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The ARNOLD ARBORETUM of HARVARD UNIVERSITY

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Front cover: Forked viburnum (*Viburnum furcatum,* 17988*B) flowers near a wetland at the Arnold Arboretum. This accession arrived at the Arboretum in 1915, from Ernest Henry Wilson's first collecting expedition to Japan. In the background, green leaves of skunk cabbage (*Symplocarpus foetidus*) emerge from the standing water. Photo by Jonathan Damery.

Inside front cover: Ernest Henry Wilson photographed Yoshino cherries (*Prunus* × *yedoensis*) at the Imperial Botanical Garden in Tokyo, Japan, in 1914. This taxon had been named by Jinzō Matsumura—the director of the botanical garden—in 1901, based on observations of this tree, planted with other representatives of the same hybrid in the 1870s. "This species or hybrid is remarkably distinct from all other Japanese or Chinese Cherries and is one of the most floriferous and beautiful of them," Wilson wrote in *The Cherries of Japan.* "It deserves to be widely cultivated." Photo modified from Arnold Arboretum Archives.

Inside back cover: Longtime Arboretum volunteer Bob Mayer first photographed the old Yoshino cherry (*Prunus* × *yedoensis* forma *perpendens,* 22542*A) on Valley Road in the spring of 2007. He has continued to photograph the tree for more than a decade, documenting its transformations. Clockwise from upper left: 2007, 2013, 2015, and 2017. Photos by Bob Mayer.

Back cover: Peter Ashton stands beside a large dipterocarp species (*Shorea flemmichii*) within the Andulau Forest Reserve in November of 1960. Ashton referred to this diverse ecosystem as a mixed dipterocarp forest (or MDF). This is now considered the most abundant forest type within Brunei. Photo from Arnold Arboretum Archives.

Searching for Wilson's Expedition to Australia

Margaret Grose

Could diaries, newspaper clippings, and letters be hidden at the Arnold Arboretum, unexamined for almost one hundred years? Might the Arboretum possess more than two hundred glass plate negatives by famed plant collector Ernest Henry Wilson without labels for location or species? In the spring of 2016, I met Arboretum scientist Peter Del Tredici while visiting MIT, and he invited me to see the Arboretum, an invitation I accepted with relish. After a tour of the grounds, including a walk in the woods, a stop on Peters Hill, a discussion of insect attack on hemlocks, and a look at the amazing old bonsai, we found ourselves in the horticultural library. "Bet you Australians don't know that Wilson went to Australia in the 1920s," Peter said. "No one has looked at the collection. It's sitting there." He pointed, and there it was, hidden in plain sight.

When I returned to Australia, I inquired as to whether, indeed, botanists knew that Wilson, famed for botanical explorations in China, had travelled to Australia. No one did. Everyone that I spoke with was astounded. Herbaria staff did not know; botanists at my university and elsewhere did not know; even those who have a long and keen interest in the botanical exploration of the Australian continent did not know.

Wilson's expedition between 1920 and 1922 was to Commonwealth countries and no others. During my time in the United States, I have been asked, on a number of occasions, what the Commonwealth is, what countries belong to it, and what it means. The Commonwealth consists of now-independent countries that once made up the British Empire, and these countries are joined by commonalities, such as a politically independent judiciary and public service, school uniforms, and cricket, the second-most popular sport in the world after soccer. Wilson's travels took him to countries now known as Australia, New Zealand, Malaysia, Singapore, India, Sri Lanka, Kenya, Uganda, Zimbabwe, Zambia, and South Africa, before returning to England and then on to Boston.

He wrote about the horticultural aspects of this trip in various garden magazines, as well as in the first volume of his book *Plant Hunting*, published in 1927 (and reprinted decades later as *Smoke that Thunders*). The writing in the book is part tourist travelogue and part horticultural journal, with a discussion of the cultural requirements and garden potential of plants met along the route. What surprised me was how much Wilson knew about the discovery of the western coast of Australia by the Dutch in the early 1600s, sailing eastwards from Cape Town to use a faster route to the East Indies. This is a lesser-known history than that of Captain James Cook mapping the east coast of Australia in the 1770s, and it shows that Wilson was remarkably well-informed in 1920.

Two years after learning about Wilson's expedition, I returned to the Arboretum with a Sargent Award for Visiting Scholars, intent on examining the archives, images, and herbarium specimens pertaining to Wilson's time in Australia. I was fascinated by the idea of a lost collection of Australia and, like many botanists, interested in the history of plant collecting. I was also curious as to whether the images might offer a glimpse of land now lost to agriculture and suburban development, both research areas of my own. What I found in the archives was a collection in excellent order, with annotated boxes, carefully arranged glass plate negatives that had been digitized in 2018, meticulously kept diaries with their labels and individual folders in boxes, and neatly ordered newspaper clippings, letters, and ephemera of the expedition. I took photos of every box and every label. It was not evident who had established the organization of the collection, but even with the clear organization, there was little documentation to suggest what was in the letters, or what the images showed and where they were taken.

PHOTOS FROM ARNOLD ARBORETUM ARCHIVES UNLESS NOTED

In *Plant Hunting,* Wilson described eucalyptus like these massive karri (*Eucalyptus diversicolor*) as "Australia's noblest trees." Karri are considered the second-tallest flowering tree species in the world, after *E. regnans* of south-eastern Australian. Note the numerical label: Y-347.

Charles Lane-Poole—formerly unidentified in Wilson's collection of glass plate negatives—stands beside a massive eucalyptus. In a letter to the Arboretum, Wilson mentioned that, soon after arriving in Australia, Lane-Poole "became guide, philosopher & friend."

While images from India and Africa were annotated with old typewriter notes on thin white paper, the Australian images—numerically numbered and coded with the letter *Y*—were not annotated, and it was unclear just where Australia started and ended.

It became clear to me that my inquiry would require three components: The examination and transcription of diaries, letters, and notes; the annotation of the unlabelled images; and a search of the Arnold Arboretum Herbarium to see what plant specimens had been submitted there by Wilson's expedition.

Wilson arrived in the port of Fremantle, on Australia's western coast, after a tedious and hot trip by boat from Sri Lanka (then Ceylon). He was immediately struck by how Perth, the capital of Western Australia, reminded him of southern California. (There is a saying in Perth, my hometown, that we have the climate that the Californians think they have.) Southwestern Australia has, like southern California, hot summers and mild winters, and this was important to Wilson because Henry Huntington, a sponsor of the expedition, was eager to hear of plants suitable for cultivation in California. This region, today referred to botanically as the Southwest Australian Floristic Region, is known for its exceptionally high levels of floral endemism—meaning plant species that are found nowhere else in the world. Wilson was astounded by the plants he found there. "To a visitor from the Northern Hemisphere, no matter how familiar he or she may be with the forest scenery of the North, Western Australia is a new world," he wrote in *Plant Hunting.* "Nay, it might well be part of another planet so utterly different is the whole aspect of its vegetation. Intimate knowledge of the plants of the boreal regions only serves to accentuate the variance."[i]

While reading Wilson's thoughts on the Australian flora, I was struck by his observational clarity, especially after recently reading a paper on the evolutionary history of the Australian flora over the last sixty-five million years. "To what extent is the Australian flora unique?" the authors—botanists Michael Crisp and Lyn Cook—asked, perhaps asking because most Australians think it is and most foreigners agree with them. They noted that thickened foliage (sclerophylly) is not unique to Australia, nor are traits that promote water storage (xeromorphy), nor is fire as a selective genetic force unique to the continent. But nowhere else do these combined traits dominate large proportions of an entire continent.[ii]

Wilson, however, immediately noted two traits as completely unique to Australia: the angle of leaf repose and the color of the flora. "In the North our trees in general have spreading umbrageous crowns, dark, often lustrous green leaves which … cast a heavy shadow," Wilson wrote. "In Western Australia the dominant trees have open, tufted crowns, gray or glaucous green leaves which … cast little or no shadow. This difference in the color of the tree-foliage and the fact that the leaves are pendant instead of spreading on the branches may seem to the reader trivial matters, but in reality they completely change the aspect of the forests and profoundly influence the whole landscape."[iii] To have quickly put his finger on these two points is a tremendous perception. The color of the Australian flora presents a world of very different greens and grays to the Northern Hemisphere, as I have found in my own research, and Wilson appeared to have recorded them all.

The unique flora of Australia made it relatively easy for me to tease out Australian images from the others. I also began to identify the unnamed individuals in the photographs. One man, who recurred in multiple photographs, was distinctive due to a hook in place of his left hand. I emailed Australian colleagues about a botanist matching this description (which I thought would have been easy), but I met a blank. Eventually, I came across a biographical entry about Charles Lane-Poole, the conservator of forests in Western Australia from 1916 to 1922, which mentioned that his left hand had been lost in a shooting accident when he was nineteen (all other biographical sketches politely did not mention this). I had my man.

I later came across Wilson's comment that he had travelled two thousand miles with Lane-Poole "through all the important forest areas." Elsewhere, in "the sand plains and savannah regions," he was guided by Desmond Herbert,

the Western Australian government botanist, who was also shown in images. Wilson noted that, without such expert guides, "I should have been completely lost among the extraordinary varied and anomalous vegetation." These men were top in their field and their companionship and assistance shows the esteem in which Wilson and the Arnold Arboretum were held. The images, however, revealed an oddity—all that I could readily identify were from the beginning of his trip in Western Australia.

With limited time, I set to work, realizing that diaries could be transcribed, letters read, and images annotated in Australia. Thus, I headed to the Harvard University Herbaria, where the Arboretum Arboretum's wild-collected herbarium specimens are housed, because I recognized that those materials could not be examined later. While Wilson's notebooks and photographs would provide some sense of his route across the continent, the specimens in the herbarium would provide more detailed information about where and when Wilson travelled, what he was collecting, and the identities of other botanists who collected on behalf of the Arboretum.

At the Harvard University Herbaria on Divinity Avenue, I was given pencils, little paper envelopes for broken off bits of specimens, and clear plastic clips to replace rusty metal clips from one hundred years ago. The collection is contained within rolling cabinets, called compactors, and I was presented with a written directive that "compactors can be opened by releasing the locking bar and smoothly rotating the handle of the appropriate bay." The instructions also suggested to "move one row at a time to prevent strain on the system," although I was not sure whether that was referring to the compactors or to me. Lists of plant families hung on the walls, indicating where the families were housed in the building's several floors and annex rooms. "Where would you like to start?" Anthony Brach of the herbaria's curatorial team asked me. I looked about wide-eyed. Well, why not Myrtaceae? I ventured, and Anthony chuckled. I had chosen "the big one"—the family of the eucalypts.

