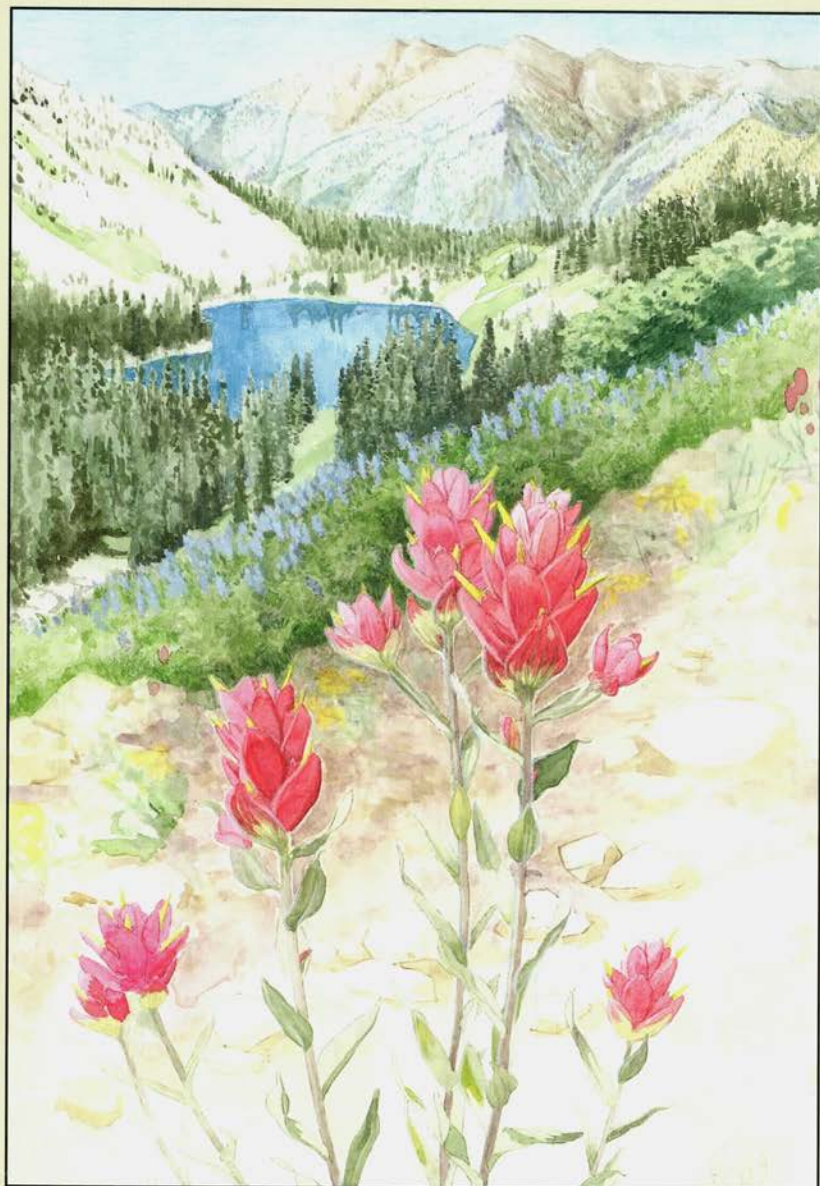


ROCK GARDEN *Quarterly*



Volume 65 Number 2

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Correction to Winter 2007 Issue

The credit for the Winter issue's cover mistakenly retained the previous year's artist's name. The Winter cover, like all those for the 2007 issues, is by Paul Bowden. Our sincere apologies to Mr. Bowden for this error.

Front cover: *Castilleja rhexifolia* in the Wasatch Mountains. Painting by Paul Bowden, based on a photograph by Tanya Harvey.

Back cover: *Gentiana parryi*. Photograph by Loraine Yeatts (see p. XX).

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ROCK GARDEN

Quarterly

BULLETIN OF THE NORTH AMERICAN ROCK GARDEN SOCIETY

Volume 65 Number 2 Spring 2007

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Special Issue: Plants of the Western Cordilleras

*Proceedings of the International Interim Rock Garden Plant Conference
Snowbird, Utah July 21–26, 2006*

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Introduction

The International Interim Rock Garden Plant Conference was planned as a showcase for the montane plants of the western United States, and what better way to learn about them than by field trips to and through their habitats? When the Wasatch chapter, of Salt Lake City, Utah, agreed to host the Conference, we took advantage of their proximity to prime floral sites in the Western Cordillera. Snowbird Ski and Summer Resort was a perfect home base for the lectures, and its central location allowed for three-day forays to the five varied and fascinating destinations. The lectures, by the most knowledgeable plants-people—plus one outstanding geologist—prepared participants to view the field flora with educated eyes. From remarks made by those returning from the field, it seems that each person felt that he or she had chosen the best of the five trips.

The success of the Conference was due to the stellar work of many. I relied upon the help of my co-chairs, Bill and Cathy King, and we were all grateful to the Wasatch chapter members who acted as registrars, trip organizers and leaders, and plant vendors.

Joyce Fingerut, Chair
IIRGP Conference, 2006

This issue includes some articles that were submitted as written text, and some that were edited from transcriptions of the audio-recorded talks, as mentioned in introductory notes. I did all of the transcription and most of the editing, and the resulting versions were submitted to the presenters in case they wished to make changes. Thanks are due to all of them for this extra effort to extend the reach of the Conference beyond the few hundred attendees.

The CD mailed with this issue contains photographs taken by participants in the field trips, which were presented to all on the last night of the conference. The images were submitted without identifying labels, but it is hoped that readers will still enjoy the beauty of the landscape and plants they capture and will be inspired to visit the Western Cordillera on their own in future summers.

Jane McGary, Editor, NARGS

Western Alpines: Life on the Tundra

Lorraine Yeatts

I am honored to be included in this agenda of expertise, and along with you, to have the opportunity to learn from the best green-thumb gardeners around, and from botanists who have had plants named for them. My mission is to transport you, vicariously, to a magical landscape that is unencumbered by trees to dilute its immensity, starkness, wind, and solar intensity. It is a place where our favorite plants grow, minute in comparison to their surroundings. These denizens of difficult places produce tapestry forms and vibrantly colored blossoms we covet for our gardens.

Even before my introduction to the Rocky Mountain Chapter of the North American Rock Garden Society in 1986, photographing and studying Colorado's native flora had become a passion. It was especially exciting to meet people who not only loved the same plants I did, but also wanted and tried to grow them. I soon learned that these alpine gardeners had plenty to teach a mere botanist about plants. Growing multiple species of a genus in the same environment yields information that is unavailable to someone like me who travels long distances to view them in their native habitats. Although nature's gardens still provide my greatest thrill, it is a joy to see alpines grown to perfection in someone's personal garden.

This presentation is partly reminiscence enabling you to experience places, my husband, Dick, and I have been privileged to visit, and partly a plant palette of nature's rock gardens that may provide inspiration for your own creations. The speakers who follow will elaborate with specifics about places and plants you will visit on your field trips and provide information about growing alpine plants.

Alpine Tundra: What Is It and Where Is It?

"Alpine" is a term derived from the place name "Alps." It refers to an area or a vegetation zone that occurs above the tree growth limit. It is also used to describe plants that grow above treeline (or timberline), such as *Penstemon rydbergii* or *Oxytropis sericea*. Rock gardeners are apt to use the term "alpine" generically for any plant with the compact form produced by environmental stress at high altitude

or in low desert. Many high-altitude habitats are polar deserts where plants experience conditions parallel to those found in low, hot deserts.

Tundra in Russia is treeless, frozen land, in Finland an arctic or barren hill, and in Lapland a marshy plain. Given the flexibility in these definitions, the clay barrens of Wyoming's Red Desert might qualify as tundra. Many of the plants that live there, such as *Physaria didymocarpa* and *Astragalus aretioides* (photos, pp. 132, 134), are hardly distinguishable from their alpine counterparts. It is quite likely that some alpines, like *Physaria alpina*, have evolved from desert species. Since there is almost no permafrost in the western United States south of Canada, and barren plains and hills are abundant below treeline, it makes sense to restrict our use of "tundra" to describe alpine vegetation or turf.

Where do we go to find alpine tundra? In the contiguous western United States, tundra exists on peaks above tree limit, over 12,000 feet/3660 m in northern Arizona on the San Francisco Peaks and in the Sangre de Cristo Range of New Mexico, decreasing to about 6000 feet/1830 m at Otokomi Lake in Glacier National Park, Montana. Major areas where you can visit alpine tundra include the Great Basin ranges, which are surrounded by a sea of desert and bounded by the Sierra Nevada and Cascade ranges to the west and by the Rocky Mountain ranges to the east. Nearly 2700 miles/4345 km in extent, the Rockies are the longest North American mountain chain. They have twice as many plant species as the West Coast ranges, and triple those of the driest Great Basin ranges. Contributing to this diversity are large areas of uninterrupted land mass above treeline and the north-south trend of the ranges, which allows plants to migrate in response to climate change.

The West Coast and Great Basin Ranges receive the bulk of their precipitation as winter snow. In addition, the Rockies benefit from regular summer thundershowers throughout July and August. As Ann Zwinger writes in *Land above the Trees*:

Subalpine forests are thick and dark and somber, dead branches snagging at the clothes, blocked vistas, deep shadows. After walking through a closed subalpine forest, the tundra seems free and expansive, like leaving the city for the country. After being enveloped in shadow, intimidated by invasions of one's own 3-D space, the tundra is such an open vacuum that one is physically drawn toward it. It is the landscape of ultimate freedom.

The same environmental factors that affect alpine plants limit tree growth. A short growing season, little moisture, high solar intensity, radical daily temperature extremes, and high winds shape life on the tundra. On Mt. Washington in the Snake Range of western Nevada, the term "treeline" or "timberline" is hardly applicable. In Colorado, however, tree growth ends in a relatively distinct line. A typical shrublike tree island features larger trees providing wind protection and support, moderating temperature, and humidity for successively smaller trees. Orange stem tips are caused by insufficient snow cover, allowing dehydration at a time when moisture cannot be replaced. Ice crystals effectively scour off all the branches on the windward side of trees on exposed ridges. *Pinus aristata*, the Rocky Mountains younger cousin of the Great Basin bristlecone pine (which can live 5000 years), has a life expectancy of about 2000 years.

As we gain altitude above tree limit, we enter an alpine world that appears botanically drab and stark for much of the year. Never mind the incredible scenery—it is the momentary burst of exuberance in the life cycle of the plants that keeps us returning. Each time, we discover new plants thriving in a multitude of nooks, crannies, and micro-environments. Now we will explore some of these habitats to discover what lives where, and what adaptations are required.

Rock Habitats: Unstable Talus and Scree

Rock, a main ingredient of rock gardens, provides an amazing number of places to nurture plants. Unstable and stable talus and scree, cliffs and crevices, rock pavement and fellfields hold many of gardeners' most coveted plants. *Penstemon montanus* has stems that root at the nodes, enabling it to tolerate burial on this sliding slope. Similarly, *Draba sobolifera* finds scree pockets among larger boulders on an otherwise barren volcanic slope in the Tushar Mountains of Utah. Members of the mustard, rose, aster, pink, figwort, grass, and sedge families are among the most prolific in the alpine zone.

A basal rosette of leaves, a common adaptation among alpine plants, maximizes sun exposure while minimizing plant size. Hairs, like a fur coat, protect the leaf surface from temperature extremes. A thumb-sized daggerpod, *Anelsonia eurycarpa*, is perfectly adapted to unstable limestone scree in the Lost River Range of Idaho and other western ranges (photo, p. 130). Also here we find *Collomia debilis* var. *trifida*, diminutive and inconspicuous, producing tiny bouquets at the tips of whiplike branches mostly buried in scree. If color is a protective adaptation, these plants have figured out how to hide in monotone, steel-gray rocks.

Dryas octopetala, a tough member of the rose family, is the most successful pioneer plant in stabilizing north-facing scree slopes throughout the western ranges. Anchored in place by a 6-foot/2-m taproot, it forms huge mats. The leathery leaves are protected underneath from surface-heated gravel by a thick felt of shaggy hairs.

Often you can hear or see hay-baling pikas scurrying among talus boulders that have accumulated at the base of an unstable slope. These rabbit relatives are active all year but need to store food to carry them through winter. One plant they utilize is alpine avens, *Geum rossii*, which contains toxins that retard bacterial growth in stored plants and break down during the winter, making the plants edible. This rose relative is a widespread and abundant climax plant of well-developed tundra.

Crevices and Cliffs

Lichens, such as *Xanthoria elegans*, fertilized by marmot urine and bird droppings, are the first to colonize rock; they excrete acids that aid in the process of converting rock to soil. Where soil collects in rock crevices and pockets, tough

“loner” plants can establish. *Draba crassa* likes more moisture than most drabas and benefits from runoff channeled into its crevices. *Draba globosa* basks in the reflected warmth of granite perches. More common to the north in the Rockies, it is disjunct at a few locations in Colorado, including Loveland Pass. Like many other members of the mustard family, drabas are often loners with a preference for rock and scree habitats.

Another pioneer loner, *Claytonia megarhiza* (p. 150), has spoon-shaped, succulent leaves, plastered flat against rock for warmth and arranged in rosette fashion to efficiently sunbathe and channel water to its 6-foot/2-m taproot. The red pigment anthocyanin offers early and late season cold protection to the leaves by converting light to heat. Debris trapped by the leaves provides sufficient soil to support other plants, beginning a succession that eventually overruns the pioneer. A fist-sized charmer, *Chaenactis alpina*, representing the aster family, is equally happy in crevices, shifting scree, and disturbed road cuts. It is widespread in western ranges above treeline, but not particularly common.

Although not exclusively alpine, the showy coralbell *Heuchera bracteata* is a great, relatively easy garden subject when confined. Two special dwarf columbines are found in the Rockies. *Aquilegia saximontana* (p. 131) grows on igneous rocks in central Colorado, sometimes seeking protection in a horizontal crevice beneath an overhang. Its tender leaves regenerate from the root each spring. A Wyoming and Montana counterpart, *Aquilegia jonesii*, can be abundant in a good year on limestone scree near roadsides.

On a ridge leading to the summit of Borah Peak, Idaho’s highest mountain, is an amazing display of *Kelseya uniflora*, a shrub of the rose family, so tightly welded to the almost black limestone it seems to be part of the rock. This mat form is a perfect response to wind and cold. On light-colored limestone in the Bighorn Mountains, a perfect one-flowered bun of *Kelseya* hangs on a vertical cliff. It is not common and is known only from scattered locations in Wyoming, Montana, and Idaho. A close-up of *K. uniflora* discloses its hairy-leaved rosettes, a successful adaptive strategy for so many alpinists. Like its cousin *Kelseya*, but much more common, *Petrophytum caespitosum* wallpapers rock cliffs and pavements with stone-hard mats in the Great Basin and Rockies. Both species seem to require calcareous substrates. In the canyon country of southeastern Utah, where *P. caespitosum* grows on calcareous sandstone, it becomes an attack plant, engulfing everything in its path.

Filling the same environmental niche in a much wetter climate, *Salix rotundifolia* subsp. *dodgeana* flows like a waterfall down the limestone of Beartooth Butte in northern Wyoming.

Vertical rock spires, impressive on the summit ridge of Beartooth Butte, are home to some uncommon species. Just a few plants of the handsome mustard *Parrya nudicaulis* were found in scree pockets below boulders on the summit ridge, the only place I have ever seen this garden-worthy subject. Equally exciting is a population of *Saxifraga oppositifolia* on the same ridge. The leaves are very distinctive: distichous, with alternate pairs oriented at right angles.

Stable Rock Habitats

On shallow slopes rock weathers in place, forming deeper soils that support larger plants and a greater diversity of species. A section of broken igneous rock pavement along the Lamoille Creek trail to Liberty Pass in the Ruby Range has wonderful displays of *Stenotus acaulis*. This is a widespread member of the aster family, with a compact form and showy yellow flowers that can take the heat.

A short distance to the south of Liberty Pass, a stabilized talus slope beneath a spring has breathtaking patches of *Epilobium obcordatum* (p. 133) intermingling with *Castilleja miniata*. This is a species of the Great Basin and Cascade Ranges.

The prolific and still evolving genus *Eriogonum* has numerous species, varieties, and forms in rocky alpine habitats all over the West. The rock pavement ridge on the summit of Wines Peak holds a dazzling array of eriogonums that defied my best efforts at positive identification. According to James Reveal, one is probably a depauperate form of *Eriogonum umbellatum* var. *dichrocephalum*, growing here in two color phases. With approximately 250 species in the genus, keying out eriogonums can be an exercise in frustration. One needs to pay careful attention to technical details like floral stipe length and the presence or absence of hairs on the tiny flowers. *Eriogonum arcuatum* var. *xanthum*, an alpine of Colorado, is one of the species with hairy flowers.

One of my favorites is *Eriogonum ovalifolium*, with varieties scattered from low desert to high alpine zones. Especially attractive is *E. ovalifolium* var. *nivale* (p. 143) with cotton-candy puffball flowerheads, filling crevices where it resides. Another is *Eriogonum caespitosum*, found on granite in the Pioneer Mountains of Idaho and widespread in the West. With its small leaves and tight mats, it belongs in rock gardens.

Fellfields

A fellfield (*fell* is a Gaelic word for “stone”) is a flat to gently sloping rocky alpine area with less than 50% plant cover, which is snow-free most of the winter. Fellfields are often found on the windward sides of broad ridges and are numerous and well developed in the Rockies where age has softened the mountains’ angles. Buns and mats present a splash of color in early summer and a mosaic of textures and shades of green during the rest of the growing season. Some of the choicest alpine plants grow here.

Silene acaulis subsp. *subacaulescens* is a prime example of a fast-growing, tap-rooted cushion plant; it reaches about one-half inch (13 mm) in diameter in 5 years, and blooming size in 10 years. *Trifolium nanum* is a pioneer mat plant that roots at the stem nodes, producing only two to four new leaves each year and taking 30 to 50 years to achieve a mat 8–10 inches/20–25 cm in diameter. Being a legume, it enriches the soil, which allows other species eventually to invade and establish. The cushion-forming pea *Oxytropis podocarpa* (p. 131) is spectacular both in bloom and in fruit, with attractive hairy, inflated pods.

Flower color is highly variable, from an occasional white to typical blue and purple, in *Eritrichum aretioides*. It has always been difficult to record accurately the blues with film that sees anthocyanin pigment that is invisible to the eye. Digital photography should be an improvement. The leaves of alpine forget-me-not wear an insulating fur coat to protect the plant on fellfield ridges, where snow cover is unlikely to be reliable. Dense hairs also protect the elongated inflorescence of *Besseyia alpina*, hence the common name "alpine kittentails." It blooms early, usually in the shelter of fellfield boulders or turf, from Wyoming south in the Rockies.

Saxifraga chrysantha is a relatively common saxifrage; it has a preference for scree pockets among the boulders in fellfields. As charmers, alpine primroses are in a class by themselves. The tiny rosettes of *Androsace chamaejasme* subsp. *carinata* sometimes form hard cushions up to 8 inches/20 cm in diameter. Pollination changes the color of the flower's eye from yellow to red. Among the earliest plants to bloom in fellfields, *Primula angustifolia* is quite adaptable and widespread in crevices and turf of the southern Rockies. In the central Rockies, *Douglasia montana* (p. 130) seems to fill the same niche.

Abundant at and above tree limit northward from central Colorado, *Phlox pulvinata* (p. 148) is wonderfully showy on Snowy Range Pass in Wyoming. Replacing it in southern Colorado, *Phlox condensata* forms even tighter cushions smothered with smaller flowers.

Mesic Tundra Meadow

As soil accumulates in fellfields, successively larger plants outcompete the early residents. *Oxytropis sericea*, a handsome pea, grows throughout the Rockies from foothills to tundra and mingles with *Hymenoxys brevifolia*. A couple of native dandelion lookalikes, *Agoseris glauca* and *Taraxacum ceratophorum*, are showy and desirable. Sometimes to distinguish them, it is necessary to look closely at the fruits. The pointy bumps at the apex of the fruit of *Taraxacum* are indicative of a dandelion species.

Probably more desirable for rock gardens are the townsendias. *Townsendia parryi* (p. 134) with beautiful large flowers is one of the best; it survives my miserable clay soil and often blooms in midwinter. One of the strangest aster family members, *Saussurea weberi*, is rare in Colorado and slightly more common in Wyoming and Montana. Typically, it is hard to spot in mesic (moderately moist) turf, but when it grows on disturbed sites, such as mine tailings, it can form attractive clumps.

Wetlands

Many interesting and striking plants are common in alpine wetlands, a generic term for areas with soil that remains saturated for much of the growing season.

Snowmelt basins have mass displays of *Caltha leptosepala* coinciding with the melting snow. This plant is also abundant on streambanks and in open willow carrs (wet, brushy areas), often with *Trollius albiflorus*, which also blooms en masse. Those who place these plants in the hellebore family do so based on fruit differences. Buttercups have many one-seeded achenes, hellebores several-seeded follicles.

Erythronium grandiflorum makes grand displays as it follows melting snow up mountainsides primarily on the west side of the Continental Divide throughout the Rockies. *Primula parryi* is one of the largest, showiest, most malodorous alpine endemics of the Rockies. It always has wet feet, which might explain its nasty odor, but more likely the skunky smell is to attract pollinators. *Mimulus* species are diverse and common in the West. Some, like *Mimulus primuloides*, are tiny, but showy when they blanket wet streambanks and hillside springs. Others are big and showy, like *Mimulus lewisii*, which forms streamside clumps but rarely lives above tree limit except in the Cascades of Oregon. A delightful, delicate saxifrage relative, *Parnassia fimbriata*, is also more common along rivulets below tree limit but does extend into the alpine zone, at least in Colorado.

Wet meadows bordering lakeshores often become a riot of color in midsummer, with outrageous combinations perhaps pleasing only in a natural setting. Pink *Pedicularis groenlandica* and scarlet *Castilleja miniata* are found here, with a few white bistorts to temper the mix—all common and widespread in the western ranges. Several other charming members of the genus *Pedicularis* are to be seen in alpine wet meadows: *P. scopulorum* in the southern Rockies and Wyoming, and *P. oederi* (p. 133) common on the Beartooth Plateau. The stigma at the end of the birdlike beak of *P. oederi* is poised to receive pollen from the back of a hairy bee.

Clementsia rhodantha, a water-loving succulent of very wet meadows and tussocks right in rivulets, is also bee-pollinated. Although gardeners tend to overlook them, sedges (*Carex* spp.) are dominant in alpine wetlands, often forming distinct zones around ponds. *Carex scopulorum* is one of the most widespread and abundant wetland sedges, flowering with white filaments and tan pistils evident.

Well-developed Tundra

In large areas of gentle terrain, soil accumulation is sufficient to support larger plants, often present en masse on well-developed tundra. *Potentilla ovina* is an example, seen on Hunt Mountain in the Bighorn Mountains of Wyoming. Continuing toward the summit of this gentle mountain plateau, we encounter the most breathtaking display of *Hymenoxys grandiflora* and *Myosotis alpestris* I have ever seen. It appears to be a monoculture of two species, but on closer inspection other species are tucked in the turf. *Dodecatheon pulchellum*, the common shooting star of the Rockies, is a runt in this alpine meadow, where it hides among the showier plants. At lower elevations it can be the star of the show in moist meadows. Its anthers hang down and dehisce by tiny terminal pores. This requires

the cooperation of a buzzing bee gripping and vibrating the anthers with its feet, like a salt shaker.

Similar well-developed tundra in Colorado can display a dominant plant like *Potentilla subjuga* or can harbor a profusion of species. Some of the gems include *Papaver kluanense*, a rare endemic of the southern Rockies, in Colorado usually found above 12,000 feet/3660 m; the ubiquitous harebell, *Campanula rotundifolia*, wide-ranging from foothills to mountain summits; its little sister, *Campanula uniflora*, usually hiding in tundra turf, often with *Gentiana prostrata*, an equally tiny gentian only an inch/2.5 cm tall, with a flower ¼ inch in diameter, that closes quickly when shaded from the direct light.

By the beginning of August, these meadows become lush with *Castilleja rhexifolia*, rosy paintbrush in all its glorious color forms. Castillejas are promiscuous, and the scarlet version has probably shared genes with *C. miniata*. Some meadows are constantly “rototilled” by pocket gophers, which spend their lives underground making tunnels while harvesting plant roots, keeping large areas of tundra churned. One gopher is capable of digging 100 feet/30 m of tunnel in one night while feeding on plant roots. Their favorite food, alpine avens (*Geum rossii*), has no trouble establishing in disturbed meadows.

In a turfey meadow, glacier-deposited boulders that have trapped deep soil provide protection for *Aquilegia coerulea*, Colorado’s state flower (p. 131), and also a place for marmots (*Marmota flaviventris*) to den and perch in the sun. Their curiosity is not a myth; they are always looking for a handout. Ptarmigan (*Lagopus leucurus*) are well suited for life on the tundra. With white plumage in winter and mottled feathers during summer, they blend perfectly with their surroundings. Males winter on the tundra, huddling in snow holes near willows and utilizing the buds for food. Females move below tree limit during winter.

Signaling summer’s end, *Gentiana parryi* (photo, back cover) is one of many spectacular gentians blooming in mesic and moist tundra meadows. To the north and west the similar *G. calycosa* is common. *Gentiana algida* is the latest-blooming gentian on the tundra in Colorado, sometimes lasting into November.

Although you may not have noticed, botanists and gardeners both have a passionate and consuming love of plants, and a greedy desire to possess as many plants as time, energy, and space permit. Botanists’ plants are flatter than gardeners’ plants and don’t need water or soil. They collect a plant to document its existence in space and time, not for its physical beauty or garden potential. The knowledge gained from both perspectives is beneficial to all. Here’s to plant lovers everywhere!

Loraine Yeatts of Golden, Colorado, is a field botanist and taxonomist specializing in alpine and desert flora, as well as an accomplished wildflower photographer who has coauthored *Alpine Flower Finder*, a simple illustrated key to Rocky Mountain plants. She lectures widely to garden and native plant groups, and over the years has been a key volunteer at the famous Denver Botanic Gardens, especially at its herbarium.

Setting the Stage: Geology of the Western Cordillera

William Parry

Note: This is an edited transcript of Dr. Parry's oral presentation, corrected by the author. We regret that we cannot reproduce the excellent visual part of this presentation, which all attendees agreed was a high point of the meeting.

I walked out of the Snowbird Lodge this morning about 7 o'clock and watched the sun come up on the peaks and ridges. I'm always astounded by the breathtaking landscape. What I hope to tell you this morning is the story beneath that landscape. The objective of my talk is to describe the mountain-building events that shaped the geology of the Western Cordillera, particularly in the context of the theory of plate tectonics.

The Western Cordillera constitutes the biggest, longest, widest mountain chain on earth. It extends from Alaska all the way to Central America, from the Pacific coast of North America all the way to the Black Hills in South Dakota. Compare that with the mountain chains of eastern North America, the puny Appalachian mountains. The Himalaya is a bit higher, but not as long or as wide. The Andes in South America are almost as long, but not nearly as wide. The Western Cordillera is geologically complex and physiographically diverse, consisting of high mountains and plateaus interspersed with valleys and lowlands.

The elevations of the Western Cordillera range from sea level and even below sea level in Death Valley to high peaks of 14,000 feet in Colorado. The distribution of plants here is controlled by environment and their physiological response to it, and by genetic processes. All plants are restricted in their geographic area by environmental conditions, so they are all in a sense endemic. The diversity of flora across the Cordillera results from the superposition of complex geological variability across special climatic conditions, ranging from high mountains—the Colorado Rockies—to arid and semi-arid valleys in the Great Basin of western Utah and eastern Nevada. The Cordillera consists, at least the U.S. part, of six physiographic provinces, beginning on the west coast of California with the Coast Ranges, the great valley of California, the Sierra Nevada, the Great Basin of eastern Nevada and western Utah, the Colorado Plateau of southeastern Utah

and adjacent areas of Colorado, New Mexico, and Arizona, and the middle Rocky Mountains of Colorado and Wyoming, extending southward into Mexico.

The rocks of the U.S. Cordillera range in age from Precambrian to present-day accumulations, and rock types range from igneous and high grade metamorphic rocks to every variety of sedimentary rock. Rocks really do make a difference. I had to convince myself of that, so I took a photograph of the next canyon to the north of us, Big Cottonwood Canyon, on a south-facing slope. You can see stripes of aspen trees, which occur on calcareous layers in the Pennsylvanian age Weber quartzite, and in between the aspens are stripes of shrubs—chokecherry, serviceberry, and sagebrush—which occur in the more siliceous layers. So in this particular locality the rock has made an enormous difference in what will grow.

Now for a review of plate tectonics. The theory of plate tectonics says that the outermost rigid layers of the Earth—we call those layers the lithosphere—consist of a mosaic of separate plates that move independently of one another; they diverge, converge, or slide past one another. For example, the South American Plate is diverging, or moving away, from the African Plate out in the middle of the South Atlantic Ocean. And the South American Plate is converging with the Nazca Plate over in the eastern Pacific Ocean. The North American Plate is diverging from the Eurasian and African plates out in the middle of the North Atlantic Ocean. The western margin of the North American Plate is a little more complicated because the Pacific Plate is sliding past the North American Plate along the San Andreas Fault, and the North American Plate is colliding with the Juan de Fuca Plate in the American Northwest. However, the east coast of North America is not a plate margin. It is a passive continental margin, not involved in lithospheric plate collision.

The lithosphere consists of a crust, and an underlying mantle that extends down to a soft layer in the mantle. From that soft layer molten matter rises buoyantly into the crust and is emplaced there as new crust; and the sides of this are forced apart, driving the motion of the lithospheric plates. In comparison, let's look at a continental plate colliding with an oceanic plate, such as has taken place on the western coast of South America. There the oceanic crust, which is denser than the continental crust, glides down into the mantle, underneath the continental plate, and the oceanic plate is there heated and partially melts, producing melted rock material which is buoyant (liquid rock is less dense than surrounding solid rock), and the buoyant rocks rise through the crust and appears at the surface as volcanoes. We call those volcanoes a volcanic arc, or a magmatic arc. The fore arc region may consist of a series of folded and compressed sediments that formed first in the ocean basin and have been accreted to the edge of the continent. The back arc region, due to the thickness of the crust here, has sagged and allowed the ocean to come in and form an inland sea. We'll see these processes over and over again as we look at the geology of the Western Cordillera.

First we have a large supercontinent known as Rodinia. Assembling Rodinia in this part of the North American continent means plastering or suturing the Mojave Province to the Wyoming Province, which consists of much older rocks.

The Wyoming Province consists of rocks dated to around 2.5 billion years before present (BP), maybe 3 billion years, maybe even older than that. And we suture this younger rock mass to the Wyoming Province along the suture zone that's referred to as the Cheyenne Zone because it goes from Salt Lake City to Cheyenne, Wyoming. Sutured to the Mojave Province is the Yavapai Province, and sutured to the Yavapai Province is the Matzatzal Province, and these two occur in the bottom of the Grand Canyon. You can see these rocks there; they are younger than the rocks we find in the Wyoming Province. So now we're putting the continental crystalline basement together. At this time, eastern Nevada and California didn't exist; they were added later. What we've done now is assemble the supercontinent of Rodinia, which consists of numerous continental fragments, an assembly that was completed about 1100 million years ago.

Rodinia then broke apart. This began about 600 million years ago. The part of Rodinia that represents the North American continent broke away 540 million years ago. The margin of what became our continent is not a plate margin; it is a passive continental margin on which sedimentary rocks accumulated as North America drifted northward. From the fragments of Rodinia, the next supercontinent assembled, which is known as Pangaea. Pangaea was assembled about 280 million years ago when South America and Africa collided with the southeastern part of North America, producing mountain ranges in southeastern North America as a consequence of lithospheric plate collision, or lithospheric plate convergence. Then Pangaea broke up, with the opening of the North Atlantic Ocean and then the South Atlantic Ocean as South America and Africa split apart about 150 million years ago. An inland sea existed behind the cordillera mountain range that had been built in South America. Now we are pretty close to the present arrangement of continents today, which was completed approximately 20 million years ago.

Now I'll go through this sequence in a bit more detail so that you can see it a little better. A paleogeographic reconstruction shows the western United States on that passive continental margin, about 510 million years ago when there was a broad continental shelf, no western Nevada and no California. On that broad continental shelf near the Equator, a very thick sequence of calcium carbonate sediments formed, about 200 million years of accumulation. You can see about 2000 feet of it looking from the summit of Notch Mountain in the House Range west of Delta, Utah. These are the sediments that accumulated on that passive continental margin as North America broke away from Rodinia. After about 200 million years of this, we're set up for the first lithospheric plate convergence—the first mountain-building event to take place since the breakup of Rodinia. There was a volcanic island arc and a convergence zone on the east side of that. This volcanic island arc drew closer and closer to the continent of North America, with its Precambrian basement rocks that made up Rodinia covered by the thick sequence of calcium carbonate that formed on the continental shelf. The volcanic island arc is named the Antler Volcanic Arc, and the mountain-building event is the Antler Orogeny. The volcanic arc moved closer and finally collided with North America and was assimilated as a part of the continent.

Those rocks of the Antler Volcanic Arc are incorporated as part of the Sierra Nevada. The thrust faulting and the thickening of the crust produced a foreland basin, and in that basin between the Antler Mountains and the main part of the North American continent, a considerable thickness of Mississippian age sedimentary rocks accumulated in Utah and Nevada—rocks that are about 340 million years old. And those rocks are exposed at the head of Little Cottonwood Canyon, where Snowbird is situated.

We've now assembled Pangaea, which consisted among other things of South America and Africa. South America collided with North America or Laurentia, and the repercussions of that were felt along the edge of southeastern North America, producing the Ouachita Mountains. And they were felt as far inland as Colorado, Wyoming, and Utah, producing what we refer to as the Ancestral Rocky Mountains. They formed when Pangaea was assembled and South America collided with North America. You see them in Colorado, and a fragment of the Ancestral Rockies is referred to as the Uncompahgre Uplift. These uplifts are cored by old Precambrian crystalline basement rock of the supercontinent of Rodinia. Associated with these uplifts are two small ocean basins, the Paradox Basin and the Oquirrh Basin. The sedimentary rocks that accumulated around these mountains are derived from windblown sand dunes.

Next, North America bumped into another volcanic arc called the Sonoran Mountains, forming an ocean basin in a region between Sonomia and the North American continent, with rivers flowing from the Ancestral Rockies into that ocean basin. Those rivers were responsible for depositing much of the red sediment that we see on the Colorado Plateau. Now we've finally got western Nevada and a little bit of eastern California.

Next, this area became covered with a thick layer of windblown sand. It has no mountain-building significance, but it does have some scenic significance because it's this windblown sand, the largest sea of sand that ever existed on earth, that is exposed in Zion Canyon.

Next came a series of three additional mountain-building events that stemmed from convergence of lithospheric plates, specifically the North American and the Pacific plates. The first event took place between 163 and 152 million years ago, with igneous intrusions, thrust faults, and thickening of the crust. That mountain building moved successively eastward: by 159 to 144 Million years ago it was in central Nevada, and by 145 to 75 million years ago it was in western Utah. So when you look west from Snowbird, if you were living there in that particular time period, you'd see a mountain range out there that looked like the Andes. This was an Andean type event called the Sevier mountain-building event. It caused the crust to sag and produce an interior seaway that extended from the Gulf of Mexico to the Gulf of Alaska. Rivers now flowed eastward into the interior ocean basin that formed as a consequence.

The next event is called the Laramide, from the Laramie Mountains in Wyoming. That event also stemmed from lithospheric plate convergence, with the Pacific Plate out west of California. The Laramide event made the Uinta Mountains and some of the other smaller features in Utah, and the Colorado Rockies,

the Wind River Range, the Teton Range, the Medicine Bow Mountains, and their eastern margin known as the Snowy and Bighorn mountains are also part of Laramide event. In the Laramide event we see Precambrian crystalline basement core uplifts like the Wind Rivers, with steep faults on both sides; and with time they have been eroded and been partially buried by sediments that have been removed from the uplifted mountains. So when you're out there in the Bighorn Mountains, you're standing on ancient rock in some places, covered partially by the mountains' own debris.

The next event was the destruction of the Cretaceous interior seaway and replacement of the seaway by lakes. In those lakes you get a fairly colorful sequence of sedimentary rocks, exposed notably in Bryce Canyon and at Cedar Breaks. The crust thickened considerably with all these mountain-building events, and finally when the North American Plate collided directly with the Pacific Plate and formed the San Andreas Fault, 17 million years ago, that thickened crust collapsed in the series of north-south trending basins and north-south trending mountain ranges that are called the Basin and Range. These mountains were later sculpted by glaciers and running water to produce the landscape we see now, for example in Lamoille Canyon in the Ruby Mountains, broad U-shaped glaciated canyons; the Ruby Mountains are a typical north-south trending mountain range bounded on both sides by faults. The Yellowstone, one of the Snowy ranges, near Livingstone, Montana, has been sculpted by glaciers and running water. The Teton Mountains are made of the Precambrian crystalline basement rock of the Wyoming Province which has been uplifted on a Basin and Range fault, the Teton Fault, on the east side of the Tetons, and then sculpted by glaciers.

A few finishing words about our local situation here in the Wasatch. Here you can see a microcosm of the geological sequence. Snowbird is in a broad U-shaped glaciated canyon. Here we find the Precambrian rock that accumulated on Rodinia, the sandstone shoreline deposit that accumulated on the passive continental margin, the limestone that accumulated on the continental margins, the Mississippian limestone that accumulated between the Antler volcanic arc and the main part of the North American continent, a thrust fault formed by the Sevier lithospheric plate convergence, the normal faults that formed during Basin and Range extension, and the igneous intrusion around which water circulated to produce the rich silver deposits that were discovered in 1858 around Alta, Utah. In summary, the geology of the Western Cordillera is the result of plate tectonic and mountain-building events from the assembly of Rodinia to present-day Basin and Range faulting.

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Penstemons of the Intermountain West

Noel H. Holmgren

Note: This is the author's written version of his conference presentation, with minor editing for publication here.

P*enstemon* is the largest genus of flowering plants endemic to North America, ranging from S Alaska and the Yukon south to Guatemala. *Penstemon gormannii* is the sole representative at the northernmost outpost, and the farthest south are *P. gentianoides* and *P. skutchii*. Between is a fantastic array of species diversity, with the greatest concentration in the western United States, and the Intermountain Region appears to have the greatest concentration with 117 species. I have selected 66 of them as examples to show you.

You know what a penstemon looks like, but allow me to distinguish technically just what constitutes one. There is a particular ground plan that sets *Penstemon* apart from all other plants. A penstemon bears flowers that contain reproductive parts of both sexes—stamens and a pistil—and the seeds form within a capsule. The flower also has sepals and petals, collectively known as calyx and corolla. The corolla consists of 5 petals that are united for most of their length and free at the apex as 5 lobes. The lobes are arranged in two lips, with two lobes above and three below. The ovary is superior, attached above the stamens, corolla, and calyx. The stamens are inserted on the corolla tube. The leaves are in opposite pairs on the stem, or in rare cases there is a whorl of three or four at a node, or they may be crowded in a basal cluster. Of the five filaments, four are fertile stamens with anthers, and one is modified into a staminode, a sterile stamen.

This description leaves us with *Penstemon* and its closest relatives: *Chionophila*, *Keckiella*, *Chelone*, *Nothochelone*, *Tetranema*, and *Uroskinnera*. *Penstemon* and *Chionophila* differ from all the others in the location of their nectar-secreting glands; in these two the nectar is secreted at the base of the upper pair of stamens, whereas in the others the nectary is a disk at the base of the ovary, called a hypogynous disk. *Chionophila* is distinguished from *Penstemon* by its tubular calyx and winged seeds. In *Penstemon* the sepals are free to near the base, and the seeds are not winged.

Now that we've identified the genus, let's look at some of the species that grow in the Intermountain Region, a floristic region bounded on the west by

the eastern base of the Sierra Nevada-Cascade Range, and on the east arbitrarily by the Utah border and including a sliver of Wyoming; on the north it includes the arid part of E Oregon and the Snake River Plain up to the edge of the mountains, and on the southwest the line is drawn where the sagebrush deserts give way to the creosote bush community of the Mojave Desert, and on the southeast the border is the rim of the Grand Canyon plateaus and the Utah-Arizona border.

This discussion groups presumed relatives close together and arranges them from "primitive" to "advanced" in evolutionary terms.

Subgenus *Dasanthera*, Section *Erianthera*

This first group contains the shrubby species that are considered to represent the most primitive species in the genus. Besides having woody stems, they all have densely long-woolly anthers, and the inflorescence in most is essentially a simple raceme, with only one flower in each axil of a bract. Most species in this group are in the Pacific Northwest, and the few in the Intermountain Region enter from the north, some just barely. In addition to these three, *Penstemon newberryi* enters the region in some of the Basin Ranges close to the Sierra Nevada.

