

ROCK GARDEN *Quarterly*



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Front cover: *Iris cristata*. Painting by Jean LeCluyse.

Back cover: *Erythronium oreganum*, *Sedum spathulifolium*, and *Lomatium* sp. Photograph by Tanya Harvey.

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ROCK GARDEN

Quarterly

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Contents

An Early Autumn Visit to Crete, KEES-JAN VAN ZWIENEN	83
Spring Geophytes in Crete, JANE MCGARY	89
Montreal's New Vertical Crevice Garden, RENÉ GIGUÈRE	94
Butterflies in the Rock Garden, BERNARD L. JACKSON	115
The Dwarf Crested Iris, <i>Iris cristata</i> , COLE BURRELL	119
Gardens on the Half Shell, PANAYOTI KELAIDIS	122
The Leviathan, the Willow, and the Wallflower, MARK FUSCO	127
The Importance of Private Plant Collections, BOYCE TANKERSLEY	130
PLANT PORTRAITS	
<i>Saxifraga oppositifolia</i> , DAVID SELLARS	134
<i>Primula bhutanica</i> and <i>Primula nana</i> var. <i>alba</i> , DENIS HARDY	136
BOOKS	
Fielding, Turland & Mathew, <i>Flowers of Crete</i> , rev. by TREVOR WILTSHIRE	139
Ward, <i>The Plant Hunter's Garden</i> , rev. by DAVID PALMER	141
Kozloff, <i>Plants of Western Oregon, Washington, and British Columbia</i> , rev. by DAVE DOBAK	142
Leijenhorst, <i>Hortus Bulborum</i> , rev. by SUSAN A. REZNICEK	144
Glattstein, <i>Bulbs for Garden Habitats</i> , rev. by HANS ROEMER	145
Enter the 2006 Photo Contest	147
NARGS Coming Events	149

This issue's cover

Artist Jean LeCluyse writes:

I remember seeing *Iris cristata* on a hike with my son many years ago. We spotted what looked like an intriguing patch of light shining out from a shaded area just off the path. On closer inspection we discovered the ground covered with these little plants blooming their hearts out. It is wonderful to have this time with my son associated with this flower.

As I was taking pictures in my yard in preparation for the drawing, I spotted a little anole lizard. When I'm lucky enough to see a creature (reptile, bird, or bug) in my garden I always pause to savor the moment. I think most gardeners consider these moments a bonus. The anole was convinced that I could not see him and held still for several minutes while I took picture after picture of him. Because he was sunning on a brownish rock and blending with it, it was hard to tell whether he was a native green anole (*Anolis caroliniensis*) or an introduced brown anole (*Anolis sagrei*), but I think he was a brown because I found him on the ground. Green anoles seem to prefer higher perches in trees and shrubs. It makes me happy to have thoroughly celebrated these two events in a published drawing.

Corrections to Winter 2006 Issue

On p. 35, *Chamaebatiaria foliosa* should read *Chamaebatia foliosa*. Author Dave Dobak notes, "These two look-alike genera are indeed slightly different: Leaves mainly 2-pinnate; pistils 5; fruit a follicle > *Chamaebatiaria*; Leaves mainly 3-pinnate; pistil 1; fruit an akene > *Chamaebatia*."

An Early Autumn Visit to Crete

Kees Jan van Zwielen

Crete, the largest of the Greek Mediterranean islands, has a unique flora. It is well known for its diversity of spring-flowering plants and its many endemic species. It is less well known that the cooler temperatures of autumn and the first autumn rains trigger a wonderful array of bulbous plants to start their annual display. The timing of my 2005 visit to the island, the last week of September and the first week of October, coincided with the beginning of the flowering season of many of these plants.

General Information

The main base for my explorations was Chersonissos in the eastern part of the island. Chersonissos lies at the foot of the Dikti Mountains and the Lasithi Plateau, a beautiful area that is also of botanical importance. If one prefers a base in the west of the island, the villages in the vicinity of Chania would be a good choice. There are many places that would make suitable bases along Crete's northern coast, although the island is by far too large to explore from any single base. Therefore, it makes sense to spend some time traveling from place to place, and in autumn it's very easy to find accommodation. Both Chersonissos and Chania are situated on the north of the island, which extends more than 250 km from west to east. Driving along the north coast is easy since there is a good road, but traveling inland and along the south coast is much more time-consuming.

The climate is typically Mediterranean. Most plants flower in spring, after a mild, moist winter. Summers are hot and dry, so late spring and early summer are the best time to see the range of mountain plants, including a number of endemic species. When the temperature starts to drop in late summer and the autumn rains arrive, plants start to grow again, and for some autumn is their flowering season. Most of the plants that flower in autumn are bulbous in the broad sense (that is, including corms and tubers).

The Cretan Floral Area

According to the *Flora of the Cretan Area* (Turland et al. 1993), Crete's indigenous flora includes more than 1,600 species, of which nearly 9% are endemic to the island. Many species found on the Balkan Peninsula and particularly in mainland Greece can be found on Crete, but there are also many species with a connection to Turkey, and even a small North African element.

As far as autumn-flowering bulbous and tuberous plants are concerned, some 25 species occur on the island itself, of which five are endemic to the Cretan Area, which consists of Crete, some small offshore islands, and the Karpathos group. A few others occur within the Cretan Area but not on Crete itself. Most of the species that are not endemic to the Cretan Area can be found in other parts of Greece, particularly the Peloponnese, or in southwestern Turkey.

Lily Family

The lily family in the wide sense—that is, prior to the recent split into Colchicaceae, Hyacinthaceae, Alliaceae, and so on—contains a large number of interesting bulbous plants. On Crete four species of *Colchicum* occur, although I did not find any sign of *Colchicum cupanii* (reported to flower there in November and December) or of *C. pusillum*.

Colchicum macrophyllum (photo, p. 97) is not endemic to Crete, being found on some other Greek islands and in southwestern Turkey. It has small populations scattered across the island, but I found it in enormous numbers in heavily grazed areas between *Phlomis* bushes on karst-limestone on the Drápano Peninsula, in the west. In the foothills of the Dikti Mountains I have seen it in open woodland under the deciduous oak *Quercus pubescens*. It is a large-flowering species that provides spectacular displays with its pink-purple, checkered flowers. The leaves are absent at flowering time. It somewhat resembles *C. variegatum*. The population in the foothills of the Dikti Mountains was quite variable. In particular, the tepals varied in the amount of tessellation (checkering), shape, and width.

Colchicum cretense (p. 99) is really a mountain species, not reported from areas below 1000 meters (3250 feet). This Cretan endemic is apparently distinct from its lowland cousin *C. pusillum*, which is also reported from the island. I have seen *C. cretense* in large numbers in the mountains around the Lasithi Plateau in the east of the island, and also on the Omalos Plateau in the west. It is said to be the smallest of all the colchicums and has pale lilac to white flowers. I have seen plants with well-developed leaves and plants without any leaves at one time within a single population. When it forms clumps it is a delightful species, although isolated bulbs look rather insignificant in flower.

Allium callimischon subsp. *haemostictum* is apparently confined to the west of the island. I have seen it at several locations, including the Imbros Gorge. *Allium callimischon* itself can be found in the Peloponnese, but this particular subspecies

is a Cretan endemic. It's just 10 cm (4 inches) tall and has white, spotted flowers. *Allium chamaespathum* grows to about 30 cm (1 foot) and has pale green or white flowers. The flowers are cylindrical with projecting stamens.

Drimia maritima (syn. *Urginea maritima*; recently renamed *Charybdis maritima*) is one of the most common bulbs on the island. Its flowering season starts in summer but continues into early autumn. It bears inflorescences up to 1.5 meters (4.5 feet) tall, containing hundreds of white flowers. The leaves are completely absent when it flowers but develop later in autumn. Just before the leaves start to grow again, the bulbs, which are huge in spring, look very shriveled.

Scilla autumnalis (recently renamed *Prospero autumnale*; photo, p. 97) is quite widespread on the island and has a large Mediterranean distribution. It is one of the earliest autumn bulbs to flower. Elsewhere in the Mediterranean I have found ripe seeds when nearby specimens were still flowering; apparently the seeds ripen very quickly. It has lavender or blue flowers, but I found a pure white specimen not far from the ancient site of Aptera, in the west of the island.

Arum Family

The Araceae are well represented on Crete. In spring the big, spectacular *Dracunculus vulgaris* is quite common, but in autumn you can find more refined species.

Biarum davisii subsp. *davisii* (p. 97) is a rather bizarre botanical treasure. This small plant has a pale yellowish, speckled spathe that is just 5 cm (2 inches) in height. It is endemic to the island, although another subspecies, subsp. *marmarisense*, can be found in southwestern Turkey. It was a great pleasure to find two specimens on the east-facing hills near the village of Imbros, in the west of the island. Here, at approximately 1400 m (4550 feet), it was very much at the top of its elevational range. Later I found two more plants in heavily grazed vegetation on karst-limestone in the east of the island, but my overall impression is that this unique plant is quite rare. The other *Biarum* to be found on Crete is *Biarum tenuifolium*, which occurs here in two forms.

Arisarum vulgare was found in the Imbros Gorge and can be seen in wooded areas elsewhere too. It is a lovely plant that prefers to grow in some shade. It has pale spathes with darker stripes and *Arum*-like leaves. Its main flowering season is spring, but it usually produces a few inflorescences in autumn. It has a large, primarily Mediterranean distribution but can even be found on the Azores and Madeira in the Atlantic.

Amaryllis Family

This important family Amaryllidaceae has no less than five autumn-flowering representatives on Crete. Its only other representative on the island is *Narcissus tazetta*, generally regarded as winter-flowering although late flowers can be seen into April.

Narcissus serotinus (p. 98) is always a pleasure to find. This delightful autumn-flowering narcissus has one or two small white flowers per stem, sometimes held upright but generally nodding. It is not confined to Crete but has a large Mediterranean distribution. I have seen sizable populations in the foothills of the White Mountains in the west and on the limestone slopes just north of the Lasithi Plateau in the east.

Three species of *Sternbergia* are reported from the island, although one, *Sternbergia lutea*, is very rare here. *Sternbergia sicula* and the endemic *S. greuteriana* are said to be more widespread. The first *Sternbergia* I found was highlighted by two small tree frogs that were climbing through some dwarf *Euphorbia acanthothamnos* shrubs which shared the habitat of the sternbergias. I found very small sternbergias (p. 98) at several places around the Lasithi Plateau, and also in the Kotsifos Gorge in the west. The latter was probably *Sternbergia sicula*, although *S. sicula* and *S. greuteriana* are, in my experience, very difficult to tell apart. The main differences are supposed to be the filament length (shorter in *S. sicula*) and the bulbs (stoloniferous in *S. greuteriana*). If I saw *S. sicula*, it was clearly much smaller than typical forms of *S. sicula* found on the Peloponnese. It was interesting to see that some populations of *Sternbergia* started to flower in early October; at the same locations, I had found no flowering plants a week earlier.

A visit in early autumn gives you the chance to find the last sea-daffodils—*Pancratium maritimum* (p. 97)—in flower, although its main flowering season is in August and September. Its large, pure white flowers are a wonderful sight. It is more or less confined to sandy beaches, although it can sometimes be found in low grassy vegetation but always near the sea. Given the mass tourism on the beaches between Heraklion and Chersonissos, it is astonishing that it still survives at some of these overcrowded locations.

Other Bulbous and Tuberous Plants

I did not find any of the autumn-flowering crocuses, presumably because they tend to bloom a little later in the year. The last two geophytes that I found in flower were *Cyclamen graecum* and the orchid *Spiranthes spiralis*.

Cyclamen graecum (p. 99) has a long flowering period, from late summer until November. The endemic subspecies *candicum* (syn. subsp. *mindleri*) is widespread on Crete and common in the foothills of the White Mountains and in hills just north of the Lasithi Plateau. Subspecies *graecum*, common to the mainland, is known in Crete only from the Kórikos and Rodopouí peninsulas. The flowers of subsp. *candicum* tend to be much paler than those of subsp. *graecum*, though both are variable in color and petal shape and display endless leaf variations.

Spiranthes spiralis, an interesting autumn-flowering orchid, has a large distribution. On Crete I found it only near the village of Imbros. Its white flowers are arranged spirally around the scape.

Woody Plants

Several woody plants also provided interest during my autumn visit—some for their fruits, like the hawthorns (*Crataegus*), and some for their flowers.

Erica manipuliflora, an autumn-flowering heather, blooms in various shades of pink and grows to about one meter (39 inches) tall. It is quite common on the island.

Vitex agnus-castus is yet another shrub that flowers in autumn. It is a member of the Verbenaceae and has generally pale blue flowers. It is quite typical of seasonal riverbeds and gorges and very widespread in the Mediterranean area.

Ceratonia siliqua, the carob, is an evergreen, autumn-flowering tree quite common on Crete. Its inconspicuous greenish flowers are visited by huge numbers of bees that can be heard from a distance.

Osyris alba (p. 98) is a rather common dwarf shrub. It superficially resembles *Ephedra campylopoda*, also found on the island, but is easily distinguished by its leaves, which are small but usually quite clearly developed, unlike the minute, scale-like leaves of the ephedra. In autumn, both carry red berries.

Crataegus azarolus var. *aronia* is an interesting hawthorn which can have orange-red or yellow fruits; I was quite surprised to find a few of the yellow-fruiting forms during my visit. It is native to Crete and is cultivated elsewhere in the Mediterranean for its edible fruits. Another hawthorn, *Crataegus monogyna* subsp. *azarella*, was found on the Lasithi Plateau and carried an enormous amount of bright red fruit.

Pyrus amygdaliformis, the wild pear, is common on the island and ripens its fruits in autumn. The apple-like fruits are about 3 cm in diameter and barely edible.

Phoenix theophrastii, one of only two palms native to Europe and listed as endangered, forms a sizable grove in the northeast, with some smaller populations elsewhere along the Cretan coast.

Autumn-Flowering Herbaceous Plants

Atractylis gummifera, a nearly stemless thistle, is quite widespread on the island. Its pink-purple flower heads are about 5 cm in diameter. It is a wonderful autumn-flowering plant, often visited by butterflies. It grows on very dry, exposed places, and all the leaves have died down by the time it flowers.

Carlina corymbosa is another late-flowering thistle quite common on Crete. It grows to about 40 cm. The small flower heads are surrounded by conspicuous yellow bracts.

Ecballium elaterium, a yellow-flowering member of the cucumber family, is an amusing plant owing to its oblong, green, 5-cm-long fruits, which can explode in response to the slightest disturbance when ripe. One has to be a bit careful touching these fruits, though, because apparently the liquid contained in them can cause skin problems. It is rather common on waste ground on Crete and elsewhere in Greece.

Euphorbia characias, a meter-high spurge, although normally spring flowering, was found in flower in October and, to my surprise, it was being grazed by a very colorful caterpillar.

Origanum dictamnus, a small, woolly, aromatic herb, is one of the most special plants of the Cretan flora. It has pink flowers in summer and early autumn. Like many Cretan endemics, it is confined to the cliffs in limestone gorges.

Ranunculus bullatus, a refined buttercup, dies down in summer and starts its life cycle again in autumn, when it produces a leaf rosette and showy yellow flowers. It is occasionally found on limestone and has quite a large elevational range. On a mountain just north of the Lasithi Plateau at 1300 meters, it created a wonderful display together with small sternbergias and *Colchicum cretense*.

Taraxacum gymnanthum, a neat autumn-flowering dandelion, was found in the Dikti Mountains and also on the Omalos Plateau.

Conclusion

Although Crete is less known for its autumn bulbs than is the Peloponnese, there is much to see. Some of the island's 25 autumn-flowering bulbous and tuberous species are extremely rare, so an autumn visit can be very rewarding. Since there were many more plants in flower during the second week of my trip (the first week of October), I would suggest visiting a bit later than I did. Any time from October through to November should enable you to see many of these autumn-flowering plants at their peak.

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Notes

A number of books on the Cretan flora can be obtained from the Alpine Garden Society bookstore; see the AGS advertisement in this issue.

The "recently renamed" remarks in the text reflect changes appearing in Fielding, Turland and Mathew 2005, which the editor obtained just before publication of this article (see "Books" in this issue). We have retained the more familiar names as well.

