ROCK GARDEN *Quarterly*

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Front cover: *Silene petersonii*. Painting by Cindy Nelson-Nold.

Back cover: Rock garden at the Hay Estate, Newbury, New Hampshire. Photo by Dianne Huling, third place, class 4, 2004 Photo Contest.

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ROCK GARDEN *Quarterly*

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Contents

Conversations in the Garden

In its earlier years this journal often included a regular feature of brief notes, letters, and reflections by the editor and readers. For a while it was called "Omnium-Gatherum," then "The Compost Pile," and for a while, "Of Cabbages and Kings." At the urging of our Editorial Advisory Committee and the NARGS administration, we're going to bring this feature back to the *Rock Garden Quarterly* under the title "Conversations in the Garden," reflecting the interaction we hope to stimulate. Whether it continues will depend on the enthusiasm and active participation of you, our readers. We'll be delighted to receive letters in any form, from penned on stationery to zapped off by e-mail. The editor's addresses appear on the last page of this and every issue. This is a good place for corrections and comments on material published in the *Quarterly*. Don't hesitate to criticize— constructively, of course.

In addition, this section will include excerpts from chapter newsletters—informative or entertaining bits too short to run as full articles—and interesting comments from the international electronic forum Alpine-L and other e-mail discussion groups. We will obtain permission from authors before quoting any of this material. Please let us know if you see a posting or other text that you think would work well in this feature.

An ongoing concern is how to fill white space at the ends of articles. Several years ago Baldassare Mineo of Siskiyou Rare Plant Nursery shared a treasure trove of his drawings, which also appear in SRPN's catalog, but we've nearly exhausted this resource. *Please* consider sending your pen-and-ink drawings for reproduction. All material is returned unharmed, and you retain copyright after our one-time use.

The Arctic-Alpine Botanic Garden in Tromsø

Finn Haugli

Situated at 70° north latitude, the botanic garden at the University of Tromsø, in the far north of Norway, is the world's northernmost such institution. Opened in July 1994, the 2-hectare (5-acre) garden lies southeast of the university campus, commanding a view of the mountains to the east and south. Its location, corresponding in latitude to the north coast of Alaska, suggests an extreme arctic climate; however, a branch of the Gulf Stream sweeping up the coast of northern Norway provides a moderating influence, and the climate of Tromsø features relatively mild winters (January average −4.4°C/22°F) and cool summers (July average 11.8°C/54°F).

From May 15 until July 27, the sun is continuously above the horizon in Tromsø. The two months of midnight sun provide some compensation for the short growing season and the low temperatures. In the months of May, June, and July, the theoretically possible number of hours of sunshine are 623, 720, and 695, respectively; however, the average hours of actual sunshine total about 200 for each of these months. From November 21 until January 17, the sun never rises. Snow generally covers the ground from October or November on, accumulating until the beginning of April. The snow then gradually melts, usually leaving the ground bare by early May at sea level but lingering far into the summer at higher elevations. The growing season in the Botanic Garden is usually from mid-May until mid-October. In 2003 and 2004, however, spring came about 4 weeks earlier than usual; it remains to be seen if this is a permanent change in climate.

Collections and plants

The garden is constructed on an east-facing slope in three broad terraces. The landscape has been given an alpine ambience through the use of large rocks and gravel. The collections are GEOGRAPHICAL (Himalaya, Kola/Siberia, North America, European Alps, Caucasus, Southern Hemisphere, and Arctic), THEMATIC (bulbs and corms, tall perennials, succulents, traditional ornamental plants,

windbreak planting, and spice and herb garden), or BOTANICAL (*Rhododendron, Primula,* Ranunculaceae, *Gentiana,* and *Saxifraga*).

Although the climate in Tromsø and northern Norway is often described as harsh, that fact (to the extent that I would agree with it at all) is actually quite advantageous for a number of alpine plants. In Tromsø we notice that visiting alpine-gardening enthusiasts from the south of Norway—and even from Scotland—are amazed and a bit envious when they see what we grow in Tromsø, and how we grow them. Admittedly, we have limitations in growing flowering shrubs and trees. But ask about alpines, and it's quite a different story! I will highlight and briefly describe some of the collections and plants.

Himalaya. Plants from the Himalayas as well as the mountains of southwestern China are included in this collection. Alpine gardeners know that we are talking about one of the greatest treasure-troves on Earth: hundreds of species of *Primula, Rhododendron, Gentiana, Codonopsis, Meconopsis, Corydalis, Cremanthodium, Lilium,* and lots more.

