Collecting in the West

by Robert Nicholson

During September 1981 I had the good fortune to spend several weeks on a plant- and seed-collecting expedition for the Arnold Arboretum. The trip brought me over 5000 miles of road and eight states in the American West, a terrain sculpted by wind and water and draped in a mantle of botanical wonders.

The purpose of the trip, in addition to that of expanding the Arboretum's collections, was to obtain seeds of plants that may be either endangered or of special interest to the plant sciences or nursery trades. I also wanted to collect herbarium specimens for certification and exchange, as many of the species I was looking for are poorly represented in herbaria throughout the world.

My trip began in the still air of libraries and herbaria, where I spent many hours combing herbarium sheets to gain a familiarity with the plants and sifting through the often cryptic locale data of former collectors. As my stack of notes grew, one element began to emerge and engage my fascination: the mysterious existence of plant disjunctions.

A disjunction, as the name implies, involves a discontinuity within a taxon's range. For example, the primary range of the Cascade azalea (*Rhododendron albiflorum*) is the Cascade Mountains, from British Columbia to Oregon, and scattered populations exist in the Rocky Mountains of Alberta, Canada, northern Idaho, and western

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Robert Nicholson has made several collecting trips for the Arnold Arboretum.

The barren northwest slope of Agassiz Peak at 11,600 feet

Montana. However, an outlying population exists in central Colorado, about 500 miles from the others. A distribution pattern such as this can raise intriguing questions as to the taxon's origins and continued existence.

E. C. Pielov, in his book *Biogeography*, created a classification scheme that groups disjunct populations according to their origins. According to his scheme the causes of a gap in the range of an organism are as follows:

(1) Splitting of a once-continuous range because of:
  (a) Geomorphological changes, i.e., an uplift of mountains
  (b) Climatic changes
  (c) Evolutionary differentiation and migration

(2) Establishment of new populations over long distances (jump dispersal) owing to:
  (a) Natural causes
  (b) Human agency

Disjunctions, therefore, are islands of botanical life, populations of plants that exist far from the mainland of a species' range. These populations may differ from primary populations — for example, they may be hardy in a greater range of habitats — and so are of interest to collectors. They also challenge the botanist to determine the cause of the split from the main range. Was it the gradual uplift of the mountains or the slow drying within the new mountain's rain shadow? Was it the movement of birds in migration or the lethargic sculpting of the glaciers?

P. aristata *on the southern slope of Agassiz Peak at the same elevation*

The Rhododendrons of Slavonia

The first disjunct population I encountered grew near Slavonia, an abandoned mining town in central Colorado, close to the Wyoming border. In the Routt National Forest, on the edge of the Zirkel Wilderness, grows the state's only native rhododendron species, the Cascade azalea (*R. albiflorum*). This species is better known as a component of the humid lowland forest as well as the subalpine areas of the Pacific Northwest. It favors high-altitude wetlands and tends to form low clumps around lakes and streams. It has an oblong deciduous leaf and in early summer bursts into creamy white blossoms about one inch in diameter.

The species was first found in the Rocky Mountains of Canada by a Scotsman, Thomas Drummond, in the wilderness years of the early 1800s. Sir William Hooker rendered the first description in *Flora Boreali-Americana* in 1840 and called it "a very beautiful and most distinct species which would be a great ornament to our gardens if it could be introduced." The latter qualifier proved prophetic, as horticulturists labored to grow it. A Dr. Graham of the Royal Botanic Garden, Edinburgh, was the first to record its flowering nonsitu and wrote: "This very distinct species was raised at the Botanic Garden from seed gathered by Mr. Drummond in British America in 1828. It does not grow freely and flowered rather sparingly in the open border for the first time in July 1837. It is to be regretted if it is found difficult of cultivation for Mr. Drummond stated it formed a very handsome shrub."

Colorado spruce (P. pungens)

The Cascade azalea has also proved difficult to grow in eastern North America, probably because of the oppressive summer heat.