Spring-flowering Geophytes in Crete

Jane McGary

In April 2005 I spent two weeks in Crete, where I enjoyed seeing many flowering bulbs and other geophytes (plants which spend part of the year as dormant storage organs underground). The terrain, though limestone rather than basalt and granite, often reminded me of the Siskiyou Mountains around the Oregon-California border. Many of the plants discussed below grow where snow falls in winter, but the temperature obviously is never very cold; olives grow up to a considerable elevation, and oranges at about the same elevations one would see them in the Sierra Nevada foothills of California.

Aristolochia ("Dutchman's pipe") is a genus of tuberous plants. Many are massive climbers of tropical regions, but a few species are native to warm temperate places. *Aristolochia cretica*, a species of moderate size, grows near the sea on rocky slopes, scrambling among the spiny shrubs for which Crete is notorious. Its flowers are thickly lined with long hairs like those of *A. chilensis*, a plant of coastal and warm inland regions in northern Chile. An endangered butterfly which depends on *A. cretensis*, the Cretan Festoon, was fluttering around the plants we saw.

Another geophytic, tuberous dicot genus is *Umbilicus* (Crassulaceae), the navelwort, which grows in shaded rock crevices and has rounded, glossy, succulent leaves. Like many other rock gardeners, I grow *Umbilicus aizoon*, a fairly large species, and the little annual *U. rupestris*. In Crete I saw two small ones: *U. horizontalis* growing near the entrance of the myth-resonant Idaean Cave, and *U. parviflorus* with attractive dark red new growth. Both should be reasonably hardy (the former was still surrounded by snow patches in April), and I've found the genus easy to grow from seed.

As in California, *Oxalis pes-caprae* is a weed found in most cultivated areas, probably smothering more interesting things; it's said to be resistant to herbicides, which are used extensively in the olive groves it carpets. I did see the interesting double-flowered form, which is attractive but probably spreads as badly as the single—the main method of increase being by bulblets, not seed.

One of the most exciting plants was *Paeonia clusii*, growing at fairly high elevations in sparse conifer woodland, in clay with much limestone rock. It had

not yet opened its flowers but even in bud it was beautiful, the foliage emerging dark red and deepest green. I'll certainly try to get seed of this species.

Corydalis uniflora is a very small alpine scree plant which seems to favor verbally wet sites, much as deciduous *Lewisia* species do in North America. The foliage is glaucous and the flowers pale lavender.

Another high point was seeing masses of *Cyclamen creticum* in flower (photo, p. 100). This species has white flowers of rather thin texture but otherwise resembles *C. repandum*. The foliage is sometimes marked with white, but not as strikingly as in some other species of *Cyclamen*. It grows at mid elevations in shady places, mostly under hardwoods and on rocky ledges. It should do well in northern California and southern Oregon, and I wouldn't hesitate to try it outdoors here in northern Oregon if I had enough plants to experiment with. John Lonsdale kindly sent me a few, but they're being kept under cover for the time being.

There were many *Ranunculus* species of the buttercup type, and also *Ranunculus asiaticus*, the bright red ancestor of the tuberous garden ranunculus. *Ranunculus ficaria* was frequent, and in deep gorges grew *R. creticus*, essentially a large version of the former.

Anemone coronaria, the ancestor of the tuberous anemones of gardens, was present in all the color forms now offered by the Dutch, but these usually grew in single-color populations that seemed to be segregated in part according to elevation. Even more frequent was *Anemone hortensis* subsp. *heldreichii* (p. 100), a small plant with white flowers, blue-gray on the reverse; this grew quite high in the hills.

We saw two amaryllids. There were late flowers on *Narcissus tazetta* in its pretty bicolor form with a white corolla and deep gold cup; the plants were growing in very moist sites, such as halfway down a streambank or among sedges in coastal wetland just behind the beach. *Pancratium maritimum* (p. 97), deep in the sands just inland from the beach, was in leaf; the flowers emerge after the leaves have withered, as described in Kees Jan van Zwienen's article in this issue.

Aroids are a conspicuous part of Crete's vegetation. *Arisarum vulgare* flowers in deeply shaded sites in good soil, often fringing the base of a boulder. The massive *Arum concinatum* grows in cultivated land, but I saw no flowers. Also yet to bloom was the more alpine *Arum idaeum*. I scrambled down the precipitous ravine fed by the waters from the Idaean Cave hoping to find flowers in a warm, sheltered spot, but to no avail. I was able to photograph flowering *Arum creticum* (p. 101) in a deep gorge; the spathes there were all cream-colored, not the primrose yellow of the popular "F.C.C." form, which I grow in my bulb frame. Recently Wim de Goede gave me an even deeper yellow form. *Dracunculus vulgaris* grew in a wide variety of sites, mostly where there was some good soil and often in old habitation sites. Most of the plants had leaves well marked with dashes of white (p. 101), which was a surprise to me since the forms I grow, from Asian sources, have plain leaves. I got seed of the Cretan form this fall from the Archibalds' list and look forward to having it in the garden. Some of the *Dracunculus* clumps were over a meter tall. Finally, *Zantedeschia aethiopica* (the calla) has escaped from gardens in some lowland areas of Crete, as it has in California.

Crete has one spring-flowering crocus, *Crocus sieberi* (p. 102). The populations I saw were blooming in scree just below melting snowfields, and there were crocus leaves in other places where the snow had recently gone. The flowers are white with yellow throats, sometimes with a little purple on the reverse.

Gladiolus italicus is robust and colorful, often growing in great masses in cultivated fields, where its many bulblets are distributed by plowing; it's hardy here in Oregon but never attains the size of the Mediterranean specimens.

Iris sisyriuchium (syn. *Gynandriris sisyriuchium*; recently renamed *Moraea sisyriuchium*; photo, p. 101) is a little plant which produces a succession of ephemeral bright lavender flowers. It grows as individuals or well-scattered colonies on fairly flat ground at mid elevations. *Iris tuberosa* (syn. *Hermodactylus tuberosus*) was flowering on rocky uplands among grasses and dwarf shrubs, here mostly a gray color form. Both of these irids seem to be hardy to at least 20° F/−6° C.

We saw two *Iris* species: *Iris unguicularis* subsp. *cretensis* (syn. *I. cretensis*; photo, p. 100), hardy outdoors in my garden, favored banks of clay and rock. It reminded me of Pacific Coast irises with its dense foliage clumps and brilliant purple and gold flowers and appears to enjoy the same well-drained sites. The tall bearded *Iris albicans*, probably an ancient introduction, lifted its floppy white flowers in old habitation sites. This too is flourishing in my garden despite much colder, wetter winters than it usually faces at home.

The form of *Romulea bulbocodium* that grows on Crete here is normally white, flowering right on the ground in vernal wet rocky clay—the kind of site where you'd find *Olsynium douglasii* in the American West, or some other *Olsynium* species in the Andes.

Allium ampeloprasum (the leek) grows wild here. The showiest onion was *Allium trifolium*; also seen were *A. nigrum* in bud, *A. roseum* in flower, and *A. rubrovittatum* in leaf. I missed seeing *A. subhirsutum* but came home to see it flowering in my bulb frame; it's a charming small, white-flowered species.

Asphodeline lutea and *Asphodelus aestivus*, liliaceous plants with thick storage roots, are among the commonest plants in Crete owing to the fact that they aren't eaten by the ubiquitous sheep and goats; both are good border plants in temperate gardens. Also everywhere is the sea squill, with big glossy green leaves that I at first mistook for *Colchicum*; it flowers later in the year and is described in the companion article. Here I resort to the common name, since botanists have recently hauled the sea squill through *Urginea*, *Drimia*, and *Charybdis maritima* in rapid succession.

A thrill for me was seeing *Fritillaria messanensis* (p. 100) growing on the rocky summit of a hill near Spili. The flowers were much more variable in their markings than specimens I've grown from seed, some with prominent green median stripes. I was also able to buy seed from this population from the Archibalds.

Gagea is a genus related to *Tulipa* which is little known in gardens, despite the fact that its little plants are delightful additions to the rock garden. There are dozens of species, at least some of which are sure to be cold-hardy. On Crete I saw two yellow-flowered species, *Gagea chrysantha* and *G. bohémica*, and the white *G. graeca* (p. 100).

Muscari comosum, one of the "tassel hyacinths" formerly known as *Leopoldia*, is dug here for food. I tried the bulbs at a taverna but found them too bitter, despite the elaborate preparation Cretans use to leach out the unpleasant compounds. It's very common in fields and uplands. *Muscari neglectum* seems less common. *Muscari spreitzenhoferi*, a dull-flowered little species, grows in beach sands.

I saw two ornithogalums: the familiar tall *Ornithogalum narbonense* among dense grasses and shrubs, and miniature *O. divergens* in rocky flats and crevices. I was confused when I saw colonies of what I took to be *Chionodoxa*, but the group leader called them *Scilla nana*. Grey-Wilson and Mathew's manual of the bulbs of Europe (1981) refers to these plants as *Chionodoxa cretica* and *C. nana*, the latter considered by some authorities "a high altitude form of *C. cretica*." The current view in the new *Flowers of Crete* is that they are both to be called *Scilla nana*, with subspecies *albescens* and *nana*; I think I saw both subspecies, respectively medium-sized and little plants with upfacing starry, white to light lavender, white-centered flowers. I saw them mostly emerging from dense thorn bushes where the sheep couldn't get at them.

Finally we come to the tulips of Crete. *Tulipa saxatilis* grew on ledges among rock outcrops; it is almost a Cretan endemic, with a few populations also on Rhodes and in southwestern Turkey. An amenable rock garden plant, it can be bought for a pittance from Dutch bulb suppliers. A true endemic is *Tulipa cretica* (p. 102), which we saw mostly in crevices of a spectacular vertical seaside cliff and in crevices of a black rock that I was told was a form of serpentine; however, there were outlying plants flourishing in rich soil, and I suspect the rocky habitat is mostly protection from rodents. I grow this in the bulb frame, where it flowers well and sets plenty of seed. *Tulipa doerfleri*, sometimes regarded as a form of *T. orphanidea*, grows in scattered colonies in upland meadows, notably around the famous Spili Mounds. *Tulipa bakeri*, which some authorities regard as a dark color form of *T. saxatilis*, is another Cretan endemic. It flourishes in fields in the upland Omalos Plain, where livestock had apparently been excluded during its growing season. Many of the flowers there were richer in color than the commercial clone 'Lilac Wonder'.

A rank newcomer to the appreciation of European terrestrial orchids, I'll refrain from discussing these geophytes, except to mention that Crete is famous for them. The island hosts around 67 species, and we saw at least 44 of them. The *Ophrys* especially are very difficult to sort out. We encountered a Dutch group who were there to look at *nothing* but the orchids. Most of the orchid species are threatened by overgrazing and particularly by fertilizer application to stimulate forage, which is subsidized by the European Union; several former orchid sites we visited had been disked and fertilized and had little on them but coarse pasture grass. Of course, the island has been grazed for millennia, but new roads and pickup trucks have probably brought many more herders to formerly little-used areas. It seems imperative that some private organization should buy choice plant areas and control the grazing schedule on them.

This trip was my first experience with a group nature tour, organized by the English firm Greentours. The experience was more positive than I had thought

it would be, and I'll probably take more such trips to places I wouldn't like to drive on my own. The roads in Crete are narrow and precipitous, but no worse than many others I've driven on, and the drivers appear careful, so I could have managed with a rental car. Tourism is a major part of the economy, and even in the off season when we visited there were ample lodgings and other services. The weather was pleasantly cool and occasionally windy and rainy—the preferred conditions for geophytes to grow—and a choking African sandstorm blew in one day.

There are many books on the Cretan flora (see a review of the latest in this issue), and access to good plant sites is easy. Along with the other authors of articles in this little thematic cluster, I highly recommend a visit to the island to all rock gardeners.

More information

Greentours, an English nature tour company, offers excellent guided botanical and birding trips to Crete and many other Mediterranean areas. See <www.greentours.co.uk> or write to Ian Green, Leigh Cottage, Gauledge Lane, Longnor, Buxton, Derbyshire SK17 0PA, U.K.

For a review of the new *Flowers of Crete*, see “Books” in this issue.

Jane McGary is the editor of the *Rock Garden Quarterly* and maintains a large collection of bulbs at her home near Portland, Oregon.

Montreal's New Vertical Crevice Garden

René Giguère

A new chapter in the history of the Montreal Botanical Garden's alpine garden began when Zdenek Zvolanek came to Montreal with his partner, Joyce Caruthers, in November 2003. As curator of the alpine garden and president of the Quebec Alpine and Rock Garden Society, I gave them a tour of the alpine garden, despite the late season. The garden had gone through several frosts and was prepared for winter with pine boughs and protective polyfoam sheets laid over the more fragile plants. Its bare aspect, however, had an unsuspected advantage: it allowed the backbone of the garden, its rock arrangement, to stand out more than during the growing season. Our guest was impressed with the quality of the rockwork, its rich texture, and its eroded look, as well as with the extent of our garden. Historically, the alpine garden is closely linked to the vision of the first curator of the Botanical Garden, Henry Teuscher, who drew the first layout of the garden in the 1930s. Construction of the Alpinum extended over 25 years, and it was not until 1962 that the first plantings were carried out.

As Zdenek and I walked around the alpine garden, we came to a bare area undergoing transformation just beyond the entrance gate. For two years, gardeners had been battling a chronic bindweed (*Convolvulus arvensis*) problem. Determined to end the waste of time spent endlessly weeding this area, I had condemned it until an interesting alternative arose. The location within the Alpinum was favored, benefiting from optimal visibility to entering visitors. When I presented the site to Zdenek and emphasized its potential, a spark went through his mind. He looked at the site with an architect's eyes and the spirit of a garden designer. I was wondering how to get more impact out of the site, and he suggested building a vertical crevice garden to grow difficult alpines. Zdenek remembered visiting Lincoln Foster's garden in Connecticut, where he had seen alpine gems grown to perfection. He suggested that the crevice garden could house collections of Foster's saxifrage and phlox hybrids. The Saxifrage Society lists 66 cultivars as Foster's creations, and Zdenek's link with specialist growers in the Czech Republic could help gather and propagate the collection.

This innovative concept suddenly offered more potential for the old problematic groundcover section. The idea I had been seeking to maximize this strate-

gically placed area was now in sight. An architect skilled at drawing, Zdenek put his idea on paper before he left. His sketch showed a rather daring project: he imagined large, parallel, vertical slabs of stone rising from a slightly elevated rectangular platform, forming distinct masses among which visitors could walk and closely observe the plants placed in the crevices. This idea, though exciting because of its innovative quality, incited some questioning among my colleagues. A common concern was the integration of this new structure into the Alpinum: How could we avoid a clash with the surrounding naturalistic mountain setting?

In January 2004, following several telephone discussions, Zdenek sent us a new design. To help integrate the crevice garden into the existing frame of the alpine garden, he proposed a structure built in a depression, which would minimize the visual contrast with the surroundings. This clever idea also generated slopes which, combined with the sun's orientation, would create microenvironments to please even the fussiest alpinists. The new design was inspired by the sinkhole formations typical of karst landscapes. When underground limestone goes into solution, caverns are left behind. Over time, as the caverns enlarge, their roofs can collapse, leaving structures called "dolines," or more simply, "sinkholes." They often have more or less funnel shapes, with steep walls around central depressions. Our interest in developing such a structure lay in having walls with various degrees of verticality around a deep, cool, humid center, creating ideal conditions to promote the growth of many alpinists. The southern slopes above the sinkhole form small amphitheatres with optimal solar energy to suit plants requiring "baking" in a northern country like ours, where growing seasons are too short for many southern plants. Heat-loving plants placed at an optimal angle to the noon sun can harden their tissues and produce more fungitoxic substances near the hot rock surface. This improved hardening in turn safeguards the plant against frost and insects.

We refined the proposal when Zdenek returned to Montreal in February 2004 as a guest speaker for QARGS. After the meeting, exciting discussions and brainstorming took place, and the final design was carefully drawn to scale in three different perspectives. The revised plan proposed a garden built around a central depression accessible to visitors, linked to the outside by a narrow path and surrounded on most of its periphery by a large footpath. The vertically placed flat stones would all be aligned east-west so the overall effect would simulate natural uplifted sedimentary rock strata.

Because Zdenek had worked on vertical crevice gardens elsewhere for over 15 years, he could easily explain the advantages of having such an unusual structure to grow alpinists. He had covered this topic in his presentation at the Seventh International Rock Garden Plant Conference in Edinburgh in 2001. Growing alpinists in vertical crevices provides stable environments for the plants to thrive and ultimately to mature. The basic idea behind such an experimental garden combines two growing techniques: the vertical crevice, and the sand bed (the fill between the rocks). Such a garden doesn't require artificial watering, nor does it need winter protection other than the natural snow cover. The concept was not new, having been described in 1860 by James Backhouse.