Among the first to flower here, just after the snow melts, are four wonderful *Primula* species in the *Petiolares* section: *P. sonchifolia,* lavender-blue and mustard-yellow; *P. bhutanica,* blue and white; *P. strumosa,* yellow and orange; and *P. tanneri,* purple and yellow. Dark reddish purple *P. calderiana*, fairly recently established in Tromsø, hopefully will soon join these stunning spring-flowering primulas.

Getting into June, a kaleidoscopic flowering takes place among the *Meconopsis,* aptly named "Poppy-sisters" in Norwegian, particularly in years when the plantings of monocarpic species are successful, such as *M. punicea* with its large, drooping blood-red petals (photo, p. 100), and the big lemon-yellow blossoms of *M. integrifolia* and *M. pseudointegrifolia* (p. 100). But large numbers of the blue, perennial species and cultivars always ensure that the Himalaya collection is worth a visit from mid-June into July.

Later in the summer, some of the most spectacular plants here are *Cremanthodium* species, a genus of alpine composites with nodding, rain-shedding flowers. Among the showiest are *C. arnicoides, C. ellisii, C. reniforme* (photo, p. 100), and *C. pleurocaule,* all with exceptionally beautiful yellow flowers on plants of attractive habit. *Cremanthodium rhodocephalum* is a wonderful low-growing plant with large, drooping rose flowers.

Rhododendron. Though I wrote that flowering shrubs and trees are not the easiest plants to grow in this cool climate, I still want to mention this collection, for there are some species and hybrids that actually do quite well with us. This collection, however, must be regarded as experimental, even more than other plantings in the garden.

Among the more interesting groups of *Rhododendron* for Tromsø, we have found that the relatively little-known and seldom-grown species within the *Taliensia* section are of particular interest. This is not surprising if one looks into the origin of this group of plants: most of them come from very high elevations. They have beautiful leaves (just think of *R. bureavii*) and wonderful growth habits. Their drawback is that most take many years to start flowering. However, there is one that starts flowering just a few years from planting, so *R. adeno-*

gynum has become one of my absolute favorites. Other notable species in this group are the dwarf *R. pronum* and *R. proteoides*. Both are being used in extremely interesting hybridization projects. John Weagle in Halifax, Nova Scotia has used these dwarf, hardy species to create hybrids suitable for cool, damp northern climatic regions.

Rhododendron caucasicum and the related *R. aureum* are both of great importance to us, both as species in their own right and as parents of great hybrids, such as 'Cunningham's White' and 'Cunningham's Blush', both excellent plants for Tromsø and well represented in the Botanic Garden.

The *R. repens* group of hybrids, such as 'Scarlet Wonder' and 'Baden-Baden', also grow and flower quite well with us.

Last but not least, I should mention some plants in, or associated with, the Lapponica subsection. 'Ramapo' (*R. fastigiatum* × *R. minus*) is one of the better lepidote hybrids. Even more impressive is the German hybrid 'Frosthexe' (*R. anthopogon* × *R. lapponicum*). *Rhodendron lapponicum* is a native of northern Norway, so one might expect this and many more in the Lapponica subsection to be good plants in Tromsø, but they often are not. This may be due to insufficient heat in the summer, as well as masses of wet snow in winter, which can damage the leaves. These climatic factors are relevant at coastal locations such as Tromsø, but not in the inland mountains where *R. lapponicum* grows wild.

Bulbs and corms. This thematic collection holds some plants of outstanding beauty and surprising hardiness. The earliest one to flower is *Erythronium sibiricum*, a stunning plant with its large pink flowers just after the snow melts, and one of the most beautiful in its genus (photo, p. 101). It hails from the Altai Mountains, as does another treasure, *Scilla rosenii*. This most beautiful of scillas has large porcelain-blue flowers fading to white at the edge of the petals.

Another genus worth mentioning is *Fritillaria*. Species coming from the hotter, drier parts of the Mediterranean (and climatically similar places) are not good here, since we rarely get a warm, dry autumn. However, species such as *F. meleagris*, *F. pyrenaica*, *F. michailovskyi*, *F. pallidiflora*, and *F. aurea* are excellent plants. So are the reticulate irises *I. histrioides* 'Major', *I. winogradowii*, and *I. hyrcana*. While most other reticulate irises do not thrive in our relatively cool, moist climate, these three do, flowering very early in spring. Another fine iris here is summer-flowering *I. latifolia* from the Pyrenees (photo, p. 100).