Penstemon montanus (cordroot penstemon) can be seen in the Wasatch Range in rock cliffs and in the talus below them. It has also been collected in the Wasatch Plateau of central Utah. It is known only from a few scattered localities in Utah, but is much more common in the mountains of Idaho, Montana, and Wyoming. Its leaves are all well spaced on the stem, whereas in the others described here the leaves tend to cluster at the base.

Penstemon fruticosus (shrubby penstemon) is found in the Owyhee Mountains in the SW corner of Idaho as a disjunct. It ranges from S British Columbia through Washington and Oregon along the eastern slopes of the Cascades, and east across Idaho to Montana and Wyoming. The type plant was collected along Lolo Creek by Meriwether Lewis on the Lewis and Clark expedition. It is a highly variable species that can with some success be sorted into three varieties; ours is recognized as var. *fruticosus*.

Penstemon davidsonii var. *praeteritus* (creeping penstemon) is a Basin and Range taxon found at high elevations in the desert mountains of NW Nevada, in Humboldt County, and on Steens Mountain in Harney County, SE Oregon. It is a short-stemmed species that seems to cling to rock surfaces. Its large, lovely blue-violet flowers blanket the plant, and in my estimation it is one of the most beautiful of all our mountain wildflowers.

Subgenus *Penstemon*, Section *Penstemon*

The next group is the large and diverse section *Penstemon*, which is well represented in the eastern states as well as in the west. The anthers dehisce across

their full length, from tip to tip. The anther sacs lack the hairiness characteristic of the preceding group.

In E Oregon and SW Idaho two closely related species are found in lava-derived soils. Both have linear leaves, stems woody at the base, and blue or bluish purple flowers. *Penstemon gairdneri* var. *gairdneri* is distinguished by its large corolla lobes and is glandular-pubescent (with many small glands covering the surface) both inside and out. Variety *gairdneri* has alternate leaves, a character that is unique in the genus. It occurs in E Oregon in N Harney and Malheur counties. Variety *oregonum* is just beyond our region to the north; it has opposite leaves. *Penstemon seorsus* (narrow-leaved penstemon) replaces *P. gairdneri* to the south. It differs in having larger anthers and smaller corolla lobes, and in lacking the glandular pubescence on the inside of the corolla. It has been collected on Steens Mountain and the Trout Creek Mountains in SE Oregon and the Owyhee Mountains of SW Idaho.

Another species pair has woody-based stems, but it differs from the preceding two in having broader leaves with toothed margins, and a corolla that is predominantly white. *Penstemon deustus* var. *deustus* (the hot-rock penstemon) consists of four geographically distinct varieties, two present in the Intermountain Region. Its stems and leaves are glabrous (smooth) to sparsely glandular-pubescent. Variety *deustus* ranges across the northern edge of the region and has white flowers with some violet lines. Variety *pedicellatus* is widespread in the Great Basin and is distinguished by its smaller flowers with a brownish upper corolla lip. *Penstemon sudans* is densely glandular-pubescent throughout the stems and leaves. It is taller than *P. deustus* and has smaller flowers. It is endemic to a small area around Susanville, California.

The next species pair is characterized by an inflorescence of one or more compact, many-flowered verticillasters (a "false whorl" in which opposing cymes of flowers, being almost sessile, appear to surround the stem), well-developed basal leaves, and a preference for moist habitats. *Penstemon rydbergii* var. *aggregatus* is one of three varieties, all with purplish blue corollas; this particular variety occurs in the Wasatch Range. *Penstemon pratensis* is a white-flowered version, otherwise very similar, found from SE Oregon and SW Idaho south to central Nevada.

Penstemon whippleanus (photo, p. 146) has a very distinctive corolla: it is abruptly ampliate (enlarged), with the expanded part on the dorsal (upper) side, and the lower lip projects far forward of the upper lip. It can be dull white, pinkish, or very dark purple, appearing black. In my experience, each population comprises only one of the color forms, but mixed populations have been reported. Nobody has given taxonomic recognition to these color forms, and I'm not about to. The forms are scattered throughout the range in a way that does not suggest genetic monophyletic lineages. *P. whippleanus* is a shade-tolerant species, usually found in mesic (somewhat moist) woodland. It has a rather broad range from SW Montana, SE Idaho, and Wyoming through Utah and Colorado to N Arizona and New Mexico.

Section *Caespitosi*

Section *Caespitosi* seems to be a fairly natural group, and this is backed up by DNA evidence. The species are small plants with leafy stems and either small or linear leaves.

Penstemon linarioides var. *sileri* has linear leaves and ascending stems. Variety *sileri* occurs in the mountains and plateaus of SW Utah and adjacent Nevada and Arizona. *Penstemon abietinus* (firleaf penstemon) is similar, different in its shorter stems, the dense bearding extending most of the length of the staminode, and its smaller anthers. It ranges beyond the northern limit of *P. linarioides*, confined to the N end of the Fish Lake Plateau and adjacent slopes of the Wasatch Plateau in central Utah. There must be something about its environment that escapes me, because the pinyon-juniper community and the soils look no different here than anywhere else.

Penstemon crandallii var. *atratus* has decumbent stems. It is distributed mostly in Colorado, entering Utah in the La Sal Mountains east of Moab. Variety *crandallii* has stems that sprawl at a wide angle, forming loose mats; it is widespread in Colorado, entering Utah in the Abajo Mountains west of Monticello.

Penstemon caespitosus var. *desertipicti* (the mat penstemon) has prostrate, mat-forming stems and leaves smaller than those of *P. crandallii*. It occurs in the S Utah plateaus and in the Grand Canyon plateaus of N Arizona. *Penstemon tusharensis* has ascending stems; the pubescence is restricted to the upper leaf surfaces and consists of closely appressed, flat, scale-like hairs. *Penstemon thompsoniae* (p. 138) has stems prostrate to decumbent, forming mats; the leaves are pubescent on both surfaces, with the same scale-like hairs.

Penstemon acaulis has been placed in this section because of its superficial resemblance to *P. caespitosus*, but DNA evidence places it closer to *P. laricifolius* in Section *Cristati*. It is found growing among sagebrush and Utah juniper in a small area of SW Wyoming and the NE corner of Utah, near Flaming Gorge Reservoir. Replacing it to the east is *Penstemon yampaensis*, obviously closely related; it is a stemless species with larger leaves and a longer calyx.

Section *Ambigui*

At first glance *Penstemon ambiguus* just does not look like a penstemon, but a closer examination shows it meets all criteria. The salverform (slender tube, expanding abruptly into a flattened limb) corolla with its slender, curved tube and reflexed upper lip and projecting lower lip is unique. DNA evidence places it close to *P. thurberi* and *P. confusus* (photo, p. 135). Variety *laevissimus* is found in sandy soils of S Utah, extending south into Arizona and east to SW Colorado and W New Mexico. The puberulent variety *ambiguus* replaces it in E New Mexico, eastward. Its favored habitat is sandy soil.

Section *Cristati*

This is a difficult group to characterize. As in the previous sections, the anthers dehisce across the full length, but it has larger seeds and most of its species have a prominently exposed and densely bearded staminode.

The following three species are closely related and share a non-glandular-pubescent inflorescence. *Penstemon pumilus* has narrow leaves. It has a limited range at the N edge of the Snake River plain, not far from Craters of the Moon. We anticipated spending some time searching for it, but we found it less than 100 feet off the highway on the first dirt road we explored. *Penstemon dolius* (p. 136) has broader leaves, but like *P. pumilus* it has pale blue corolla lobes. These lobes are long and do not overlap. It has a broader distribution, from NE Nevada to central Utah, common among sagebrush and pinyon-juniper vegetation. *Penstemon duchesnensis* has darker blue corolla lobes that are orbicular and overlapping. It is limited to the vicinity of Duchesne, Utah, in the W Uinta Basin.

The following four species form a replacement series from north to south. They share horseshoe-shaped anthers. *Penstemon nanus* (p. 137) is small, with pubescent stems and leaves; the leaves have entire (untoothed) margins. It is found in the foothills west of Milford, Utah. Chances are you've never seen *Penstemon franklinii*, which was discovered fairly recently by the Utah Natural Heritage Program botanist Ben Franklin, out in the sagebrush desert in the north end of Cedar Valley, west of Parowan, Utah. It is taller than *P. nanus* and has toothed leaves. *Penstemon pinorum* is another recent discovery, this one by John Shultz, found in the pinyon-juniper-wooded hills west of Cedar City. It is taller than *P. franklinii* and has glabrous leaves with toothed margins. Finally, *Penstemon distans* is even taller, but has entire leaves. It was first collected by Duane Atwood at the rim of the Shivwits Plateau, overlooking the Colorado River.

The next two species are closely related, differing only in technical characters; geographically they are separated by the West Tavaputs Plateau. *Penstemon goodrichii* has a nearly radially symmetrical corolla (i.e., the lobes are all nearly evenly placed around the center). It grows in sandy clay soils of the Duchesne Formation, only in a small area in the Uinta Basin near Tridell and Lapoint, west of Vernal. *Penstemon marcusii* has a similarly shaped corolla and grows in clay and gravel soils near Price, Utah.

When Dave Keck wrote his monographs on *Penstemon*, the Great Basin valleys were poorly collected, and the few specimens he examined gave him the impression that they were conspecific with *P. miser*; he confessed there was a lot of geographic variation that didn't make much sense. Now, with many specimens available, it makes good sense to split out *P. janishiae* and *P. barnebyi*. *Penstemon miser* (the Malheur penstemon) differs from the following two in that its staminode is only slightly exerted (extending beyond the corolla), and only slightly curved at the tip or even straight, and the corolla throat is only moderately expanded. It grows in diatomaceous and ash soils in N Malheur County and adjacent Baker County, Oregon. It's hard to imagine that *Penstemon janishiae* was considered to be *P. miser* for so many years. Its corolla is not only differently

shaped, it is larger, and the staminode is conspicuously exerted and heavily bearded at its coiled tip. It ranges across much of the N third of Nevada and enters adjacent parts of Idaho, Oregon, and California, in sagebrush and juniper vegetation, often in clay soils derived from igneous rocks. *Penstemon barnebyi* was also a part of Keck's *P. miser*. Its flowers are miniature versions of *P. janishiae*, including the exerted staminode, but its color is very different, and it seems to grow mostly on limestone alluvial deposits. Its main area is in E Nevada, with a disjunct population on limestone-derived soils on the east side of the White Mountains in California. *Penstemon concinnus* is similar to *P. barnebyi*, but the corolla is smaller, the leaves are glabrous, and the distribution is to the east, in desert areas between Great Basin National Park and Milford, Utah. *Penstemon atwoodii* (photo, p. 135) is another small-flowered species similar to the foregoing two. I first encountered it in 1965 while collecting with Jim Reveal in S Utah. This was the first undescribed penstemon I discovered, but Stan Welsh described it before I got around to it.

Penstemon ophianthus is a larger-flowered member of the *Cristati* that ranges across S Utah and into SW Colorado and NW New Mexico. *Penstemon grahamii* has a lovely, large violet corolla; the flowers blanket the small plants in good years. It occurs on oil shales in the E Uinta Basin in Uintah County, Utah, and adjacent Rio Blanco County, Colorado. *Penstemon cleburnei* grows in sagebrush in SW Wyoming and adjacent Utah; I photographed it on top of a bluff south of Green River, Wyoming. Finally, *Penstemon monoensis* is a lovely species found in the foothills of the White and Inyo Mountains of SE California.

Section *Coerulei*

This section includes plants with thick, glabrous, glaucous leaves with entire margins, and with congested inflorescences. *Penstemon arenicola* has a blue corolla and grows in sandy soils in SW Wyoming and adjacent Utah. *Penstemon acuminatus* var. *latebracteatus* has blue to lavender flowers; the stems are stout, and the bracts are broad, hence the variety name. It grows in sandy soils, often on sand dunes in W central and NW Nevada, SE Oregon, and SW Idaho. Variety *acuminatus* occurs north of the Blue and Wallowa mountains in the Columbia Basin; it has smaller flowers, more slender stems, and bracts not so broad.

Penstemon flowersii is bright pink and occurs in gravelly soils of the Uinta Basin south of Roosevelt, in a small area on both sides of the Duchesne/Uinta county line. *Penstemon pachyphyllus* var. *congestus* (p. 138) ranges across most of the southern two-thirds of Utah to E Nevada, while var. *pachyphyllus* occurs in the Uinta Basin. The former does especially well in dry, disturbed habitats, making it a good candidate for a western xeric garden. It has bluish purple flowers and a broad staminode with a beard of long, tangled hairs. *Penstemon mucronatus* has exceptionally broad leaves tipped with a sharp point (mucronate); the sepals are also broad. It grows in juniper and pinyon-juniper woodlands around the east end of the Uinta Mountains in NE Utah, NW Colorado, and adjacent

Wyoming. *Penstemon bracteatus* is the dwarf of the *Coerulei* penstemons, endemic around Bryce Canyon in S Utah on gravelly shale slopes.

Section *Gentianoides*

In our area this section includes plants with a more open inflorescence and a corolla color ranging from red to magenta or violet. Most red-flowered penstemons have evolved to accommodate hummingbirds, with the loss of a "landing platform," which would get in the way of a hovering bird, but *Penstemon utahensis* has a very prominently projecting lower lip.

Section *Spectabiles*

This section is characterized by toothed leaves, tall stems, and large, inflated corollas. *Penstemon rubicundus* is mainly restricted to a small area in W Nevada in the canyons and lower slopes of the Wassuk Mountains, with a disjunct population not too far away at the S end of the Pine Nut Mountains. *Penstemon palmeri* var. *palmeri* has upper leaves that are connate-perfoliate, which means that the opposite pairs are united across the stem so that the stem appears to pierce them. Its flowers are pink, "flesh" color, or white; the throat is greatly inflated like a pouch, and the bearded staminode is prominent. This seems to be one of the easiest penstemons to grow.

Section *Petiolati*

This section contains one very special species. *Penstemon petiolatus* is found in cracks and crevices of limestone outcrops from the SW corner of Utah across S Nevada to the Spring Mountains northwest of Las Vegas. Its leathery, glaucous leaves have toothed margins. The stems are woody at the base and are much branched. The corolla is a beautiful reddish magenta.

Subgenus *Habroanthus*

The most characteristic feature of the species in this subgenus is the line of dehiscence of the anthers. The anther sacs split open from the distal end (the end away from the point of attachment to the filament), but not all the way to the connective point, leaving the proximal portion indehiscent (closed).

Section *Glabri*

This section includes species with blue or blue-violet corollas. *Penstemon ammophilus* is one you probably haven't encountered yet. Leila Shultz discov-

ered it just south of Zion Canyon on Canaan Mountain, and now it has been found farther east in some canyons east of Kanab, Utah. The plant is glandular-pubescent throughout, the anther filaments are glabrous, and the stems are sometimes hollow and swollen. It grows in loose, sandy soils, usually in blowout areas of dunes with *Wyethia scabra*; none of the known localities is easy to get to.

I discovered *Penstemon navajoa* from an old herbarium specimen from Navajo Mountain in San Juan County, Utah. That was all the site information given. Navajo Mountain is a laccolithic dome. We found the only road up the dome, and the base was too steep for our two-wheel-drive truck, so we hiked up on foot, not knowing where or when we were going to find the plant, if at all. We finally found it on the very top of the mountain. It's possible that it was once more common, but everything was grazed to the ground by sheep and goats. This species has since been found in Dark Canyon in the Abajo Mountains, some distance from Navajo Mountain.

The corolla of *Penstemon leiophyllus* var. *francisci-pennellii* is blue and fairly large. This is the common penstemon at subalpine elevations in the Great Basin National Park's part of the Snake Range in E Nevada.

Penstemon cyananthus var. *cyananthus* (p. 135) is the most common species on the Wasatch Range. It is mostly past flowering by late July, but up on the slopes of the Albion Basin some might still be in flower. It has blue corollas, broad leaves, and pubescent anthers; the inflorescence is dense. It extends north beyond the Wasatch Range to the Caribou Range in SE Idaho. *Penstemon cyananthus* var. *subglaber* is a plant I hated to demote to a variety. In the Basin Ranges of NW Utah it looks different enough to be accorded species rank, with its narrow stem leaves, but it extends east across S Idaho, where it appears to have exchanged genes with var. *cyananthus*, obscuring the distinctions. Another reason it was difficult for me to sink it is that Steve Clark gave it the name *P. holmgrenii* to honor my father, who was professor of plant taxonomy at Utah State University, and Steve's mentor.

Penstemon compactus (p. 136) is a Bear River Range endemic from the area of Tony Grove Lake to the Franklin Basin in adjacent Idaho. The inflorescence is few-flowered and more or less secund (the individual flowers are arranged on one side of the stem); the plant is low, with decumbent stems; and the anthers are short-hairy.

Penstemon speciosus is a common plant throughout most of the Great Basin. My photo shows a dwarf alpine form, very atypical, but with flowers of normal size and color. It has relatively large anthers; the anther sacs twist so that the line of dehiscence is S-curved. This species is widespread from central Washington to S California, east to SW Idaho, Nevada, and NW Utah.

Penstemon laevis is a sand-dweller from SW Utah and adjacent Arizona, closely related to *P. speciosus* but differing mostly in its greater height; all the other characters that are consistent in *P. laevis* appear here and there in *P. speciosus*.

In the Intermountain Region, whenever you see a very distinctive habitat, you can anticipate an interesting plant. That is exactly what Duane Atwood suspected when he discovered *Penstemon idahoensis* (p. 137) flourishing in white,

tufaceous soil. It's endemic to the Goose Creek drainage in S central Idaho and the corners of NW Utah and NE Nevada. The whole plant has a pubescence of short, stubby hairs that must be glandular (sticky), because they are covered with particles of this soil. The dark green foliage and bright blue flowers are beautiful against this white background.

Penstemon moriahensis is restricted to the N end of the Snake Range around Mount Moriah, and across a low gap on the north side in the Kern Mountains. It has woolly anthers. *Penstemon comarrhenus* is a tall plant with narrow leaves, a widely branched inflorescence, and densely woolly anthers; the corolla is pale blue to lavender.

Section *Elmigera*

This section includes the red-flowered species of subgenus *Habroanthus*. The type locality for *Penstemon eatonii* var. *eatonii* is just over the ridge from Snowbird in American Fork Canyon, at the N edge of its range. It ranges south through Utah to SW Colorado, NW New Mexico, Arizona, E and S Nevada, and the desert mountains of S California. The corolla is tubular and nearly regular—obviously hummingbird-pollinated. *Penstemon barbatus* var. *torreyi* is another red-flowered species, this one distinctly two-lipped; the lower lip is sharply reflexed, with the upper forming a hood over the anthers and style.

Subgenus *Saccanthera*, Section *Saccanthera*

The name *Saccanthera* refers to the anthers, which dehisce across the connective, leaving the distal ends indehiscent. Section *Saccanthera* includes the species with blue, violet, or lavender flowers, excluding the red ones.

Penstemon floribundus is known only in the Jackson Mountains of NW Nevada. Its nearest relative seems to be *P. azureus* of the eastern foothills of the Sierra Nevada in California. The upper surface of its leaves is minutely puberulent with granular papillate hairs, and it has large, showy violet corollas.

Penstemon tiehmii is another narrow endemic, known only from Mount Lewis, the highest peak in the Shoshone Range east of Battle Mountain, Nevada. It is a high-elevation relative of *P. kingii*, which occurs across central and N Nevada in the sagebrush deserts between the mountains. *P. tiehmii* forms loose mats on steep talus. An unusual feature for the genus is the presence of petiolate (stalked) leaves throughout the plant.

Penstemon leonardii is a plant you can expect to find in the Wasatch Mountains; look for blue flowers low to the ground, on sprawling stems. It often grows in rocky places at mid and subalpine elevations in the Wasatch Range and sporadically across the Uinta Mountains.

Penstemon patricus was known only in the Deep Creek Range in W Utah, near the Nevada border south of Wendover, in the middle of nowhere, but it has now

been found in the House and Canyon ranges to the south and east. My father was the first to collect it, back in the early 1940s, so I named it in his honor. It is a shrubby species closely related to the following two.

Penstemon platyphyllus is abundant around the mouth of Little Cottonwood Canyon, where Snowbird is located, and can be found in other Wasatch canyons as far north as Ogden Canyon, and sparingly south over the ridge in American Fork Canyon, where it grows with the following species. The most noticeable differences between these two are that *P. platyphyllus* has longer, lanceolate sepals, puberulent stems, and granular-papillate pedicels. *Penstemon sepalulus* resembles the former in its shrubby habit, narrow leaves, and violet flowers, but closer examination discloses short, ovate sepals and glabrous stems and pedicels. It occurs in similar habitats from American Fork Canyon south to the S tip of the Wasatch Range.

Section *Bridgesiani*

This section contains one species in our region's flora. *Penstemon rostriflorus* has a red to red-orange corolla, attractive to hummingbirds. This is a good example of convergent evolution: note how similar it is to *P. barbatus* of the *Glabri* section. Other than this, its characters are quite different. *P. rostriflorus* ranges widely from the S Sierra Nevada and the mountains to the south in California, east across the S halves of Nevada and Utah, and across N Arizona to SW Colorado and NW New Mexico.

That is the last species of *Penstemon* treated in the *Intermountain Flora*, and when the volume was published in 1984, it was number 104. Since that time 13 species have been added. Seven are discoveries new to science, two are range extensions into NE Utah from Colorado, one is a Pacific Northwest species that escapes from cultivation, and three are former varieties that have been raised to species level. *Penstemon* is either the second or the third largest genus in the region, with *Astragalus* taking first place honors; second place depends on how many species Jim Reveal ends up with in Intermountain *Eriogonum*.

Dr. Noel H. Holmgren taught at Oregon State University and Lehman College of City University of New York, but spent the greater part of his career—42 years—as a curator of botany at the New York Botanical Garden. He is best known as a lead author of the multi-volume *Intermountain Flora*. After completing that work and its one-volume condensed manual, he hopes to undertake a thorough revision of the genus *Penstemon*. His work on North American flora has earned many honors, including the NARGS Edgar T. Wherry Award.

Eriogonum in the Garden

James L. Reveal

Note: The following article is a condensed version of a much longer text and has been approved by the author. The original version, which includes much more technical botanical, taxonomic, and distributional information, may be obtained from the editor by readers wishing greater detail. You may request an electronic version (rtf) to be sent as an e-mail attachment from janemcgary@earthlink.net. We regret that our budget does not permit us to provide paper copies.

This plant list includes some taxa listed as endangered, sensitive, or otherwise in need of conservation. Almost all of these are presently maintained in botanic garden or nursery collections, from which gardeners should obtain their seeds and plants. Be aware that collecting any material from protected populations is prohibited, except under permits obtained from the proper authority (for example, the U.S. Forest Service).

Several confessions are necessary at the start. The foremost is that I am not a gardener and have grown none of the species mentioned below save for a few as part of greenhouse studies. Next is that I am a taxonomist, and worse yet, an academic one, so that this presentation is more voluminous and erudite than some readers may wish. I leave it to the reader to decide what to absorb and what to ignore.

My role with the genus *Eriogonum*, the largest genus of the knotweed family (Polygonaceae), has been one of a monographer—the person who attempts to understand and account for all of the variation in the group and to make that information available following traditional taxonomic methods. Think of this as concentrating on the “who, where, and why” information model associated with the classification, biogeography, and evolution of this genus. Things like “value” I leave for others. Products of this effort have been published for decades, the latest being a treatment of the genus and most of its immediate allies in volume 5 of *Flora of North America* (Reveal 2005). More is coming, first in 2008 with a revision of the genus for *The Jepson Manual*, a flora of California, and eventually in the final volume of the *Intermountain Flora*. Today, much can be found on the Internet (e.g., Reveal 2001 to present). I am slowly expanding what is already present on the Web to include detailed descriptions, complete summary

of the nomenclature including type information, distribution maps for each entity based on confirmed herbarium material, and a series of images (mainly photographs) illustrating each element. Eventually, this will include all of the approximately 325 species of the subfamily Eriogonoideae found throughout North America and southern South America.

My association with wild buckwheats began during the summer between my sophomore and junior year at Utah State University (1961), doing range surveys for the Bureau of Land Management in NW Utah. I had taken a course in plant taxonomy from Arthur Holmgren, and I made numerous collections over that summer. What I did not expect were new kinds of wild buckwheat. Art suggested I send duplicates of my curious specimens to George Goodman at the University of Oklahoma and to John Thomas Howell at the California Academy of Sciences. Both wrote back saying they did not know what they were, and Tom Howell suggested this would be a good genus for a young person to study. He also sent me a copy of Susan Stokes's revision of *Eriogonum* (1936). Now worn and battered, that copy remains a prized possession.

Art Holmgren suggested I follow up on what Tom suggested. I asked Art how, and basically he said "Go through everything in the herbarium and learn the species." Furthermore, I should compile all information on the genus—all names and publications included—and come see him when that was done. Four months later I showed up in the Intermountain Herbarium with several notebooks and original descriptions and asked what I should do next.

The answer was to start monographing the genus; and I have been trying to do that for over forty years. This has been a wonderful avenue to botanical explorations and discoveries. Even today new wild buckwheats are being found in the western United States and northern Mexico. It is fun to travel the West and see plants I have named, and it is still exciting to find something new.

The bulk of this presentation is devoted to species I feel are worthy of consideration for the garden. These suggestions are based solely on my view of what might be appropriate in cultivation; I trust I have not missed some that others feel are worthy.

Eriogonum and Its Relatives

The genus *Eriogonum*, or wild buckwheats, is one of the largest genera of vascular plants found in North America, exceeded in number only by *Carex*, *Astragalus*, and *Penstemon*. The approximately 252 species of *Eriogonum* occur from the offshore islands of California to the coastal plains of South Carolina, Georgia and Florida, and from near Eagle, Alaska in the north to the trans-volcanic ranges of central Mexico. *Eriogonum* is second only to *Penstemon* in being the largest genus endemic to North America.

Eriogonum is one of 20 genera belonging to the subfamily Eriogonoideae, which is restricted mainly to arid regions in the temperate New World. In South America, members of the subfamily are found mainly in Chile and Argentina; in North

America, representatives are found in Alaska, Canada, much of the United States (West Virginia and Virginia southward in the East), and the northern half of Mexico. While some grow in moist eastern deciduous forests, most are in arid regions of the American West. Representatives may be found below sea level in Death Valley, California, and among the highest plants to be seen on nearby Mt. Whitney.

The subfamily is traditionally divided into two tribes: *Pterostegieae*, composed of the annual genus *Pterostegia* and the perennial genus *Harfordia*, both from the Southwest and Baja California; and *Eriogoneae*, with far more genera. Next to *Eriogonum*, the most species are in *Chorizanthe*, mostly California annuals along with nine perennial species in Chile. Related to *Chorizanthe* are the small genera *Mucronea*, *Systemotheca*, *Centrostegia*, *Dodecabea*, *Aristocapsa*, and *Lastarriaea*. All occur in California; only *Centrostegia thurberi* and the species of *Lastarriaea* occur beyond that state. The near relatives of *Eriogonum* are *Dedeckera*, *Stenogonum*, *Goodmania*, *Gilmania*, *Oxytheca*, *Acanthoscyphus*, *Sidotheca*, *Nemacaulis*, and *Johanneshowellia*. *Hollisteria* is somewhat in between *Eriogonum* and its relatives and those associated with *Chorizanthe*. Representatives of all of the genera allied with *Eriogonum* (with the exception of *Stenogonum*) occur in California.

Looking at *Eriogonum* itself, this genus is divided into seven subgenera of unequal size:

1. *Eucycla*, approximately 111 species, 105 of them north of Mexico in the American West and Great Plains; all perennial shrubs or herbs, including many caespitose or matted expressions.
2. *Micrantha*, 2 species of the Great Plains and Texas, tall erect annuals (or biennials) with leafy stems.
3. *Clastomyelon*, one species of Death Valley region in California, a tall wand-like perennial.
4. *Eriogonum*, 2 species of the SE United States, with flowers on long stipes and densely covered with long hairs, and erect, leafy stems.
5. *Oligogonum*, well-known to gardeners for its member *Eriogonum umbellatum*, with most species in the West except *E. allenii*; stipitate flowers; mat-forming or shrubby with numerous spreading, leafy caudex branches arising from a taproot, and erect flowering branches rising along the caudex branches.
6. *Pterogonum*, primarily Mexican (6 of the 11 species occur north of Mexico), with flowers lacking a stipe, tall, erect stems, mostly sparsely leafy, and more or less winged fruits.
7. *Ganysma*, 62 species (53 north of Mexico), perennials and annuals, the latter often weedy.
8. *Oregonium*, mostly annuals, some weedy.

Eriogonum in the Garden

Numerous species of *Eriogonum* are now available to gardeners. Nicholls (2002:111–26) provides the most detailed horticultural information about *Erio-*

gonum presently available, though some corrections are noted below. The following brief descriptions include the plant's name, authorship, and subgenus, followed by a description, distribution, and evaluation of its place in the garden. Related species are also noted so a comparison can be made with similar garden subjects. Detailed taxonomic information is available in *Flora of North America* and at www.life.umd.edu/emeritus/reveal/pbio/eriog/eriog.html.

An asterisk marks those ideally suited for the rock garden. Images of nearly all of these species are available via www.life.umd.edu/emeritus/reveal/pbio/eriog/eriogarden.html or www.life.umd.edu/emeritus/reveal/pbio/RevealSlides/slideindexEriogonum.html. The abbreviations N, S, E, W, and C are used in the sense of northern, southern, eastern, western and central to apply to portions of states or provinces.

****Eriogonum acaule* Nutt.** (*Eucycla*) (Nicholls, p. 112). Of the several low, matted, caespitose perennials in *Eriogonum*, this is one of the prettiest. The flowers are in small clusters arranged in a single involucre atop a flowering stalk that barely exceeds the length of the leaves. This true rock garden plant is somewhat slow to grow to its maximum size of about 50 cm across, and difficult to maintain in cultivation. Seeds are available but the young plants are difficult to grow. It occurs mainly in S Wyoming and also in Moffat County, Colorado. See *E. brevicaula* and *E. contortum*.

***Eriogonum allenii* S. Watson** (*Oligogonum*) is a large, attractive perennial already well established in cultivation. Its long leaves (to 30 cm) and profuse inflorescence of numerous branches covered with bright yellow flowers are its main attractions. Although restricted in the wild to the shale barrens of Virginia and West Virginia, it can be grown in a variety of habitats. Avoid over-watering, as the barrens are hot and dry even though surrounded by deciduous forest. Although attractive in flower, this plant tends to be leggy in cultivation, making it decidedly unattractive during much of the year. It is best to cut away the flowering stems (unless seeds are desired); the leaves are a nice addition to the winter garden until they too wither. See *E. correllii* and *E. wootonii*.

****Eriogonum alpinum* Engelm.** (*Oligogonum*) is restricted to high ridges in the Cory Peak and Mt. Eddy region of N California, on serpentine ridgetops and slopes. Listed as endangered in the state, it is easily recognized by its nearly round leaf blade and spreading scapes with a whorl of 3 to 5 leafy bracts, capitate inflorescence, and bright yellow flowers. Rarely found in cultivation. See *E. siskiyouense*.

***Eriogonum ammophilum* Reveal** (*Eucycla*) is a low, spreading subshrub related to *E. nummulara*, and it has little to recommend its use in the garden. It is much more modest than *E. nummulara*, but if pruned back to be more compact, it could be attractive. It is considered sensitive by the Bureau of Land Management (BLM), but seed is readily available in late summer and early fall.

****Eriogonum androsaceum* Benth.** (*Oligogonum*) is infrequent in cultivation, but it requires more attention by the rock gardener than it presently receives. A low, matted perennial typically of subalpine habitats in the northern Rocky Mountains of SW Alberta and NW Montana, it is related to *Eriogonum flavum* but differs in leaf shape, stem and leaf color, and its pale yellow flowers. In many

respects *E. androsaceum* is the more attractive of the two. As it occurs mainly in national parks, permits are required to gather seed.

Eriogonum anemophilum* **Greene (*Eucycla*), in a strict sense, is a plant of limestone outcrops on the West Humboldt Range of Pershing County, Nevada. It belongs to a group of closely related mat-forming perennials found mainly in the Intermountain West. Woolly stems and cream-white flowers characterize it. Most populations now assigned to the species are found much lower on volcanic tuffaceous outcrops in C Nevada. This is an attractive wild buckwheat, worthy of cultivation. See *E. diatomaceum*, *E. tiehmii* and *E. roseense*.

Eriogonum annuum **Nutt.** (*Micrantha*) is a widely dispersed annual or biennial species of the Great Plains. With a tall, erect, leafy stem and white flowers, it is attractive but can become weedy, though seen occasionally in specialists' gardens. It does best in deep, sandy soil.

Eriogonum apricum* **J. T. Howell (*Eucycla*) has two varieties, the Ione (var. *apricum*) and Irish Hill (var. *prostratum*) wild buckwheats, both federally listed as endangered. These rare plants are erect to spreading, or prostrate (in the latter variety) perennial herbs with round-ovate basal leaves and cymose inflorescences dominated by white flowers. Var. *prostratum* may well be worth introduction. The species is known from only a few scattered sites in Amador County, California.

Eriogonum arborescens **Greene** (*Eucycla*) is an island endemic, naturally restricted to Santa Cruz, Santa Rosa, and Anacapa islands off S California. Now widely cultivated, it has become naturalized on the mainland of coastal California. Without any natural barriers, this will hybridize with several coastal species. A large, decorative shrub, it has to be carefully pruned and maintained. Great care should be taken to prevent this buckwheat from being introduced elsewhere. See *E. giganteum*.

Eriogonum arcuatum* **Greene (*Oligogonum*), formerly known primarily as *E. jamesii* var. *flavescens*, has two elevationally separated varieties. Var. *arcuatum* is the low-elevation phase, found from SE Wyoming, Colorado and NE Utah south to N Arizona and NW New Mexico, mainly in pinyon-juniper or conifer woodlands below 3000 m. Of greater interest to the gardener is the more depressed and compact expression, var. *xanthum*, restricted to subalpine and alpine ridges and slopes along the backbone of the Colorado Rocky Mountains. (see Nicholls, p. 117; illustrated but mistakenly identified as *E. umbellatum* on p. 122). It does well in cultivation and is often seen in rock gardens. In the field it is found up to 4200 m on the higher peaks. Not yet in cultivation is var. *rupicola* of Zion National Park, Utah, similar in aspect to var. *xanthum* but confined to sandstone ledges at much lower elevations. See *E. flavum*, *E. jamesii*, and *E. wootonii*.

Eriogonum aretioides* **Barneby (*Eucycla*) is a low, matted, caespitose perennial with each individual composed of 20 to 50 compact rosettes, forming flattened hummocks on limestone gravel; it is found mainly in the Red Canyon Natural Research Area of Garfield and Emery counties, Utah. The inflorescence is tightly appressed to the rosette of tiny leaves and consists of a single involucre with pale or, more commonly, bright yellow flowers. This is a worthy, albeit challenging, addition to the rock garden. See *E. shockleyi*, *E. tumulosum* and *E. villiflorum*.

**Eriogonum argophyllum* Reveal (*Eucycla*) (Nicholls, p. 112), the Sulphur Hot Springs wild buckwheat, is restricted to a single location on private land in Ruby Valley, Elko County, Nevada. It is considered critically endangered by the state. It is a low, mat-forming perennial similar to *E. kingii*, having densely white tomentose leaves and pale yellow flowers. It is worthy of cultivation but difficult to maintain. See *E. holmgrenii* and *E. kingii*.

Eriogonum arizonicum S. Stokes ex M. E. Jones (*Ganysma*) has round, basal to sheathing leaves, grayish or whitish on both surfaces, and an erect to spreading habit. The slender flowering stems and branches have long peduncles bearing a narrow involucre containing yellowish to yellowish red flowers. It is uncommon, found on sandy to gravelly flats and in rocky washes in widely scattered locations in Arizona. Like *Eriogonum inflatum*, this species can be a first-year-flowering perennial.

Eriogonum artificis Reveal (*Eucycla*) is a rare plant, known only from a single location near Frisco in Beaver County, Utah. A member of the *E. brevicaulis* complex, it is a perennial herb up to 45 cm tall, with flowers that vary from cream through pale yellow to bright yellow. The species is marginally worthy of cultivation. See *E. mitophyllum*, *E. ostlundii* and *E. spathulatum*.

**Eriogonum bicolor* M. E. Jones (*Eucycla*) (photo, p. 139; see Nicholls, p. 112). Few low, matted subshrubs rival this one for sheer color and beauty. It is heavily branched, becoming up to 30 cm across but only about 8 cm tall. The narrow leaves are slightly exceeded by the flowering stems, but the numerous, rather compact inflorescences position the white to eventually red or rose flowers above the leaves. It is common from Castle Valley and the San Rafael Swells of Utah, east to Grand Valley of Utah and Mesa County, Colorado, and fairly common in Canyonlands National Park and Grand Staircase-Escalante National Monument. It does fairly well in the garden and deserves more attention. See *E. ericifolium*, *E. microthecum*, *E. ripleyi* and *E. thornei*.

Eriogonum × *blissianum* Mason (*Eucycla*) is an established hybrid involving two island species, *E. giganteum* var. *formosum* and *E. arborescens*. The hybrid is now infrequently seen in cultivation, although it is more graceful than typical *E. arborescens*.

**Eriogonum brandegeei* Rydb. (*Eucycla*) is a rare species, known presently from nine occurrences along the Arkansas River in Colorado and listed as sensitive. The plant is a low, spreading perennial herb with grayish leaves, stems, and branches. The flowers are creamy white. Field selections could result in a worthy addition to the garden. See *E. brevicaulis* and *E. loganum*.

**Eriogonum breedlovei* (J. T. Howell) Reveal (*Eucycla*) (see Nicholls, p. 113) is confined to the southern Sierra Nevada of California. Both var. *breedlovei* and var. *shevockii* are rare and infrequent on quartzite or granitic outcrops in Kern and Tulare counties. The flowers are whitish to reddish, and the plants tend to be loosely matted in the wild but more compact in cultivation. See *E. crosbyae* and *E. roseum*.

**Eriogonum brevicaulis* Nutt. (*Eucycla*) (photo, p. 139; see Nicholls, p. 113) displays considerable variation, and many forms are not garden-worthy. The rock

gardener's efforts should be confined to the low, matted forms. The low-elevation var. *bannockense* resembles *E. desertorum*; it is found in W Wyoming, SE Idaho, NW Utah and NE Nevada, mainly in sandy to shaly or gravelly soils in sagebrush and mountain mahogany communities. High-elevation expressions of var. *nanum* are found in the Wasatch Range of N Utah; this phase can have yellow or white flowers. Var. *caelitum* occurs in N Utah and is probably the best for gardens. The widespread var. *laxifolium* is found from Idaho south into N Utah, mainly along the western foothills of the Wasatch Range. It is exceedingly variable and almost always leggy in cultivation. Nicholls confused this plant with *E. desertorum*, although his illustration (p. 113) is of *E. kingii*. Var. *canum* (syn. *E. lagopus* Rydb.) may be worthy of consideration for its hairy flowers and preference for an arid setting on sandstone ledges in Montana and Wyoming. Neither var. *brevicaule* nor var. *micranthum* is particularly suitable for the rock garden; the former is occasionally grown, although the latter would be a better choice. See *E. acaule*, *E. brandegeei*, *E. contortum*, *E. ephedroides*, *E. loganum*, *E. natum*, and *E. viridulum*.

***Eriogonum butterworthianum* J.T. Howell** (*Eucycla*) is a rare and localized species growing in the cracks of Vaqueros sandstone near The Indians in the Santa Lucia Range of Monterey County, California. It is a low shrub with narrow leaves sheathing the lower half of its numerous stems, and long involucre with yellowish white to rose flowers. The U.S. Forest Service considers it a sensitive species. This might be of some interest to the rock gardener who can accept a plant up to 30 cm tall and 40 cm across in the wild, and potentially much larger in cultivation. If treated as a bonsai, the result could be most elegant.

****Eriogonum caespitosum* Nutt.** (*Oligogonum*) (Nicholls, p. 113) ranges from SW Montana, S Idaho and SE Oregon south to W Wyoming and Utah, Nevada, NW Arizona, and E California. Plants along the eastern edge of the Sierra Nevada in Long Valley of southern Mono County, California, form large, dense, whitish-gray mats unlike any other population. In addition to Nicholls's image of this species on p. 114, there are ones of mature female plants on pp. 115 (lower right, misidentified as *E. gracilipes*) and 119 (lower left, misidentified as *E. ovalifolium*). Individual plants of this species are functionally either male or female, and to obtain seed in the garden, both phases are required. Functionally male flowers tend to be yellowish even at maturity and do not elongate with age. Functionally female flowers tend to be reddish at maturity and elongate significantly as the fruits mature. Plants with immature flowers can be challenging to "sex" as both anthers and pistils are present, but only the stamens or pistil will develop fully.