I thought then that this odd Colorado population, growing so far out of range, might offer a genotypic variation that would be suitable for cultivation. One segment is centered near Slavonia and another, three miles to the northeast, near Gilpin Lake. I reached the area via a long dirt road and found no buildings or remnants of the former town. The area is now a favorite starting point for hunting trips into the Zirkel Wilderness, and on the day I arrived packs of hunters sporting state-of-the-art bows were methodically preparing for their foray into the wild. After I had prepared my own hunting gear — a few seed envelopes and some pruning shears — I crossed a stone and wire bridge and headed up an east-facing slope. It was traversed by several streamlets and springs and supported a profuse growth of mosses. Only a few hundred feet from the bridge I found my first Cascade azalea, and I soon discovered that the plant grew in profusion throughout the area. To see such an unusual plant so common in situ was indeed a rare pleasure.

A canopy of Colorado spruce (*Picea pungens*) and Douglas fir (*Pseudotsuga menziesii*) dominated the slope but surrendered somewhat in the wetter areas. The transition zone between the forest and the open mossy area was the niche the rhododendron settled into, forming large mounded patches of yellow fall foliage. There, hidden in

Douglas fir (P. menziesii)

the cool tuck of a mountain in the wilderness, was a plant whose creamy white display in spring must stir the hearts of any who happen upon it. I searched hundreds of branches for seed but found all the capsules disappointingly green. Luckily, I was able to arrange for a later shipment from Michael Calhoun, a local resident with a special interest in the azaleas.

The background of these unique Coloradan populations is fascinating from both biogeographical and historical perspectives. The plants have had only sporadic contact with humans. I had been told at the Denver Botanical Garden that the first discoverer of the stand probably was George W. Kelly, an amateur botanist in Colorado. Now 86 and in the process of writing his 10th book, he generously answered my inquiries about the area in a warm letter. "I am just an amateur botanist but spent many wonderful days in the Slavonia area years ago. This is a real island of botany, almost identical to the coast area many miles to the west. . . . My discovery was the first local recognition of the plant, previously all woody plants were just bushes. I was probably the first to make a herbarium collection. So far as I have heard, this group in the Slavonia area is the only one in the state." Without doubt George Kelly has done the most to make the botanical world aware of the stand, and it was his herbarium specimens that first directed me to the still-extant population.

Rocky Mountain maple (A. glabrum)

The earliest published reference to the population is an article that named the plant as a new species, *Azaleastrum warrenii*. Aven Nelson of the Rocky Mountain Herbarium received a single specimen dated July 14, 1911, from Edward R. Warren, a Colorado Springs naturalist. Warren wrote to Nelson, "I found it at my camp on the lower slope of Mt. Zikel, at the head of navigation [for prairie schooners] on the 'Ute Pass Trail'. If I remember correctly, it was quite abundant. It was a low plant, perhaps not more than a foot high. . . . I evidently did not collect much of it, for I have but a single twig left and am sending you half the flowers and leaves from it."

Nelson split the plant (as *A. warrenii*) from *R. albiflorum* on the basis of the glandular, ciliolate leaves of the former, which otherwise were glabrous. Five years later, in 1918, J. Francis Macbride transferred the species to the genus *Rhododendron*. Because of the paucity of pressed material, little comparative analysis with *R. albiflorum* was done and *R. warrenii* remained obscure.

In 1936 Louis O. Williams in *Annals of the Missouri Botanical Garden* compared three collections from the Coloradan populations with specimens of *R. albiflorum* from the Northwest. He believed that the two species were the same, and other botanists in the area concurred. The plant is now considered *R. albiflorum*.

