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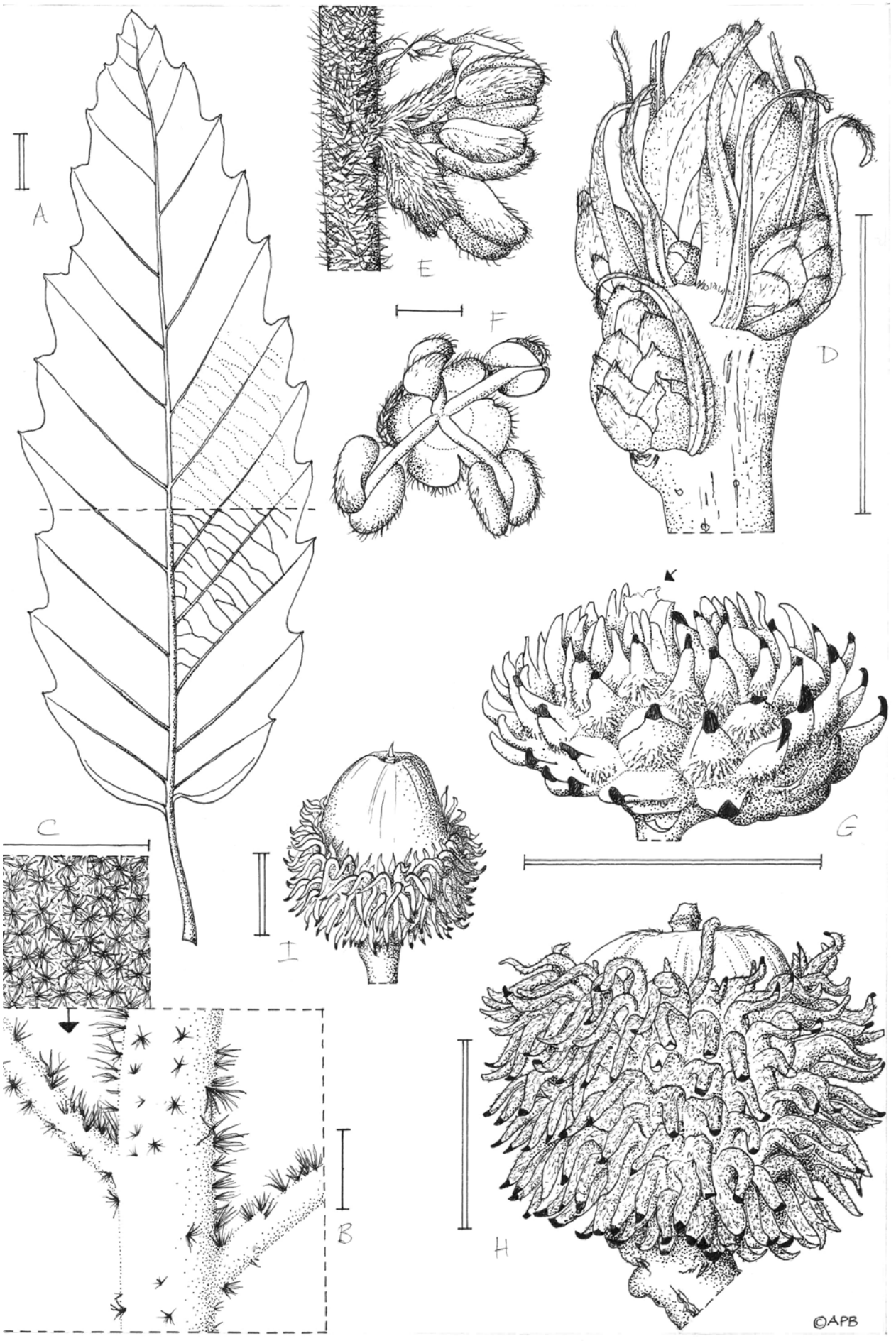
The Magazine of the Arnold Arboretum

VOLUME 75 • NUMBER 3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VOLUME 75 • NUMBER 3 • 2018

Arnoldia (ISSN 0004–2633; USPS 866–100) is published quarterly by the Arnold Arboretum of Harvard University. Periodicals postage paid at Boston, Massachusetts.

Subscriptions are $20.00 per calendar year domestic, $25.00 foreign, payable in advance. Remittances may be made in U.S. dollars, by check drawn on a U.S. bank; by international money order; or by Visa, Mastercard, or American Express. Send orders, remittances, requests to purchase back issues, change-of-address notices, and all other subscription-related communications to Circulation Manager, *Arnoldia,* Arnold Arboretum, 125 Arborway, Boston, MA 02130-3500. Telephone 617.524.1718; fax 617.524.1418; e-mail arnoldia@arnarb.harvard.edu

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Postmaster: Send address changes to
Arnoldia Circulation Manager
The Arnold Arboretum
125 Arborway
Boston, MA 02130–3500

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The ARNOLD ARBORETUM of HARVARD UNIVERSITY

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Front and back covers: Keeper of the Living Collections Michael S. Dosmann captured this photo one misty morning while on expedition in Pingwu County, Sichuan Province, China, in September 2017.

Inside front cover: Quercus castaneifolia. A, leaf; B, stellate hairs on leaf ribs; C, lower surface of leaf showing stellate hairs; D, apical bud, showing linear scales; E, male flower with inflorescence axis; F, male flower; G, female flower, (arrow points to styles); H, young acorn and cupule; I, mature acorn and cupule. Scale bars: double bar = 1 cm; single bar = 1 mm. Drawn by Andrew Brown. Image courtesy of *Curtis's Botanical Magazine.*

Inside back cover: Viburnum opulus (European cranberry-bush) puts on a dazzling fruit and leaf display in autumn, as seen in this plant in Ukraine. Photo by Brendan Keegan.

2017: A Banner Year for the *Campaign for the Living Collections*

Robert Dowell and Michael S. Dosmann

Since the Arnold Arboretum began its *Campaign for the Living Collections* in 2015, plant-collecting expeditions have launched with a fervor and sweeping extent rarely seen before. So far, 14 separate trips have taken place across Europe, Asia, and North America. These forays yielded incredible plant riches, from new collections of the dainty-leaved regal lily (*Lilium regale*)—first introduced from China to the Arboretum by Ernest Henry Wilson—to the mast harvested from towering American beeches (*Fagus grandifolia*) in mature forests of eastern North America. With the 2017 season concluded, the Arboretum has progressed well toward its 10-year goal of securing germplasm from almost 400 target taxa or desiderata enumerated in the *Campaign's* opening communiqué (Friedman et al., 2016). So far, the Arboretum has acquired 147 taxa from the list, resulting in over 200 accessions now in propagation and production at the Dana Greenhouses and Nursery—with a few already growing in the permanent collections.

Deciding how, when, and where to collect a diverse array of target species requires organization, and several precepts guide our efforts. One of these is the "greatest bang for the buck" principle: geographic areas with the highest concentrations of plants on our wish list become hot spots for concentrated and repeated expeditionary activity. Our teams focus on these areas first, and as the *Campaign* progresses and we check targets off the list, high priority areas shift to those of lower priority. Because eastern North America and eastern Asia possess many of our desiderata, they will always remain important collecting spots, as they were in 2017.

A second principal in the *Campaign* gives precedence to species with confined native ranges, or select portions of their native range. For example, the nutmeg hickory (*Carya myristiciformis*) grows in isolated populations from Texas to South Carolina, and its importance was a reason why a team of explorers went to the coastal southeast. The *Campaign* also

In 2017, Arboretum explorers mounted four major expeditions: three occurred in North America: Wisconsin (WIE), Arkansas-Missouri (ARMOE) and the Coastal Southeast (COSE); a fourth was a North America-China Plant Exploration Consortium trip to Sichuan (NACPEC2017). Individual markers are where the explorers made specific collections.

MICHAEL S. DOSMANN

Manager of Horticulture Andrew Gapinski admires a handsome *Hydrangea bretschneideri* in northern Sichuan during the 2017 NACPEC trip. Although the Arboretum already cultivates three different wild-sourced lineages of this species, the team opportunistically collected a fourth for further evaluation of its ornamental potential.

seeks to increase the genetic diversity within certain genera grown at the Arboretum. This means growing as many species as possible within each genus, as well as growing multiple, well-documented representatives of each of those species. This is particularly true for the Arboretum's six Nationally Accredited Plant Collections™: maple (*Acer*), hickory (*Carya*), beech (*Fagus*), *Stewartia,* lilac (*Syringa*), and hemlock (*Tsuga*). For species in these and other priority genera, we seek to grow accessions representing the center and distinct reaches of the native ranges.

Beyond acquiring targeted species, the *Campaign* leverages chance by making supplemental or opportunistic collections in the field. To date, over 350 of these taxa have been collected for the *Campaign,* many on expedition. Some have promising ornamental merit and await further trial and selection, such as the paperbark filbert (*Corylus fargesii*), an up-and-coming horticultural commodity collected on the 2015 NACPEC trip to China. Other collections represent novelty, such as the Georgian oak (*Quercus iberica*), a species never before grown in the living collections and acquired in 2016 in the Republic of Georgia.

Just as we cannot predict all the species we will successfully acquire, we cannot anticipate all of the challenges and hazards encountered along the way. Treacherous road conditions, seasonal drought, and terrestrial leeches are just some of the things that can affect an expedition. Despite these and other encounters in the field, however, the 2017 expeditions bore amazing fruit: over 100 taxa and almost 150 separate collections! This leads to one more reflection about the *Campaign for the Living Collections:* it is as much about the growth of people as it is about the growth of our collection. This year, eight Arboretum staff members went into the wilds. Whether it was their first or their tenth

The native range of red maple (*Acer rubrum*) spans much of eastern North America. However until 2017, wild-sourced accessions in the Arboretum's collections were from only three northeastern provenances (×). The 2017 WIE and ARMOE expeditions sought out, and secured, germplasm from two new regions (+). Map modified from: Little, E. L. Jr. (1999). *Atlas of United States Trees.* U.S. Geological Survey.

MICHAEL S. DOSMANN

The 2017 collecting team in Sichuan passed abandoned homesteads and towering *Meliosma* in their search for rare species.

expedition, each collector discovered and grew, and brought those experiences back to the Arboretum.

The *Campaign* articles profiled in this issue of *Arnoldia* highlight some of those experiences, from the humbling appreciation and celebration of history to the excitement of encountering a familiar species for the first time in the wild. We appreciate how "reading a habitat" leads to species acquisition, and how there is no substitute for seeing a plant in the wild in order to figure out how to cultivate it. Lastly, there is the value of persistence: sometimes, to secure a species you must collect it far and wide, and at other times, you must resort to an unusual propagation method. These represent just a few of the stories from 2017, and we look forward to those that the next seven years will bring.

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Robert Dowell was a Living Collections Fellow (2016–2017) and Michael S. Dosmann is the Keeper of the Living Collections at the Arnold Arboretum.

Keeping the Legacy: Retracing Century-old Footsteps

Michael S. Dosmann

PHOTO BY THE AUTHOR

Earthquakes followed by heavy rains caused many of the roads in Pingwu County to subside into the rivers. The collecting team, and the wandering yak-cow hybrids seen here, choose their footsteps carefully.

August steamed hot as plant explorer Ernest Henry Wilson traversed the wilds of northwestern Sichuan in 1910, leading his fourth expedition to China. At this point in his career, many of the species Wilson saw were becoming familiar to his eyes, even mundane, and he was eager for something different. Although the expedition targeted conifers he observed on previous excursions, namely firs (*Abies*) and spruces (*Picea*), he was eager to see new habitats and with them, new species. On earlier trips, Wilson had visited Songpan—his destination—from Chengdu, Sichuan's capital to the south, using one of two routes. The most direct option tracked the Min River north, though it was rather depauperate in botanical diversity. Wilson had also used a counterclockwise route that bore him north-northeast of Chengdu through modern-day Mianyang and beyond to Pingwu (Longan Fu in his day), and then west-northwest to Songpan.

This time, he forged a way through an expanse few westerners save a couple of missionaries had braved before. The path cut between the previous routes and would provide him the opportunities he sought. On the outset of this trip's leg, he did indeed encounter several things for the first time: he was robbed, from one of his own porters no less, and a local official dismissed his request for an escort through the unchartered territory.