****Eriogonum callistum* Reveal** (*Eucycla*) should make an attractive addition to the rock garden. The large, roundish mats are composed of numerous tight rosettes of persistent leaves that remain attractive long after flowering. The small hairy flowers are in tight heads atop long stems. The persistent fresh leaves, plus those that remain on the branches from previous years, allow the mats to accumulate soil and plant debris and thus enlarge each growing season. The natural habitat in the Tehachapi Mountains of S California suggests that it requires little watering, prefers gravelly soil in open, sunny places, and should survive with little or no maintenance. This new species will be introduced into cultivation in 2007.

****Eriogonum capistratum* Reveal** (*Eucycla*) (Nicholls, p. 114, under *E. chrysocephalum*), in var. *capistratum*, is rather common in the mountains of central Idaho, mainly on granitic soils and outcrops. This is a low, matted perennial with spatulate to elliptic leaves. Var. *muhlickii* of the Bitterroot and Pintler ranges of W Montana occurs on rocky outcrops in alpine settings. It differs in having a smaller, more compact habit with both glandular and tomentose (not just tomentose) leaves. This would be an attractive addition to the rock garden. See *E. crosbyae*, *E. meledonum* and *E. verrucosum*.

****Eriogonum chrysops* Rydb.** (*Eucycla*) is known only from five scattered locations in the Skull Creek area of Malheur County, Oregon, on basaltic or rhyolitic slopes and outcrops in sagebrush communities. It is a matted perennial with leaves densely white to grayish tomentose on both surfaces; the flowers are yellow. Listed as threatened by the state of Oregon, it should be an excellent addition to the garden. See *E. crosbyae*, *E. ochrocephalum*, and *E. scopulorum*.

***Eriogonum cinereum* Benth.** (*Eucycla*) is a large (to 1.5 m tall and 2.5 m across), grayish shrub. The inflorescences are restricted to the upper nodes, bearing white to pinkish flowers. It grows on sandy beaches, coastal bluffs, and mesas near the Pacific Ocean in S California, and on Santa Rosa Island. Although long cultivated, it is infrequently found in gardens today. Properly pruned and maintained, this shrub is a lovely addition to the ornamental garden. See *E. fasciculatum* and *E. parvifolium*.

***Eriogonum clavellatum* Small.** (*Eucycla*) (photo, p. 140) is a low, heavily branched, slow-growing, bright green subshrub with thickened leaves borne in clusters along the stems, and white flowers. It is confined to heavy clay washes and slopes in salt-bush communities in a few scattered sites in the Four Corners area where Utah, Colorado, New Mexico, and Arizona meet. The BLM considers it a sensitive species throughout its range. Like *E. bicolor*, this species is worthy of cultivation but unless heavily pruned it is probably too large for the rock garden. Its bright green aspect is in sharp contrast to the reddish hue of *E. bicolor*. See *E. pelinophilum*.

****Eriogonum codium* Reveal, Caplow & K. A. Beck** (*Eucycla*), when initially found on volcanic bluffs overlooking the Columbia River in Hanford Research National Monument in Benton Co., Washington, had a large, vigorous population. Since then, wildfires have destroyed a significant number of individuals so that the species is now considered a candidate for federal protection under the Endangered Species Act; it is already so listed by the state. It has lemon-yellow flowers. Ongoing efforts to cultivate it have shown it to be slow-growing, and in the wild, a newly established plant can take up to seven years before it flowers.

****Eriogonum coloradense* Small** (*Eucycla*) is a high-elevation expression derived from *E. lonchophyllum*, restricted to the backbone of the central Colorado Rocky Mountains; it is considered sensitive. It differs from *E. lonchophyllum* by its low, matted habit and capitate inflorescence. In cultivation its matted habit persists, suggesting that the plant deserves formal taxonomic recognition and a place in the rock garden.

***Eriogonum compositum* Douglas ex Benth.** (*Oligogonum*) (photo, p. 140; Nicholls, p. 114), in var. *compositum*, has been in cultivation since about 1830,

where it tends to be both leggy and rather trashy, but its cream to yellow flowers, large leaves, and inflorescences with an abundance of flowers have overcome the perceived faults. Of the three varieties, var. *leianthum* is the most attractive, though presently seen mainly in European gardens. The plant occurs from S British Columbia, Washington and Idaho south into N California and NW Nevada. If the flowering stems are removed after flowering, the long leaves can be attractive if they too are carefully maintained so that each plant becomes a dense clump. Dead leaves can be removed from mature plants in most garden settings so that the decorative leaves persist through the winter.

***Eriogonum congdonii* (S. Stokes) Reveal** (*Oligogonum*). Few shrubs of the genus deserve more attention by the gardener than this one. While not appropriate for the rock garden, this spreading or even matted subshrub to small shrub could find a place as a featured specimen. Selecting bright green and glabrous plants is a first step. The numerous, large, bright sulphur-yellow flowers are a bonus. It is found in the mountains of NC California, often spectacularly set off against the greenish-black of the serpentine outcrops where it occurs naturally.

****Eriogonum contortum* Small ex Rydb.** (*Eucycla*) is seen mainly in the Grand Valley area of Utah and in western Mesa County, Colorado, on Mancos Shale flats and slopes in saltbush communities. The narrow leaves are bright green, with revolute margins that usually hide a white tomentose lower surface. The bright green stems and branches are boldly set off by bright yellow flowers that become reddish-yellow with age. The plant is rarely cultivated but would make a worthy addition to the rock garden as a low, compact subshrub, typically no more than 10 cm tall.

***Eriogonum correllii* Reveal** (*Oligogonum*) is known in only a few scattered populations in N Texas, growing on clayey flats and mounds in mesquite communities. It is a robust herbaceous perennial in the *E. jamesii* complex. The flowers are bright yellow and the leaves are large, green above and densely white-tomentose below. Like *E. allenii*, it requires careful maintenance for otherwise it will become leggy and rather trashy with age. Removing flowering stems after flowering, and dead leaves, will encourage the formation of tight clumps and decorative leaves even during the winter months.

***Eriogonum corymbosum* Benth.** (*Eucycla*) requires more study to resolve taxonomic problems. The var. *corymbosum* is now defined to include four slightly differing phases with more or less discrete ranges in SW Wyoming, E Utah, W Colorado, and N Arizona. The var. *aureum* is restricted to the Shivvits Hills of SW Utah, and is a yellow or rarely cream-colored flowering phase. The var. *glutinosum* is now defined as a large, roundish shrub with numerous, mainly yellow (infrequently white) flowers, growing in saltbush, blackbrush and sagebrush communities on the Colorado Plateau. Var. *nilesii*, another large shrub with yellow (rarely white) flowers and densely white lanate to tomentose leaves, is confined to the Mojave Desert in SW Nevada, with perhaps a disjunct population in Kane County, Utah. Of the remaining varieties, only var. *velutinum* and var. *orbiculatum* are worth serious cultivation. These are large shrubs that form rounded mounds, covered when fully mature with white flowers over green to whitish gray leaves. Both these vari-

eties occur on the Colorado Plateau, although the former extends well into NC New Mexico. All of these shrubs can be up to 1 m high and 2.5 m across. A high-elevation matted phase, var. *heilii*, occurs on Thousand Lake Mountain in Wayne County, Utah, and may well be worth a spot in the rock garden if the low expression with capitate inflorescences is selected. See *E. lancifolium* and *E. thompsoniae*.

***Eriogonum crocatum* A. Davidson** (*Eucycla*), as one of the more widely cultivated species, has attracted numerous enthusiasts. Interestingly, it is rare in the wild, found only from the Conejo Grade area of the Santa Monica Mountains in Ventura County, California. As a small, erect to spreading shrub or subshrub, it is rarely seen in rock gardens, being preferred as border plant, where its lanate to tomentose leaves, flowering stems and branches are brilliantly offset by the numerous bright yellow flowers. Unlike most species of the genus, the saffron wild buckwheat retains a degree of form and color even in the vegetative state.

***Eriogonum cronquistii* Reveal** (*Eucycla*) is confined to Bull Mountain in the Henry Mountains of Garfield County, Utah, but might be worthy of cultivation. It is a low, spreading perennial with crenulate leaves and white flowers. As a plant of granitic talus slopes and outcrops, it is probably slow-growing. For a rock garden, one should select small, compact plants with subcapitate inflorescences.

****Eriogonum crosbyae* Reveal** (*Eucycla*) has been expanded (Reveal 2005) to include a series of widely scattered populations of low, matted, herbaceous, scapose perennials, all potential rock garden plants. The major phases of this species complex are maintained here (as *Eriogonum capistratum*, *E. meledonum* and *E. verrucosum*), as is the more distantly related *E. ochrocephalum* var. *alexandrae*. Each offers a slightly different array of features. In a strict sense, *E. crosbyae* is a plant with weakly erect, tomentose scapes bearing capitate inflorescences of campanulate, weakly rigid involucre with five teeth. The yellow flowers are glabrous. It is found on low-elevation white tuffaceous volcanic outcrops, flats, washes and slopes in SE Oregon and N Nevada and is considered a sensitive species by the BLM in both states. See *E. chrysops* and *E. ochrocephalum*.

****Eriogonum cusickii* M. E. Jones** (*Eucycla*) is a low, matted perennial allied to *Eriogonum prociduum*. The bright green, glabrous leaves, flowering stems and branches quickly distinguish the species; the flowers are yellow. It is found on low-elevation sandy, volcanic flats in mixed grassland and sagebrush communities and in montane conifer woodlands of central to SC Oregon. It would make a worthy addition to the rock garden.

****Eriogonum desertorum* (Maguire) R.J. Davis** (*Eucycla*) is a low to mid-elevation cespitose, matted perennial with oblanceolate to elliptic or ovate leaves and yellow flowers, confined to gravelly or silty to clayey flats, slopes and ridges on soils mainly derived from a limestone substrate in NE Nevada, and NW Utah. Upper-elevation plants, mostly above 2600 m, from the Jarbidge, Independent and Kinsley mountains in Nevada and the Grouse Creek Mountains in Utah, tend to have broader leaf-blades and a shorter, more compact habit; these were formerly called *E. lewisii*. See *E. crosbyae*.

****Eriogonum diatomaceum* Reveal, J. Reynolds & Picciani** (*Eucycla*) is restricted to white chalky slopes in saltbush communities in the Churchill

Narrows south of Fort Churchill State Park in Nevada. It is similar to *E. anemophilum* and *E. tiehmii*. Like them, this is a low, matted perennial with creamy-white flowers. Considered sensitive by the state, it is worthy of cultivation, but other allied species are more attractive. See *E. ochrocephalum*.

****Eriogonum declinum* Reveal** (*Oligogonum*) (Nicholls, p. 114) is a low, spreading, matted perennial with distinctly different male and female expressions. The male plants tend to have capitate inflorescences of small, often pale yellow to yellow flowers that wither with age. The female plant, in contrast, starts out with a capitate inflorescence of mostly yellow flowers, but after pollination and as achenes mature, the inflorescence branches and the flowers become rose to red. The leaves (and thus the mats) are surprisingly attractive throughout the year, making this a potentially useful groundcover. It is found in the Siskiyou and Trinity mountains of N California and SW Oregon, confined to serpentine flats and slopes. See *E. incanum* and *E. marifolium*.

****Eriogonum douglasii* Benth.** (*Oligogonum*) (Nicholls, p. 114) is subdivided into a series of varieties. In a strict sense var. *douglasii* is a low mat-former with spatulate leaves, found mainly in the Blue and Wallowa mountains of SE Washington and NE Oregon, and also in Idaho and just inside the Intermountain Region in Malheur County, Oregon. In NE California, W Nevada, and extreme SC Oregon is var. *meridionale*, the phase most commonly seen in cultivation because the flowers often turn deep red with age. An expression with even larger flowers is var. *elkoense*, known only from the Sunflower Flat area of Elko County, Nevada, and worthy of introduction. See *E. sphaerocephalum* and *E. twisselmannii*.

***Eriogonum effusum* Nutt.** (*Eucycla*) is a large, diffusely branched, spreading shrub of the Great Plains and E Rocky Mountains from SW South Dakota and SE Wyoming through SW Nebraska into E Colorado to NE New Mexico. It is infrequently seen in cultivation but deserves more attention. With careful pruning the shrub becomes rather floriferous. Without care, it can be straggly and its branches quite diffuse. See *E. helichrysoides*, *E. leptocladon* and *E. nummularae*.

***Eriogonum elatum* Douglas ex Benth.** (*Eucycla*) is an erect herbaceous perennial with large, green leaves, an open inflorescence with green and glabrous or graying and villous flowering stems, and white flowers. The stout, woody taproot is easily transplanted, and the species does well in cultivation. It is widely distributed on dry, often grassy slopes from E Washington to N and E California and N Nevada. The common, glabrous stem phase is var. *elatum*; plants with villous stems are var. *villosum*. The latter has a reduced range mainly in SW Oregon and N California and NW Nevada. See *E. nudum*.

***Eriogonum elongatum* Benth.** (*Eucycla*) is a tall, erect to slightly spreading perennial herb with numerous stem leaves. The long, whiplike branches allow the plant to grow in windy areas, and the large, stout taproot ensures ease of transport and survival. In Baja California one may encounter var. *vollmeri*, which has off-yellow flowers. The more compact var. *aerorivum* of the Vizcaino Desert may be more attractive. *Eriogonum elongatum* is less pleasing in the garden than *E. elatum* because it tends to be rather trashy except in full flower. Both species have long been in cultivation.

Eriogonum encelioides Reveal & C. A. Hanson (*Eucycla*) belongs to the *Eriogonum giganteum* complex, and as such is worthy of cultivation. Unfortunately, it is localized in the western portion of the Vizcaino Desert in C Baja California, Mexico, and thus difficult to obtain. Additionally, its open, sparsely branched inflorescence is decidedly less attractive than its northern relative. Still, *E. encelioides* tends to be a more compact, grayish white shrub, and with aggressive pruning could form an elegant decorative plant.

Eriogonum ephedroides Reveal (*Eucycla*). Few members of the *E. brevicaulis* complex are garden-worthy, but this is a possible exception. It has relatively narrow leaves near the base of its grayish green flowering stems and branches that bear scattered cream to pale yellow flowers. It is infrequent in NE Utah and NW Colorado. See *E. viridulum*.

**Eriogonum ericifolium* Torr. & A. Gray (*Eucycla*) is a low, spreading and matted subshrub with revolute, linear leaves and white flowers that turn bright red in fruit. Rare and local in the Verde River Valley of Yavapai County, Arizona, it is seen occasionally in cultivation, often misidentified as *E. microthecum*. This is an excellent candidate for the rock garden but will require pruning to keep it from becoming leggy, which it tends to be when protected from browsing animals. See *E. pulchrum*, *E. terrenatum* and *E. thornei*.

**Eriogonum exilifolium* Reveal (*Eucycla*) is a low, matted perennial. The linear, revolute leaves and the stems tend to be dark green but may have a slight grayish look. The bright white flowers are a stark contrast against the green herbage and the red soil where the plant grows in SW Wyoming and NC Colorado. It does fairly well in cultivation but tends to form less compact mats than most of the plants in the *E. ochrocephalum*/*E. roseum* complex.

Eriogonum fasciculatum Benth. (*Eucycla*). The low matted subshrubs to large shrubs of this species often dominate chaparral communities in California; elsewhere the plant is common on the Mojave and Sonoran deserts of California, Nevada and Utah, south through Arizona into Baja California and NW Sonora, Mexico. Various forms have been in cultivation since the early 1800s. Var. *polifolium* is the most widespread of the recognized variants. Some of the populations found on limestone outcrops are composed of compact shrubs that might be garden-worthy. The yellowish-green phase known as var. *flavoviride* is more attractive. The most commonly cultivated phase is the coastal Californian var. *foliosum* (Nicholls, p. 115), a large shrub (up to 1.5 m tall and 2.5 m across). Less often seen in the garden but certainly the most interesting of all is var. *fasciculatum*, a low, spreading, often glabrous and dark green subshrub (rarely a low shrub) found along coastal bluffs and mesas near the Pacific Ocean from San Luis Obispo County south. Some populations in N Baja California should be considered for the rock garden. See *E. cinereum* and *E. parvifolium*.

**Eriogonum fastigiatum* Parry (*Eucycla*) is a Baja California endemic of coastal sage communities, where it forms low, compact mats of numerous small green leaves and scattered clusters of white flowers. It is highly attractive even when not in flower and may well form a suitable ground cover in sandy sites. It should do well in cultivation.

**Eriogonum flavum* Nutt. (*Oligogonum*) In addition to var. *piperi* (Nicholls, p. 115), the var. *flavum* itself is worthy of consideration in the garden. The var. *piperi* is the western phase of the species, found mainly in the foothills and mountains of Montana, Idaho, and E Washington south into NE Oregon and NW Wyoming. In Canada, this variety occurs in S Alberta and British Columbia. It is a larger, more open plant than var. *flavum*, which is much more compact and tends to be a plant of the Great Plains, though extending into the mountains in Alberta and Montana. Because of its well-developed taproot, this species can be easily transplanted and does well in a variety of conditions. High-elevation plants of the species in Montana (called var. *polyphyllum*) may be depauperate forms of either var. *piperi* or var. *flavum*; these are the populations that would be attractive in the rock garden. The var. *xanthum* mentioned by Nicholls is treated here under *E. arcuatum*.

Eriogonum galioides I. M. Johnst. (*Ganysma*). Most perennial members of the subgenus *Ganysma* are not worth of a place in the garden except as novelties, but the bedstraw wild buckwheat of NE Baja California might have a greater role with careful selection. It is a low, sprawling perennial with basal and cauline leaves, a stout, often woody flowering stem, and yellow flowers that age reddish.

Eriogonum giganteum S. Watson (*Eucycla*). Among the island endemics of the genus, this is the most widely cultivated member, today widely naturalized in coastal California. Three varieties are recognized, and all three may be found in gardens. The var. *giganteum* is a large shrub in the wild, with some individuals on Santa Catalina Island being 3.5 m tall. The San Clemente Island endemic is var. *formosum*. The rare variety from Santa Barbara and Sutil islands, var. *compactum*, is cultivated mostly in botanical gardens. The introduction and naturalization of this species (and *E. arborescens*) onto the mainland of California is resulting in introgression of these species with coastal natives, with unknown long-term impact. Every effort should be made to remove the insular species from along the coast to prevent their genetic contamination with other species. At present, most garden plantings are of a single specimen shrub, but in a few instances shrubs of either the Santa Catalina or San Clemente varieties can be seen as border plants along driveways. This can be spectacular, but the plants require consider effort to maintain a compact, roundish shape and a manageable stature.

**Eriogonum gilmanii* S. Stokes (*Eucycla*) is a rare species not known to be in cultivation, but certainly worth introduction. It is restricted to limestone gravel and rocky outcrops in the Cottonwood, Last Chance and Panamint mountains of Inyo County, California. It has strongly dimorphic flowers, a feature shared by *Eriogonum ovalifolium*. The outer perianth lobes of the off-yellow flowers have a large reddish midrib, making this one of the more attractive flowers in the genus. It is a low, pulvinate perennial with short, elliptic leaves, flowering on spreading branches.

**Eriogonum gracilipes* S. Watson (*Eucycla*) (Nicholls, p. 115). This low, caespitose, matted perennial has leaves densely white-tomentose below. The flowers, borne on a short stem, are white to rose. It occurs on the eastern slope of the Sierra Nevada and in the White Mountains of SE California, and just inside

Nevada. It does well in the garden as a young plant but is difficult to maintain for more than a few years. See *E. holmgrenii*.

***Eriogonum grande* Greene** (*Eucycla*), a large, much branched and often matted herbaceous perennial or subshrub, is subdivided into four varieties, three of which are confined to offshore islands along the California coast. While both var. *grande* (of Santa Cruz, San Miguel, Santa Catalina, Anacapa, and San Clemente islands) and var. *timorum* (of San Nicolas Island) are infrequently seen in gardens, one often sees the red-flowered var. *rubescens*. That variety occurs naturally on San Miguel, Santa Cruz and Santa Rosa islands, and while not yet naturalized along the coast, it is likely this will occur eventually. On some of the near-shore island of Baja California, and just on the mainland near Ensenada, one finds var. *testudinum*, which may be worth growing, as its flowers also turn reddish with age. See *E. nudum*.

***Eriogonum gypsophilum* Wootton & Standl.** (*Eucycla*) is a federally protected endangered species, so access to seeds is limited. This bright green herbaceous perennial with equally bright yellow flowers is found on low gypsum hills in Eddy County, New Mexico. It has been cultivated, and garden-collected seed may be available.

***Eriogonum heermannii* Durand & Hilg.** (*Eucycla*) has eight varieties, most of them large, rounded shrubs of the arid Great Basin and portions of California. Only var. *sulcatum* is worth serious consideration by the rock gardener. This is a spreading, highly branched subshrub with usually greenish, compact stems and numerous, densely compacted branches racemosely topped by clusters of small, yellowish-white flowers. It is a plant of dry limestone cliffs and outcrops in saltbush, blackbrush, sagebrush, and mountain mahogany communities, and in scrub oak and pinyon-juniper woodlands in the desert ranges of SE California, S Nevada, SW Utah, and NW Arizona. Given its habitat, this may be difficult to grow. Also, any damage to the mature plant is slow to recover. The recently described var. *subspinosum* might be growable; it has stout, smooth branches arranged in dense clusters bearing racemes of yellowish-white flowers. This is an elegant plant, dark green throughout the year, and being 10–30 cm tall but up to 80 cm across, it should fit well into small areas where a dominant plant is wanted. See *E. plumatella*.

***Eriogonum helichrysoides* (Gand.) Rydb.** (*Eucycla*) is a diffusely branched, spreading, dark green shrub up to 40 cm tall and 80 cm across, restricted to clay slopes or chalky limestone outcrops in grassland communities of SW Kansas. It should be an ideal introduction when a larger shrub is wanted although sparse flowers mean that it cannot compete with *E. corymbosum*.

***Eriogonum heracleoides* Nutt.** (*Oligogonum*) (Nicholls, p. 115) ranges in the Rocky Mountains and also in scattered desert ranges of NW California, SE Oregon, S Idaho, N Nevada, and W Utah. Plants in the Pacific Northwest traditionally have been separated as var. *angustifolium* because of their narrow leaves, but this distinction is not taxonomically significant. The distinguishing feature of var. *heracleoides* is the presence of a whorl of leafy bracts midlength along the flowering stem. This is missing in the var. *leucophaeum*, mistakenly called var.

minus by Nicholls. Such plants are found mainly in grassland communities of E Washington and WC Idaho. There is considerable variation in the overall color of the flowers as well as in the amount and color of the tomentum. Populations of var. *heracleoides* from the higher Cascade Range in C Washington (where it can occur in the subalpine zone) are composed of depauperate individuals with short, sprawling stems and inflorescences. Such plants would be attractive in the rock garden, unlike the much more open and sprawling lower-elevation forms.

***Eriogonum birtellum* J. T. Howell & Bacig.** (*Oligogonum*) is one of the more attractive members of the genus, and certainly worthy of cultivation. Unfortunately, this low, spreading herbaceous perennial with its bright green leaves, stems, and branches may not attract the interest of the rock gardener as the plant can be up to 35 cm tall. Still, the large mats (up to 60 cm across) of closely arranged leaves do make a colorful groundcover as the leaves change from green to red when the season moves from late summer to fall. The bright yellow flowers mature to a red, albeit rusty, hue in the fall, making the plant attractive well into early winter. This is a plant of serpentine slopes and outcrops in oak and conifer woodlands of the Klamath Mountains in NW California. It is considered a sensitive species by the BLM. See *E. latens* and *E. ursinum*.

****Eriogonum holmgrenii* Reveal** (*Eucycla*) (Nicholls, p. 116) is similar to *E. gracilipes* but much more restricted in distribution, being confined to the Snake Range of Nevada. Compared with *E. gracilipes*, it has narrower leaves and fewer involucre. It is also more compact, with flowers that turn deep red in fruit. For these reasons the plant is desirable to the rock gardener. Both species occur at high elevations and are a challenge to retain in cultivation.

****Eriogonum incanum* Torr. & A. Gray** (*Oligogonum*) (Nicholls, p. 116) has grayish tomentose leaves, giving the loose mats a different hue from its near relatives. It occurs mainly in the central Sierra Nevada of E California and WC Nevada, up to 4000 m in the south. It is a dioecious plant with two morphologically different sexes.

***Eriogonum inflatum* Torr. & Frém.** (*Ganysma*), or “desert trumpet,” is a first-year flowering perennial common throughout the American Southwest and often cultivated as a novelty because of the inflated (“fistulose”) flowering stems and branches. It is not an attractive plant, and certainly not suitable for the rock garden, but it is curious. The related annuals, *E. fusiforme* and *E. clavatum*, are easier to grow although both can be weedy. The first annual is rather low (up to 4 dm tall) whereas the latter is significantly taller (up to 22 dm). Another annual, *E. contiguum*, of the greater Death Valley area lacks a fistulose stem but is a more elegant plant with golden yellow to reddish flowers. See *E. arizonicum*, *E. pilosum*, *E. preclarum*, *E. repens*, and *E. scalare*.

***Eriogonum intrafractum* Coville & C. V. Morton** (*Clastomyelon*) is a rare Death Valley endemic confined to the Cottonwood, Funeral, Grapevine and Panamint ranges of Inyo County, California, in limestone washes, on slopes and on cliff faces. It is probably a difficult plant to grow. This perennial herb can be up to 1.5 m tall, with a cluster of short basal leaves at the bottom and a compact

inflorescence atop the long, whiplike stem. Adding to the strangeness of the only species of its subgenus is that when the flowering stem dies back, its base fragments into segments resembling napkin rings. These rings are not capable of asexual reproduction; rather, they seem to be a means of providing the long stem with enough flexibility to survive hot canyon winds. Permits must be obtained from the National Park Service to collect seed.

***Eriogonum jamesii* Benth.** (*Oligogonum*), or “antelope sage” (Nicholls, p. 116), in var. *jamesii* is largely confined to the central Rocky Mountains of Colorado but ranges well to the south and east on the grasslands of N New Mexico, extreme W Oklahoma and N and W Texas down to 1000 m. On the chalky hills in Logan and Scott counties, Kansas, one finds var. *simplex*, so named because its inflorescence is reduced to a single umbel. Var. *undulatum* is found mainly on limestone slopes in the mountains of SE Arizona, S New Mexico and SW Texas south into Mexico. It differs from the others in having leaves with undulate and frequently crisped leaf margins; it is more sprawling than var. *jamesii*. None of the varieties is as attractive as *E. arcuatum*. See *E. turneri*.

***Eriogonum jonesii* S. Watson** (*Eucycla*), a spreading subshrub with dense white to brownish tomentum, would not likely be of interest to the rock gardener; the large, cordate leaves that sheath the lower portion of the stems and the brownish-white flowers are not very attractive. However, it is an uncommon plant, restricted to limestone or sandstone washes, flats and outcrops mainly in Coconino County, Arizona.

****Eriogonum kelloggii* A. Gray** (*Oligogonum*), Nicholls (p. 117) says correctly, this is a species that one could “drool over,” but remember that it is exceedingly rare and listed as an endangered species by the state of California, and the BLM considers it a species of “special” status. It is worth a place in the garden if nursery-grown seeds can be obtained.

****Eriogonum kennedyi* Porter ex S. Watson** (*Eucycla*) (Nicholls, p. 117). To the three expressions mention by Nicholls, var. *purpusii* must be added. Like vars. *kennedyi*, *austromontanum*, and *alpigenum* of the Transverse Ranges of S California, var. *purpusii* is a low, matted perennial, but here the tomentum is bright white and much denser. Furthermore, its flowers are an attractive bright white rather than the dull white to brownish white of the others. It is found on the eastern slope of the southern Sierra Nevada and on the White Mountains on sandy flats and slopes (often of a volcanic origin); it is more common than the southern expressions and much prettier. See *E. wrightii*.

****Eriogonum kingii* Torr. & A. Gray** (*Eucycla*) (photo, p. 141) is one of the more attractive rock garden species. The typical phase has greenish yellow to pale yellow flowers. It is confined to limestone flats, slopes and outcrops in the Granite, Ruby, East Humboldt, and Cherry Creek ranges of NE Nevada, in mixed grassland and high-elevation sagebrush communities, and in subalpine conifer woodlands. A low-elevation expression found mainly on granitic gravels in the Snake Mountains, Elko Hills and Dixie Hills differs in having a more attractive white-tomentose leaf (rather than greenish-tomentose) and flowers that can be cream, pale yellow or rarely bright yellow. The low-elevation one may do best in

the garden. Nicholls (p. 113) illustrates *E. kingii*, mistakenly calling it *E. brevicaulis* var. *laxifolium*. See *E. argophyllum*.

****Eriogonum lachnogynum*** Torr. & A. Gray (*Eucycla*) has densely white pubescent flowers with a bright yellow interior. The widespread var. *lachnogynum* is found mainly on sandy to gravelly (often calcareous) or shaly to clayey or gypsum flats and washes in contiguous parts of Arizona, Colorado, Kansas, New Mexico, Oklahoma, and Texas. It has a long flowering stem. Much more to the liking of the rock gardener are two depauperate varieties found to the west: var. *sarabiae*, a hummock-forming perennial with stems 1–6.5 cm long, greatly exceeding the length of the leaves; and var. *colobum*, flattened hummocks with stems only 0.1–1.2 cm long, barely more than the leaves. Both these forms occur in New Mexico on federally protected lands.

***Eriogonum lancifolium* Reveal & Brotherson** (*Eucycla*), a member of the *E. corymbosum* complex, is confined to heavy clay flats and rolling slopes near Wellington, Utah. This is a spreading, diffusely branched shrub with a distinctive bright grayish tomentum, unlike the more brownish hue in most related species. If properly pruned and maintained this shrub should make a tight crown covered with white flowers, but unfortunately is not attractive out of flower.

***Eriogonum latens* Jeps.** (*Oligogonum*) is a compact herbaceous perennial with bright green, pilose leaves and a long, naked flowering stem. The mats are not much more than 20 cm across. The cream to pale yellow flowers are arranged in dense clusters atop the stems. It is found on sandy to gravelly granitic slopes and ridges in sagebrush communities, and in montane to subalpine conifer woodlands in the White Mountains on the California/Nevada border, and along the eastern slope of the northern Sierra Nevada. See *E. ursinum*.

***Eriogonum latifolium* Sm.** (*Eucycla*) (photo, p. 141) is a species of Pacific coastal bluffs from S Oregon, to SC California. It was gathered by some of the earliest naturalists to visit western North America. A low, much-branched herbaceous perennial to subshrub as up to 2 m across, with dense tomentum varying from white to tan or rust and white to pink or rose flowers, it was quickly introduced into cultivation and has been a favorite for nearly 200 years. With careful tending, this can be attractive; in coastal settings it can remain in flower throughout the year. It appears to be easy to grow and maintain, but it does require a lot of care pruning and dead-heading. If selections were made for a low, mat-forming cultivar, this could be even more popular. See *E. nudum*.

***Eriogonum leptocladon* Torr. & A. Gray** (*Eucycla*) forms slender-stemmed, grayish to greenish desert shrubs on sandy flats and dunes of the Colorado Plateau of Utah, Colorado, Arizona and New Mexico. There are three varieties: white-flowered, gray-hairy stemmed var. *ramosissimum*, the most common; yellow-flowered, greenish-gray, hairy stemmed var. *leptocladon*; and white-flowered, bright green or gray but glabrous-stemmed var. *papiliunculi*. None is particularly attractive, as the sprawling habit does not lend itself to most garden settings. However, the species does well in an arid, sandy habitat, appears to grow rapidly, and adjusts to the ever-moving sand. In dense masses as seen on the San

Rafael Desert of Utah, it is most attractive, nicely set off from the red sands. See *E. effusum* and *E. nummularae*.

***Eriogonum leptophyllum* (Torr.) Wooton & Standl.** (*Eucycla*). Few of the large perennial shrubs related to *E. microthecum* and *E. corymbosum* make attractive plants in the garden if left unattended, but this one may be an exception as it is naturally a rounded shrub with congested inflorescences on numerous stems. The white flowers are dramatically displayed against the tall (to 80 cm), wide (to 120 cm) dark green shrubs. It is found mainly on the S Colorado Plateau southward into NE Arizona and NW New Mexico, on clay flats, slopes and outcrops in mainly mixed grassland, brush, and pinyon-juniper woodland.

****Eriogonum libertini* Reveal** (*Oligogonum*) (Nicholls, p. 117) is an uncommon plant worthy of cultivation, although the mats I have seen have been far smaller than what Nicholls reports. It is known only from Dubakella and Tedoc mountains in NW California.

****Eriogonum lobbii* Torr. & A. Gray** (*Oligogonum*) (Nicholls, p. 117) occurs in the Sierra Nevada and in the northern coastal ranges of SW Oregon and NW California. While the Sierran plants are attractive, and those of high elevations in Mono and Inyo counties are diminutive, plants from the coastal ranges are much more attractive and diverse in terms of local minor variation. In general, it is fairly easy to grow but does not persist long in cultivation. See *E. robustum*.

***Eriogonum loganum* A. Nelson** (*Eucycla*) belongs to the *E. brevicaulae* complex and is uncommon on sandy to gravelly slopes, primarily in low-elevation sagebrush communities and juniper woodland, or rarely on gravelly limestone slopes in high-elevation sagebrush communities and subalpine conifer woodland in Cache and Morgan counties, Utah. The low-elevation expression is now rare because most populations have been destroyed by recent construction on the Utah State University campus. Efforts to reintroduce the plant are ongoing, so cultivated material is available. The high-elevation expression is found along the backbone of the Bear River Range and would interest the rock gardener. These plants form denser mats (though less attractive than the tannish to olive-green mats found in and around Logan) with shorter flowering stems. Both produce cream or yellow flowers. See *E. brandegeei* and *E. brevicaulae*.

***Eriogonum lonchophyllum* Torr. & A. Gray** (*Eucycla*) is frustrating taxonomically; the variation within the species is obvious, and given the long list of synonyms, past attempts to parse that variation have had limited success. This is an herbaceous perennial or spreading to erect subshrub with narrow to broad leaves, green and typically glabrous stems and branches, and white flowers. It is widespread in sagebrush-dominated communities in the Rocky Mountains of Colorado, N New Mexico and E Utah. None of the variants, named or otherwise, seems worth growing, but the long, broad-leaved "fenderlianum" phase may be the most attractive. The rock gardener could choose the slender, high-elevation "intermontanum" phase from the Book Cliffs and Tavaputs Plateau of NE Utah and NW Colorado.

***Eriogonum longifolium* Nutt.** is the common species in portions of Missouri and Kentucky south to E Texas, Louisiana, Alabama, and Florida. This is a tall

(to 2 m), erect perennial herb that has been cultivated with some success in the garden, though not particularly attractive. The two disjunct varieties, var. *harperi* of Alabama and Tennessee (extirpated in Kentucky), and var. *gnaphalifolium* of the sand hills of peninsular Florida, have the greatest potential in the garden, especially the latter with its long flowers. See *E. tomentosum*.

**Eriogonum mancum* Rydb. (*Eucycla*) (photo, p. 142); Nicholls, p. 117) is a low mat with clusters of several small involucrets holding white flowers (rarely yellow). It is found on gravelly to clayey flats and slopes in mixed brush communities and juniper woodland in SE Idaho, SW Montana, and NW Wyoming. A disjunct phase known only from the Notch Peak area of the House Range in WC Utah has broader leaves than its northern counterpart.. See *E. crosbyae* and *E. soliceps*.

**Eriogonum marifolium* Torr. & A. Gray (*Oligogonum*) (Nicholls, p. 118) is another dioecious species, so that it is not uncommon for collectors to consider the male and female plants different species. It forms a low, spreading mat that typically arises from a single, slender taproot even though the mat itself can be nearly a meter across. The leaves are initially an olive-green and turn deep red in autumn. Var. *marifolium* occurs in scattered populations, often on volcanic peaks, in C Washington, C Oregon, and NC California, and is much more common in the northern Sierra Nevada and in WC Nevada. Var. *cupulatum* is a low-elevation expression restricted to pumice flats south of Mt. Shasta; it is a taller, more erect plant with long, narrow leaves. See *E. diclinum*, *E. incanum* and *E. polypodium*

**Eriogonum meledonum* Reveal (*Eucycla*) (photo, p. 142) is one of the more elegant of the species allied to *E. crosbyae*. It is known only from two areas near Stanley, Idaho, where it is considered "in danger of becoming extinct" by the state. It is a low, caespitose matted perennial with densely grayish white tomentose leaves and bright yellow flowers. The intensity of the leaf and flower colors makes it attractive for the rock garden. See *E. capistratum* and *E. verrucosum*.

Eriogonum mensicola S. Stokes (*Eucycla*) is a small perennial herb (to 30 cm tall) with round leaves and white to whitish brown flowers, small enough to fit comfortably into the rock garden and vegetatively attractive enough to warrant a place toward the front. It occurs in the Inyo Mountains and in the Panamint and Coso ranges of SE California, with a disjunct population in the Sheep Mountains of SW Nevada. See *E. panamintense* and *E. rupinum*.

**Eriogonum microthecum* Nutt. (*Eucycla*). Of the 13 varieties now recognized within *E. microthecum*, five are of interest to the rock gardener who desires small, compact plants suitable for an alpine setting. Var. *lapidicola* is a low, decumbent subshrub with reddish-brown tomentum and small, elliptic leaves; it is infrequent in the southern mountains of the Great Basin. Closely allied is var. *phoeniceum*, a rare plant scattered in Juab and Millard counties of W Utah. Both varieties have flowers that vary from white to various shades of orange, pink, rose, or red. Var. *alpinum* is a true subalpine to alpine expression of the central Sierra Nevada and the Sweetwater Range of California, with whitish tomentum. Var. *johnstonii* is a rare subalpine form restricted to the upper San Gabriel Mountains in S California. Var. *arceuthinum* of Lincoln County, Nevada and perhaps

adjacent Utah remains to be rediscovered in the wild. It has tightly revolute leaves that are mostly glabrous and dark green. Of all the varieties, this one would be the most attractive in the garden. Depauperate populations of var. *laxiflorum*, yellow-flowered var. *ambiguum*, and of var. *simpsonii* are known. Low-elevation plants of var. *simpsonii*, found on low clay hills in E Utah, are remarkably attractive, taking on the appearance of miniature trees. Similar plants are found on clay outcrops near Salmon, Idaho; it is believed these plants were introduced to the Shoshone because the plant was used in certain rituals by Native American tribes mainly in Arizona and New Mexico. Var. *lacus-ursi* is known from Bear Valley, California, where it is restricted to a few hundred individuals in a single area subject to development. Var. *schoolcraftii* is a larger plant restricted to arid mountains in NE California and adjacent Nevada; it would be attractive in the garden as a shrub up to 80 cm tall and 120 cm across, with bright yellow flowers.

***Eriogonum mitophyllum* Reveal** (*Eucycla*) may be of interest due to its linear, threadlike, glabrous leaves. Otherwise it is rather typical of its near relatives in the *E. brevicaulis* complex, having rather boring flowers that vary in color from pale or greenish yellow to, rarely, white. It is known only in the Arapen Shale badlands above Lost Creek near Salina, Utah. See *E. spathulatum*.

***Eriogonum molle* S. Watson** (*Eucycla*), a large, decorative shrub, has been in cultivation since its formal naming in 1888. It belongs to the group characterized by *E. giganteum*, but its inflorescence is reduced to a tight, capitate cluster atop a long stem. It requires warm winters and a coastal, Mediterranean environment to do well. With care, it can be an attractive, floriferous shrub, ideal as a large border plant along roads and paths. Left alone, it becomes rather open and ragged. Like other members in the *E. giganteum* complex, it produces a lot of litter, and it lacks the attractive reddish bark of *E. arborescens* or the dominating inflorescences of *E. giganteum*.

***Eriogonum mortonianum* Reveal** (*Eucycla*). It is unlikely this diffusely branched shrub can be tamed to a picturesque garden subject. Still, given its bright green leaves, stems and branches highlighted by pale yellow to yellow or even white flowers, it might be worth the attempt. It is restricted to gypsophilous clay flats and outcrops, making its soil requirements challenging, and is known only from just west of Fredonia, Arizona.

***Eriogonum natum* Reveal** (*Eucycla*) is a rare plant known only from alkaline clay flats in saltbush communities in Millard County, Utah, near Sevier Lake. It is probably a recently evolved species, since its entire habitat was buried under pluvial Lake Bonneville until some 10,000 years ago. Being related to *E. brevicaulis*, it is a spreading, herbaceous perennial up to 35 cm high and 40 cm across. The leaves are elliptic, densely tomentose below and greenish tomentose above, and its flowers are a bright yellow on grayish stems.

****Eriogonum nervulosum* (S. Stokes) Reveal** (*Oligogonum*) (Nicholls, pp. 118, 124) is a low, matted herbaceous perennial with compact basal rosettes of leaves, and flowers that are yellowish white at first but become pinkish rose to deep red in fruit. It comes from N California. While it tends to be a spreading subshrub, with careful pruning it could be an attractive addition to the rock garden. See *E. ursinum*.

