

Plant Collecting on Wudang Shan

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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 Caihang, 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.

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 ver-



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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.

tical 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 fragrancancy, growing together with *Forsythia giraladiana*, 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

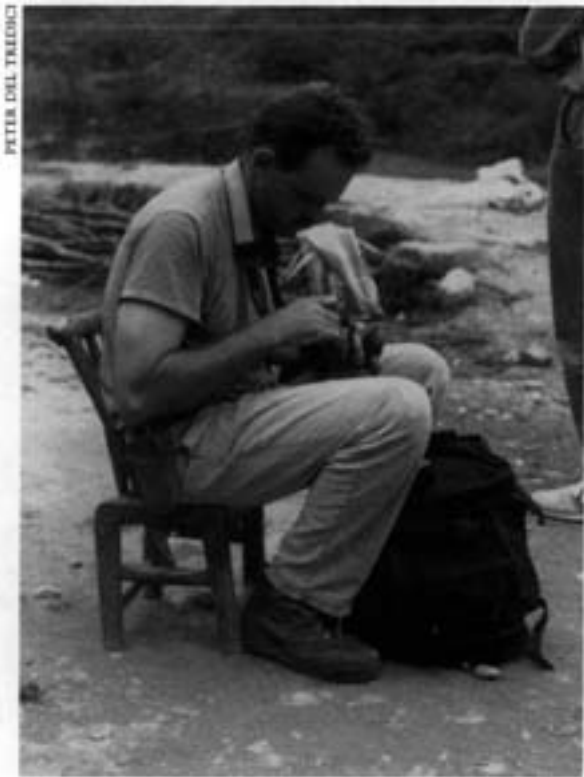
tall, and about fifteen seedlings less than 30 centimeters tall. This makes for a mixed-age population of approximately forty plants. The three largest trees were situated at the base of a steep cliff, and we nearly killed ourselves trying to reach them.

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



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

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 consanguinum* 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.

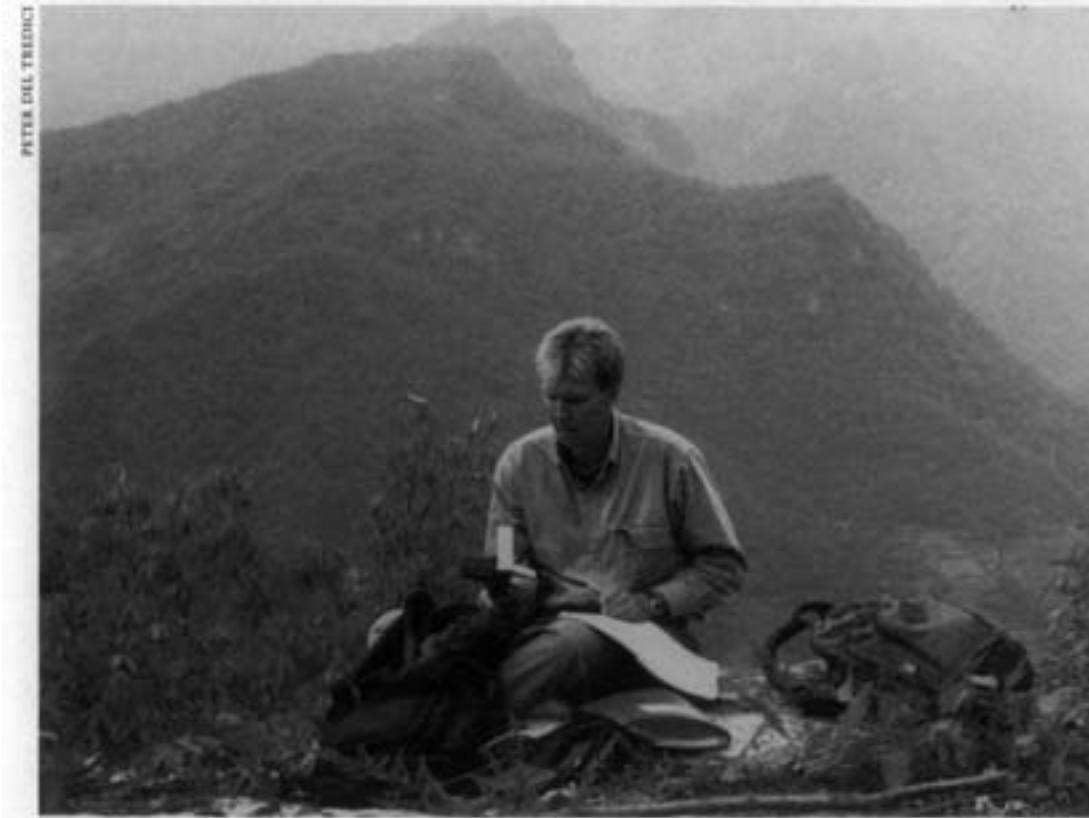
both in the family Hamamelidaceae. The former reached tree-size proportions on Wudang Shan, upwards of 10 meters, while the latter was decidedly shrubby. At lower elevations we encountered the marginally hardy but very beautiful *Loropetalum chinense*, growing up to 4 meters tall. This plant produces 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 wood-eating 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-leaved *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. Shortlived 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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