Applying this concept to the Alpinum's situation in Montreal presented both promises and challenges. Our first concerns were not winter harshness and cold temperatures, but rather occasional hot spells in summer. How could the plants benefit from growing in a highly mineralised environment in an open situation where the heat could rise to high levels? The answer lay in the cool root run in the deep crevices and in the shady north-facing micro-habitats behind the stones.

With such a promising though avant-garde prospect, with an expert ready to contribute to the construction, and with prospects of new spaces to grow more alpines, we definitely wanted to proceed. The timing was right for us to apply to NARGS's Norman Singer Endowment Fund. Our project was selected and given a grant: a green light.

Early in the planning phase we needed to explore the subsoil and find the water table so drainage would be perfect. A specialized technician inspected the soil profile and located the depth of water. We found that water rested at 1.7 meters below the soil surface, which necessitated a slight modification of the proposed depression to ensure proper drainage. Zdenek modified the plan by raising the whole structure about a meter. Later we excavated nearly the whole area the crevice garden was to occupy to a depth of about 2 meters, and to improve drainage we set up several rows of drainage tubing (big-O in a geotextile sleeve) over a thick bed of coarse gravel running from a higher to a lower point toward the periphery. This was then covered with coarse sand to a depth corresponding to the floor of the central depression from which the rest of the crevice garden would rise.

The first phase of construction took place in October 2004. Zdenek arrived on October 14 from England, where he and Alpine Garden Society members had just built a vertical crevice garden of sandstone at the AGS headquarters. Rock hunting was first; we had to select rock that would more or less match that of the existing Alpinum. A visit to a nearby quarry allowed us to select suitable rocks. The selected rock is Postdam sandstone (96.22% silica, 1.09% ferrous oxide), locally extracted and sorted into various thicknesses and shades. We also obtained crushed gravel of the same material to use as top-dressing and fill in the crevices. The selected 38 tons of flat stones arrived at the garden by October 18 and 19, by which time we had begun excavating the desired grades and defining the depression and narrow path. Once the basic levels were achieved, the entire surface was covered with a geotextile sheet to prevent recolonization by bindweed. The sheet was then covered with a 15-cm layer of ordinary garden soil, containing some sand and compost. Over this soil layer we added coarse sand to create the bed in which the rocks were to be set upright. In much of the garden this meant a considerable depth of sand; in all, we used 100 cubic meters of sand. Using sand had many advantages: it was easily available and cheap and easy to handle even manually with shovels, and since we had to place the rocks by sinking them into a firm substrate, sand was an obvious solution. As opposed to soil, sand is an interesting material to work with even under rainy conditions. But more important to the plants, the sand was free of weeds and fungi. Because sand is easily aerated, the top layer dries quickly after rain, an added advantage with alpines whose crowns are susceptible to rot.



Left, *Colchicum macrophyllum* (p. 84) in the foothills of the Dikti Mountains, Crete;
right, *Scilla autumnalis* (p. 85) near the Lasithi Plateau. (K.-J. van Zwienen)

Left, *Biarum davisii* (p. 85) near Imbros, Crete, c. 1400 meters;
right, *Pancratium maritimum* (p. 86) near a beach between Hersonissos and Iráklío.





A small *Sternbergia* (*S. sicula* or *S. greuteriana*; p. 86) in mountains north of the Lasithi Plateau. (K.-J. van Zwienen)

Left, *Narcissus serotinus* (p. 86) in the foothills of the White Mountains, Crete; right, *Osyris alba* (p. 87) in fruit, Dikti Mountains.

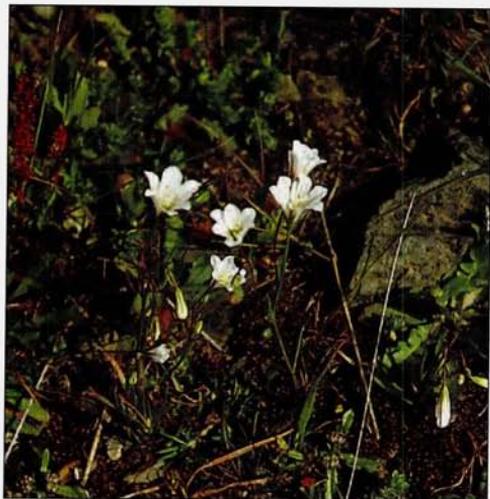




Flowers and well-marked foliage of fall-blooming *Cyclamen graecum* (p. 86) on the Lasithi Plateau. (K.-J. van Zwiennen)

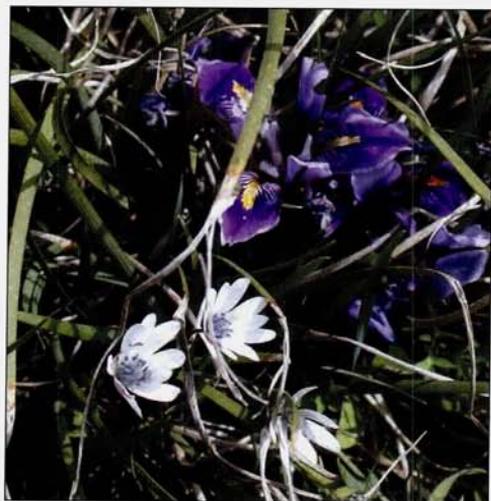
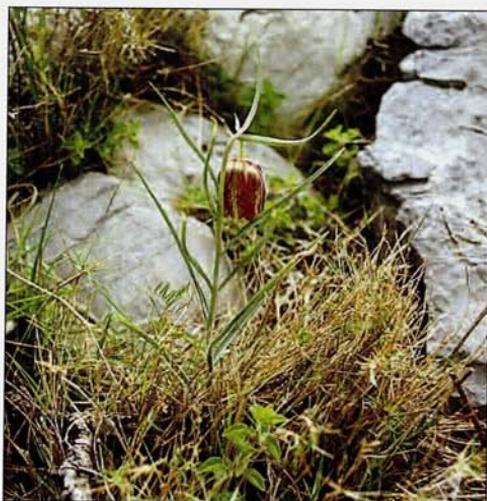
Colchicum cretense (p. 84) in mountains just north of the Lasithi Plateau.





Left, *Cyclamen creticum* (p. 90) with seedlings; right, *Gagea graeca* (p. 91). (J. McGary)

Left, *Fritillaria messanensis* (p. 91); right, *Iris unguicularis* subsp. *cretensis* and *Anemone hortensis* subsp. *heldreichii* (p. 97), both near Spili, Crete.





The beautifully marked Cretan form of *Dracunculus vulgaris* (p. 90). (J. McGary)

Left, *Arum creticum* (p. 90) in Antonios Gorge; right, *Iris sisyrinchium* (p. 91).





Tulipa cretica (p. 92) in a vertical crevice on a sea cliff near Plakias. (J. McGary)

Crocus sieberi (p. 91) flowering amid thorny shrubs just below melting snow in the White Mountains, Crete.





The new vertical crevice garden at the Montreal Botanical Garden (p. 94). (R. Giguère)

Joyce Carruthers planting.





Left, Short-tailed Swallowtail (*Papilio brevicauda*) nectaring from native *Iris setosa*; right, Milbert's Tortoiseshell (*Nymphalis milberti*) on garden *Primula marginata* (p. 115). (B. L. Jackson)

Left, Green Comma (*Polygonia faunus*) on *Erica carnea* 'King George'; right, Red Admiral (*Vanessa atlantica*) on *Sedum spectabile*.





Troughs at the Denver Botanic Gardens (p. 122). Above, “Brown’s Park” (NW Colorado) in May, with *Eriogonum ovalifolium*, *Erigeron consimilis*, *Penstemon mucronatus*, and *Oxytropis* sp.; below, “Mosquito Range” with lavender *Erigeron compositus* ‘Como’, yellow *Erysimum capitatum*, pink *Silene acaulis*, white *Arenaria ledebouriana*, blue *Penstemon hallii*, and rose *Oxytropis* sp. (P. Kelaidis)





Above, "Pikes Peak" with pink granite, *Clematis columbiana* var. *tenuiloba*, white *Phlox condensata*, *Viola pedatifida*, and spikes of endemic *Heuchera hallii*. Below, "Pueblo County" with calcareous shale, the cactus *Echinocereus reichenbachii* var. *perbellus*, whitish *Castilleja sessiliflora*, yellow *Lesquerella engelmannii* var. *ovalifolia*, and budded *Penstemon versicolor*. (P. Kelaidis)





Above, "West Spanish Peak" (an ancient volcano on the Great Plains) with high alpiners: yellow *Hymenoxys brandegei*, tiny white *Androsace septentrionale*, blue *Mertensia viridis*, *Polemonium viscosum*, bronze *Rhodiola rosea* var. *integrifolia*, and lavender *Erigeron simplex*. Below, "San Juan Mountains" (SW Colorado), also volcanic rock, with lavender *Erigeron leiomerus*, tall yellow *Erysimum capitatum*, low yellow *Physaria floribunda*, chartreuse *Ivesia gordonii*, pink *Oxytropis viscida*, and yellow composite *Hymenoxys acaulis* var. *caespitosa*. (P. Kelaidis)





The interpretive rock garden at Mt. Goliath near Denver, built with assistance from a NARGS grant (p. 127). (Sam Bissell)





Typical *Iris cristata* (p. 119) in cultivation in Stefania Wajgert's garden in Poland, honorable mention in the 2005 Photo Contest. (S. Wajgert)

A fine colony of *I. cristata* 'Edgar Anderson' at Joe Pye Weed's Nursery in Massachusetts. (Jan Sacks)





Select cultivars of *Iris cristata* (p. 120). Above left, 'McDonald'; above right, 'Powder Blue Giant'; below left, 'Little Jay'; below right, 'Dick Redfield'. (J. Sacks)





Saxifraga oppositifolia (p. 134). (D. Sellars)

Two special forms of *S. oppositifolia*: left, 'Splendens'; right, *S. oppositifolia* subsp. *rudolphiana*.





Primula bhutanica (p. 136); this photo won 4th prize, class 3, in the 2005 Photo Contest for Denis Hardy.

Primula nana var. *alba* (p. 138), grown and photographed by Denis Hardy.



The rockwork began with using one large original piece of the alpinum's limestone which had long been lying flat in a corner of the site. Zdenek saw in its size the potential to create height by standing it upright. This first setting of rock in the garden was critical to set the orientation of all the other rocks, so we made sure of the east-west orientation. We used machinery to move this large piece into the prepared hole. A mound was created using other large rocks, originally from the alpinum, against this first major rock. All other rock used was obtained from the quarry and aligned parallel to this first set. The floors of the central depression and the pathway were the first sections to be crevice-paved with rocks selected for this purpose. Then we set rocks into place on the sloping surfaces which lead into the depression and along the path by leaning them against the ends of the rocks making up the floor. This method ensured that the rows of rocks would not slide down the slopes as weight accumulated when rocks were added uphill. In certain places we created cliffs up to 1.5 meters high, with the largest stones tilted slightly but nevertheless placed at angles close to 90°. We used different methods to close vertical crevices and prevent leaking of sand along their edges. We tried coconut fiber in some situations, or slices of block peat soaked in a soft clay solution. Some vertical crevices around saxifrages and the tiny primulas Joyce planted were permanently sealed with chock stones hammered in. *Sempervivums* were used to seal some steep ledges. The 38 tons of rock were almost all placed by the time Zdenek left on October 27.

The second phase took place in May 2005, with the addition of 12 more tons of rock. At that point, we could see that the larger slabs placed vertically to form side walls had not moved under the force of strong, continuous winter frosts. The edges along the peripheral pedestrian footpath were modified to give more height. The peaks created the preceding fall were supplemented with additional rocks to produce more dramatic effects and modulate the relief. Zdenek now returned to Montreal, this time accompanied by Joyce Carruthers. We planted more than 2204 plants and 22 *Pinus aristata* (bristlecone pine) during the 14 days they were here. During typical spring weather, the sun was so strong that we needed to shade new planting temporarily.

The garden is divided into three sections corresponding to three geographical regions—Asia, Europe, and the Americas. An area exposed to the hot afternoon sun, facing south-southwest, houses a special collection of cacti provided by our specialist grower: eight species of *Escobaria*, six *Echinocereus*, and one *Pediocactus*, accompanied by examples of *Lewisia*, *Orostachys*, *Delosperma*, *Jovibarba*, *Maihuenia*, *Eriosyce*, *Yucca*, and *Carduncellus*.

The Foster saxifrages (we have managed to gather 21 cultivars) were planted expertly by Joyce in a section of their own where they enjoy the coolest northern slopes of the garden. Much attention was devoted to finding the best niches to plant the small rooted cuttings. Joyce's planting technique, in which each plant is well fixed in place by meticulously tapping in small rocks all around, was a lesson for all who carried out the planting. A variety of tiny European *Primula* seedlings was planted in the same manner. These plants were raised from wild-collected seed by Hans Roemer.

Plant material came mostly from Beaver Creek Nursery in British Columbia and from our own nursery. We have planted 271 taxa (species, subspecies, varieties, and cultivars), 50 from our own production either from seed or vegetative propagation. Plants of the same taxon are grouped to make the garden look more natural. We selected alpine based on their eventual size, preferring those that will mature around 15 cm in height and 30 cm in spread. Some seedling phloxes and dwarf penstemons were directly pricked from pots into narrow crevices. Because the substrate within the crevices consists essentially of coarse sand, we have locally added a handful of soil in each hole before setting the plant in it. As areas were being planted and before they were watered, a good layer of crushed stone mulch was applied where needed.

We inventoried the plants in the crevice garden at the end of July to help us visualize how the plants were behaving and to keep records. The weather was rather difficult for newly planted alpine, with several unusually hot spells accompanied by smog. Nevertheless, we have noted good growth overall. We irrigated during the hot spells; otherwise, the plants were left on their own. The inventory now points out the loss of 6 taxa and some form of damage, mostly minor, to 41 taxa. These results, however, reflect a first reading on relatively newly planted material.

As I write this in January 2006, the garden sleeps comfortably under a good blanket of snow, which this year came and remained from November 17 on. This, combined with the fact that November and December temperatures have been mild, lets us hope for a fairly good outcome for the spring.

The future of the garden holds much promise, and there is still considerable room to experiment with more plants. The search for more Foster hybrids constitutes one important challenge. The concept of creating this garden was born in the idea of honouring Lincoln Foster's memory by gathering a collection of his hybrids. Much work has yet to be done to find the phloxes he worked with, and to a lesser extent his saxifrage hybrids.

Visitor's reactions to the completed crevice garden (photos, p. 103) have focused on its unusual configuration. The public is not accustomed to the use of flat stone in this vertical manner and in such a massive arrangement. There is also much surprise at seeing cacti planted outdoors at our latitude—45° 34' north, in Canadian zone 5b, corresponding to USDA zone 4. We must explain that these cacti originate from reasonably high elevations, which lets us think they will withstand the test of time. The crevice garden's accessibility, with a footpath all around, brings plants close to the eye and helps visitors appreciate the intricate beauty and complexity of alpine. Visitors' interest in this garden is clear and certainly will continue; besides its innovative concept, its privileged location sets this garden in focus. It is hoped that many rock gardeners will come to benefit from our experimental garden and gain ideas for their own projects.

René Giguère is curator of the Alpinum in the Montreal Botanical Garden, Quebec.

Butterflies in the Rock Garden

Bernard S. Jackson

There are few things more beautiful than a good rock garden in full bloom, but I believe that such beauty can be enhanced by the movement and color of butterflies, bees, and hummingbirds. Flowers exist for these and similar creatures, and though our main passion may be for the plants themselves, there are few gardeners who are not moved by the comings and goings of such small native wildlife. My own love for rock gardens coincides with a similar feeling for butterflies, so for me, each enhances the fascination and value of the other.

Though there are some notable exceptions, butterflies on the whole prefer sunny, open, flower-bedecked habitats. Much has been written on the art of butterfly gardening in general, but little, as far as I know, has addressed the value of a rock garden as a suitable environment for these active, colorful insects (photos, p. 104).