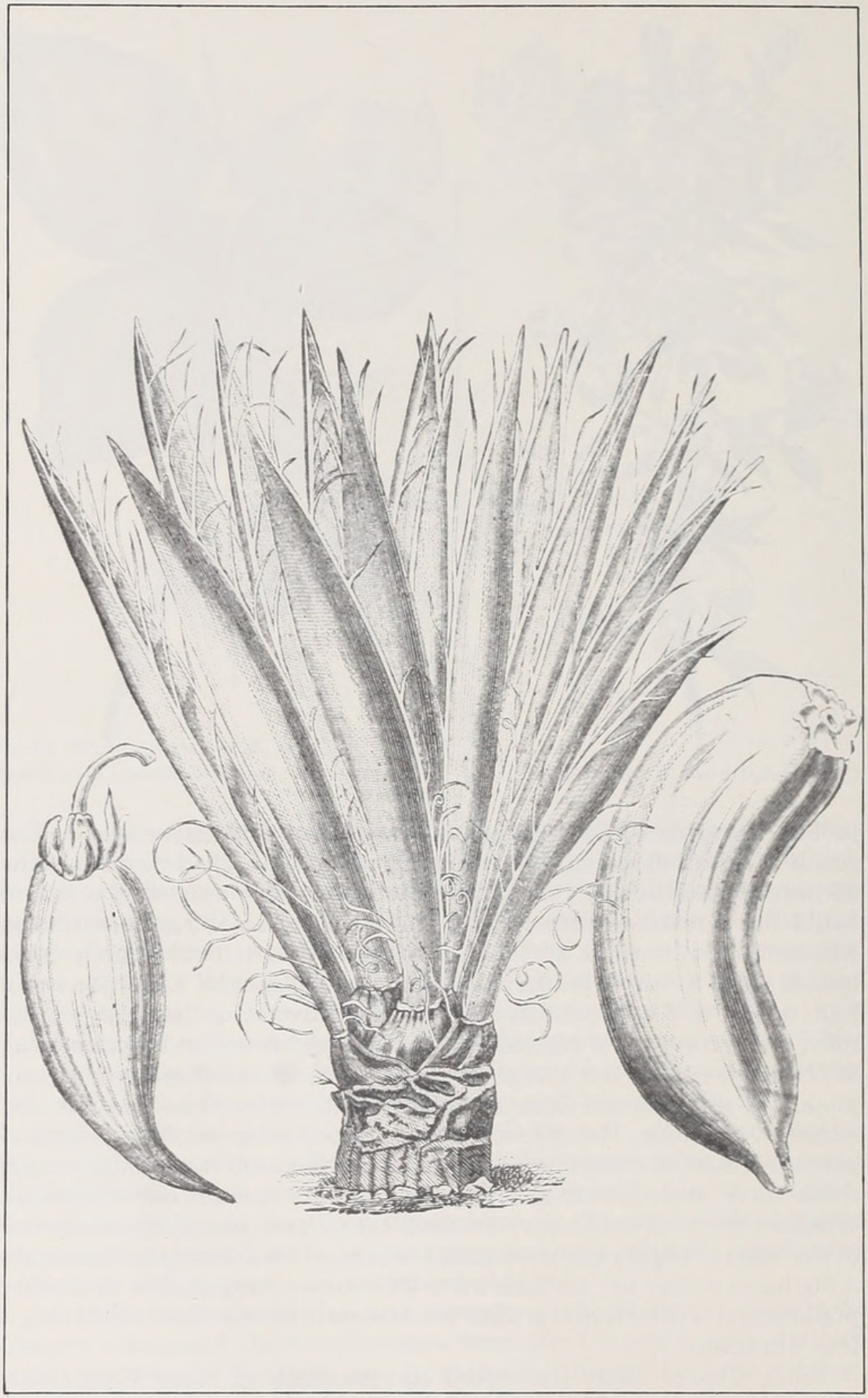
The few isolated populations of *R. albiflorum* east of the Cascades

Cliff fendler bush (F. rupicola)

Pacific trillium (T. ovatum)

