium-sized, somewhat open and rounded shrub with slender, medium-length needles (about two inches by 1/8th inch). It will eventually reach ten to twelve feet in height with half the spread. It occurs naturally in moist woodlands and thickets on limestone slopes throughout eastern, central, and northwestern China, including Sichuan and Yunnan provinces. This species was first collected for the West and brought to the United States by Wilson as *C. drupaceae* var. *sinensis*; Rehder later changed the name to *C. harringtonia* var. *sinensis* and Li ultimately elevated it to *C. sinensis*.[30] Plants are generally cold hardy through zone 6; they may suffer winter burn in exposed sites but have held up well to ice and snow in Boston. *C. sinensis* makes a lovely evergreen shrub in appropriately shaded sites, where it contributes an elegant, yet informal ornamental character.

***Cephalotaxus wilsoniana* Hayata (Wilson plum yew, Taiwan plum yew)**

This species is endemic to Taiwan, being widely but sparsely distributed in diverse woodlands at middle elevations.[31] It is a medium-sized tree, growing to thirty feet with pendant branches. Its needles tend to be slender and of moderate length (about two inches by 1/8th inch). In the United States, it is likely be cold hardy into zone 8. *C. wilsoniana* is in cultivation at Kew and the Royal Botanic Garden at Edinburgh, but it is not in this country.

**Propagation**

My work with four of the most hardy species and several cultivars indicates that similar propagation techniques are likely to apply to all *Cephalotaxus*.[32] Propagation from seed or cuttings is quite a long process. Seed gives best germination after ten to twelve weeks of cold stratification and after removal of the fleshy seed coat (which, unlike the similarly constructed *Ginkgo*, is usually only very slightly malodorous). Seeds that have overwintered outdoors under the mother plants give reasonable germination results as well. Even in a warm greenhouse, seedlings take a worrisome length of time to completely emerge, and it is particularly important to maintain consistently moderate moisture during this period. One is tempted to conjecture that this slow seedling emergence may contribute to the apparently low regeneration rate of *Cephalotaxus* in the wild.[33]

Propagation from stem cuttings is not difficult, but it too is slow. In the northeastern United States, four- to six-inch stem cuttings can be successfully rooted throughout the year once the spring flush has been completed and foliage has hardened off somewhat (between July and March). In the southeastern United States, cuttings root best when taken during fall or winter (October to February), avoiding the peak heat of the summer. Stem cuttings will root even without rooting hormones, but moderate concentrations result in slightly larger, fuller root systems. With bottom heat, cuttings generally take about four months to develop a viable root system, although they can take as long as six months in low light. Heavily flowering branches from male plants should be avoided since profuse flowering competes with developing roots, and male flowers are a haven for fungal spores. Flowers on female shoots, on the other hand, have little effect on rooting and do not cause fungal problems. Informal observa-

## *A Plethora of 'Prostrata's*

There is great confusion in the trade over plum yew selections with low, creeping, horizontally spreading or prostrate growth habits. A plethora of prostrate forms have been propagated and given names like variety *prostrata*, forma *prostrata*, or cultivar 'Prostrata', 'Prostrate Form', or 'Prostrate Spreader'. Most of these prostrate forms are an artifact of propagation from stem cuttings that used lateral branches instead of terminal shoots. Rooted cuttings of lateral branches retain their lateral orientation, and so young plants grow horizontally for many years. Eventually, such plants will develop at least one upright leader and will begin to grow as an upright shrub or small tree, as most seedlings do in nature. It can take anywhere from three to thirty years for plants grown from lateral branch cuttings to develop a leader, depending on growing conditions and characteristics of the parent plant. Historically, many plants have been used as sources of cuttings for these prostrate forms. Thus, two individual prostrate plants, both, for example, with the botanical name *prostrata* may have been propagated from two very different parent plants. One, both, or neither of the parent plants, however, may have been prostrate in habit, and both parents may exhibit very different landscape characteristics, such as degree of cold hardiness and performance in full sun.

At the turn of the century, to name a plant based on a developmental trait rather than a genetic trait was no problem because it was then correct usage. Confusion entered in the mid-1900s when the botanical designations *forma* and *varietas* were uncritically translated into cultivar names set in single quotes.[1] As a result, a primary source of confusion is that, unlike *varietas* and *forma*, cultivar names with single quotes now imply clonal parentage.[2] This has become a particular problem with prostrate plum yews.[3] For example, Hillier Nurseries now lists their exceptional selection of prostrate Japanese plum yew as cultivar 'Prostrata'.[4] Unfortunately, that cultivar name has been indiscriminately applied in this country to many other plants propagated from the lateral branches of random parent plants, which may or may not have been propagated from clones of the Hillier plant. Horticulturists desiring all of the exceptional qualities associated with the Royal Horticultural Society's Gold Medal Award-winning *C. harringtonia* 'Prostrata' must look for plants produced from clonal propagations of the Hillier Nurseries plant.

**Notes**

[1] For innumerable examples, see L. H. Bailey et al., *Hortus III* (New York: Macmillan, 1976).

[2] For further discussion of this issue with regard to conifers, see H. J. Welch, *Manual of Dwarf Conifers* (Little Compton, R.I.: Theophrastus, 1979), 40–48, also 151–152, 392.

[3] Propagation of many different plants from lateral cuttings and indiscriminate naming of all of the resulting propagules 'Prostrata', regardless of parentage (or quality of the plant), has led to great confusion among prostrate plum yews in the U.S. nursery trade (see K. E. Tripp, "A Plum Yew Primer," *American Nurseryman* (1994) 180(9): 28–37).

[4] Hillier Nurseries, *The Hillier Manual of Trees and Shrubs*, 6th ed (Devon, England: David and Charles, 1991), 584–585, 677, 679.