A well-designed, generously planted rock garden has much to offer a variety of butterflies and other pollinating insects. In North America, it can also draw hummingbirds. Which butterflies are to be attracted will depend largely on the garden's geographic location and the amount of suitable flowers that are in bloom and producing nectar when the various butterfly species in that area are on the wing. Not all butterflies are on the wing at the same season, nor are all species attracted to the same flowers. Some butterflies—for instance, the showy Red Admiral (*Vanessa atlantica*) and American Lady (*Vanessa virginiensis*)—visit a wide variety of flowers, whereas others, such as the Brown Elfin (*Callophrys augustinus*) are far more specific in their choices.

Of course, the larger and more physically varied the rock garden is, the better; nonetheless, a small rock garden can attract butterflies if it is one element of a larger, more diverse horticultural landscape. And, naturally enough, a gardener working close to wild countryside will probably have more visiting butterflies than one in an urban area.

Butterflies have an aversion to strong wind, so a sheltered garden with depressions, gullies, boulders, and similar wind protection will often be most attractive to them. These insects must keep up their body temperature to remain active, and so they spend much of their time “recharging their batteries” by sunning on

rocks, paths, and so on. Obviously, then, a rock garden is an ideal site to meet these needs, especially early in the day, after a rain, or when a cloud moves across the sun.

Some butterfly species, such as swallowtails (*Papilio* spp.)—especially those living in hot climates—indulge in an activity known as “mud-puddling.” This term refers to the imbibing of natural salts, in solution, from damp soil. Such areas are often impregnated with some form of animal excretion or rotting vegetation, but the water feature in a rock garden often attracts this behavior. Incidentally, male butterflies are relatively more involved in mud-puddling; it is thought that they require more salts to support their higher activity level.

Because my more than forty years of work with rock gardens and butterflies has been largely in Maritime Canada (on the Atlantic coast), I assume that most people reading this will be dealing with many different butterflies and plants than I have. There are approximately 690 different species of butterflies in North America, along with various types of habitats and hardiness zones. NARGS members in Great Britain, Europe, or Japan will encounter an even wider variety of butterflies. Nonetheless, the basics of rock gardening and attracting butterflies are similar, no matter where one lives.

The main factor is the choice of plants, which provide nectar for adult butterflies and host material for their caterpillars. So what rock garden plants are useful in attracting these insects? I use the term “rock garden plant” somewhat loosely, referring to plants of dwarf stature and of a character compatible with our broad impression of what a rock garden should look like. Although these insects are often attracted (thank goodness!) to plants from outside the local area, or even from other continents, they of course show a greater affinity for the plants with which they have evolved. This is not a bad thing, for many such plant genera are admired and sought-after—for example, *Phlox*, *Aster*, *Primula*, *Erigeron*, *Aquilegia*, *Townsendia*, and *Viola*. One of the most useful groups of plants is those with single, daisy-like flowers, so we could include *Hymenoxys*, *Inula*, and *Arnica*. Look to your native flora first for inspiration. A few butterflies that migrate considerable distances—such as the Monarch (*Danaus plexippus*), Painted Lady (*Vanessa cardui*), and American Lady—are inclined to visit a wide variety of flowers, presumably because they have evolved being exposed to the flowers of the various regions through which they migrate. Others, such as the more sedentary Arctic Skipper (*Carterocephalus palaemon*), are in my experience far more finicky.

It is beneficial to grow a large selection of suitable flowers, but this is easier in a large rock garden than in a smaller one. The reason for seeking variety is that not all flowers bloom when there are sufficient numbers of types of butterflies on the wing. Also, in the larger rock garden there is more room to establish larger colonies of individual plants, which are more likely to attract the attention of passing butterflies than a single specimen would.

Some of the alpine plants we grow may not attract the butterfly species that have evolved with them. Although we may manage to cultivate these plants in lowland gardens, it is unlikely that the associated butterflies would leave their

treeless zone to reside lower down. Nonetheless, a plant that attracts a butterfly in one area may have just what it takes to attract others elsewhere. There is room for careful observation here.

For those butterflies that overwinter as adults—such as Milbert's Tortoiseshell (*Nymphalis milberti*; photo, p. 104) and Mourning Cloak (*Nymphalis antiopa*)—it is spring-blooming nectar sources that are important. Here I would include shrubs such as *Erica carnea* 'Springwood Pink' and 'King George'; indeed, any of the spring-flowering heaths would be valuable. Later in the season, the Cornish heath (*Erica vagans*) is a superb attractant in areas where it is winter-hardy. Catkins on the early-flowering dwarf willows are also a good source of early nectar. Common, easily grown plants such as *Arabis*, *Aubrieta*, and *Alyssum* provide both early color and valuable nectar. Although many species of alpine pennycress (*Thlaspi*) are insignificant nuisances, *Thlaspi rotundifolium* is beloved by early-season butterflies. I have it in a scree where, though short-lived, it self-sows admirably.

Daphnes can really pull in butterflies, but there are very few daphnes that are hardy in my Zone 5 garden. However, *Daphne mezereum* does well for me in its normal color form; I haven't yet seen butterflies nectaring on the flowers of my *D. mezereum* 'Bowles White'. It would be worthwhile to investigate the potential of *D. arbuscula*, *D. cneorum* var. *pygmaea*, and *D. domini* if you can purchase them.

Though some sedums are downright ugly, this is nonetheless an important group for attracting butterflies. Fortunately, there are enough beautiful, less invasive sedums to allow for their generous use. Some of the smaller *Vaccinium* species can prove useful, as can the native leatherleaf (*Chamaedaphne calyculata*), which looks good as a specimen plant.

Alliums attract butterflies, and many of the smaller types are good subjects for the rock garden or even the alpine trough. Indeed, this is a somewhat under-used group of plants. *Allium senescens* is reputed to be particularly attractive to these insects, and even the common chives (*A. schoenoprasum*), if grown in a frugal soil, can be quite charming; it is a magnet for many butterflies and the day-flying Hummingbird Hawkmoth. Some creeping plants, such as *Thymus* and *Veronica*, can be useful. Try *Thymus praecox*, *T. serpyllum*, *Veronica repens*, and *V. pectinata*. Mints attract butterflies, but though I now grow the diminutive Corsican mint (*Mentha requienii*), I have not had it long enough to evaluate it as a butterfly plant.

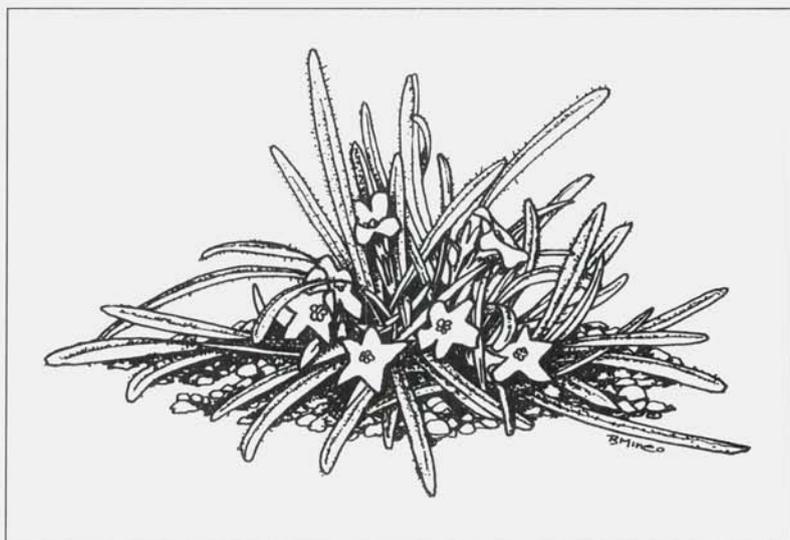
There are many more genera which have representatives of a stature suitable for the rock garden and which attract butterflies. Some that come to mind are *Campanula*, *Chrysanthemum*, *Dianthus*, *Iberis*, *Solidago*, and *Scabiosa*. Even some of the bulbs, such as crocuses and *Scilla siberica*, play their part in early spring when nectar is at a premium. Late in the season, *Chrysanthemum weyrichii* and *Aster dumosus* can be effective.

Some gardeners may be concerned that butterflies frequenting their plants will produce destructive caterpillars. This is a legitimate concern, but I myself have never found it enough of a problem to worry about it. Generally speaking, these insects lay eggs on plants unlikely to be found in the typical rock garden.

I have, however, seen the caterpillars of the American Lady on my *Antennaria dioica*, and those of Short-tailed Swallowtail on Scotch lovage (*Ligusticum scoticum*) in a larger rock garden. In the wild, I have seen caterpillars of the Arctic Blue (*Agriades glandon*) on *Diapensia lapponica*, but should you be lucky enough to grow this treasure, it would be most unlikely that this butterfly would find it. Caterpillars that damage plants in the rock garden are, I believe, more likely to belong to a moth than to a butterfly; and even then, numerous other creatures—slugs and aphids, for instance—pose a far greater threat.

In any case, butterflies in a rock garden are to be admired and, where possible, encouraged. In an age of diminishing wild places, climate change, and humans' apparent indifference to the world they leave their children, I believe that we, as lovers of natural beauty, should do all we can to conserve at least some small component of the natural world.

Bernard S. Jackson, LL.D., ODH, of Truro, Nova Scotia, was a professional naturalist before going into horticulture. He built the rock garden at Memorial University in St. John's, Newfoundland, and worked there for 22 years until retiring. In addition to plants and butterflies, his interests include birds, photography, and speaking to garden clubs. He is the author of a book on butterfly management, *Mindful of Butterflies*, published in England in 1999 (ISBN 1- 85776-339-4), with a foreword by Roger Tory Peterson.



Anchusa caespitosa, a gem among Crete's alpiners. Drawing by Baldassare Mineo.

The Dwarf Crested Iris, *Iris cristata*

C. Colston Burrell

Iris incite more rapture than any other flower, with the possible exception of the rose. The genus is named for Iris, messenger to Hera, the Greek goddess of marriage. According to legend, Iris traveled over the rainbow to reach Earth, and from her footsteps sprang flowers arrayed in the seven colors of the rainbow. In European history, the iris has been prized since at least the sixth century; it became an icon for nobility in the twelfth century, when King Louis VII of France adopted the iris as his Fleur-de-Louis, now known as fleur-de-lis. American irises, though lacking a direct connection to Greek gods, have no less varied a history. The dwarf crested iris, *Iris cristata*, was the first American species sent to England in the 1730s by the botanist John Bartram. It has graced gardens on both sides of the Atlantic ever since.

Iris is the type, or original, genus identified in the Iris family, Iridaceae. The cheery blue-flowered dwarf crested iris (photos, p. 109) is perhaps the best-loved of the eastern American woodland species. Iris flowers have a unique configuration with a total of six segments. The sky blue or occasionally white flowers have reclining standards over drooping falls, giving them a somewhat flattened appearance. The signal spot on the falls is white to pale blue, bordered with a halo of darker blue, and the fall also bears a small, bearded yellow to orange crest. This crested fall gives rise to the common name "crested iris." Last, a triad of arching columns containing the male and female reproductive structures curves out of the center of the flower and lies directly over the falls, forming a tunnel through which bees must travel in order to fertilize the flowers. The blossoms average 2 inches wide and are borne singly or paired in succession from an ephemeral bloom stalk surrounded by an inflated sheath of three modified leaves. Fans of three to five persistent, tapering leaves stand just 4 to 8 inches high when mature. The plants creep over the ground with slender, wiry rhizomes which are swollen at the nodes. In favorable sites, plants eventually form broad, dense clumps.

Crested iris is fairly common in loamy alluvial soils on floodplains, rocky slopes, and outcrops above rivers and streams and in open rocky woods from southern Pennsylvania and Ohio, west to southern Illinois and eastern Missouri, and south to South Carolina, Mississippi, Arkansas, and far eastern Oklahoma.

In the garden, plants thrive in rich, moist circumneutral to subacid loamy soil in light to partial shade. Plants tend to grow best on mineral soils with high organic content, but less vigorously in pure humus. In the wild, they are usually confined to slopes with shifting mineral-based loams where excess leaf litter does not collect. Thick layers of leaves and debris will smother plants in the garden. Crested iris forms extensive mats when sited properly and not crowded. Clumps thrive in deciduous shade and bloom most heavily if they have some direct summer sun.

Divide *Iris cristata* in mid to late summer. Replant the divisions with the top of the rhizome just above the soil surface. The roots are fine-textured and can dry out rapidly, so don't leave them bare for long. Sow fresh seeds outdoors when they ripen in late summer. Self-sown seedlings sometimes appear, but vegetative propagation is far faster, and the only way to maintain named selections. Plants are hardy in USDA zones 3 to 9.

I value crested iris for its broad mats of tidy foliage and the carpet of showy spring flowers which enliven a woodland or shade garden. Place them on a wooded slope, at the front of a bed along a path, or in a rock garden where they have plenty of room to spread. Use them as a groundcover under shrubs and flowering trees. They compete well with established tree roots and excel even in dry shade. Combine them with Jacob's ladder (*Polemonium reptans*), spring beauty (*Claytonia*), wild ginger (*Asarum*), and creeping phlox (*Phlox stolonifera*). Use twin-leaf (*Jeffersonia diphylla*), bloodroot (*Sanguinaria canadensis*), merrybells (*Uvularia*), Solomon's plume (*Smilacina racemosa*), and ferns to add height to the combinations. They also are lovely in shade gardens with hostas, lungworts (*Pulmonaria*), barrenworts (*Epimedium*), hellebores, and sedges.

There are a number of named cultivars which vary in size and flower color. My favorite is 'Abbey's Violet', one of the darkest selections, with deep blue-violet flowers. 'Alba' is pure white, but many white-flowered forms (sometimes listed as *I. cristata* var. *alba*) bear this name and are variable in flower size and bloom time. Here are some recent selections. Many have been introduced by Joe Pye Weed's Garden (see Sources); one of the proprietors, Jan Sacks, has helped with these descriptions and provided some photographs.

- 'Dick Redfield' (photo, p. 110), a beautiful sport with six deep blue-violet falls, bright white signals with dark halo, yellow and white crests, and pale style arms; vigorous and compact, it was found by its namesake in his Connecticut garden.
- 'Eco Little Bluebird', a dwarf to 4 inches with deep blue flowers and orange crests; selected by Don Jacobs.
- 'Eco Orchid Giant', large blue-violet flowers; selected by Don Jacobs.
- 'Eco Texas Purple', deep purple-blue flowers; selected by Don Jacobs.
- 'Edgar Anderson' (p. 109), a large-flowered, early, periwinkle blue with darker tips to the falls, broad white signal, and white, fringed crests; found by iris specialist Robert Pries and named for a staff member of the Missouri Botanical Garden.
- 'Heavenly Blue', saturated medium blue flowers on 4- to 6-inch stems.
- 'Little Bluebird', moderate-sized rich blue flowers on 4-inch stalks.

- ‘Little Jay’ (p. 110), very deep blue flowers (“bluer than any other *cristata*,” writes Jan Sacks) with blue-and-white rather than yellow crests; originated at Joe Pye Weed’s Garden.
- ‘McDonald’ (p. 110), pale lavender-blue with white signals and contrasting yellow crests.
- ‘Merle’s Ruby’, violet-blue flowers.
- ‘Navy Blue Gem’, compact flowers with short, stubby, broad deep purple-blue falls with golden crests; originated in the iris nursery of Lorena Reid, Springfield, Oregon.
- ‘Powder Blue Giant’ (p. 110), aptly named for its huge (3- to 3.5-inch) flowers in pale sky blue with a dark halo around yellow signals held heads above other selections; found in the wild in Litchfield, Kentucky, by Sam Norris, it received the Founders of SIGNA Medal of the American Iris Society for best introduced species iris.
- ‘Sam’s Mini’, 3.5 inches tall with small soft blue-violet flowers, forming large, dense mats; found by Sam Norris in Olive Hill, Kentucky.
- ‘Shenandoah Skies’, a popular and widely available cultivar with medium sky-blue flowers.
- ‘Summer Storm’, deep blue flowers.
- ‘Tennessee Form’, medium blue and vigorous.
- ‘Tennessee White’, selected for its large, pristine white flowers with bright orange signals.
- ‘Vein Mountain’, pale blue with a yellow signal, large-flowered.

The beguiling lake iris (*Iris lacustris*) was once considered a subspecies or variety of *I. cristata*. This diminutive species is even smaller than the crested iris. The 2-inch blue or white flowers are more pert than those of its cousin, with erect standards and falls held flat or slightly elevated. The leaves are very similar but reach only 4 to 6 inches and are generally more narrow and erect. This little gem is rare in nature and has a restricted range on lakeshore dunes and gravel ridges around the western Great Lakes. Plants grow well beyond their native range in light, well-drained, alkaline to subacid soils in sun or partial shade. This species is hardy in zones 4 to 7.