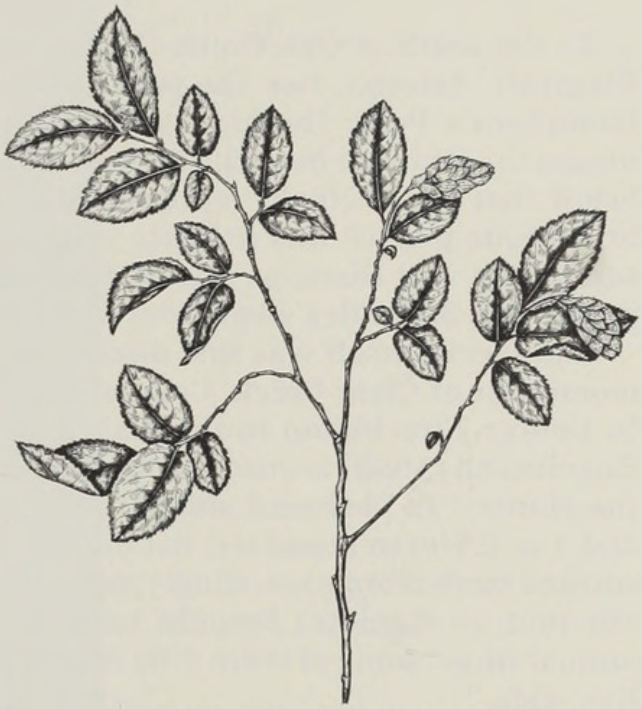
probably originated by different means. Those in Alberta may be the result of jump dispersal following the Wisconsin glaciation. But the disjunct population in Colorado, which may have evaded glaciation, could have resulted either from jump dispersal or range splitting. Rhododendron seed is so small and light that it could easily have lodged itself in fur or feather. Wind is also a dispersal agent for small light seeds, and it is conceivable that seed from the Cascade populations could have been carried east in a powerful storm. Volcanoes are another possibility but a highly unlikely one. *R. albiflorum* is a component of the Cascade flora and inhabits the sides of both active and extinct volcanoes. The recent Mt. St. Helens eruption, which spread ash as far east as Colorado, raises the question as to whether the seeds could have been blown into the stratosphere and carried eastward. Whether the seed could survive the intense heat and poisonous gases of the blast is highly questionable, but it is an idea that gives botanists a big bang theory to call their own. Of course, it is possible that other populations will be found within the 500-mile disjunction, rendering it less dramatic.

Since George Kelly has noted the presence of other West Coast disjuncts, such as Pacific trillium (*Trillium ovatum*) and Lewis mimulus (*Mimulus lewisii*), near Slavonia, it would follow that it is a refugium rather than the end point of a jump dispersal. We might



Banana yucca (Y. baccata)

Engelmann spruce (P. engelmannii)



Knowlton hornbeam (O. knowltonii)

speculate that the Cascade azalea once had a wider range than it has now. Two events probably diminished the range. First, the Cascade and Sierra Nevada mountains uplifted, blocking Pacific rainstorms and creating dryer environments on their east sides. Second, the Wisconsin glaciation buried the more northerly populations under a sheet of ice. The few populations in Colorado survived probably because they were unaffected by glaciation and because the mountains on whose bases they grow held enough rainstorms to sustain them.

After leaving Slavonia, I spent two days in the Mesa Verde National Park, clambering up and down the jagged canyons looking for the cliff fendler bush (*Fendlera rupicola*), the banana yucca (*Yucca baccata*), and the Rocky Mountain maple (*Acer glabrum*). Next, in southwest Utah, I reached the summit of Abajo Peak, an 11,445-foot mountain capped by Engelmann spruce (*Picea engelmannii*) and offering a number of interesting rockery plants on the exposed rock faces. To the north of that summit, near Moab, Utah, I searched in Negro Bill Canyon for the Knowlton hornbeam (*Ostrya knowltonii*). Although this is one of the rarest North American trees, it is not presently listed at any American botanical garden. It remains so as I failed to locate the species at this site. However, I was able to collect seed from two intriguing cliff dwellers — the monkey flower (*Mimulus eastwoodii*) and the columbine *Aquilegia pallens* — growing in a cliff-face crack where enough moisture was seeping out to support their tenuous existence.

During the following days I visited Oak Creek Canyon, Arizona, a botanical treasurehouse that contains four distinct vegetation zones over its 20-mile length.