***Eriogonum niveum* Douglas ex Benth.** (*Eucycla*) (Nicholls, p. 118) is a low, spreading species found mainly on sandy to gravelly flats, slopes, bluffs or rocky, often volcanic, outcrops in mixed grassland and sagebrush communities, and sometimes in montane conifer woodlands at lower elevations from S British Columbia through E Washington and WC Idaho into NE Oregon. It has been in cultivation since the 1830s, but today it is rarely seen in the garden because of its ragged appearance. Still, in a cobbly area of a rock garden, this plant will creep around and over any obstacle as a rather attractive albeit loose mat of white to tannish tomentose leaves. See *E. strictum*.

***Eriogonum novonudum* M. E. Peck** (*Eucycla*) has a spreading, rather leggy appearance that distracts from its attractiveness, and its height (up to 90 cm) makes it difficult to place in the garden. It is found mainly on sandy clay slopes and washes in the Leslie Gulch area of Malheur County, Oregon.

***Eriogonum nudum* Douglas ex Benth.** (*Eucycla*) (Nicholls, p. 118). In addition to the three expressions (out of 13) mentioned by Nicholls (vars. *nudum*, *oblongifolium*, and *scapigerum*), two more may be added. Var. *westonii* is a large plant with glabrous, often bright green stems (sometimes inflated) and branches, and hairy but intensely yellow flowers; it occurs in arid habitats in the drier portions of the southern San Joaquin Valley eastward onto the desert ranges of the N Mojave Desert. Var. *paralinum* is found on coastal cliffs at the California/Oregon border. In many respects it has the habit of *E. latifolium* but is smaller and more compact. See *E. elatum*, *E. grande* and *E. latifolium*.

***Eriogonum nummulare* M. E. Jones** (*Eucycla*) is not a pretty plant. It is a sprawling shrub with gangly branches, mostly grayish or at least dirty brown, leaves that quickly wither, and ordinary white flowers. It is widespread throughout most of the Intermountain Region. Having disparaged it, I must add that some scattered populations might appeal to some gardeners. First, the shrubs found on moving sand (as at Sand Mountain in Nevada) may be useful in certain settings. The low, sprawling forms on the western edge of pluvial Lake Bonneville, if carefully tended, could be attractive, especially those with coin-shaped leaves. The densely tomentose phase near Dugway, Utah, is the most deserving of attention. See *E. ammophilum*, *E. effusum*, and *E. leptocladon*.

****Eriogonum ochrocephalum* S. Watson** (*Eucycla*) (Nicholls, p. 118). In addition to var. *ochrocephalum* mentioned briefly by Nicholls, there is also var. *calcareum* of SW Idaho and SE Oregon. Both are matted herbaceous perennials with rather tall (up to 50 cm) scapes and clusters of yellow flowers. There are prettier species in this complex to consider for the rock garden. See *E. anemophilum*, *E. argophyllum*, *E. breedlovei*, *E. capistratum*, *E. chrysops*, *E. crosbyae*, *E. cusickii*, *E. desertorum*, *E. diatomaceum*, *E. gracilipes*, *E. holmgrenii*, *E. kingii*, *E. mancum*, *E. meledonum*, *E. procidium*, *E. rosense*, *E. scopulorum*, *E. soliceps*, *E. tiehmii*, and *E. verrucosum*.

***Eriogonum orcuttianum* S. Watson** (*Eucycla*) is difficult to evaluate. This large, greenish shrub of central Baja California tends to be rather open, with off-green leaves and flowers of soft yellow fused with red. It tends to grow in rocky places. With effort it might be made into a suitable shrub for the garden, but getting it established to a displayable size may prove difficult.

***Eriogonum ostlundii* M. E. Jones** (*Eucycla*) is a rather uninteresting perennial herb of modest height (up to 45 cm) with basal leaves and small white flowers; restricted to C Utah. Still, it is a pleasing plant to see and likely would do well in cultivation as it requires little care. See *E. artificis* and *E. mitophyllum*.

****Eriogonum ovalifolium* Nutt.** (*Eucycla*) (Nicholls, p. 119) is probably the wild buckwheat most widely cultivated in rock gardens. The geographic distribution patterns for each of the varieties are somewhat greater than Nicholls suggests. For example, var. *depressum* is uncommon in Oregon but much more common in Idaho, W Montana and NW Wyoming; it forms low mats of grayish leaves. Var. *nivale* (photo, p. 143) is found mainly in the Cascade-Sierra cordillera from S British Columbia to the southern tip of the Sierra Nevada; it forms low mats of whitish leaves. The recently described var. *monarchense* is known only from a few individuals on limestone outcrops in the Kings Canyon area of Fresno County, California. While its rarity might appeal to specialists, there are more attractive expressions. The same is true of the federally endangered var. *vineum* of the eastern San Bernardino Mountains of S California, although its garden potential is greater and it is already in cultivation. Var. *eximium* is found mostly in the Carson Range of WC Nevada. Allied to this is the federally endangered low-elevation var. *williamsiae*, confined to the nearby Steamboat Springs area of Nevada, which does well in the garden. The high-elevation var. *caelestinum* of the Toiyabe and Toquima mountains of C Nevada and near Tioga Pass in EC California is worth attention given its low, matted habit and bright yellow flowers on short scapes. The same may be said of some local populations of var. *purpureum*, forms of which occur on rocky, wind-swept ridges at low elevations in W Wyoming. It is not known if such plants will retain their depauperate habit in cultivation. Several additional expressions of the species occasionally are seen in gardens. The large, yellow-flowered var. *ovalifolium* and its white- or cream-colored counterpart var. *purpureum* (photo, p. 143) are the most common. Var. *ochroleucum* may be of interest for it has a scape up to 40 cm long, towering well over its short, narrow leaves. The flowers are white but can become reddish or somewhat purplish with age. Considerably more restricted and more curious is var. *pansum* of Idaho and Montana, which differs from all others in having long, narrow involucre on short (and often obscured) peduncles. The image in the lower left on p. 119 of Nicholls is a female plant of *E. caespitosum*.

***Eriogonum panamintense* C. V. Morton** (*Eucycla*) belongs to the *E. racemosum* complex and is a perennial herb with brownish tomentum that gives some relief from the usual grays and greens of the genus. The plants are short, to 30 cm tall, and the flowers are dull white to brownish white. It is fairly common in the desert ranges of SE California, eastward into the mountains of SW Nevada and the Hualapai Mountains and Mt. Bangs of NW Arizona.

****Eriogonum panguiense* (M. E. Jones) Reveal** (*Eucycla*) (Nicholls, p. 120). In addition to var. *alpestre* mentioned by Nicholls, some populations of var. *panguiense* might be attractive in the garden, despite the long scapes (up to 30 cm). It does well in cultivation.

***Eriogonum parvifolium* Sm.** (*Eucycla*) (Nicholls, p. 120). Of the several expressions of wild buckwheats along the California coast, this is one of the more variable,

with several minor populations worthy of selection for the garden. A few might even be suitable for the rock garden if severely pruned and shaped. Forms on the windswept bluffs overlooking the Pacific are the most attractive—low, compact, and often wonderfully twisted and gnarled subshrubs. As these are environmentally induced features, retaining them in cultivation will be challenging. Both white- and yellow-flowered populations are known. Large plants found inland in Santa Paula Canyon in Ventura County are in cultivation and highly attractive, although they tend to sprawl. See *E. cinereum* and *E. fasciculatum*.

****Eriogonum pauciflorum* Pursh** (*Eucycla*) (Nicholls, p. 120). The expression described by Nicholls is the densely tomentose to lanate one with broad leaves, often distinguished as var. *gnaphaloides* and found in SE Wyoming, W Nebraska and NE Colorado. This phase slowly gives way to an expression with a looser grayish tomentum and narrower leaves. The species occurs mainly in the Great Plains from S Saskatchewan and Manitoba south through the Dakotas and E Montana to NE Colorado and W Nebraska. Hybrids between *E. pauciflorum* and *E. effusum*, called *E. ×nebraskense*, produce individuals with a profusely branched inflorescence.

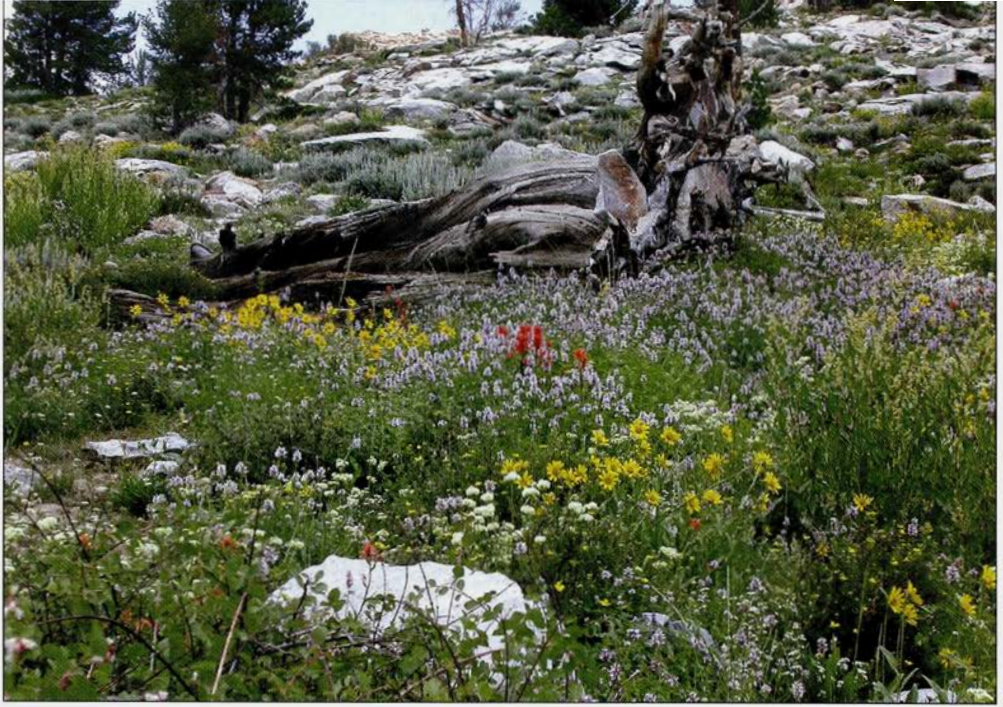
****Eriogonum pelinophilum* Reveal** (*Eucycla*), a federally listed endangered species with a designated critical habitat, is known only from Mancos Shale hills in Delta and Montrose counties, Colorado. It is similar to *E. clavellatum*. *Eriogonum pelinophilum* is a smaller plant with distinctive features in the perianth. Much of its former habitat has been destroyed since the species was listed in 1984 by local development on private land. It has proved difficult to grow.

***Eriogonum pendulum* S. Watson** (*Eucycla*) is a strange plant, an erect to slightly spreading shrub up to 50 cm tall and 80 cm across with tomentose leaves sheathing the stems. The inflorescence consists of a few slender branches with long peduncles bearing solitary involucre filled with several large, white, densely hairy flowers; even the achenes are covered with long hairs. It is uncommon in the Siskiyou Mountains of NW California and SW Oregon and could be attractive in the garden. See *E. spectabile*.

***Eriogonum pharnaceoides* Torr.** (*Ganysma*), in var. *pharnaceoides*, seen occasionally in cultivation, and if planted densely this annual is rather attractive. The hairy leaves are greenish to yellowish-green, aging reddish. The large inflorescence contains numerous white or rose flowers. More attractive but not yet in cultivation is var. *cervinum*, a shorter plant with yellow flowers. Var. *pharnaceoides* is widespread in N and E Arizona and W New Mexico, also in Chihuahua, Mexico. Var. *cervinum* is known only from S Utah, and adjacent N Arizona.

***Eriogonum pilosum* S. Stokes** (*Ganysma*). Of the perennial members of the *E. inflatum* complex confined to Baja California, this one is comparatively unattractive. The flower stems are not inflated, the tiny flowers are greenish yellow aging reddish, and the habit is erect and open. See *E. repens* and *E. scalare*.

***Eriogonum plumatella* Durand & Hilg.** (*Eucycla*) is a species that causes one to question introducing any shrubby wild buckwheat into the garden. This is an erect, narrow shrub. Its few leaves tend to fall away. While the inflorescence does form rather curious, flat-topped and divaricate arrangements of numerous gray



Alpine meadows brimming with flowers were a favorite sight on the Conference tours.
(photos received without credit; photographers please notify the editor)

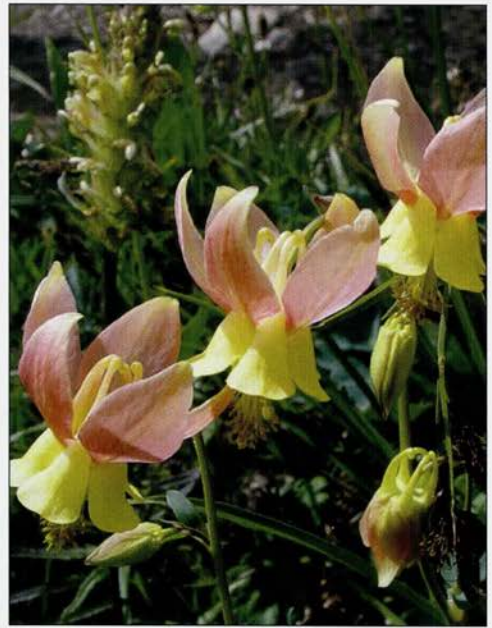




Anelsonia eurycarpa (p. 85). (Loraine Yeatts)

Douglasia montana (p. 88, 188).





Aquilegia coerulea (left) and *A. flavescens* (right) hybridize in some areas (p. 90, 211). (L. Yeatts)

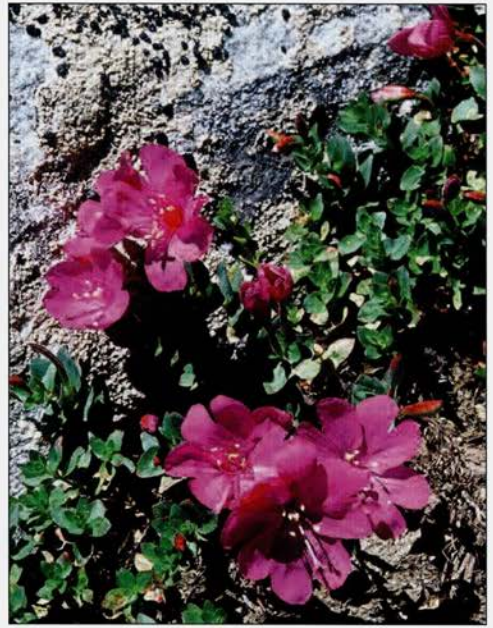
Aquilegia saximontana, a dwarf species of the Rocky Mountains (p. 86).





Two showy alpine members of the pea family: above, *Astragalus aretioides* with *Physaria didymocarpa* (p. 84); below, *Oxytropis podocarpa* (p. 87). (L. Yeatts)





Pedicularis oederi (left, p. 89) and *Epilobium obcordatum* (right, p. 87, 178). (L. Yeatts)

The complex flower of the monument plant, *Frasera speciosa* (p. 211).





Physaria didymocarpa bears showy seedpods (p. 84). (L. Yeatts)

Townsendia parryi (p. 88).





Penstemon atwoodii (p. 101). (Noel Holmgren)

Penstemon confusus (left, p. 99; N. Holmgren);
Penstemon cyananthus (right, p. 103; Tanya Harvey).





Penstemon compactus, a rare endemic (p. 103). (Graham Nicholls)

Penstemon dolius (p. 100, 204). (N. Holmgren)





Penstemon idahoensis (p. 104). (N. Holmgren)

Penstemon nanus (p. 100).





Penstemon pachyphyllus var. *congestus* (p. 101). (N. Holmgren)

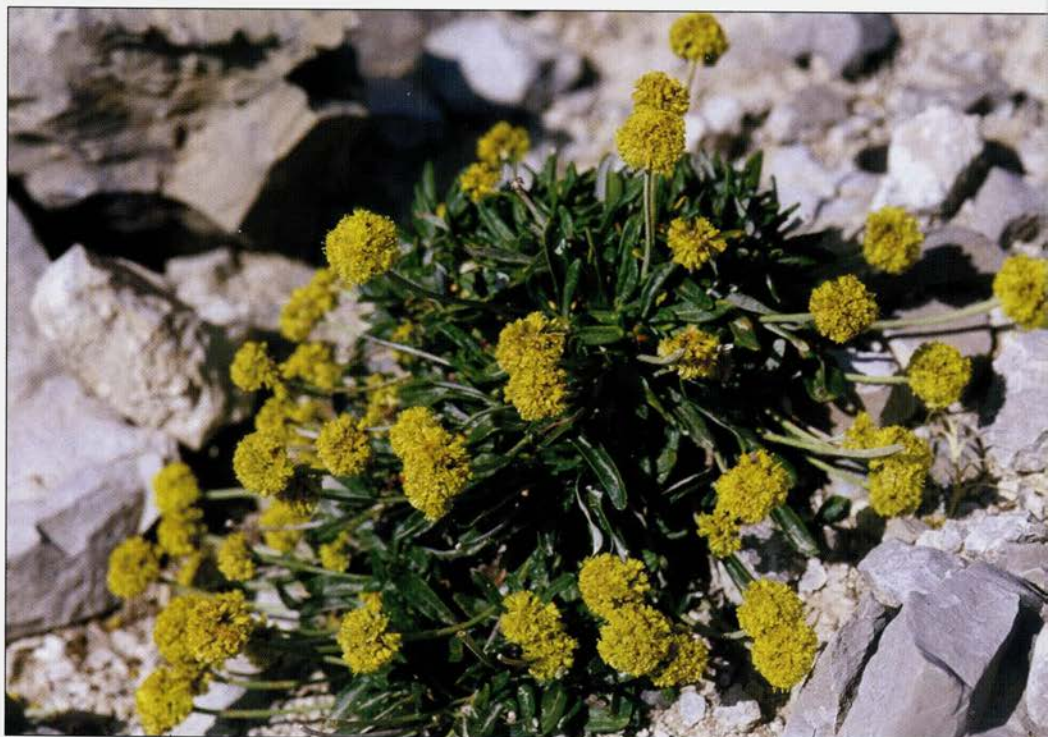
Penstemon thompsoniae (p. 99, 187, 204).





Eriogonum bicolor (p. 111). (James Reveal)

Eriogonum brevicaule (p. 111).





Eriogonum clavellatum (p. 113). (J. Reveal)

Eriogonum compositum var. *compositum* (p. 114).





Eriogonum kingii (p. 121). (J. Reveal)

Eriogonum latifolium (p. 122).





Eriogonum mancum (p. 124). (J. Reveal)

Eriogonum meledonum (p. 124).





Eriogonum ovalifolium var. *nivale* (p. 87, 127). (L.Yeatts)

Eriogonum ovalifolium var. *purpureum* (p. 127). (J. Reveal)





Eriogonum shockleyi (p. 155, 204). (J. Reveal)

Eriogonum soliceps (p. 156).





Rock gardeners view Wasatch mountain flowers on the ridge above the Snowbird conference center. (Tanya Harvey)



A meadow in the Snowy Mountains (p. 206). (Richard Hildreth)

Penstemon whippleanus in the Tetons (left, p. 98; Graham Nicholls);
Calochortus weedii (right, p. 205; J. McGary).





Castilleja sulphurea (p. 211). (G. Nicholls)

Clematis columbiana above Tony Grove Lake (p. 178). (J. McGary)





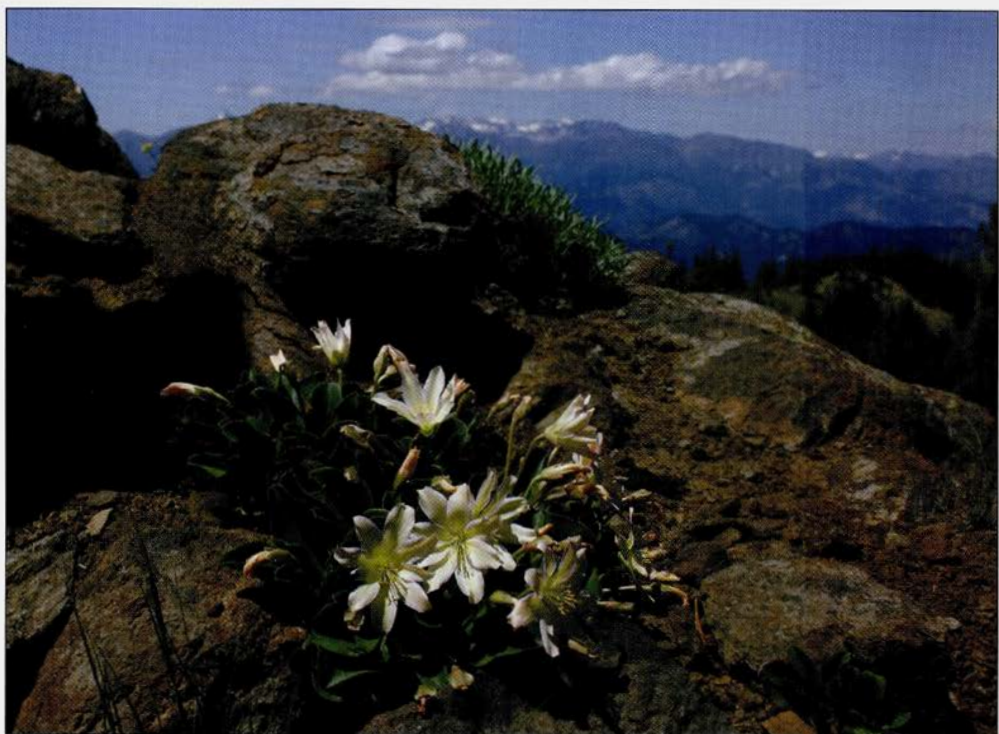
Phlox pulvinata (p. 88, 176, 205). (G. Nicholls)

Townsendia montana (p. 202). (T. Harvey)





Lewisia rediviva (above, p. 168) and *Lewisia tweedyi* (below, p. 172, 182) in eastern Washington.
(Ruth Happel)





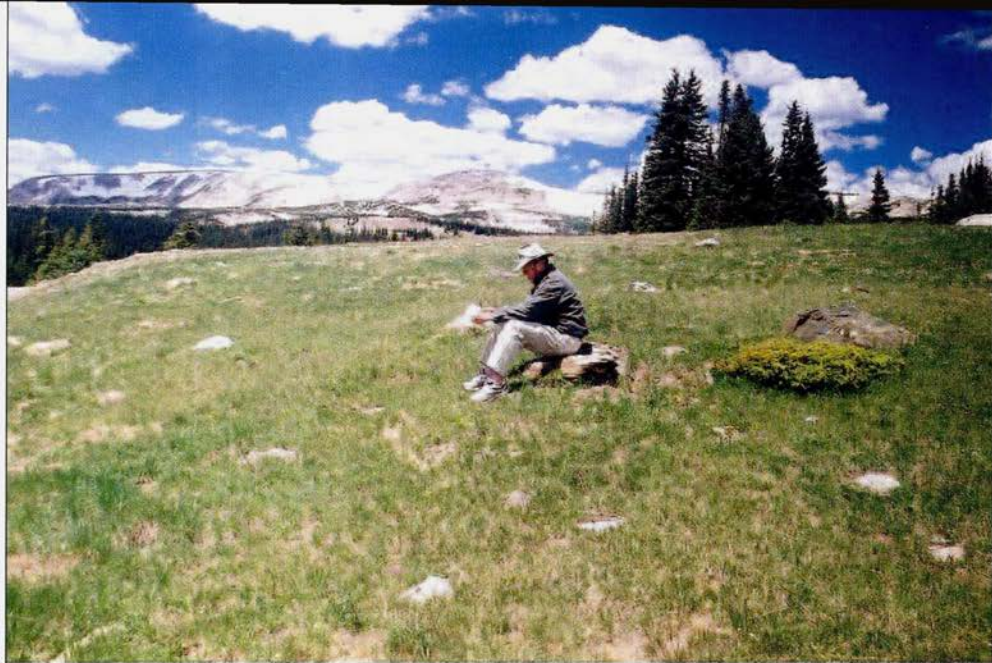
Lewisia stebbinsii (p. 168). (Jack Muzatko)

Claytonia megarhiza (p.86,174) adds its large, succulent leaves to a combination of alpine plants on Hoosier Ridge in Colorado. (J. McGary)



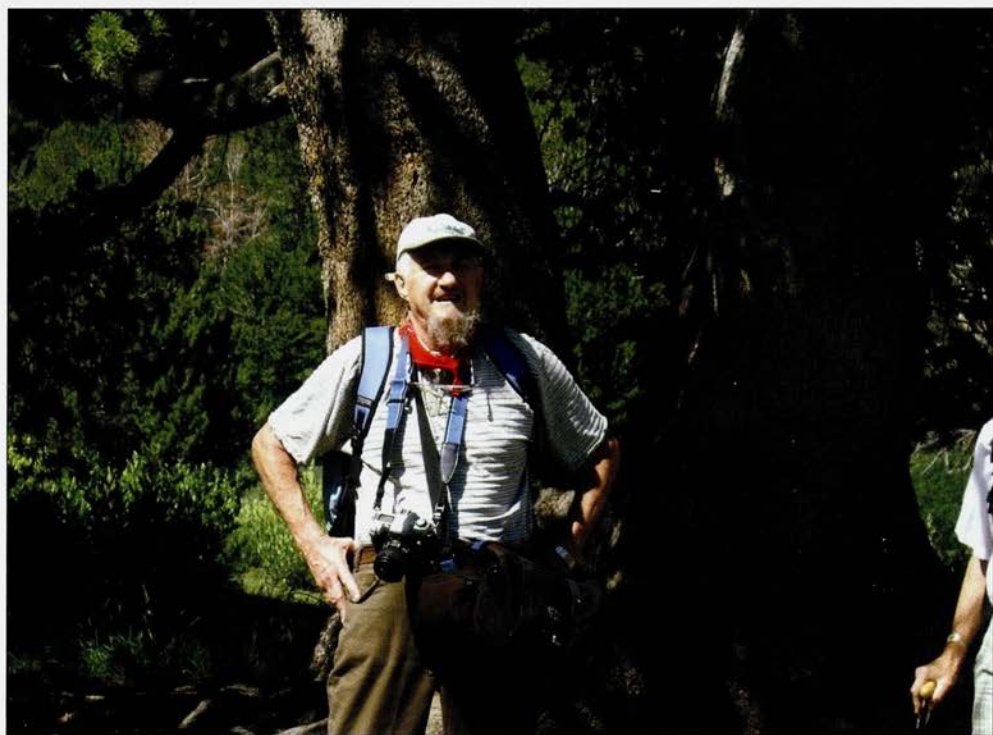


Erigeron aureus (p. 176) is a favorite of Mt. Tahoma proprietor Rick Lupp. (Tanya Harvey)



Bill King, outgoing NARGS President, was an organizer of the International Interim Conference and got to relax for a moment in a Snowy Mountain meadow.

Dick Bartlett, current NARGS President, takes a break in the shade on a Conference tour.



or off-green branches, the whole appearance is messy. The white to pale yellow flowers are few and small. Added to that the plant flowers sparingly and much of the time has a sparse, twiggy look: in short, rather ugly. Still, for those wishing a challenge, it is infrequent in the Mojave Desert of SE California, S Nevada and NW Arizona. See *E. heermannii*.

****Eriogonum polypodum* Small** (*Oligogonum*). Chalky white flowers, a low, matted habit, and reddish tomentum makes this an attractive garden plant. The leaves are only about 1 cm long and wide. The species has male and female flowers on separate plants and is restricted to the southern Sierra Nevada of California.

***Eriogonum pondii* Greene** (*Eucycla*), a low, spreading shrub of Cedros Island and the western Vizcaino Desert of Baja California, is certainly worthy of cultivation. The large leaves, creamy-white flowers, and off-green, faintly reddish herbage combine to produce an elegant shrub in bloom. Plants away from the coast tend to be larger, more floriferous, and better shaped. This could be an ideal border shrub.

****Eriogonum prattenianum* Durand** (*Oligogonum*). Both expressions, var. *pratzenianum* and more southern var. *avium*, would do well in the garden. These form large mats to erect shrubs with variously tomentose leaves and terminal clusters of golden flowers. Plants from Nevada and Placer counties in the Sierra Nevada of California tend to be shrubbier than those from Madera and Tuolumne counties, where matted forms are more common; the latter would be attractive to the rock gardener.

***Eriogonum preclarum* Reveal** (*Ganysma*) is the only perennial member of its subgenus worthy of the garden. It is a low, spreading herbaceous perennial with long, dark green, flowering stems and branches. The large, dark green, thickish leaves tend to be confined to the base of a short, erect, main stem terminated by numerous spreading branches bearing upright clusters of elegant yellow to rose flowers. Native to washes and along canyon walls near the ocean in the western Vizcaino Desert of Baja California, it is a challenge to find.

****Eriogonum prociduum* Reveal** (*Eucycla*) competes with *E. meledonum* to be the prettiest of the *E. ochrocephalum*/*E. rosense* complex. There are two expressions: var. *prociduum*, which has both leaf surfaces densely tomentose and small flowers atop a scape less than 5 cm long, and grows on volcanic slopes in the border counties of Oregon, California, and Nevada; and var. *mystrium*, which has greenish leaves but with larger flowers on a longer scape; it is found on sandy to gravelly slopes in sagebrush communities in the Owyhee Mountains, Idaho, the Santa Rosa Range, Nevada, and in Harney County, Oregon. Var. *prociduum* is the more attractive for the rock garden. See *E. crosbyae*.

****Eriogonum pulchrum* Eastw.** (*Eucycla*) belongs to the *E. microthecum* complex and is the ugly stepsister of *E. ericifolium*. This is a low, spreading, somewhat matted subshrub with grayish green to reddish, spreading flowering stems and branches. The narrow leaves are slightly revolute or at least thickened, but lack the magic of *E. ericifolium* and *E. microthecum* var. *arceuthinum*. The larger, open inflorescence and the ordinary white flowers do little to promote this wild buckwheat to a favored place in the garden, although the flowers do turn reddish

eventually. It is found on gravelly to rocky soil and outcrops in N Arizona. See *E. terrenatum*.

****Eriogonum pyrolifolium* Hook.** (*Oligogonum*) is occasionally seen in cultivation. It is a small, compact, matted plant most often found on volcanic-derived soils. The ovate to round leaves are in loose basal rosettes, they are bright green at least above. The prostrate to weakly erect flowering stems are terminated by white to rose flowers. The more common var. *coryphaeum* occurs from the mountains of S British Columbia to NW California and then eastward across Idaho to W Montana. Var. *pyrolifolium* is mostly restricted to volcanic peaks in the Cascades and northern California. Only in central Idaho is it relatively common and then nearly always growing with var. *coryphaeum*.

***Eriogonum racemosum* Nutt.** (*Eucycla*) has been in cultivation for generations, but almost entirely in Europe. It is a tall (to 100 cm) perennial herb with mostly erect tomentose flowering stems. The leaves are up to 10 cm long and 5 cm wide. The flowers vary from white to pinkish and can be rather long. It is common from C Nevada, Utah and W Colorado south to N Arizona and N New Mexico. See *E. mensicola*, *E. panamintense*, *E. rupinum*, and *E. zionis*.

***Eriogonum repens* (S. Stokes) Reveal** (*Ganysma*) is a low, creeping perennial member of the *E. inflatum* complex confined to central Baja California. The flower stems are not inflated, the tiny flowers greenish yellow aging reddish, and the habit open. As a garden plant, it is suited to dry sandy to slightly gravelly places and prefers limited water. See *E. pilosum* and *E. scalare*.

****Eriogonum ripleyi* J. T. Howell** (*Eucycla*) is a low, heavily branched, sprawling to decumbent subshrub known only from two areas in N Arizona, one near Frazier's Well in and a second near Cottonwood; it is considered sensitive. Related to *E. pulchrum* but never erect and with a longer flower, this one is far more attractive and garden-worthy.

***Eriogonum rixfordii* S. Stokes** (*Ganysma*) is one of the few annual species that should be considered for gardens. A member of the *E. deflexum* complex, the pagoda wild buckwheat has an inflorescence composed of a dense series of flattened branches, one above the other, resulting in a unique shape. The white flowers are like tiny lights against the dark green herbage. It is confined to the greater Death Valley area. A word of caution: this annual is prone to becoming weedy.

****Eriogonum robustum* Greene** (*Oligogonum*) (Nicholls, p. 117, under *E. lobbii*) is a larger, more robust expression than *E. lobbii*. The large flowers vary from creamy to pale yellow. Infrequently seen in cultivation, it is restricted to altered andesite soils in WC Nevada.

****Eriogonum rosense* A. Nelson & P. B. Kenn.** (*Eucycla*) (Nicholls, p.120). In addition to the var. *rosense* mentioned by Nicholls, there is also var. *beatleyae*. The first is the common yellow-flowered, matted, high-elevation species of the Sierra Nevada and mountain ranges just to the east in Nevada. The latter is less common, found mainly on volcanic tuffaceous outcrops at low elevations in Nevada. Var. *rosense* occasionally is grown and does well if, as mentioned by Nicholls, it is properly trimmed and maintained. His recommendation applies to all of the members of the *Eriogonum ochrocephalum* complex, to which may be

added the admonition to avoid over-watering. These are arid species, often of specialized soils, and are indeed "tender." See *E. crosbyae*.

***Eriogonum rupinum* Reveal** (*Eucycla*) is a stouter, taller plant than the related *E. panamintense*, and is found mainly to the north and east in Nevada's Great Basin. It would likely do well in cultivation, but more as a botanical specimen than as a decorative addition. See *E. mensicola* and *E. racemosum*.

****Eriogonum saxatile* S. Watson** (*Eucycla*) (Nicholls, p. 120) has white to rose or yellowish flowers, with white or grayish leaves. It forms loose to dense mats up to 20 cm across, with its leaves in basal rosettes. It occurs mainly on decomposed granitic or volcanic flats, slopes and ridges in the mountains of S California and SW Nevada. It has been widely cultivated and does well in the rock garden, requiring less care than *E. crocatum*.

***Eriogonum scalare* S. Watson** (*Ganysma*) is a member of the *E. inflatum* complex but is basically a spreading perennial herb up to 80 cm across. The inflorescences can be dense to open depending upon the size of the plant and the length of the branches. The flowers open white and age to deep red in fruit. The combination of the numerous gray branches offset by the many deep red flowers might make this attractive in the garden. It occurs in NW Baja California, especially around El Rosario. See *E. pilosum* and *E. repens*.

****Eriogonum scopulorum* Reveal** (*Eucycla*) is known presently only from a few scattered locations on rocky granitic outcrops in the Wallowa Mountains of NE Oregon, and in the mountains of WC Idaho. It is a low, matted herbaceous perennial with pale yellow flowers. The small leaves are densely white tomentose and glandular on both surfaces. It is worthy of introduction to rock gardens. See *E. crosbyae*.

****Eriogonum shockleyi* S. Watson** (*Eucycla*) (photo, p. 144; Nicholls, p. 120) varies geographically in a number of botanical features. The Colorado Plateau form has been distinguished as var. *longilobum*. Low, compact hummock plants in SW Idaho have been termed var. *packardiae*. The morphological differences have been shown not to be genetically significant, however, and thus the species is no longer subdivided into varieties. Plants on moving sand dunes at Baking Powder Flat in Lincoln County, Nevada, can reach 2 m across, a distinctive habit. A bright white-tomentose phase occurs in the Inyo Mountains, California. See *E. aretioides*, *E. tumulosum*, and *E. villiflorum*.

****Eriogonum siskiyouense* Small** (*Oligogonum*) (Nicholls, p. 121) has long been in cultivation. It is a low, matted perennial with bright green or olive-green, mostly glabrous leaves, with short flowering stems bearing usually a solitary involucre containing numerous sulphur yellow flowers. It is restricted to a ridge system of serpentine outcrops in N California. Most individuals have but a single involucre atop each flowering stem, but at lower elevations and in somewhat more protected sites the inflorescence may be umbellate. See *E. alpinum*.

***Eriogonum smithii* Reveal** (*Eucycla*) is an erect to spreading, often diffusely branched, bright green shrub up to 100 cm tall and 200 cm across; it has yellow flowers. It should do well with vigorous attention if the soil requirements can be met: it is a plant of moving sand that is rich in selenium. It is restricted to the San

Rafael Desert of Utah. The bright green herbage and yellow flowers beautifully contrast with the red sands where it occurs.

**Eriogonum soliceps* Reveal & Björk (*Eucycla*) (photo, p. 144). For the rock gardener, this is an exciting addition. Outwardly similar to *E. mancum*, it has an inflorescence reduced to a single involucre atop a slender peduncle. The leaves are smaller, and the mat even more compact. It is known from white outcrops of tuffaceous sandstones in the Beaverhead Mountains of Idaho and Montana, and a few other places in SW Montana.

**Eriogonum soredium* Reveal (*Eucycla*) (Nicholls, p. 121) is a magnificent rock garden plant. The compressed, dense mats (up to 30 cm across) are dominated by numerous, white tomentose, small leaves. The flowering stems are no more than 1.5 cm long and bear a terminal head of bright white flowers. Unfortunately, this plant requires great care to maintain in cultivation. Still, the mound-like growth, numerous flowers, and bright colors make this worth the effort. This is a rare and localized species known only from the San Francisco Mountains of WC Utah and is listed as sensitive by the state.

Eriogonum spathulatum A. Gray (*Eucycla*) is not particularly attractive in the garden: basically an upright but spreading plant to 40 cm tall with long, narrow leaves and flowers varying from creamy white to pale yellow. It occurs in gravelly calcareous places in W Utah. See *E. artificis*, *E. mitophyllum*, *E. natum*, and *E. ostlundii*.

Eriogonum spectabile B. L. Corbin, Reveal & R. Barron (*Eucycla*) is similar to *E. pendulum* except much shorter (to 15 cm) and more compact. The densely villous and glandular white flowers are attractive, so this would be a more manageable plant in the garden. However, it is known only from about 250 individuals confined to gravelly soil in scrub and woodland in Lassen National Forest, California. The U.S. Forest Service considers it sensitive, and a permit would be required to gather seed.

Eriogonum sphaerocephalum Douglas ex Benth. (*Oligogonum*) (Nicholls, p. 121). In addition to yellow-flowered var. *sphaerocephalum* and cream-flowered var. *halimioides* mentioned by Nicholls, there is also var. *fasciculifolium*. This expression has cream-colored flowers like var. *halimioides*, but its leaves are glabrous, making it a more attractive plant. It is restricted to SW Idaho. Another expression, var. *sublineare*, is a low, somewhat matted subshrub with linear, revolute leaves. This is infrequently seen in cultivation and clearly requires vigorous pruning to produce an ornamental plant; it is known from east of the Cascade Range in SC Washington and NC Oregon. A clear distinction between this phase and *E. douglasii* var. *douglasii* is not sharp in portions of Oregon, and some plants of *E. sphaerocephalum* var. *halimioides* are often confused with var. *sublineare*. See *E. douglasii*.

Eriogonum strictum Benth. (*Eucycla*) (Nicholls, p. 121). Var. *proliferum* occurs from 150 to 2700 m elevation and has white to rose or even purple flowers. This and *E. niveum* are sometimes difficult to separate, especially in SE Washington. The yellow-flowered var. *anserinum* occurs in E Washington, E Oregon and NE California then eastward into SW Idaho and NW Nevada. Var. *greenei* is restricted to serpentine slopes and ridges in montane conifer woodlands in the Coast

Ranges of N California; it is distinguished by its densely lanate leaves. This last expression would be ideal for the garden, as the white-woolly leaves are attractive even when the plant is not in flower. Also, the flowers of this variety tend to be a brighter white than those of var. *proliferum*. As for var. *strictum*, this differs from the above in having glabrous flowering stems and branches; it is found in SE Washington, WC Idaho and NE Oregon and is less attractive than the others. See *E. niveum*.

****Eriogonum suffruticosum* S. Watson** (*Eucycla*) is a rare, local species, known only from limestone outcrops at five scattered locations in Brewster and Presidio counties, Texas. Its relationship to others in the genus is obscure. It is a low, spreading, highly branched subshrub with narrow, revolute leaves that are silky tomentose above. The flowers are yellowish white with large reddish to maroon spots in the center. This would be an ideal plant for the garden, especially if the habit can be shaped attractively.

***Eriogonum tenellum* Torr.** (*Ganysma*) has three varieties, all in cultivation. A perennial herb, this is a gray, glabrous plant with broad to roundish tomentose leaves and white to pink flowers. The most widespread is var. *tenellum* which occurs from SE Colorado and New Mexico east into W Oklahoma and N and W Texas; it has strictly basal leaves and is the least attractive. Var. *ramosissimum* is restricted to granitic flats, ledges and crevices in Burnet, Gillespie, Llano and Mason counties, Texas, and is the one most often grown. Var. *platyphyllum* is primarily in N Mexico, extending into four counties of SW Texas.