Eucalyptus is a major genus in Australia and is rare in the world in that this single genus virtually defines an entire continent. There are now over eight hundred species (the number always rising), and this usually surprises overseas visitors to Australia, who often think that there are only a few "gum trees." The eucalypts include the world's tallest flowering plant, *E. regnans,* known as the mountain ash, which reaches heights of 295 feet (90 meters). Timber records in the nineteenth century reported that trees logged then had reached far greater heights—up to 490 feet (150 meters). This loss underscores one of the reasons Wilson was keen to see the Australian forests.

Eucalypts, however, are not all tall; some are small and gnarled; many are low shrubs and suitable for home gardens; some have brilliant flowers; some have dusky gray leaves that are suitable for the flower trade; some possess huge bud caps that gave the genus its name—*eu* (well) and *kalyptos* (covered); some are small and gnarled; some are single-trunked; others have a *mallee* form, an Aboriginal term referring to plants with multiple trunks that emerge from underground lignotubers. Most live in mixed woodlands. Wilson was captivated by their variety and the colors and forms of trunks. He noted, for example, that the salmon gum (*Eucalyptus salmonophloia*) "is a handsome tree, with a smooth white to pinkish trunk … the twigs are reddish" and that the gimlet (*E. salubris*) is "fluted and twisted like a screw—hence the name gimlet."[iv] In photographs, he recorded fire-scarred trees, and he was clearly impressed by the extraordinary capacity of most eucalypt species to resprout after fire.

During the next few weeks, I extracted hundreds of specimens from the expedition across a large range of families and genera, all from blue folders that indicated the specimens came from Australia. These were easy to spot among swathes of green, orange, pale orange, yellow, pale yellow, beige, white, off white, and ranges of pinks and reds. In short, if a folder was blue, I knew it was mine to take out and examine. How curious and exciting it was to search through the blue folders and find labels with Wilson's name and handwriting. "Near a salt-lake," he noted on one. "In a group of trees," he wrote on others. He described a now-rare little shrub (*Daviesia euphorbioides*) as a "centipede bush" and called a large shrub (*Banksia sessilis*)

SPECIMENS FROM HARVARD UNIVERSITY HERBARIA

Herbarium specimens provided historical evidence about Wilson's travels through southwestern Australia. Clockwise from top left: *Hakea platysperma,* a small shrub, collected on the sandplain at Yoting on October 25, 1920. *Casuarina fraseriana* (now *Allocasuarina fraseriana*) collected at Albany, on the southern coast, on November 6. *Eucalyptus ficifolia* (now *Corymbia ficifolia*) collected from the Frankland River region in November (day unspecified). *Eucalyptus flocktoniae* collected near Widgiemooltha in November (day unspecified).

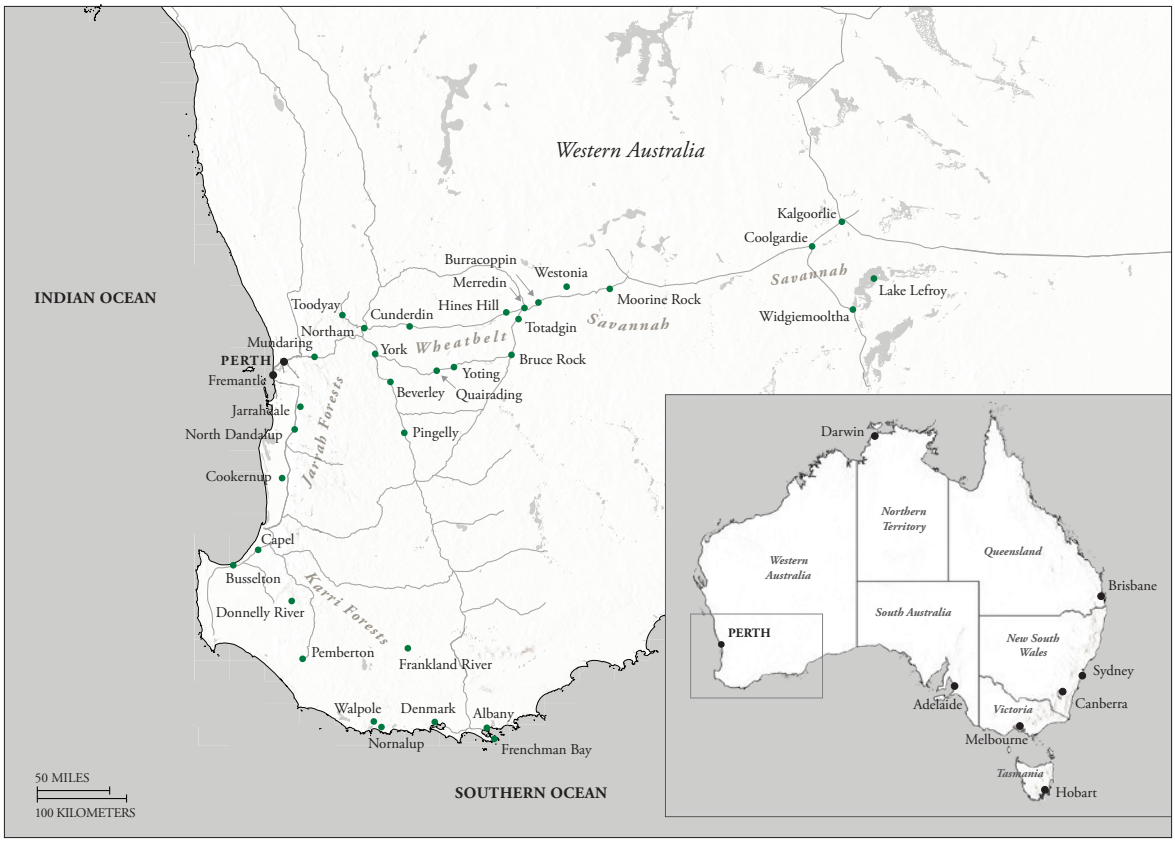
SPECIMENS FROM HARVARD UNIVERSITY HERBARIA

Diverse members of Proteaceae include: *Banksia grandis* (left) collected October 25, 1920, in the Darling Scarp, east of Perth. Wilson noted the yellow flowers—produced in a large cone-shaped structures—were collected from a small tree, about 15 feet (4.5 meters) tall. *Hakea multilineata* (right) collected 20 miles (32 kilometres) south of the once-thriving gold-mining town of Coolgardie, now a near ghost town.

"parrot bush." Many labels included collection numbers that related to the diaries.

From the images, I knew that Wilson and his travel companions appeared to have gone by horse, train, and a roofless Model T Ford. They travelled south of Perth through wetlands near Busselton, into the Darling Scarp—the hills east of Perth—to collect in the jarrah (*Eucalyptus marginata*) forest. They continued south to the tall karri (*E. diversicolor*) forests, east through heavily cleared land of wheat and sheep fields, and still farther east into semi-arid country. Labels in the herbarium revealed place names: Yoting, Burracoppin, Merredin, Toodyay, Widgiemooltha, Quairading, Coolgardie, and Kalgoorlie. Many of these are indigenous names given to country towns or settlements that in 1920 and 1921 were gold-mining camps. At one such now-tiny outpost, Westonia, Wilson noted in his diary on October 22, 1920, that "Saturday night in a mining camp is not a quiet place. Singing and chat extended far into the night." Looking at the labels in the herbarium, I was amazed to see where Wilson went—to places remote enough now, let alone then. A whole suite of specimens was collected "20 miles south of Coolgardie," in hot and dusty conditions, but Wilson enthused over the "astonishing" variety of species. In his diary, he wrote, "they are mostly prickly in character and many of them especially so."[v]

Reviewing the specimens belonging to the Proteaceae was a treat for me because my doctoral dissertation had been on the ecophysiology of *Banksia,* which is the most well-loved member of the family in Australia. As I opened the compactors, I could see the banksias in their blue folders, and I laughed—they were large,



Locations recorded on Wilson's herbarium specimens and in notebooks revealed extensive collections throughout southwestern Australia, from the towering karri (*Eucalyptus diversicolor*) forests, south of Perth, to the semi-desert forests farther east. Contemporary train lines are shown in gray. The Trans-Australian Railway, completed in 1917, connected Kalgoorlie with eastern cities.

chunky folders. Banksia flowers grow in hairy cone-shaped inflorescences, which measure up to seventeen inches long. Some of the cones—the flower heads or remaining fruiting bodies—were stored elsewhere, in boxes, due to their size, and Anthony Brach got them out for me. These attracted comment from passing taxonomists in the herbarium, but I pitied that they could not see them on the trees instead of these dead, dry relics. One even commented: "How wonderful to work on these. Some people," she shuddered, "have to work on grasses!"

Wilson collected various banksia species near Perth and inland, and many of his images are of banksia trees. As I pulled out specimens, I mused as to what Wilson must have thought about when he looked at the banksias, with their wire-tough thick leaves, erect demeanour, and vibrantly colored inflorescences, usually buzzing with insects and birds with tongues and beaks evolved to suck nectar from these exact trees. In *Plant Hunting,* he described the genus as "among the most wonderful flowering trees of Australia." He described the large pale lemon and yellow flowers of *Banksia grandis,* with cones measuring up to eight inches long, and he noted elsewhere that the species should be grown in California.

Beyond the visual appeal, many contemporary botanists were intrigued by the banksias—which are particularly prominent in southwestern Australia—because these were clearly related to the striking diversity of *Protea* from South Africa. Our contemporary understanding of continental drift was first proposed by the German scientist Alfred Wegener in 1912, and we now know that Antarctica, Australia, South America, Africa, India, and

***Kingia australis*—slow-growing and long-lived monocots—fascinated Wilson. He called them "weird and extraordinary" and suggested, in *Plant Hunting*, that "the scene would be more complete if … a Nothotherium, a Dinosaurus, a Plesiosaurus or some other monster of the remote Lizard Age" were present.**

New Zealand were once joined in the supercontinent Gondwana and shared flora. Proteaceae is one of the oldest families in the Southern Hemisphere and once was found across Gondwana, right across what is now Antarctica. Fifty-million-year-old fossils have been found in Patagonia and New Zealand that even an untrained eye would easily recognize as lovely banksias. But alas, as Wilson knew, none of these living beauties would grow in Boston's climate for the Arboretum.