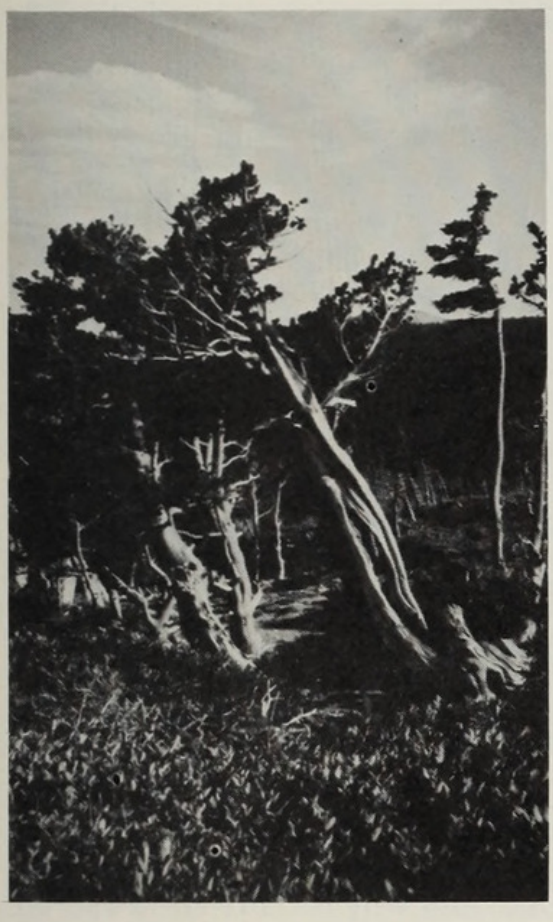
Arizona's Isle of Antiquity

To the north of Oak Creek Canyon and overshadowing the city of Flagstaff, Arizona, rise the peaks of the San Francisco Mountains. Humphrey's Peak, the highest in the group, is Arizona's champion mountain and reaches 12,633 feet. Treeline ceases about 1000 feet below that and is chiefly represented by the low matted growth of the bristlecone pine (*Pinus aristata*). This population was the main reason for my visit there, as it is Arizona's only population of bristlecone pine and is 325 miles away from the nearest neighboring population.

The species itself was first discovered by Charles Parry in the high mountains of Clear Creek, Colorado, and subsequently was described by George Engelmann in the *American Journal of Science* in 1862. Engelmann (1880) accurately described both the habitat and habit of the plants: "In sheltered situations it forms a tree 40 to 50 feet high and 1 or 2 feet in diameter, but on the higher bleak mountains it is a stunted bush often exceedingly slow, as a stick of scarcely more than one inch in diameter brought back by Dr. Parry shows nearly fifty annual rings, some of them 1/60 of a line, and none more than 1/6 of a line wide."

The species is most notable for its glacial growth but also for its thick bottlebrush growth of needles and for the white dandrufflike resin exudations that spot these needles. Until recently *P. aristata* growing in the White Mountains of California were regarded as the oldest living organisms on the planet. However, in 1970, on the basis of needle characteristics, D. K. Bailey split the species into two. The Coloradan, New Mexican, and lone Arizonan populations were kept as *P. aristata*, while the more renowned Californian populations and those in Nevada and Utah became a new species, *P. longaeva*. Bailey's work was taxonomically sound and has generally gained acceptance, but it does complicate the biogeographic history of these plants gripping the lava rock of the San Francisco Mountains.

The first collector to scour these mountains is believed to have been E. Palmer in 1869, but the earliest specimens taken of *P. aristata* were probably those of Bischoff, a member of the Wheeler expedition of 1871. Pilgrimages have been made by numerous botanists since to study both the rare Arizonan alpine flora and the vegetation in the zones below. C. Hart Merriam in 1887 was especially attentive to the acute differentiation of the region into vegetation zones that he distinguished on his climb up the mount: ". . . it may be said that in ascending from the hot and arid desert of the Little Colorado to the cold and humid summit of the mountain, no less than seven zones are encountered, each of which may be characterized by the possession of forms of life not found in the others." Merriam (1898) noted that these zones surround the mountains as skewed concentric rings, each zone of plants terminating farther up the mountain on the warmer southwestern side than on the colder northeastern. In some cases this



Bristlecone pines (P. aristata) *at Mt. Evans, Colorado. Robert Nicholson photo.*

altitudinal difference can be as much as 900 feet from one side of the range to the other.