This same region of Pingwu became the destination for the 2017 NACPEC (North America–China Plant Exploration Consortium) expedition, which Andrew Gapinski (Arnold Arboretum), Jon Shaw (*Harvard Magazine*), Kang Wang and Jian Quan (both from Beijing Botanical Garden), Huaicheng Li (Chengdu Institute of Biology), and I undertook from 15 September to 1 October, 2017. I had tracked Wilson's footsteps several times in the past, quite literally during the 2014 filming of *Chinese Wilson* (a documentary produced by Central China TV), seeing towns, roadways, mountain views, and of course plants that he had also visited. However, this trip was more poignant, for I now bore the title of Keeper of the Living Collections; the title of Keeper used only once before at the Arboretum, given to Wilson in 1927.

During our trip, we endured roadways capsized during the season's earthquakes and rains, and we got up-close-and-personal with terrestrial leeches that slink ubiquitously in these rich, mesic forests. On the morning of September 23, our team set out to explore one of the many mountain valleys near Si'er, an area Wilson referred to as Tu-ti-liang shan or mountain. Wilson had been awestruck by the herbaceous

A fruiting, type specimen (Wilson 4301) from the Herbarium of the Arnold Arboretum (A) of *Cercidiphyllum japonicum* var. *sinense*. In his hard-to-discern handwriting, Wilson notes "one tree measured 55ft. in girth 5 ft above ground!" Although the variety is no longer accepted, plants with the pubescent leaves and follicles can be recognized as *C. japonicum* f. *miquelianum*.

plants there, in particular the fingerleaf rodgersia (*Rodgersia aesculifolia*), which grew "in [the] millions." "It was in the fruiting stage," he noted in *China, Mother of Gardens,* "but when in flower the acres of snow-white panicles must have presented a bewitching sight. Nowhere else have I seen this plant so abundant or luxuriant." In an adjacent valley the previous day, we had seen the same species, each of its coarse leaflets reaching nearly a half-meter (20 inches) in length. As enthralled with it as Wilson had been, we joyously made a collection.

As we ascended the valley on foot, marching along a roadway that was tumbling into the torrent below, we were impressed with the expanses of large trees to either side. We spotted dove tree (*Davidia involucrata*), several species of birch (*Betula* spp.) and gargantuan specimens of the multi-stemmed Chinese beech, *Fagus engleriana.* Giant panda, we learned from our guide, often overwintered between the stout boles of these very beech trees. Wilson's 1907 collection of the beech from Hubei is the only representation at the Arboretum, and likely anywhere else. Thus, on our hike back down the mountain, we secured fruits of this and other species.

Wilson may not have recognized the heavily wooded landscape that we saw. He described this sparsely populated hamlet of Hsao-kou (now Xiaogou and depopulated) as having "… open, park-like slopes, quite unlike anything I have encountered elsewhere in China. Now largely denuded of trees these glades are covered with grass, and horses, goats, and pigs are raised here in some quantity."

The lumberman's axe and the herder's livestock had eliminated many of the conifers Wilson had hoped to find in the area. However, on August 17, 1910, he enthusiastically noted an abundance of *Cercidiphyllum japonicum* (katsura tree) growing throughout the landscape. Although he had seen the species on his previous travels, he had never seen so many growing together. The intrepid explorer got busy with his vasculum, collecting herbarium vouchers. This collection (Number 4301) would represent the type of what he and Alfred Rehder later described as a separate botanical variety with pubescent leaves and follicles, *Cercidiphyllum japonicum* var. *sinense.*

Wilson reported trees up to 36.6 meters (120 feet) tall, and 2.1 to 6.1 meters (7 to 20 feet) in girth. Even amidst these giants, one specimen stood out for its enormity—not in height but in girth: it was multi-stemmed and hollowed in

the core, yet 16.8 meters (55 feet) around, which would be a diameter of 5.3 meters (17.5 feet)! Words are not necessary to conjure what Wilson saw, for he memorialized the tree in a photograph. This exact tree was our destination for the day's hike, and for me it glimmered with personal significance, because *Cercidiphyllum japonicum* had drawn me to China for the first time in 1999 and I considered this a bit of a reconnection. This was now my eighth trip to China, and perhaps a bit like my predecessor, I sought some reprieve from the mundane.

I imagine that due to the openness of the landscape 100 years ago, Wilson spied the specimen easily from the path. Yet, even after our team left the road and ascended the steep and muddy streambanks, dense woods left us completely blind to our target. We had to bushwhack through the brush, and upon arriving at last, we could do nothing but marvel. Like the forest around it, the tree had recovered over the last century. The specimen had been but 8 meters (25 feet) tall in 1910; it now stood over 20 meters (65 feet) in height, and the diameter of the largest stem was just under 2 meters (6.5 feet). The three massive, original basal stems remained, though showed considerable wear. The tree at Wilson's time was probably coppiced repeatedly for firewood, and it had since rebounded by sprouting many new stem suckers. The ability of *Cercidiphyllum* to resprout following stress (age, drought, fire, coppicing) is well known. Assuredly this aged survivor had once been a single stem, hundreds of years before even Wilson photographed it.

Years later, Wilson recalled this visit to the tree in August of 1910, stating that it was actually the first time he ever saw the species

ARNOLD ARBORETUM ARCHIVES

JONATHAN SHAW/COURTESY *HARVARD MAGAZINE*

Wilson photographed the leviathan *Cercidiphyllum* with three of his collectors on August 17, 1910, in what he described as "open country." By 2017, the same tree and the forest around it had rebounded considerably, dwarfing NACPEC17 collectors (l to r) Kang Wang, the author, and Andrew Gapinski as they recreate Wilson's shot.

ANDREW GAPINSKI

The short-shoot spurs of the large *Cercidiphyllum japonicum* bore rounded to cordate leaves, waxy on the undersides, and small green fruits (follicles), which the team gleefully harvested.

in fruit. He added parenthetically, "Later I collected ripe seeds, and this tree is now growing in the Arnold Arboretum, where it promises to be quite hardy." Technically, it would have been Wilson's collecting team that acquired the seeds and fruiting vouchers that October, for on September 3rd, 1910, a few weeks after initially seeing this *Cercidiphyllum,* he was caught in a landslide that busted his leg in multiple places. Luckily, his steadfast companions carried him to Chengdu where he spent the remainder of the autumn recuperating, before returning to Boston in early 1911. Our 2017 team was lucky, too, for this huge *Cercidiphyllum* bore fruits, which we collected under number NACPEC17-020 (we also collected fruits from other trees in the population under NACPEC17-021). And, luckily, none of us broke an appendage.

Of Wilson's 1910 seed collection, but a single tree grew in the Arboretum. It was sited on Peters Hill, just to the south of the summit's present-day access road in an area then called "rare trees of the Arboretum." Accession 7281*A was near an American beech (*Fagus grandifolia,* accession 22798*E) that remains to this day. This *Cercidiphyllum* had survived the brutally cold winters in the early- to mid-1930s, proving its hardiness. However, by 1946, for an undocumented reason, it was dead. The tree had previously yielded enough budwood to produce five additional accessions, and a grafted plant (accession 133-41*B), the last of its lineage, grew in the *Cercidiphyllum* collection off Meadow Road. It was alive in 1948, but died shortly thereafter when its base snapped off, likely due to graft-incompatibility.

In early November of 2017, just weeks after I returned from China and the Arboretum propagator sowed the seed, the first seedlings of both of our 2017 collections germinated with abandon. In a few years, it will be a privilege and a joy to reintroduce an exact Wilson acquisition to the collections. While no doubt some trees will go along Meadow Road and elsewhere, I think one should return to the spot near the Peters Hill Summit, for old time's sake.

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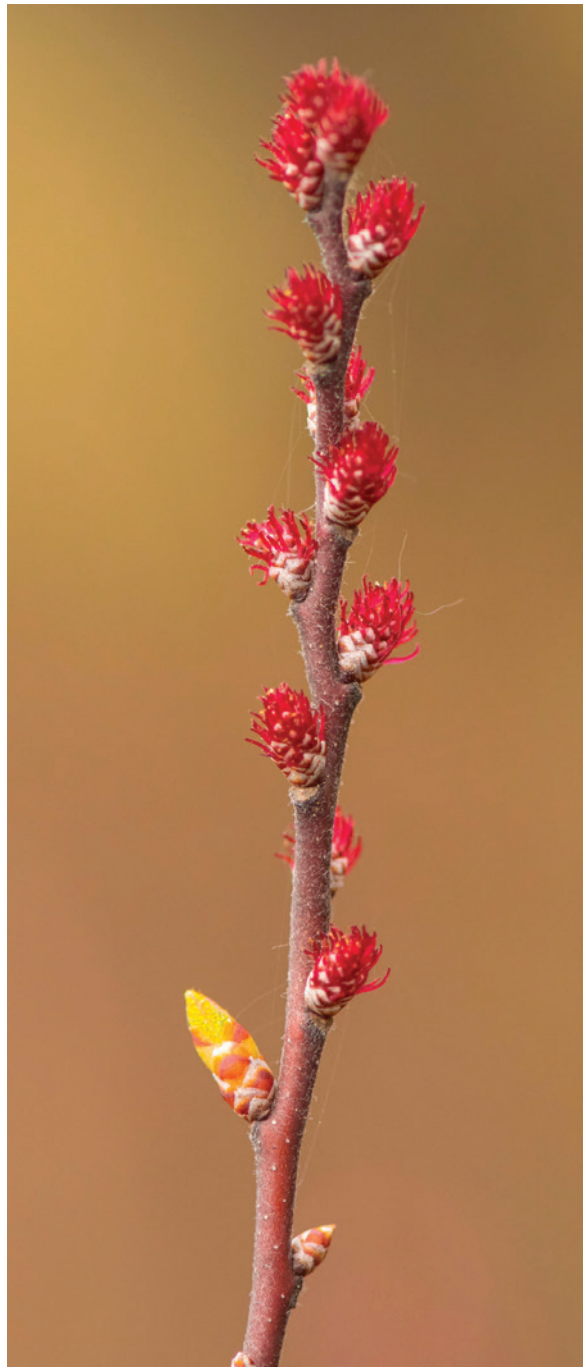
Michael S. Dosmann is the Keeper of the Living Collections at the Arnold Arboretum.

Betula pumila: A Dwarf Among Giants

Tiffany Enzenbacher

When one conjures an image of a birch (*Betula* spp.), typically a majestic tall tree with graceful architecture comes to mind—certainly not a low-growing, wide-spreading shrub. But, the small-statured bog or low birch (*Betula pumila*) is exactly what the 2017 Wisconsin Expedition (WIE) team, Manager of Plant Records Kyle Port and I, pursued from 23 August to 3 September of 2017. Since I began employment at the Arnold Arboretum three years ago, I have viewed our low birch accessions on an almost daily basis. Due to their short and scrubby growth habit, the specimens grow at the Arboretum alongside other dwarves: the plants of the Bonsai and Penjing Collection. Even as a caretaker of our dwarf potted plants, never did I imagine that I would be seeking *B. pumila.*

The Arboretum has record of receiving 11 *Betula pumila* accessions prior to 2017. Founding Director Charles Sprague Sargent obtained the inaugural accession in 1876 from Mount Mansfield, Vermont just four years after the Arboretum's inception. Presently however, just two living accessions exist, the first comprising the two plants (800-93*A and B) growing next to the Bonsai and Penjing Pavilion. Jack H. Alexander III, former Arnold Arboretum Plant Propagator at the Dana Greenhouses (1976 to 2016), collected those seed-bearing catkins in Gros Morne National Park in Newfoundland, Canada in the fall of 1993. Our second accession (660-2016) is still in production at the Dana Greenhouses. We received small plants from the National Plant Germplasm System of the USDA-ARS (United States Department of Agriculture – Agricultural Research Service) in 2016, with the seed originally harvested from Bremer County, Iowa. As the Manager of Plant Production, I obviously have regular check-ins with these seedlings.



JOSHUA MAYER

When caught at the right moment in early spring, the pistillate (female) catkins of low birch can be striking.

KYLE PORT

Coordinates from a 1958 herbarium voucher helped the collecting team locate this low birch (*Betula pumila*) population, still thriving in the drainage ditch bog along Highway 54 in Jackson County, Wisconsin.

JOSHUA MAYER

The ripening pistillate (female) catkins of low birch are bright green, nestled amidst the rounded to ovate, toothed leaves.