As my notes from the herbarium accumulated, I soon realized that, as with the photographs, the specimens were almost entirely collected in Western Australia. This was odd, as Wilson's diaries revealed that he had travelled by train across Australia after leaving Perth, and had visited Adelaide, Melbourne, and Sydney, where he spent Christmas in 1920. He then went into the New South Wales heartland, north into Queensland, and then eventually to Tasmania in April 1921, after a sojourn in New Zealand. The diaries said little but did give the names of plants collected, with collection numbers. Yet, while I came across the odd specimen from Queensland and Tasmania, I found none collected by Wilson from New South Wales or Victoria. This was a mystery. At the end of each day in the herbarium, which closes precisely at five o'clock, I would close the compactors, pull down the bar, and turn off the light, as directed.

Wilson returned to the Arnold Arboretum in 1922, after visiting India and various Commonwealth countries in southern Africa, which were recorded in his images. But what had happened to the herbarium specimens and images from a major part of his Australian tour? One day, in the middle of my stay, I turned to materials in the archives, to see if I could shed some light on the mystery of the missing Australians. The key was in a box of newspaper reports. An article described Wilson's "great disappointment" at losing much of the collection because the boat carrying two large consignments of photographic plates and specimens was lost at sea. The ever-helpful Lane-Poole had earlier shipped the entire Western Australian collection, which arrived safely in Boston. Sargent's response is not known. He had considered a study of Tasmanian conifers "one of the most important objects of the expedition,"[vi] but those collections were all gone. Other questions were answered: printed black-and-white images from Tasmania were sent by the noted Hobart photographer John Beattie after the loss of Wilson's collection, and unlabelled lantern slides, sent to Wilson, all depict New Zealand in a travelogue style.

One of the many delights of my own expedition into the 1920s expedition was the people I met along the way who still enliven the images and specimen sheets. Many of the herbarium specimens had been reassigned by David Moresby Moore, a British plant taxonomist and systematic botanist with a major interest in the flora of Gondwana, Patagonia, and the Antarctic and sub-Antarctic islands. His work amid the Australian collection at Harvard in the 1960s made my job far easier, because the plants were correctly assigned and thus correctly catalogued. "DM Moore"—his appellation on the bright white labels near Wilson's originals—was a welcome sight.

Other collectors assisted the Arnold Arboretum and donated specimens from Western Australia, South Australia, and Queensland as part of the Expedition. Most important were those submitted by Frederick Schock ("F.M.C Schock" on the labels), who was a forest ranger in Western Australia. Schock's specimens were largely collected in 1916, but they were sent to Harvard after Wilson returned and were labelled "Arnold Arboretum Expedition to Australasia, India, and Africa." Many included flower parts that had not been seen by Wilson during his summer visit, because many of these species, typical of southern Australia, do not flower in summer.

With the addition of these donated specimens, one of the missions of the expedition began to become apparent to me: to add to the global collection of specimens and images held at the Arnold Arboretum. The Arnold Arboretum celebrated its fiftieth anniversary in 1922, and Charles Sprague Sargent, the founding director, laid out this global vision in a report on the Arboretum. "If the Arboretum is to become

Wilson stands within a jarrah (*Eucalyptus marginata*) forest, in the Darling Scarp, east of Perth. The trees beside him have been scarred by fire.

a great institution for gathering and spreading information about trees and allied plants, specimens and a series of photographs of every species of tree in the world should be found in the herbarium," Sargent wrote. His ambition was that the work already achieved "should be extended over the rest of the world." [vii]

Given Sargent's desire to develop global collections of photographs and herbarium specimens, it made sense that additional Australian specimens would be requested from Schock and others, to fill gaps within Wilson's collection. While the Arnold Arboretum could only grow plants that suited Boston's cold winters and humid summers, Wilson's expedition to Commonwealth countries revealed the equal importance of the herbarium and archives for institutional collecting goals. I had noted, in the herbarium, hundreds of specimens from Australia that were not from trees and that were of botanical interest, rather than of forestry value, reflecting Sargent's desire for a comprehensive collection.

I was also struck by letters of thanks from Sargent regarding the donation of pamphlets and books on specific aspects of the world's flora, as well as the contribution of physical specimens (including cones and seeds), sent from the countries visited on Wilson's expedition, even though these would not grow in Boston. With these materials, the various missions of the expedition to Australia became even more apparent. In addition to collecting images and specimens, Wilson was to make connections between the Arboretum and the staff of other international botanical institu-

tions, while investigating potential timber trees for production in the United States and assessing firsthand the state of forests in the world. Wilson achieved all these goals despite the loss of much of the physical collection.

Wilson's travelling companions in Western Australia were highly informed and are now famous men in Australian botany. I wondered what they talked about, especially given Lane-Poole's desperate unhappiness with the lack of forest protection in Australia, and Wilson's diary comments about the ruthless destruction of woodlands for agriculture in Australia.[viii] Only a few months after Wilson's visit, Lane-Poole resigned, in 1922, as the conservator of forests because the government did not appear interested in conservation but was solely concerned with timber extraction. Letters between Wilson and Sargent show that the whole idea of forest protection was of great importance to the expedition because they both saw that forests were under threat across the world. This suggested to me that the conservation movement was more alive in the 1920s than many of us fully appreciate today.

Wilson, Sargent, and Lane-Poole all saw that the world's forests were in danger of overexploitation and habitat loss, and both Wilson and Lane-Poole named the loss of large old trees as of greatest concern in Western Australia. Yet one hundred years later, botanists and conservationists are still raising this issue because it needs to be raised—surely something that would have saddened these men. The great banksia woodlands surrounding Perth have been substantially lost due to suburban development, and the woodlands east of the Darling Scarp, where Wilson noted an abundance of "curious," "wondrous," and "extraordinary" plants, continued to be clear-cut for agriculture into the 1980s. Today, ecological agriculture and ecosystem repair are imperatives for the future.

With my time at Harvard running out, I had to cease work at the herbarium and say my goodbyes at the Hunnewell Building and the Weld Hill laboratories, where I had my office. And I had found that the answers to my search for the Arnold Arboretum's Expedition into Australia's spectacular flora lay not simply in one place. As Sargent noted, the arboretum is a three-part collection, with a living museum, an herbarium, and a library.[ix] I had needed all of the resources and staff of the arboretum to begin to understand this last great journey that Wilson undertook.

Acknowledgements

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Déjà Vu Viburnums: A World Away but Close to Home

Anthony S. Aiello and Michael S. Dosmann

It is a truth universally acknowledged that closely related plants occur in widely varying locations around the globe, yet going from a truth universally acknowledged to a truth personally observed is a profoundly gratifying process. In September 2018, along Lake Yuno, within Japan's Nikko National Park, we collected fruits of the forked viburnum (*Viburnum furcatum*). The fleshy drupes were reddish-orange, although a number had already turned blackish and were mushy to the touch. We reached them by standing on tiptoes in the muck, and pole pruners came in handy for those higher up. When not browsed by deer, the shrubs stood up to ten feet tall and sometimes just as wide, the sprawling branches positioning the round, saucer-sized leaves like open hands to capture light in the shady understory of maples and conifers. While this species is native to eastern Asia, we could have fooled ourselves into thinking we were standing in front of the hobblebush (*V. lantanoides*) of eastern North America, given the striking similarities between the two species' appearance, habitat, and associated genera.

It was already a great morning collecting, and not far away, deciduous azaleas (*Rhododendron wadanum*) and hollies (*Ilex geniculata*) grew near the shoreline of the mountain lake, as did the occasional clethra (*Clethra barbinervis*). Higher up on the ridges, large beech (*Fagus crenata*) and hemlock (*Tsuga diversifolia*) filled the overstory. Because these genera also occur in eastern North American forests, we could have sworn we had already experienced this collecting day before, a hemisphere away. While we have long understood the profound concept of biogeographical disjunctions, it has taken compounded years of plant exploration for us—as colleagues at sister institution that share a long history of cooperation and collection goals—to personally observe these connections in far reaching places.

Our collaborative expedition to Honshu, Japan, also included Steve Schneider from the Arnold Arboretum, Todd Rounsaville from the Polly Hill Arboretum, and Mineaki Aizawa and Tatsuhiko Shibano from Utsunomiya University. During our two-week trip, we visited six locations and made fifty-eight collections of fifty-five different taxa. Like the viburnum, half of the genera we collected co-occur in eastern Asia and North America, creating even more moments of *déjà vu*.

Botanical Kin

At Lake Yuno, most of the forked viburnum's wide, rounded leaves had heavy insect herbivory, giving it the Japanese common name of *mashikari* (always eaten by insects), yet the habit and leaf shape instantly reminded us not only of the American hobblebush but another eastern Asian species, *Viburnum sympodiale*. The genus *Viburnum* (Adoxaceae) has a wide geographic range, with approximately 165 species occurring across the Northern Hemisphere and dipping into South America and Southeast Asia. Botanists have organized these species into sub-generic groups or clades, based on how closely related these are to one another. These three viburnums occupy the *Pseudotinus* clade, which also includes a fourth species, *V. nervosum* (also from eastern Asia). The four share a distinctive branching architecture, which Erika Edwards and colleagues have dubbed the "furcatum pattern" (drawing on work Michael Donoghue published in *Arnoldia* in 1981). The branches grow horizontally with the ground (known as plagiotropism) until the end of the season when one of the terminal buds turns upwards to produce a short, reproductive shoot. The next spring, the main, horizontal growth continues from the other terminal bud, creating a sympodial growth pattern, where one of two forked branches becomes dominant. This branching structure is acknowledged in the specific epithet of *V. sympodiale*.

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On a 2018 expedition to Japan, the authors and colleagues collected fruits of *Viburnum furcatum* near Lake Yuno (bottom left). Insects had devoured the leaves (top), yet the resemblance to the North American species *V. lantanoides* (bottom right) was unmistakable. These disjunct species are two of four representatives of the *Pseudotinus* viburnums.

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JONATHAN DAMERY

Unlike the other *Pseudotinus* viburnums, *Viburnum nervosum* (left) lacks the ring of sterile flowers around the margin of each inflorescence, although the individual flowers are larger. *V. lantanoides* (right) shows a more characteristic structure.