****Eriogonum ternatum* Howell** (*Oligogonum*) is found in the coastal ranges of SW Oregon and adjacent NW California, mainly on sandy to gravelly often serpentine slopes and outcrops. This is the basic expression of a series that includes *E. libertini* and *E. congdonii*. It is a low, spreading, matted herbaceous perennial often with brownish tomentum that takes on a blackish hue. The flowers are sulphur yellow.

***Eriogonum terrenatum* Reveal** (*Eucycla*) is a sprawling to erect shrub. The narrow leaves are somewhat similar to those of *E. pulchrum*, but the rolled margins are suggestive of larger specimens of *E. ericifolium*. The compact inflorescence holds white flowers. The two mentioned relatives occur in N Arizona, but *E. terrenatum* is confined to two areas in SE Arizona.

***Eriogonum thompsoniae* S. Watson** (*Eucycla*) is a robust herbaceous perennial of sandy to clayey flats and slopes in Kane and Washington counties, Utah, and adjacent Mohave County, Arizona. The stems and branches of the rather large, open inflorescences are bright green. The flowers may be yellow or white. None of the varieties is particularly common, and essentially all seem to be confined to red rock outcrops. Var. *thompsoniae* is likely the most attractive for the garden, having broad leaves and yellow flowers. Var. *albiflorum* is similar but has white flowers. On the southern fringe of the range is var. *atwoodii*, which has linear leaves and white to pale yellowish flowers. This expression is possibly a stabilized hybrid involving var. *albiflorum* and *E. mortonianum*.

****Eriogonum thornei* (Reveal & Henrickson) L. M. Shultz** (*Eucycla*) is known from a single canyon in the New York Mountains of San Bernardino County,

California, on copper-rich quartzite gravel in pinyon woodland. It is a spreading or matted subshrub up to 8 cm tall and 25 cm across. The linear leaves are small, and the flowers white. The species is worthy of cultivation, and should do well if its unusual soil preference can be replicated in the garden.

****Eriogonum thymoides* Benth.** (*Oligogonum*) (Nicholls, p. 122) is an exquisite species found concentrated in three regions of the Pacific Northwest: along the eastern edge of the Cascade Range of Washington and NC Oregon; from C Oregon to W Idaho; and in and around Gooding County, Idaho. Male plants tend to have yellow flowers that quickly fade after pollen release. Female plants tend to have white to pale yellow flowers that persist and greatly elongate as the achene matures. Both sexes are required to obtain good seed set, but aside from the differences in the flowers, the overall aspect of the two is similar.

****Eriogonum tiehmii* Reveal** (*Eucycla*) is a low, caespitose, matted perennial with densely white or grayish tomentose leaves and yellowish white or whitish to cream colored flowers. It is known only from the Silver Peak Range of Nevada and is considered sensitive in the state. It belongs to the large, rock garden-worthy *Eriogonum ochrocephalum*/*E. rosense* complex, in this case being found on rocky clay slopes and washes in saltbush communities. See *E. anemophilum* and *E. diatomaceum*.

***Eriogonum tomentosum* Michx.** (*Eriogonum*) is a tall (to 120 cm) perennial herb with white to rufous tomentum and long basal leaves. The densely woolly flowers are initially cream to light tan but soon become rust-colored. It is widely distributed in the SE United States, extending from South Carolina (where it was collected by Mark Catesby in the 1720s) south to Alabama, Georgia, and the sandhills of C Florida. It has been cultivated sporadically, mainly in Europe, for decades but deserves consideration elsewhere.

***Eriogonum tripodum* Greene** (*Oligogonum*) is a low, spreading, green, slightly hairy subshrub up to 50 cm tall and 60 cm across. It has an umbellate inflorescence that can be rather large and always open; the small flowers are yellow. It occurs in widely scattered locations on serpentine flats, slopes and outcrops of the inner coastal ranges of California and along the western foothills of the central Sierra Nevada. It would make an impressive addition to the garden, but is less desirable than *E. congdonii*.

****Eriogonum tumulosum* (Barneby) Reveal** (*Eucycla*) (Nicholls, p. 122) is infrequent in Utah and Colorado. It is often confused with *Parthenium ligulatum* (Asteraceae) because both grow together and form dense hummock-like mats. It occurs on gravelly to clayey flats and slopes. See *E. villiflorum*.

****Eriogonum turneri* Reveal** (*Oligogonum*) is allied to *Eriogonum jamesii* var. *undulatum* but is smaller in all features and restricted to gypsophilous outcrops near El Refugio, Nuevo Leon, Mexico. It does not compare in garden value with either var. *jamesii* or *E. wootonii*, although its small size may well be useful in some settings.

****Eriogonum twisselmannii* (J. T. Howell) Reveal** (*Oligogonum*), isolated and rare, is a matted perennial up to 40 cm across, with numerous rosettes of relatively small leaves. The flowers are pale yellow. It is known only from Slate Mountain and The Needles in Tulare County, California. See *E. douglasii*.

**Eriogonum umbellatum* Torr. (*Oligogonum*) (Nicholls, p. 122), the sulphur flower, is the most variable species of *Eriogonum*, with some 40 varieties scattered through most of the W North America. The brief remarks here augment those by Graham Nicholls, with a few minor corrections. First, his illustrations: the lower right on p. 122 is *E. arcuatum* var. *xanthum*; those on page 123 are *E. umbellatum* var. *porteri* (left) and var. *sandbergii* (right).

Varieties with a flowering stem seemingly with a whorl of leafy bracts about midlength

Var. *torreyanum* is a relatively rare plant confined to sandy to gravelly granitic slopes in the Sierra Nevada of California. Many of its historical sites were destroyed by road construction and development, especially near Lake Tahoe; most collections of this plant were made before 1900. The whole plant is glabrous and bright but dark green, with large yellow flowers in a simple umbel.

Var. *glaberrimum* (Nicholls, p. 122, misapplies the name to var. *torreyanum*) is a light, less intense grayish-green than the former variety. The flowers are cream or whitish, and while the mats are more compact and larger, the plant's height is only about half that of var. *torreyanum*. This variety is a rare and localized taxon known only from the Warner Mountains of SC Oregon and NE California.

Plants without a whorl of leafy bracts about midlength Plants with yellow flowers and a simple umbel

Var. *umbellatum* is common in the mountains of E Idaho, SW Montana, W Wyoming, NE Utah, and the Colorado Rockies. It is occasionally found in cultivation.

Var. *cladophorum* (Gand.) Reveal is restricted to mineralized edges of the geyser basins in three locations within Yellowstone National Park, and differs from var. *umbellatum* in having lanate to densely tomentose leaf surfaces.

Var. *stragulum* Reveal has thinly floccose leaf surfaces and inhabits the foothills and adjacent mountains on and north of the Snake River Plains in Idaho; it just enters W Wyoming.

Var. *aureum* (Gand.) Reveal is one of the more widespread varieties, found from E Oregon, Idaho and W Montana south to S Colorado, Utah and C Nevada. The leaves are essentially or entirely glabrous. It is common in cultivation, especially in European gardens.

Var. *porteri* (Small) S. Stokes (Nicholls, p. 123). Although traditionally accepted, this is little more than an alpine expression of var. *aureum*. At their extremes the two are markedly distinct, and based on limited observations of cultivated plants, they maintain their basic habits when grown under uniform conditions. This variety is widely scattered, usually above 2750 m elevation, in the Uinta and Wasatch mountains of Utah as well as in the Colorado Rockies; it is also in NE and C Nevada.

Var. *hypoleium* (Piper) C. L. Hitchc. is the western, disjunct expression of var. *aureum*, confined to montane and subalpine settings in Chelan and Kittitas

counties, Washington. It differs from most (but not all) populations of var. *aureum* in having hairs on the edge of the leaf blades.

Var. *sandbergii* **Reveal** occurs on the foothills and low mountains of the north Cascade Ranges of NC Oregon and C Washington. It is a low, loosely matted perennial with bright green leaves, woolly below. This has long passed as var. *umbellatum* in the Pacific Northwest.

Var. *hausknechtii* (**Dammer**) **M. E. Jones** (Nicholls, p. 122) is a low, typically prostrate mat with leaves tannish-tomentose underneath and olive-green above. It is a high-elevation phase found mainly on volcanic peaks in NC Oregon and SC Washington. It is common on Mt. Hood and Mt. Adams and is typically found growing with *E. marifolium*, so that mixed collections of the two often are found in herbaria, a distinctive olive-green color to the upper leaf surface being common to both. It is occasionally seen in cultivation, especially in European gardens.

Var. *canifolium* **Reveal** is infrequent in the southern Sierra Nevada of California, and in the Argus Mountains to the east. The densely lanate leaf surfaces and the low, matted habit are distinctive. As the plants mature the amount of tomentum on the upper surface of the leaf-blades thins. It would make a wonderful addition to the garden.

Var. *modocense* (**Greene**) **S. Stokes** is the common form on non-serpentine soils mainly east of the Cascade Range from C Oregon to N California, less frequently in N Nevada and SW Idaho. In California and Nevada, plants now assigned to this name have generally gone under the name *E. umbellatum* var. *polyanthum* in the pre-1989 literature; it is so treated by Nicholls, p. 123. A selection of this variety resulted in the popular red-flowered 'Alturas Red' frequently seen in American gardens.

Var. *dumosum* (**Greene**) **Reveal**. Of the several varieties of *E. umbellatum* that form shrubs, this is one of the more attractive, up to 50 cm tall and 100 cm across. The flowers are bright yellow and large. It occurs on sandy to gravelly flats and slopes in mixed grassland and in oak and conifer woodlands in NE California, and SW Oregon, only occasionally on serpentine.

Var. *goodmanii* **Reveal** is a low, spreading mat former with densely woolly leaves. The flowering stems are rather long (to 40 cm), as are the yellow flowers. It is found on sandy to gravelly serpentine flats and slopes at lower elevations and is common only in the Waldo area of Josephine County, Oregon, although it is also found elsewhere in SW Oregon and in N California.

Var. *humistratum* **Reveal** (Nicholls, p. 123) is a smaller version of var. *goodmanii* with shorter flowering stems, leaf blades, and flowers. It is restricted to exposed serpentine areas in N California, including Mt. Shasta, and is occasionally seen in cultivation.

Var. *nevadense* **Gand.** Nicholls (p. 123) misunderstood var. *nevadense*, seemingly confusing it with var. *covillei*. Var. *nevadense* is a low, mostly spreading subshrub with thinly tomentose to floccose leaf blades. This is the common phase of the species at lower to mid elevations in the (mainly) eastern Sierra Nevada and in the desert ranges of the western Great Basin.

Var. *vernum* **Reveal**, pale to bright yellow-flowered and up to 90 cm tall, is obvious when in full flower in May and early June. It is confined to mainly volcanic flats and slopes in northern Nye Co., Nevada and is worthy of introduction.

Var. *covillei* (**Small**) **Munz & Reveal** is a high-elevation derivative of var. *nevadense*, found on gravelly rocky or talus slopes and ridges in the Sierra Nevada and the White Mountains of California. Unlike its subshrubby counterpart, Coville's sulphur flower forms a low, prostrate mat. It is seen occasionally in cultivation.

Var. *mohavense* **Reveal** is known only from the Black Rock and Wolf Hole mountains area on the Arizona Strip of Mohave County, Arizona, and the Pine Valley Mountains of Washington County, Utah. Related to var. *subaridum*, it is a much smaller plant and flowers in spring and early summer (rather than late summer and fall).

Var. *minus* **I. M. Johnst.** (Nicholls, p. 123) is seen with some regularity in gardens. It is a small, dense mat former, mostly less than 10 cm tall and up to 20 cm across. The compact umbellate inflorescence bears relative short lemon yellow to yellowish red flowers that quickly become red to rose. The variety is rare and local in the San Bernardino and San Gabriel mountains of S California.

Var. *nelsoniorum* **Reveal** is a low, spreading, matted herb or small subshrub with leaves that are densely white tomentose to lanate below. It is known only from three locations on serpentine in Humboldt and Trinity counties, California.

Plants with pale yellow to cream or whitish flowers and a simple umbel

See var. *vernum* (above) and var. *versicolor* (below).

Var. *dichrocephalum* **Gand.** is widespread and common throughout most of the arid Intermountain West, extending into central Idaho, western Montana, and western Wyoming beyond that floristic region. It forms loose mats and resembles var. *porteri* in size in NE Nevada.

Var. *desereticum* **Reveal** has essentially glabrous leaves and pale yellow to cream-colored flowers. It is found in S Idaho, SW Montana and W Wyoming, south into NE Nevada and N Utah. Depauperate high-elevation populations may be seen in the Ruby Mountains; it is this phase that would be an attractive addition to the rock garden, especially since the glabrous leaves turn bright rust-red in fall.

Var. *majus* **Hook.** (Nicholls, p. 123, as var. *subalpinum*) is distinct from and often grows with var. *umbellatum* in Colorado, leading many local taxonomists to distinguish the two at the species rank, calling this *E. subalpinum*. In Wyoming and Montana, var. *majus* can be difficult to differentiate from var. *dichrocephalum*. It is widespread and common in the Rocky Mountains of S Canada south to S Colorado, and then westward into N Utah, NE Nevada, Idaho, and onto the Cascade Range of Washington. The large, prostrate mats with their numerous compact clusters of leaves make it an attractive groundcover. It is occasionally in cultivation, mainly in Europe.

Plants with yellow flowers and compound umbels

Var. *ellipticum* (Nutt.) Reveal, long known as var. *stellatum*, produces a large mass of flowering stems and branches dotted with clusters of yellow flowers, all arising from a small, compact mat. In the field, the flowering stems can be long and leggy, thus tending to collapse under their own weight. The plant is found on sandy to gravelly flats and slopes in the mountains of SE Washington, E Oregon, Idaho, and WC Montana. The most attractive phase for the garden is the large one in EC Idaho.

Var. *devestivum* Reveal is similar in all ways to var. *ellipticum* except the leaves are essentially glabrous. It is infrequent in SE Washington, NE Oregon, and Idaho. The plants are bright and showy and would make an excellent addition to the garden.

Var. *furcosum* Reveal occurs in the southern Sierra Nevada and in the Carson Range of Nevada. The plants are low, rounded subshrubs with smooth leaf margins.

Var. *argus* Reveal occurs in the Siskiyou/Trinity mountains of S Oregon, and in N California. It is the serpentine counterpart to var. *furcosum* of volcanic and granitic soils in the Sierra Nevada. There is no doubt that var. *argus* is a more elegant plant and much more attractive. The wavy margins of the leaf-blades differentiate this variety from all the others.

Var. *bahiiforme* (Torr. & A. Gray) Jepson forms mats of leaves that are densely white to gray lanate on both surfaces. It grows on sandy to gravelly, mostly serpentine flats and slopes in the central coastal ranges of California, with a disjunct population in the San Gabriel Mountains.

Var. *smallianum* (A. Heller) S. Stokes occurs in the northern coastal ranges of California and is the northern counterpart to var. *bahiiforme*. The plants form low, spreading mats of leaves that are lanate to tomentose only on the under-surface. They are found on sandy to gravelly, mostly serpentine flats and slopes in oak and montane conifer woodlands. Both this and var. *bahiiforme* deserve a place in the garden.

Var. *subaridum* S. Stokes is widespread across the southern portion of the species' range from SE California across S Nevada, C and S Utah and N Arizona to SW Colorado. It is usually a low, rounded subshrub, but at higher elevations in the southern Wasatch Mountains it can be matted.

Var. *chlorothamnus* Reveal deserves a place in the garden. Bright green and essentially glabrous throughout, the large subshrub to shrub of the eastern slope of the Sierra Nevada is stunning in the wild. Although the bright yellow flowers are on the small side, this is compensated by their sheer number.

Var. *munzii* Reveal occurs mainly in the Transverse Ranges of California, basically along the edge of the Mojave Desert, and also in the San Jacinto Mountains and Laguna Mountains. It is related to var. *subaridum*, and distinction between the two is not always sharp. Generally, the leaves are densely white tomentose on the upper surface.

Var. *lautum* Reveal. Of all the compound umbellate sulphur flowers, this low, spreading mat with leaves densely white woolly below, and with large compound

umbels of bright yellow flowers, is the most worthy of cultivation. It is restricted to the Scott Valley area of Siskiyou County, California.

Var. *polyanthum* (Benth.) M. E. Jones. The name var. *polyanthum* has been widely misapplied to plants here called *E. umbellatum* var. *modocense* and var. *dumosum*. The inflorescences are commonly compound umbellate, but plants with reduced yet bracteate inflorescences do occur. The more common, branched-inflorescence expression is rare throughout its range on the western foothills of the Sierra Nevada, on serpentine flats and slopes in oak and montane conifer woodlands. It forms a round, rather open shrub up to 100 cm tall and across.

Var. *speciosum* (Drew) S. Stokes. This large, rounded to spreading shrub (up to 150 cm tall and 200 cm across) is known presently only from a few scattered locations in Humboldt and Trinity counties, California. The name has been widely misapplied to var. *dumosum*, var. *polyanthum*, and especially var. *abartii*. This variety is certainly worthy of cultivation because of its large flowers. It occurs mainly on serpentine flats and slopes at low elevations.

Var. *abartii* Reveal is probably the most attractive of the shrubby varieties. It forms large, densely branched shrubs up to 80 cm tall and 130 cm across, with large leaves. It occurs on serpentine in oak and pine woodlands in Butte County, California.

Var. *cognatum* (Greene) Reveal has decidedly more rounded leaves than most seen in *E. umbellatum*, and the whole plant is smaller and more compact than most, being only about 30 cm across. It is a plant of sandy flats and slopes of N Arizona, most frequently in the greater Flagstaff area. It is cultivated occasionally but deserves more attention.

Plants with non-yellow flowers and compound umbels

Var. *versicolor* S. Stokes (Nicholls, p. 124). Although some populations at higher elevations might be considered "dwarf," as suggested by Nicholls, most are rather open, spreading mats. The flowers vary greatly from cream to reddish brown or even rose with often a large, darker red to maroon spot on each outer perianth lobe. It is infrequent in scattered mountain ranges across S Nevada into SE California, where it may be somewhat more common. Some populations with highly colored flowers ought to be introduced into cultivation.

Var. *juniporinum* Reveal. In this widespread but infrequently encountered variant the leaves are floccose to glabrous on both surfaces. It occurs in widely scattered desert ranges from S Utah and NC Arizona westward across S Nevada to SE California

**Eriogonum ursinum* S. Watson (*Oligogonum*) is rather common in the northern Sierra Nevada. It forms large, colorful mats on the forest floor, with rather compact but compound divided umbels of pale yellow flowers. It does well in the garden (see Nicholls, p. 124). Var. *erubescens* has longer involucre and flowers and a less complex inflorescence; it is known from NW California. See *E. nervulosum*.

**Eriogonum verrucosum* Reveal (*Eucycla*), a member of the *E. ochrocephalum*/*E. rosense* complex is the pustulose or bumpy texture of the flower base and midribs

of the perianth lobes. This is a low, caespitose, matted perennial with numerous leaves that are densely white tomentose, often on both surfaces. It is known from Idaho, mainly along the Salmon River drainage, and in the mountains to the south. Most populations consist of yellow-flowered plants but there are a few mixed populations of cream and yellow flowered plants.

***Eriogonum villiflorum* A. Gray** (*Eucycla*) (Nicholls, p. 124) is inconspicuous in the field, seen in Utah and Nevada. The sprawling nature of the flowering stems with the large clusters of involucre and woolly flowers is distinctive. See *E. aretioides*, *E. shockleyi* and *E. tumulosum*.

***Eriogonum viridulum* Reveal** (*Eucycla*) is one of the few attractive members of the *E. brevicaulis* complex. The basically linear, revolute leaves are glabrous and bright green and thus similar to the bright green flowering stems. The flowers are bright yellow, so the color combination is alluring. This is known only from eastern Duchesne and Uintah counties, Utah. See *E. brevicaulis* and *E. ephedroides*.

***Eriogonum wootonii* (Reveal) Reveal** (*Oligogonum*) is allied to *Eriogonum jamesii*, differing by having bright yellow flowers. The species is known only from the San Francisco Mountains of S New Mexico. It would be an ideal addition to the garden. See *E. allenii* and *E. correllii*.

***Eriogonum wrightii* Torr. ex Benth.** (*Eucycla*) (Nicholls, p. 124), the "bastard sage," consists of nine varieties, only three of interest to the rock gardener. In addition to var. *subscaposum* mentioned by Nicholls, there is the alpine var. *olanchense* of granitic talus slopes above 3500 m in Tulare County, California. It forms tight, compact mats up to 6 cm tall and 30 cm across. The flowers, like others of the species, vary from white to pink. In the Sierra San Pedro Mártir of Baja California Norte, Mexico, one finds var. *oresbium*, much more like var. *subscaposum* in habit. Among the other varieties, one might find some forms of var. *trachygynum* garden-worthy, especially the densely lanate ones from the coastal ranges of C and N California. Already in cultivation are var. *membranaceum* of S California and N Baja California, and its southern counterpart var. *taxifolium* of coastal Baja California Norte and offshore islands. These are well-formed subshrubs with small, elliptic leaves. The more shrubby varieties, notably var. *nodosum* of SE California and its close relative var. *pringlei* of Arizona, are too scraggly to be attractive in most garden settings. Still, the tiny involucre and flowers of Pringle's bastard-sage are curious, and the dense lanate condition of the stems, branches and leaves of both varieties are pleasing. In an open, roomy, arid garden, any of these three expressions might be worth a try. See *E. kennedyi*.

***Eriogonum zapatoense* Moran** (*Eucycla*). Aside from *E. encelioides* of the *E. giganteum* complex, this rare and local shrub is the most worthy of cultivation. What is attractive here are the numerous yellow flowers that should, if properly trimmed and groomed in the garden, completely cover the shrub. It is known only from a small islet off Isla Guadalupe, well out in the Pacific Ocean off the coast of C Baja California, Mexico.

***Eriogonum zionis* J. T. Howell** (*Eucycla*) is one of four species in the *E. racemosum* complex found from the desert ranges of eastern California to the Rocky Mountains. Of these, only *E. zionis* has any attributes truly worthy of a place in

the garden. While the large leaves and white to pale yellow or yellow flowers of this more or less erect herbaceous perennial might strike someone's fancy, it is the bright red flowers of the var. *coccineum* that are remarkable. Var. *zionis* is found in scattered populations in S Utah and N Arizona, while var. *coccineum* is rare and local, known only from two populations on the edge of the Grand Canyon and in the Hack Canyon area of N Arizona.

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A *Lewisia* Tour

Sean Hogan

This is about the genus *Lewisia*, but I have a short attention span, and it's always been really hard for me to be a one-genus guy. So when I'm out looking at lewisias I'm looking at 30 other things as well. When we're looking at any kind of plant, it's great to see it in habitat, to see what it's growing with, because a lot of those things are indicator plants we might have seen or grown before. It's also good to learn as much as we can about the climate in which they grow, the rocks on which they grow, and so on.

We have many genera in the family Portulacaceae in North America, and they're represented especially well in South Africa and South America. The genus *Lewisia* itself has three major groups: the section *Cotyledon*, the section *Rediviva*, and the section *Pygmaea*, and arguably others. Those of section *Pygmaea* are the most alpine, and certainly some of them are the most finicky, but if you like things high and dry and above the trees, this is the place to see them. There are about half a dozen of them, ranging from the center of diversity in the Sierra Nevada up into the south and central Cascades of Oregon, and then throughout the West.

One particularly rich spot is the northern Sierra near Castle Peak. Margaret Williams had said she had seen *Lewisia longipetala* there, and I'd always wanted to see it, but at about 9000 feet, right at the treeline, for several years the spot where it was supposed to grow was under snow throughout the year, and then there was a drought year and nothing emerged at all. So it took me about five years to finally find it. But there are five or possibly six lewisias in the *Pygmaea* group that occur together here, so it's a pretty exciting spot. Most of them are around a quasi-permanent snowfield which collects in the winter and then slowly recedes. *Primula suffruticosa* is also here, making an appearance only every two or three years. *Lewisia triphylla*, the ugliest one, emerges first and then everything gets better. It's definitely a snowmelt plant, appearing in earliest spring, which could be March or September depending on the elevation and latitude, usually growing within a couple of feet of melting snow. Its little tiny flowers are just a couple of millimeters across, from a little bulblike root. Unfortunately *L. triphylla* usually has only two leaves, which is no help if you're trying to key it out in habitat. *L. tri-*

phylla is pretty miffy to grow; you might ask why I'd want to, but sometimes we do. If you can mimic nine months of frozen conditions and then a month of bliss with bright sunshine and cold running water, and then pure drought, go for it. I know people in England have large refrigerators for this purpose, but I gave up on this one a long time ago.

Lewisia longipetala, another one arguably in the same group, is a great plant and seemingly much more adaptable. Centered mostly on the Desolation Wilderness in the north central Sierra Nevada to the west of Lake Tahoe, it again took me several years to find. It grows in a lot of different substrates; it grows virtually in running water, and up in rock outcrops. Strangely it does not have a wide distribution, only about 30 miles, but it's very good in cultivation. It's easy to keep it evergreen. Plant it in fairly mineral soil and keep it damp in a reasonably cool situation throughout the summer. It also hybridizes freely with *L. cotyledon* and some other species. I photographed *L. longipetala* around August 1 growing in nearly permanent water, at 9200 feet elevation, where the ground is exposed for only about three months, so it's a delightful surprise that it does so well at lower elevations in cultivation. It has beautiful glands—not something you'd necessarily compliment somebody on, but if you look at those jewel-like bracts on the flower, they're every bit as pretty as the petals. It is long-flowering, and in cultivation the scapes can be nicely branched. It grows with eriogonums such as *E. lobbii*, *Primula suffruticosa*, and *Penstemon rupicola*.

Lewisia kelloggii is another species found up and down the Sierra Nevada in various spots (and one population in southern Idaho), each population very isolated, and each a little bit different. And each one of these is just as difficult to grow. Again, if you can mimic 2 inches of pure granite on top of 33° F running water and bright sunshine, and then absolute dormancy and then ten feet of snow, go for it. I've gotten this to grow several times, but not for very long. The plant is 4 or 5 inches across. I photographed it in mid-June or a little later, and a couple of weeks later, all I could find in its habitat were little finger-sized holes like trapdoor spider holes: all the plants were dormant and pulled underground.

Another close relative, though closer to *Lewisia nevadensis*, is *Lewisia oppositifolia*, a relatively narrow endemic of the serpentine soils of the Illinois Valley of southern Oregon at about 3000 feet, extending just into northern California. There are two fairly distinct varieties. Var. *richii* grows at higher elevations, up to about 5500 feet. It flowers around the first of April, usually white to pale pink. The Siskiyou are an amazing part of the world, extremely high in endemism; I think there are seven or eight endemic *Viola* species just in this valley, some carnivorous plants, and some genera otherwise found only in Asia.

A telltale sign of *Lewisia nevadensis* is that it resembles *L. pygmaea* with a slightly "pinched" flower. It is also summer-deciduous, so it is a lower-elevation plant found nearer the Pacific coast and definitely shows more Mediterranean characteristics. It seems to come up in habitat during mid to late November with the first rains, and it's gone by the end of April. Its typical habitat is Jeffrey pines, very sparse open forest. You can get a couple of months of flowering out of it in

cultivation, and then you need to set it discreetly out of the way, because you're going to have a lot of ugliness for the next 8 months.

A rather obscure species from the Mendocino Mountains of northern California, and a very narrow endemic, is *Lewisia stebbinsii* (photo, p. 150), named after the great botanist. It's also fairly close to *L. nevadensis*, with which it grows at about 7000 feet. *Lewisia stebbinsii* intergrades with *Lewisia nevadensis*, so there are patches of offsetting, light pink, very full-flowered *L. nevadensis* growing with it. They experience snowmelt and then a fairly long summer drought. It is growable, though a little trickier than *L. oppositifolia*, but again, if it's given an ample damp season it likes to grow in the winter as long as it's not in the snow, and it really would like a little bit of a baking, not in a microwave but just on a nice bench.

Be careful with summer water on all of these species once they've gone dormant. If you are lucky enough to live right next to the Pacific Ocean or in the British Isles, a place where as far as these plants are concerned it's always February, then many of the deciduous species and certainly the evergreen ones will go all year. They love you. Inland where I garden in Portland, Oregon, they need to go dormant and be kept that way. Alpines, cool maritime plants, and Mediterraneanans have a lot in common. Basically, the fungi that occur in the soils are dormant when they're cool, and warm wet soil when the plants are dormant is a pretty sure way to do them in. So just decide when your off season is, and leave them alone then.

Lewisia brachycalyx has a rather strange distribution: along the Mogollon Rim in central Arizona all the way to San Diego County in south coastal California, and I think into the San Bernardino Mountains around Big Bear Lake, and then in the Sierra San Pedro Martir in northern Baja California, growing again in either snowmelt areas or seasonally damp swales in ponderosa pine and incense cedar woodland, and a lot of cow dung. This habitat type was one of my first hints about how to grow these species. When it's cool and they're growing, don't skimp on the water. *L. brachycalyx* has also been fairly easy in cultivation, and because of its easterly distribution it really likes summer thundershowers, so even the dormant plant can take some summer moisture. Just grow them in mineral grit, when you do water be sure you bang some drums as a thunder effect—they like that. A little fertilizer doesn't hurt them, either.

Not far from the northernmost habitat of *L. brachycalyx* is the southernmost limit of our next group, the *Rediviva* section. The northern Arizona habitat is in the juniper country and into the ponderosa pines, again in soils very damp in spring.

This section's distribution is mostly around the Great Basin of the Intermountain West. There's actually a population of *L. rediviva* in Saskatchewan, certainly in Alberta, in southern British Columbia in the lower Okanagan valley; it ranges through eastern Washington and eastern Oregon, coming west into the valleys where it gets very dry, and into California. The endemics in the section are *Lewisia disepala* in the southern Sierra, and *Lewisia maguirei* in southern Nevada.

Lewisia rediviva (photo, p. 149) and its name have an interesting history. It was collected by Lewis and Clark; of course it was discovered by them after they had been eating it all winter, given it in different forms by the Native Americans. It was taken back to Philadelphia in 1804, boiled and mounted, but apparently not boiled long enough, because with the moisture it appeared to come alive. Pursh planted it, and it actually sprouted. So it was named *Lewisia* after Lewis and *rediviva* meaning “coming back to life.” A tough little succulent plant! If you like *L. rediviva*, it offers a lot of variation. They are very much summer-dormant plants. Most of the Great Basin does get some moisture in fall with the first Pacific storms. When that happens, up come the little bright green rosettes; they grow all winter, especially in the wet times, and flower in early to mid spring—February to June depending on elevation and latitude—and then immediately go dormant. Upon that dormancy, you want to tuck them out of the way, keeping them in where they can have some soil humidity, but just don’t give them too much moisture. Often with cooler, damper weather, they’ll let you know when they’d like to be watered—they’ll sprout again in the fall. They often grow around vernal pools in the western valleys, mostly in the Rogue Valley down to the Sacramento Valley. Vernal pools are definitely worth visiting for their flora other than lewisias, as well. The Alvord Desert on the east side of Steens Mountain in Oregon is the northern distribution of a lot of Mojavean plants, such as ephedras and *Atriplex*. The *Lewisia rediviva* that grows here is very lacinate; some of the petals are bifurcate all the way to the edge of the flower, making it very pretty.

Another form is *L. rediviva* var. *minor*, arguably a subspecies, and certainly a nice plant, first made famous on Mount Rose about 30 years ago by Margaret Williams. The same form grows on Black Butte, a 7000-foot mountain south of Christmas Valley, Oregon, where I had a family house for a long time, flowering at the end of March. Its flowers are a little larger than a dime. It’s worth looking for variations in flower color in the northern part of its habitat. Another portulacad sometimes found with it is *Talinum spinescens*, a little, succulent bun former, 6 or 8 inches across, which flowers for two months or more and is evergreen if you keep it watered. The same habitat in the arid scablands of east central Oregon also has an array of *Eriogonum* species, notably *E. thymifolium*.

Yosemite National Park holds the sites of *Lewisia disepala*. A tiny *Rediviva* member, it is most accessible near the Wawona Tunnel. It’s a high-elevation plant, growing usually above 6000 feet. It flowers up on the high granitic domes when the snow blows off and melts early, so you get to hike through snow to see it. Way up high, in almost shifting sand dune-like areas of granite, is where *Lewisia disepala* tends to grow. It’s a really pretty little plant, perhaps 4 inches tall in bloom at the end of April. It has a fair amount of variation in color if you like pink, from pearly pink to dark pink, and little tiny leaves. We did manage to grow this from seed and did get it to flower, but the collection was left at the University of California, Berkeley, and I don’t know what’s happened to it. I would keep it as cool as you can, in mineral soil, with a little extra fertilizer in late winter and early spring; then don’t make any direct eye contact with it, and it’ll be fine.

At the base of the mountains as one gets into southern Nevada there's a great limestone flora. One of the endemics in the Cherry Creek Range is *Lewisia maguirei*. It's like your pet: you think it's beautiful even if nobody else does. This probably didn't evolve over hundreds of thousands of years to be beautiful to me, though. The main taxonomic difference between this and the rest of the group is that, unlike *L. rediviva*, this has one to three flowers per inflorescence, while *rediviva*'s almost always got just one. It grows only over a couple of miles in limestone at about 7500 feet elevation. It has little, leathery, succulent leaves and small white flowers. Kath Dryden in England has done very well with this—in the refrigerator. Its typical community is pinyon/juniper woodland, with eriogonums and various cacti.

Finally we get to the most popular section of *Lewisia*, section *Cotyledon*. These are West Coast plants, liking to be in places that are at least near winter rainfall. To the south we have *Lewisia congdonii*, then *L. cantelovii*, all of the true *L. cotyledon*, and up toward Washington is *L. columbiana*. Interestingly where the Rockies hit a low spot just north of the Willows in Oregon through Lolo Pass into Montana, you find a lot of typical Pacific Northwest vegetation, including this lewisia, where there's ample moisture.

There's a funny story about *Lewisia congdonii*. Dr. Congdon, having set eyes upon this voluptuous portulacad, then searched for it again and declared it had gone extinct. He'd done it several times before someone else pointed out that it is a summer-dormant member of the *Cotyledon* group. It starts to come alive again in early fall, looking like little green dots, in preparation for the rains. I photographed a population along the Merced River. Rather ephemeral, the flowers are pretty if you're close enough to them. It's the horticultural category of interesting rather than beautiful. On several peaks surrounding Yosemite around 4000 feet, however, the plants are horticulturally stunning. The flowers can be nearly an inch across, and many of them have good color saturation. Like their relative to the north, *L. cantelovii*, they have relatively indeterminate flower stalks, so if you keep them watered they just keep blooming. The leaves turn a beautiful red as they're attempting to go dormant. With them grows a nearly endemic sedum, *Sedum spathulifolium* var. *yosemiteense*, which I photographed atop Mt. Trumbull.

A little farther north is a plant that had only three populations known when we started playing in its habitat and looking around, and I think we're up to 15 or 18 sites now. This is *Lewisia serrata* or *L. cantelovii* var. *serrata*, a gem of a plant, with evergreen, wonderfully serrate leaves and a flowering stem reaching up to 18 inches. They grow in a spectacular habitat of very steep canyons in the western face of the Sierra Nevada, in places where you have to hang by one arm to photograph the plants. They're found between about 3000 and 5000 feet elevation. They do go dormant in summer, and they can be nearly deciduous if they're dry enough. Domesticated, they rot easily. Usually the flowers are just pale pink. A little to the north toward the Yuba River, the plants are noticeably larger and become *L. cantelovii*, which has a range of about 100 miles on the western face of the Sierra. In summer, when everything's dry and dormant, it turns red and

holds its breath for fall. With winter rains it revives quickly, becoming quite succulent and growing rapidly from November through March. From a typical cliff habitat, *L. cantelovii* likes good drainage; it often grows on metamorphosed volcanic rock that's shaly and has been well baked, on sites rocky enough that the canyon live oak, Douglas fir and other trees can't shade it out. The type location for it is on the Feather River, and it is still abundant there. It's a pretty plant, and fairly easy in cultivation. Variety *shastensis* is much larger, with flowering stems up to 40 cm. *Sedum spathulifolium* var. *purdyi* is commonly found with it, a pretty little rock garden plant, and sometimes *Cyripedium californicum*.

Now we're heading up toward the Siskiyou and northern California. It's very folded country, where many bits and pieces of the Earth crashed into one another—a real terrain wreck—and that means a lot of good plants. *Lewisia leana* is a fairly localized plant in the Siskiyou, with one pocket in the south central Sierra Nevada in Fresno County. In several places it meets *L. cotyledon* and they make their own hybrids, which are quite beautiful. This is also the part of the world where there are the most sympatric conifers, some 23 to 26 species depending on how far a walk you consider “together.”

Lewisia cotyledon var. *cotyledon* is here, growing in granite, sometimes with intermediates with *L. leana*. Typical habitat is found near Cook and Green Pass. About half a dozen endemic species of *Iris* grow in this area, too. The top of Fiddler Peak is a wonderful spot for *Lewisia cotyledon* var. *purdyi*, a variety name I accept in spite of the fact that Carl Purdy demolished many populations of plants in the region for his nursery trade. The color saturation tends to be very good in this population, and many of the deep mustard yellows that have been brought into cultivation came from here. *Lewisia cotyledon* var. *howellii* tends to be a river plant, growing not too far above the flood line on many creeks and rivers in that part of the world. Its main distinction is undulate leaf margins rather than toothed or entire ones. *Lewisia cotyledon* var. *heckneri* can be seen growing along the Pit River and the New River, pretty steep territory but wonderful for all kinds of plants.

The final group of true *Cotyledons* is the *Lewisia columbiana* group. *L. columbiana* is a rewarding plant, and because it has such a large distribution it's quite variable, from tiny forms to big ones, in pink or white. In the mountains above Hell's Canyon and the Snake River on the Oregon/Idaho border is *L. columbiana* var. *wallowensis*. I don't think there is really any taxonomic difference from the western populations, just a geographical separation, and the eastern forms do tend to be white-flowered. Near Cascade Pass in the North Cascades in western Washington *L. columbiana* has very large flowers, rather like var. *rupicola*. Saddle Mountain is in the northern Oregon Coast Range; you can see the ocean from its summit. Here, climbing the escarpments, is *L. columbiana* var. *rupicola*, and all the plants there have a deeply saturated rose color. On these tall basaltic cliffs grow a number of rare plants and endemics, only about an hour and a quarter from Portland.

A little farther north and east, we're in the Wenatchees, and looking at a plant that is or is not a lewisia: you decide, it's either a lewisia or something related

more to plants of western South America, but whatever it is, it's *tweedyi*, one of the most wonderful endemics in the Pacific Northwest (p. 149). Mark Hershkovitz in *Flora of North America* put it in the genus *Cistanthe*, but to most of us it's still *Lewisia tweedyi*. It grows on granitic and serpentine soils in the Wenatchee Mountains of central eastern Washington and into southern British Columbia. The first time I visited this habitat I wondered what kind of rarefied soil it grew in, but I found it in quite a variety of substrates. It grows in the woods on north slopes, or on south slopes in sagebrush, just about everywhere in its range. There's a lot of variation in its roughly 100-mile range north to south, from very dark peach tones to cream and even pure white. On the coast, we find it's all right to water it all year round if you're careful. Inland, give it a little careful dormancy.

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Western Alpines: Over Here

Rick Lupp

Note: The author submitted this written version of his presentation.

My good friend Graham Nicholls and I each are discussing our different approaches to growing and propagating Western American alpines. I will talk about the methods that I use in western Washington state, and Graham about the methods he uses in England. We hope that you will find this approach entertaining and informative.

My home and business, Mt. Tahoma Nursery, are in Graham, southeast of Seattle, at an elevation of about 800 feet/250 m. Mt. Rainier is a bit over 20 miles away by air and about twice that distance by road. We get around 55 to 60 inches (137–150 cm) of precipitation a year, most of which falls as rain between October and June, leaving us with quite dry summers. An average winter low temperature is about 10° F/–12° C, but we have been as low as –12° F/–25° C. I grow as many of my plants as possible in the open garden, a series of ten raised sand beds of various sizes.

These beds range from a narrow 55-foot/17 m-long bed to an 35- by 6-foot/11- by 2-m bed, with a number of smaller beds as well. These beds average about 24 inches/60 cm deep and are filled with pure, coarse, washed sand over a liner of permeable groundcloth that keeps out earthworms. Worms can introduce a great deal of humus into a sand bed over the years. I fertilize these beds each year in late winter with a very light application of encapsulated fertilizer. The beds are watered well the first year after construction but receive very little watering after that. Proper depth is very important in these beds. Everyone whom I have ever known to report poor results with a sand bed has made the bed much too shallow. Deep beds hold moisture even in very hot weather for the long, deep-delving roots of alpine plants.

Almost all my sand beds include rockwork to provide crevices facing in all possible directions, offering a good mix of microclimates for my plants. This allows me to grow plants with such different requirements as *Saxifraga* and *Draba* in the same bed. I also have a number of short, open-ended film-covered hoop greenhouses facing in different directions, which I use to grow many of my

potted plants. I grow these without any artificial heat. Many other plants are grown in troughs and hypertufa pots.