Sources

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Eco Gardens, P.O. Box 1227, Decatur, GA 30031

Garden Vision, 63 Williamsville Rd., Hubbardston, MA 01452-1315; darrellpro@earthlink.net

Seneca Hill Perennials, 3712 Co. Rte. 57, Oswego, NY 13126; <http://www.senecahill.com>

Rice Creek Gardens, 11506 Highway 65, Blaine, MN 55434; www.ricecreekgardens.com

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Garden on the Half Shell:

Denver's Synoptic Trough Garden Display

Panayoti Kelaidis

My first encounter with trough gardens was at the First Interim International Rock Garden Plant Conference in summer 1976 in Vancouver, British Columbia. Members of the Alpine Garden Club of British Columbia were each assigned a specific mountain range from North America (and one or two from the Andes) to encapsulate in a single, fairly uniform trough garden. The troughs were sizable, but not massive (a meter long and half that in width). A poster describing the plants in the trough garden, with pictures of plants contained therein that were not blooming in July, made this exhibit even more compelling and educational. I remember jostling between rapt onlookers for hours trying to get a better view of the Siskiyou Mountain trough, or the one from the Olympics or the Cascades. I was dazzled by the artistry and organization that went into this effort—although I did experience a smug moment when I found that the Southern Rockies trough contained plants from a huge swath of mid-America, including some one would never find growing near one another. The word that describes this sort of thing best, I believe, is “synoptic,” defined by Webster as “affording a general view as a whole”—in this case, presenting an array of highly individual trough gardens which, taken together, provided a wonderful overview of the alpinism of the Americas.

I was so impressed with this trough extravaganza that I completely forgot to photograph either any of the individual troughs or the overall display. However, I've enjoyed revisiting these troughs, which were subsequently placed near the alpine house at the edge of the Ed Lohbrunner Rock Garden at the University of British Columbia. Over the years, I noticed that plants in these troughs appeared to have become mobile. Some from the Northern Rockies appeared in the Sierra trough, for example, and moss grew luxuriantly on the concrete and eventually smothered some of the diminishing alpinism (I was almost jealous: we can never get moss to grow like this in Colorado.) Little did I suspect that in a decade I would be married to someone who would stage a similarly ambitious trough display at the next Interim Conference, which we helped stage in Boulder, Colorado.

The troughs Gwen Kelaidis planted in 1984 and 1985 in preparation for “The Rockies, Backbone of a Continent” were almost all constructed by Stan Metsker,

a masterful gardener from Colorado Springs, who was superintendent at the Country Club of Colorado, a spectacular golf course at the foot of Pikes Peak. Most were a tad smaller than the troughs in Vancouver—some only 18 inches (45 cm) long, and half of them perhaps 30 inches (75 cm) long, and both not much more than a foot (30 cm) wide. Gwen chose to feature only plants of the Rocky Mountains, from the northern Rockies of Canada and Montana to New Mexico. The rockwork was far more daring than in the Vancouver examples, and Gwen was scrupulous in utilizing only rocks and gravel from the very mountains she was re-creating in miniature. Most of the several dozen troughs she planted featured mountains in Colorado and Wyoming, including Pikes Peak, Mt. Evans, the Mosquito Mountains in Colorado, and the Medicine Bow, the Ferris Mountains, and the Bighorns in Wyoming. Gwen also chose to feature lower-elevation steppe environments like Alcova Reservoir, the Uinta Basin, and Brown's Park (photo, p. 105), where the plants resemble tundra species in their tight cushion forms but are much more tolerant of drought and heat.

Special lamps purchased by the Rocky Mountain Chapter were placed over each of the troughs. These were staged in a special exhibit hall in the cavernous Events Center at the University of Colorado, where they positively glowed under their spotlights. Gwen and I dashed off on a post-conference tour, and the troughs were deposited at a nearby garden, where they scorched in the mid-summer sun after five days in the shady, air conditioned hall. Even so, most of the plants in them survived that summer, and a large proportion are alive today in the same troughs—over twenty years later! In fact, a few specimens, such as a *Phlox bryoides* in the Ferris Mountain trough, hardly seem to have changed at all in that two-decade interval. The phlox does condescend to bloom every year; otherwise we might wonder if it hadn't simply petrified.

Both synoptic trough garden displays were designed to be at their peak of interest for a single event. Many of the troughs were several years in the making before the conferences, and many have persisted for some time subsequently. The only comparable assemblages of troughs I have seen elsewhere are the fabulous stone troughs staged near the Alpine House at the Royal Botanic Garden in Edinburgh, and the numerous trough displays at the Royal Horticultural Society's garden in Wisley. Both displays feature a wide assortment of rockwork, plants, and styles. I recall several troughs at Edinburgh which had a distinctly geographical theme: one contained nothing but plants from Spain, for instance. Because these exhibits are permanent and must look good year in and year out, they have undergone frequent maintenance. The horticulturists may not want to be tightly constrained by provenance in selecting good-looking plants. The synoptic theme seems to be a Western Hemisphere specialty.

In 1999 a comprehensive redesign of much of the Denver Botanic Gardens was undertaken under the direction of Rob Proctor, an author and designer living in Denver. He detested the existing cutting garden, a complicated maze of raised beds. The cutting garden was moved to a large, underutilized space across a pond, where it was completely redesigned by Rob, and the raised beds were gleefully demolished. Rob thought this would be an ideal place to install a

trough display along the lines of the one at Edinburgh which both of us admired so much.

The synoptic theme crops up again: this time, each of the several dozen troughs would feature some mountain, valley, or hill in Colorado. Many contain plants that are rare or even endangered. It is an attempt to show the tremendous variety of geology and floristic biodiversity in the state. The creators devoted a summer to camping all over Colorado, from the Southwest Corner to the Great Plains. We gathered rocks and gravel from the properties of many friends and not a few national forests. We collected seeds and cuttings of hundreds of native plants. But what to do about the troughs? Where on earth could we find that many troughs? And the area, several thousand feet square, demanded much larger troughs than were available anywhere we knew of.

Providentially, Mark Fusco was hired the summer of 2000 to maintain the recently planted alpine garden on Mt. Goliath, at nearly 12,000 feet on Mt. Evans. He was so inspired by the trough project that he took on the challenge of building 20 troughs, some of them weighing hundreds of pounds. Many were the size of ancient sarcophagi fit for kings. These had to be transported into the garden with heavy equipment, so the careful laying of flagstone to complete the garden had to wait until Mark had placed the last giant trough. Nine authentic stone troughs, imported from India where they had been used as mortars, were subsequently added to this garden.

As each trough was completed and put in place, special soil was mixed to Gwen's specifications, and she would rapidly compose the idealized simulacrum of the site where the rocks and plants originated. The theory was that each trough would resemble a swatch of tundra or high mountain parkland that had floated intact, as it were, down to Denver. It took a year or two for some of the troughs to reach maturity, but in rich scree soils with deep root runs most of the seedlings and rooted cuttings grew like mad, and these troughs quickly attained a mellow look of maturity (photos, pp. 105–107). They have been a tremendous success; many visitors proclaim that this is their favorite exhibit among the dozens of highly sophisticated gardens that comprise the Denver Botanic Gardens' York Street site.

Mark has summed up the garden's goal for this feature: "Wildflower Treasures [the official name of the display] literally depicts the notion of 'sense of place.' Plants native to the Great Plains and Rocky Mountains thrive in proximity to one another, giving visitors a capsule view of the diversity of western flora. Visitors can enjoy Wildflower Treasures for its impressive display of brilliant spring and early summer show of native wildflowers, as well as for its educational value."

These monumental troughs seem to be an ideal way to display tiny, delicate plants. I am personally surprised at how much better most alpiners grow in these troughs than they do even in our most elaborate crevice gardens. It must be something about the elevation and drainage in a trough, perhaps some evapotranspirative cooling that takes place owing to the high walls of the troughs exposed to the elements. This seems to create an environment much more con-

ducive to the growth of alpiners than any sort of open ground at our elevation (5280 feet/1625 m). *Phlox condensata* and *P. pulvinata* will grow for a while in a crevice garden in Denver, but they eventually decline, rarely lasting more than three or four years. These same phloxes planted in the monumental troughs are vigorous, overwhelming their neighbors and spilling over the edges, showing no sign of decline after five years. In fact, they are regularly sheared.

The same is true with *Polemonium viscosum* and *Arenaria obtusiloba*: transient plants in a rock garden, but long-lived and vigorous in the trough environment. One of our greatest triumphs has been *Clematis columbiana* var. *tenuiloba*, which can be evanescent in the garden, thriving a few years and then suddenly melting away. It is a positive scourge in the Pikes Peak trough, popping up everywhere and showing no sign of decline. As luck would have it, the plant in this trough is the most compact in habit and has the darkest, most beautiful flowers of any *tenuiloba* we have seen, so its weedy tendencies are welcome. Conversely, steppe plants from much drier environments also seem to thrive in these troughs, developing character and staying much more compact than when grown in the open ground. The superior drainage of troughs is undoubtedly beneficial for both alpiners and steppe plants.

Here are some comments by Mark on a few of the planting combinations: "The Mosquito Range Trough (photo, p. 105) includes mountain avens (*Dryas octopetala*), with its shiny leaves and white daisy-like flowers, and the endemic Avery Peak twinpod (*Physaria alpina*). The plants are tucked among the same rock types in which they naturally grow. Adjacent to this trough is the Pikes Peak Trough (p. 106), in which the luminous Hall's alumroot (*Heuchera hallii*) grows beside the deep purple rock clematis (*Clematis columbiana* var. *tenuiloba*) planted between chunks of Pikes Peak granite. Perhaps the finest reward is watching these plants come alive in early spring. Genetically programmed to bloom within a short growing season, alpine plants seize the moment, and at the first sign of spring they put on a show of color, blooming several months earlier at Denver's 5,280-foot altitude than they do above treeline in the Rocky Mountains. Just a short distance away, one can find Colorado beardtongue (*Penstemon auriberbis*), *Penstemon versicolor*, and Engelmann's bladderpod (*Lesquerella engelmannii*) living together happily in the Pueblo County Trough (p. 106)."

Alas, troughs—even the monumental troughs of Wildflower Treasures—are not maintenance-free. They need frequent irrigation in Colorado's hot summers, although the largest troughs need far less than small troughs would. Beware unexpected weeds: *Viola pedatifida*, a highly local plant in Colorado, known only from a few sites in two counties, has spread far beyond its El Paso County trough home to every trough within a stone's throw. It is sad when you find yourself weeding out a plant that is quite rare in nature.

Cerastium beeringianum seems quite demure and delicate in its tundra home, but it has revealed its chickweed cousinship in the trough, forming a cancerous mat that swallows all delicacies in its path. Perhaps the worst offender in the garden, however, is *Campanula rotundifolia*, which has all the modesty and restraint of a Donald Trump. It completely overwhelmed one trough where it

was planted, which had to be emptied and replanted with fresh soil. We have had the pleasure of telling Mr. Trump's botanical avatar, "You're fired!"

The theme of western native plants continues in the display's surround. Mark describes it: "The outer beds surrounding the plaza are filled with herbaceous perennials grouped according to the region from which they hail. North-south-east-west directions are used as an easy reference for visitors. For example, the eastern bed is filled with pink large beardtongue (*Penstemon grandiflorus*), purple gayfeather (*Liatris punctata*), bright orange butterfly milkweed (*Asclepias tuberosa*), and the blue wild indigo (*Baptisia australis*). All of these Great Plains and tallgrass prairie perennials are perfectly suited to Colorado's dry climate and bloom reliably year after year. My favorite garden bed is probably the southern bed, which features plants from New Mexico, Arizona and southern Colorado. Two hyssops that stand out are sunset hyssop (*Agastache rupestris*) and giant hyssop (*Agastache barberi*). Both hyssops attract hummingbirds and have a sweet, lemony scent. These are interplanted with hot pink sage (*Salvia greggii*) and red bird-in-a-nest (*Scrophularia macrantha*)."

This third attempt at a synoptic trough display is gratifying on many counts. The monumental size of the troughs seems to be especially conducive to healthy plant growth. Propping up the giant troughs on supports brings them closer to the eyes, so visitors can enjoy these gardens without stooping. Within a few years, however, the character of the plantings can change quite a bit, and pioneer plants find it hard to maintain themselves in a stabilizing environment. Yet age gives great character to some of the dwarf shrubs planted in the containers, and many of the mats and mounds are beginning to drape picturesquely over the sides of the troughs. Although I have been party to creating many a garden, I think that few designs show off miniature alpine more artistically than a synoptic display such as this, with a unifying theme and artistic, monumental containers. It's an idea that other public gardens throughout North America would do well to imitate as a way of displaying the smaller plants of their regional flora.

Panayoti Kelaidis is Director of Outreach at the Denver Botanic Gardens. A recipient of multiple NARGS national awards, he lectures worldwide, leads plant tours, and contributes frequently to this journal.

The Leviathan, the Willow, and the Wallflower:

The Alpine Rock Garden at Mount Goliath

Mark Fusco

The alpine rock garden at Mount Goliath, like many of the plants of the surrounding tundra, has undergone a slow evolution (photos, p. 108). Over the past eight years it has morphed from a rock garden and trailhead to an interpretive exhibit and nature center. Situated at 11,560 feet (3560 m), the site lies at the foot of Mount Goliath, the northern shoulder of Colorado's Mount Evans massif. With a paved road to the top, Mount Evans is by far the most accessible of the 54 Colorado "fourteeners," peaks above 14,000 feet. The winding highway leads visitors up through the subalpine zone at the base of Mount Goliath and past its peak, crosses the alpine tundra, and ascends to the top of Mount Evans at 14,335 feet/4411 m. More than 90,000 people per year make the drive, most for the views, and many without realizing the significance of Mount Goliath.

Denver Botanic Gardens' involvement with Mount Goliath officially started in 1962 with the opening of the M. Walter Pesman Trail. Pesman was a respected landscape architect, professor, botanist, author, Denver Botanic Gardens board member, and champion of western native plants. He is probably best known today for his book *Meet the Natives*, one of the first books about Colorado native plants written for novices. It is an appropriate tribute to him that this special trail bears his name.

A walk on the 1.5-mile trail highlights the significance of this site. This is the gateway to the most accessible stand of bristlecone pines (*Pinus aristata*) in Colorado. Within a mile of the trailhead you will be in the second largest bristlecone pine forest in the state, containing trees as old as 1600 years. This is a perfect place to observe various alpine plant communities whose inhabitants occupy specialized niches or grow freely throughout the tundra and below.

Starting at the trail's upper end in the treeless tundra, you traverse a fellfield dotted with prostrate pink *Silene acaulis*, mounding *Paronychia pulvinata* with tiny chartreuse flowers, and the blueberry-scented, aptly named alpine forget-me-not, *Eritrichium aretioides*. A gradual ascent leads you to patches of meadow and rock crevice communities. In the former, impressive yellow sweeps of the showy composite *Hymenoxys grandiflora* display their prominent heads, and *Erysimum capitatum* dots the tundra. This is one of the few places in the Rocky Moun-

tains where the *Erysimum* blooms in hues ranging from deep lavender to yellow and all shades between. Subtle *Claytonia megarhiza* rosettes are tucked into tight, shady boulder crevices. Quickly you come to the Mount Goliath peak and catch the outline of the bristlecone pine forest in the distance.

During your descent through a dry meadow community, you may notice yellow-flowered cushions of *Hymenoxys acaulis*, one of the smaller species in the genus. Along the trail, dry meadow and rock crevice plant communities give way to krummholz (German for “crooked wood”). Twisted bristlecone pines and Engelmann spruce (*Picea engelmannii*) cover the hillside, displaying the gnarled and stunted character of carefully groomed bonsai. A continued descent through the krummholz leads you to the ancient bristlecone forest and a glimpse back into time. You may linger in wonder, surrounded by thousand-year-old trees. Follow the trail through a forest of subalpine fir (*Abies lasiocarpa*), bristlecone pine, and Engelmann spruce and finish your hike after crossing through a willow carr (*Salix brachycarpa*) at the lower Goliath parking area and the Dos Chappell Nature Center, surrounded by the alpine rock garden at Mount Goliath. Your journey isn’t over.