Other significant work on the mountains was done by E. L. Little (1941), who compiled the most complete list of the alpine species (49 in all), and by Thomas Moore (1965), who hypothesized on the origins of the flora. My own ascent of Agassiz Peak began on the western side at the end of the access road. The Arizona Snow Bowl, a ski lodge, is situated at 9600 feet, so I could hike to the upper peaks on its cleared slopes. Despite the ease in walking, however, the trip still had its share of difficulties. As I passed the 10,000-foot level, a thunderstorm blew in from the west and seemed to stall against the peaks. The thunderclaps were both frequent and loud, and at that altitude one had the feeling of being within the storm rather than under it. After contemplating a run for the bottom, I instead opted to huddle next to a Douglas fir and attempt to keep panic at bay. The rains soon became heavier and, lacking rain gear, I had to improvise quickly with the plastic garbage bags I used for herbarium specimens. As I sat and looked up the forested incline, the storm released its final surprise, a barrage of dime-sized hailstones. The forest floor was alive with the white pebbles, which bounced frantically down the slope after their earthward plunge.

The storm finally slid over the peaks and I pushed upward towards the timberline, the upward limit of normal-sized trees. Both *Picea*

engelmannii and *Pinus aristata* reach timberline and extend upward to treeline, surviving as a stunted matted form known as krummholz. Here I took a number of specimens but no seeds, as these trees were barren. At that elevation on the mountain the skewed nature of the vegetation zones became amazingly apparent. Above the tree line on the west side, a short walk of a few hundred feet around the cone of the mountain to the southwest side put me directly back into the krummholz zone.

The last 500 or so feet of Agassiz Peak is the alpine zone. Here and there on the coarse gray volcanic rock were a few ground-hugging plants. Little enumerated some 49 species on the peaks, but the long-term warming trend of the Southwest dooms many. I was able to collect seed from a number of interesting alpines, most notably *Heuchera versicolor* (Saxifragaceae), which should be a first-rate plant for rock gardens or for ground cover. The lack of oxygen at that altitude more than once tested my determination to collect. All movement seemed draining, and my lightweight Olympus camera felt like a cinderblock around my neck.

Prior to Bailey's split of the species, the nearest populations of *P. aristata* had been those in the mountains of southwest Utah, some 150 miles north of the San Francisco Mountains. With the new differentiation the closest population shifted to the east, some 325 miles away in the Sangre de Cristo Mountains of New Mexico. How then did the species come to migrate to Arizona, and why is there such a large disjunction between the populations despite the existence of plausible sites for colonies?

During the Wisconsin glaciation, the entire Southwest was subjected to a lowering of yearly average temperatures. As a result, vegetation zones existed at lower altitudes, and the alpine and subalpine floras undoubtedly grew over both a far greater and a more southerly range. With the glacier's retreat the climate warmed, and the cold-loving species began a migration upward for survival. Those populations that ran out of altitude were like nonswimmers stranded on a rock in the incoming tide. There was simply no place left to move to and they perished.

At the San Francisco Mountains, and nowhere else for 325 miles, the correct conditions existed for the continued survival of *P. aristata.* That such a large disjunction exists is puzzling, for between the Arizonan and New Mexican populations a number of peaks reach altitudes of over 11,000 feet. If we assume that these peaks were the bridge by which *P. aristata* spread from New Mexico, what can account for the species' absence now? Bailey suggests that the subalpine conifers on these peaks present too much competition for the pine, yet the same conifers are found in the San Francisco Mountains. It could be that an insect infestation or disease eliminated the bristlecone pine from these stations, but it is certainly a question that needs further investigation.

Pacific dogwood (C. nuttallii) *flowers*

In the Valley of the Dogwoods

I spent my last days of collecting in Central Idaho. After a long drive through the sparse plain of Southern Idaho on a dark night, I found another of my targeted disjuncts, the Pacific dogwood (*Cornus nuttallii*). The site is known to botanists and nurserymen throughout the northwestern states, and the disjunction is among the most remarkable in the United States.

On the edge of the Clearwater National Wilderness is the small village of Lowell, Idaho. Here two rivers, the Lochsa and the Selway, merge to form a third, the Clearwater. These rivers have cut deeply through the land, and their escarpments are steep and well forested. Along their banks, and extending upwards onto the hillsides, grow several species notable as belonging to the northwestern coastal flora, a flora native to an area 300 miles west on the opposite side of the Casades. Indeed, the Lowell area is the only area east of the Cascades where *C. nuttallii* is known to exist. The Pacific dogwood was the primary reason for my visit to the area, but I also was successful in collecting seed of other species such as the giant arborvitae (*Thuja plicata*), the great silver fir (*Abies grandis*), the Pacific yew (*Taxus brevifolia*), and the red alder (*Alnus rubra*).