Claytonia megarhiza var. *nivalis* is one of my favorite Western American alpiners and is mostly found growing on north- or east-facing screes in the Wenatchee Mountains of Washington. The typical color is rose pink, and the foliage is succulent. Ron Ratko has given me two other wonderful color forms that he collected as cuttings while gathering material for his seed list. The first is a soft pastel pink, which surprisingly comes true from seed. Ron also gave me a cutting of a lovely deep pink form, which does not come true from seed. I have found *Claytonia megarhiza* var. *nivalis* very easy to propagate from cuttings. I keep a flat of stock plants of all three forms I grow and simply take cuttings from them each year in late March to maintain my stock. This plant makes plenty of offsets, so cuttings can be produced in large numbers each year. I stick my cuttings in flats of sand and pumice, which are left uncovered in my hoop houses in an area that is bright but gets no direct sun. The cuttings root in about six weeks. Seed is also easy to grow but it is produced erratically, so it has to be collected every few days during the flowering season or it is dispersed by the plant before you can get to it. *Claytonia megarhiza* var. *megarhiza* (photo, p. 150) grows in the Rocky Mountains, where I have seen it in large numbers in north-facing rock outcrops at high elevations. I grow several different forms; my favorite has large spoon-shaped leaves and blooms that start out almost flesh pink and fade to white with age. This plant does not offset well at all, so I propagate my stock from seed, which ripens erratically as in var. *nivalis*. I hand-pollinate my plants to ensure good seed set. The seed germinates well when the seed pot is left outside on a bench over winter. I grow all forms of *C. megarhiza* in north-facing crevices in the rockwork of my sand beds, where they are trouble-free and long-lived. The main bloom is in May in my garden.

The almost exclusively North American genus *Douglasia*, which has recently been sunk into *Androsace* by some authorities, includes some superb plants for our rock gardens and alpine houses. My favorite is *D. laevigata* var. *ciliolata*, found in the Olympic Mountains of Washington and south to some of the coastal peaks of western Oregon. This plant almost always grows in sunny, exposed sites with sharp drainage at alpine elevations. I grow it in full sun in my sand beds, where it makes very nice dense, tight domes that slowly increase in size each year and reliably produce rich pink flowers held in clusters on very short stems. *Douglasia laevigata* var. *laevigata* is a smaller plant in all of its parts and is usually found in much cooler north- or east-facing sites in nature. It often grows right on cliff faces in the western Cascade Mountains, so it needs a cool site in the rock garden, with excellent drainage. The Columbia River Gorge is home to a form of *D. laevigata* var. *laevigata* that grows right down at sea level and has much lighter pink blooms than other forms. This is almost always found in north-facing or shaded cliffs, often right beside the waterfalls for which the Gorge is famous. Cone Peak in central Oregon is home to a very unusual population of var. *laevigata*, the southernmost population of this species. Here the plants often grow out in full sun, but the most unusual thing about them is that many have exerted stamens

that extend out beyond the throat of the corolla, much like some primulas. I first noticed this feature some years ago and brought it to the attention of Sylvia "Tass" Kelso, the authority on North American Primulaceae. She suggests that this might be an ancient population that has features which no longer exist in more evolved populations.

Douglasia nivalis var. *nivalis* ranges from the Wenatchee Mountains of Washington to the inland mountains of western Canada. Its cousin, var. *dentata*, is found only in Washington and differs only in having dentate leaves. Both varieties have blooms in rich shades of wine red which really make them stand out from other members of the genus. *Douglasia nivalis* is often found on serpentine screes in full sun. I have seen it growing at elevations ranging from 4000 to 8000 feet in the Wenatchee and Sawtooth ranges of Washington. This plant does well for me when planted in south-facing crevices of sand beds or troughs.

All species of *Douglasia* are easy to grow from seed. I sow it in December and cover it with crushed pumice or grit. The pots are left in the open on a bench until they germinate in spring. Cuttings root well when taken in fall after the weather cools down. I root the cuttings in covered propagators in a mix of sand and pumice.

Douglasia nivalis also grows on Mt. Bigelow in the Sawtooth Range, which is the only known station in Washington for *Eritrichium nanum*. *E. nanum* grows right along the summit ridge of Mt. Bigelow at about 8000 feet, and only in a narrow band that extends down about 200 feet from the top of the ridge, but thousands of plants make their home at this site. A friend has been there several times for seed but has never found more than a couple of seeds. The site is crawling with ants, and our theory is that they are dispersing the seed as soon as it ripens. I have never been able to grow *E. nanum* in the open, but it can certainly be grown under cover as a pot plant. I grow it in a very lean mix with pieces of slate placed under the cushion to help keep it dry during winter. Once the plant goes dormant in winter and turns brown, watering should cease until new growth appears in spring. I also keep the pot very near the open end of my hoop house to ensure good air flow. The plants usually behave like monocarps and die soon after blooming for the first time, although I have had a couple of them live to bloom twice, and both set good seed after the second bloom. While some of the Asian *Eritrichium* species root well from cuttings, I have had no success with cuttings of *E. nanum*.

The genus *Erigeron* provides many plants that add greatly to the color and interest in my sand beds, troughs, and alpine house for a very long period beginning in early spring and ending for the most part in late fall, with a few hybrids continuing to bloom all winter in the alpine house. *Erigeron elegantulus* makes its home at alpine elevations in central Oregon and is only a few inches high in bloom. The masses of violet-blue flowers make a good show in late spring to early summer and often repeat in fall. This plant slowly forms large mats and thrives in my sunny sand beds and troughs.

Erigeron leiomerus is a plant I highly recommend, as it always produces a good show of large, soft violet daisies from spring to fall in my garden and is very long-lived. I have plants in my original raised sand beds that are now 13 years old and still thriving. *E. leiomerus* grows throughout the Rocky Mountains and is found

in Washington in the Wenatchees. I like to plant this little beauty in the crevices of my sand beds, which are soon packed tight with this accommodating plant.

Erigeron basalticus is a little-known endemic of basalt cliffs of the Yakima River valley in Washington. It forms really impressive domes covered with 1-inch/2.5-cm white blooms flushed purple-pink. It usually grows in west-facing cliffs and does best for me when planted in south-facing walls in the sand beds or when grown as a potted plant in the alpine house. It is difficult to keep in character in the alpine house and is not long-lived in the open garden, persisting for two or three years before rot attacks the woody base.

A plant of very wide distribution throughout western North America is *Erigeron compositus*. It comes in a wide assortment of colors including white, pink, violet, and blue, as well as bicolor forms, but I like the pure white forms best. Different varieties also exhibit a wide range of variation in foliage form, with some sporting very finely dissected leaves. This species in all its forms thrives in my sunny sand beds and self-sows modestly. Plants are only a few inches high in bloom.

Erigeron aureus (photo, p. 151) is also widespread throughout western North America and is prized for its rich golden blooms and compact habit. This plant does best for me when grown in cooler sites, such as east-facing crevices in rockwork, and is usually not long-lived in the open, where it persists for two or three years. It does make a wonderful, long-lived plant in the alpine house. While hiking one day in the Goat Rocks of the Washington Cascades, I came across a natural hybrid growing in among a colony of *E. aureus*. *E. compositus* was the only other species growing in the area and must have been the pollen parent. I brought back some cuttings and introduced the plant to cultivation as *E.* 'Goat Rocks'. It grows well in my sunny sand beds and troughs, but very sharp drainage is essential for success with it.

All erigerons—except the hybrids, which are sterile—are easy to grow from seed planted fresh upon harvesting and sown on the surface of some grit. Stratification is not necessary. Cuttings root very easily from all species I have tried, and root cuttings also do well. You can just decapitate a plant in a pot and you will get a number of little plants coming up from the roots.

The western American phloxes are well known for their great beauty and for the difficulties they present to the grower. Many are not easy to please in cultivation, especially in the open, unless you happen to live in a suitable climate, such as in Denver. These plants can also present problems for the propagator. *Phlox hendersonii* is found in the Olympic Mountains of Washington and in the Cascades, making its way at least as far south as Mt. Hood in Oregon. The foliage is very glandular and sparkles in the sunlight; the large blooms are especially well formed and come in shades of white to pale blue, and sometimes even pale pink in forms from the east side of the Cascades. This is a plant that does do well in the open garden or troughs but tends to bloom best when grown under cover. It likes to grow in a little richer soil than my sand beds, so I often grow it in troughs.

Phlox pulvinata (photo, p. 148) forms dense domes that cover themselves with stemless white or blue flowers which have a nice fragrance on warm days. This Great Basin species does best for me with winter cover, so I grow it in pots or in my large covered, raised sand bed, where it makes a beautiful display.

Betty Lowry of Renton, Washington found a spectacular color form of *Phlox kelseyi* in Lemhi County, Idaho, and named it 'Lemhi Purple'. In nature it grows in very alkaline soils, but it does well for me without benefit of lime. I grow it in pots, troughs, and raised sand beds with good results, but flowering is best under cover.

Of all the western American phloxes I grow, *P. diffusa* is the best all-around garden plant. Found from British Columbia to California in the mountains, it has many color forms including white, pink, lavender, purple, rose-red, and intermediate shades. I find it easy to please in sand beds and troughs.

The western phloxes are noted for being difficult to propagate from cuttings, although they are easy to grow from seed—when seed is available. One day while I was hiking in the Goat Rocks a few years after the eruption of Mt. St. Helens, I came across a good pink form of *Phlox diffusa* so I stopped to take a few cuttings. While doing so, I noticed that the plant had layered extensively, apparently as a result of being nearly buried by volcanic ash. When I got back to the nursery, I took a number of my western phloxes and repotted them down low into their pots so that the new growth was making contact with the potting mix. When I checked the plants a couple of months later, almost all of the stems had rooted, and I was able to make many new plants from each pot. I now propagate all of them in this manner with great results.

Phlox adsurgens comes to us from subalpine elevations in the mountains of central and southern Oregon on the west side of the Cascades. This species finds my sand beds too lean for its taste and does better in a well-drained garden soil. Some forms can do well in full sun, making mounds covered with bloom, but most forms do best with morning sun and dappled shade later in the day, producing more lax growth. This species is easily propagated from cuttings taken in early spring or fall.

Western North America is home to a number of very good *Silene* species, and my favorite of the bunch is *S. hookeri* subsp. *bolanderi*. It grows at mid to low elevations in dry, rocky areas in the mountains of southern Oregon and northern California. All forms of it are terrific subjects for pot culture and also do well in my sunny sand beds and troughs, as long as they're protected from slugs. I once grew a batch of seed from a potted *S. hookeri* subsp. *bolanderi* that was growing right beside a flat of *S. petersonii*, a beautiful pink-flowered species from the eastern Great Basin. When the seedlings bloomed, I was surprised to find that I had a whole range of "bee hybrids," some of which looked much like *S. petersonii* only with lighter shading, and others which were much like *S. hookeri* only with very narrow petals. All these hybrids are sterile and produce a very long and prolific bloom. *Silene hookeri* subsp. *pulverulenta* sometimes produces flowers of so dark a pink that they are nearly red. All forms of *S. hookeri* that I grow make good seed in cultivation, especially if hand-pollinated, and the seed generally germinates well with stratification. Cuttings also root reasonably well when taken in early spring, but not much cutting material is produced.

Collomia debilis var. *larsenii* is commonly found growing in volcanic screes at high elevation in the mountains of western North America. It's a real jewel that always makes me stop in my tracks and take time to admire it. This phlox relative has sticky, highly scented foliage and covers itself in bloom in late spring and

early summer in the garden. It makes a good pot plant under cover but does not do well in my climate in the open sand beds or troughs. *C. debilis* var. *debilis* is a slightly larger form that does very well in the open and even self-sows. Both varieties make plenty of seed, so this is the preferred means of propagation.

Clematis columbiana var. *tenuiloba* (photo, p. 147) is the smallest of the western American clematis and certainly the most beautiful. It is found at alpine elevations in the mountains of Montana and extends eastward into the Dakotas. The nodding purple blooms are reminiscent of a *Pulsatilla* and are often produced in great numbers. It also bears ornamental seed heads. I like to grow it in a large, deep pot, and I have also seen beautiful plants running about through large troughs. My plant benefits from repotting every few years. This is easily grown from seed when given stratification, and internodal cuttings usually root well when taken after the plant has bloomed.

Epilobium obcordatum (photo, p. 133) is a small mat-forming species found at alpine to subalpine elevations in parts of the northern to central Great Basin, mostly in rocky areas. I really like the fact that this is a summer bloomer, which adds a lot of color to my sand beds at a quiet time of year. It likes full sun and also does well in a trough or pots. The only real problem that I have with this plant is that it can be attacked by rusts during damp periods, a problem with all members of this genus. This species produces lots of seed, which is easy to grow, and cuttings taken in the fall root fairly well. Potted plants can be divided in early spring.

The small aquilegias add a lot of interest to our troughs and raised beds and also make interesting pot plants. My favorite of the western American species is *Aquilegia scopulorum*. Its flowers range from blue to white, with intermediate color combinations as well. A typical plant is only about 3 inches/7.5 cm high when bearing its flowers, which are about as long as the plant is high. *Aquilegia scopulorum* in its various forms is found throughout the eastern Great Basin, and the Snake Range of Nevada is known as home to some interesting color forms. My violet and white form came from this area, and I have found that the color forms will come quite true from seed if they are kept isolated from other forms during the bloom season. I grow this species in sunny crevices in my sand beds, where it makes very long-lived plants; I even have some growing in the walls surrounding the sand beds. They also do very well in troughs and pots when given plenty of sun and sharp drainage. Propagation is by seed, which needs stratification.

I find that a few ferns scattered about in the rockwork of my sand beds and troughs add a lot of interest and elicits many comments from visitors. *Cheilanthes fendleri* is the best of the rock ferns for the open garden in my climate. It comes from the southern Rockies of Colorado and Arizona, where it grows in dry, rocky areas. I plant it in sunny crevices of the sand beds where the roots can remain shaded from the hottest sun, and it will fill a crevice over a few years. Propagation is best accomplished by simple division.

Penstemons are an important part of my garden, and I make heavy use of them in the sand beds, troughs, and alpine house, where they provide a wonderful range of color and form throughout spring and early summer, and often a bonus fall rebloom. *Penstemon davidsonii* var. *menziesii* is one of our most com-

mon species in Washington and one of my favorites. The mats of dark green foliage are attractive all year, and the large, plentiful blooms sit right down on the mat. This species is found in the mountains from British Columbia to California and is an easy-to-please garden plant when given good drainage and full sun. Many variations of foliage and bloom are found in nature. I found an especially large-flowered, soft pink form near Mt. Rainier some years ago that has proven a very good garden plant.

No other penstemon has such bright pink blooms as *P. rupicola*, another real favorite. This is not as easy to please as *P. davidsonii*, probably because in nature it is almost always found growing in cliffs or rock outcrops with perfect drainage, which is hard to provide in the garden. My best plant is growing right in a south-facing wall of a sand bed and has been healthy and happy there since 1993, producing good bloom year after year. *P. rupicola* has much the same distribution as *P. davidsonii*, and they hybridize both in nature and in the garden.

Penstemon procerus var. *tolmiei* is found in the Cascade Mountains of Washington and southern British Columbia and also in the Olympics. One of its best features is the range of colors produced in nature, from bright electric blues to pure white and all shades and colors in between. I found a very unusual pink form on Hawkeye Peak in the Goat Rocks and offer it under the cultivar name 'Hawkeye'. It is only 3 or 4 inches high in bloom and produces masses of flowers when well grown. It thrives in my sunny sand beds and in troughs. Another surprising feature of this cultivar is its sweet fragrance, unusual in *Penstemon*.

I find *Penstemon crandallii* to be a long-lived, easily grown dwarf penstemon, valuable for its rich blue blooms and neat habit. It is a perfect choice for a sunny trough or sand bed with good drainage. It forms a cushion of narrow green foliage and holds its blooms on short stems. It comes from the southern Great Basin.

All penstemons are easy to grow from seed with stratification, and a wide range of seeds is usually offered by Northwest Native Seed and Alplains as well as other seed companies and exchanges. Most will bloom in their second year from sowing. Basal cuttings of almost all species root well for me when taken in spring before bloom is set. I root mine in covered propagators or even in covered 6-inch pots. All the mat-forming species root as they spread and are easy from division. So if you have a sunny rock garden, you have no excuse if you fail to fill it with plenty of penstemons.

Hymenoxys lapidicola is a fairly recently described species from Utah that makes a grand specimen in a trough or pot. I cannot get this little beauty to survive the winter in our climate without cover unless I grow it in a vertical south-facing crevice, and even then it is not nearly as beautiful as when given winter cover. This species is reportedly found only on sunny sandstone flats at about 7000 feet on Blue Mountain in Utah. In cultivation, it forms dense, tight domes of narrow green foliage with 1-inch yellow daisies sitting right down on the cushion. I have only been able to root a few cuttings of this species; most cuttings rot before they root. It also seems to be self-infertile, as I get good seed only when I hand-pollinate two plants. I sow my seed on the surface of some pumice or grit over my normal potting mix just as soon as the seed is ripe. The seed germinates well in a few weeks and continues to germinate erratically for at least two years.

Hulsea nana is one of those plants you think you just have to grow the minute you first see them in nature. It is found in high-elevation volcanic scree and rocky snowmelt areas from southern Washington to California. The silver-hairy buds emerge from a cushion of silver-hairy, succulent foliage and open to bright yellow daisies. The entire cushion is only 3 or 4 inches high in bloom. Although this beautiful plant makes plenty of seed and the seed is easy to germinate and grow, I have found it impossible to come even close to keeping it in character in cultivation. The leaves and stems etiolate to such an extent that you would never recognize the plant. Here is a real challenge for someone to overcome.

I would also love to be able to grow *Senecio neowebsteri*, but this is another one that has eluded cultivation, for quite a different reason than *Hulsea nana*. *S. neowebsteri* grows only in a restricted area in Olympic National Park, so seed has never been made generally available. It inhabits north- and east-facing slopes at about 5000 feet in rocks and sandy soil. The large, single, yellow blooms are slightly pendent and are held on strong stems over tufts of very attractive toothed foliage. The plant is about 6 inches high in flower. Overall, it looks much like its near relatives from the Himalaya, *Cremanthodium*. Judging by the site and climate, I think it would be no problem to grow if material ever became available. I know of no other North American plant quite like it.

Another choice resident of the Olympics is *Synthyris pinnatifida* var. *lanuginosa*. It makes clumps of crinkled, silver-gray foliage with brittle stems. The beautiful blue flowers are held on 4-inch stems and appear in March in the alpine house. I have grown one plant for over ten years now and find it trouble-free in a very well drained potting mix. I replot it about every two years and make divisions when I replot. It is found in nature on rocky ridgetops at about 6000 feet. My plant has never set seed, but wild-collected seed germinates well with stratification, and the resulting plants are easy to grow on under cover.

Calyptridium umbellatum has been a favorite of mine ever since I first saw it in the Washington Cascades. This striking plant usually grows in sandy soils at subalpine elevations but sometimes makes its way up very high, while retaining its preference for sandy areas. The rosettes of spatulate leaves spread to form small mats. The blooms can range from white to pink and in really good forms almost red. It blooms well in sunny sites in my sand beds. Only a few inches high, it rarely flowers more than once in cultivation but usually sets plenty of seed, which germinates well in spring when sown in fall or winter. This species ranges from British Columbia to California and east to the Rocky Mountains.

Anemone drummondii is seldom seen in cultivation but is widespread throughout the mountains of the Pacific Northwest at subalpine to alpine elevations, in rocky areas or on exposed ridges. The attractive dark green foliage is shiny and finely divided. The white blooms open from blue-tinged buds held on 5-inch stems, which elongate as the seed ripens. I like to grow it in cool crevices in the sand beds and troughs, where it makes a slow but steady spread. The cotton-coated seed is easy to germinate without stratification, and the plant even self-sows a bit. I came across an odd double form of *A. drummondii* while hiking on

Mt. Bigelow on my way to view *Eritrichium nanum*. It was a small plant with no cutting material available, so I was not able to bring it into cultivation.

Although western North America is not known for an abundance of choice campanulas, we do have a few that are well worth growing. *Campanula scabrella* makes its home in hot volcanic screes at high elevations from Washington to California, often growing in the company of *Eriogonum ovalifolium* and *Phacelia sericea*. It spreads underground via stolons and can make quite extensive colonies in nature. The narrow foliage has a nice silver-gray cast and the blooms are lavender-blue. The plant is only 2 or 3 inches high in flower. I have come across pure white and ice-blue forms as well. This is not an easy species in the open garden unless you live in a very dry climate, because slugs and fungus both find the plant very much to their liking. It does well in the alpine house but needs full sun and a very lean mix. I grow it right up against a south facing-window. It is not difficult from seed with stratification and even sets seed well in the alpine house. I have a vigorous hybrid from this species, but I don't have a clue what the pollen parent might have been. Established plants can be divided to increase your stock.

Campanula piperi is another first rate species, this one endemic to the Olympic Mountains in rocky areas and screes at high elevations, often with a western exposure. Like *C. scabrella*, it spreads by underground stolons and is only a few inches high in bloom. The foliage is small, shiny, and toothed, attractive when the plant is out of flower. The pretty star-shaped flowers are usually in shades of blue, but several white forms have been found in nature and are now in cultivation. I usually grow *C. piperi* as a potted plant in a hoop house, where it is no problem in a lean mix with plenty of pumice. I have also grown it in open sand beds, where it sometimes persists for two or three years before it falls prey to slugs or fungus. It does best in my sand beds in a sunny site in the company of rocks or in a crevice. Propagation is the same as for *C. scabrella*.

There are a number of attractive arenarias in western North America, and one of my favorites is *Arenaria obtusiloba*, which is found in rocky areas at high elevations from Alaska to California and eastward to the Rockies. It forms mats or attractive domed mounds in the garden and produces a heavy bloom of half-inch white flowers on 3-inch stems in late spring. I find it easy in sunny sand beds and also in troughs. Propagation is via seed sown in fall or winter or divisions made in early spring. Cuttings root well in early spring before bloom.

An unusual fully double form of *Arenaria rubella* was found by Steve Doonan of Grand Ridge Nursery and the late Dr. David Vesall while they were hiking in the Olympic Mountains. They chose the fitting name of 'Popcorn' for this clone. It makes mats of short, green needle-like foliage and does best for me in the open garden, in a cool crevice with a northern or eastern exposure. It also makes a very attractive pot specimen and is longer-lived in a pot with winter cover. The plant is strongly tap-rooted and so does not divide well, but cuttings taken in early spring and fall root fairly well.

Lewisia rediviva pops up everywhere on the east side of the Cascades and throughout the Great Basin, from low-elevation sagebrush areas to high mountains. It thrives in areas of low rainfall and goes completely dormant after blooming

in late May, only to begin new growth in the fall, putting on most of its growth in the winter. It does pretty well in my open sand beds without cover but blooms best when given winter cover. I grow this species from seed, which is produced best when I hand-pollinate. Colors range from rich dark pink to pure white.

Lewisia pygmaea is a tiny species, best appreciated when grown en masse. I leave its pot out in the open all year, and the plants seed a good bit each year, so the pot just gets better with age. This is quite variable and is the only lewisia native to Alaska. It ranges south to California and east to the Rockies. I find it very easy in the garden or a trough. Seed is produced in abundance and comes up well with stratification.

Lewisia disepala is closely related to *L. rediviva* and has much the same habit but is not so easy to please. It grows on exposed summits above Yosemite Valley on granite and goes dormant in summer after blooming. I grow it in shallow pots in a lean mix topped with granite grit. Care must be taken with watering while it is dormant or the plant will rot away. The whole plant is only a couple of inches high and produces cup-shaped pink flowers. Seed set is poor in cultivation, but seed germinates well with stratification.

Lewisia congdonii is another native of the west slopes of the Sierra Nevada in California, where it grows on cool cliffs and slopes that are wet in spring and dry in summer. It has rather long green leaves, thin and rather succulent to the touch. Some people call this the ugly duckling of the genus *Lewisia*, but I find it rather attractive with its pretty pink flowers held in clusters on 8- to 9-inch stems. It is easy species as a pot plant under cover, where I give it good sharp drainage and plenty of water in spring and winter but keep it barely moist in summer, when it goes more or less dormant. I have grown this lewisia in north-facing crevices in my sand beds, where it slowly lost vigor and eventually died after three years. I get some seed set on it and have a number of bee hybrids from this seed, some quite attractive and all evergreen. The plant can also be increased by careful division when dormant.

Many growers in the Pacific Northwest consider *Lewisia tweedyi* (p. 149) the premier alpine plant native to our part of the world, and it would be hard to argue otherwise. It grows in the Wenatchee Mountains of Washington and in a small area of the North Cascades and southern British Columbia, mostly at sub-alpine elevations in north- and east-facing rock outcrops and sometimes in open pine woodland. It has thick, fleshy leaves and large flowers, up to 3 inches across. Most are apricot to pink, with the occasional white-flowered plant. In cultivation it does best with some protection from winter wet in our climate; it can be grown under the protective eaves of a house or an overhanging conifer. It also makes a terrific, long-lived plant in a pot or trough. I grow almost all of my plants from seed, although cuttings root well when taken in spring and stuck in coarse sand or pumice. It is best to plant your seed in fall so that it gets a long period of stratification, as germination is erratic.

Southern California and Arizona are home to *Lewisia brachycalyx*, which grows mostly in high meadows where it never totally dries out in summer. The large, sessile blooms can be white, soft pink, or white with pink stripes. I grow it in pots under cover in a well-drained mix with some peat added. I keep my plants

well watered in spring and let them become just surface-dry before watering in summer and winter. Seed set is good, especially if you hand-pollinate, and seed germinates well with stratification over winter.

Western America is also well known for some lovely plants growing at sub-alpine elevations, which we often plant in our woodland gardens. *Erythronium revolutum* is a great favorite of mine for its beauty and ease of cultivation. It makes prodigious amounts of seed and will self-sow into a small colony in a few years from just a few plants. I collect my seeds and scatter them in areas of my woodland, and I now have hundreds of blooming plants in spring. The large pink flowers are usually held singly, but sometimes a plant will have two or more on a stem. The foliage on older plants exhibits lovely mottled patterns. I sow seed as soon as it ripens either directly into the garden or in deep pots or flats. The first-year plants look like grass; true leaves appear in the second year. It takes about four years to bloom from seed. *E. revolutum* ranges from British Columbia to northern California, in the coastal mountains and usually along streams.

Cypripedium montanum is one of our most beautiful hardy orchids, found from northern California to Canada and east to Wyoming in subalpine forest. It is wonderful that this and other *Cypripedium* species are now being made available as flask-grown plants so that we can all enjoy their great beauty in our gardens. I grow some of mine in a raised bed with *Meconopsis* and *Trillium* in an acidic mix of aged sawdust and pumice over a layer of pure sand. This bed is in a cool spot which becomes shaded about noon, and I never let it totally dry out in summer. The biggest problem is keeping the slugs at bay, but this is easier when the plants are grown in a raised bed. I also grow a number of cypripediums in large pots in a similar mix. Older plants can be divided to increase your stock.

One of my fondest memories of Alaska was seeing acres of *Rhododendron camtschaticum* in bloom in the hills around Nome. The plants were only a few inches high, with rose-pink flowers about 3 inches across. They slowly increase from underground suckers, and the foliage takes on colors of red to yellow in fall. I grow it in the same raised bed as the *Cypripedium* because it also likes a cool site with good drainage and never should dry out. The plant can be increased by cuttings taken in July or by removing small rooted pieces and treating them like cuttings until they are well established. Seed is often available through the seed exchanges and is a good although slow way to grow this species. I grow rhododendron seed in clear plastic containers, leaving the seedlings for a couple of years until I can line them out in large covered flats to grow for another year or two before moving them into individual pots. This tiny rhododendron is worth whatever trouble it takes to get it into your garden.

Rick Lupp is the proprietor of Mt. Tahoma Nursery in Graham, Washington, near Seattle and Mt. Rainier, where he propagates the choicest alpine plants of North America and the Old World. His growing skill is informed by his lifelong love of hiking and climbing, exploring the flora and their habitats. He is a frequent contributor to this journal, and his slide lectures are popular with NARGS chapters.

Western Alpines: Over There

Graham Nicholls

The last time I spoke to a NARGS conference was 12 years ago, in Asheville, North Carolina. On the Sunday we had a fashion parade, and everyone who was involved with the chapter had to come dressed as something related to gardening—and I was heavily disguised as the English Gardener. So tonight, for one night only, the English Gardener returns: I'm putting on my bowler hat.

We live in Tisbury in the southwest of England, a village that goes back to the year 900—almost as old as I am. It's near Bath. Our area gets annual rainfall of around 40 inches, most of which falls in November, December and January. Consequently, we can't grow many of the western North American plants outside; apart from the rainfall, there's high humidity. And what is snow? We very rarely see it! If you grow things like dionysias, you can almost see the *Botrytis* growing as you watch. So we've got to grow a lot of these western plants inside.

My garden is 300 feet long and 30 feet wide, and it's an L shape. We're on limey conditions, so I take lots and lots of grit and just dig it into the soil and hope the plants will grow. I have a raised alpine bed, and I've recently added a sort of crevice garden based on the Czech style and my own interpretation of that—which is a bit poor, but I grow lots of plants there. I've also got a sand bed like those described by Rick Lupp in this issue.

In those beds I grow a wide range of plants. I find I can grow eriogonums outside pretty easily, such as *Eriogonum caespitosum*; if I try to grow this indoors under glass, the stems get very long, but outside, as long as it has a deep root run it's pretty good. *Penstemon pinifolius* 'Mersea Yellow' was raised in the UK, and the red form of *P. pinifolius* grows easily outside although it comes from New Mexico. Propagation is by taking cuttings, and sometimes the red form will layer itself. One of the easiest penstemons of all must be *P. hirsutus* var. *pygmaeus*. Propagation is by seed: all the seedlings are *hirsutus*, but not so many are *pygmaeus*, so you have to rogue out the large forms. (Anyone who grows from seed has his own way of bringing up the seedlings, pricking out the ones he wants, throwing the others away, or taking them down to the local chapter plant sale and hoping somebody's going to pay a couple of dollars for them.) There's a white form of this latter species, and it comes true from seed. Like the purple form, some are short and some are tall.

Penstemon confertus is yellow-flowered and grows well in spite of our wet winters. The stems root as they go along, making propagation easy, and I also get plenty of seed. I always make sure I sow penstemon seed before the end of the year. *Penstemon davidsonii* I find an excellent plant to grow in the rock garden or in a trough. I don't bother with collecting seed because the stems root as they go along, so all I do is take "Irishman's cuttings" and pot those up.

Many people sow the seed of dodecatheon and after a couple of years they think there's nothing growing and turn the pot out, and they find there's no roots and throw it away. But you've got to remember that the roots are very small, short and near the surface. I grow *Dodecatheon* seedlings on in a pot for about three years and plant them all out together in one clump. Later I can stick them about as I want. *Dodecatheon pulchellum* 'Redwings' is a good example of this.

Some *Lewisia* species are difficult for me, but 'Pinkie', a hybrid, is one I can grow: a marvelous pink, and easy propagation by side rosettes. Any of the lewisias that have *L. columbiana* ancestry will grow perfectly all right for us. I've got *L. columbiana* crossed with *Lewisia* 'George Henley', which has smaller flowers but a beautiful carmine color—a lovely plant, and so easy.

Silene acaulis doesn't always flower as well as on Pike's Peak. Still, it's an easy plant to grow outside. Propagation is by cuttings after it's finished flowering.

Clematis columbiana 'Ylva' is a UK selection from seed. I grow all mine from seed, but propagation is also possible from rooted side shoots. If you've got a good color form, just cut the shoots off and pot them up. It's a very nice plant for a trough or a pot.

I grew the red form of *Anemone multifida* from seed somebody sent me from Ireland. When you collect seed from this variable, widespread species, all the seedlings will come true to color.

Once you progress from growing easy plants in the garden, you want to grow some of the rarer ones, the more difficult ones. You can collect seed in the wild if you want, collect your own seed, or there are plenty of seed lists around—Ron Ratko, Rocky Mountain, Sally Walker, Alplains, all great lists—so you can get many rare plants that way. If you turn to general commercial suppliers and exchanges rather than the specialists I mentioned, whatever you ask for, you don't always get. The specialists have a reputation to keep up, but even with them there can be mistakes. For example seed of "*Eritrichium nanum*" turned out to be *Silene acaulis*, and a request for *Aquilegia jonesii* resulted in *Penstemon alamosensis*—a nice plant, but not the one I ordered.

Now we progress from the open garden to troughs. Make your own troughs; NARGS has produced an excellent booklet. You can buy them too. When I give groups an introduction to alpinines, I always finish up with troughs, so it ends up with my having to cart a trough home. But this gives me a chance to put some of the rarer plants there. I can plant all these western alpinines there, grow them on through the winter, and see how they go. In the AGS shows we have a class for miniature gardens, and it draws some beautiful exhibits, but if you put them outside the wind and the weather can damage them, so you keep them indoors or just in a cold frame.

Or if you've got an odd Roman coffin knocking around, you can plant it up. You can grow plants in all sorts of containers.

Once you have your seed, you have to sow it. I try to sow as soon as possible and in the past left all the pots facing the winter weather, bringing them into the alpine house once germination had taken place. With the climate changing, now we have very few frosts and autumn brings us almost monsoon-like conditions. With this in mind, I have lately been leaving seed sowing until spring, or sowing in the autumn and putting the pots under cover instead of leaving them outside.

So what about what you can't grow in troughs? Some of the plants I've grown from seed I put in troughs. One is *Douglasia laevigata* Gothenburg Form, which comes true from seed, though too many plants are floating around under that name because seed-grown plants appear to be the same as the parent. Propagation is from seed or removed rosettes. A lovely penstemon for troughs is *Penstemon leiophyllus* var. *francisci-pennellii*. I had one growing in the garden that was only about 3 inches tall, the smallest penstemon I've ever grown outside. So I dug it up, put it in a pot, thinking it would make a great show plant; it never flowered for five years, and then it died. So there's a moral there: don't dig it up.

I grow a nice range of aquilegias. A lot of the species aquilegias don't hybridize. *Aquilegia laramiensis*, a nice one from the Laramie Mountains, about 6 inches tall, comes true from seed. When you collect seed from aquilegias, you'll find that the pod is green at first, and as the gloss lessens it becomes dark green and then starts to go brown; that's when you collect the seed. If you leave the pod until it goes entirely brown, all the seed will be gone, so collect it when it's still sticky. *Aquilegia scopulorum* has a beautiful form, with blue spurs and a lovely white interior. I find that *Aquilegia coerulea* needs to stay in the pot about two years before I can plant it out.

There's a wide range of primroses we grow, but the problem is getting seed from them. The easiest one, *Primula ellisiae* also known as *P. rusbyi*, and all the other American primulas except one go dormant after they flower. Once the weather gets hot, snowmelt is gone, the ground gets hard, and they disappear below ground. Only *P. suffrutescens* is evergreen. But in the UK we keep watering *P. ellisiae* in a pot, we want to keep it growing for some reason, and so it stays green right into the autumn when in nature it would be down underground. I have one out in the open in a trough with the rainfall on it all through the winter but still it flowers OK in the spring or early summer.

Silene hookeri var. *ingramii* must be the deepest pink there is in silenes, a superb thing. The only problem with this is slugs. If I want to collect seed from it I haven't got to hand-pollinate; it will automatically set seed. As soon as the flower dies and you feel the calyx is nice and fat, you can harvest and sow the seed when it's ripe. It germinates sometimes in the autumn but always in the spring, and with all these silenes it's quite likely that you'll get flowers on them in the same year they germinate, though they're perennial, not annual.

I grow *Townsendia rothrockii* in the crevice garden and in a trough. It has lovely big flowers. If you sow townsendia seed as soon as it is ripe it germinates pretty

quickly, usually within the next few weeks. This species is very easy to grow, but many others are a bit more difficult.

If you grow plants from seed, remember that I mentioned selection, and *Eriogonum thymoides* is a good example. On one occasion I grew a pot of them from seed and I had one that was showing growth like a tiny bush, so I selected that for showing—and all the others that were growing up straight I put out for sale. The selected seedling eventually grew into a small dome spreading outward, and it's a fantastic form.

Phlox kelseyi 'Lemhi Purple' must be the best phlox introduction we've had for years and years. Propagation is very easy. If you collect seed from it, the seedlings range from very tight, compact forms to forms that have long stems, but the flowers always appear the same, a deep purple with a yellow eye. It will propagate from layers, so quite often now I don't take any cuttings at all; I just give it a trim in the autumn and stick bunches of trimmed stems into a pot of compost and give it a watering and leave it, and by spring all those have rooted. And then I sell them at an exorbitant fee so I can come over to America, of course.

Now we turn to alpine houses. Suffice to say an alpine house is a greenhouse with extra ventilation. You can inherit an alpine house, as I did, or you can build your own. Leave some of the panes of glass out for ventilation and maybe have fans blowing through it. Once you've got this cover, you can grow some of the rarer and more difficult plants. We appreciate that because of our heavy rainfall, since some of the desert plants have to stay dry over winter.

I show a lot of plants, and many of my customers are also exhibitors. Here are a few species I grow and show. There are two forms of *Penstemon eriantherus*, one with smooth leaves and the other with hairy leaves, and I grow the latter. I don't know why I grow this, because on the Friday before the show, all the tiny black flies in the district come around and stick onto the leaves, and while you're cleaning off the pots you find all these little black things in the hairs. But *P. eriantherus* is a wonderful plant, and there's a dwarf form too. Propagation is by seed. All the stems have flowers and thus aren't suitable for cuttings, so you have to collect your own seed or get it from a seed list.

Penstemon thompsoniae (photo, p. 138) is a beautiful plant for exhibition. It flowers and flowers and flowers. Each flower only lasts 2 or 3 days, so it must be continually deadheaded. It sets plenty of seed as well as running along the surface, so you get Irishman's cuttings. It's quite a difficult one to grow in a pot; I found it sometimes collapses for no reason at all. It's got a mind of its own.

Anyone who's seen my plant list will know that my logo is *Penstemon grahamii*. It's easy to grow but difficult to propagate, because what seed is set in cultivation rarely germinates. I've had seed from professional lists and very little of that has germinated. I've tried taking cuttings, but because all the stems have flowers, none of them wanted to root. What a lovely thing it is, though, so try and grow it.

Now we go to what some botanists call *Tetraneuris*. Have you heard such a name? It sounds like a dinosaur, doesn't it? This is *Hymenoxys* to us—*Hymenoxys acaulis* var. *caespitosa*, a superb compact plant with silver leaves and stemless flowers.

I never get seed in cultivation. *Hymenoxys acaulis* var. *nana* from Ron Ratko's seed collection is much taller, but still a fantastic thing.

Now we go on to *Douglasia montana* (p. 130), which has to be grown under cover. I tried it outside and within two years it had died. The plant shown in my talk is double-potted. Sometimes when you put plants into shows in the three pan class, and you've got two 6-inch pots and one plant in a 3-inch pot, you drop the 3-inch into a 6-inch pot just to make it even. On other occasions you have a plant that doesn't like much moisture, so you double-pot it and water the medium between the two pots. The inner pot takes up the moisture, and you don't get any water on the plant's foliage and base. *Douglasia montana*, a beautiful thing, flowers all over. You can take cuttings from it or sow the seed, which is often set in cultivation.

Another douglasia is *D. nivalis*, the Chumstick form. Phyllis Gustafson had it for sale in the seed list she sent out for a few years. Seed is set in plenty, and all of the flowers are very similar, darkly shaded at the base of the petal.

Douglasia ochotensis comes from northwestern Alaska. There's only one clone in cultivation these days, and that came from Rick Lupp originally. Everyone propagated it, and cuttings were handed around in the UK. Last year mine set one seed, and that one seed germinated, when I left home the seedling was half an inch across, and when I get home it'll probably be curled up. But if it's still growing, we'll have two clones in the UK.

Now for "kit." Does everyone carry a penknife and two pieces of sandpaper? No? If you want to grow the peas—*Astragalus* or *Oxytropis*, for instance—you must do this. Forget the chemical seed germination aids we read about. If you collect large seeds like those of *Astragalus coccineus*, just chip a piece off each seed coat and then sow it. With the other, smaller seeds, put them between two pieces of sandpaper and rub them together for about 15 seconds. You'll find seed shoots out all over the place and you've got to pick it up and do it again, and by the time you've done that, the coat of the seed will be quite thin. You sow those seeds and give them plenty of moisture, and within six weeks I've had all the seeds germinate. But you've got to prick them out very early, because the roots get long very quickly. On many occasions all they've got is cotyledons on top, and the roots will be coming out of the pot. If you leave them any longer before pricking out, all the roots will get tangled and break when you empty the pot of seedlings out, and you won't have any plants grown from those seedlings. But once you've potted up and grown the plants on, you'll get wonderful things. *Astragalus detritalis* is another superb plant, as are *Oxytropis multiceps* and *O. nana*. Many *Oxytropis* species flower on the current year's growth, so after flowering and perhaps seed harvest, we have to chop the stems back to within an inch or so of the main stem, so they send out new green growth the following year.