Low birch is the only shrub birch native to Wisconsin and is widespread throughout the United States, indigenous to the northern Midwest, West Coast, Northeast, as well as much of Canada. It occurs in a variety of wetlands, such as bogs (areas of soft, water-logged ground), fens (low lying, frequently flooded land), and swamps (wetlands dominated by woody plants) in calcium-rich regions. During our expedition, Kyle and I anticipated finding abundant plants because the majority of the Nature Conservancy preserves we planned to visit harbor these bodies of water.

After several days of looking in these prime habitats, to my utter disappoint, not a single *Betula pumila* was found. Viewing the Arboretum's only *ex situ* accessions every day for years had made this the one target taxon that I truly desired to acquire. So on our expedition's fifth day, Kyle and I decided to try another approach and go on a plant hunt using coordinates we pulled from a 1958 herbarium voucher in the Wisconsin State Herbarium database. The point was off Highway 54 in Black River Falls, above the Wildcat Ridge State Natural Area. The record indicated that the bog was being drained, and that black chokeberry (*Aronia melanocarpa*), eastern larch (*Larix laricina;* another WIE priority taxon), and black spruce (*Picea mariana*) were associated species.

KATHLEEN DOOHER

The author counts and cleans the tiny seeds—winged nutlets—of *Betula pumila* before direct sowing, or placing them under cold stratification at 2.2–3.3°C (36–38°F) for 3 or 4 months. These three different treatments will evaluate which brings greatest germination success.

After navigating to our location using our GPS, Kyle and I parked the vehicle, walked a short distance from a turnout, and began to look around. We excitingly noted that black chokeberry was still abundant, and walking further down the highway's shoulder, we were elated as we saw the 1950's low birch population flourishing 60 years later. At last, my long sought-after shrub was right before me in its native environment, after being so elusive the entire expedition. As the shrub groupings were not accessible

from the road, we carefully made our way into the bog using sedge (*Carex* spp.) clumps as stepping stones.

As we got closer, Kyle and I went over the identifying traits on our mental checklist to validate that they were indeed low birches. They stood approximately 2.5 meters (8 feet) tall, which is in the 0.9 to 2.7 meter (3 to 9 feet) range. This is a stark contrast to the 20-meter (65-feet) height attained by another native Wisconsin birch species, yellow birch (*Betula alleghaniensis*), which we collected the following day. The other features of these plants were the same as the very familiar Arboretum accessions and the description that Kyle and I had memorized. New twigs were characterized by smooth, reddish brown bark with speckled white lenticels (raised pores on stems that permit gas exchange between the environment and plant tissue). Dentate (bluntly or sharply toothed) leaves were small, 3.8 centimeters (1 ½ inches) long by 3.2 centimeters (1 ¼ inches) wide, and oval or slightly orbicular (round) in shape. And luckily, the plants harbored persistent female catkins that contained small, 3.2 millimeter (1/8 inch), winged nutlets.

Kyle and I harvested as many catkins as possible from the low birches in the vicinity, placed them in a labeled cloth bag, and later that afternoon mailed them overnight to the Dana Greenhouses with other bounties accumulated over two days' time. Upon my return from the field, I insisted on cleaning and processing the seed myself. Later as I removed the chaff and counted thousands of nutlets, I thought it fitting that once again a team member from the Dana Greenhouses, keepers of the Bonsai and Penjing Collection, was the one to collect this unusual dwarf shrub in a tree genus.

Tiffany Enzenbacher is the Manager of Plant Production at the Arnold Arboretum.

TIFFANY ENZENBACHER

Manager of Plant Records Kyle Port collects new GPS coordinates of a low birch specimen.

Coastal Southeast Expedition 2017: How Habitat Type Guides Collecting

Sean Halloran and Jenna Zukswert

CAMERON STAND

The COSE team included (l to r): Cat Meholic (University of Delaware), Ethan Kauffman (Stoneleigh, Natural Lands Trust), Jenna Zukswert (Arnold Arboretum), Jessica Slade (Morris Arboretum), Sean Halloran (Arnold Arboretum), and Tom Clark (Polly Hill Arboretum and Mount Holyoke Botanic Garden). Not pictured are local collaborators Richard Porcher, Mike Ammons, Gary Kauffman, and Andy Walker, who led the team to wonderful wild places.

The *Campaign for the Living Collections* takes explorers to many diverse parts of the temperate world in search of target taxa. Specific knowledge of plant ecology and plant communities helps us determine where we can find these taxa, and therefore where we will travel. From October 12–19, 2017, the multi-institutional Coastal Southeast Expedition (COSE) brought us to the coastal plains of South and North Carolina. Traveling through national forests, private lands, and public parks, we saw many habitat types, including calcareous forests, maritime depressions, pocosins (wetland bogs), Carolina Bays, longleaf pine savannas, pond cypress swamps, and ecotones (transitional regions between these habitats). In covering several hundred miles of Atlantic coastal plain between these two states, we targeted and collected taxa successfully by understanding and interpreting the plant community associations inherent in these various habitat types.

The classic paradigm of plant collecting involves gathering historical locations of desired

SEAN HALLORAN

The prickly pear cactus, *Opuntia humifusa*, grew in well-drained shell mounds. This target species may wind up in the Arnold Arboretum's recently renovated Rockery.

taxa, while leveraging local knowledge through floristic experts in the targeted collection areas. During COSE, we saw the importance of plant collectors combining these classic ideologies with the knowledge of ecological fundamentals such as floral associates, environmental factors, and lifecycle needs to identify and locate our target taxa.

Our trip began in a calcareous, or limestone, bluff forest in the Francis Marion National Forest in South Carolina, where we collected *Acer barbatum* (southern sugar maple). By seeking out this rare forest type in South Carolina, which is unique in its exposed rock outcroppings and high-calcium soils, we found the home of several species that are otherwise rare in this region. We collected seedlings of *A. barbatum,* and found *Sabal minor* (dwarf palmetto), *Ulmus rubra* (slippery elm), *Juglans nigra* (black walnut), and various ferns. Just down the bluff was Wadboo Creek, a tributary of the Cooper River. In this wooded swamp, we expected to find plants that would thrive in a similar soil type, but with much more available water, such as *Cornus foemina* (swamp dogwood) and *Ampelaster carolinianus* (climbing aster), the latter of which was climbing other shrubs and trees on both sides of the creek. We were just in time to enjoy its yellow-centered lavender flowers.

We then traveled to the Sewee Shell Ring in Francis Marion, where an interpretive trail leads to a 4,000-year-old shell ring and an 800-year-old clamshell mound. These shell mound sites, called middens, were created by Native Americans discarding clam and oyster shells that have since broken down into soil that favors the growth of certain plant species. By seeking out a sandy shell-influenced soil type at a maritime forest edge, we found *Opuntia humifusa* (eastern prickly pear) and *Tilia americana* var. *caroliniana* (carolina basswood). Just inland from these collections we found true maritime forest, with heavier soils and accordingly an abundance of stately *Quercus virginiana* (southern live oak) draped in *Tillandsia usneoides* (Spanish moss), with wonderful twisted trunks overhanging salt marsh flats.

Another habitat we encountered was the longleaf pine savanna. Once covering more than 60 million acres in the American southeast, these habitats, dominated by *Pinus palustris* (longleaf pine), have shrunk to less than 3 million acres due to overharvesting and deforestation. Despite the overwhelming dominance of *P. palustris,* these ecosystems are actually among the most diverse in North America, with plant diversity levels in the understory among the highest outside of the tropics (Outcalt and Sheffield, 1996). Many of the herbaceous species found in these habitats depend on conditions created by the presence and dominance of *P. palustris,* or on frequent fires. Without fires inhibiting woody plant expansion, the understory would not be nearly as diverse.

We first sought out this ecosystem type in South Carolina, and collected *Pinus palustris* cones in conservation lands at Brookgreen Gardens, led by their natural lands manager Mike Ammons. This pine savanna had dry, sandy soils, which don't occur frequently in the coastal plain, and we expected to find *P. palustris* trees in all stages of growth, given its tolerance to fire and need for sandy, well-draining soils.

CAT MEHOLIC

The longleaf pine (*Pinus palustris*) savannah at Brookgreen Gardens in South Carolina exhibited all stages of longleaf pine development from grass, bottlebrush, and sapling stage (first branching), all the way up to mature trees with charred trunks. The species can stay in its grass stage for many years, and then in a single year grow rapidly and tall enough to escape the effects of potential fire.

SEAN HALLORAN

Longleaf pine savannas in South Carolina support an array of fascinating understory species, including *Asclepias humistrata* (sandhill milkweed), with a sprawling growth habit in sandy areas that makes it appear to grow sideways.

In North Carolina, we encountered longleaf pine savannas in the Croatan National Forest. Botanists Andy Walker and Gary Kauffman introduced us to this habitat and pointed out rare plant species, such as federally endangered *Lysimachia asperulifolia* (roughleaf yellow loosestrife). These savannas were wetter than those we visited in South Carolina, and thus had more species tolerant of wet conditions. In small, wet depressions, for example, we found several *Sarracenia* (pitcher plant) species as well as *Dionaea muscipula* (Venus fly trap). In addition to these carnivorous plants, we collected *Persea palustris* (swamp bay), *Gordonia lasianthus* (loblolly bay), and *Zenobia pulverulenta* (dusty zenobia). We learned from Andy and Gary how quickly these plants re-establish after fire: within two seasons, burned areas become nearly impassable to humans due in part to regenerative shrub growth, as well as the vining *Smilax laurifolia* (laurel greenbrier).

Familiarity with the ecosystems of our target species is valuable not only for finding and collecting them, but also for considering the next phases of life for our propagules. While the Arnold Arboretum landscape does not feature the same conditions that we encountered in the Carolinas, we can attempt to replicate some of their characteristics when siting the COSE collections as Arnold Arboretum accessions. Luckily, with each germplasm collection, we took copious notes describing the plant and the environment where we found it—this documentation is just as important as the germplasm itself. To give our collections the best chance to thrive in Boston, we can consider these data with other criteria pertaining to the Arboretum landscape, such as topography, soil conditions, water status, and even how the original species associates perform here.

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Pieris phillyreifolia: The Opportunistic Climbing Fetterbush

Sean Halloran

At its core *The Campaign for the Living Collections* is a strategic endeavor involving years of planning and ten years of execution. Each expedition is organized thoroughly in advance, and anchored by specific target species or desiderata. However, no amount of planning can account for all of the factors at play when collecting plants in the wild, and as such non-target species are often collected opportunistically. Opportunistic collections can include biological outliers, like *Pieris phillyreifolia* (climbing fetterbush), the only Ericaceous (belonging to the heather family) plant native to North America that is also a woody vine or liana. After seeing this unique *Pieris* species, I could not resist the chance to collect it for the Arnold Arboretum, as a participant in 2017's Coastal Southeast Expedition (COSE).

Pieris comprises seven known species. The two most utilized as ornamentals are the North American native *Pieris floribunda* (mountain andromeda) and *Pieris japonica* (Japanese andromeda). During our trip, we sought out the lesser-known *P. phillyreifolia,* found only in South Carolina, Georgia, Florida, and coastal areas of Mississippi and Alabama. Walter Judd (1982) wrote about this species in detail, but W.J. Hooker first described it in 1837, initially placing it in the genus *Andromeda* (Lemon and Voegeli, 1962).

IMAGE COURTESY OF BIODIVERSITY HERITAGE LIBRARY

An 1837 illustration of *Pieris phillyreifolia,* appearing in Volume 2 of W. J. Hooker's *Icones plantarum,* where he originally placed it in the genus *Andromeda.* The specific epithet (*phillyreifolia*) reflects the resemblance of its leaves to those in the Mediterranean genus *Phillyrea,* in the olive family (Oleaceae).

While exploring Francis Marion National Forest in South Carolina, we crossed paths with Clemson University's Patrick McMillan leading a group tour of the natural history of the area. Ethan Kauffman of Stoneleigh Gardens (one of the COSE participants) was keen to collect the unusual climbing fetterbush, and mentioned this to Patrick, who then produced a hand-drawn map of a nearby location of *Pieris phillyreifolia* for the team. Armed with this treasure map, our group eagerly set out in the National Forest along US Route 17 to find it. Our collecting routine was a bit comical: we would drive along the highway and then every few minutes Ethan would jump out and run into the woods, only to emerge seconds later to let us know we were not there yet. This occurred several times and admittedly, I was growing skeptical that we would find ever this population. Finally, after turning around on the highway several times, Ethan got out of the car and motioned for us to join him in the woods: he believed he found the spot and the particular *Taxodium ascendens* (pond cypress) we were seeking. We all got out and trudged through the swampy borderlands of the highway to see if he was correct. He was! We found lianas just 9 meters (10 yards) from the highway.