**Cephalotaxus fortunei**, *thirty feet high and three feet in circumference, photographed by E H Wilson at an altitude of 4000 feet near Wa-shan, China, September, 1908.*

tions in the eastern United States indicate that terminal cuttings are slower to root than lateral ones, sometimes needing an additional two to four weeks; these will, however, result in plants with upright growth. Lateral cuttings, while quicker to root, result in plants with prostrate growth, at least for a number of years. For some as yet unexplained reason, 'Duke Gardens' has been more difficult to root than other cultivars.

The only challenge in propagating this genus is the degree of patience required. It would be worth experimenting with fog systems to see if they might hasten the process of rooting. Janick et al. reported success with micropropagation of *C. harringtonia*,[34] but to the best of my knowledge no one has yet applied the technique on a commercial scale.

### *Cephalotaxus* at the Arnold Arboretum

The Arnold Arboretum has had a long and significant relationship with *Cephalotaxus*, having been among the first to collect and cultivate the genus in this country. Several men made important collections of *Cephalotaxus* for the Arboretum, among them Frank Meyer, William Purdom, Joseph Rock, and Charles Sargent; however, the many collections made by E. H. Wilson included some of the most interesting. In Japan, Wilson collected *C. harringtonia*, *C. harringtonia* var. *nana*, and *C. koreana*. In China, he collected *C. fortunei*, *C. harringtonia*, and *C. oliveri*, and was the first Westerner to collect what would eventually be named *C. sinensis*. Throughout his collecting years he consistently expressed an interest in the genus. Both Wilson and Alfred Rehder worked on describing and naming the genus over many years.[35]

While none of the Wilson-era accessions or their progeny survive at the Arnold, the Arboretum remains actively interested in *Cephalotaxus*, and its living collections are home to one of the country's most diverse collections of source-documented, wild-collected germplasm. Among others, Stephen Spongberg has collected material in China, Japan, and Korea. The most recent collections of *Cephalotaxus* for the Arboretum were made by Peter Del Tredici in China last year. We are especially pleased to have new germplasm of *C. sinensis* collected by Peter from the northerly portion of its range, which may offer improved cold hardiness and winter performance in the winter landscape.

*Cephalotaxus* was once an integral part of the prehistoric, indigenous flora of both North America and Asia. This genus has long since disappeared in North America and is now seriously endangered in Asia, yet plum yews are among the most interesting, beautiful, and useful of evergreen conifers. *Cephalotaxus* warrants increased study and conservation—with respect for its importance as both a wild and cultivated conifer.

**Acknowledgments**

The author gratefully acknowledges Shiu-ying Hu for translation and interpretation of texts from relevant Chinese systematic references, and sincerely thanks Jack Alexander, Allen J. Coombes, Peter Del Tredici, Michael Dirr, Aljos Farjon, Martin Gardner, Richard Hartlage, Andrew Knoll, Gary Koller, Cynthia Osman, M.D., Stephen Spongberg, Chris Strand, Benito Tan, Tom Ward, and Elizabeth Wheeler for critical discussion, useful information, or helpful suggestions.

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Kim E. Tripp is a Putnam Fellow at the Arnold Arboretum, using the living collections for research, teaching, and writing.

**Notes**

[1] E. H. Wilson, *The Conifers and Taxads of Japan* (Cambridge: Publications of the Arnold Arboretum, University Press, 1916), v–viii, 6–9.

[2] P. F. von Siebold and J. G. Zuccarini, *Flora Japonica* (1835).

[3] L. K. Fu, "A study on the genus *Cephalotaxus* Sieb. et Zucc.," *Acta Phytotaxonomica Sinica* (1984) 22(4): 277–288.

[4] J. T. Buchholz, "Generic and subgeneric distribution of the coniferales," *Botanical Gazette* (1948) 110(1): 80–91; W. C. Cheng, *Sylva Sinica* (Beijing: Editorial Committee of Flora of Woody Plants of China, 1983), 379–385; W. C. Cheng, L. K. Fu, and C. S. Chao, "Cephalotaxaceae, *Cephalotaxus*," *Flora Reipublicae Popularis Sinicae*, tomus 7 (Beijing: Science Press, 1978), 422–436; H. H. Hu, "Distribution of taxads and conifers in China," *Proc. 5 Pacif. Sci. Congr.* (1934) 4: 3273–3288; S. Y. Hu, "Cephalotaxaceae," in "Notes on the Flora of China IV," *Taiwania* (1964) 10: 13–62, 25–31; S. C. Lee, "Distribution of Woody Plants of China," *Taiwania* (1963) 9: 11–21; T. B. Lee (Tchang Bok Yi), *Illustrated Flora of Korea* (Seoul: Hyangmunsa, 1979), 58; H. L. Li., *Woody Flora of Taiwan* (Narbeth, PA: Livingston, 1963), 38–39; H. L. Li, "New species and varieties in *Cephalotaxus*,"

*Lloydia* (1953) 16(3): 162–164, H. L. Li, "Present distribution and habitats of the conifers and taxads," *Evolution* (1953) 7: 245–261; J. Ohwi, *Flora of Japan* (Washington, D.C.: Smithsonian Institution, 1965), 111; A. Steward, *Manual of Vascular Plants of the Lower Yangtze Valley of China* (Corvallis: Oregon State College, 1958), 61–62.

[5] R. Florin, "The distribution of conifer and taxad genera in time and space," *Acta Horti Bergiana* (1963) 20(4): 121–326.

[6] See, for example, A. Rehder and E. H. Wilson, "Cephalotaxus," *Plantae Wilsonianae*, vol. II, ed. C. S. Sargent (Cambridge: Harvard University Press, 1916), 3–6. The exact position of *Cephalotaxus* has been argued back and forth since Neger placed it as a single genus in its own family in 1907 (*Die Nadelholzer (Koniferen) und übrigen Gymnospermen*, Leipzig), which was contrary to A. W. Eichler's original placement within the Taxaceae ("Coniferae" in A Engler and K. Prantl's *Die Naturlichen Pflanzenfamilien*, Leipzig, 1889).