One of my best eriogonums is *Eriogonum holmgrenii*. I've never collected seed from it and never been successful with cuttings, but it's excellent because it's got these lovely white flowers that age to a raspberry color. This is one for which you probably won't find seed available anywhere; it was available about ten years ago, so all I've got is two plants, the only two plants in the UK now. And I'm scared stiff! How can I propagate them?

Now we go on to campanulas. A word of warning: if you go up to Castle Lake in California looking for *Campanula shetleri* in April, you won't find it. But if you do hit it at the right time, you'll see a lovely plant. I grow it outside in a trough and also show it. If you collect seed from it, you get much variation in flower color, from white to dark blue. As for propagation apart from seed, it runs underground, so the top 2 inches of the compost has to be all grit. It's very easy as long as you have these 2 inches of grit so it can run.

Campanula piperi 'Townsend Violet' is one of Rick Lupp's introductions. It's a wonderful color, with violet flowers and a very dark stigma. It has set seed for me once, and a wide range of likely hybrids came from it, but it's so vigorous that I just divide it every spring. I knock out the pots when it starts to grow and pull pieces off and pot them up. 'Townsend Ridge', the white form, is just as vigorous, and I do exactly the same with it—and people throw money at me.

Most of you have seen *Monty Python*, haven't you? Have you ever thought that parrots, especially dead parrots, are somewhat like plants? You never know whether they're dead—or *resting*. A typical example is what happens when you grow lewisias in pots. If they overheat, the leaves start to go upward and get wrinkled, and so many people who see this for the first time sling a bucket of water over them, thinking that they need moisture. Well, actually what they're doing is going into near-dormancy because of the heat, and what they need is to be put in the shade, under the staging or somewhere else where it's cool, for a week or so just to get them back to growing properly. So many lewisias have been killed by being over-watered and not just given a rest.

If you want to grow lewisias from cuttings, take off a side rosette. My cutting compost is pure silver sand, very fine sand. I take these rosettes off in June and put them in the silver sand, and six weeks later they are rooted and potted on. *Lewisia rediviva* makes small green growth in fall, grows on through the winter, and as the leaves start to wither out come the flower stems. It sets its seed and then goes down below ground around the end of May and stays there until September. It doesn't want any water during that time or it will probably rot. Many people think they can't grow *L. rediviva*, but as long as you think about the dormant period, you can grow it. There are white forms, but if you collect or buy seed of *L. rediviva* 'Alba', there's no guarantee it will come white; quite often it will come pink. If you want a white one, you've have to grow *L. rediviva* var. *minor*, which incidentally I saw last year on Mt. Diablo near San Francisco. Seedlings from that one always comes white.

Lewisia kelloggii sets its seed in a capsule below ground so all the little critters dig it up and spread it around. That's a very difficult one to grow; even if you get a small plant, it may take several years before it flowers. I has to be grown like *L. rediviva*.

If you want a vulgar one, there's an Ashwood hybrid called 'Magenta Magic'. Many people want this for showing. Is the color vibrant, or is it terrible? One of the nicest hybrids is 'Patricia Forrest', one of its parents is *L. brachycalyx*. Rick says it's one of the best he's got. It's a beautiful color, and evergreen as well. Propagation is by side rosettes. There are only a few around, so we've got to keep it going.

You might also ask, "Is it dead or is it resting?" about *Penstemon hallii*. How many times have I cut pieces off this in the spring only to find it's green in the middle? This superb plant will root as it goes along, or it will set seed. It's one of the best penstemons I have, a nice plant for a trough or a pot in the alpine house.

I grow a couple of epilobiums. To propagate *Epilobium rigidum*, you've got to collect seed. All the stems have flowers and propagating material is almost impossible to find. The pod tends to split as soon as the flowers are gone, and you've got to get it before that. The seed are like parachutes and just drift away. *E. obcordatum* is totally different. It does set seed, but as the stems just flop over and root as they go along, it's much easier to propagate. The first will grow in a trough, but the other will just rot off outdoors, so I grow both of them under cover.

I was given *Talinum brevifolium* when I went to Arizona by someone who grew it there. It's easy in the alpine house. Propagation is by seed. When the flower is withered, the seed capsule is like a tiny ball bearing, and if you touch it when the seed is ripe, it will pop out everywhere, so you've got to put an envelope underneath it. It dies back to a central rootstock below ground, then comes into growth around early summer. 'Zoe' is a completely different talinum. It has rosettes, so propagate it by taking a rosette in very early spring and put it in sand, and by the end of the summer most likely you'll find it's got one flower on it.

Aquilegia scopulorum makes clumps of short-stemmed blue-and-white flowers. Propagate by seed collected as I mentioned earlier.

Silene hookeri var. *hookeri* is pale pink and sets seed without any hand pollination, and is quite easy in a pot. All these silenes come from a taproot, and seed must be sown early, as soon as it is ripe, for them to germinate the following year most likely in spring. *Silene bolanderi*, the white form, I have to hand-pollinate to get seed. It's a lovely show plant, but the trouble is that when you put it on a show bench and you've cleaned it completely, so there are no aphids at all, you turn your back on it and when you turn round, there are aphids again! They love this plant. So you wait until the judges are just about there, and then run away and hope that no aphid lands on it. It's a superb flower up close, a photographer's dream.

I also have to hand-pollinate *Silene hookeri* ssp. *pulverulenta*. On many of these silenes the calyx is very sticky, and I get sticky fingers when collecting seed, and the paintbrush sticks to the plant something terrible when hand pollenating. *Silene californica* has superb brick-red flowers. There is a form of this with stems about 12 inches long, but that's no good for exhibition. You need to select a plant with short stems. Sometimes you can take cuttings. If you scrape away the top surface of the compost you'll find that stems coming from a central rootstock have roots on the sides, so you can cut them off near the taproot and pot them up.

I was given some seed of *Townsendia exscapa* from Arizona. The flowers were 2 inches across, the most marvelous plant. I grew that on for two or three years, but eventually it died. I couldn't propagate it at all. Very little seed was set. A friend of mine took cuttings from it and rooted them before it died but all of his plants eventually died. This is one of the beautiful townsendias to grow.

Townsendia spathulata is from the Prior Mountains, one of the most difficult plants to grow in the genus. If you overwater it, it will rot off. If you don't water it enough, it'll rot off. I don't know why it rots off in both cases, but it does. It never set seed for me in cultivation. The seeds to grow this are collected in the wild. This year my plant was fantastic, but will it be there when I get home? It needs individual attention. Mine isn't double-potted, but I think it should be.

Phlox lanata is difficult to propagate, so I don't take cuttings from it at all now, I just hope to grow more from seed bought from commercial specialists. I cannot propagate *P. muscoides* either, but *P. hendersonii* I find an easy plant to increase. I lower it in the pot and cover it with grit compost in autumn, and by spring all the stems have rooted, and I snip them out and pot them up.

You all grow *Eritrichium nanum*, don't you? It's easy to grow as long as you give it a dry neck over winter, grow it indoors, with no water in winter but a little moisture at the roots, and it will come through the winter. It stays fairly evergreen for me and then comes into growth about March. As you can see there are various shades of blue. I found three different shades within a 10 foot square on Pike's Peak. *Eritrichium howardii* sets masses of seed and pulls back completely to tiny green rosettes in the winter. You think the plant is dead—it's all black—and then in early spring, as soon as you get a bit of sunshine, away it grows.

Viola flettii has a fleshy central rootstock. If you ever see a plant labeled as *V. flettii* without dark purple leaf veins, don't buy it. It comes into growth very late. If you water it too early it will rot off. *Viola beckwithii* is another superb thing. Propagate it by seed. The first year it sends up one cotyledon, the second year two leaves, and the third year—if your fingers are crossed and the wind's blowing in the right direction—it will flower for you. It's dormant in summer.

You've got to grow *Lepidium nanum* from seed with really coarse grit in the compost and plenty of hot sunshine, near the glass, to get a tight, dense dome. If you keep it within the middle of the alpine house, it will grow lean and lanky.

I think *Monardella macrantha* is the best monardella of all, a lovely red one. You can get seed, but propagate it by cuttings from around the edge. I find the cuttings root almost all year round.

Our meeting is in Utah, isn't it, and what do people come to Utah for? They come to see Zion, Bryce, and Arches, don't they? And if you go to Arches, go to the Fiery Furnace Wall. I recommend it—a nice easy but beautiful hike. You may see *Dodecatheon dentatum* var. *utahense*, difficult and like the previously mentioned dodecatheon one I propagate it by splitting it up, and *Townsendia mensana*. Among other plants from this region that I grow, there's *Penstemon acaulis*; grow it from seed, or occasionally the rosettes send down roots if you've got a big enough plant and are brave enough you can detach these rosettes and pot them up. I saw the little roots on my plant but I'm scared to cut it up. *Penstemon duchesnensis*, a lovely dwarf, is propagated by seed. *Penstemon uintabensis*, a tiny thing, is best in a trough, again propagated from seed. *Astragalus loanus* is one of the more difficult astragali, and would tend to rot off if it got too much moisture. *Aquilegia chrysantha* I photographed in Zion with water pouring all down it, so it needs more moisture than normal for aquilegias. In the wild *Aquilegia grahamii* grows

to 30 inches tall because it grows in shady canyons, but in cultivation short stemmed plants, about 8 inches tall, can be grown and come true from seed. On a visit to Blue Mountain, *Hymenoxys lapidicola* was in flower when everything else was in seed. *Eriogonum soledium* can collapse at any time. *Sphaeralcea caespitosa*: is it an annual or a short-lived perennial? Mine set plenty of seed but died in the winter, so I assume it's an annual. *Lepidium ostleri* is another from Utah. Grow it exactly the same as *L. nanum*. To propagate *Primula domensis*, split it up or collect seed; it's fairly easy to grow but it does go dormant in summer. *Gilia caespitosa* is a difficult plant tending to collapse suddenly but well worth growing for the lovely scarlet flowers.

Finally, those of you who were at the NARGS conference at Breckenridge were each given a plant of the true *Aquilegia saximontana* (photo, p. XX), a plant that is easy to grow and just needs a bit of care. I don't know about all the others, but my plant was flowering a couple of months ago in my alpine house.

Graham Nicholls is the proprietor of Graham's Hardy Plants in England and the author of *Alpine Plants of North America* (Timber Press, 2002) and *Dwarf Campanulas* (Timber, 2006). His plants have won three Farrer Medals at Alpine Garden Society shows, and he is now an AGS National Judge. He has lectured extensively in the UK, Ireland, and North America and frequently visits his favorite plants in their native lands.

The Wasatch Rock Garden

William Gray

Note: This article was submitted by the author as a condensed written version of his presentation.

Rock gardeners can be divided into two main groups, those who dig and those who watch. The former create breathtaking miniature landscapes with plants gathered from around the world. The latter, of whom I am one, prefer to visit other people's gardens, or better still to visit the plants in their native deserts and mountains. My own Wasatch "rock garden" is shared with thousands of others who do their various parts in protecting, weeding, maintaining trails, picking up litter, and so on. This talk is aimed at helping you appreciate what a wonderful garden lies right next to a big city.

Wasatch Mountains

The Wasatch Mountains of northern Utah can't really be considered a major range, but they are a treasure for naturalist and rock gardener alike. They span about 150 miles from Mt. Nebo (near the town of Nephi) to the Idaho border, with the Salt Lake and Utah valleys abutting the central section. A large fraction of Utah's 2 million people live in those valleys and elsewhere along the Wasatch Front. Dozens of peaks top 11,000 feet (3300 m), with most of those lying in the southern half. Correspondingly, a huge number of people live within half an hour's drive of prime mountain wildflower habitat.

To the west stretches the desert, 500 miles of mountain ranges, basins, and salt flats between here and the Sierra Nevada. The Wasatch is considered the most westerly range of the Rocky Mountains, rather than the most easterly of the Basin and Range province. One thing that sets it apart is the amount of precipitation, almost all of it in winter. At Snowbird and Alta in Little Cottonwood Canyon the average annual snowfall is nearly 500 inches (12 m), while the record is about double that; by contrast, summer rainfall is slight while irradiation is intense. Microclimates abound.

Add to this setting a rich geological history, and the scene is set for a tremendous diversity of plant life. A layer cake of rocks spanning more than 2 billion years was bowed upward by igneous intrusions. Later, stretching of the earth's crust to the west created the Wasatch Fault; many thousands of feet of vertical movement, and erosion of the softer rocks, give us a look at the now tilted layers of the cake. At Snowbird we are perched on the igneous dome, adjacent areas have 2 billion-year-old Precambrian rocks, and just a few miles north are limestones that are only 150 million years old. On a trip to Big Cottonwood Canyon immediately to the north of Little Cottonwood, we pass through spectacular upended strata. A great diversity of rocks can easily be seen from Snowbird—igneous rocks themselves, and shales, quartzites and limestones that have been transformed by contact with them.

Wasatch Plant Diversity

Utah as a whole, with its wide-ranging terrain and climate, has an impressive array of plants. Welsh in his 2003 edition of *A Utah Flora* lists almost 4000 taxa for the state. As one might expect, the flora is dominated by a combination of Rocky Mountain and Intermountain species, especially in the north.

Some years ago Beverly Albee and her colleagues at the Garrett Herbarium of the University of Utah created an *Atlas of the Vascular Plants of Utah* (1988) based on collection data for verified herbarium specimens. This was later digitized and made available on the Internet (see References below). Using this resource, I have measured plant species diversity in each 7.5-minute quadrangle for the whole state (1500 quads in all): five places score above 400 species. The Snowbird conference took place in the richest of all these places with more than 500 species, and three of the other four are immediately north and south of it. Of course, there is bias because collecting is focused near big university cities, but this represents an amazing display.

Some Special Places for Viewing Plants

To be honest, the local Wasatch is not great for truly alpine plants, using the criterion of "above timberline." Relatively small areas fit that category because timberline is mostly around 11,000 feet in this area. Still, we have a lot of land in the 8000 to 11,000 foot range, and it is there that the greatest display of flowers is to be found.

Mount Nebo. At close to 12,000 feet, Mt. Nebo dominates the southernmost section of the Wasatch. Relatively few people visit the higher areas, which are rather steep and forbidding—it is a 5-mile, 5000-foot elevation gain to reach the summit. I have not visited the upper parts myself, though wildflowers are reported as being wonderful. Within anybody's reach is the Mt. Nebo Loop, a drive along smaller roads that wind up to about 9000 feet through meadows of

lupine, paintbrush and penstemon. It is a favorite drive for the spectacular fall colors.

Mount Timpanogos. The second highest peak in the range, “Timp” extends its narrow 11,500-foot ridge for 4 miles, creating a huge wall to the east of the Utah Valley, just south of the Salt Lake City area. Hiking Timp was for many years almost a rite of passage, with huge parties organized. So much habitat damage resulted that the practice was banned, and a more civilized, appreciative group now makes the long trek. As on Mt. Nebo, the upper parts are very steep and rugged. However, there are excellent trails to take strong hikers to a series of alpine cirques at about 10,000 feet on the eastern side of the ridge. These have to be some of the best alpine flower gardens in Utah. Being cirques, they are concave, with plenty of moisture, rather than convex peaks with dry tundra. Consequently there are lush meadows of lupine (*Lupinus argenteus*) and associated plants. A few small permanent snow patches create perennial streams along which can be found *Epilobium alpinum*, *Ligusticum filicinum*, the intense blue *Veronica wormskjoldii*, and many other wet-loving plants.

On the talus slopes around the bowls, and by the trail, are plants adapted for very different conditions. Some of these could be excellent choices for rock gardens and may already have been domesticated. Among my favorites are the dense mat formers such as *Phlox pulvinata* (photo, p. 148) and *Silene acaulis*—the latter also native to Britain and northern Europe. Another low-growing plant familiar to Europeans will be the little *Sibbaldia procumbens*, like a tiny cinquefoil. Less dainty than these and more sprawling are two that seem specialized for the unstable world of loose talus. *Penstemon montanus* displays large blue-lavender-pink flowers above a loose mat of serrated leaves. Truly outstanding is the *Collomia debilis*, a fairly close relative of *Gilia* (*Ipomopsis*). Although the overall habit is loose, the individual inflorescence is a dense cluster of blue, lavender, pink, or white funnel-shaped flowers, the anthers of which also come in various shades. It is quite an amazing sight on a bare rock slope. As on Mt. Nebo, good mountain roads enable one to visit mid-level elevations (up to about 8000 feet) by car to see wildflower meadows and fall colors.

The Cottonwood Canyons. Two major canyons that penetrate the Wasatch from the Salt Lake valley are Big and Little Cottonwood. They are the sites of old silver and gold mining activity, being located at the junction of igneous and sedimentary layers. Nowadays, gold is brought into the canyons by skiers who cherish the dry powder snow. Many peaks above 11,000 feet ring Little Cottonwood. As mentioned before, plant diversity is very high here. One little bit of true alpine tundra can be reached by moderate hiking from the top of the tram at Snowbird, but the area’s greatest wonder is the subalpine meadows in and around Albion Basin.

Riding the gondola takes you from Snowbird at 8000 feet to the top of Hidden Peak at 11,000 feet in a few minutes, with spectacular views of surrounding peaks, the glaciated trough of Little Cottonwood Canyon, the Salt Lake Valley, and a geology textbook of rocks. Construction of the lift facilities has severely degraded the top of Hidden Peak itself, but close by is some fine subalpine and

alpine terrain. From the tram station follow a gravel road down to a saddle: off to the right is Mineral Basin, a good area but not outstanding. As you continue along the saddle toward Mt. Baldy there are many subalpine plants, including the beautiful *Zigadenus elegans*. Just here it grows on dry windswept ridges, but at lower elevations it is taller and inhabits wet ground. I sometimes wonder whether they are really the same plant.

Beyond the saddle is Mt. Baldy, just topping 11,000 feet. This is a fairly small alpine summit, with the usual array of cushion plants, including *Phlox*, *Silene*, and *Draba*. It is also home to a rare local endemic, *Ivesia utahensis*, not to be confused with the abundant *Ivesia gordonii*. My favorite is Old Man of the Mountains (*Hymenoxys grandiflora*), nestling by a fine *Lupinus argenteus*. Across the canyon is Mt. Superior with its massive cap of reddish quartzite resting on pale gray granite. On the back side of Superior, in Big Cottonwood Canyon, the quartzite is polished and broken, creating wonderful niches for rock plants.

In normal years one can hike down Peruvian Gulch back to Snowbird, with the expectation of seeing well over a hundred species in bloom. However, the trail was closed in 2006 for major ski industry construction. The alternative Gad Valley trail is rather steep, with loose footing, and not recommended except for strong hikers.

One thing that makes the Albion Basin special is the fact that it can be reached directly by car, so the meadows are accessible to walkers of all abilities. There is even a drive-in campground at 9400 feet. A busy day flower-watching in and around the basin can turn up over a hundred species. Surrounding Albion Basin are high cliffs, predominantly of limestone, variously modified by contact with the hot igneous rocks. The basin proper contains great meadows, replete with *Mertensia ciliata*, its soft blue flowers set off by smoky blue leaves, *Castilleja rhexifolia* in pink, purplish, or yellow, and the marvelous 4-foot spikes of *Swertia radiata*. A fascinating aspect of *Swertia* is that the topmost, terminal flower can have from 3 to 6 petals, while all others seem invariably to have four. *Polemonium foliosissimum* is an abundant, tall, white-flowered Jacob's-ladder, very handsome. Huge limestone boulders dot the area, some with the delicate *Chaenactis alpina* growing on the sheer sides. Tucked away in a few corners are species of *Mimulus*, *Saxifraga*, and similar wet-loving plants. The local endemic *Erigeron garrettii* is also found here.

A very gentle hike runs from the road's end, traversing the meadows and climbing a few hundred feet to Cecret Lake (a 19th-century miner's misspelling). An intermediate hike is up to Katherine's Pass, the divide between Little and Big Cottonwood canyons, and back. Just up from the pass itself is Sunset Peak, where *Townsendia montana* can be found. More adventurous hikers continue over the top and down into Big Cottonwood to a trailhead at Brighton.

Along the drier slopes on all the hikes can be found the very showy *Castilleja applegatei*, *Orthocarpus tolmiei*, yellow *Linum kingii*, and *Linanthastrum nuttallianum*. The last two could make fine rock garden plants with their compact habit and plentiful, showy flowers.

North of Little Cottonwood is Big Cottonwood Canyon, site of the town of Brighton (8700 feet). The road up to it passes through variously tilted layers of

Precambrian shales and quartzites, among the most spectacular geological formations in the Wasatch, then through limestones, finally ending in the igneous layers. Polished by glaciers, the rosy quartzites provide niches for plants such as *Sedum lanceolatum*, *Zauschneria latifolia*, and *Selaginella watsonii*. Brighton is lower than Albion Basin and much more developed. Several nearby lakes provide easy walks to view meadows of flowers broadly similar to those found in Albion Basin.

In late July most of the snow patches will have melted, even on north-facing slopes. An exception may be the area around Lake Katherine. These little patches are home to some of the prettiest “snow-chasers,” plants that do well in the short-lived moisture that drains from melting snowbanks. Favorites among these include the amazing *Dicentra uniflora*, *Claytonia lanceolata*, *Erythronium grandiflorum*, *Mertensia brevistyla*, and *Ranunculus adoneus*. The first three of these bloom in March-April in the foothills around the Salt Lake Valley, and in July at Albion Basin.

Snow Basin, about 90 minutes’ drive from Snowbird, was a major site for the 2002 Winter Olympics skiing events. It lies on the eastern flank of Mt. Ogden (9600 feet). Like many other ski areas, it doubles as a summer resort, with a gondola taking passengers to about 8700 feet, out of the heat of the valleys. Easy hiking trails allow access to small cirques, meadows, and mountain brush communities with plenty of flowers. Some fine plants known from here include *Clematis hirsutissima*, *Calochortus nuttallii*, a pink variety of *Orthocarpus tolmiei*, and *Zauschneria latifolia*.

Plant Information Resources

This section includes only information about native and naturalized plants, not those available for cultivation. Three sources have been mentioned already in the text: the excellent *A Utah Flora*, covering the whole state, and the paper and digital versions of *An Atlas of the Vascular Plants of Utah*. Utah is wholly contained within the Intermountain Region as defined for the purposes of *Intermountain Flora*, a wonderful six-volume series from the New York Botanical Garden. All but one of the volumes is complete, with line drawings of all species.

For the central Wasatch area a detailed flora was produced by Lois Arnow and her colleagues. This is unfortunately out of print, but a major new edition is in progress. Based on Arnow’s book I produced an interactive CD with keys and thousands of photographs, available through the NARGS Book Service.

Just recently (July 2006), two new resources became available. First, the U.S. Forest Service made public a new website where one can access checklists and information about especially good wildflower viewing areas. There is an excellent list for Albion Basin, not comprehensive but covering the plants most likely to be seen by visitors. Second, the nonprofit Cottonwood Canyons Foundation has just produced an excellent guide to the more colorful flowers of the area.

Acknowledgments

I thank the many friends and colleagues in the Utah Native Plant Society and Wasatch Chapter of NARGS for sharing their love of our native plants. Without their efforts over many years there would be much less for us to enjoy. Special thanks go to my wife Sylvia, with whom I have hiked, birded, and “flower-watched” our wonderful trails over more than three decades.

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Dr. William R. Gray was born in England and received his degrees in biochemistry at Cambridge, becoming the author of more than 100 scientific papers in that field. He came to the United States in 1964 and was professor of biology at the University of Utah. Now retired, he enjoys photographing and mapping the plants of Utah and is current co-president of the Utah Native Plant Society.

Some Plants of Southern Utah

Elizabeth Neese

Note: The following article is an edited transcript of Dr. Neese's oral presentation.

The Country

When I was asked to talk about plants of southern Utah, it took me rather Waback: there are over 1500 taxa in southern Utah alone. So I want to discuss the phytogeographic areas of Utah and the plants that live in them, and then look at some of the representative plants in their habitats in those phytogeographic areas.

In terms of distribution, I will describe mostly the areas where I've seen specific plants rather than over their entire ranges. The very best thing to get for studying the plants in Utah is the *Atlas of Utah Vascular Plants* by Beverly Albee. It has a map of the state with dots for every known collection site for that species. This was done some years ago, so there are new distributions recognized now, but you can turn to any species and it will tell you the general vegetation type it's in and whether it's an annual or a perennial, and whether it's spread all over Utah or is a narrow endemic. The other great reference work here is the *Utah Flora* by Stan Welsh and others. The third edition has quite a few new taxa in it, and it's a wonderful job, especially the introductory material about the setting, the vegetation, and the geology. Dr. Welsh says that in Utah particularly, perhaps more than in most of the world, geology is a controlling factor, and you can't really learn the plants if you don't know the geology. And fortunately, in southern Utah this geology simply shouts at you. Once you have a geology map showing the different strata, you can learn the sites and go over to the next county, east or west or north or south, observing how the geological formations peter out and crop up, and soon you're set in terms of doing floristics in Utah.

Our conference site, Snowbird, is in the Wasatch Mountains, and the Wasatch Plateau continues southward. The southern field party will go down to the Markagunt Plateau and the Tushar Mountains, and Red Canyon and Bryce Canyon. The canyonlands are entrenched in all these various strata discussed by Dr. Parry: the sandstones, the mudstones, the siltstones, the clays, all isolated

more or less from each other because the area has been dissected by copious streams coming off the Colorado Plateau. The Colorado Plateau gradually uplifted a couple of miles or even more, and as it was uplifting it was eroding; it eroded all to the west, at least so far as relates to Utah, and cut into all those strata, exposing them at different elevational levels. That is why there is so much endemism in the southern canyonlands—because of the removal of all of the detritus that came off the Colorado Plateau, washing down the Colorado River. The Great Basin, in contrast, is landlocked: it does not drain to the ocean. The mountains there are old, but they have their feet buried in their own detritus, which has eroded off them and accumulated in the valleys. That is why the valleys are saline, gypsiferous, and almost all recent alluvium.

The Utah plateaus essentially start at the Wasatch Plateau and continue south through the Aquarius Plateau, the Markagunt, the Paunsaugunt, and Kaibab plateaus. These plateaus are held up by resistant strata that have the cliff systems cut into their sides as the softer strata erode toward the Colorado River. Then in the southwestern part of the state we have the intrusion of the Mohave Desert. The Ruby Mountains are in the Great Basin. Great Basin National Monument is just over the Utah border to the west, and from there over to the California border is the Basin and Range territory.

A ridge of Precambrian quartzite runs almost the entire length of the Uinta Basin, and there are not many endemics up there. One endemic is *Penstemon uintabensis*, an absolutely wonderful-looking rock garden plant. I worked on part of an inventory of the high-elevation lakes because they were going to stabilize them as they were building lower reservoirs. We got to go in by horse and hike over all of these areas looking for rare plants. Argyle Ridge at the south end of the Uinta Basin shows the Green River shales. On the breaks along the top of the ridge there are wonderful erigerons and some endemics. In contrast is the Mancos Shale, laid down much earlier, in the Hanksville area. The Mancos Shale looks very barren, but it does harbor some rare plants too. The Wingate Sandstone is a massive cliff former around Lake Powell and the Escalante drainage and Coyote Canyon, and here in the rocks we can see the drifted pattern of ancient sand dunes. This is the stratum that contributed a lot of sand to the area, the coral-pink sand dunes, and quite a lot of areas here have really lovely sand-loving plants.

The field trip is going to Cedar Breaks and Bryce Canyon. Where the Breaks come off, the Claron formation is exposed with its suite of rare plants. Vegetation over the Utah plateaus is principally across the top: ponderosa pine and aspen, and a little higher the firs and spruces, and then the highest peaks have beautiful tundra with good plants. I hope you go up to the summit of Bryan Head rather than just stopping at the overlook, because the summit is where you see the good plants. There will be a lot of limber pine (*Pinus flexilis*, so called because you can tie knots in the slender branchlets, and they do not break); it resembles the bristlecone pine (*P. aristata*), which is there too.

Moving into the Basin and Range, Great Basin National Park contains the highest point in Nevada, Mt. Wheeler. I climbed it on July 4 one year in a snow-storm. There's bristlecone pine there too. The White Mountains on the

Nevada/California border rise over 13,000 feet. They are extremely arid, but up at treeline there are more bun plants, more dwarf plants, than I've ever seen any place else together, in terms of number of taxa. If you ever get a chance to go to the White Mountains do it, because that is where the Bristlecone National Monument is, for one thing. The bristlecone pine there is a different species (*P. longaeva*) than the one in Colorado.

The Plants

The sunflower *Helianthus annuus* is native here, and it's a dead lookalike for an endemic in the sands just north of Lake Powell, *Helianthus anomalus*. You can't really tell them apart until you learn whether the bracts are linear or ovoid. We have some other big sunflower-like plants down in the sandy areas, too. One of them is *Wyethia scabra*, which grows in deep sand in the Hanksville area; it doesn't look like a good rock garden plant, but it's striking when you see it and it is restricted to that area in the sand. Another of the great large sunflowers is *Enceliopsis covillei*, which occurs just west of Death Valley and is called the Panamint daisy. A plant of Utah that would be a lot better for rock gardeners is *Enceliopsis nudicaulis*, which grows through most of the southern third of Utah in fines and badland soils; it is not that limited to special soils. *Hymenoxys acaulis* is a lovely thing in the rock garden. *Hymenoxys lapidicola* grows in vertical crevices in the Weaver sandstone, not in the high mountains but in the lower-elevation Diamond Plateau margins at the south end of the Uinta Mountains. It became famous for a while in England, I understand. A few more yellow composites are *Haplopappus armerioides* (*Haplopappus* and *Hymenoxys* look very similar), and *Haplopappus acaulis* (syn. *Stenotus acaulis*)—so we have both *Hymenoxys acaulis* and *Haplopappus acaulis*, which is a little confusing. Both of them make nice mounds. *Haplopappus clementis* grows on the Aquarius Plateau. *Chrysopsis jonesii* is very closely related to *C. villosa*, which is common in southwestern part of the state, but *C. jonesii* grows on the plateaus near Zion in sand, and is very appealing.

There are approximately 70 species of *Erigeron* in Utah, and almost all of them are beautiful enough to want in the garden. *Erigeron uncialis*, meaning one inch high, is a very dwarf one that grows on limestone cliffs. A colleague and I were searching for it for a rare plant study, but the plant we found was undescribed; it turned out to be *E. cavernii*, growing on Cave Mountain. Those are two Great Basin taxa. Very common on top of Brian Head in the Markagunt Plateau is *E. compositus*, one of the few species that has lobed leaves. Another one from the Markagunt is *E. flagellaris*, so called because of its whiplike stolons. Another one you might see is *E. utahensis*, which I photographed in Bryce Canyon. It is smaller than the others mentioned, but it makes quite a show in good years. *Erigeron pumilus* subsp. *concinnooides* is extremely widespread. There are quite a few subspecies, scattered all over the West, but in Utah we only have subsp. *concinnooides*. Sometimes the centers of the flowers vary from yellow to pink to purple in a calico effect, so it is a very pretty plant, although common.

Townsendia montana (photo, p. 148) occurs in the high Uintas and also in the high Tetons of Wyoming, an alpine plant. *Townsendia incana* is widespread, very pretty in some populations and in other places not so pretty. I photographed it growing in the sand on Canaan Mountain in Washington County, close to where *Penstemon eremophilus* grows. *Machaeranthera commixta* is limited to the Canyonlands area and down into Arizona; it blooms in the fall and forms great masses in good years, a beautiful thing.

Southern Utah has quite a few cacti. *Pediocactus simpsonii* is a montane species (one of the few such) and very widespread. It can get 4 or 5 or even more inches across, and I think it's fairly easily grown. *Echinocereus triglochidiatus* var. *melanocephalus* is called "dark-headed" because the buds are dark. I've seen mounds 4 or 5 feet across covered completely with flowers. This occurs in southern Utah, south central Utah, and central Utah just about to the Uinta Basin. There a couple of other varieties. Welsh says that the best population of it is almost on the Colorado border, at the base of the LaSalle Mountains. Almost all of them have no spines at all. However, there are occasional populations without spines throughout the distribution of var. *melanocephalus*, so Welsh treats the spineless one as not worthy of taxonomic designation. If you want to call it anything, call it forma *inermis*. When you see it, it looks so different you think it can't possibly be the same species. Another variety is var. *arizonica*; it doesn't really come into Utah—you see it on the rocky cliffs if you do a float trip down the Grand Canyon in Arizona—and it doesn't look much like var. *melanocephalus*.

Sclerocactus is a big group with quite a few narrow endemics. Everyone who works on it seems to come up with a different assemblage of names. *Sclerocactus parviflora* is usually pink, but there is a yellow form too. It has long, viciously hooked white spines. *Sclerocactus glaucus* has all straight spines; the central spines here are black and they arch upward, with no hooks at all. It was recorded from the mouth of Sand Wash on the Green River. People had looked for it hard and thought it might be extinct, so when I went down there looking for it, I looked around, and the only place you could get to was the floodplains along the river. Well, that's not where cacti grow. So I climbed up to the gravelly terraces just above the river, and it was all over. It was very satisfying. There is a form in the Uinta Basin that seems to bloom as a juvenile and has absolutely no spines; maybe it's just blooming before it develops the spines. There's another form that has a deep black, stiff, hooked spine one millimeter long at the center of the spine cluster. *Sclerocactus wrightii* is distinctive because of its vase-shaped flowers, which don't open up wide; it grows to a large extent on the Mancos Shale and on the surrounding gravel pediments, especially the Curtis formation. Walk up the drainage and find where there are little gravel beds related to the outwash, or if you're up on top go to the edge where there's a little gravel margin, and you'll find *Sclerocactus wrightii* over many geologic strata here, growing in gravels on top of very fine, shaly clay soil.

Pediocactus winkleri grows on Oystershell Reef just west of the Henry Mountains on the San Rafael Swell. It is very tiny: in a good year you can see it grow to a size bigger than a cherry but much smaller than a golf ball. Its little flowers are

usually a sort of peach color. The difficult thing about trying to do an inventory of it is that after it flowers, its husky taproot starts drying and shriveling, and it pulls the cactus down level with the surface of the soil; the little white areoles are indistinguishable from the litter on the ground, and it is very hard to find.

Opuntia fragilis is a very widespread taxon; it goes into the prairie states to the east. It has tiny pads, mostly looking just awful, growing on shallow soils where rocks are outcropping. You almost never see a bloom on it; it's the kind of thing that you want to never see again until you find a flower. This year there were some flowers at the summit of the Henry Mountains at the campground near the top. Another cactus, very little known, is *Opuntia pulchella*. It's not really a staghorn cactus, not really a *Platyopuntia*, and not a ball cactus; it's in a group of its own, with very short joints something like a *Cylindropuntia*. It grows mostly in sands accumulated on basaltic soils. It has very pretty flowers and is not very tall; I'm sure cactus specialists grow it.

Now I'll touch briefly on *Penstemon*. To review the characters by which penstemons are identified, the plants are obviously two-lipped. Is the staminode bearded or is it glabrous? Is the flower pubescent on the palate, or is it pubescent outside the flower? Is the inflorescence glandular? Are the anthers hairy or glabrous? How do they dehisce? It seems very difficult, but it isn't. The lovely things about penstemons are, first, that there's usually only a handful in a given area, and if you have a distribution map you can narrow your identification down a lot. The other thing is that the diagnostic characters are very good once you learn to see them (a dissecting microscope helps). With Noel Holmgren's wonderful keys they can be identified without too much trouble, with great confidence, if you know where they're from, because the local assemblage is very important.

Noel Holmgren talked about *Penstemon whippleanus* as one of the few tall plants of the upper montane community. He showed a dark purple one and a white one, and I've seen everything in between. There is no way you can make separate taxa out of these. It can often be a very dingy color with a non-compact habit and not very attractive, but when you find that deep purple one it is striking. *Penstemon petiolatus* grows in the limestone crevices in the Mohave community as a desert endemic, and it is a very pretty plant.

As you go down to Bryce Canyon, you see the erosional cliffs at the margins of the plateaus above. The Paunsaugunt Plateau is the one that caps the Bryce Canyon area. One of the dominant taxa there, along with the ponderosa pines, is *Arctostaphylos patula*—not perhaps a good rock garden plant, but a good manzanita for a garden where you can keep it small enough, and enjoy its beautiful flowers. In that same area we find *Penstemon bracteatus* growing on the terrane limestone in the pine-manzanita community near Bryce and near Red Canyon; look for it on the talus underneath the ponderosa pines and manzanita. *Penstemon grahamii* from the Green River shales grows with *Astragalus lutosus* in absolute barrens, in the crevices where there's perhaps a little more water. Some years it's almost impossible to find; it was believed extinct for a while, at least in Utah, but in good years it has quite a good distribution. It is, however, threatened by the potential for oil shale harvest, which would scrape off almost all its habitat,

and there's not a lot of it. *Penstemon duchesnensis* has a very limited distribution near Starvation Reservoir, and its lookalike is *Penstemon dolius* (photo, p. 136) to the west. This I think is a good candidate for a rock garden. *Penstemon acaulis* is a beautiful, diminutive plant, restricted as far as I know to Daggett County on the northeast side of the Uinta Mountains. Speaking of mat formers, *Penstemon caespitosus* sometimes gets a foot across. If you find this species on your trip down south, it will be var. *perbrevis*. *Penstemon thompsoniae* (p. 138) has one variety that is rather shrubby, growing at low elevations where it can make a beautiful stand. *Penstemon flowersii* has a lovely dusty pink color, unlike that of anything else I know. *Penstemon utahensis* is not quite red but not quite pink; "cerise" is close. It does vary a bit in color and has quite a wide range across south central Utah.

Now for the very large genus *Astragalus*. *Astragalus utahensis* grows in the Wasatch Front on the gravelly terraces just above where housing development has occurred, sometimes scattered by the hundreds. I love its gray foliage and large flowers, and later on the seed pods are very fuzzy balls, more spherical than those of *Astragalus purshii*.

One of the recently described species is *Astragalus equisolensis*, closely related to *A. desperatus* and *A. barnebyi*, but its stems are more upright, it bears more flowers, and the pods are distinctively angular. We named it because it's found on Horseshoe Bench above Green River, the Horseshoe Bend, and though the Romans apparently didn't have horseshoes, they did put a kind of sandal on their horses, so *equisolensis* is "horse sandal." *Astragalus barnebyi* has differently shaped pods, but the botanist Rupert Barneby did reduce *equisolensis* to a variety under this. *Astragalus ceramicus* has really wonderful pods. Some others you may find are *A. fucatus*, *A. anxius*, and *A. siliceus* in Garfield County. *A. saurinus* does not have lovely flowers, but it does have interesting pods. The Uinta Basin endemic *A. chloodes* occurs on sandstone in crevices, growing in the accumulated sand between outcrops near the base of the Uinta Mountains. *Astragalus lutosus* grows up on the Green River Shale along with *Penstemon grahamii*.

Oxytropis jonesii is found on Wheeler Peak; it too has beautiful pods. *O. caesalpinia* has pretty flowers and spreads by underground runners; the pods are big, round, flat things, and when it's covered with pods it's quite showy. There are also quite a few species of *Trifolium* in the Great Basin, and you will see some really nice ones on Brian Head. One of the high-elevation ones is *Trifolium parryi* which extends over to Colorado and Wyoming.

To go quickly over some eriogonums, *Eriogonum shockleyi* (p. 155) is found around Starvation Reservoir and is widespread in the Uinta Basin. *E. gracilipes* is one of the cushion plants so frequent in the White Mountains. *E. ovalifolium* has flower heads that range from yellow to red to rust. *E. umbellatum* is very widespread too.

There are several *Calochortus* species in Utah. *Calochortus nuttallii* is the state flower. *C. gunnisonii* is widespread in eastern Utah and into Colorado, and is named for the Gunnison River. The species in southern Utah is *C. flexuosus*, whose stem winds and twists up through protecting brush. A very unlikely kind of *Calochortus* is the bizarre-appearing *C. weedii* (p. 146) from California. Finally, we have *C. aureus* in southern Utah.

Phlox longifolia and *P. pulvinata* (p. 148) on the Markagunt Plateau make an unbelievable display in early July, and also on the Kaibab Plateau. *Linantbastrum nuttallii* is pretty widespread, from the White Mountains even into the Uintas. *Polemonium viscosissimum* everybody knows as “sky pilot”; there’s a lot of it down in the Brian Head area. I have read that *Collomia debilis* is not a very attractive plant, but one population I found in the northern Wasatch Mountains is really lovely.

Having covered some of the most important genera, let’s move on to a few other showy flowers that will catch the visitor’s eye. Yellow-flowered crucifers include *Lesquerella subumbellata* comes from Wheeler Peak; you’ll see a lot of *Lesquerella wardii* as you climb Brian Head. One notable plant of the high Utah plateaus is *Androsace septentrionalis*. It’s very early and doesn’t make much of a show, being only a couple of inches tall, but when it’s in fruit and the sun catches, it has a lot of artistic merit. The columbine in the Bryce Canyon area is *Aquilegia scopulorum*. It loves growing as a little tuft of leaves between the rocks but has enormous flowers. I read in one of the rock garden journals that *Campanula parryi* was not very pretty, but it looked good where I found it in southern Utah, with upfacing rather than nodding flowers.