It is often unique plant form and function that interest people the most, and what makes the story of this species so fascinating is not just where and how we found, but what it grew on, and the mechanics of that growth. The common name, climbing fetterbush, is apt as we found it climbing on *Taxodium ascendens* in a cypress swamp. The root system was nestled in the buttressing roots of the cypress, and the stem traveled up the host tree *underneath* the bark, emerging from vertical cracks every 1 to 2 meters (3.3 to 6.6 feet) as aerial

SEAN HALLORAN

Climbing fetterbush rhizomes grow underneath fissures in the fibrous pond cypress bark, emerging periodically to produce leafy green branches.

shoots that extended outward up to half a meter (20 inches) from the tree. The plants we found were robust climbers reaching at least 6.1 meters (20 feet) up the *Taxodium*. On our trip last fall, we only observed this plant climbing *T. ascendens*, however it also grows on *Chamaecyparis thyoides* (Atlantic white cedar), *Cyrilla racemiflora* (swamp cyrilla), *Pinus elliottii* (slash pine), and other downed trees and soil mounds, most likely to avoid standing water (Lemon and Voegeli 1962; Judd 1982).

As a plant propagator, it is invaluable to understand a plant's life cycle to grow it successfully in a controlled environment. For many taxa there are established protocols for germinating seeds, rooting cuttings, or grafting budwood. However, this is not the case for *Pieris phillyreifolia*. When in doubt we often look to established protocols for related species, so I decided to treat the seed via cold stratification for 90 days at 4 degrees Celsius (39 degrees Fahrenheit), which our propagation records indicate work for other species of *Pieris*. My first-hand knowledge of climbing fetterbush's natural environment will also be put to good use as we figure out where to cultivate this unique Southeastern U.S. native once we have successfully propagated it. Given where we found it growing, I recommend we site this plant in a wet depression under heavy deciduous shade where it can grow up a trunk or trellis. Given its native range, we should protect it from harsh winters by establishing it in a warmer microclimate within the Arboretum. Observing a plant's unique form in the wild, and researching its fascinating history upon return, deepens the appreciation for all propagules collected afield. The climbing fetterbush is no exception.

CHRIS EVANS, UNIVERSITY OF ILLINOIS, BUGWOOD.ORG

The white, bell-like flowers of *Pieris phillyreifolia* are borne in short, axillary racemes.

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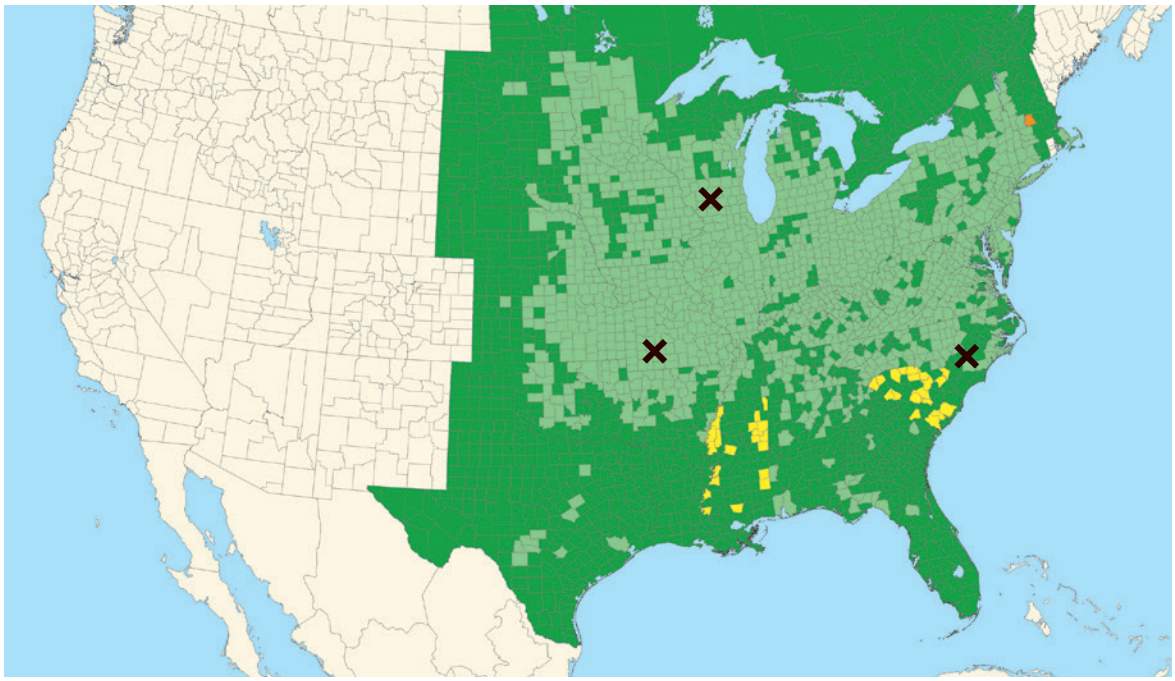
Three Times a Collection: The Quest for Moonseed

Kea Woodruff

For members of Arnold Arboretum plant expedition teams, the target taxa list is their guiding document: What are we looking for and where will we find it? Being interested in all things botanical, each collector is also invariably curious about which plants are on the other teams' target lists. When these species are duplicated on a few different teams' lists, a friendly competition arises that also unites them over a shared mission. As a first-time collector accompanying Robert Dowell on the Arkansas-Missouri Expedition (ARMOE), I was eager to test my field identification skills and compare expedition stories with the other two domestic teams in 2017. If the others were picking beechnuts in the Carolinas, I wanted to find them in Arkansas. If they were digging up red maple in Illinois, I wanted to find it in Missouri. There were several species targeted by multiple teams, but only one was successfully collected across all three domestic expeditions—*Menispermum canadense* (Canada moonseed).

Menispermum is a temperate genus in a primarily tropical family, and contains just two species: *Menispermum dauricum* from northeastern Asia, and *M. canadense,* found throughout much of eastern North America. The Arnold Arboretum has only one accession of this woody vine, obtained in 1994 from a



Common moonseed occurs throughout much of eastern North America, and the collections (×) in 2017 represent the north-northwestern, southwestern, and southeastern portions of its range within the United States. Dark green portions of the map illustrate states or provinces of species' nativity, with specific counties of occurrence shown in light green. Counties where the species is rare are shown in yellow, while counties with historic concurrences are in orange. Map modified from: Kartesz, J.T., The Biota of North America Program (BONAP). 2017. *Taxonomic Data Center.* (http://www.bonap.net/tdc). Chapel Hill, N.C.

JAN DE LAET, PLANTSYSTEMATICS.ORG

The broad, palmately lobed leaves of *Menispermum canadense* are up to 24 centimeters (9.5 inches) wide and long. Small white flowers develop into clusters of round, green and then purple fruits (drupes) when ripe.

cultivated source. The absence of wild material prompted its inclusion on the target list. Not only did our successes fulfill the *Campaign* goal of bringing in material of wild origin, but because they came from diverse geographic regions, they collectively improve the robustness of the Arboretum's holdings. Growing multiple accessions of a species from across its native geographic range increases the overall genetic diversity represented in the Living Collections. These different individuals are likely to exhibit a broader range of species' traits and adaptations, leading to a richer resource for researchers and visitors alike. And, generally speaking, growing multiple accessions of different provenances increases the odds of success (although this species is rather easy to cultivate).

Canada moonseed is not a showy vine—a former Arboretum researcher once called it "charming but overlooked" (Young, 2014). Plants can climb up to 5 meters (16.5 feet) tall, and can be mistaken for various species of *Vitis*, or wild grape. Unlike wild grape, however, all parts of the Canada moonseed are toxic. For the plant collector working in the field, diagnostic features are crucial in identifying the correct plant. A lack of tendrils—the threadlike tissue vines use to coil or spiral around supports—in *Menispermum* is a critical feature that can help distinguish it from its lookalikes. Another important diagnostic feature is its distinctive, crescent moon-shaped seed, from whence it takes its common name.

Seed is a fickle commodity. For the plant collector, locating a target species and then finding it barren of fruit can be a disappointing experience. Fortunately, many species can be collected through other means. Seedlings or young plants are an alternative if granted permission and the local plant community will not be negatively affected. Collectors will often dig up seedlings early in an expedition, hedging their bets in case they never find seed later on. Such was the case in 2017. In Missouri, my collecting partner Robert Dowell identified a

SEAN HALLORAN

The moon-shaped seed collected in Wisconsin (Accession 285-2017) germinated readily upon sowing.

creek bed in Mark Twain National Forest as a likely habitat for *Menispermum canadense.* Looking in the understory beneath huge sycamore (*Platanus occidentalis*) trees, we found many vine seedlings, including *Smilax* spp. (cat briar), *Vitis* spp., and poison ivy (*Toxicodendron radicans*). It took close (and careful!) inspection to positively identify *M. canadense* among the others. Although seedlings were abundant, the lack of mature vines meant finding seed would be improbable, so we dug them up. The Wisconsin-Illinois team collected earlier in the fall, and found seed only after first collecting seedlings. Their stories kept us hopeful that the experience would be duplicated for us. And, sure enough, later that same day, while creeping slowly along the road, we found *M. canadense* plants bearing fruits which we harvested with much jubilation. The Coastal Southeast team eventually collected their seedlings in North Carolina, too.

When we all got back and compared notes, there was a great sense of shared excitement that multiple teams collected this species, yielding six new accessions. All three teams found *Menispermum canadense* in shady understories, very near a creek, and in the same habitat as poison ivy. Once old enough to be planted out, these additions will provide an interesting native species to the shrub and vine collection. Easy to grow, this vine is generally free of insect predators and disease, and tolerates a range of conditions from full sun to full shade when in cultivation. This broad adaptability increases the likelihood that individuals from all three collection sites will thrive in Boston, giving Arboretum staff and future visitors a chance to observe and study potential differences in habit and performance among them.

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Going Clonal: Beyond Seed Collecting

Robert Dowell

Seed is the most important and most valuable propagation material an expedition targets. A handful of seed can offer genetically diverse, and logistically easy, material to procure and grow for the Arboretum's collections. Yet some target taxa present unique difficulties for collectors searching for seed. One species that exemplifies this is *Cladrastis kentukea* (American yellowwood).

As part of the *Campaign,* American yellowwood is a target. This species is unique as the only member of its genus native to North America—all others occur in Eastern Asia. Furthermore, not only is it disjunct from its Asian relatives, but its North American populations are scattered in distribution. Of the 13 living accessions in the Arboretum landscape, only one (accession 51-87) has known wild origins, collected in 1986 by Rob Nicholson in Tennessee during the Southeastern States Expedition. Thus, to broaden the species' genetic diversity in cultivation in the Arboretum, we selected its westernmost range to source additional wild material.

During the September 22 to 30, 2017 Arkansas-Missouri Expedition to the Ozarks (ARMOE), Kea Woodruff and I pursued *Cladrastis kentukea.* This tree can be a hard target to hit and offers several lessons for the plant collector. The species is nowhere abundant in its range, so pinpointing it can be an exercise in frustration. Thus, a previous collector's notes on the locations of existing populations, as well as observations of population health and size, can greatly aid a future collector's hunt. Luckily, we tracked *C. kentukea* in Arkansas due to the insights of a previous collector, Jeffrey Carstens, of USDA-Agricultural Research Service's North Central Regional Plant Introduction Station in Ames, Iowa.

When collectors do find *Cladrastis kentukea,* they often find a small population of individuals producing few if any viable seeds. Even if a

KYLE PORT

White, pea-like flowers of *Cladrastis kentuckea* are abundantly borne in long racemes, as in this old tree in the Arboretum's collection (accession 16370*A).

***Cladrastis kentuckea* occurs in scattered, disjunct populations throughout the south-central United States. The large expanse in the westernmost part of the species range served as the source of the 2017 collection. Modified from Little, E. L. Jr. (1999). *Atlas of United States Trees.* U.S. Geological Survey.**

ROBERT DOWELL

Root cuttings of American yellowwood, buried horizontally in a mixture of peat, perlite, and pinebark.

collecting team is lucky enough to beat these odds and find a healthy population with high seed set, they must do so in August. The species disperses its seed before many others do—and before most collecting expeditions occur. These frustrations have played out for past Arboretum collecting efforts. In 1986, Rob Nicholson procured seven seedlings (four of which remain in the collections), because no seed was available in October. During the Southern Appalachian Expedition (SAPPE) of late September 2016, I observed the species in both North Carolina and Georgia, yet each small population also lacked seed. Thus, we were not hopeful to find seed-bearing American yellowwood on our trip.