[7] Significant differences in the embryogeny and development of *Cephalotaxus* from the taxads and other conifers were reported by J. T. Buchholz ("The embryogeny of *Cephalotaxus Fortunei*," *Bulletin of the Torrey Botanical Club* [1925] 52[6]: 311–322) but were most definitively elucidated by H. Singh ("The life history and systematic position of *Cephalotaxus drupaceae* Sieb. et Zucc.," *Phytomorphology* [1961] 11: 153–197), whose work in this area has remained a standard reference for modern authors treating the group.

[8] As, for example, in C. N. Page's "Cephalotaxaceae," *The Families and Genera of Vascular Plants. I Pteridophytes and Gymnosperms*, ed K. U. Kramer and P. S. Green (Berlin & NY: Springer-Verlag, 1990), 299–302; and in *The New Royal Horticultural Society Dictionary of Gardening* (New York: Stockton Press, 1992), 569.

[9] K. R. Sporne, *The Morphology of Gymnosperms* (U.K.: Hutchinson, 1965).

[10] Page, op. cit.

[11] H. Singh, op. cit.

[12] A. Farjon, C. Page, and N. Schellevis, "A preliminary world list of threatened conifer taxa," *Biodiversity and Conservation* (1993) 2: 304–326.

[13] Q. Huang, "*Cephalotaxus mannii* Hook. f.," *China Plant Red Data Book—Rare and Endangered Plants*, vol. I, ed. L. K. Fu and J. M. Jin (Beijing. Science Press, 1992), 24–25.

[14] Throughout the *Cephalotaxus* literature, both old and new, there are recurring references to destruction of its habitat due to pressure from humans—both from general activity, like forestry, and from harvesting of the *Cephalotaxus* itself for various purposes. E. H. Wilson noted the use of the seed as an oil source in Japan (op. cit., p. 7). Barry Yinger, after several trips to Korea, reported the general destruction of populations of *C. koreana* by clear-cutting ("Notes on *Cephalotaxus*, the plum yew," *Bull American Conifer Society* [1989] 6(3): 57–59). In a 1988 publication, Zou Shou-qing reported that the forest cover of Xishuangbanna prefecture was cut from 60% to 33% over the prior twenty years and lists *C. oliveri* as one of the endangered relict species there ("The vulnerable and endangered plants of Xishuangbanna prefecture, Yunnan province, China" *Arnoldia* [1988] 48(2): 3–7) Both *Cephalotaxus* species listed in the *China Plant Red Data Book* are reported to be threatened by lumbering, and *C mannii* is also reported to be endangered by harvesting for use as a medicinal herb (see Q. Huang, "*Cephalotaxus mannii* Hook. f," and Z. C. Luo et al., "*Cephalotaxus oliveri* Mast." in the *China Plant Red Data Book*, 24–27).

[15] The importance of *Cephalotaxus* has expanded beyond horticulture to include potential use as a source of anticancer compounds found in its tissues (C. R. Smith, R. G. Powell and K. L. Mikolajczak, "The genus *Cephalotaxus*, source of homoharringtonine and related anticancer alkaloids," *Cancer Treatment Rpt* [1976] 60: 1157–1170). The ester alkaloids cephalotaxine, harringtonine, and allied chemicals have shown significant antitumor activity in a number of *in vitro* studies, and there are recent reports of phase I clinical trials (pharmacokinetic) (see D. M. Graifer et al., "Effect of alkaloids of the *Cephalotaxus* group on the elongation of the polypeptide chain on human ribosomes," *Molecular Biology* [1991] 24(6): 1344–1350), and phase II clinical trials (therapeutic) on human subjects as well (see C. T. Tan et al., in *Cancer Treatment Reports* [1987] 71 1245–48, cited in E. R. Wickremesinhe and R. Arteca, "Establishment of fast-growing callus and root cultures of *Cephalotaxus harringtonia*," *Plant Cell Reports* 12 [1993], 80–83). Other recent publications indicate that progress has been made in development of separation (see D. G. Cai et al., "Semipreparative separation of alkaloids from *Cephalotaxus fortunei* Hook f. by high-speed countercurrent chromatography," *Journal Liquid Chromatography* [1992] 15: 2873–2881) and synthetic production systems for cephalotaxines and harringtonines (see T. P. Burkholder and P. L. Fuchs, "Total synthesis of the *Cephalotaxus* alkaloids *dl*-cephalotaxine, *dl*-11-hydroxycephalotaxine, and *dl*-drupacine," *Journal American Chemical Society* [1990] 112: 9601–9613; and M. Ikeda et al., "Synthetic studies on *Cephalotaxus* alkaloids. A synthesis of (±)-cephalotaxine," *Chemical and Pharmaceutical Bulletin* [1993] 41(2): 276–281), as well as improvements on *Cephalotaxus* tissue proliferation techniques (see P. J. Westgate et al., "Approximation of continuous growth of *Cephalotaxus harringtonia* plant cell cultures using fed-batch operation," *Biotechnology and Bioengineering* [1991] 38: 241–246; and E. R. Wickremesinhe and R Arteca, op. cit.)

[16] T. P Chu, "A study of the alkaloids in *Cephalotaxus* and their bearing on the chemotaxonomic problems of the genus," *Acta Phytotaxonomica Sinica* (1979) 17(4): 7–20.

[17] The primary conifer references, such as Krussman's 1976 (1984 translation) *Manual of Cultivated Conifers* (Portland, OR: Timber Press, 66–69), pl. 63, and Humphrey Welch's 1990 *The Conifer Manual*, vol. I (Netherlands: Kluwer Academic) 191–194, rely on these often tenuous, morphological characters to distinguish *Cephalotaxus* taxa.