By 1996 the last 100 yards/meters of the Pesman Trail and lower Goliath trailhead had fallen into disrepair. The final section of trail had turned into a series of informal “social trails” through the willows. The Colorado Department of Transportation had driven and parked heavy equipment on areas adjacent to the parking lot, marring the tundra.

The Garden Club of Denver funded an initiative to repair the lower trailhead and add a small rock garden to the site. Panayoti Keliadis persuaded Zdenek Zvolanek and Joyce Carruthers, from the Czech Republic, to build the garden and restore some integrity to the lower Pesman trailhead. With the aid of USFS and Denver Botanic Gardens employees and volunteers, Zdenek masterfully assembled a rock garden on the site in only two weeks. Simultaneously, the USFS and Volunteers for Outdoor Colorado (VOC) began construction on a defined trail through the willow carr, repairing the unsightly social trails. All plants removed from the new trail were carefully placed in the rock garden. Practically overnight, the site was restored and an interest in lower Pesman trailhead was rekindled.

Denver Botanic Gardens continued to care for the garden over the next five years, adding more native plants, grasses, and sedges. The garden now looks more like the surrounding tundra, thriving and nearly maintenance-free. This garden generated so much interest in the USFS, Denver Botanic Gardens, and Volunteers for Outdoor Colorado that they decided to put a kiosk on the site. With Dos Chappell (director of VOC) leading the charge, the kiosk idea turned into plans for a nature center. By 2003, construction was completed and the building commemorated Chappell, whose untimely death occurred in February 1999.

In June 2004, Denver Botanic Gardens staff and volunteers began building the alpine rock garden at Mount Goliath with the help of a grant from the NARGS Norman Singer Endowment Fund. Around the nature center, visitors

notice large boulders, skeleton pines, and many of the plants viewed along the Pesman Trail. A closer look reveals that the garden is more than just a complement to the Dos Chappell Nature Center—it is part of it. Aesthetically, the garden links the building to the natural area and the existing rock garden. Educationally, it replicates and represents six different plant communities found on Mount Goliath and interpreted inside the Nature Center. More than 100 tons of boulders and other rock were carefully placed to replicate the settings and offer the plants the best chance of survival. As visitors examine the garden areas, they encounter a crevice garden, cracks stuffed with mounds of *Eriogonum flavum* var. *xanthum*, *Heuchera bracteata*, and *Claytonia megarhiza*, and a fellfield full of gray-blue *Phlox pulvinata* and mats of white *Minuartia obtusiloba*. The climax community of the dry meadow contains grasses and sedges interspersed with *Castilleja puberula*, white lollipops *Bistorta bistortoides*, and blue *Campanula rotundifolia*. A few steps beyond, yellow and red *Castilleja occidentalis* and *C. rhexifolia* grow next to a bevy of pink *Pedicularis groenlandica* in the wet meadow. There will eventually be a bristlecone pine forest complete with krummholz. The eventual goal is to include all 257 species found at Mount Goliath in the rock garden.

Presently, the garden holds 70 taxa. The herbaceous plants are all grown in the greenhouses at Denver Botanic Gardens from seed collected on Mount Goliath and Mount Evans, then brought back up the following year. The Engelmann spruce, bristlecone pine, and subalpine fir are either grafted or seed-grown. Each year, volunteers from the Garden Club of Denver, Rocky Mountain Chapter of NARGS, and Denver Botanic Gardens dedicate substantial time to planting and seed collecting, ensuring the success of this project. This is one of the few projects in the United States where the USFS is partnering with a botanic garden to reclaim a disturbed natural site and educate the public about native flora. At first glance it may appear to be just a rock garden, but Denver Botanic Gardens and the United States Forest Service envision a model for future projects at the busiest sites within our national forests and parks. A short drive from Denver, incredible vistas, sweeps of wildflowers, thousand-year-old trees, and North America's highest public rock garden are just a few reasons to take this journey. Do come and see it!

Mark Fusco has a degree in landscape design from Colorado State University and has worked in various capacities at Denver Botanic Gardens since 1997, being involved in developing three new gardens there. His primary focus has been on western native and Colorado alpine plants. He designed and built the troughs described in Panayoti Kelaidis's article in this issue as well as the Alpine Rock Garden at Mt. Goliath. He also teaches classes and lectures on Asian plants and gardens, trough gardening, and western native plants, and is researching greenroofs and rooftop gardens.

The Importance of Plant Collections, Public and Private

Boyce Tankersley

Can maintaining collections of plants contribute toward preserving the natural world and serving the best interest of mankind? I've always thought so, but not everyone shares my opinion.

Today, with reports of new threats to our natural world and the large human populations it supports, there is debate over the value of maintaining living plant collections. Why should resources be devoted to developing and maintaining collections of "cultivated" plants, rather than reallocating those resources to rare and endangered "non-cultivated" plants in natural habitats? I suggest that we must do *both*, and that we choose one over the other at our peril. I believe cultivated and non-cultivated plant species are both important to the relative health of the global environment we call Earth, and to the survival of our own species.

You might be wondering why I'm using the terms "cultivated" and "non-cultivated" instead of "native" and "non-native." If we assume that humanity has evolved on Earth (let us not enter the debate on the length of time that took), then we must also assume that humans are part of the natural world, and that the modifications that they have created to support large human populations are also part of the natural world. If we accept those assumptions, then—lacking imports of plant species from other worlds—any plant found growing on Earth has to be "native," doesn't it? So the debate about the value of plant collections really is about cultivated versus non-cultivated plants, not native versus non-native.

Without a doubt, I recognize and champion the need to protect our non-cultivated plant life and the ecosystems upon which it depends for survival. Our long-term survival is intimately tied to planet Earth: Who could claim to know what links in the web of life are going to be crucial in the future? In a similar way, I recognize and champion the need to protect our cultivated plant life—the very basis for the *human ecosystem*.

The human ecosystem is the natural environment that has developed and been modified over the ages to support large human populations. This ecosystem is based on humanity's success at modifying habitats around the globe to

meet basic needs for food, shelter, and protection, regardless of culture or nationality. An important part of this ecosystem that our human ancestors developed were groups of objects that proved important to survival at home as well as successful colonization of new environments. These utilized objects included collections of plants and animals with beneficial attributes as sources of food, fiber, medicine, structural materials, cosmetics, and ornamental beauty—and recent research suggests that the last is very important to our *emotional well-being*.

Are ornamental plants really important enough to justify devoting attention and resources to cultivated plant collections, as against somehow reallocating those resources to non-cultivated species? Research by William C. Sullivan of the University of Illinois Human-Environment Research Laboratory suggests that ornamental plants in the landscapes in which we live are very important. In studies of human populations in public housing with landscaping (trees and grass) in the environment versus those with bare concrete and asphalt paving, the differences were remarkable. Violence, aggression, and other antisocial behaviors were all statistically significantly higher in the environments devoid of landscaping. These results have been duplicated in a number of other U.S. cities. For the first time, to my knowledge, scientific evidence supports the importance of plants regardless of their value for food, fiber, medicine, structural materials, or cosmetics: ornamental plants do have an important role in the well-being of human individuals and groups.

So I propose that plants used for food, fiber, medicine, structural materials, cosmetics, and ornamentals are a basis for, and critical to, the survival of the human ecosystem. Take out a link and the system is weakened; take out too many links and the system fails.

Collections of economically important plants are under the care of national, regional, and business enterprises that tend to preserve the collections over multiple human generations. Some ornamental plants with high economic value are also conserved in these collections, but most are not. What ornamental plants are the most important to collect and conserve? Again we have to ask: Who among us is foolish enough to say “save these” and “disregard those”? I believe they are all important, but how do we allocate scarce resources?

Botanic gardens and arboreta collect and conserve some plant taxa (a term that includes species, subspecies, varieties, and cultivars), but their resources are limited and there is competition from competing programs within many of these institutions. Commercial businesses can create some very valuable collections (Hillier's Arboretum is perhaps the best known), but the challenge is to protect the plant germplasm after it is no longer commercially profitable. That leaves the conservation of the majority of cultivated plants to members of plant societies and individual gardeners who collect particular kinds of plants.

Plant societies and individual collection holders have enormous potential to contribute in a significant way to the conservation of cultivated plants—and, in effect, to the health of human societies. What information do they need to ensure that the greatest benefits accrue from their loving investment of time

and resources? The answer, in documentation jargon, is what is known as *passport data*. A plant with good passport data

- has an accurate scientific name,
- is from a known source or a known location,
- was collected or obtained by a known individual or group,
- on a specific date or collecting trip,
- with description of the location or address of the source,
- with importation permits (if imported), and authorization for CITES plants,
- and can be linked to a specific plant population or group of cultivated plants.

From this set of data, scientists can ascertain the fitness of a plant or group of plants to participate in solving a given problem.

Collections of plants with good passport data are found in many places. Certainly national crop germplasm protection programs feature exemplary passport data, as do many botanic garden and arboretum collections. Not to be discounted are the equally well documented collections found in many personal and business-related gardens. To preserve plant diversity effectively all of these collections, coordination and communication play a vital role.

Coordinating the efforts of federal agencies, botanic gardens and arboreta, and commercial and individual collections is an enormous but necessary task in North America. Among the current efforts, the North American Plant Collections Consortium (NAPCC), administered by the American Public Garden Association (formerly known as the American Association of Botanic Gardens and Arboreta), is funded by and works in collaboration with the USDA Plant Germplasm Network to coordinate botanic garden and arboretum collections at the national level. NAPCC has adopted rules to permit a botanic garden to partner with a non-botanic-garden collection holder to submit a proposal to become a national collection. This is a significant step toward recognizing the existence of genetically significant collections outside the botanic garden/federal community. No such collaborative proposals have been submitted yet, but in time this amendment should bring national collection status to some very significant collections that *should be preserved beyond the life of the creator of the collection*. For more information about NAPCC (including contacts), go to www.aabga.org.

Are seeds from collections—whether in private hands or in botanic gardens—as valuable as seeds harvested directly from the wild? It depends on the rarity and origin of the plant. Efforts to conserve non-cultivated taxa, like Kew's Millennium Seedbank, are the approach with the greatest likelihood of success for non-cultivated plants. But not even these large, well-funded multinational projects can do everything. Collections outside the Millennium project are the only repositories of some plants. In many cases seeds collected from these plants can and should provide the research specimens to study reintroduction protocols. In these cases, why collect rare plants out of the wild (possibly edging them closer to extinction) when the germplasm has already been collected and is represented in living collections?

On the other hand, collections of the cultivated plants that support the human ecosystem are absolutely appropriate in a garden setting. Gardens not only represent their birthplace but are the location where they live. For many heirloom cultivars, seeds collected from cultivated plants and shared are the only mechanism for survival.

When it comes to preserving plant diversity for the future, few accurate predictions can be made. A simple review of the accuracy of the projected extinction rates proposed in the 1970s and 1980s for the end of the century (2000) exemplifies the difficulties. However, climates change, tectonic plates shift, and hurricanes, solar flares, and meteor impacts simply happen. Organisms will continue to evolve and adapt to survive. The survival of humans depends on the survival of the components of the ecosystem in which they live—and this includes the cultivated as well as the non-cultivated.

Go forth, create well-documented collections of plants (and share the documentation when the plants are shared), and make provisions for passing them on to the next generation (another point of great importance). The health of the human ecosystem depends on it; and frankly, there can not be too much emotional well-being!

Boyce Tankersley is Manager of Living Plant Documentation at the Chicago Botanic Garden. He is a member of AABGA and has maintains a strong interest in technology and plant collections. He serves on the IUCN Species Survival Committee for Bulbs and the Chicago Botanic Garden Invasive Species Committee and is Project Director for PlantCollections—A Community Solution. PlantCollections is a three-year project to share the information from 15 botanic gardens and arboreta databases on the World Wide Web and is funded by an Institute of Museum and Library Services National Leadership Grant in the Building Digital Resources project category for museums. He can be reached at btankers@chicagobotanic.org.

PLANT PORTRAITS

Saxifraga oppositifolia

DAVID SELLARS, Surrey, British Columbia; sellars@shaw.ca

Most high alpine species are a challenge to grow in the open garden near sea level. Even when you can get plants such as *Silene acaulis* to grow for a few years, the reward is only a few anemic-looking flowers, not at all like the spectacular display this plant exhibits in the mountains. One exception to this general rule is *Saxifraga oppositifolia* (photos, p. 111). Even though it is found in nature up to 3800 meters (12,500 feet), it does surprisingly well in the rock garden if it is given the conditions it requires. Not only does it have good longevity, it also flowers both profusely and reliably and does not need rain protection. What more could the rock gardener want?

Clues to the garden requirements of *Saxifraga oppositifolia* can be gained from observation of the plant in the mountains. It is frequently found in exposed positions on north-facing rock cliffs in shady, slightly moist conditions. Snow tends to blow off steep cliffs during winter storms, and *Saxifraga oppositifolia* probably does not enjoy the dry, protective winter snow cover as many other alpenes do. This could explain why the plant is tolerant of wet winter conditions at sea level. The fact that *Saxifraga oppositifolia* grows profusely in the wild at low elevations in the arctic is another indication of its adaptability. However, it may not suit warmer continental climates. Lincoln Foster (1968) of Connecticut wrote that it was a difficult saxifrage to grow—certainly not our experience in coastal British Columbia, where we find it is one of the easiest high alpine plants to cultivate.

In the rock garden, *Saxifraga oppositifolia* needs to be moist and shaded from the hottest midday sun, in addition to the usual alpine plant requirements of good drainage, gritty soil, and a coarse stone mulch. The best position is in a north-facing rock garden, tucked below a large rock to provide partial shade. This setting is, of course, slug heaven, but fortunately slugs do not have as much interest in saxifrages as we do. Though we have a cornucopia of slugs (one reason

high alpine species are challenging in our garden), slugs have the same attitude to *Saxifraga oppositifolia* as children do to broccoli; they apparently can't stand the texture and taste.

We grow a variety of selected forms, including 'Wetterhorn', 'Michaud', 'St. Kilda', and 'Theoden', all of which are fairly similar, at least to my untrained eye. 'Vaccariana' seems to be slightly more vigorous, though it has less attractive foliage in our garden. 'Splendens' (p. 111) is a particularly good form which grows happily for us in a more sunny location. We also grow 'Florissa', which has curious star-shaped flowers—fine if you want something different.

Another delightful feature of *Saxifraga oppositifolia* is that it is easy to propagate by cuttings. Clip off a shoot about half an inch (1.5 cm) long and remove the leaves from the bottom half. Strike the cutting in moist coarse sand and keep it in a light but shaded position. We use a plastic propagating cover to maintain humidity. The cutting will root in about six weeks, and the addition of a little dilute liquid fertilizer will promote more growth. Don Martyn of Yarrow, British Columbia has had success rooting *Saxifraga oppositifolia* in tufa. He drills a small hole one-eighth of an inch in diameter and inserts the cutting in the hole with some ground-up tufa. The tufa must then be kept moist in a north-facing location so that the cutting is shaded.

Saxifraga oppositifolia flowers in March in our garden and in late June to early July in alpine areas. In our local mountains, it is very difficult to see it in flower. The deep snow cover in the Mount Baker area of Washington state, for example, does not melt until late July, so access to the remote high cliffs above 2000 m (6,600 feet) where *Saxifraga oppositifolia* can be found is difficult when the plants are in flower. Access is much easier in the European Alps because the snow cover is not as deep and it melts earlier. Furthermore, there are plenty of roads and cable cars, making it much easier to reach high elevations. Alaskan plants can be seen flowering in roadside gravel at mid elevations near Anchorage.

We have found beautiful flowering plants of *Saxifraga oppositifolia* at many locations in the Alps, but the most spectacular collection that we have seen is near Hannover Haus in the Austrian Alps, on the west ridge of Ankogel. Access is from the village of Mallnitz by the Ankogelbahn, which usually opens in early July. The steep, shattered north-facing cliff below Hannover Haus drips with huge clumps of *Saxifraga oppositifolia*. There are also other interesting subspecies in this area, including *S. oppositifolia* subsp. *rudolphiana* (p. 111), which has extremely tight foliage compared with the somewhat lax foliage of subsp. *oppositifolia*. Although subsp. *oppositifolia* is circumpolar, subsp. *rudolphiana* is found only in the Alps, according to Harding (1992).

With its profusion of early flowers, attractive foliage and garden reliability, I have to say that *Saxifraga oppositifolia* is my favorite plant. The excitement of seeing beautiful forms in the mountains simply adds to its fascination. If you plant it in the right location in gritty soil, you can leave it alone and it will flower year after year without any fuss—for me, the definition of an ideal rock garden plant.