Especially thrilling to me was the discovery of a stand of Oregon maple (*Acer macrophyllum*), one large matriarch and her few sapling offspring. The parent tree measured approximately 75 feet in height, and its twin trunks each measured 2 feet DBH. As I had never heard of

Western yew (T. brevifolia)

the species being reported in Idaho, I at first thought I had a real find. Subsequent talks with Idaho botanists, including Frederic Johnson, revealed that the stand was known. Locals believe that the parent tree was either a planted specimen or an escape. A coring to determine the tree's age would surely help settle the question. I dug dozens of seedlings from around the tree and brought them back to the Arboretum in the hope that they would prove to be hardier here than their West Coast relatives.

But most remarkable among the area's woody species is the Pacific dogwood (*C. nuttallii*). It has a large range, extending from British Columbia down into the Sierras of California. It is also one of the largest dogwoods, reaching 100 feet in prime locations. Its flowers, like those of most dogwoods, are inconspicuous, but the petallike bracts that surround them number between four and seven and are somewhat larger than those of its eastern relative, the flowering dogwood (*C. florida*).

Giant fir (A. grandis)

The species has an erratic flowering schedule, having been reported blooming in both spring and autumn. When I visited the Idaho population in late September, some flowers still remained on the trees, and a local resident told me that was their third flush of the year.

The species itself was easy to find and could not be labeled uncommon. The stand begins about 9 miles west of Lowell and seems to grow best within a 4-mile radius of the town. The population stays within the narrow confines of the three river valleys and continues intermittently about 25 miles northeast along the Lochsa River and about 12 miles southeast along the Selway River.

The population is interesting not only for its disjunct location but also for a bit of its early history, a near brush with the area's first itinerant botanists Meriwether Lewis and William Clark. In early September 1805 the party of Lewis and Clark traveled through the

Pacific dogwood (C. nuttallii)

Lolo Pass from Montana and continued their long trek to the mouth of the Columbia River. They proceeded down the Lochsa River watershed and cut north into the Bitterroot Mountains. At one point in their arduous trek, at Hungery Creek, they were within 5 miles of making the initial discovery of the species' most disjunct population. As it developed, Lewis and Clark were the first to discover *C. nuttallii*, but only west of the Cascades.

The Idaho population remained nestled in the deep river valleys and passed unnoticed by the botanical world for another 85 years. J. B. Leiberg was the first to give it attention in print, in a U.S. Geological Survey forestry report in 1900. He was quick to perceive the unusualness of a *C. nuttallii* population in Idaho: "That the species should occur in the basins of the Clearwater drainage is remarkable. Its home in this latitude is in the Cascades and so far as is known, it does not grow at any intermediate station."

Since Leiberg's report, a number of other coastal disjuncts, such as red alder (*A. rubra*), and endemics, such as *Phlox idahonis*, have been documented in the region, singling it out as a refugium. The formation of this refuge has been thoroughly explained by Rexford Daubenmire. He postulates that the course of the disjunction is a sequence of events including the formation of the Rocky Mountains, the uplift of the Cascade Mountains, and the Wisconsin glaciation.

Beginning in the Oligocene Epoch and continuing into the Miocene Epoch, the Rocky Mountains were formed and separated the continent into eastern and western regions. During the late Pliocene Epoch the Cascades were formed by a combination of volcanic process and uplifting, effectively splitting the *C. nuttallii* population into two. To the east of the new mountains, a rain shadow formed and dried up the lowlands between the Cascades and the Bitterroot Mountains, reducing the range of many species, including *C. nuttallii*.

With the onset of the Wisconsin glaciation, the climate of eastern Washington and northern Idaho was altered by a lowering of temperatures, which drove the more tender species to lower altitudes and latitudes. The Clearwater River drainage area became an important refuge. It was the first area south of the glaciation with a warm, deep valley and an adequate moisture regimen. Here, it has been speculated, were driven the last intermountain populations of *C. nuttallii*, and it is here and only here that they survive today.