[18] A specific example of such a tenuous morphological trait used to distinguish a taxon is the "V" outline supposedly created by the foliage of *C. harringtonia* var. *drupaceae*, which has been cited by many prominent references to separate *C harringtonia* var. *drupaceae* from other *Cephalotaxus* In reality, this trait can be seen on many plants of *Cephalotaxus* regardless of species—see, for example, W. J. Bean, *Trees and Shrubs Hardy in the British Isles* (England: John Murray, 1950), 405-406; P Den Ouden and B. K. Boom, *Manual of Cultivated Conifers* (The Hague: Martinus Nijhoff, 1965), 65-69; Hillier Nurseries, *The Hillier Manual of Trees and Shrubs*, 6th ed. (Devon, England: David and Charles, 1991), 584–585, 677, 679; G Krussman, op. cit ; J Lewis, "Cephalotaxaceae," *The European Garden Flora*, vol. I, ed. S. M. Walters et al. (London: Cambridge University Press, 1986), 73–74; and H. J. Welch, op. cit.

[19] S. Y. Hu, "The Metasequoia flora and its phytogeographic significance," *Journal of the Arnold Arboretum* (1980) 61: 41–94.

[20] Interestingly, Fortune collected this species and sent it back to the USDA as part of a shipment of material collected on an expedition in search of the best forms of tea plants *(Camellia sinensis)* (see R. Gardener, "Robert Fortune and the cultivation of tea in the United States," *Arnoldia* (1971) 31(1): 1–18). This was a fortuitous opportunity to include *Cephalotaxus* as part of the collections.

[21] In fact, *C. oliveri* was originally confounded with *C griffithii* Oliver's 1890 illustration of *C. griffithii* was *C oliveri* (see D. Oliver, "*Cephalotaxus griffithii*," pl.1933, *Hooker's Icones Plantarum*, vol. X , pt. I, 3rd series, J. D. Hooker, 1890) This was later clarified by Masters (see *The Gardener's Chronicle* [1903] 850: 226–228).

[22] J. D. Hooker, *Flora of British India*, vol. V (London, 1890), 647–648.

[23] As reported by J. Ohwi in the 1965 *Flora of Japan* (Washington, D. C.: Smithsonian Institution), p. 111, and as observed by S. Spongberg when traveling in Japan.

[24] For notes on collections made during the Spongberg and Weaver expedition to Japan and Korea, see S A. Spongberg, "Korean Adventure," *Arnoldia* (1978) 38(4): 132–152, and S. A. Spongberg and R. E. Weaver, Jr., "Collecting expedition to Japan and Korea," *Arnoldia* (1978) 38(1): 28–31

[25] 'Korean Gold' was described in C. Hahn and B. Yinger, "Cultivars of Japanese plants at Brookside Gardens," *Arnoldia* (1983) 43(4). 3–19.

[26] Hillier Nurseries, op. cit.

[27] See, for example, the primary reference, W. C Cheng et al., op. cit.

[28] Pl. 1523 in J. D. Hooker's "*Cephalotaxus mannii*" (op. cit., 1890) shows the elegant character of this foliage beautifully. Hooker remarks in the accompanying text on *C mannii*, "A very distinct species . . . but so like *Taxus baccata* as to be easily mistaken for it." Recall the elegant, gracefully tapering outline of English yew, and you will understand the comparison.

[29] M. T. Masters, op. cit.

[30] Alfred Rehder in the 1941 article, "New species, varieties and combinations from the herbarium and the collections of the Arnold Arboretum" (*Journal of the Arnold Arboretum* 22: 569–571) changed the name of what had been called *C drupaceae* to *C. harringtonia* (he concluded that *harringtonia* was the older of the two specific epithets), and hence, all of the included botanical varieties became *C. harringtonia* Subsequently, H. L. Li, in his 1953 article, "New species and varieties in *Cephalotaxus*," elevated it to the species *C sinensis*.

[31] H L. Li, 1963, op. cit.

[32] For further information on propagation of *Cephalotaxus*, see M A. Dirr and C. W. Heuser, Jr., *The Reference Manual of Woody Plant Propagation* (Athens, GA: Varsity Press, 1987), 104, A. Fordham and L. Spraker, "Propagation manual of selected gymnosperms," *Arnoldia* (1977) 37(1): 48; and J. A. Young and C. G Young, *Seeds of Woody Plants in North America* (Portland, OR: Dioscorides Press, 1992), 93.

[33] Huang, op. cit., cites a naturally low pollination rate, and Luo et al., op. cit , report infrequent regeneration, but neither source cites other work in support of these statements. It is possible that a combination of dioecious reproductive biology, relatively slow seed maturation and germination, seed predation by birds and mammals, increasingly sparse distribution of mature plants, and general destruction of habitat favorable for seedling survival and development, leads to the reported infrequent regeneration of *Cephalotaxus*

[34] J. Janick et al., "Micropropagation of *Cephalotaxus harringtonia*," *HortScience* (1994) 29(2): 120–122.

[35] For details of taxa collected on specific expeditions and early taxonomic commentary on various taxa, see A. Rehder, "Enumeration of the ligneous plants of northern China," *Journal of the Arnold Arboretum* (1923) 4(3): 117–128; A. Rehder, "New species, varieties and combinations from the herbarium and the collections of the Arnold Arboretum," *Journal of the Arnold Arboretum* (1923) 4. 107; A. Rehder and E H. Wilson, "Enumeration of ligneous plants collected by J. F Rock on the Arnold Arboretum expedition to northwestern China and northeastern Tibet," *Journal of the Arnold Arboretum* (1928) 9· 5–20; A. Rehder and E. H. Wilson, "Cephalotaxus"; E H. Wilson, "The taxads and conifers of Yunnan," *Journal of the Arnold Arboretum* (1926) 7· 39–68, and E. H. Wilson, *The Conifers and Taxads of Japan*, op. cit.