Although there are no European representatives, this quartet is a fascinating case study of the history of botanical description and horticultural introduction. The description of these four species follows a familiar arc from the initial exploration and cultivation of North American natives in the late eighteenth century, followed by the introduction and study of Chinese and Japanese species through the early twentieth century, and it coincided with an increasingly refined understanding of biogeography and the eventual explanation of lookalike species that are spaced a world away from one another.

The native range for *Viburnum lantanoides* stretches between Canada's Maritime Islands and northern Georgia. This species—the first of the *Pseudotinus* to be attributed a scientific name—was described as *V. alnifolium* by Humphrey Marshall, a cousin of botanists John and William Bartram, in an alphabetical catalogue of plants growing in the eastern United States. Marshall's publication in 1785 described the leaves as "heart-shaped, oval, sharp-pointed, deeply sawed on their edges, strongly veined, and placed opposite upon long slender footstalks," but the most telltale characteristic was the halo of sterile flowers encircling each inflorescence—a feature also shared with *V. furcatum* and *V. sympodiale.*

At first, this portrayal seems unmistakable, but as it turns out, Marshall's description was not of the hobblebush viburnum. Marshall based his description upon an earlier one (by British botanist Philip Miller in 1768), which was confused, in part, with smooth hydrangea (*Hydrangea arborescens*) given the shared floral characteristics and large leaves that are arranged opposite one another along the stem. Almost twenty years after Marshall's publication, André Michaux proposed the alternative name, *Viburnum lantanoides,* which is now

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JONATHAN DAMERY

While botanists have long considered *Viburnum furcatum* and *V. lantanoides* to be closely paired within the four *Pseudotinus*, recent analyses have shown that *Viburnum sympodiale* (left) and *V. furcatum* (right) are more closely allied.

widely accepted. (For further background reading on the confusion between the two names, see Ferguson, 1966, and Mackenzie, 1927.)

In some sense, it's surprising that such a widespread shrub would have escaped the attention of earlier botanists. After all, one of the shrub's characteristic qualities is its ability to lay branches and root, creating bulky masses of foot-catching vegetation that give the species its common name: hobblebush. When describing the species' habitat, phrases like "damp woods," "moist woods," "cool moist woods," "rocky woods," "deep woods," "swampy woods," and other combinations thereof leap off the labels of most specimens at the Harvard University Herbaria, and when it comes to describing the shrubs themselves, another word dominates: "thickets."

Even now, however, the species is scarce in the nursery trade and often slips under the horticultural radar. We first jointly encountered the species near its southernmost range edge in May of 2002, while hiking along the Blue Ridge Parkway in Transylvania County, North Carolina. On either side of the path, the shrubs bore large and roughly heart-shaped leaves that stuck out at wide angles to catch the light. Just two years before, and not far away, Tony had first seen and collected the species in very similar habitats at Nantahala National Forest in North Carolina and near Clingman's Dome in the Great Smoky Mountains National Park.

Disjunct Discoveries

The next *Pseudotinus* species to enter the botanical literature was *Viburnum nervosum*—the most basal of the four species. While we often think that the earliest Western botanical explorations to Asia occurred in Japan and coastal China, the European presence in India meant that trans-Himalayan species were often described earlier in the nineteenth century,

before their eastern counterparts. In 1825, forty years after Marshall's putative description of the hobblebush, David Don, the librarian for the Linnaean Society, described *V. nervosum*, based on collections made by Nathaniel Wallich and Francis Hamilton in Nepal.

Neither of us has encountered *Viburnum nervosum* in the wild, but this species occurs at exceptionally high altitudes and is common in open, boggy habitats at (or even above) the tree line in Sichuan, Xizang, and Yunnan Provinces of China, as well as in Bhutan, India, Myanmar, Nepal, and North Vietnam. The *Flora of China* notes that it can grow up to 14,700 feet (4,500 meters) above sea level. Unlike the other three *Pseudotinus* species, *V. nervosum* does not produce the distinctive halo of sterile flowers around each inflorescence; instead, the fertile flowers within each inflorescence are larger. Showy fertile flowers are an alternative to showy marginal flowers for attracting pollinators, according to Brian Park and colleagues.

The Japanese species that we observed at Lake Yuno—*Viburnum furcatum*—was next to be described. Japan was predominantly closed to Europeans and Americans until 1868, the year of the Meiji Revolution, but in 1858, the German botanist Carl Ludwig Blume obtained an herbarium specimen of a Japanese viburnum and labelled it with this name. The species would not be properly described, by Carl Johann Maximowicz, for another two decades. Nonetheless, in 1859, Harvard botanist Asa Gray noted the presence of a Japanese viburnum that he suspected was the same or a closely related species as *V. lantanoides,* based on herbarium specimens collected by Charles Wright, botanist on the United States North Pacific Explor-

ARNOLD ARBORETUM ARCHIVES

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In 1914, Ernest Henry Wilson photographed *Viburnum furcatum* growing on a woodland edge in the Yumoto region of Japan, near the location where the authors also observed the species. Among the *Pseudotinus*, *V. nervosum* (right) has the most atypical habitat preferences—shown within a montane bamboo and heath scrub at more than 10,000 feet (3,200 meters) elevation in Yunnan, China (notice the broader leaves, tucked in the center of the frame).

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Branching structure is a defining characteristic for the *Pseudotinus* viburnums. Here, *Viburnum sympodiale*—photographed in Hunan, China—shows how the branches fork, with one side continuing the dominant horizontal growth and the other turning upwards to produce flowers and fruit.

ing Expedition between 1853 and 1856. This and other early specimens, initially referred to as *V. plicatum* (and occasionally *V. tomentosum*), supported Gray's theories of disjunction of species, particularly between the eastern United States and eastern Asia.

Gray concludes his momentous essay, published in 1859, with a provocative summation: "Under the light which these geological considerations throw upon the question, I cannot resist the conclusion, that the extant vegetable kingdom has a long and eventful history, and that the explanation of apparent anomalies in the geographical distribution of species may be found in the various and prolonged climatic or other physical vicissitudes to which they have been subject in earlier times."

Gray recognized that the occurrence of distant doppelgängers like these North American and Japanese viburnums could only be explained through change on a geologic timescale. This argument would gain substantial theoretical weight with the publication, in 1860, of *On the Origin of Species,* written by Gray's friend and scientific correspondent Charles Darwin. It is noteworthy, therefore, to see this group of *Pseudotinus* viburnums—or even just the paired Japanese and North American species—along this timeline of scientific breakthroughs. As botanists like Gray began to work with a greater volume of herbarium specimens from Asia, an evolutionary and geologic story began to emerge. Global exploration and paradigm-changing scientific discovery necessarily moved in tandem.

The final viburnum in the quartet—*Viburnum sympodiale*—was described by Paul Graebner in Ludwig Diels' epic *Die Flora von Central-China,* published in 1901. Graebner named this species using herbarium specimens

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Along with ornamental flowers and fruit, the *Pseudotinus* viburnums produce exceptional fall color. On a 2005 expedition in China, Tony observed *Viburnum sympodiale* (top) with red fall color. And in the Adirondacks, in 2008, Michael observed a striking mix of colors on *V. lantanoides* (both bottom).

collected by Augustin Henry and Arthur von Rosthorn, and he noted how its forked (or sympodial) branching structure resembled that of *V. furcatum*. Ernest Henry Wilson observed *V. sympodiale* during his initial trip to China (between 1899 and 1902), while working for Veitch Nursery, as well as later while working for the Arnold Arboretum, and he noted in his collection notebooks that the species was "very rare!" This characterization stands in stark contrast to his observations of the common Japanese species.

Hobbled Horticulture

No matter the botanical interest of these species, it was another thing to bring them into more widespread cultivation. In 1889, Charles Sprague Sargent, the founding director of the Arnold Arboretum, wrote a short article about *Viburnum lantanoides* for *Garden and Forest*. He praised the species as "one of the most beautiful plants of our flora," yet he noted that the hobblebush was "impatient of cultivation" and "the most difficult of all our native shrubs to cultivate." At the Arnold Arboretum, only two early hobblebush accessions achieved long-term success. Both arrived as plants and perished in the mid-twentieth century. Repeated attempts to cultivate the species since then—via seeds as well as layers from the wild—have been in vain until recently. Seeds refused to germinate, and the plants rarely lived beyond a few years after planting out. However, several plants collected in the Adirondacks in 2008 have survived near a swampy spot adjacent the North Woods, known for a planting of corkwood (*Leitneria floridana*)—the same location where one of the two earlier successes had grown.

The other three species have been equally slow to enter North American gardens. Sargent collected seeds of *Viburnum furcatum* from Japan in 1892, yet no records of successful germination (or planting) exist. It was not until early 1915 that two collections from Ernest Henry Wilson in northern Honshu made their way to the Arnold Arboretum. One collection originated as plants, the other as seeds, and the resulting accessions (numbers 17988 and 17989, respectively) were also sited near the *Leitneria*. The year those accessions arrived, Sargent noted that the species was "as handsome a plant as the American species, and will probably prove equally difficult to manage." However, the seed-derived accession survived until 1997, occasionally dying to the ground and sending up suckers. The other accession (containing three plants) has persisted in the location for a century, putting on dramatic floral displays typically in late April to early May. Another seed-derived accession arrived in 1998.

Perhaps because this species takes more readily to various propagation techniques, *Viburnum furcatum* seems to be the most widely cultivated of the four species, showing up in some forty-three public gardens in fourteen different countries according to Botanic Garden Conservation International's PlantSearch database. The American species is growing in twenty-seven gardens in ten countries, while *V. nervosum* and *V. sympodiale* are growing in only eleven and nine gardens, respectively. These numbers, while likely accurate in the ranking of each species' popularity (or amenability to cultivation), are likely underestimates, for the database requires individual gardens to self-report what they are growing. For instance, no gardens in Japan are noted as cultivating *V. furcatum*, and they likely are.