References

- Harding, Winton (1992). *Saxifrages: A Gardener's Guide to the Genus*. Alpine Garden Society.
- Foster, H. Lincoln (1968). *Rock Gardening: A Guide to Growing Alpines and Other Wildflowers in the American Garden*. Timber Press.

Source

Select forms of *Saxifraga oppositifolia* are available from Mt. Tahoma Nursery (see advertisement in this issue).

Primula bhutanica and *Primula nana* var. *alba*

DENIS HARDY, Muir of Ord, Scotland

Primula bhutanica (photo, p. 112) is one of three closely related species that inhabit different areas of the Himalaya, from western Bhutan through southeastern Tibet and northeastern Burma to Sichuan in China. The other two are *P. whitei* and *P. sonchifolia*. The three species constitute the lovely "blue primroses" of the Petiolares Section of the genus.

Only a few Asiatic primulas—for example, *P. sinensis* and *P. sieboldii*—are known to have been in cultivation in China and Japan for some centuries. Botanical exploration in the Himalaya by Europeans began in the late eighteenth century, but not until the early twentieth century were large numbers of species, notably of *Rhododendron* and *Primula*, successfully introduced to European gardens from their remote native habitats by George Forrest.

Primula whitei was first collected by Sir Claude White in Bhutan in 1905, and subsequently several times by R. E. Cooper in 1914–1915. *Primula bhutanica* was first found by Frank Kingdon Ward in Assam in 1935. From 1933 onward, the team of Frank Ludlow and George Sherriff made many important discoveries in Bhutan and southern Tibet, and they were the first to use the "flown home" method to introduce plants and seed to cultivation, notably in Scotland, where the climate has some (only some!) of the characteristics of high-altitude Bhutan, such as cool summers. They collected *P. bhutanica* extensively in conifer and mixed forest at 10,000–14,000 feet (3000–4300 meters), where it often grows in masses under rhododendrons and on damp, mossy banks. The story of their journeys, recounted in Harold Fletcher's book *A Quest of Flowers* (Edinburgh University Press, 1975), makes fascinating reading.

One of their collections of the blue primula in southeastern Tibet in 1947 had some corolla lobes (that is, petals) characteristic of *P. whitei* and others more like those of *P. bhutanica*, which led Sherriff to conclude that there existed just one variable species. The name *Primula bhutanica* was thus relegated to that botanical hinterland, the limbo of synonymy. However, cultivation of flown-home plants later showed that there were important differences between *P. bhutanica* and *P. whitei* which were also visible, with hindsight, in the herbarium

specimens. They are now recognized as distinct species; *P. whitei* is restricted to central and western Bhutan, and *P. bhutanica* is found only in the east of that country, in Assam, and in southeastern Tibet.

I first grew *Primula bhutanica* in my garden in Aberdeen, Scotland, from about 1976 onward. The plants came from Alex Duguid at Edrom Nursery in southeastern Scotland; his stock derived from the original Ludlow and Sherriff introduction. They flourished in a well-drained, peat-based compost in a frame in the shade of a north wall, the glass serving only to keep off autumn rain; winter snow would blow in the sides. *P. bhutanica*, in common with *P. whitei* and *P. sonchifolia*, forms a closed, above-ground resting bud which opens in February or March to reveal the ice-blue flowers. Well-flowered plants could be potted up for shows, then later returned to the frame without ill effect.

All the flowers were pin-eyed, but seed was sometimes set, and I sowed it fresh. The seed of these primulas is generally considered to be of short viability, although some growers have found that seed stored at 4° C remains viable for several years. One seed pan of mine lay dormant for two years until a very cold winter (I assume) triggered germination. Most primulas exhibit heterostyly; all the flowers in a plant are either pin-eyed (having a long style, with the anthers deep inside the corolla tube, as in the photo) or thrum-eyed (with anthers near the mouth of the corolla, as in the photo of *P. sonchifolia* at Tromsø shown on p. 99 of issue 63.2 of this journal). Fertility is generally greatest when pollination occurs between pin and thrum flowers, but seed can be set in an exclusively pin-eyed population with no loss of vigor in later generations.

Seed of *P. bhutanica* has been offered in recent years in the Scottish Rock Garden Club's annual distribution, but it is unlikely to remain viable for long. Another way to increase stock is by division of suitable plants in spring.

These primulas have never been widely available in the UK and are perhaps even less so in North America. The only reference I could find in the last eight years of the *Rock Garden Quarterly* is to *P. bhutanica* in the O'Byrne garden in Eugene, Oregon, where "even in the height of summer the nights are cool enough to keep soil temperatures down" (56.1, p.43). Growers in southern England complain that they cannot grow these plants as well as we can in the cooler north owing to their greater summer heat, which leads the plants to collapse and also encourages red spider infestation. Prophylactic systemic treatment is recommended against this pest, and also for that greater menace, the vine weevil. The whitish grubs of this dreadful creature lurk under the crown of the plant and eat through the roots until all are severed and the plant dies. Biological control with nematodes may also be available.

Although *Primula bhutanica* was almost submerged by Sherriff into *P. whitei*, it seems to have triumphed as the only member of the pair to have survived in cultivation. There is a vigorous sterile hybrid of the two, given the clonal name *P. × 'Arduaine'* (pronounced "Ardoonie"). John Richards, in his book *Primula* (Timber Press, 2003), suggests it may have originated in George and Betty Sherriff's Scottish garden, where both parents self-sowed, but *P. whitei* is thought not to be currently in cultivation (see, for example, Alan Furness in the AGS's *The Alpine*

Gardener, Sept. 2004, vol. 72, p. 339). There is a good photo of 'Arduaine' on the American Primrose Society's website, www.americanprimrosesoc.org.

Primula edgeworthii var. *alba*, the white-flowered form of a species whose original introductions were blue-flowered, was the first Petiolarid primula that I grew, in the early 1970s (photo, p. 112). Unfortunately, *P.edgeworthii* has a confused taxonomic history, which I will summarize, with names in order of priority.

Primula nana ("dwarf") was the name given to the plant collected by R. Brinkworth in 1824 in Kumaon, an area of the Himalaya just west of Nepal. The type specimen (perhaps unfortunately, as we will see) still exists as a herbarium specimen at Kew. It did not pass into cultivation.

Primula Edgeworthii (names derived from individuals were given upper case in those days) was collected in the northwestern Himalaya by Drummond in 1888 and named after an earlier collector. Again, no successful introduction was made. Then, in 1909, E. L. Winter found "north of Naini Tal at 3000m. a most attractive farinose plant which was successfully introduced into this country by seed in 1909 and when in flower in 1911 was named *P. Winteri*. . . . It proved a marked horticultural success and is widely known under that name" (W. W. Smith and H. R. Fletcher, *Transactions of the Royal Society of Edinburgh* 61 [1944], p.290). The species has been in continuous cultivation ever since, albeit with a change of name from *P. winteri* to *P. edgeworthii* as the identity of the two became accepted, following Smith and Fletcher's paper in 1944.

That was the position until John Richards published his major taxonomic review of the whole genus in *Primula* (Timber Press, 1993; revised ed., 2003). He concluded that the type of *P. nana* from 1824 "is the same as the species currently known as *P. edgeworthii*. Consequently, I regret that this familiar name must be changed." Thanks to the International Code of Botanical Nomenclature, which requires using the earliest published name, we now have *P. nana* as the only member of *Primula* Section *Petiolares* Subsection *Edgeworthii*!

Getting back to my original purchase of *Primula edgeworthii alba*, as it was then known, from Jack Drake's nursery near Aviemore, I was unaware of the detailed requirements for Petiolarid cultivation, beyond the need for a well-drained peaty compost and protection from autumn rain. Thus, when the plants set seed and the capsules crumbled in the way that I later learned was characteristic, I just sowed the seed and was soon rewarded with a healthy collection of seedlings. With a number of plants available for experimentation, I grew some in the open on the north side of our house in Aberdeen. All the seedlings came true, with flowers of a lovely velvety white and a texture resembling kid leather; none were the blue of the originally introduced form *P. winteri/edgeworthii*. Later introductions of *P. nana* from about 1974 on, especially from Nepal, have had lilac or pink flowers. The white form I describe is of unknown origin; it is said to persist in cultivation, although I am not aware of a current source. My stock did not survive our move here from Aberdeen, so the label reading "*Primula edgeworthii alba*" is now one of many "tombstones" in my collection. I still have the photographs, though.

BOOKS

Flowers of Crete, by John Fielding and Nicholas Turland, edited by Brian Mathew. London: Royal Horticultural Society, 2005. 650 pp. 1900+ color photos. Hardcover. ISBN 1 84246 079 X. Available in North America through amazon.co.uk.

Reviewed by TREVOR WILTSHIRE

The authors have visited the island many times, and this wonderful book encapsulates their outstanding knowledge of the Cretan flora. The extraordinary geological and climatic history of this rugged island has resulted in a great range of different plant habitats and remarkable plant diversity, with a high degree of endemism—nearly 10% of the total flora. I have waited for a book such as this for years to enable me to name and catalogue all the slides of plants taken in Crete since my first visit in 1986. I have had the good fortune to travel with John Fielding in Crete on two field trips, one in March–April 1995 and the other in October 1996.

John Fielding is a Kew-trained professional horticulturist and specialist plant photographer with his own slide library of plant portraits and gardens. He has visited Crete on many occasions photographing, identifying, and recording its rich flora. His photographs have appeared in many publications; recently he supplied many of the portraits for W. T. Stearn's *The Genus Epimedium*. He has also worked in designing, planting, and maintaining gardens in Britain, notably that of Sir Robert and Lady Sainsbury. He cultivates a large range of plants in his private collection, especially Cretan species.

Nicholas Turland first visited Crete in 1984. Fascinated by the flora, he has revisited the island regularly ever since. In 1993 he co-authored *Flora of the Cretan Area: Annotated Checklist and Atlas*, published by the Natural History Museum, London, where he worked as a botanist. In 1997 he relocated to the Missouri Botanical Garden, St. Louis, Missouri, to work on the *Flora of China*. He still maintains a keen interest in the flora of Crete.

Brian Mathew was awarded the coveted Herbert Medal in 1992. He started his horticultural career in 1957 at Birch Farm Nursery under the tutelage of Will,

Walter, and Paul Ingwersen, and entered Wisley's training program in 1961. After graduation he took a leading part in the famous Bowles Scholarship Botanic Expedition (BSBE) through western and central Asia in 1963. He then worked at Kew Gardens, where the whole of his 25-year career revolved around the petaloid monocots. He then became editor of *Curtis's Botanical Magazine*. He is the author of 17 monographs and botanical-horticultural books on bulbous plants.

This book is no field guide: it is huge, measuring 12 by 9.5 inches by 1.5 inches thick (288 by 238 by 40 mm) and weighing 4.5 pounds, and it would easily fill your hand baggage allowance. With more than 1900 photographs and 650 pages, it sets a new standard for well-illustrated guides to Mediterranean plants. It was with huge regret that I left it home during my June 2005 visit to western Crete—I would have loved to refer to it each evening on return to my hotel.

The photographs in the book are testament to both authors' painstaking attention to detail. When traveling with John, I have had to chase him to hurry up! He always brackets his shots, always uses a tripod and cable release. Indeed, he devotes two pages of his preface to his photographic technique—very useful for those of us who try to capture images in trying conditions in the field. His affinity with *Cyclamen* is clearly evident, with more than 16 pages devoted to the four *Cyclamen* species of the island. Most of these pictures are of the plants in habitat, invaluable for those wanting to replicate a habitat in their own gardens.

The introduction has subheadings of geography, geology and soils, climate, vegetation, crops, ethnobotany, and threats to vegetation. The sections are further divided to cover essays on such things as floristic elements, vegetation history, and woodland. Scrub communities are defined and the differences among maquis, garrigue, and phrygana explained. Steppe and high mountain vegetation are discussed and illustrated with copious photographs. Cliff dwellers have three pages, and the extensive beaches two. It may surprise some regular summer visitors to see photographs of snowfall and winter rainstorms.

The angiosperms are divided into dicotyledons, A–Z, on pages 73–447, and monocotyledons on pages 447–569. The few gymnosperms (conifers and related plants) on the island are given 7 pages and the pteridophytes (ferns and fern allies) 12 pages. There is then a useful chapter on cultivated plants (the Greeks love their patio plants, which can hail from all corners of the world.)

There is a page on frost tolerance of Cretan plants (down to -10° C/ 14° F), based on the authors' personal experience of growing many of these in their own gardens. There are appendices covering areas of special interest, with locations and plant lists; I can imagine quite a few holiday itineraries will include these in the future. There is a checklist of endemic species and subspecies in Crete, and finally a list of publications for further reading. The index is easy to use, with photographs identified with bold type.

Crete is a floral paradise in spring. From March to June, spring moves week by week up from the coast into the mountains, so that visits need not be planned around particular weeks. I once visited in mid-June after their coldest winter on record to find *Cyclamen creticum* still in flower on the pass up to the Omalos.

Autumn visits are also rewarding—leave it late—October is good, but expect to be rained on at that time of year. Some years after the rains, the autumn geophytes can look stunning as they flower in their millions. Crete has an extraordinarily rich and unique flora which can be experienced only by a personal visit.

I recommend this book to anyone visiting the Mediterranean area, and it's an absolute must if you are visiting Crete.

Trevor Wiltshire is Superintendent of the rock garden, RHS Wisley.

The Plant Hunter's Garden: The New Explorers and Their Discoveries,

by Bobby J. Ward. Portland: Timber Press, 2004. 340 pp., color photos throughout. ISBN 0-88192-696-5. Hardcover, \$39.95.

Reviewed by DAVID PALMER, West Linn, Oregon

Many of the stalwarts of our gardens we owe to the early plant explorers. The mid-1800s to the early 1900s have often been thought of as the golden age of plant hunting. The names of Robert Fortune, William Purdom, Frank Kingdon-Ward, Joseph Rock, Ernest Wilson, and George Forrest are linked with so many of our excellent garden plants.

In *The Plant Hunter's Garden* Bobby Ward, a former president of NARGS, profiles 32 of the "new plant explorers," some of the modern-day explorers who have produced a surge of plant introductions over the past two decades. The Introduction sets the tone of plant exploration by giving a general overview of its history.

Each chapter on an explorer begins with interesting biographical background information before the subjects discuss some of their favorite plants they have collected or introduced. The range of plants is very diverse—from diminutive alpine and bulbs to camellias and *Michelia*, that wonderful member of the Magnoliaceae. Several excellent photographs accompany each chapter, showing either the plants' natural habitat or a garden setting, along with a portrait of the explorer. Ward has provided multinational appeal by choosing subjects from the United States, England, Canada, Chile, South Africa, and the Czech Republic.

With these explorers covering a wide range of countries and habitats in their search for new and exciting plants to fill our gardens, each chapter reads like a mini-travelogue. The plant descriptions are very good, with occasional hardiness zone information.

A few of the new explorers strayed from plant collecting in the traditional sense. Some of the plants they introduced were found not in the wild but in the garden. *Eucomis* 'Sparkling Burgundy', introduced by Tony Avent, was selected from a batch of seedlings and evaluated for fourteen years before being introduced. *Tetrapanax papyrifer* 'Steroidal Giant' was obtained by Sean Hogan and Parker Sanderson from California through Ed Carman and Roger Warner, having come to Ed via Hawaii from Japan. Barry Yinger has found a remarkable source of plant material among the rooftop nurseries of Japan.

In the final chapter of the book, "Invasive Plants," the author sets out the arguments both for and against the introduction of exotics and the potential for invasive plants.

Although there are several books which cover the early plant explorers, it is gratifying to find a book that covers the present-day explorers. For those longing to feel like an intrepid explorer without the discomfort of having to (as Brian Mathew writes in the Foreword) "sleep on rocks and drink dew for breakfast," this is worthwhile reading.

David Palmer, a Wisley-trained horticulturist now working in Oregon, has introduced plants he has found in various regions of the world.

Plants of Western Oregon, Washington and British Columbia, by Eugene N. Kozloff. Portland: Timber Press, 2005. 512 pp., 710 color photos. Hardback, \$65. Available from NARGS Book Service.

Reviewed by DAVE DOBAK, Portland, Oregon

This field guide to Pacific Northwest plants includes natives and naturalized aliens found in the area from the Pacific coast to the Cascade crest in Oregon, Washington, and British Columbia. It promises aid to botanists in southwestern Oregon, an area neglected in field guides for decades.