Luckily, *Cladrastis kentukea* illustrates an important yet less often approach for collectors: gather vegetative or clonal material instead of seeds. Depending on the season and the species, this could include leafy cuttings, dormant stem scions, or root cuttings. However, like a number of other woody genera in the legume family (Fabaceae), the only viable method for *Cladrastis* is to collect root cuttings, as enumerated by Peter Del Tredici (1995). With asexual or clonal propagation, the genetic diversity in any given collection is significantly lower than if you collect seed. A handful of sexually derived seed from one tree is a much greater pool of genetic diversity than a handful of cuttings from the same tree (which would yield identical clones). For this reason, when taking cuttings one should sample as many individual trees in a population as possible to maximize genetic capture.

Armed with this knowledge of root cutting possibilities, and location data from Jeffrey Carstens, we set our sights on an American yellowwood population at the Long Pool Recreational Area, in the Ozark National Forest. This population is located upslope—and on a very steep slope at that—from a trail running adjacent Big Piney Creek. The dry understory was noticeably rocky, with the ever-present limestone bedrock well known in Arkansas. The population we encountered was small, about 20 mostly juvenile trees; many exhibited significant dieback. The largest tree, approximately 9.1 meters (30 feet) tall and with a diameter at breast height of about 30.5 centimeters (12 inches), was the victim of recent storm damage. The tree's main leader had snapped off, and was on the ground like a decaying skeleton. As we expected, there was no seed, but we were able to gather one to two root cuttings each from seven juveniles (cuttings from young trees tend to root more easily). After excavating a bit of the soil, we collected cuttings from as near the root crown or base of the tree as possible, being cautious to do as little harm as possible. This region also lies within the "cone of juvenility" that propagators know maximizes their chances for successful rooting.

The cuttings themselves are generally 7.6 to 15.2 centimeters (3 to 6 inches) long and about 1.3 centimeters (0.5 inches) wide. When collecting them, the *proximal* end (the end closest to the trunk) is cut straight across whereas the opposite or *distal* end is cut at a slant. This allows the propagator to later identify the correct polarity or orientation of the cuttings if they insert them vertically in flat filled with growing media (proximal end up). However, typically cuttings are placed in the flat horizontally. Root cuttings generally do not require any hormone treatment (unlike stem cuttings) and are simply placed in a warm greenhouse environment to induce rooting.

After considering the special circumstances in which to use them, asexual propagation techniques serve as additional tools in the toolbox that collectors can rely on to enhance their expedition success. Of the 68 taxa (104 accessions) collected on the three 2017 domestic expeditions, 11 taxa (14 accessions) represented collections of clonal material. Some of these were the more traditional leafy cuttings or rooted divisions, but others like the American yellowwood were of root cuttings. For example, *Ulmus* spp. (elm) disperse their seeds very early in the season, so Kea and I collected root cuttings of *Ulmus alata* (winged elm) and *Ulmus rubra* (slippery elm) on our trip. These elms were already sprouting shoots by early November 2017.

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Recalling Plums from the Wild

Jonathan Damery

In 1811, a fur trader named George Sibley led a small team on a search for a storied salt mountain in the northern prairies of present-day Oklahoma. Sibley found the location in late June, although the salt did not mound; rather it formed a shimmering plain that stretched over dozens of snow-white miles. Bison peppered the expanse. On sandy hills rimming the salt plain, the team found shrubs, scantly waist high, that were loaded abundantly with small ripe plums.

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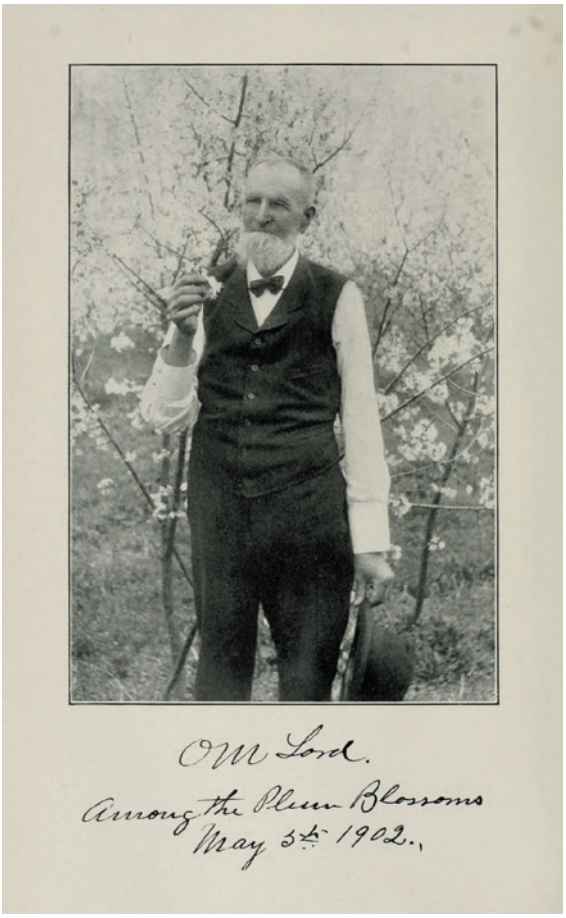

This image of Orville Lord at the age of 77 appeared in the June, 1902 issue of *The Minnesota Horticulturist*. The annotation below is in his own handwriting.

Sibley plucked these eagerly; they were, he said, "the most delicious plums I ever tasted."[1]

Small native plums can be found across much of North America. The most widespread species, *Prunus americana,* ranges from New England to the Rockies, and it has garnered common names fitting for this range: the American plum or, more generally, the wild plum. Taxonomists disagree on the number of native plum species, but the *Flora of North America* includes thirteen, nine of which inhabit the central part of the continent, west of the Mississippi (see pages 32 and 33 for a gallery). Sibley probably waxed about the Oklahoma plum (*Prunus gracilis*), given the early fruiting time and sandy habitat, but despite such arduous praise ("the most delicious"), native plums seldom appear on grocery shelves or beneath farmers market tents. That has not always been the case.

Luther Burbank, the famous horticultural polymath who began breeding plants at his home in Santa Rosa, California, in 1875, asserted that there were three important periods for plum cultivation: "the wild era," "the backyard era," and "the railroad era."[2] The disappearance of native plums occurred along this historic trajectory, at a collision between technology and taste.

Selecting Plums from the "Wild Era"

When Charles Sprague Sargent, the first director of the Arnold Arboretum, wrote about plums in his fourth volume of the *Silva of North America,* published 1892, he noted that the fruits of several native species were common in markets, particularly in inland cities like St. Louis, where foraged plums were sold both fresh and jellied. Pomologists in Iowa, Minnesota, Wisconsin, Texas, and elsewhere were also selecting cultivated varieties or cultivars (at the time referred to simply as varieties) with larger fruits, thinner skins, and freestone pits. "Selected varieties sometimes produce

PETER ASSMANN

The yellow to red fruits (drupes) of the Oklahoma plum, *Prunus gracilis*, range from 1 to 2 centimeters (0.4 to 0.8 inches) in size.

excellent fruit," Sargent wrote, "and have been largely cultivated, in the western states especially, for many years."[3]

While the Arboretum did not grow any native plum cultivars at the time, Sargent would have received insights about breeding and selection efforts from the pages of *Garden and Forest*, the horticultural magazine he began editing in 1888. In an article from 1891, Emmett Stull Goff, the first professor of horticulture at the University of Wisconsin, recounted a field trip to an orchard in southeastern Minnesota, along the banks of the Mississippi. The owner, Orville Lord, had gained regional acclaim for native plum cultivation, shipping fruits as far as New Jersey. Lord had introduced a cultivar of American plum that he named after a nearby creek, 'Rollingstone.' Goff compared the fruit of 'Rollingstone' favorably to 'Green Gage,' a popular cultivar of domestic plum (*Prunus domestica*), which, even today, occasionally appears in grocery bins. Fruits of 'Rollingstone' and 'Green Gage' were about the same size, Goff reported, and although the skin of 'Rollingstone' was thicker, he conceded that the native was nonetheless "delicious."[4]

Horticultural experimentation with native plums occurred for practical reasons. While domesticated plums had been imported from Europe, where plum consumption has occurred since Roman times, if not earlier,[5] pests and diseases proved persistent obstacles for orchardists in the central United States. Black knot, the fungal disease that forms aptly named lumps on plum branches, was one of the chief problems, as was the plum curculio, a weevil that feeds on flowers and greening buds and eventually young fruit. Although the native species were not completely immune from these problems, they fared significantly better.[6]

Orchardists in northeastern states had better luck with classic European cultivars, so interest in native cultivation remained primarily within the Mississippi watershed. Liberty Hyde Bailey, at Cornell University, listed 140 cultivars of native plums in his 1892 publication, *The Cultivated Native Plums and Cherries*, but it is clear that he had not grown many himself.[7] Rather his curiosity had been aroused by the vexing taxonomy of the species. Taken as a whole, Bailey thought native plums represented a classic instance of "contemporary evolution," given the high-degree of hybridization and morphological plasticity. His descriptive list of cultivars included fruit reviews, flowering times, and provenance narratives, but even this seemed to straddle a dual function: a horticultural guide for would-be orchardists, coupled with an attempt to systematically describe the range and variability of particular species.

Cultivated varieties provided Bailey with useful taxonomic information because, according to his estimation, more than half were wild-collected favorites, imported directly from the hedgerow to the orchard. Significantly, none of the 45 cultivars of American plum on Bailey's list originated from wild locations east of Illinois, despite a species range that extends all the way to New England.[8] Most came from Minnesota, Wisconsin, Iowa, and occasionally Missouri. One of these wild selections was Lord's 'Rollingstone,' which he first encountered in 1852, the same year he arrived in southern Minnesota and settled among mounded Mississippi bluffs. The original shrub was growing on the edge of a seasonal settlement used by the Mdewakanton—a subgroup of the Dakota—who may have intentionally selected and planted it near their encampment. Certainly, the Dakota have long valued native plums, both fresh and preserved, as have other tribes across the continent.[9] Lord was instantly enamored with the large, sweet fruit, although he would not introduce 'Rollingstone' to market for about three decades, when his attention, in older age, shifted evermore towards horticulture.[10]

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Hedrick, in *The Plum's of New York*, considered 'De Soto' "first place among the American plums" for its productivity and ability to withstand shipping. The cultivar was discovered on the banks of the Mississippi River near De Soto, Wisconsin in either 1853 or 1854.

In Minnesota City, Lord attempted to grow every cold-hard variety, reporting in 1903 that he was cultivating more than one hundred distinct selections.[11] The most extensive trial, however, likely belonged to Jonathan Kerr, a

nurseryman in Denton, Maryland. Bailey spent a considerable amount of time at Kerr's Eastern Shore Nurseries, researching varieties before he published his plum report. Unlike Lord, who primarily raised native plums for commercial fruit production and experimentation, Kerr intended to supply homeowners and orchards with plant material. In an 1895 catalog, Kerr announced that orchardists near Baltimore and Philadelphia had sold native plums for up to four times as much as the domestic plums. "They pay better,—the pay oftener, than any other tree fruit," the catalog promised.[12] The following year, Kerr reported that the nursery was growing more than 250 varieties.[13] Over the next decade, that figure would double.[14]

Tracing Plums into Backyards and Orchards

It might be careless to assume a proliferation of cultivar names implies a corresponding proliferation of cultivated acres. William Wight, a botanist for the U.S. Department of Agriculture, noted the cavalier nature of many of the horticultural selections. In a taxonomic report on the species, published in 1915, Wight estimated that more than 800 selections had been named, and some of these, he suggested, were "no better, doubtless in some cases not so good, as those found in a wild state."[15]

Even so, the native plum industry was far from mere nursery hucksterism. According to the U.S. Census of Agriculture—a report, established in 1840, tabulating everything from acres of barley to pounds of butter and fertilizer expenditures—plum production exploded throughout the central United States during the final decade of the nineteenth century. Iowa emerged as a leader, with more than 1.3 million plum trees under cultivation, almost five times the amount reported a decade before. Illinois and Missouri increased at similar rates, amounting to more than a half million trees for Illinois and three-quarters of a million for Missouri.[16]

While the census did not delineate between species of plum, the authors noted that "Chickasaw and allied varieties" predominated in the "Mississippi Valley."[17] This assessment echoed recommendations at state horticultural society meetings throughout the region, where native cultivars were always the most praised and discussed. "Our natives are the only sure foundation for commercial plum orchards in Iowa," an orchardist from Cedar Rapids, Iowa announced at one of these characteristic local meetings in 1896.[18]

Return to the Hedgerows

While the U.S. Census of Agriculture traced the rise of the plum, it also recorded the subsequent bust. Almost a million fruit-bearing plums disappeared from Iowa over the first two decades of the twentieth century. Illinois production was halved over the same period, and Missouri plums also dwindled to almost half (see data, next page). If the rising number of cultivated names paralleled an explosion of cultivated acres, then the same trend seemingly held true as production of nursery stock dwindled. The catalog for Kerr's Eastern Shore Nurseries listed only nine native cultivars in 1914, along with two hybrids that claimed native parentage, far from nearly two hundred selections previously advertised.