The Morris Arboretum has two specimens of *Viburnum nervosum*, which were acquired as cuttings from a specialist nursery in 2010. The Arnold Arboretum has only attempted to cultivate the species twice—two seed collections in the early 2000s—and, in both cases, the seeds failed to germinate. Wilson had made several herbarium collections of *V. nervosum* (as *V. cordifolium*) in western Sichuan, where he observed it was "common" and formed "thickets." Joseph Rock also collected the species in high plateaus of Yunnan and noted it growing as both a shrub and even a tree up to twenty-five feet in height. Yet, the earliest record of the plant's introduction to North America seems to be a 1927 accession donated to the United States Department of Agriculture by the Lloyd Botanic Garden in Darjiling, India.

As for the final species, Tony encountered *Viburnum sympodiale* in September 2005,

while collecting in Gansu Province, China. Although there were no fruits, he and the other explorers gathered leaf tissue and herbarium specimens for future molecular work, and long-term preservation, respectively. This experience caused another *déjà vu* moment all over again, and the field notes for the collection (NACPEC05-033) acknowledge "this species is very reminiscent of *Viburnum furcatum* or *V. lantanoides*." The team found it in a mesic, mixed deciduous and coniferous forest—much like the habitats preferred by the Japanese and American species—replete with three maple species and a hemlock (*Tsuga chinensis*), as well as littleleaf boxwood (*Buxus sinica*), rosy dipelta (*Dipelta floribunda*), *Rosa davidii,* and katsura (*Cercidiphyllum japonicum*). Despite four attempts, the Arnold Arboretum has only had this species in cultivation once: cuttings from the Royal Botanic Garden, Edinburgh, which rooted and survived on the grounds for eight years. Three seed acquisitions were never successful.

Disjunct Reunions

If the early work of plant explorers enabled discoveries pertaining to biogeography, like Gray's initial articulation of disjunct species, then the slow acquisition of other disjunct species (including *Viburnum nervosum* and *V. sympodiale*) makes us wonder what breakthroughs current and future plant exploration will enable. Aside from *Viburnum furcatum,* our expedition to Japan yielded a number of other collections of species that have familiar North American relatives. Among the most exciting was a collection of *Stewartia:* another genus with members that only occur in eastern North

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Like both the North American and Japanese *Pseudotinus, Viburnum sympodiale* grows in moist woodlands. Here it flowers within a roadside forest in Hunan, China. The young secondary forest included an overstory of pines (*Pinus*), along with planted larches (*Larix*).

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While in Japan, the authors and collaborators collected fifty-five unique species. Half of the genera, like *Viburnum,* co-occur in eastern Asia and eastern North America. At left, collaborators Tatsuhiko Shibano and Mineaki Aizawa (left and right) scan the canopy of a steeply sloped forest at the University of Tokyo Forestry Department Research Station, searching for fruits of *Stewartia pseudocamellia.* The striking bark of this species is show at right.

America and eastern Asia. At the University of Tokyo Forestry Department Research Station, in Chichibu, west of Tokyo, we encountered a population of Japanese stewartia (*S. pseudocamellia*) perched on a steep hillside, the trunks elongated, stretching for light among an overstory of impressive beeches (*Fagus japonica*). This stewartia, known for its exfoliating bark, large white flowers, and rich autumn leaf colors, is among the most ornamental plants that have come to our gardens from Japan. We were excited to make this collection because, despite its common name, our collecting companion Todd Rounsaville confirmed that the only documented, wild collections of Japanese stewartia in the United States are of Korean origin. Our collection represents an infusion of novel Asian material into cultivation.

We also collected a second species of *Stewartia* at the last location of the expedition, the Hokkaido University Forestry Station in Wakayama Prefecture on the Kii Peninsula, the southernmost tip of Honshu. This mountainous region is among the wettest areas of Japan, receiving upwards of 118 inches (300 centimeters) of annual precipitation, which we experienced during a continuous downpour—one of the wettest collecting days of our collective careers. We made collections of *Stewartia monadelpha,* aptly named the tall stewartia, which grew to about 40 feet (12 meters) tall, with trunk diameters of nearly 18 inches (45 centimeters)—showcasing the slick, orange-red bark.

Of course, we made other collections of disjuncts on the trip, including green- or snake-barked maples (*Acer micranthum* and *A.*

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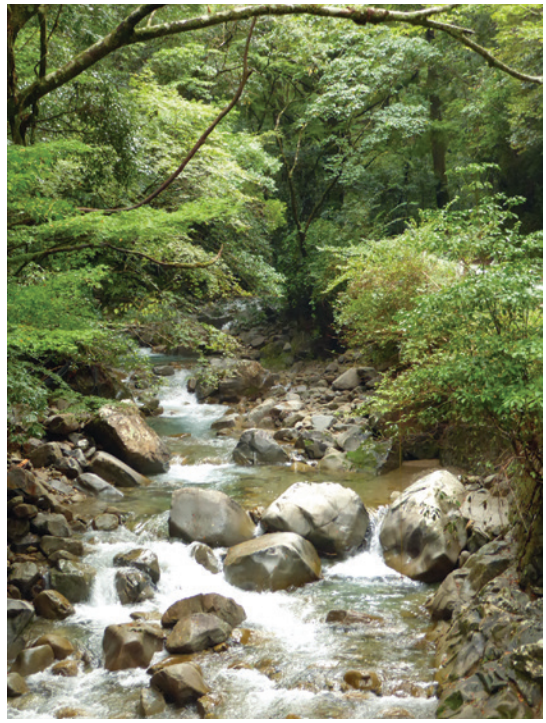

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In addition to collections of familiar genera such as *Viburnum* and *Stewartia,* the expedition yielded unusual species including wheel tree (*Trochodendron aralioides*), which have no disjunct counterparts. At top, Michael holds a specimen of *Trochodendron,* which collaborators Tatsuhiko Shibano and Mineaki Aizawa (left and right, bottom left) collected from a towering specimen along one of the many mountain torrents charged with the recent rains.

tschonoskii) that are within the same section or clade as our familiar North American moosewood (*A. pensylvanicum*). We also couldn't help but notice the genera without disjunct representatives. On the rain-soaked day in Wakayama, we collected three species of *Enkianthus* (*E. cernuus* f. *rubens, E. nudipes,* and *E. sikokianus*), a genus in the heath family (Ericaceae), which is represented by six species in Japan, seven in China, but none in North America. It was remarkable to see three distinct species growing together on one mountainside. Earlier on the trip, we collected *E. campanulatus* and *E. subsessilis,* bringing our total to five of the six Japanese species. We also made two horticulturally and botanically interesting collections at Wakayama: wheel tree (*Trochodendron aralioides*) and Japanese umbrella pine (*Sciadopitys verticillata*), which both have a peculiar taxonomic standing. Wheel tree has only one other member in its family and order (Trochodendraceae and Trochodendrales, respectively), and the umbrella pine is the lone representative of its family (Sciadopityaceae).

Importantly, through collection we've brought these species—long-lost cousins (as well as evolutionary orphans)—together in common gardens, as living plants, to observe them in cultivation. And like our pursuit of these four déjà vu viburnums, the work as plant explorers continues. Gray used collections of herbarium specimens as inspiration to make daring hypotheses about biogeography. In that same vein, as plant explorers and curators we build collections to inspire future scientists to make new discoveries using not herbarium specimens and DNA samples (important as they may be) but living organisms. It is a long-game we play, however, for a century after the last species in the quartet was described, it has nearly evaded our cultivation. But, with dogged determination, hopefully we (or our successors) will achieve the perfect ensemble: a full quartet growing and performing together for audiences to enjoy and to study.

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ASHTON, P. 2019. IN BORNEAN RAINFORESTS: EXPLORING THE FLORA. *ARNOLDIA*, 76(4): 26–39

In Bornean Rainforests: Exploring the Flora

Peter Ashton

At twenty-three years old, I found myself on an open-aired launch, motoring from the island of Labuan, off the northern shore of Borneo, and entering the humid mouth of the Brunei River. The riverine settlements near Bandar Brunei, the capital, sprawled before me. Houses and other structures rose on stilts, interconnected with bridges and walkways that formed a vibrant and densely populated community, all above water. Boats crisscrossed in every direction. It was 1957, more than two decades before I would be appointed the sixth director of the Arnold Arboretum, and I was arriving in Brunei to work as the first official forest botanist for the Bruneian government. At the time, I could scarcely have predicted that this would mark the beginning of five years working under the auspices of Omar Ali Saifuddien III—the Sultan of Brunei—or, for that matter, that it would mark the beginning of a lifetime of research on the forests of northern Borneo.

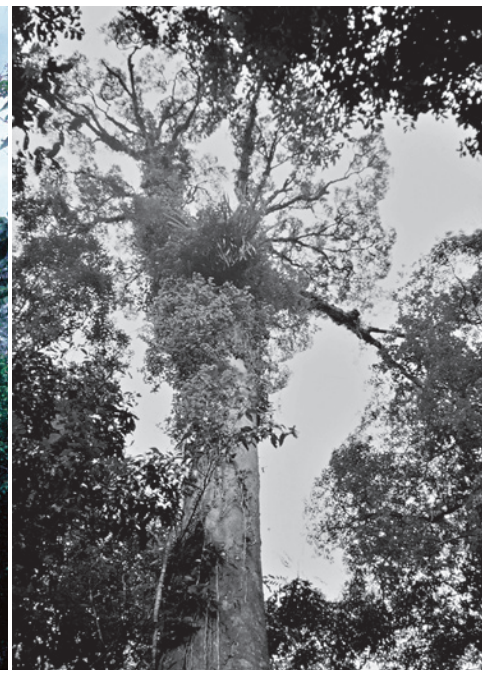
At Bandar Brunei (now known as Bandar Seri Begawan), I was welcomed by Bertram (Bill) Smythies, who held the title of state forest officer. Bill was the author of classic texts on the birds of Burma and Borneo. His father and grandfather had been botanists in the Indian Forest Service, and as he stood, awaiting my boat on the north side of the river, I could immediately see that his gaunt and sinewy physique had been shaped by his ceaseless fieldwork. During World War II, he had been protected behind Japanese lines, within Kachin longhouses, while he continued his research in northern Burma. I later learned from my local team members that he spoke their language (Iban) so fluently that, were he hidden from view next door, he would not be recognized as a foreigner.

By comparison, I was exceptionally new to this world. My first and only prior field experience occurred in 1954, at age twenty, when I spent my freshman summer with two friends on the northern bank of the Amazon River, near Monte Alegre, Brazil. Before that, my only expeditionary qualifications had been on family holidays in France and Italy. I went to Brazil as an entomologist, and I returned with a keen interest in forest botany. John Corner, a professor of tropical botany at the University of Cambridge, encouraged my new enthusiasm, and he promised to pass on any leads about career opportunities for a budding field worker.