# Arnold Arboretum Weather Station Data — 1994

| | Avg. Max. Temp. (°F) | Avg. Min. Temp. (°F) | Avg. Temp. (°F) | Max. Temp. (°F) | Min. Temp. (°F) | Precipitation (in.) | Snowfall (in.) |
|---|---|---|---|---|---|---|---|
| JAN | 30 | 10 | **20** | **53** | -6 | 5.46 | 25.5 |
| FEB | 35 | 16 | **26** | **65** | 3 | 3.37 | 26 |
| MAR | 45 | 28 | **37** | **66** | 13 | 8.34 | 7.5 |
| APRIL | 61 | 37 | **49** | **85** | 29 | 2.13 | 0 |
| MAY | 67 | 47 | **57** | **88** | 36 | 5.14 | 0 |
| JUNE | 82 | 60 | **71** | **98** | 50 | .95 | 0 |
| JULY | 87 | 67 | **77** | **97** | 57 | 1.33 | 0 |
| AUG | 81 | 60 | **70** | **92** | 50 | 6.76 | 0 |
| SEPT | 72 | 53 | **63** | **84** | 42 | 5.18 | 0 |
| OCT | 65 | 40 | **53** | **74** | 33 | .33 | 0 |
| NOV | 58 | 37 | **48** | **78** | 19 | 4.58 | 0 |
| DEC | 45 | 28 | **37** | **66** | 10 | 5.75 | 0 |

| | |
|---|---|
| Average Maximum Temperature | 61° |
| Average Minimum Temperature | 40° |
| Average Temperature | 51° |
| Total Precipitation | 49.3 inches |
| Total Snowfall | 59 inches |
| Warmest Temperature | 98° on June 19 |
| Coldest Temperature | -6° on January 16 |
| Date of Last Spring Frost | 30° on April 19 |
| Date of First Fall Frost | 32° on November 11 |
| Growing Season | 205 days |

Note: According to state climatologist R. Lautzenheiser, 1994 was the 14th warmest year recorded in 124 years. It tied with 1951 and 1976. It was also wetter than average with 6.11 inches above normal. The summer months of June and July brought very high temperatures and minimal rainfall, causing the plants at the Arnold Arboretum to suffer with drought stress. However, the months of August and September were cooler than normal, and we received 11.94 inches of rain that once again invigorated the plants.

As a whole, 1994 was a very good growing year. The year ended with 205 growing days, 20 more than 1993, which in turn had 31 more growing days than 1992 at 154. However, 1991 exceeds all succeeding years with 222 growing days; 1990 had 193.

# The Arnold Arboretum

SPRING • NEWS • 1995

## The Visiting Committee Visits

*Robert E. Cook, Director*

Reading the history of Charles Sprague Sargent's directorship, which spanned the period from 1872 to 1927, one gains the distinct impression that he reported to no one in particular at Harvard University. Although he was appointed by the president of the University and submitted an annual report each year, he managed the Arboretum with a great deal of autonomy from the Cambridge administration.

In these more democratic times, I retain a considerable amount of this autonomy, although a good third of my time is spent addressing administrative and University matters in Cambridge. In this capacity, I report to the Vice President for Administration at Harvard, Sally Zeckhauser, who manages much of the physical plant and personnel side of the University on behalf of the seven-member Harvard Corporation. However, like other schools and institutes at the University, the Arboretum has a Visiting Committee, a group of individuals appointed to review the workings of the Arboretum and report back to the Board of Overseers, an elected body that governs alongside the Corporation. Our Visiting Committee includes horticultural and botanical scientists, educators, and long-time friends of the Arboretum.

Peter Del Tredici, Assistant Director for Living Collections, guides members of the Visiting Committee on a tour of Chinese Path. From left are Donna F. Hartman, Christopher T. Bayley, chair, Elizabeth C. Sluder, and W. Hardy Eshbaugh. Committee members not shown are Gregory J. Anderson, Robert A. Bartlett, Jr., William B. Coughlin, Caroline G. Donnelly, Jane C. Edmonds, Thomas S. Elias, Corliss Knapp Engle, Francis O. Hunnewell, Joan M. Hutchins, Matthew J. Kiefer, Ellen West Lovejoy, Janine Evnin Luke, Edith N. K. Meyer, and Robert Orndduff.

In early May the Visiting Committee visited for a day and a half, focussing their attention particularly on the quality of care we bring to the maintenance and curation of the living collections here in Jamaica Plain. I am pleased to report that they were extremely supportive and very impressed with the appearance of our landscapes, the richness of our holdings, and the extra lengths to which we go to maintain accurate records of all our shrubs and trees. We feel confident that we are setting the standard for what for serious scientific arboreta, and that we have the best documented collection of trees in the country.

## A Day to Celebrate Trees

On Saturday, May 6, the Arboretum held its first Celebrate Trees Day. It featured talks on urban forests and street trees, tours of the landscape, a children's storyteller, and giveaways of spruce trees and yellowwood seeds. By the end of the day we had distributed almost 200 spruce and over 100 pots sown with yellowwood. Despite a rather blustery and cool spring day, the volunteers and staff enjoyed the opportunity to spread the word about the importance of trees.