This is a book of keys, beyond which there is no synopsis of descriptive information for each species, although there may be an illustration. It is like "little" Hitchcock, not like the manuals of Jepson or Peck (see References). The keys are designed to be "nondestructive"—that is, as far as possible, not requiring digging or dissecting the plant. The book generally achieves this goal. For instance, the key to *Allium* does not call for looking at bulb coats. The *Penstemon* key begins, as usual, by splitting away the members of subgenus *Dasanthera* with easily viewed hairy anthers, but then the species of the two remaining subgenera are keyed by more evident vegetative characteristics, rather than encouraging flower dismemberment to examine the manner of pollen sac opening. Minutiae are avoided when possible. The key to *Eriogonum* does not begin with the obscure observation of the perianth base (is it "stipe-like" or not?). But nutlets are still needed for the *Boraginaceae*; some details are just unavoidable. Reading the keys, I sometimes have the feeling that Dr. Kozloff is looking over my shoulder; the dry, formal text of the key gives way to "the bracts may be small, especially in *E. ovalifolium* var. *nivale*, so look carefully."

In all, 710 plants are illustrated with color photos and many more with line drawings by Jeanne Janish and others, previously published in Hitchcock. Complete plant illustrations are used, not the excerpted vital fragments found in the shorter Hitchcock manual. This choice results in fewer taxa being illustrated, while graphic information beyond the minimal needs of keying is included. Oddly, there are pages with substantial white space where another drawing or

photo could have been added. I am puzzled by inclusion of color plates of the introduced weeds *Vinca minor* and *Lunaria annua*, perhaps at the expense of excluding more interesting plants.

Many field guides have color photos that look pretty but aren't very useful for identification. Not so in this book; most of the photos include foliage as well as flower images. Many of the plants are shown against a plain dark background. But many of the pictures are printed too dark, a tendency that seems prevalent in botanical publishing. Among many examples, the leaves of *Eriogonum compositum* are a dark blob, and an otherwise interesting underwater photo of *Lobelia dortmanna* has nearly invisible flowers. Blue and purple flowers suffer especially. This problem has been noted in a review of Jim Jermyn's recent book; someone at Timber Press needs to address this problem.

Liliaceae is retained as a family, not fractured. The Scrophulariaceae, Orobanchaceae, Plantaginaceae, and Phrymaceae are not realigned. The lumping of Asclepiadaceae into Apocynaceae, and of Hydrophyllaceae into Boraginaceae, are not recognized. Traditionalists will be happy, but the cohort of newer botanists will have to readjust to the old nomenclature.

The Oregon disjunct population of *Fauria crista-galli*, discovered in 1999, is mentioned. But the reported Oregon outlier populations of *Fritillaria camschatcensis* are not recognized, though these discoveries are at least 20 years old. Not all news travels with equal speed in the botanical jungle.

It's hard to tell what the resolution rule is in the treatments. *Heuchera micrantha* is split into two varieties, but *Triteleia hendersonii* is not distinguished as to the varieties *hendersonii* and *leachiae*.

Since I was reviewing this book during winter, field checking the keys was not an option. I recalled days in the forest when I had to resort to beginning with the key of All Dicots to identify *Circaea*, *Shepherdia*, *Eriodictyon*, or *Mentzelia*. The book passed all four of these tests with no difficulty. Many other armchair keying efforts were successful. However, a novice kneeling before *Fritillaria glauca* or *F. pudica* would be hard pressed to find *Fritillaria* in the Liliaceae key, having followed the branch "none of the leaves in distinct whorls."

Despite the promotional claim that "botanical coverage is complete," there are many missing taxa. *Lewisia leeana*, *Pedicularis rainierensis*, *Crepis nana*, *Collomia larsenii*, *C. mazama*, *Cimicifuga laciniata*, *Polygonum cascadenense*, *Asplenium septentrionale*, *Dodecatheon alpinum*, *Arenaria pumicola*, *Ribes watsonianum*, *R. erythrocarpum*, *R. binominatum*, *Eriogonum dielinum*, *Erigeron eatonii*, *Mimulus kelloggii*, *M. pygmaeus*, *Penstemon newberryi*, *P. cinicola*, and *Rhamnus ilicifolia* are examples. (There may be more, as I have only spot-checked.) Some of these are endemic to the region, while some are more plentiful elsewhere and rare here, but all are of interest to enthusiastic botanists. I have seen most of these plants on day hikes, or even within shouting distance of the car. They deserve to be included. Contemplating the tremendous effort that has evidently gone into authoring this book, I am puzzled by these gaps in coverage that impair its usefulness for professionals and even advanced amateurs. This book must be considered a popular wild-flower guide rather than the "definitive" flora it claims to be.

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Dave Dobak and his wife, Jan, are longtime and active members of the Native Plant Society of Oregon as well as of NARGS. They travel extensively in the Pacific Northwest to botanize and lead NPSO field trips.

Hortus Bulborum: Treasury of Historical Bulbs by Leslie Leijenhorst.

Arnhem, Netherlands: self-published, 2004. 102 + 79 pp. ISBN 90-71123-74.
For distributors, see below.

Reviewed by SUSAN A. REZNICEK, Ann Arbor, Michigan

For botany, the science of plants, all definitions of roots are of utmost importance. For gardeners, knowing the correct names of the plants we are growing shows others our expertise and measures our status among our peers. Knowing the pedigrees of one's cultivars defines one as a connoisseur of the art of gardening.

Hortus Bulborum: Treasury of Historical Bulbs by Leslie Leijenhorst is a history of the bulb trade in Holland told through the story of the collections of historical bulbs in Limmen Village, which celebrated their 75th anniversary in 2003. The book is written in both Dutch and English, printed in parallel columns. Included are historical photos of the gardens and memorabilia. This is a book for the bulb enthusiast for whom history is also a fascinating adventure.

The bulbs in Limmen Village have persisted through that time with the help of passionate growers, enduring a world war, harbored during the hard times when the people were starving and forced to eat flower bulbs, and undergoing two major relocations within the village. The Limmen Hortus Bulborum is a unique collection of bulbs, all reproduced vegetatively annually and requiring rigid, painstaking inspection to maintain the purity of the lines. Today the collection encompasses more than 2500 different species and cultivars: more than 1500 tulips, about 800 daffodils, 80 hyacinths, 22 irises, 49 crocuses, and 17 fritillaries. Each of these bulbs is described to class of cultivars, such as Darwin tulips, single late tulips, or lily-flowered tulips, defining the distinguishing features of each and illustrating each type with an exemplary picture. The raiser, lineage, year of origin, flower color, breeding, and occasionally synonymy for the bulbs are given when known, as well as the derivation of some of the cultivar names—such as the tulip 'William Rex', named after the Dutch king (stadhouder) William of England. All this information not only clarifies the relationships of the bulbs but also gives some measure of how long some bulbs, still favorites in the garden, have been in cultivation. The oldest known cultivar tulip

listed is 'Duc van Tol Red & Yellow' from 1595, the oldest narcissus the large corona daffodil 'Sir Watkin' (all yellow) from 1868, the oldest hyacinth 'Gertrude' (pink) from 1850, the oldest species *Crocus*, *C. tommasinianus* introduced in 1847, the oldest *Fritillaria*, *F. persica* from 1573, and the oldest Iris 'Imperator' (deep blue with an orange pattern) from 1920.

Since the collection's founding, samples of the historical tulips have been shared with Uppsala, Sweden and Holland, Michigan. Other collections of historical bulbs in the Netherlands are also described in this book as to their bulb specialties. Listed are addresses of other gardens with extensive bulb collections throughout the world, including the city park of Holland, Michigan, which celebrated its 75th anniversary in 2005, and the Hampton Court Palace Gardens in Surrey, United Kingdom.

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Bulbs for Garden Habitats, by Judy Glattstein: Timber Press, 2005. ISBN 0-88192-693-0. 296 pp., 127 color photographs and five line drawings. Hardback, 29.95.

Reviewed by HANS ROEMER, Victoria, British Columbia

Garden habitats are defined very broadly in this book, as is already evident when one turns to the table of contents. The chapter headings are more about geography and macroclimate than about moisture conditions, substrate, aspect, sun/shade and microclimate, factors that are ordinarily included under "habitat." However, it quickly becomes obvious that the author has a thorough understanding of both the climate types and the habitat factors that play such a decisive role in determining which "geophytes" will do well in our gardens in the long term. In the introductory chapter and again where geophytes for the Mediterranean garden are discussed, it is made clear how important it is to distinguish the climatic regimens of the regions where our bulbs originate and to apply this knowledge when considering them for the region where we garden.

The book has two excellent introductory chapters which cover the history of bulb growing, definitions, morphology, classification, distribution, cultivation and care, propagation and plant partnerships for geophytes. The author then takes us through Temperate Woodland, Mediterranean, Texas and Southeastern US gardens and discusses suitable species and cultivars, habitats, and limitations for geophytes in these regions. Limitations include not only lacking or

over-abundant rainfall, heat, and cold through the seasons that may prevent these plants from thriving in the discussed region, but also the omnipresent deer and rodents that may prevent us from enjoying them for very long. These co-inhabitants of our gardens are the reason why the genus *Narcissus* and other inedible members of the Amaryllidaceae figure so prominently in this book. North American woodland geophytes, mainly those of the temperate region, have their own chapter. One chapter is entirely devoted to geophytes for wet habitats, another one covers geophytes for rock gardens, and the final one explores fall-flowering geophytes.

Both near the beginning and the end of the book the author writes about the “thugs” among bulbs (“Bulbs Going Wild”), geophytes that can get out of hand. We in the Pacific Northwest would put some of the ground covers and companion plants recommended elsewhere in the book into the same category, for instance periwinkle and ivy. Despite her obvious know-how, Judy Glattstein lets an army of gardening acquaintances (not necessarily experts) speak about their successes and failures with geophytes in their respective regions.

The subject matter of this book would have lent itself to a more systematic (shall I say scientific?) and less conversational style. The two main determinants, geographic climate type and garden habitat, could have formed a matrix within which the species could have been tabulated. Some people abhor tables and lists; however, at least an appendix could have provided broader overviews, allowed comparison, and made the selection of species more interesting to the reader. A six-page summary titled “Quick Picks” could have been replaced by reference lists and/or tables. As a rock gardener focused on species rather than garden varieties, I found the amount of space devoted to the description of cultivars a little tiring.

Altogether, this book is packed full of basic, accurate information, useful how-to advice, and many interesting observations. Most important, it does not follow the “one fits all” approach found in so many other gardening books.

Hans Roemer is an enthusiastic grower of bulbs.

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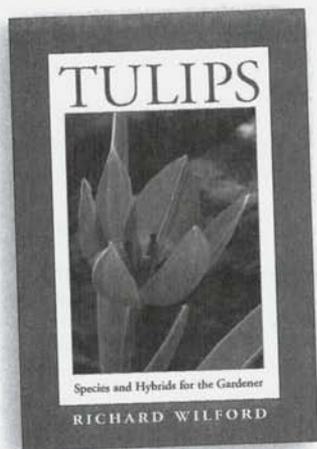
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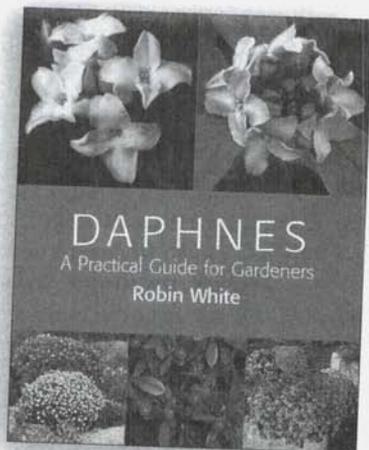
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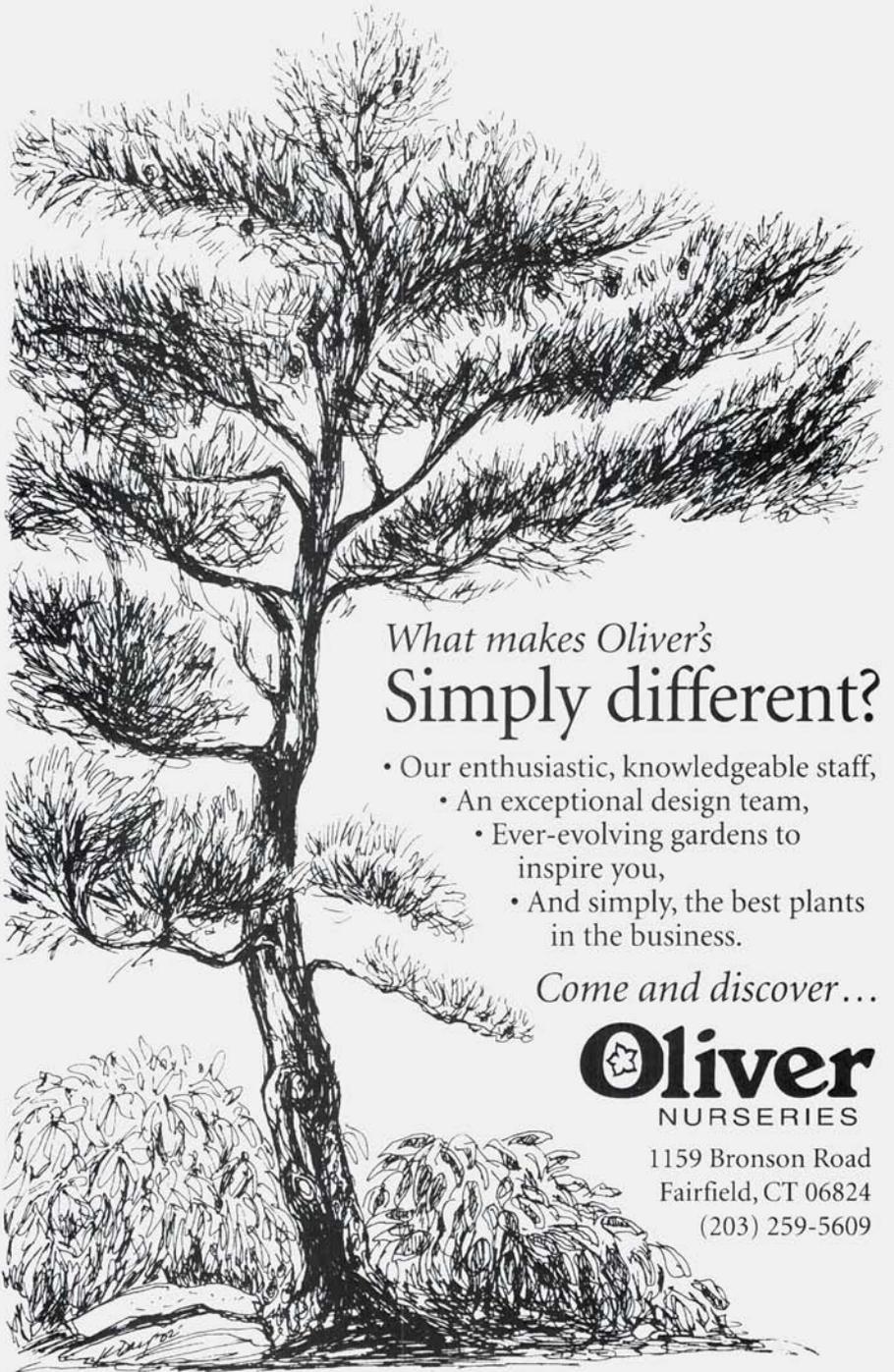
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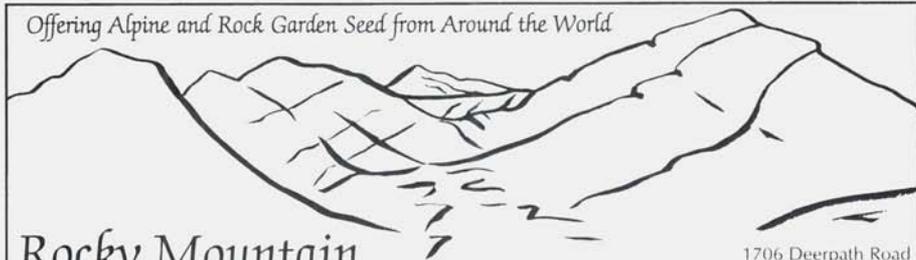
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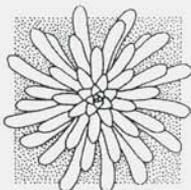
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