Thus, my arrival in Brunei. We would be leaving for the Temburong River the following morning, Bill informed me. This river flows through the eastern portion of Brunei—which is divided into two noncontiguous sections—and once we departed from the capital city, familiar accommodations would be scarce. Bill scrutinized my appearance—athleticwear that, in retrospect, was more suited for camping in the English countryside—and he pointed me in the direction of a provisions store. "You had better go and buy some clothes," he said.

As a new forest botanist, I had been charged with gaining field information about the tree flora of a region slightly larger than Delaware, concentrating on the dominant tree family, Dipterocarpaceae. Dipterocarps are colossal monarchs of the paleotropical rainforest, dominating the overstory. Over the previous half century, they had become the leading source of general-utility timber, and they also provided quality hardwood for flooring and decks. Because dipterocarps were entering the regional export market, I was to provide preliminary information that would guide sustainable management for this timber. I had visited the herbarium at Royal Botanic Gardens, Kew, near London, to read up and see examples in the herbarium. But the specimens revealed a diversity of foliage that was unfamiliar and complex. My knowledge, at the start, was little more than rudimentary.

Before my departure from Bandar Brunei, I learned that my office in town lacked botany books and that no tree flora for Borneo had been published. Moreover, the herbarium at the office consisted of a closet with a small col-



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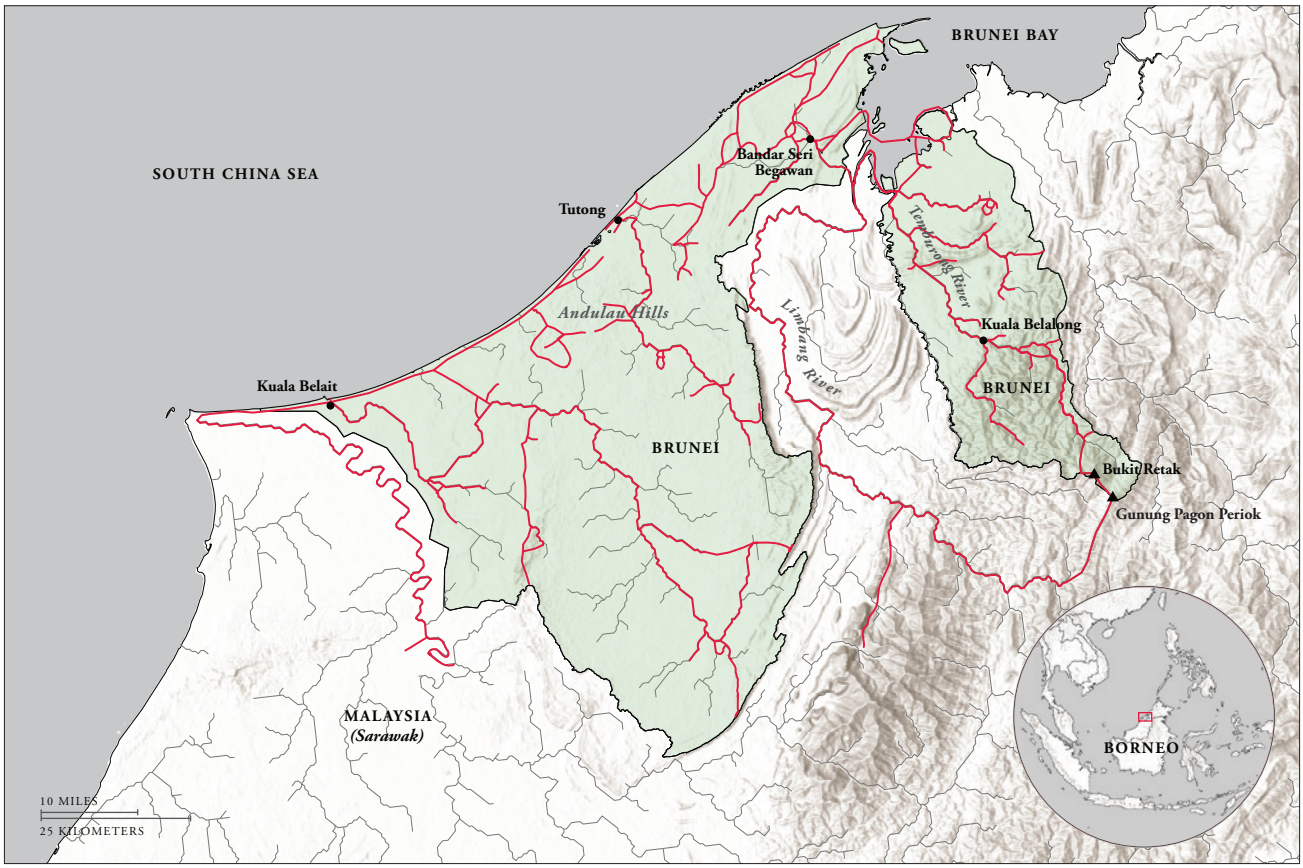

MAP BY PETER ASHTON, ARNOLD ARBORETUM, AND GIS COMMUNITY

Ashton arrived at Bandar Brunei (now known as Bandar Seri Begawan, top left) in 1957. His research in the Bruneian forests between 1957 and 1960 focused on overstory species like this giant dipterocarp, *Shorea longisperma* (top right), and followed routes mapped in red.

lection of specimens, mostly from the 1930s. I needed help, so Geoffrey (Geoff) Wood, a forest botanist from adjacent Sabah—now a state in Malaysia—came down to be my botanical tutor for the first three months. Geoff had hurt his leg in a field-hockey game before the expedition, causing his ankle to swell painfully, but he was nonetheless a tireless worker, and his field experience proved invaluable.

It took us three days to reach Kuala Belalong, the fork where the Temburong River meets the white waters of the Belalong River, deep between hills that rise nearly 2,000 feet (600 meters), enshrouded in mighty emergent trees. I had learned much on the way up: I now knew that my life would revolve around an outboard-driven prahu (dugout canoe). I knew that I needed to learn the lingua franca Malay, and fast, and that Iban would be useful as well, given that I would spend day and night with a team of Iban lads near my own age: Ladi anak Bikas, Asah anak Unyong, and Naban (whose paternal name I do not recall, because we worked together more briefly). The Iban are members of an inland minority on Borneo, known collectively as the Dayak, which includes major groups that speak distinct languages. Later, an older and more experienced Iban collector named Sengelang anak Nantah joined my team. Given his considerable experience and wisdom, I called him Apai, meaning Dad.

My field companions possessed an optimistic, energetic and ribald self-confidence. That first evening and night was both exciting and reassuring. My companions were endlessly helpful and friendly, although already detecting opportunities to pull my leg. The rush of the rapids, with the calls of the evening cicadas, frogs, and birds, was both exotic and inviting.

I was already familiar, from student days, with the customary method of collecting botanical specimens and inserting them in wooden presses to dry, but the special requirements of doing so in dense forest under a climate of intense humidity and heat was challenging. The aim

TIMOTHY CHARLES WHITMORE

The field team (from left) included Asah, Naban, Ashton (wearing his indispensable leech socks), and Ladi.

Ladi demonstrates how diagnostic notches are made in the trunk of a large dipterocarp species, *Shorea slootenii,* using a parang. At right, a leaf is shown with the notched trunk of *Dipterocarpus conformis*.

was to collect eight quality vouchers of every tree in flower or fruit, to send to regional herbaria, as well as to leading herbaria worldwide, including at Leiden University, Kew, and yes, the Arnold Arboretum—my first introduction!

As a newcomer, the challenge of identifying giant trees, towering more than 200 feet (60 meters) overhead, quickly introduced me to the parallel world of Iban forest botany—a world very independent of the formal plant science of a western university. Flowers provide the best means to identify the botanical family, using methods devised by Linnaeus, but discovering fallen petals (or fruit) was rare. Canopy species only start to flower once their crown is in the sun. Few Bornean species flower annually, and some go many years without. If they do flower, however, it is most likely between the two wet monsoons, in and around April, when sunny periods of a few days are frequent in most years. So this was always the time to plan major collecting expeditions, and it was, in fact, around this time that our trip commenced.

As I began to grasp a little of the Iban language, I started to ask Asah for help. Asah's approach was, first, to note the overall bark appearance, observing its color and whether it was smooth, flaky, fissured, or otherwise. He would then slice into the bark. He would smell the wood, look for sap or latex, and note the overall color of the inner bark and sapwood, as well as the presence of radiating pale lines (known as medullary rays). For this purpose, we all wore a parang at our waist—a short, sharp blade resembling a billhook without a bill, crafted by a blacksmith from a truck spring. (Parangs were also used for cutting paths and much more.) These wood and bark character-

istics provided enough information to home in on the family and often the genus, for which Asah and the other collectors would often know an Iban name.

Eventually, I learned that nearly all species could be identified on the basis of their leaf and petiole morphology, at times with the added assistance of trunk characteristics or a fallen twig fragment, without requiring flowers or fruit. Bill and I would bring samples back to the camp for Geoff to examine. In addition to providing a loose identification for the specimen, he could tell us whether something had already been well-documented with other herbarium collections. With this guidance, we knew what to collect.

At this point, the fun really began. Asah, Ladi, and Naban were extraordinary tree climbers. (We *never* needed to fell a tree to collect specimens.) The men would clasp the trunk in a crouched position, using their arms and the soles of their feet, and then stretch up to embrace the trunk again. The trunk needed to be sufficiently slender to clasp, so if the target tree was too large, the climber sought out a smaller tree nearby. He would climb this neighboring tree until the stem began to bend, and then, using his weight to swing the crown of his tree back and forth, he would lean towards the next tree and hook a long, forked pole (known as a *penyulok*) around a branch. He could then tie the lower end of the *penyulok* in place, bridging the two trees. By hauling up a new *penyulok* on rattan cord, the procedure could be repeated until the main branches of the emergent tree were reached. The rest depended on confidence, agility, and iron will!