Now, more than a century after the native plum boom, most selections have vanished from markets and from cultivation at large. The U.S. Department of Agriculture's National Plant Germplasm System maintains repositories to conserve genetic diversity for future crop breeding. The plum collection is located in Davis, California and offers the most probable location to encounter an assortment of historic native plums. Yet compared to the number of named varieties offered for sale in Kerr's 1896 nursery catalog, the diversity is slim. The collection includes thirteen accessions of American plum, a majority representing wild provenances. Of five with cultivar names, only 'Wolf' was included on Kerr's list of more than 110 American plum selections,[19] although another ('Anderson') was also a nineteenth-century selection. Both, incidentally, were wild-collected from Iowa.

My recent search for Orville Lord's orchard in Minnesota City, Minnesota, turned up no fruit, except for several wild American plums growing near a boat launch about a mile away from his property. The center of his land is now

Midwestern Plum Cultivation

American plum production trends resemble a slow partner dance, as orchards in one region expand concurrently with reductions elsewhere. Native plums dominated cultivation in the Mississippi Valley—including states depicted here—at the dawn of the twentieth century, but as the national market for California hybrids grew, Midwestern production crashed. California growers eventually outcompeted themselves, creating an oversupply revealed with plummeting Depression-era fruit prices.[1] In the late 1950s, demand for canned plums encouraged additional Michigan production, but as consumer taste shifted towards fresh fruit, swelling California cultivation was once again cited as critical competition.[2] Data extracted from the *U.S. Census of Agriculture* represent the number of fruit-bearing plum trees reported from 1890, the first census to include plum data, through 1997. Subsequent reports have noted acreage rather than tree counts.

[1] Matthews, G. 1985. The apricot war: A study of the changing fruit industry during the 1930s. *Agricultural History.* 59(1): 25–39.

[2] Ricks, D. J. 1983. The Michigan and U.S. purple plum industry—Trends and changing marketing patterns. *Michigan State University Agricultural Economics Staff Paper.* 83(56): 1–46.

* (D) signifies "withheld data"

NUMBER OF FRUIT-BEARING PLUM TREES			
	1890	1900	1910
CALIFORNIA	1,509,833	9,823,713	7,168,705
ILLINOIS	104,111	572,774	600,087
INDIANA	146,378	723,815	566,988
IOWA	260,600	1,302,217	1,155,041
KANSAS	410,426	852,702	624,648
MICHIGAN	168,318	1,378,952	464,917
MINNESOTA	47,458	191,313	233,736
MISSOURI	152,688	745,187	917,851
NEBRASKA	227,129	542,450	351,321
NORTH DAKOTA	681	4,745	19,147
OHIO	145,832	892,441	1,001,734
SOUTH DAKOTA	42,797	123,175	268,268
WISCONSIN	18,451	94,338	105,909

a small subdivision, and a separate orchard of his in the Mississippi bottomlands was flooded when the Army Corps of Engineers built a lock and dam in 1935.

Plums of the "Railroad Era"

The disappearance of native plum cultivars can be partly explained by matters of taste. Anyone who has foraged one of these plums will likely describe the astringency of the skin, even while savoring the sweetness of the flesh inside. This characteristic is generally true of all native species. Ulysses Hedrick, who joined Bailey at Cornell, wrote a 1911 monograph on plums. He noted that while the American plum had been introduced to Europe in the mid-eighteenth century, if not before, the species was always considered a flowering ornamental in European gardens, not an orchard plant. "The Old World plums are so superior, speaking generally, in size, appearance, and flavor, the qualities which appeal to those who eat plums, that the native varieties stand small chance for popular favor," he wrote.[20]

Still, work of orchardists like Orville Lord might have continued in the central United States if not for technological innovations. In 1887, Lord imagined a native plum industry that could surpass the $2.5 million market for imported plums and prunes. "Does this sound visionary," he exclaimed at a meeting of Minnesota horticulturists. "I may ask who would

NUMBER OF FRUIT-BEARING PLUM TREES								
1920	1930	1940	1950	1959	1969	1978	1987	1997
CA 8,768,436	16,668,590	12,915,324	10,285,039	8,971,175	9,809,553	9,522,743	13,866,499	15,909,878
IL 273,554	160,494	98,382	62,148	5,765	1,659	16,511	1,623	698
IN 214,202	117,713	59,155	42,181	7,467	4,197	4,369	1,990	603
IA 313,769	290,613	177,375	118,018	11,076	4,950	824	487	426
KS 143,473	139,590	46,665	32,434	4,684	1,122	1,241	302	544
MI 377,123	312,899	204,022	264,976	237,325	579,239	480,651	315,164	131,085
MN 193,668	224,974	160,947	130,449	10,337	2,022	2,243	1,299	2,501
MO 528,649	317,598	239,804	121,032	15,426	1,325	4,394	2,910	544
NE 86,183	118,133	36,173	33,574	4,812	209	441	274	(D)*
ND 41,254	47,423	14,657	48,989	19,573	1,779	1,340	(D)*	(D)*
OH 459,265	323,731	187,548	130,587	44,651	32,518	17,151	10,182	5,165
SD 117,677	100,185	21,137	63,222	4,302	802	769	266	628
WI 117,844	126,538	102,891	83,242	10,522	2,913	4,345	2,838	878

have dared to predict, thirty years ago, the small fruit business of … Chicago, Minneapolis or St. Paul. Then, a carload would have supplied the market of either place. Now, thousands of bushels are daily marketed in their season."[21]

Lord was optimistic about the voracious appetite of a booming city. Over the same thirty-year period, Chicago grew from a city of about three hundred thousand to a metropolis exceeding one million, but Lord missed the implications of the same appetite. If Chicagoans could each consume one quart of strawberries—berries that were not grown in the city, but rather, were grown in the hinterlands and shipped inward via rail—then the same transport innovations could undercut the need for locally grown native fruits. Over the decades that Lord cultivated increasing acres of native plums, railroads had connected the coasts. The first transcontinental passage occurred in 1869, and, in 1890, a California fruit shipper, Edwin Earl, devised a railcar suited for long coast-to-coast shipments. Along the way, pantries and iceboxes in Chicago and beyond became less beholden to horticultural limits for the region.

Luther Burbank alluded to these innovations when he posited the "railroad era" as the ultimate stage for plum production. "The railroad became a factor in plum improvement by bringing millions of plum-hungry easterners within reach—by affording quick and economical shipping facilities where there had been no


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Horticulturist Luther Burbank, flanked by Thomas Edison (left) and Henry Ford (right), in this image that appeared in Burbank's 1916 seed catalog *Twentieth Century Fruits*.

shipping facilities before," Burbank quipped to editors of his multi-volume biography, published in 1914.[22] *Garden and Forest* recorded this rail-powered influence, announcing in 1895 that classic cultivars of domesticated European plum had arrived in New York on rail shipments from California, along with peaches, pears, and grapes. "Forty-four car-loads of California fruits were sold here in five days of last week," the magazine reported.[23]

As the final achievement of the "railroad era," Burbank—an alchemical breeder, dubbed a horticultural "wizard" in his own time[24]—developed large thick-skinned plum hybrids that were easier to ship across country. Ironically, he used native species to impart that thicker skin, along with disease resistance, but otherwise, the flavor and appearance most strongly resembles the other parents: the Japanese plum (*Prunus salicinia*) and the apricot plum (*Prunus simonii*).[25] Burbank's hybrids—most famously 'Santa Rosa'—still dominate the American plum industry and have been the parents of other successful and widespread cultivars.[26]

Another Era for the Native Plum

Recent attempts to introduce native plums into the market have centered on beach plum (*Prunus maritima*), a species that hems the sandy coastline of New England, growing on shifting dunes, alongside American beachgrass (*Ammophila breviligulata*). The James R. Jewett Prize was established at the Arnold Arboretum for research on the species in 1940, and although the award waned after little more than a decade, it was reinstated in 1997 when researchers at Cornell University launched a concerted commercialization project.[27]

Richard Uva, who instigated the Cornell research under the direction of Professor Thomas Whitlow, now grows three acres of beach plums on his cut-flower nursery, Seaberry Farms, in Federalsburg, Maryland. He estimates that twenty-two acres of beach plum are currently under production between sixteen growers in Massachusetts, Maryland, New Jersey, and Long Island. This is not enough to meet the growing commercial demand, especially among distillers, brewers, and winemakers. Growers have also found a market among chefs, especially in tourist beach towns, where the plums are a stamp of local credibility for the menu. Jam and jelly productions remains a relatively small scale.

For other plum species, production and research has yet to return, although interest in indigenous ingredients has swelled more generally in recent years. Part of this interest

GREENHOOK GINSMITHS

One of the first of alcoholic products made from beach plum is a gin liqueur, manufactured by Greenhook Ginsmiths in Brooklyn. It is made in the manner of sloe gin—a product made with a European native plum (*Prunus spinosa*)—by steeping whole plums in gin for a matter of months.

MICHAEL S. DOSMANN

The author makes observations on a beach plum (*Prunus maritima*) submerged by sand dunes on Cape Cod in 2010.

could be attributed to work by organizations like Slow Food, which, in 1996, launched a program known as the International Ark of Taste, designed to protect and preserve distinctive regional foods that are threatened with gastronomic extinction. Beach plums are listed among more than two hundred imperiled products in the United States, as are other oft-overlooked native foods like shagbark hickory nuts (*Carya ovata*), groundnut tubers (*Apios americana*), and tangy staghorn sumac fruits (*Rhus thypina*).

Whether interest in native plums will be rekindled as part of this larger trend is yet to be seen. But during the historic boom of native plum cultivation, Abraham Dennis, an orchardist in Cedar Rapids, Iowa, became particularly inspired by the long history of plum cultivation among Native American communities in the region. He suggested there was almost a moral imperative to perpetuate the process. "It is not alone our duty to rescue these fruits from their wild state and reawaken by culture these higher qualities given them by similar efforts by ancient horticulturists," Dennis said at a horticultural meeting in 1897. "But," he continued, "we must transmit them to future horticulturists more perfect fruits than we found them—new qualities added—worthy of the advanced and scientific age it is our privilege to live in."[28] Now, well over a century later, Dennis's challenge resonates, enticing foragers and horticulturists back to the hedgerows and thickets to reclaim plums from the wild at last.

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***Prunus americana* by T. Davis Sydnor, The Ohio State University, Bugwood.org**

***Prunus angustifolia* by Karan A. Rawlins, University of Georgia, Bugwood.org**

***Prunus nigra* by R. W. Smith, Lady Bird Johnson Wildflower Center**

THE AMERICAN PLUMS

Plum taxonomy has long perplexed botanists, including Bailey. "Native plums constitute probably the hardest [black] knot in American pomology," he wrote. "The group is one of the most inextricably confused of any one of equal extent in our whole flora."[29] More recently, Joseph Rohrer, writing about *Prunus* for the *Flora of North America*, described the "particularly troublesome" delineation of plum species. "Surely," he wrote, "as more molecular and genetic data are analyzed and, more importantly, correlated with morphological data, circumscription will be redrawn and the number of North American plum species further reduced."[30] As it stands, *Flora of North America* recognizes thirteen species of native plums, outlined below.