• *see pictures on page 7*

# Location by Location—Mapping 265 Acres of Plants

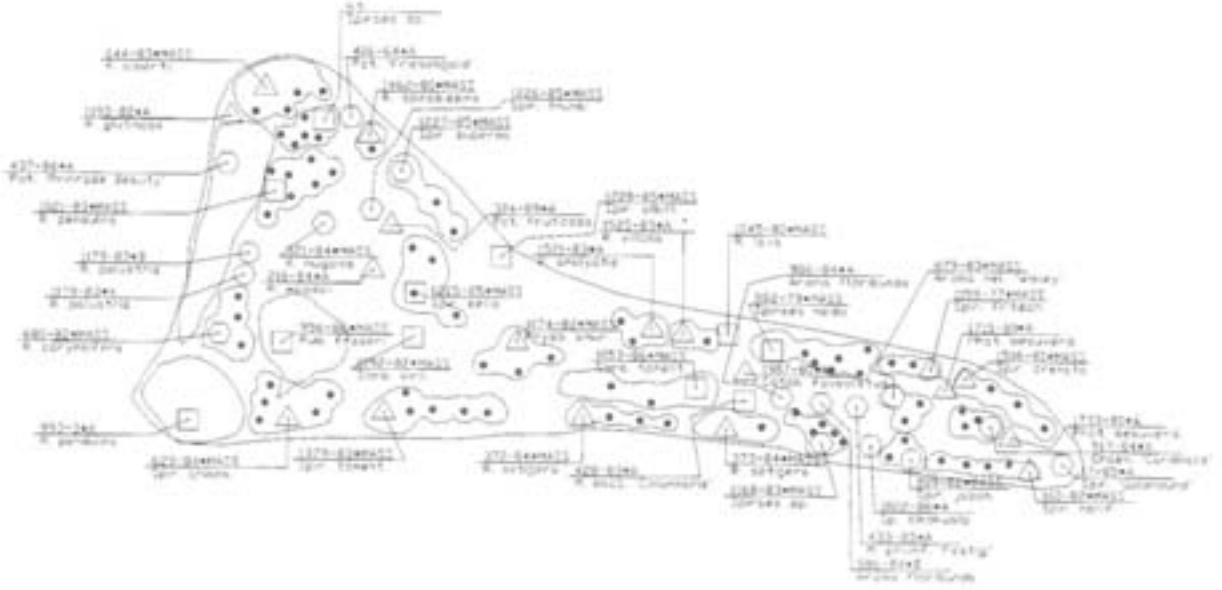
*Susan Kelley, Curatorial Associate*

Since its establishment in 1872, the Arboretum has continuously developed and maintained a living collection of trees, shrubs, and vines from around the world, plants that now number nearly 14,000. The collections are a resource for resident and visiting scientists and graduate students of botany, horticulture, and landscape studies, all of whom rely upon the Arboretum's maps and the extensive records that are maintained for each plant in the collection. At the time a specimen is planted on the grounds, its record is opened with its unique identifying accession number and its botanical and common names; the plant's provenance (whether collected from the wild or obtained from a nursery or other botanical institution); how it was received (as a seed, a graft, an individual plant, etc.); and the region(s) of the world to which the species is native. Yet this information is of little value unless the plant in question can be readily located on the grounds, and since 1937 the Arboretum has maintained hand-drawn, finely detailed maps that enable Arboretum curators and visiting scientists to find and study individual specimens.

To improve the accuracy and efficiency of plant records and mapping, the staff of the Arboretum made a commitment in the mid-1980's to convert to computerized systems the existing plant data (until then maintained on 3" x 5" index cards) and hand-drawn maps. With improved records management an immediate goal, a database was designed specifically for the maintenance of botanical garden and arboretum plant records. The system, called BG-BASE, is based on the Arnold Arboretum's documentation methods and is now in use not only at the Arboretum but at fifty-five other botanical institutions around the world. (The Winter 1989 issue of *Arnoldia* [49:1] was devoted to the whys and hows of curating the living collection.)

The first step toward the new mapping system was to contract Swissair Photo + Surveys, Ltd. (Zurich) to survey the Arboretum grounds. From aerial photography, Swissair Photo provided the Arboretum with a base map, compatible with a CAD (computer aided design) format, that shows topographic contour lines at intervals of 10 feet and roads, paths, water features, and buildings. A grid system overlaid onto the base map divides the property into 64 individual maps, each 400 feet by 600 feet, and each map is further divided into four quadrants labeled NW, NE, SW, or SE.

•• *continued on page 6*



The map for bed 7A in the Bradley Collection of Rosaceous Plants showing symbols denoting provenance type, accession number, and an abbreviated form of the botanical name. The dark circles denote multiple plants within a specific accession.

# A New Face for Chinese Path: A Gallery of Asian Plants

*Richard Schulhof, Assistant Director for Education and Public Affairs*

In a landscape known for trees of historical significance, the Arboretum's Chinese Path stands alone as a place where history is written in plants. Roughly a hundred years ago, a series of events made possible the creation of a gallery of trees and shrubs near the summit of Bussey Hill that exists today as a magnificent living record of Asian plant explorations and introductions to the North American continent. This spring, work resumed on a project to enhance Chinese Path both aesthetically and as an interpretive display for Arboretum visitors.

**The Chinese fringe tree, one of many Asian species to be enjoyed along Chinese Path.**

The site of Chinese Path, the 198–foot Bussey Hill, has long held significance for the people of Boston. During the Revolutionary War, Colonel Eleazer Weld, ancestor of Governor William Weld, owned "Weld Hill" as part of a larger property that included much of the present-day Arboretum. At that time, the summit's commanding views of the Boston basin gave strategic importance to Weld Hill, the site of an earthen fortification. In 1806, gentlemen farmer Benjamin Bussey acquired the property and made the hill the centerpiece of one of Boston's finest country estates. In addition to a mansion on the hill's south-facing slope, Bussey constructed an observatory at its summit where evenings of study included star gazing with fellow Bostonians who shared his scientific interests. By the time Bussey bequeathed the property to Harvard and the Arboretum was founded, the name "Bussey Hill" was firmly affixed to the property.

When Charles Sprague Sargent and Frederick Law Olmsted negotiated for the inclusion of the Arnold Arboretum in the Boston park system, Bussey Hill's outstanding views were to once again determine its use and development. As part of its agreement with Harvard, the City of Boston at first specified that eleven acres near the summit of Bussey Hill be left unplanted for a picnic area. The picnic area was never realized, however, and in 1895 the City of Boston released the reservation area so that it could become part of the Arboretum proper.

The timing of the City's decision was truly fortunate, as it provided space for an unprecedented influx of new species for the Arboretum collections. Beginning in 1892 with Charles Sargent's trip to Japan, the Arboretum launched a series of expeditions to eastern Asia that resulted in the addition of over 1,000 species and varieties to the living collections in Jamaica Plain. With space elsewhere already planted, the new Asian collections found a home on the former city property on the southwest side of Bussey Hill. The area, initially named Azalea Path, featured an extensive planting of the Royal azalea *(Rhododendron schlippenbachii)*, collected by John G. Jack in Korea in 1905. Over the next twenty years, specimens of other Asian species collected by Sargent, Jack, and most notably, the great plant explorer Ernest H. Wilson, filled adjacent beds called the "Collection of Chinese Shrubs." Eventually this area expanded to form the broad horseshoe-shaped gallery known today as Chinese Path.