The question now remains as to whether this population is a hardier race tempered by the elements through the ages or whether it is a race that was able to migrate to the warmest area. I collected 3 pounds of seed from a dozen sites within the population, and some 400 seedlings have been grown from this seed. These seedlings are now being tested at the Arnold Arboretum and a half-dozen East Coast nurseries.

Weather data from the Fenn Ranger Station on the Selway River suggest that climatic extremes in the Clearwater drainage area are comparable to those in Boston, so with any luck a few more refugia for *C. nuttallii* may be created in East Coast gardens.

References

Axelrod, D. I. 1940. "Late Tertiary Floras of the Great Basin and Border Areas." *Bulletin of the Torrey Botanical Club*, 67: 477–487.

Bailey, D. K. 1970. "Phytogeography and Taxonomy of *Pinus* subsection *Balfourianae*." *Annals of the Missouri Botanical Garden*, 57: 210–249.

Coves, Elliott. 1893. *History of the Expedition under the Command of Lewis and Clark*. Harper and Row, New York.

Daubenmire, R. 1970. "Floristic Plant Geography of Eastern Washington and Northern Idaho." *Journal of Biogeography*, 2(1): 1–18.

Engelmann, George. 1880. "Revision of the Genus *Pinus* and Description of *Pinus elliottii*." *Transactions of the Academy of Science of St. Louis*, 4: 161–189.

Graham, Dr. 1838. "Description of Several New or Rare Plants Which Have Lately Flowered in the Neighborhood of Edinburgh, Chiefly in the Royal Botanic Garden." *The Edinburgh New Philosophical Journal*, 24: 422.

Hooker, Sir William Jackson. 1839. "*Rhododendron albiflorum*." *Curtis's Botanical Magazine*, 65: t. 3670.

———. 1840. *Flora Boreali-Americana*, vol. 2. Henry G. Bohn, London.

———. 1910. "*Cornus nuttallii*." *Curtis's Botanical Magazine*, 136: t. 8311.

Johnson, Frederic D. 1979. *Escaped, Naturalized, and Long Residual Woody Plants of Idaho*. University of Idaho, Moscow.

Johnson, Frederic D., and Robert Steele. 1978. "New Plant Records for Idaho from Pacific Coastal Refugia." *Northwest Science*, 52 (3): 205–211.

Leiberg, J. B. 1900. "Bitter Root Forest Preserve." *Twentieth Annual Report of the U.S. Geological Survey, Part 5, Forest Reserves*: 317–410. U.S. Government Printing Office, Washington, D.C.

Little, Elbert L., Jr. 1890. "Alpine Flora of San Francisco Mountain, Arizona." *Results of a Biological Survey of the San Francisco Mountain Region and Desert of Little Colorado, Arizona*. U.S. Government Printing Office, Washington, D.C.

———. 1941. "Alpine Flora of San Francisco Mountain, Arizona." *Madrono*, 6(3): 65–81.

Macbride, J. Francis. 1918. "Various American Spermatophytes, New or Transferred." *Contributions of the Gray Herbarium*, 56: 50.

Merriam, C. Hart, and Leonard Stejneger. 1890. *Results of a Biological Survey of the San Francisco Mountain Region and Desert of Little Colorado, Arizona*. U.S. Government Printing Office, Washington, D.C.

Moore, Thomas C. 1965. "Origin and Disjunction of the Alpine Tundra Flora on San Francisco Mountain, Arizona." *Ecology*, 46 (6): 860–864.

Nelson, A. 1913. "Contributions from the Rocky Mountain Herbarium." *The Botanical Gazette*, 56: 67.

Pielov, E. C. 1979. *Biogeography*. Wiley, New York.

Roper, Laren A. 1970. "Synecology of *Cornus nuttallii* in Northern Idaho." Master's thesis, University of Idaho, Moscow.

Williams, Louis O. 1936. "Field and Herbarium Studies, IV." *Annals of the Missouri Botanical Garden* 23 (3): 447–456.