***Prunus americana* (American plum):** The most widespread species, with a range stretching from New England to the Rocky Mountains. According to Hedrick, about 260 cultivars were derived from this species during the historic plum boom.

***Prunus angustifolia* (Chickasaw plum):** A distinctive southern species, ranging from Virginia to eastern New Mexico and south through Florida and other Gulf states. In 1911, Ulysses Hedrick counted about twenty horticultural selections of this species.[31]

***Prunus geniculata* (scrub plum):** A federally endangered species found on sandy hills in central Florida. Fruits develop early compared to other species, from March to May.

***Prunus gracilis* (Oklahoma plum):** A small suckering species, no more than 1.5 m (4.9 ft) tall, which grows in dry, sandy locations. No significant horticultural varieties have been named, although Frank Waugh of the Vermont Agricultural Experimentation Station reported, in 1901, that the "fruit is sometimes gathered and sold in local markets."[32]

***Prunus hortulana* (hortulan or wild goose plum):** Distribution for this species centers on Missouri and Illinois, with scattered pockets through southern Ohio and possible introductions in the Virginias. In older literature, this species was divided into two groups—wild goose and miner plums—which collectively resulted in about thirty-six named selections, according to Hedrick, although Kerr advertised more than fifty.

***Prunus maritima* (beach plum):** A denizen of the sandy coastline between Maine and Delaware. In 1911, Hedrick counted only two cultivars ('Bassett' and 'Beta'). The num-

ber climbed by at least another dozen in the 1950s, through work funded by the Jewett Award,[33] and most recently, Rutgers released a cultivar named 'Jersey Gem.'

***Prunus mexicana* (Mexican or bigtree plum):** The largest of native species, forming a tree up to 12 m (39 ft) tall. It ranges from northeastern Mexico to northern Illinois, east to Kentucky and Alabama.

***Prunus murrayana* (Murray's plum):** A suckering shrub known only from scattered populations near dry streams and canyon beds in southwestern Texas.

***Prunus nigra* (Canada plum):** A northern species that grows around the Great Lakes, ranging east to Massachusetts. It offered hardy characteristics for orchardists in Minnesota and Wisconsin, who, according to Hedrick, named about forty cultivars.

***Prunus rivularis* (creek or hog plum):** A widespread species that has come to encompass a larger-statured taxon, *Prunus munsoniana*. The primary distribution is located between Texas and Missouri, with scattered populations to southern Ohio. At least sixty horticultural selections were made of this species by 1911, particularly among southern orchardists.

***Prunus subcordata* (Sierra, Klamath, or Pacific plum):** Found in California and Oregon, this is the only plum native west of the Rocky Mountains. Hedrick did not count the number of cultivars derived from this species, but he quoted Luther Burbank, who described certain selections with fruit as "sweet as honey."

***Prunus texana* (peachbush or Texas wild peach):** Long considered a peach rather than a true plum, this fuzzy-fruited species has a small range stretching from central Texas to the Gulf coast. DNA sequencing has revealed that subgeneric classification of *Prunus* is more complicated than the five-parted system that formerly partitioned plums and peaches into separate subgenera. While other native peach-like species occur throughout the southwest, recent work places *P. texana* clearly within the plums.[34]

***Prunus umbellata* (hog, flatwoods, or Allegheny plum):** A shrub or tree, growing to 6 m (19.7 ft) in height, this species ranges between North Carolina and eastern Texas. Traditionally a northern population in Michigan and the Allegheny Mountains was treated as a separate species, *P. alleghaniensis*, but the taxa have more recently been grouped.

***Prunus subcordata* by Terry Spivey, USDA Forest Service, Bugwood.org**

***Prunus texana* by William R. Carr**

***Prunus umbellata* by James H. Miller and Ted Bodner, Southern Weed Science Society, Bugwood.org**

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Insights from a Sole Survivor: *Quercus castaneifolia*

Peter J. Zale

Oaks (*Quercus* spp.) have become a worldwide symbol of tree conservation. Of the approximately 450 described oak species, at least 175 are of conservation concern and many require further conservation assessments (Oldfield and Eastwood, 2007; Jerome et al., 2017). To aid in these efforts, public gardens around the world have invested significant energy to develop taxonomically and geographically exhaustive, genetically diverse oak collections with high conservation value. Aside from their importance as landscape and garden specimens, maintaining living collections of oaks in public gardens is particularly important because recalcitrant (desiccation intolerant) oak seeds cannot be stored long term in germplasm repositories, highlighting an increased need for *ex situ* conservation of individual trees and improvements in collection practices. Within the United States, the American Public Gardens Association (APGA) has recognized the efforts of 20 public gardens who have formed a Plant Collections Network *Quercus* multisite collection to tackle some of these efforts (APGA, 2017).

Benchmarking studies have become an important tool to help these and other gardens prioritize their conservation and collecting efforts by revealing the diversity of oaks in their collections relative to those in cultivation elsewhere. Gaps, or missing species, reveal areas for future development, and the identification of species (or clones) uniquely or poorly represented in cultivation can indicate those in need of further preservation and distribution. However, the power of benchmarking is predicated on the quality of records and the verification of species to accurate identity. In 2015, verification of tree plantings on perimeter areas of Longwood Gardens revealed a mysterious oak bearing an incorrect label. An exercise in curatorial sleuthing led me on a chase to discover the species' identity to be *Quercus castaneifolia,* chestnut-leaf oak, and that the accession had a provenance linked to the wilds of northern Iran. In my further investigations, I learned more about its natural history and, eventually, saw it growing in its native habitat.

Taxonomy and geography of chestnut-leaf oak

Quercus castaneifolia was first described in 1831, and belongs to Section *Cerris* and Subsection *Cerris,* a placement within the genus that has remained stable since Camus' 1936 monograph. However, the taxonomy within *Q. castaneifolia* has been debated, with at least eight intraspecific botanical taxa (varieties, subspecies, and formae) described based on differences in leaf, acorn, trichome, foliar epidermis, and pollen morphology (Panahi et al., 2011). Molecular analysis using Amplified Fragment Length Polymorphisms (AFLP) indicated that the differences at the molecular level were not enough to distinguish among the previously proposed intraspecific taxa, except for *Q. castaneifolia* subsp. *aitchisoniana,* and that molecular variation in some cases was indicative of introgression from other species (Azadbakht et al., 2015). Presently, the botanical community considers *Q. castaneifolia* to be a single polymorphic or highly variable species (Rix and Kirkham, 2009; The Plant List, 2017).

In addition to its distinct leaf characters, diagnostic morphological features of this species include its linear bud scales, and curiously elongated, but variably sized, ellipsoidal acorns—maturing in two years—that reach 2 to 4.5 cm (0.78 to 1.78 in) in length and have cupules or caps covered with prominent scales (see inside front cover). The branching habit of mature trees is variable, ranging from upright with a dominant central leader, to a spreading structure devoid of a strong central leader that

LONGWOOD GARDENS

***Quercus castaneifolia* is aptly named, with leaves [7 to 20 cm (2.8 to 7.9 in) long and 3 to 6 cm (1.2 to 2.4 in) wide] resembling those of the sweet or Spanish chestnut (*Castanea sativa*). This herbarium voucher was collected from the specimen growing at Longwood Gardens.**

The natural range of *Quercus castaneifolia* (shown in green) extends from Azerbaijan's Talysh Mountains along the southern border of the Caspian Sea to Gorgan, Golestan Province, Iran (map modified from Sales and Hedge, 1996).

results in a distinctly rounded canopy. In the wild trees can reach heights of 45 m (148 ft), but 10 to 25 m (33 to 82 ft) tall and wide seems more typical, particularly in cultivated trees. Fall color develops late in the season in hues of clear yellow and brown.

Chestnut-leaf oak is a member of the Hyrcanian Forest (from "Hyrcania", the Greek form of an old Persian word describing the region of Gorgan or Asterabad, Iran), a relict forest widespread during the Tertiary Period (65 to 15 million years ago) and now occurring only on the mountain ranges that surround the southern Caspian Sea. The forest is a well-defined glacial refugium rich in endemic species, including this oak (Milne and Abbott, 2002). Throughout its range, it grows from sea level to 2400 m (7875 ft) in elevation, and is reported to grow on the northern aspects of mountain slopes. (My personal observations, however, indicate a more general distribution, at least in Azerbaijan.) In the Talysh Mountains of southeastern Azerbaijan and northwestern Iran, it is a component of the *Quercus-Buxus* Forest that once dominated the Caspian Coastal Plain, and the *Quercus-Carpinus* Forest in the lowlands to 1200 m (3937 ft). The latter forest type transitions to the *Quercus-Zelkova* Forest in the drier climate of Iran's Alborz Mountains (Panahi et al., 2011). In some of these areas, *Quercus castaneifolia* can form pure stands, although it becomes a member of *Fagus orientalis* (oriental beech)-dominated forest above 1200 m (3937 ft). It is a minor forest component in the eastern portion of its range, in areas dominated by *Platycladus orientalis* (Oriental arborvitae) (Menitsky, 2005). One study indicated that *Q. castaneifolia* comprises 6.5% of the total Hyrcanian Forest, belying the fact that it is among the most commonly encountered species in the region (Panahi et al., 2011). It has yet to be analyzed for Red Listing to determine its conservation status (Oldfield and Eastwood, 2017).

The Specimen at Longwood Gardens

In the 1950s Longwood Gardens became part of a large-scale project called the Michaux Quercetum. This project began as a partnership between the Morris Arboretum of the University of Pennsylvania and the Northeastern Forest Experiment Station of the USDA, and was financed in part by the Michaux Fund of the American Philosophical Society. The primary purpose of the study was to develop a large-scale provenance test of US native oak species with the goal of selecting genetically superior trees for breeding and forestry purposes. Another part of the project was defined loosely as "preliminary tests of exotic oak species from all temperate oak-inhabited parts of the northern hemisphere" (Schramm and Schreiner, 1954). Little information exists on the full extent of exotic species of oaks trialed in the various Querceta, but in 1968, several exotic oaks were planted adjacent to the original Michaux Quercetum here in Longwood Gardens.

Among these were oak seedlings bearing USDA Plant Introduction (PI) numbers 228074 and 228075, both originally collected in 1955 as acorns by USDA Agricultural Explorer Howard Scott (H. S.) Gentry in northeastern Iran. The Plant Introduction Inventory (USDA, 1964), records Gentry's description for the collections, each listed as yet-to-be-identified *Quercus* sp. For PI 228074: "Col. Nol. 15709. Twenty-five miles south of Kalow, Caspian slope of Alborz. Sept. 12, 1955. Elevation 6,000 feet. Second

PETER ZALE

In 2016, the specimen at Longwood Gardens (accession 1957-2444*A) was 15.5 m (50.9 ft) tall and 21.9 m (71.9 ft) wide, and had a DBH (diameter at breast height) of 112.5 cm (44.3 in). It has an ascending branching pattern and a distinctly rounded, spreading crown.

growth from cut trees." And, for PI 228075: "Col. No. 15799. Fifty-four miles east of Gorgan. Sept. 15, 1955. Spreading tree to 30 feet high." These were grown at the US Plant Introduction Garden (USPIG) in Glenn Dale, Maryland, and in September 1957 Longwood Gardens received three seedlings of PI 228074 and two of 228075, which were planted in the research nursery and later near the Michaux Quercetum.

The Michaux Quercetum and adjacent oak plantings received little attention for the next five decades, providing a true test of a tree's ability to survive with relative neglect. During the summer of 2015, the plant records office was inventorying trees in this part of Longwood Gardens and 'rediscovered' an unidentified oak tree. It was then brought to my attention and I began the detective work. An old planting map indicated the tree was Longwood Gardens accession 1957-2444*A, and the original packing slip from the USPIG linked that accession to one of Gentry's collections: PI 228075 (accession 1957-2443 was assigned to PI 228074). It appears as if one seedling of each collection perished in the first few years. In 1971, an inventory of the Quercetum indicated that the two remaining seedlings of PI 228074 had perished due to sun scald, but no update was given for PI 228075. Using Gentry's original collection notes of the tree's nativity, I used the distinct shape of the tree's leaves, acorns, and linear bud scales to confirm the identify as *Q. castaneifolia.* Further research indicated that it is the only remaining tree in cultivation from Gentry's collection, and is thus unique among cultivated accessions of this species in public gardens worldwide.