This spring the Arboretum continued its efforts to transform Chinese Path into an interpretive exhibit that will trace the history of plant exploration and the

••• *continued on page 4*

• • • *from page 3*

introduction of new plants from East Asia. The redesign, prepared by Gail Wittwer, a student at the Harvard Graduate School of Design, aims to better guide circulation through the area and to update the collection with specimens obtained through recent plant explorations.

The Arboretum's Pat Willoughby and Don Garrick (from left) plant a *Cornus kousa* that was collected by the 1980 Sino-American botanical expedition.

The path's defining feature is the botanical legacy of E. H. Wilson and other Arboretum explorers. Magnificent specimens from turn-of-the-century explorations—the dove tree *(Davidia involucrata),* Japanese stewartia *(Stewartia pseudocamelia),* and a paperbark maple *(Acer griseum)* that many believe to be North America's most outstanding specimen—are now joined by plantings of *Sorbus yuana, Ilex fargesii, Rhododendron fargesii,* and other shrubs collected by the 1980 Sino-American botanical expedition, the first cooperative venture between American and Chinese botanists since 1947. The crowning glory of the area's new plantings will be a grove of more than a dozen wild-collected dawn redwoods *(Metasequoia glyptostroboides)* that will soon mark the southern terminus of the path. It is hoped that these historic specimens, together with pamphlets, story labels, and other exhibit materials to be provided through a grant from the National Endowment for the Humanities, will reveal to visitors the story of over a century of plant exploration and its impact on botanical science, horticulture, and the North American landscape.

Dawn redwoods propagated at the Dana Greenhouses await planting on the grounds. A grove planting of these trees will define the southern end of Chinese Path.

## Susan Hardy Brown Honored

Susan Hardy Brown, herbarium curatorial assistant, has been honored in a new program that recognizes outstanding employees at Harvard University. Over the years, Susan has done an exceptional job in mobilizing and leading an active group of volunteers to help her and other plant mounters assemble dried plant material into labeled specimens for the collections in Jamaica Plain as well as those in the Harvard University Herbaria in Cambridge. Last year, 18,217 specimens were created in all.

Many of the specimens constitute works of art as well as tools for research. Once mounted, they become critical material in support of our efforts in botanical systematics and biodiversity conservation. In nominating Susan for this recognition, Bob Cook applauded the energy and intelligence she brings to her work and the great cheer and good spirits with which she accomplishes it.

Candace Julyan has joined the Arboretum staff as project director for the Community Science Connection, a new science education project funded by the National Science Foundation. Candace earned her doctorate at the Harvard Graduate School of Education where she investigated students' understanding of seasonal change in trees. Before coming to the Arboretum she developed and directed the National Geographic Kid's Network, a science education project in which students share experimental data about local environmental conditions across a national computer network. In addition to her work with the Community Science Connection, Candace is the developer and host of an interactive television program on MCET entitled "The Changing Nature of Trees."

## Computer Networks, Local Schools, and the Living Collection

*Candace L. Julyan, Project Director, Community Science Connection*

What role can or should the Arnold Arboretum play in providing science learning opportunities to teachers and students in the surrounding communities? How might computer technology be used to support students' understanding of science? How can the Arboretum serve as a resource for parents interested in supporting their children's science education? Over the next four years, many people at the Arboretum and in local schools will be grappling with these three questions as part of the NSF-funded project, Community Science Connection. As described in Bob Cook's recent Director's Report, this project has evolved from the Arboretum's continuing work with area schools, led by Diane Syverson, while introducing computer technology as a new element in this work.

The $1.2 million grant will allow the Arboretum to work with teachers in the Boston, Brookline, and Newton schools to develop a series of investigations that students can conduct in their schoolyards, in neighborhood natural areas, and on the Arboretum grounds. By exchanging letters and data on a computer network, students will be able to share their ideas with one another and interact with Arboretum scientists as they consider the implications of their findings. In addition, the project will develop ways for parents to support their children's learning through science investigations conducted at home and through special science activities for families on the Arboretum grounds.

The initial goal of the project, which began in February 1995, has been to create a community among the twenty-six teachers who will serve as the early pioneers in this effort. These teachers are from nine schools within a three-mile radius of the Arboretum: in Boston, the Agassiz School, the John F. Kennedy School, the Joseph P. Manning School, the Ellis Mendell School, the Richard J. Murphy School, and the John Winthrop School; in Newton, the Mason-Rice and Memorial-Spaulding schools; in Newton and in Brookline, the Lawrence School.

This spring, the twenty-six teachers have been exploring their own understanding of the changing nature of trees through direct observations. In addition, they have been mastering the computer technology that they will be using with their students in the fall. This summer these teachers and Arboretum staff will develop the investigations that will serve as the foundation of the project's work. Some of these will involve observations of seasonal changes; others may include working with Arboretum scientists. One possibility suggested by Peter Del Tredici, Assistant Director of Living Collections, is to have students conduct some experiments for him on animal feeding preferences by collecting data about which fruit squirrels select first when offered a selection that

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Different features within the landscape are assigned to different layers within the CAD system, so not only has the ease of managing the plants (which can be seen on their own layer) been greatly improved, but information about landscape elements such as irrigation lines, utility lines, and abutting properties can now be readily obtained.