We all know *Oenothera caespitosa*, one of the very early flowers from the Mohave Desert, and *Oenothera primiveris*, the “first thing in spring.” Another species, a little bigger and with beautiful goblet-shaped cups and tremendously long stigmas, is *Oenothera acutissima*. The leaves are very narrow and sharply lobed; it grows in wet bedrock covered with other denizens of marshy habitats, and in spring it sprinkles the area with huge yellow flowers.

Dr. Elizabeth Neese is a botanist who has spent the past 50 years finding and learning about the plants of the Intermountain region. She has collected some 20,000 herbarium specimens and has discovered and/or described numerous new taxa. She coauthored *Uinta Basin Flora* and contributed the section on *Penstemon* to *A Utah Flora*, and that on *Collinsia* to *The Jepson Manual of the Higher Plants of California*. A co-founder of the Utah Native Plant Society, she has lectured widely to both horticultural and botanical groups.

From Snowbird to Snowy Range

Richard Hildreth

The longest of the field trips planned for the International Interim Rock Garden Plant Conference took us from Snowbird along Interstate Highway 80 for some 375 miles to the Snowy Range of Wyoming. The Snowys, as the range is affectionately called, is a 6-mile-long granite escarpment in the Medicine Bow Mountains. The highest point is Medicine Bow Peak at 12,013 feet/3662 m. If the winter snowpack, spring thaw, and early summer temperatures have been favorable, there should be abundant wild flowers.

The vascular plants of the Medicine Bow Mountains include 80 families, 320 genera, and 867 species.

Heading east from Salt Lake City on the interstate we pass through Emigration Canyon and by Park City, site of the 2002 Winter Olympics. From here we follow the Weber River to Echo Canyon and Echo Reservoir, source of much of the water for Salt Lake City. Echo Canyon has wonderful outcrops of reddish Navajo sandstone that are colorful in the morning light. We continue to climb, eventually topping out at Evanston, Wyoming. The Uinta Mountains lie to the south, the only major east-west oriented mountain range in the United States. From here on the highway is straight and flat, the landscape is mostly treeless, and many consider it one of the most boring stretches in the country. In the wintertime it can be treacherous, with snow blowing horizontally, creating a whiteout. Under these circumstances the Wyoming Highway Patrol closes metal gates to stop traffic, sometimes in both directions, until conditions improve. You may notice lines of a special fence along the freeway, not to corral cattle but to prevent the blizzard snow from piling up on the freeway. You may spot a single pronghorn antelope on the prairie, or sometimes several family groups.

Our first rest stop is at Little America. I first stopped here in 1942 as our family drove to Salinas, California from Cheyenne, Wyoming. I remember Little America as a service station with glass-enclosed pumps, a small restaurant and motel, and amazingly, for a kid from Wyoming, a live penguin!

Shortly we pass through a tunnel at Green River, where the river runs from its source in the Wind River Mountains ultimately to join the Colorado River. John Wesley Powell named the river on his exploration of the tributaries flowing into

the Colorado. At Rock Springs we are on the edge of the Great Divide Basin, which is formed by the Continental Divide as it branches into two arms around the basin. The basin is about 80 miles across at 7,000 feet elevation. On the southern end is the Red Desert, a desolate-looking stretch, but filled with interesting flora and fauna. Since there is no outlet, water just evaporates, leaving a very alkaline, saline soil. Plants adapted to these conditions include many halophytes (salt-tolerant plants), with salt bush (*Atriplex* sp.) and greasewood (*Sarcobatus vermiculatus*) the most prominent. Their leaves accumulate so much salt that you can taste it. We watch a couple of videos about the Red Desert produced by KUAT public television as the bus heads east. David Yetman is host for this weekly series, called "The Desert Speaks." We'll overnight in Rock Springs on our return trip.

About 20 miles east of Rawlins, we head south across ranch country for Saratoga and our lodge, the Saratoga Inn. You can unwind in mineral hot baths on the premises.

The next morning, we ascend the Medicine Bow Range. Of the three fingers of the Rocky Mountains that poke up from Colorado, the Laramie Mountains are on the east of the Laramie Basin, the Sierra Madre lies to the west, and the Medicine Bow Mountains are between these. We pass fragrant fields of new-mown and stacked hay. Next comes oak woodland, then Ryan Park ski area amid lodgepole pines (*Pinus contorta* var. *latifolia*). This species was a favored wood for railroad ties and was harvested and hewn by "tie hacks" from 1867 until 1940; tie hacks were about as colorful as mountain men.

Gradually the pine forest gives way to aspen (*Populus tremuloides*), subalpine fir (*Abies lasiocarpa*), occasional blue spruce (*Picea pungens*), and Douglas fir (*Pseudotsuga menziesii* var. *glauca*), with limber pine (*Pinus flexilis*) thriving on exposed slopes. Small lakes, rushing streams, and meadows with wildflowers dot the landscape.

Our morning stop is at Lake Marie, a beautiful glacial lake that as a youngster I thought was named for my mother. The strenuous hikers in the group head to the high country with guides Anne and Joe Spiegel, on a trail starting at the lake. Those who wish a more leisurely stroll join Sue and me to check out the wildflowers around the lake and a nearby outlet stream.

About noon we drive past the high point of this Scenic Byway road at Libby Flats (10, 847 feet elevation). There is a magnificent panorama of the Snowy Range from this vantage point, as well as snow-capped mountains in Colorado to the south, including Long's Peak on a clear day.

Monday afternoon is taken up with a leisurely stroll about a windswept knoll on the east end of Brooklyn Lake. Last year we listed more than 22 species from this site. The Hildreth family cabin is among the 17 cabins on Brooklyn Lake. Sue and I would return for a stay in mid-August. My father purchased the primitive log cabin in 1936, and we still maintain it as a simple, peaceful family retreat without electricity, telephones, or plumbing. Unless you are prepared to snowshoe or ski in during the prolonged winter, the active season here is from Independence Day to Labor Day.

Early Tuesday morning we return to the Libby Flats area to check out the wildflowers. Here, look especially for the blue mounds of *Eritrichium nanum*. It was abundant in 2004, but about the same time in 2005 we didn't find any in bloom.

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A Field Trip to the Tetons

Noel Holmgren

The first base for the field trip to the Tetons was the town of Jackson, Wyoming, situated at the south end of Jackson Hole, snuggled behind the East Gros Ventre Butte. Traveling about 4.5 miles north of the town square on the main highway you suddenly come into full view of the Tetons. Even when you have been there before, the sudden view takes your breath away.

The Tetons are formed from an uplifted tilted block as a part of the geological Basin and Range event. As the Tetons have been lifting (forming a “horst” structure), the valley floor has been dropping (forming a “graben”). The valley has dropped at least twice as far down as the mountains have lifted, so the displacement along the Teton Fault is even greater than it outwardly appears. I read frequent articles in the *Jackson Hole News* about the likelihood of an earthquake that would rival the “big one” predicted along the San Andreas Fault in California. One of the worrisome things about such an earthquake is that the Jackson Lake dam, upstream from most valley habitations, could fail, and the flood would wash out many homes and endanger many lives in the low-lying land along the Snake River.

The range is spectacular because of its grandeur and youth. Most of the uplifting has occurred within the past 2 million years, and most of the erosion has been from glacial carving, excavating cirques into the rock walls and scouring out U-shaped canyons. The sharp peaks were formed when the glaciers carved away on both sides. There are still some glaciers present, though they’ve become very much reduced in size in recent decades. Most of the rock that you see in the central highest part of the Tetons is Precambrian granite and gneiss, and the sandstone, shale, and limestone cap that covered it has been washed away. This is the part that includes the most spectacular peaks, the Grand, Middle, and South Teton peaks, and Mt. Owen, and Teewinot Mountain. The sedimentary covering is still present in the southern section of the range. Just beyond the park boundary, on Rendezvous Mountain, there is a lot of limestone (or dolomite).

The field trip ended in Logan Canyon in the Bear River Range of northern Utah, which is the northern part of the Wasatch Range. There is a lot of local

flowering plant endemism in the Bear River Range, and there is none in the Teton Range. However, the Teton flora is still rich in species; it has a marvelous complement of Rocky Mountain species, especially wonderful for rock gardeners.

I suspect the lack of endemism in the Tetons has to do with the fact that during the ice ages (the Pleistocene epoch), all but the jagged peaks were under ice, much of it scouring the surfaces. The entirety of Jackson Hole was covered by a thick ice sheet. The glaciers that came down out of the canyons converged on a lobe of thick ice that was pushing out of Yellowstone. It pushed its way to the south end of the Hole, where the ice was so thick that it completely covered the buttes near the town of Jackson as well as Snow King Mountain on the south side of town. As the last ice age waned, the space in front of the retreating ice was bared and opened to colonization. All the plants that became established came in from neighboring areas, and there has been too little time for new species to evolve.

In contrast to this scenario, as mentioned above, the Bear River Range has several endemics. In the vicinity of Tony Grove Lake there is *Penstemon compactus* (photo, p. 136), and just downslope from there is *Orthocarpus tolmiei* subsp. *holm-greniorum*, and nearby are *Viola frank-smithii*, *Musineon lineare*, *Erigeron cronquistii*, *Primula maguirei*, *Draba maguirei*, *Boechea lasiocarpa*, and *Physaria multicaulis*. What a list! There is more local endemism than that in the Wasatch Range as a whole; for example, in Little Cottonwood Canyon, where Snowbird is situated, there are some endemics, such as *Corydalis caseana* subsp. *brachycarpa*, *Physaria garrettii*, *Penstemon platyphyllus*, and *Ivesia utahensis*, and just over the ridge near the mouth of Big Cottonwood Canyon is the shooting star *Dodecatheon dentatum* var. *utahensis*, and over the ridge to the south, in American Fork Canyon, is *Penstemon sepalulus*. I know that is not a complete list of known species, but these are the ones that come to my mind.

There are still sizable portions of the Wasatch that have not been explored by botanists. In comparison with the Tetons, the Wasatch Range had only isolated glaciers and its valleys were virtually free of ice. The largest glaciers were in the two Cottonwood Canyons, and signs of the Little Cottonwood glacier can be seen around Snowbird.

Getting back to the Teton Range and some of its flora, in the flats at the base of the Tetons are whorled buckwheat (*Eriogonum heracleoides*), sticky geranium (*Geranium viscosissimum*), and Gray's groundsel (*Senecio canus*). Along streams is the black twinberry (*Lonicera involucrata*) and in the shady forests is the Utah honeysuckle (*Lonicera utahensis*). Huckleberry (*Vaccinium caespitosum*) and bog laurel (*Menziesia ferruginea*) are denizens of the acid soils around Jenny Lake. Coralroot orchids, such as *Corallorhiza maculata*, are found under coniferous trees. *Pedicularis bracteosa* var. *paysonii* is common in semishaded areas of the forest. A close relative of the bracteate lousewort, which has not been found in the Tetons but is across the valley in the Gros Ventres, is *Pedicularis procera*, which is at its northernmost limit here, coming up from Colorado and eastern Utah. It is very similar in morphology to *P. bracteosa* but is taller and has larger flowers and leaves, about twice the size. *Rubus parviflorus*, the thimbleberry, is a common

shrub. You don't want to linger around bushes that produce fleshy fruits in the late autumn, as the bears are fattening up on them in preparation for hibernation.

Fritillaria atropurpurea with its nodding flowers often goes unseen. They are often fortuitously noticed when you are looking up the slope. With the elkweed (*Frasera speciosa*; p. 133), a close look at the petals reveals some interesting structures: a pair of glands or foveae on each petal, each framed by a delicate fringe. This is the only species of *Frasera* with paired foveae; the other species have single foveae, and these species can be distinguished in part by the shape of the foveae and the nature of the fringe and surrounding tissue. Under optimal conditions, *Frasera speciosa* can grow up to 7 feet (over 2 m) tall. The virgin's bower (*Clematis occidentalis* var. *grosseserrata*) is one of three species of *Clematis* in Jackson Hole. The serviceberry (a.k.a. shadbush or saskatoon) is represented in the range by *Amelanchier alnifolia*. A little farther south there is the Utah serviceberry (*A. utahensis*) with smaller leaves and petals. A couple of orchid species include the fairy slipper (*Calypto bulbosa*) and the heart-leaved twayblade (*Listera cordata*).

Indian paintbrush (*Castilleja*) can often be difficult to identify to species. In the Rocky Mountains *C. miniata* and *C. rhexifolia* hybridize quite freely. In the Intermountain region, these two seem to be less likely cross and are easier to distinguish. In good, pure *C. miniata* (scarlet paintbrush) the bracts are bright red and have long, acute lateral lobes, whereas the bracts in *C. rhexifolia* are violet and entire, or there may be a couple of very short, rounded lateral lobes. The sulphur paintbrush, *Castilleja sulphurea* (p. 147), seldom presents a recognition problem, at least in fresh material. When you lose the sulphur yellow coloration in old, dried specimens, it is difficult to distinguish it from old, faded *C. rhexifolia* specimens.

The Colorado columbine, *Aquilegia caerulea* (p. 131), is always a welcome sight. The flowers with blue sepals and spurs are found mostly in Colorado. In some populations in Wyoming you'll see some pale blues, but more often pure white to pale purplish. It can hybridize here with *A. flavescens* (p. 131), which is yellow and has shorter spurs and petal blades rather than the long ones of the Colorado columbine.

From Teton Village you can ascend Rendezvous Mountain by way of the aerial tram. This is a wonderful and nearly effortless way to visit the alpine flora. At the top of the tram there is a well-used trail that leads down into Cody Basin, a large glacial cirque, and before leaving the ridge the trail forks off to the Granite Canyon to the north, and Cody Basin to the south. The Granite Canyon hike is all downhill, but you end up at the trailhead 2 miles from your car at the tram station.

The slopes along the ridge near the tram station is the lovely sunflower called "graylocks" (*Hymenoxys grandiflora*). The krummholz is a typical tree form at treeline. Spruce and fir will assume this stunted form in response to wind-blown ice storms and other severe winter conditions that keep them from growing erect and tall. The "flag" arrangement of the branches on the leaders shows the direction of the winter wind. A little bit higher trees cannot grow at all, hence we have a "tree line."

Some of the other plants you will find up there include *Astragalus kentrophyta* var. *tegetarius*, which forms mats, as do so many alpine species. The daisy-like *Erigeron leiomerus* is one of my favorite erigerons. The common anemone in the area is the cutleaf anemone, *A. multifida* var. *tetonensis*. That variety name might make you think, "Aha!; so there is an endemic"; but no, it is found south well into Utah, eastern Nevada, and southern Idaho. The alpine buttercup *Ranunculus adoneus* appears among the rocks around melting snowbanks. Silky *Phacelia serrulata* also grows near treeline. It has quite a wide elevational range; at lower elevations it is taller and has an elongated inflorescence. In this area the local species of twinpod is *Physaria paysonii*. *Smelowskia calycina*, a circumboreal species, occurs here.

Once again at the base of the mountain, we find the lovely heart-leaved twayblade (*Listera cordata*) and the stinkweed (*Astragalus bisulcatus*), one of the astragali (or locoweeds) very toxic to livestock. Another poisonous plant is the lupine (*Lupinus argenteus*), which is common; on the main road near the Jenny Lake turnoff, there is a place called Lupine Meadows. In similar habitats we see the western sweetvetch (*Hedysarum occidentale*) and the thick groundsel (*Senecio crassulus*). Bog laurel (*Kalmia microphylla*) grows in moist habitats.

Both Rendezvous Mountain in the Tetons and Tony Grove Lake in the Wasatch are wonderful places to visit for enjoying wild flowers. Both places have well-developed trails for exploring different habitats. The Rendezvous Mountain aerial tram takes you to 10,400 feet/3170 m elevation, which is right at tree line. It is a great place for the Rocky Mountain alpine flora. Tony Grove Lake is slightly above 8000 feet/2440 m and is great for the subalpine flora, and from it you can hike to Naomi Peak at just under 10,000 feet/3048 m for a very different alpine flora..

Dr. Noel H. Holmgren taught at Oregon State University and Lehman College of City University of New York, but spent the greater part of his career—42 years—as a curator of botany at the New York Botanical Garden. He is best known as a lead author of the multivolume *Intermountain Flora*. After completing that work and its one-volume condensed manual, he hopes to undertake a thorough revision of the genus *Penstemon*. His work on North American flora has earned many honors, including the NARGS Edgar T. Wherry Award.

The Ruby Mountains

Stewart Winchester

Note: This article was edited by Joyce Fingerut from a transcript of Stewart Winchester's talk.

This will be a whirlwind tour of the Ruby Mountains. The reason that the Rubies were originally chosen by me as a location for botanizing and study is that it's within a ten-hour radius from my base in the San Francisco Bay area. It's also nice for another reason: as an example of continental climate regimes. We are strictly Mediterranean in the Bay area and can't grow most of the species that we visit in other areas, and it's important to understand the context in which they grow. Since only about 2% of the world's mass, including some parts of California, is considered as Mediterranean climate, it is important to see other climatic regimes and start thinking differently about plants. This is especially important to my students who are future landscape architects and designers. You will not receive detailed explanations of geology from me, as I'm a person who is steeped in horticulture, propagation, and environmental design.

I will be discussing plants that are blooming about the fourth week in July, along the road from Elko, Nevada to the Rubies. Along this road, the first crest overlooks an interesting little city that sprang up as a result of the sudden influx of people who were employed in the gold mines in north central Nevada. The elevation at the peak of Ruby Dome is 11,380 feet/3470 m. They were called the Rubies because the garnets that were found there resembled rubies. Indeed, we visit the Rubies for another reason: to look at something that was actually part of the continental shelf a long, long time ago. If you look at the Paleozoic continental shelf, the Rubies were actually a part of shoals that were under ocean water. What you can find is a lot of interbedding of intrusive granite coming up through shales, limestones, and metamorphics, and you will see that the patterns of plants change based on their substrate. On the eastern Rubies there are still remnants of the lakes that dried up after the last ice age. If you are interested in birding, it's an excellent place to visit birds of all sorts, especially water birds, as it is a part of an important flyway.

You are also looking at the origins of a lot of vegetation. A paper published some years ago by Dwight Billings on the alpine vegetation and biogeography in

the Great Basin discussed pluvial (rainy) periods and pluvial areas, and the periods when cold climates forced many species downslope—for instance, *Astragalus*—which later returned upslope as the climate moderated. These plants also increased their ability to handle high photon energy, as a result of their migrations between higher and lower elevations during sequential warm and cold periods. Iliamna is a nice little shrub belonging to the mallow family (Malvaceae), one of the families that came up from the south.

As you approach the eastern part of Nevada, you get contributions from the Great Basin. There is less and less igneous rock and more that is sedimentary, with the “rubies” as evidence that the rocks were at one time sand that has been compressed. The interbedded granite shows as white, and the gray is ocean floor bedding that has been compressed and is now very fractured. Metamorphic rocks in the Great Basin are pretty much limited to the Rubies, and a few of the Deep Creek and the Shell Creek Range Mountains, with a few more examples in southern California. There is a lot of limestone derivative, which plants seem to enjoy as it offers the calcium required for growth initiation, as well as the porosity to hold water. This produces a nice soil and a good deal of plant variety.

As a result of the topography in the Rubies, we have a certain amount of isolation and, this being a rather nice island in the Basin, a certain exuberance. This includes the Sierras (in California), the White Mountains on the western edge of the Great Basin, Spring Mountain (down by Las Vegas), the Toiyabes, the Jarbidge Range in northeast Nevada, and the Wasatch Front, where Snowbird is situated. The Jarbidge is one of the wettest places in Nevada. In the latest glaciation, the Sierra was certainly covered, as well as the Cascades, plus a few mountains in the Great Basin. That had a profound influence, and you will find areas here that are built like layer cakes, with scouring producing interesting shapes that are somewhat rough in places. There are wonderful fellfields resulting from the combination of limestone and granites, and some plants grow on one or the other exclusively. Nicholas Polunin’s book on the circumboreal flora discusses the Northern Hemisphere flora from the top down. There are several species here—including some *Poa*, fescues (*Festuca*), *Deschampsia*, the wonderful *Arenaria* species, *Oxyria*, *Salix*, and species of *Potentilla*—that are typical of the circumboreal flora and are found in eastern North America and Canada, as well as eastern Asia. A lot of these species are also found in the Rubies, among them *Silene acaulis*, which is always wonderful to see no matter where you are. It seems to prefer limestone in the Rubies . . . but not always.

The annual rainfall in the Rubies is 16 to 18 inches (400–450 mm), but the most important component is the summer rainfall. There can be a sudden 6- to 8-inch rainfall, which I have experienced. It’s a wonderful place to be when it’s moist. For this reason, a lot of range extensions occur there; it’s the Yosemite of Nevada, because of the amount of glacial activity that has occurred. There are little flower gardens, with *Helianthella* and *Penstemon* and *Polygonum*.

Island Lake is one tour that is quite nice, and only about two miles each way. Above it is Mt. Thomas, one of the second or third highest places in the range, where you can see dwarfer forms of the same plants found at lower elevations. An

interesting hike is up Thomas Canyon to the high country, with a cut over a saddle to make a loop of it. Another trip would be Right Fork Canyon to the Echo Lake area. The total area is not large, but there is a variety of rocks, showing scouring and patches of *Potentilla*. This is more pleasing to my eye than the Sierra, where I need to wear sunglasses (which I don't like to do) and the albedo (reflectivity) is too strong for me.

Looking up Right Fork Canyon, you can see how green it is—almost Alp-like. There are good hikes, but you need to start early in the morning because at this time of year it gets very warm, even though the end of the road at Lamoille is at 8800 feet/2682 m elevation. You need to begin at around 6500 feet/1980 m and get up to some cooler air in the higher elevation and find some shade, otherwise you're toasted. There are many little *Solidago*, or goldenrods, on the road. *Linanthrastrum* is very fragrant in all these disturbed areas; it grows on granite or anything else, being very ecumenical. As you hike along, you are looking up at precipitous cliffs that are primarily ocean floor metamorphic rock. At lower elevations, there is *Lewisia rediviva* and interesting landscapes of juniper understory with aspen above. It is still quite warm at this elevation. There are large plants in this lush zone, like *Angelica* and lots of shrubs and herbaceous perennials, even *Shepherdia canadensis*, a very nice plant, and *Lonicera involucrata* in flower and fruit. Once you start getting higher, you encounter a shrub zone of mainly artemisias and snowberries (*Symphoricarpos*), with tall *Delphinium occidentale* sticking out of the shrubs. You'll also find *Tragopogon dubius* along the trail. The trail is well-trod, without much divergence, and you pretty much want to stay to that trail. There are little peonies (*Paeonia brownii*) that are quite nice, and of course chokecherries (*Prunus* spp.) all along the trail, with fall color and fruit that are very good. You will also find *Cornus sericea* or *Cornus stolonifera* down in the canyon.

In the rocks, *Primula parryi* is growing partly in limestone and partly in the fractured metamorphics, along with big patches of many monkshoods (*Aconitum* spp.). Another shrub, *Holodiscus*, can be found here, and it's always fun to see these nice showers of flowers, growing in rock and coming down the hill. One of the plants that's a real draw is *Arctostaphylos uva-ursi*, because we don't have many in California. *Helianthella uniflora* is a very nice upland species, giving a kind of golf course effect higher in the canyons. There are also horsemints (*Monarda*), *Linanthus*, and *Agastache*.

The maps show a nice big lake, but when you get there you find that it is really a bunch of little tiny pools that have 60 million mosquitoes; moving water is better. There are little *Pedicularis* and saxifrages, swamp onions (*Allium validum*), *Mimulus primuloides*, and *Dodecatheon alpinum*. I think there is a very short form of *Eriogonum kingii*, as well as forms with foliage that is very gray and extends up nice and tall.

At the pass at the top, there are little *Physaria* and *Eriogonum*, plus a great mountain view. *Penstemon speciosus* is all around the passes. The pine here is *Pinus albicaulis*, the western whitebark pine, which is favored by the nutcrackers. These trees do leave some picturesque snags, too. There are asters of all sorts, and most of them key out to *A. watsonii*. Some are very tight, some very loose; some have

black phyllaries, others have no black phyllaries: they all seem to key out to the same thing. We also encounter nice willows up there: *Salix arctica* and *S. nivea*.

Sibbaldia grows on the rocks; it is one of those circumboreal plants. There is *Agoseris aurantiaca*, a nice little orange composite. You'll find patches of *Arnica*. The streams flow down and go below the surface, so that you can hear them but not see them.

At Lamoille Canyon, you park at the end of the road in the morning seeing lots of clouds, which is not very good, and you hope for good weather later. The hike is from the parking lot to Liberty Pass, the most popular of the passes. It is not as high, but you do change orientation, and when you get to the other side, there is a lot of different vegetation. You are surrounded by *Helianthella quinquenervis*—the big fat sunflowers you find down in the flats—and immediately you go up the hillside, it turns into *H. uniflora*. There are some wonderful tall *Leymus* grasses, too, along the roadside. As you walk up within timberline, below the trees there are a lot of what are thought of as typical alpine plants, but they are within the forest, so the alpine area goes way down in the Rubies, because of the deep canyons and the recent scour. You can find *Ranunculus eschscholtzii*, *Primula parryi*, *Geum rossii*, and *Parnassia fimbriata*.

Traveling through the area of the Dollar Lakes, you cross through a forest of whitebark pine, with *Zigadenus elegans* and *Thalictrum fendleri*. Closer to the pass, there are agastaches, and little gardens of lovages and castillejas. Moving to Liberty Pass, you will find *Deschampsia* grass growing on the top where it is moist; water was flowing over this, but dried up in a couple of days. *Petrophyton*, or rock spiraea, grows predominantly in the limestone. A typical *Dugaldia* shows its typical wandering ray florets. Moving down the canyon, you find a lush thicket of *Rubus* and *Senecio serra*, *Castilleja miniata*, bistort (*Polygonum* sp.), *Platanthera*, *Sambucus racemosa*, and *Smilacina amplexicaulis*. You can also see the big *Frasera*, tower gentian or monument plant, with its beautiful florets. At the pass itself, you are in the wilderness area, with gardens dripping down the limestone.

Stewart Winchester has taught environmental horticulture at California's Diablo Valley and Merritt colleges and has led natural history field trips in California and nearby areas since 1985. Trained as both environmentalist and horticulturist, he exposes students to the inherent difficulties in successfully melding human activities with the land.

The Post-Conference Tour

Robin Magowan

The day after the conference, 27 of us, half of whom were from overseas (the U.K., Denmark, Germany, and Australia), set off for a tour of Wyoming's Big Horn mountains. We had the good fortune to be led by Elise Erler, who knew both Wyoming and the concrete details of its geology, ably assisted by Cindy Cromer, and on the plant side by Iza Goroff and the indefatigably helpful and experienced Andrew Pierce. Iza had made several previous trips to the Bighorns, the last two at the same time of year, while Andrew had surveyed the route three weeks earlier.

The season was too advanced to see much in the dry, treeless sagebrush desert through which we passed on our way to Burgess Junction, a resort in the Bighorn range surrounded by the Shoshone Indian reservation. But at Boysen Dam, at the mouth of the spectacular Wind River Gorge, we stopped to admire the spine-tipped *Mentzelia*, a concentric 3-foot bush with drooping, pale pink, ten-petaled flowers that open in midafternoon. The Wind River led out into an idyllic tableland, out of which tiny, almost toylike mountain peaks tilted away into cloudless infinity.

In this gently rolling tableland, Iza Goroff announced, the best way of finding plant sites was to look for patches of discontinuity in the landscape—a stream, say, breaking up a meadow. By one such brook, near Granite Pass, we came upon beguiling white-petaled *Parnassia fimbriata* growing alongside bright yellow *Mimulus guttatus* and the stream-dwelling *Saxifraga occidentalis*. On another day, climbing a rather steep streambed, we chanced upon *Gentianopsis detonsa*, a small, delicate bluish-purple biennial. There were even two-toned ones, pale lavender tubes with white “ears.”

On another roadside hill, in a little cavity formed by some opal-topped rocks, we located a couple of clumps of *Machaeranthera pattersonii*, a dark blue tansyaster featuring a slightly upraised reddish-orange disk. What interested me was the way the blue of the ray florets vibrated like the shutters of a window, disclosing the identifying green of the underlying stem. While we were prospecting among the rocks, a pair of good-sized prairie falcons shot by, borne along on the central edifice of the wind.

On the whole, individual sightings like these stood out, rather than the striking abundance we might have encountered in an earlier year. Then again, the lack of bloom hardly mattered when set against the immensity of the geologic spectacle, and the unquestioned pleasure I found in just being at 10,000 feet, high on a hillside, surrounded by an always exhilarating wind. The Bighorns are not so much a land of flowers as a land of wind, with the disunity of a sky unfolding between disbelieving eyes that wind brings. When we poured out of the bus, there was always the waking shock of space and spaciousness. In a world where we feel increasingly hemmed in, such vast sweeps of space hold out a measure of hope for both humans and animals. Flowers, in turn, bring their own precision to the vastness; know the geology and you know the point the plants underline.

The high point of our trip came on Hunt Mountain Road, just off US 14A. We had stopped by several patches of *Aquilegia jonesii* that Andrew had photographed in stunning bloom five weeks earlier. We mounted over a carpet of *Astragalus kentrophyta*—a tiny purple flower as gorgeous in its way as anything we had seen—to some rocks where we sat, backs to the sun, picnicking like gophers. Profiled at the peak of a little rock just above us, I made out a Townsend's solitaire, renowned for its utterly individual song. That got me to my feet: In a dearth of blooms, how about birds? Almost immediately I noticed some vibrantly patterned longspurs, fluttering just far enough away to be unidentifiable, but clearly different from the white tail-edged pipits we had been seeing. Following them along a dried-up stream, from one potentilla exuberance to the next, we found ourselves on a bluff overlooking a steep ravine. There, embedded in the rocky turf, was that rarest and most ungrowable of tiny shrubs, *Kelseya uniflora*, a bush that in its swollen blue-green mounds rather resembles certain species of *Raoulia*. The rock this unlikely rose relative was suspended on was a white and deeply porous dolomitic limestone of razor-sharp coral-like consistency. The cliffs were, in turn, liberally splashed with lichens: orange-rust, lime-green, and most startling of all, a tiny gray. On the coral-like rock, suspended in vertical liveliness, the *Kelseya* community sparkled as it never could in mere soil. I found fascinating the way the *Kelseya* threaded its way into cracks, crevices, and the very ancient colonies it had spawned. Among them, as I descended on the left, was a very colorful alpine flora: not, alas, the shooting star (*Dodecatheon conjugens*) that bloomed in the seeps at the base of the cliff a few weeks earlier; but deeply embedded *Townsendia montana* added its purple to the gorgeous yellows of *Hymenoxys*, to vast drifts of *Telesonix jamesii*, and some nice ferns, among them *Cystopteris fragilis*, the delicate *Woodsia oregana*, and the shadowgrowing *Selaginella densa*.

Wherever we stopped—Dead Indian Pass, Beartooth Plateau—we saw flowers, often rare ones like *Lesquerella alpina* and *Eritrichium howardii* spread like stars in the scree. Is that what flowers are: daylight apparitions? Messengers from some geologic long ago? In paying attention to their presences, what else can we learn about the sky and its ever-governing winds, or even about our bodies compounded as they are out of elemental dust?

These thoughts arose in the course of our next-to-last day's afternoon, spent largely at Cody's beautifully appointed Buffalo Bill Museum. On the wide streets

of the town an international convention of Hell's Angels was in full swagger, anxiously attended by every imaginable species of hovering cops. Easy enough to guess why the Angels might have chosen to convene in Buffalo Bill's town: Wasn't he at one point the most famous man in the world? But the Museum of the Plains Indians, wrenchingly presented from the obliterated side, held much that could appeal even to flower obsessives. That the Native Americans possessed a plant taxonomy of their own, almost as copious as our Linnaean, seems indisputable. And, as committed artists in our gardening way, we found it enlightening to learn how central beauty was to their daily lives—the only people to have ever devised an art from porcupine quills; to see case after case of the exquisitely sewn garments in which they dressed their young children; to learn of the joy with which, over and over again, they pulled up stakes and set off for new hunting grounds. Life in a landscape so open to the elements may have been as prone to violence and as generally difficult as it is now. But, with a little help from the buffalo, they carried it off with a panache we can still perhaps envy.

I had groused about the weather, a global warming more advanced than any of us had anticipated. But on the last day, as the weather turned suddenly autumnal, we realized that we might have experienced the five days of actual summer that Wyoming annually receives. That a few of the plants we grow hail from such a place, and actually thrive there, is one of those lessons that bear repeating. It might be well worth reconvening there for a week in mid-June, just to see how different nature is from the selective illusion of a garden.

Robin Magowan, a poet and travel writer, gardens near Salisbury, Connecticut, and is a frequent contributor to this journal.

BOOKS

The Caucasus and Its Flowers by Vojtěch Holubec and Pavel Křivka.

Privately printed, 2006. ISBN 80-902541-3-6. Available from NARGS Book Service.

Reviewed by PANAYOTI KELAIDIS, Denver, Colorado

I have a large bookcase full of rock garden books and another overflowing with rock garden journals. I am always surprised that a rather small group of hobbyists, really, have managed to produce such a respectable body of literature. Who would have thought that with careers, gardening and traveling, so many rock gardeners would still find time to write as well? On long winter evenings, I for one, am mightily glad this is the case.

The Caucasus and Its Flowers has just been published in the Czech Republic, written by Vojtěch Holubec and Pavel Křivka, field botanists who have produced what can only be called a masterwork. This weighty tome is unique in the rock garden canon: it is undoubtedly the most lavishly produced, beautifully illustrated rock garden book ever. Of course, it also serves as a general wildflower guide, with much valuable information for those unfortunate souls who have not discovered the joy of growing alpinists. But I doubt that there has ever been a book concerning rock garden plants with this much in the way of new information, new plants, and encyclopedic scope when it comes to capturing the many facets of this major and yet little-known floristic region.

First, the essentials. There are 390 pages, all but a few of them illustrated, often with 4 or more photographs to a page (do the math!). The bulk of the book is a detailed breakdown by principal families of the wildflowers of the Caucasus—509 species, each illustrated with a crisp closeup (usually depicting the whole plant, but often with companion plants, rocks, and even scenery behind). The most spectacular Caucasus endemics, like *Daphne glomerata*, *Draba longisiliqua*, *D. ossetica*, *Gentiana oschtenica*, *Saxifraga columnaris*, or *S. dinnikii*, are often pictured in many different contexts—long shots with scenery, masses of plants, or even plants in seed—to give you a full sense of the plant's habit and habitat. Not

only is each photograph clearly numbered so you can quickly relate it to adjacent text, but there is full credit to the photographer and where it was taken (even the altitude), unobtrusively but clearly included at the bottom of each page (a unique and praiseworthy innovation).

Casual readers might be put off by the crisp, abbreviated text that follows each species discussed. The horticultural directions are laconic, to be sure: "In screes with good drainage," "dry sunny slope or scree." For seasoned gardeners, these hints reverberate, but beginners will be frustrated by their Delphic brevity. The scientific language of plant descriptions will be a disappointment to those who fail to find poetry in "leaves lanceolate with distinctly reticulate venation." Alas, this is a reference book, not an impressionistic work.

The reason why our rock garden shelves are yearning for this book, however, is twofold. First is the front matter, 73 large pages filled with densely packed historical, geographical, ethnological, ecological, climatological, and other information about the Caucasus. The English may not be colloquial, but you will not find the pithy content of these opening essays in any other book in English, nor on the World Wide Web. Second, and above all, this is an extraordinary work of bibliographic and photographic art. Practically every picture in it is a prize-winner: hundreds and hundreds of beautiful, meticulously reproduced photographs of a myriad of unfamiliar plants (or plants long familiar but here shown in their native haunts), page after page of sumptuous information, lovingly designed and perfectly packaged.

I randomly open the book to *Jurinella subacaulis*. I have seen references to this in the past, but the lavish portrait (larger than life) is as rich and tantalizing as a French pastry. Turn the pages again: ten photographs of yellow-flowered saxifrages on page 128, one of which (*Saxifraga juniperifolia*) I have grown, but the other nine photos depict five species I have never even heard of before. I am chagrined to find so many plants I did not know, that have now shot to the top of my "must see and grow" list.

I have always suspected that the mountains of the Caucasus were equal to the Alps, Andes, or Rockies in terms of biodiversity and scenic grandeur. This magnificent tome makes it clear to me now that the Caucasus is second only to the Himalaya.



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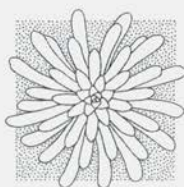
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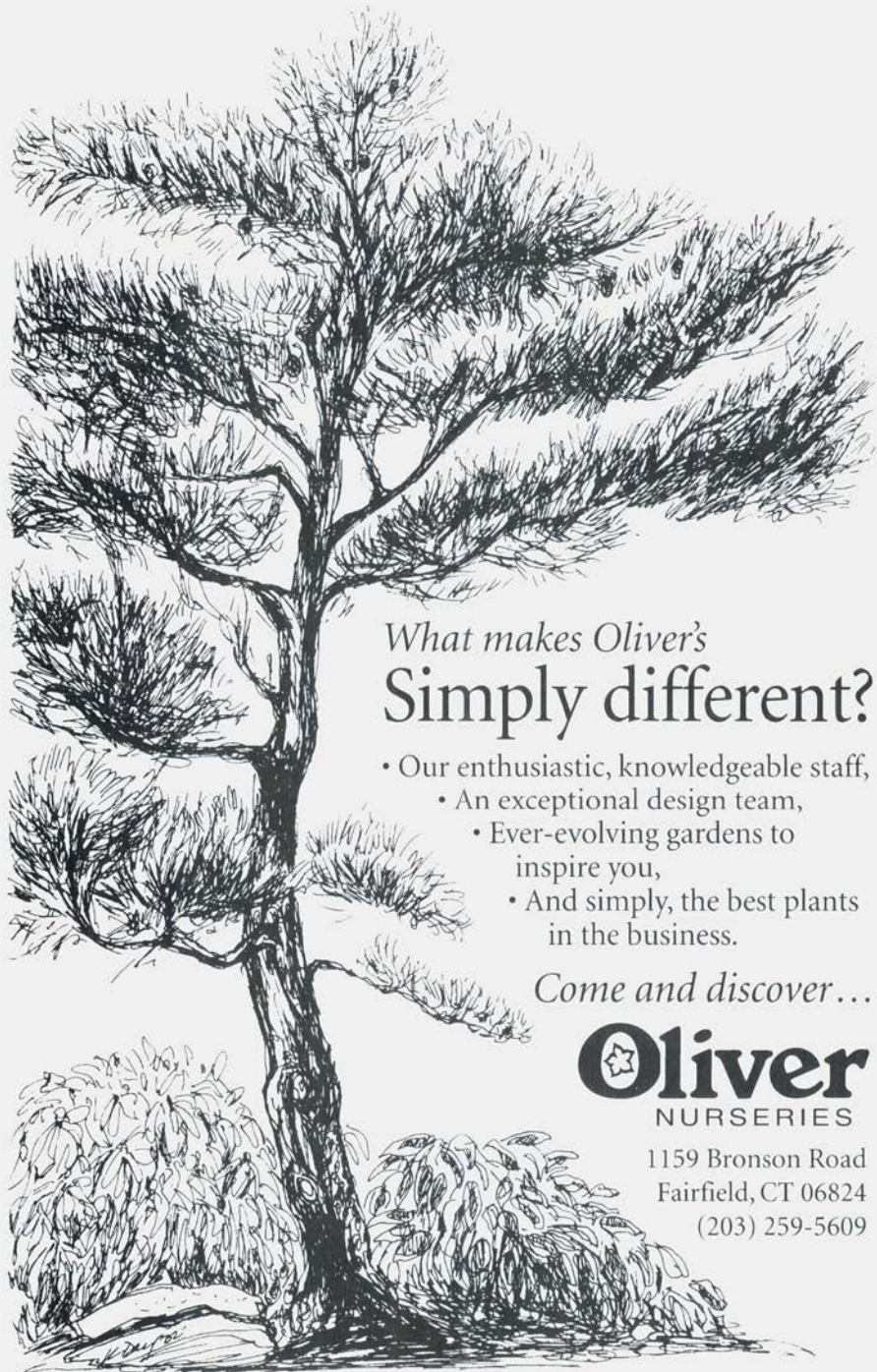
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A Field Guide to Wildflowers of Northeastern/Northcentral America (Peterson Field Guide Series), Peterson and McKenny. Houghton Mifflin, 1968. Suggested retail \$19.99

Out of Print:

The Appalachians, Maurice Brooks. Essays and insight to the geology, ecology, flora and fauna of the Appalachian Mountains. Houghton Mifflin, 1965. Used prices starting at \$9.00

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