The twigs, once dropped from on high, would be tied in bunches and placed in large plastic bags familiar to field botanists. I initially learned the Schweinfürth method of preparing specimens, which was developed for wet, hot climates in the region by Dutch botanists. The method requires rustproof metal containers, which were made by local tinsmiths. These were designed with a cross-section large enough to fit specimens, which were entered between sheets of newspaper. It was both surreal and entertaining, in the gloaming of a rainforest evening, to spend moments reading the goings-on in the local newspapers from seaside locales near Los Angeles—Santa Barbara, Laguna Beach, Ventura—from where they had been exported as packing material. The packed specimens were then doused with a mixture of 90 percent ethyl alcohol, fortified with formalin and mercuric chloride powder, which helped to preserve the specimens until they could be dried in presses at the herbarium and dispatched or mounted.

Bornean forests are not dangerous places, so long as care and discretion are the rule. Beyond villages and longhouses, mosquitoes and sandflies (no-see-ums) are confined to the riverbanks. Leeches are a perpetual pest, but they can be excluded by wearing gabardine knee-length stockings. Dangerous animals are few, although I did manage, a few months later, to step on a pit viper, after which Ladi carried me on his back for two days across high hills to the boats. Nevertheless, inland roads were scarce, and ascending white-water rivers presented a perpetual hazard. Moreover, the dense forests of undulating lowlands created conditions where one could easily get lost, especially on cloudy days, when the sun provided no bearing.

Scarcely two months into my time in Brunei, however, I learned a sobering lesson about backcountry perils. The mixture of chemicals used for the Schweinfürth were dangerous, even to the touch. I would later search for an alternative, but tragically, while we were breaking camp in the Andulau hills—near the coast, west of Bandar Brunei—a five-gallon drum of ethyl alcohol, standing too close to a camp fire, exploded on Geoff. One of our Iban assistants ran for help and managed to secure an Australian roadbuilder with a short-wheelbase Land Rover, in which we carried Geoff, fifteen miles along the beach at high tide, to an oil-field hospital. He did not recover. The experience was traumatic, and I recall riding with Geoff's climbers—Kadazan men from Sabah—to the little graveyard in Kuala Belait, on the western coast of Brunei. All of us wept. The Kadazan collectors returned home, while I would return to the field. Geoff, who I had not known before, was patient and immensely knowledgeable. We had shared long evenings of relaxed banter under canvas, and he could not have been a better instructor in the art and science of tropical forest botany.

GEOFFREY WOOD

SPECIMENS FROM HARVARD UNIVERSITY HERBARIA

Collectors on a later expedition in Sarawak rest while setting up camp (top left). Schweinfürth tins—used for preserving herbarium specimens—are stacked in the foreground. Asah and Naban are photographed climbing *Shorea curtisii* (top right). Asah has reached the basal branch of the crown; Naban is positioned about halfway up the trunk, where a small neighboring tree has been bridged with the *Shorea;* and Ashton stands at ground level. Ashton sent specimens to the Herbarium of the Arnold Arboretum, including *Shorea amplexicaulis* (fruits at right) and *Shorea laxa* (at left)—both collected in 1958.

The tidal rivers of Brunei are inhabited by taxonomically diverse mangrove species like *Avicennia alba* (top), *Heritiera globosa* (along with nipa palm, *Nypa fruticans*, bottom left) and *Rhizophora apiculata* (bottom right). Notice the unusual seedlings of the *Rhizophora*, which germinate and produce long drooping stems while the seeds are still attached to the parent plant.

Brunei is a small place, and most collecting trips took only a few days, although even those entailed slow travel up small rivers, with a nightly welcome in longhouses or forest camping beneath waterproof flysheets. Once a year, throughout most of my five years in Brunei, I took advantage of expected drier times in April to mount a major expedition. (I did the same in other parts of Borneo over the subsequent five years, amounting to six expeditions in all.) The first, undertaken when I had been in Brunei just over one year, tried my organizational and leadership skills and proved among the most eventful. Not only had my familiarity with the trees grown substantially over the previous year, but I had also learned sufficient Iban to get the gist of the endless exchanges of robust humor in the boats as we travelled. My knowledge of Malay was growing as well.

My first long backcountry expedition targeted Brunei's highest mountain, Gunung Pagon Periok, which is a steep sandstone slab that rises over 6,000 feet (1,850 meters) at the cascading headwaters of the Temburong River in the eastern portion of the country. We would access the peak via a montane ridge in nearby Sarawak. With that elevation, I suspected that it should be possible to collect within all equatorial forest types, which are differentiated according to altitude. Pagon is visible on the horizon from Bandar Brunei, the capital city, but although it is hardly more than fifty miles distant, I knew from aerial surveys and maps that it would take many days to reach.

The length of time we could spend hiking in the rainforest depended on the number of field assistants required to haul equipment and food, especially rice. The basic backpack is a *selabit,* woven from rattan. Its base fits snuggly in the small of the back, while the top reaches the crown of the head. For a two-month trip that required overland travel, we would need about fifteen field assistants—recruited along the way—in addition to the Iban climbers. Before heading towards Pagon, a day was spent shopping for sufficient food to last six to eight weeks: rice, cooking oil, salt fish, little red onions, chilies, and all-important matches and kerosene.

I departed Bandar Brunei with Apai and Ladi, winding through vast mangrove swamps in an outboard prahu. We crossed the Bay of Brunei and entered the mouth of the Limbang River, whose valley separates the two halves of Brunei. This swamp, bordering the whole extent of the bay, harbors an exceptionally diverse flora, as well as a rich fauna including the notorious long-nosed, white-faced proboscis monkey (*Nasalis larvatus*). We then continued up the winding river through fertile floodplain farmland, to the large and elegant Iban longhouse of Tanah Merah. We were welcomed with a ceremonial bowl of *tuak* (rice wine), which was followed with a dinner of rice and chicken, loaded with plenty of chilies, and traditional dancing in the evening. I was cajoled into attempting a sword dance, which caused much hilarity.

We managed to attract six enthusiastic assistants and a second outboard prahu, and we set off early again upriver. On a daily wage equivalent to my climbers (but lacking their field allowance), these recruits soon became socially part of our team. About midday, the current quickened, the occasional rapid had to be maneuvered, and the hills began to close in on both sides. We were now in the country of the Murut, a different ethnic nation from the Iban, but with a long-standing friendly relationship. When we stopped in a village, our welcome was subdued, as many were away, tending to their paddy farms. We spent our second night in one of their longhouses, which smelled strongly of rancid *tuak*—a sign that harvest festivities were over. We did succeed, however, in gaining another motorized prahu and a second contingent of young woodsmen so that our party, now fifteen, was complete.

At noon on the third day, we reached Nanga Medamit, the tributary that drains the western flanks of Pagon. We pulled the prahus up the hillslope above the river, above highest flood levels, packed our equipment and food into *selabits,* and ascended the steep slopes to the ridge where we set up camp for the night. This gave me my first opportunity to chat with the Muruts, who were more reserved than my boisterous Iban companions. I had planned to use the expedition to start recording medicinal plant uses. One Murut seemed quite knowl-

On the way to Gunung Pagon Periok, Ashton encountered a lower montane forest, known as *kerangas,* for the first time. During subsequent fieldwork in *kerangas* forests, Ashton photographed lipstick palm (*Cyrtostachys renda,* left), named for vibrant red leaf sheaths that do not appear in the photograph, and Borneo kauri (*Agathis borneensis,* right) a member of the coniferous family Araucariaceae. A Malay collector named Karim is pictured.

edgeable about plants, but, on seeking his experience, he answered that, although his people were unsurpassed in their knowledge of plants that increase the hunting and sniffing skills of their dogs, all that they knew for humans concerned poisons.

The following day, we successfully shot a fat boar, the Bornean bearded pig (*Sus barbatus*). Some was consumed on capture but most was boiled with salt and stored for the weeks to come.

Time being limited, we decided to collect little until our base camp was achieved. This gave us the opportunity to observe changes in forest structure and flora as altitude increased. We followed the ridge upward, trading the sounds of the water for the occasional ghastly cackle of the helmeted hornbill (*Rhinoplax vigil*)—a call that now brings back happy memories. We came upon a large water-filled wallow that, I was assured, had been made by a rhinoceros—the little two-horned species (*Dicerorhinus sumatrensis*), also found in Sumatra. In late afternoon, we scaled a small peak, about 2,100 feet (650 meters) high, where I detected an upper dipterocarp forest for the first time, just below the cloud base. These trees were shorter of stature with unfamiliar species including a dipterocarp that later proved new to science: *Shorea flaviflora.*

The next morning, we started an ascent to about 2,800 feet (850 meters), which led us into a lower-statured woodland, lacking emergent trees but with a profusion of trees in the oak family (*Castanopsis, Lithocarpus*). This was my first experience of a lower montane forest. It differed from textbook descriptions in its open canopy and dense understory of pole-sized trees. I later learned this was a forest type

known as *kerangas,* which is widespread on Bornean mountains. The going got steeper as we approached a high spur, where, at 5,700 feet (1,750 meters), the trees were hardly more than head height. Everything, including the contorted branches of the trees, became so carpeted in moss that their dwarf crowns could hardly be distinguished from the ground, giving purchase to spectacular orchids and occasional rhododendrons (*Rhododendron* sect. *Vireya*). This was the upper montane forest, daily immersed in fog, dripping, and so unnervingly silent that our voices hardly carried more than a few yards. We sought out a campsite while Apai and Ladi pressed on, cutting through the vegetation with parangs. The only visible way through was a tunnel made by wild boar. So thick were the moss tussocks that we had to stay two more nights while a passage was cut to squeeze through with the baggage.

We set up our permanent camp in an ecotone between lower montane *kerangas* and upper montane thicket, where we could see the base of Pagon's imposing sandstone slab, with its flat densely wooded southern slope facing us. We spent three weeks there, exploring, collecting, and setting out one-acre plots (we had not become metric in those days), which we fully censused. We scaled the perilously narrow summit ridge, which bore a short shrubby thicket, with little in flower. But the forest around the camp yielded exciting new discoveries including, amazingly, a new dipterocarp, which I would name *Shorea monticola.*

After nightfall one rainy day, we saw a curious pale globe of light, less than a meter in diameter, moving slowly downhill through the distant trees, eventually disappearing. Could it have been a form of ball lightning? It did not last long, and my campmates were unperturbed, casually explaining it to be a benign forest spirit, going about its business.