Changes made in the collections are noted in the database and are reflected on the maps via a utilities program that links the mapping system to BG-BASE. The locations of new plantings on the grounds are determined by measuring the distance to nearby plants already on the maps. Individual plants are then digitized onto the maps, with the exact location marked with a symbol that denotes a plant's provenance type (wild or garden collected). Linked to each symbol is the plant's accession number and an abbreviated form of its botanical name. All of this information is gathered directly from the database and is accessed from an active list within AutoCAD. Maps are then printed at a map book size of 11 inches x 17 inches for the Arboretum staff who use them daily to locate individual plants for pruning, horticultural review, making herbarium specimens, or labeling. Each plant in the Arboretum's collection is labeled with a dog tag of sorts, a credit card-sized aluminum strip on which is printed the specimen's accession number, botanical name, provenance information, a common name, and a map location. These labels serve staff and visiting researchers as well as students and the some 250,000 visitors who explore the Arboretum each year.

## New Staff

Kirsten Thornton, Landscape Preservation Assistant, joined the Arboretum staff in January. Kirsten is participating in our collaboration with the Olmsted Center for Landscape Preservation of the National Park Service. With the help of the Arboretum's nursery staff she is in charge of establishing and maintaining a historical plant nursery in our south nursery area. The nursery will be a holding area for approximately 250 plants propagated from historically significant trees and shrubs from National Park Service sites. When the plants reach an appropriate size, they will be returned to their respective sites as a genetically identical replacement for a plant that has been lost or is in imminent danger. We are currently nurturing propagules from the Olmsted elm at Fairsted, in Brookline; from the yellowwood planted by the Adams family at their Quincy homestead; and from a number of historic apple trees from the home of Franklin Delano Roosevelt in Hyde Park, New York. Kirsten is a 1994 graduate of the University of Rhode Island with a degree in plant science. She was a 1994 Arnold Arboretum summer intern.

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includes the gingko and other tree species.

In September 1995 the first group of students will begin to communicate with one another and with the Arboretum staff about their findings. At the end of the school year, they will be invited to the Arboretum for a conference at which they will present their findings to each other and meet their electronic colleagues face-to-face. In the 1996–1997 school year, we will invite additional teachers and schools to join the project.

The CSC approach to science education is in keeping with many of the science education reform initiatives taking place in the state and in the nation. The unusual aspect of the project is its base in an institution like the Arnold Arboretum. We feel that our position as a community resource and a scientific research community makes us uniquely qualified to explore new possibilities for collaborations among schools and informal science institutions. Throughout the project we will document our experiences in order to encourage and support other arboreta and botanical gardens interested in replicating our work. By the end of the project we hope to have answers to our questions about the role of the Arboretum in school science programs, about the role of computer technology in supporting meaningful science activities, and about the role that parents can play in their children's education.

# A Day to Celebrate Trees:

## Events to Promote the Appreciation and Enjoyment of Trees

A pot of yellowwood seeds (in the bag) and a young spruce tree head for a new home.

Jim Gorman, second from left, led visitors to some of the highlights among the spring-flowering trees and shrubs.

*Magnolia* 'Elizabeth' was the cynosure of all eyes and several cameras.

Richard Schulhof, right, discusses the ideas behind the design of the Arboretum on a walking tour.

Gary Koller, not seen, led an informal forum on street trees on the Arborway as well as within the grounds. Among participants were (from left) Sydelle Pearl; Dave Bloniarz of the University of Massachusetts; Anne Joseph; Jim Gorman, Arboretum staff; and Corliss Engle, Arboretum volunteer and member of the Visiting Committee.

## Dr. Dwight Celebrates 92nd Birthday

Richard Dwight, MD, has been a volunteer at the Dana Greenhouse for seventeen years. On April 30 of this year, he celebrated his 92nd birthday, making him our oldest volunteer. A graduate of Harvard Medical School, he is a retired surgeon. In addition to being an avid gardener, he is a gourmet cook, plays the flute, and supports the Boston Symphony Orchestra. He played competitive tennis until age 91 and plans to start again soon. Commenting on the tasks he has been asked to do in the greenhouse, Doctor Dwight says simply, "I like to be useful."

## PROGRAMS & EVENTS

In summer, the Arnold Arboretum designs many of its courses, workshops, lectures, and special events to fit into vacation schedules. A small sampling follows. Please note that fees printed in **boldface** are for Arboretum members.

**WAL137 A Visit to Cricket Hill Herb Farm**
*Judith Kehs, Owner and Herb Expert*

Our visit to Cricket Hill will begin with an introductory talk on herbs by herb professional Judith Kehs. We will tour the greenhouse and specialized gardens in which Cricket Hill produces the many varieties of herbs they market. Our visit will conclude with refreshments in the garden.
**Friday, July 7/ 12:30–3:30 pm (TBA, Rowley, MA).**
**Fee: $18, $21**

**HOR 134 Summer Flowering Shrubs**
*Richard Stomberg, Manager, Harvard University Herbaria Glasshouses*

The hot humid days of midsummer bring a wide variety of color and texture to the shrub border. This class will focus on the culture of a range of mid- and late-summer flowering shrubs, including *Aesculus,* dwarf buckeye; *Vitex,* chaste tree; *Buddleia,* butterfly bush; *Genista,* dyer's greenweed; *Clethra,* summersweet; *Clerodendrum,* glorybower; *Calluna,* heather; and many others. This is an outdoor walking course held rain or shine.
**2 Thursdays, July 20, 27/ 4:00–6:00 pm (Dana Greenhouses).**
**Fee: $40, $46**

## New Staff

Irina Kadis, a graduate of Leningrad State University with a degree in plant ecology, is dividing her time at the Arboretum between greenhouse work with manager Tom Ward and assisting Putnam Fellow Kim Tripp with data collection and analysis for several ongoing experiments. In that capacity, she is also contributing to a review article on genotypic variability in woody plant

performance in managed environments, a task that involves extensive literature searches and records management. For intensive work on the genus *Alnus,* she is translating key Russian texts.

Irina brings to the Arboretum a wealth of botanical experience. In the course of her study of relationships of plants in forest environments, she has held a teaching assistantship at her alma mater and a research assistantship at the Biological Research Institute in St. Petersburg (Leningrad).