Because of its unique lineage, and the rarity of wild-collected *Q. castaneifolia* in the US (see below), I collected acorns in 2016. Oaks are

TONY KIRKHAM

The Kew specimen (accession 1969-15985) is one of the largest trees at Kew, and is the largest chestnut-leaf oak in the British Isles. In 2016 it was approximately 35 m (115 ft) tall, 30 m (98 ft) wide, and had a DBH of 2.52 m (8.26 ft) at 1.5 m (4.9 ft).

anemophilous (wind-pollinated) species that generally rely on fertilization from genetically different individuals of the same species for successful seed development. But there is some evidence that oaks have the ability for self-pollination on a limited basis (Yacine and Bouras, 1997). Of the 24 seeds collected, 12 germinated and the resultant seedlings so far appear to be true-to-type, despite extensive nearby plantings of US native and exotic species including *Quercus macranthera* (Caucasian oak), which is reported to hybridize with *Q. castaneifolia.* Despite promising initial results, verification to identity will have to wait until the seedlings mature. If anything, they can serve as understock to graft scions from the original tree, which would preserve the exact genetic lineage.

Chestnut-leaf Oak in Cultivation

The Botanic Gardens Conservation International (BGCI) PlantSearch website indicated that 68 public gardens worldwide (mostly in Europe) grow this species. For comparison, 148 gardens list the commonly grown *Quercus cerris* (Turkey oak), while 54 gardens list the less common *Quercus libani* (Lebanon oak). Perhaps the best-known specimen in cultivation is the tree growing behind the Water Lily house at Kew Gardens, London. Widely accepted as the first introduction of the species to cultivation in western Europe, the accession was received as seed in 1843 and was reputedly planted in 1846 by William Hooker himself (Rix and Kirkham, 2009). This imposing specimen is one of the most recognized trees in the collection at Kew and was one of few to survive the great storm of 1987 without damage.

Records of this species in cultivation in the United States are few. Some of the largest are two 1938 trees (239-38*A and D) at the Arnold Arboretum of Harvard University, which came from the Mount Mashuk Forest Garden Experimental Station in Pyatigorsk, Russia (Northern Caucasus), which is outside of the species natural range. The larger of the two (239-38*D) stands 22.33 m (73.3 ft) tall, has a spread of 18.3 m (60 ft), and a DBH of 98.6 cm (38.8 in). A query of the most current inventory (2014) of the members of the Plant Collections Network multisite *Quercus* group indicated 19 living accessions of *Quercus castaneifolia* in nine gardens. Of these, 16 are of garden or nursery origin, two are from wild collections, and one is actually a hybrid: *Q. castaneifolia* × *Q. cerris.* Interestingly, the two wild plants are 1994 accessions growing at the UC Davis Arboretum and originally came from Dr. Ahmad Mossadegh, Professor of Silviculture at the University of Tehran. He collected seeds from the Loveh Region, near Gorgan, Iran at an elevation of 830 m (2723 ft). This source locality, similar to that of the Longwood specimen, indicates that all of the known wild-sourced material in cultivation in the US comes from a similar place in the eastern extent of the species range. In addition to growing in the institutions mentioned above, chestnut-leaf oak is also at the Bartlett Tree Research Arboretum (Charlotte, NC), Denver Botanic Garden, Cornell Botanic Gardens (Ithaca, NY), and Morton Arboretum (Lisle, IL). Its ability to grow in such diverse places suggests a tolerance to extremes of heat and cold (USDA Hardiness Zones 5 to 9), as well as drought and a range of soil types. It is worth experimenting growing the tree in colder and drier regions where the palette of available landscape trees is limited.

Quercus castaneifolia, recognized for its durability and ornamental qualities, has a number of selections. Aimée Camus, in her 1936 *Les Chênes: Monographie du genre* Quercus, was the first to mention four cultivars (then formae) of *Q. castaneifolia:* 'Asplenifolia', 'Filicifolia', 'Aureovariegata', and 'Pyramidalis'. Although there were no descriptions provided, it is likely that the first two had fern-like, and the third had variegated leaves; the fourth likely had a narrow, yet not fastigiate, habit. No plants bearing these names have been found living in modern collections. Several other cultivars in Europe bear the place name where the original plant was selected. 'Sopron', 'Zorgvlied', and 'Zuiderpark' originated in European parks or cities, and have not been widely propagated or distributed. Though listed as a selection of chestnut-leaf oak, 'Algerensis' appears to be synonym for *Quercus afares,* the Algerian oak, a morphologically similar species from the coastal Atlas Mountains of Algeria and Tunisia.

Perhaps the most common cultivar is 'Green Spire' (note spelling, as numerous sources have it listed as 'Greenspire'), selected and introduced by Hillier and Sons Nursery (Winchester, UK). It is described as "a broadly columnar form of compact habit, raised in our nurseries about 1948. A vigorous, tall tree. Probably *Q. castaneifolia* × *Q. libani*" (Hillier Nurseries, 1991). This selection has become available in the US and its putative hybrid origin requires verification. The species is known to hybridize with others (particularly within Section *Cerris*), and although hybrids are poorly represented in cultivation, could prove valuable for creating widely adaptable, drought-tolerant trees suitable for managed landscapes, notably urban forests. Oikos Tree Crops (Kalamazoo, MI) offers *Q. castaneifolia* ECOS Form, an open-pollinated strain sold as both seeds and seedlings from their original trees. According to their website description, the trees were originally obtained by growing acorns from gardens and arboreta, and may represent hybrids between *Q. castaneifolia, Q. cerris,* and *Q. acutissima* (sawtooth oak). They were reported to be the fastest growing oaks in their nursery, reaching nearly 2 m (6.6 ft) in height after two years from seed.

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A large tree near Lankaran, Azerbaijan, had grey-brown bark with prominent, vertical ridges.

Quercus castaneifolia in Azerbaijan

From 9 to 22 September, 2017, the Plant Collections Collaborative (PCC, 14 US public gardens with similar interests in domestic and international plant exploration) organized and performed a plant collecting trip to the Republic of Azerbaijan. Participants included Phil Douglas (Chicago Botanic Garden), Matt Lobdell (Morton Arboretum), Vince Marrocco (Morris Arboretum of the University of Pennsylvania), and myself. Henrik Sjöman of the Gothenburg Botanical Garden (Sweden) joined us for the last week of the trip. Among the collection targets developed during trip planning was *Quercus castaneifolia,* no doubt inspired by my now familiarity with Longwood's single specimen.

We were pleasantly surprised to find the species ubiquitous in the Lankaran Region of southern Azerbaijan, in the wild as well as a cultivated tree. It grew at sea level and was still abundant at 1500 m (4921 ft) in elevation, the highest point we reached between Lerik and Orand. We found it with other characteristic species of the Hyrcanian Forest: *Acer velutinum* (velvet maple), *Buxus sempervirens* (common boxwood), *Carpinus betulus* (European hornbeam), *Parrotia persica* (Persian ironwood), and *Zelkova carpinifolia* (Caucasian zelkova). Trunks of old, open-grown trees were often massive and supported a distinctive branching structure with a tall, straight central leader and irregular branches that resulted in a loosely rounded crown. Unfortunately, none of the trees bore mature acorns, and our guide, Dr. Haçiaga Sofarov, Deputy-Director of Hyrcan National Park in Lankaran, indicated that they would not be ready until late-October or early-November. This corresponds to the timing of seed maturation of the tree at Longwood, but differs from

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The acorns found on trees near Lankaran, Azerbaijan were unripe in mid-September of 2017, foiling the collectors' plans.

Gentry's field collection date of September 15, 1955, suggesting that acorns may mature earlier in the southeastern part of the species range.

Chestnut-leaf oak is perhaps the most widely cultivated tree in the Lankaran Region. We immediately encountered extensive plantings used as windbreaks amongst the vast agricultural expanses that dominate the Caspian Lowlands. Street trees were also common, which thrived despite compaction from surrounding sidewalks and streets, late-summer heat and drought, pollution from vehicle exhaust and general neglect. PCC members are again planning an autumn 2018 trip again to southern Azerbaijan to make collections of this and other important, under-represented species. Hopefully, our success in capturing the northwesternmost extent of its range will increase the presence of wild-origin *Q. castaneifolia* at public gardens across the US,

Conclusion

Curatorial mysteries, like the story of Gentry's unidentified oak, are found in public gardens throughout the world. When acknowledged and solved, they not only enrich the collections and institutions where they exist, but also the greater public garden, horticulture, and botanical communities. As is the case for *Quercus castaneifolia* at Longwood Gardens, unraveling this mystery helped us inform, revise, and add value to our plant collections, their data, and our broader collections development objectives. The project shed new light on an underrepresented and under-collected species worthy of greater attention, and I hope this work serves to open new avenues of germplasm preservation, acquisition, and interpretation.

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A restaurant nestled in a shelterbelt of chestnut-leaf oak north of Lankaran, Azerbaijan. Like cultivated trees observed elsewhere, the trunks were painted white, supposedly as a preventative measure against trunk damaging insects.

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A Winter Beauty: *Viburnum opulus*

Brendan Keegan

When I think back on my experience as a Peace Corps volunteer in Ukraine, my memories are often drawn to the cold, snowy days of January. In the silence of winter afternoons, the plants in the small town of Terebovlya seemed especially distinct. I often walked through haunting groves of silver birch (*Betula pendula*), white bark against the white snow of fields beyond. Near the school where I worked, two magnificent bigleaf lindens (*Tilia platyphyllos*) towered like giants among young European hornbeam (*Carpinus betulus*). However, nothing stood out against the winter gray so much as the bright red fruits of *Viburnum opulus,* a plant that Ukrainians have long praised in song, poem, and prose as a visceral symbol of beauty and identity.

Native to Europe, Asia, and North Africa, *Viburnum opulus* is a multi-stemmed deciduous shrub. It has a rounded growth habit and can grow up to 5 meters (16 feet) tall. Although it is known as *kalyna* in Ukrainian, Western Europeans often call it the guelder rose, so-named for a region of the Netherlands where the popular "snowball tree" cultivar supposedly originated. In North America, *Viburnum opulus* is called European cranberrybush, because of its tart, cranberry-like red fruits, despite the fact that it is in the moschatel family (Adoxaceae) and unrelated to the true cranberry (*Vaccinium macrocarpon*), a member of the rhododendron family (Ericaceae). (European cranberrybush is *V. opulus* var. *opulus;* the similar looking American cranberrybush, previously known as *V. trilobum,* is now known as *V. opulus* var. *americanum.*)

During the summer months, *Viburnum opulus* bears three-lobed, dark green leaves, 5 to 10 centimeters (2 to 4 inches) long and wide. These palmate leaves, which resemble those of some maples, have deeply impressed venation, wrinkled surfaces, and soft undersides. In the autumn, the foliage often turns beautiful hues of red and purple.

Red is also the color of the fully ripened berry-like drupes (fleshy, single-seeded fruits), which mature in late fall and can remain on the plant until the following spring. The vibrant fruits hang in dense clusters and, although they are primarily consumed by birds, they are also edible to humans. Tart and bitter until softened by frost, they are nonetheless believed to have medicinal properties, and Ukrainians consume small quantities raw, baked, or in tea to help treat various illnesses. It is also common to see fruit clusters adorning entryways, as well as on traditional Ukrainian embroidered clothing, as symbols of health and fertility.

In North America, the beautiful white lacecap inflorescences of *Viburnum opulus* are often considered the plant's defining aesthetic characteristic. Each cyme is composed of a single ring of large, white petaled, sterile florets on the outside and bunches of smaller fertile florets on the inside. Some cultivars, such as the popular *V. opulus* 'Roseum' produce inflorescences composed of entirely sterile flowers that look like snowballs or pom-poms, leading to the nickname "snowball tree." Another popular cultivar, *Viburnum opulus* 'Xanthocarpum' has the typical flat white corymbs, but produces bright golden yellow fruits instead of red.

Earlier this year, I stopped by three *Viburnum opulus* accessions (352-78*A, C, and E, collected in the wild from the northeast of Denmark) in our Viburnum Collection. Humble looking among their neighbors, it was interesting to reflect that this plant is ubiquitous in small Ukrainian towns and villages where it is proudly planted next to homes. I had the chance to reflect on this again later in October when my wife and I were visiting friends in Ukraine. While there, one of her former colleagues asked where I worked, and I stumbled over describing the Arnold Arboretum and its mission of plant research and conservation. However, when he followed up my explanation by asking whether or not we grew *kalyna,* I was proud to say yes.

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