After five weeks in the forest, rice was beginning to run low. We had to retain enough supplies for our return when the weight of the food would be replaced by that of the full cases of specimens. Because we had accessed the mountain

The collectors viewed the sandstone slab of Gunung Pagon Periok, with its steep slopes carpeted with upper montane forests, from their ridge of approach in early morning.

from the Limbang River—which runs through Sarawak rather than Brunei—I discussed return options with Apai and our other teammates and was attracted to the idea, if possible, of continuing southeast with a few of our most energetic team members to access the Temburong River headwaters, which we would follow until the stream became navigable. This area had been explored by an oil geologist thirty years earlier, but it was otherwise unknown to western researchers.

Apai confidently assured me that, upon reaching the Temburong, a bark raft could be constructed. So the main party returned the way we had come, carrying most of the baggage, while Apai, Ladi, one Murut assistant, and myself bid them farewell and set off, lightly equipped with five days of rice and other basic foodstuffs. That first day we made a steep descent of the northern slope of Gunung Pagon Periok to a ridge that connected to a lesser peak, known as Bukit Retak. Apai suggested that we should scale this peak to search out our route and possibly spend the night on the summit where we could usefully commune with mountain spirits. I succumbed to the idea, so we spent a soggy fog-enshrouded night beside a summit dewpond—but to no avail. We camped in an open valley the next evening and spent the following day scaling Bukit Lesong, the northernmost of Brunei's mountains, where I found another dipterocarp of unfamiliar leaf shape (which I would later know as a species of *Vatica*). Because we were traveling light, we had no means to collect specimens.

On the following day—our third since leaving the others—we descended for five hours and came on the main Temburong stream, but it was flowing over massive boulders and was far too steep to attempt navigation. We followed it until evening, and at daybreak the next day, we searched for a tree with suitable bark for a raft. No such tree was to be found, so we felled the next best. The result was riverworthy but pliable, resembling a giant banana skin. We had not gone far that morning when we heard a

After Ashton and his team finished their fieldwork near Gunung Pagon Periok, they descended towards the headwaters of the Temburong River, photographed on a later trip near Kuala Belalong.

Within the forests of the Temburong District—the easternmost enclave of Brunei—Ashton observed large overstory species like *Anisoptera costata* (left), which is a member of the dipterocarp family (Dipterocarpaceae), and *Tristaniopsis whiteana* (right), a member of the myrtle family (Myrtaceae). An Iban collector named Mujah is pictured.

massive clap of thunder over the mountains to the south and soon noticed a rise in the waters. We leapt to shore, dragging our craft as high up the steep hillslope as we could. Within little more than a minute, the waters had gone up fifteen feet, swirling, carrying whole trees, the rocky bottom shaking and rumbling.

No further travel was possible until the following day, when the flood had somewhat subsided but the current was still strong. We proceeded with caution. Ladi and I had ascended the Temburong some months earlier, and we were stopped by a two-meter waterfall called Wong Uan, which was practically impossible to portage or descend. Below it, a cataract known as Gerugu Rimau raged between the cliffs. We knew we were getting close. After little more than one hour on the river, we rounded a bend, and Ladi and I recognized the terrain—only too late. We leapt into the torrent, while our Murut assistant attempted to haul in the raft by its attached cord. All to no avail. The raft turned, bent in two, and flipped over the fall, and within it our clothes (including our shoes!), our remaining food, and our parangs—everything. The three of us crept to the edge of the fall and looked down. All that came up, turning in the whirlpool, was Apai's bamboo cigarette container which, after rescue, revealed five vital matches.

Our only option was now to find the nearest Iban longhouse, several days walk downstream. We rested, and the next day—the fifth since we left the main party—was a disaster: showery, cloudy, with no clear view. Walking barefoot in the rainforest proved easier than I had imagined, but in late afternoon, we began to identify bent twigs with which we had marked our morning

trail. We had turned in a complete loop. We set up a shelter by snapping off leaves from a fan palm (*Licuala*), and we found dipterocarp resin within a hollow tree, which, with some tinder, allowed us to start a fire. We spent that night toe-to-toe around the flame.

The following morning, the sun revealed clear blue skies, so Ladi, climbing a tree, was able to discern the best way forward, bypassing a major turn of the river down to its confluence with a stream called Nanga Temburong Machang. By this time, Ladi was getting exhausted. We crossed the river, which had begun to subside, and Apai and our Murut assistant left us, floating on a log down the rapids in search of help. Ladi and I lit a fire with the last matches. We had plenty of water to drink, but food was sparse: some young turtles, which were exceedingly chewy after we cooked them in their shells, and the sweet and familiar fermenting pulp from the fallen fruits of a giant leguminous tree. We even took to eating clay to fill our stomachs, which turned them to cement.

We waited and waited. Three days passed. Ladi became increasingly concerned and eager to find a floating log himself, but I discouraged him. Then, on the fourth day, the distant noise of an engine could be heard, coming, then going. That's an airplane, Ladi said in sad conviction, but I was more confident. Sure enough, after a long wait, around the river bend came a prahu manned by my friend Penghulu Gimang (an upriver chief), with his son Jah. They had been alerted by Apai and his Murut companion, and they brought a feast: salt fish, over which they poured condensed milk. Never, ever, have I tasted anything so delicious! We descended the river, stopped at Gimang's longhouse, and then proceeded down to the estuary and across the bay to the capital. On the way, we noticing occasional shirts, towels, and other flotsam high in the branches of the overarching trees.

This initial immersion in Bornean forest botany lasted twenty-six months. During that period, Ladi and Asah became my friends for life. (We

Wong Uan, a waterfall on the Temburong River, stranded Ashton's team without supplies. It was photographed here at more placid conditions in 1958.

Ashton's fieldwork documented 151 dipterocarp species in Brunei, including species like *Dipterocarpus lowii* (left), and *Shorea rubella* (right), which are both considered critically endangered by the International Union for Conservation of Nature.

still communicate from time to time through a Malaysian friend.) We made nearly four thousand collections from which Dutch colleagues at Leiden University would assign over seven hundred scientific names. This was enough for Hasan bin Pukol—curator of our new herbarium in the attic of a local cinema—and I to publish a checklist of trees, which included local names. I also gained enough knowledge of the dipterocarps to publish a manual describing Brunei's 151 species, of which 33 were new and formally named for the first time (only 3 more have subsequently been discovered).

This information would prove essential for future sustainable management and conservation efforts, and, on a personal front, these months in the field provided materials that would become the basis for my doctoral dissertation and a career beyond, including as the director of the Arnold Arboretum. Along the way, I had come to recognize the floristic and ecological patterns in the forest, and a newcomer—a neophyte, really—had found a way of life. My paleotropical education had officially begun.

Peter Ashton is Harvard University Bullard Professor Emeritus and was director of the Arnold Arboretum from 1978 to 1987. Among many career honors, his research on tropical forests was recognized with the prestigious Japan Prize in 2007. He and his wife, Mary, live in Somerset, England.

The map in this article was created using Esri, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, based on an illustration that originally appeared in Ashton, P. 1964. *A Manual of the Dipterocarp Trees of Brunei State and of Sarawak.* Oxford: Oxford University Press.

The Old Timer

Bob Mayer

More than ten years ago, I photographed an odd-looking tree growing in front of the Roxbury puddingstone outcropping on Valley Road. It was early May, and the tree was in bloom—sort of. One of the main branches was barren. It looked like the tree had been mistakenly passed over by the crews clearing away the dead and dying after a long winter. When I photographed the tree two years later, in 2009, the horticultural staff had visited, not to remove the tree but to prune it vigorously. The barren branch was gone, and the tree resembled a warty, one-eyed beast, sprouting feeble arms. I checked the metal tag: a Yoshino cherry (*Prunus* × *yedoensis* forma *perpendens,* accession 22542*A). It was accessioned in 1925, a dozen years before my own birth date. Perhaps because of that, I developed an attachment to this aging—indeed ancient by cherry standards—tree despite is ungainly appearance, and I occasionally grabbed other images of the "old timer," as I nicknamed it.

While the record label suggests this accession was grown from seed sent from the Imperial Botanical Garden in Tokyo, Japan, I learned that an important intermediate step was involved. The tree was grown as a seedling from another Yoshino cherry (accession 5351*A), which arrived from the Imperial Botanical Garden (now known as the Koishikawa Botanical Garden) in 1902. The original tree grew near the Forest Hills Gate, and Charles Sprague Sargent often commented on the pink and white flowers. Even though the buds were regularly nicked by spring frosts, Sargent esteemed the hybrid as "one of the handsomest" cherries from Japan.

According to Donald Wyman—a long-time horticulturist at the Arboretum—the Arboretum's original tree represented the first introduction of the Yoshino cherry into America. This predated a more famous gift of the hybrid (along with other Japanese cherries) to the city of Washington, DC, in 1912, where it formed the basis of the famous planting that clouds the Tidal Basin with evanescent blossoms each spring. This lineage is especially significant given that, when Ernest Henry Wilson visited Japan in 1914 and 1915, he reported that forty-year-old trees at the Imperial Botanical Garden were the oldest known representatives of this hybrid (which is now considered a complex cross between *Prunus speciosa* and *P. subhirtella*) and that the original taxonomic description had been based upon them.

Wilson observed the old Yoshino cherries flowering at the Imperial Botanical Garden, with benches where visitors could sit beneath the outstretched branches. Despite the recent scientific recognition of the hybrid, Wilson described its omnipresence throughout Tokyo. "This is the Cherry so generally planted in the parks, temple grounds, cemeteries and streets," he wrote in *The Cherries of Japan,* published in 1916."Its flowers herald an annual national holiday decreed by the Emperor. In all over fifty thousand trees of this species are growing in the precincts of the city." This celebration, known as *hanami,* is still enormously popular in Japan, and it is premised on appreciating ephemerality—a celebration of fleeting beauty.

After discovering the significant background of the old timer, I returned recently for another look. It seemed taller and statelier, now that I had uncovered its history. Horticultural care during my decade of observations had maintained—seemingly even resurrected—this old tree, which looked even healthier now than when I first encountered it. If the spring flowers symbolize the swift passage of the seasons, then the knobby form of this tree seems to extend this metaphor even further, embodying the passage of years. I'm confident the tree will survive much longer than this humbled observer.

Bob Mayer has been birding, photographing, and volunteering as a docent and field study guide at the Arnold Arboretum since 2002.




The ARNOLD ARBORETUM of HARVARD UNIVERSITY