North America. This is a new collection, and planting is unfinished. Species (and some hybrids) within genera such as *Phlox, Penstemon, Townsendia, Mimulus, Oenothera,* and *Lewisia*, as well as *Primula* and many other alpines, will find a new home here.

Almost all the *Lewisia* species do extremely well in Tromsø. The most gorgeous are *L. tweedyi* and *L. rediviva*. I am always astonished to see how well the latter performs in our climate, which is utterly different from the dry, hot-summer climate of its native habitat.

We have had some problems getting hold of species *Phlox*, since seed is usually not available. If some reader is growing them, I should be most thankful to receive cuttings by air mail (label them "Botanical cuttings"). We do have quite

a few hybrids, though, and expect most alpine species to succeed also. The alpine *Penstemon* species are great plants, generally doing very well here. We have a dozen or so species, including *P. rupicola* and *P. davidsonii*, but again cuttings of the rarer, compact alpine species would be most welcome.

Primula. There are about 430 species of *Primula* in the world. For our Arctic-Alpine Garden, we are aiming at growing almost 25 percent of them. We are not there yet, but if things continue to go well, we could increase the number from the current 70–80 species to nearly 100. In discussing the Himalaya collection above, I mentioned species in the *Petiolares* section. In the *Primula* collection, a bit further down the garden, you would see most of these. Another spectacular show here in early spring is offered by species in the *Auriculastrum* section, the European alpine primulas, of which there are about 25 species. Some, like *P. allionii*, can not be grown outside in our climate, but most of them do very well in Tromsø. Suffice it to mention yellow, fragrant *P. auricula*, gorgeous pink *P. hirsuta*, magnificent blue *P. marginata,* and delightful *P. minima* and *P. integrifolia*. The little "mountain" created for these species in the *Primula* collection is a marvelous sight in early spring (photos, p. 97–99).

From early spring into early summer, the *Primula* collection also shows off a number of *Crystallophlomis* species, followed by species in the *Proliferae* and *Sikkimensis* sections. Here, the *Crystallophlomis* (or *Nivales*) species generally do extremely well; as high alpines, they like our cool climate. The same holds true for the *Sikkimensis* primulas, but we have more problems with many in the *Proliferae* section.

American rock gardening readers may like to know the American primulas established in Tromsø: *P. parryi, P. ellisiae, P. rusbyi,* and *P. angustifolia* all do well here. *P. nevadensis* presently exists more precariously in a few private gardens.

European Alps. Skipping the collections of Ranunculaceae, tall perennials, succulents, traditional plants, and herbs and spices, we now arrive in the relatively newly established collection of plants from the Alps and other central European mountains. This of course includes a vast number of alpines, and again only a sampling can be given. Here, the first to flower is *Pulsatilla vernalis*, soon followed by close relatives such as *P. halleri, P. vulgaris,* and *P. alpina*, the latter in both its white and yellow forms. Another famous genus from these mountains, *Gentiana*, is also in place, notably *G. verna* and *G. acaulis,* as well as several closely related species. Then there are the small but showy *Erinus alpinus, Hutchinsia alpina,* and wonderful alpine *Dianthus* species such as *D. alpinus, D. glacialis,* and *D. neglectus* (syn. *D. pavonius*). We also have the exotic *Ramonda myconi*, endemic to the Pyrenees. *Ramonda* is hardy in Tromsø, but its performance depends on the site. Our plants are just a year or two past the seedling stage, so it is too early to say how well they will do.

The Alps collection also contains a number of other European alpine plants, including the European alpine primulas mentioned above, as well as several of the European saxifrages, discussed next.

Saxifraga. This is one of the most exciting collections in the Botanic Garden, created through the interest and engagement of local and international *Sax-*

ifraga enthusiasts (photo, p. 97). Locally, Ole P. Olsen, who lives down the fjord of Balsfjord about 50 km from Tromsø, got it started back in 1994 when he donated several *Porphyrion* and other saxifrages to the then newly established Botanic Garden. Later, after I became director in 1997, several members of the International Saxifrage Society became involved. Gifts in the form of cuttings were received from Peter Smith in England (species and hybrids in section *Saxifraga*), from Ger van den Beuken in the Netherlands, from Raymond Fairbairn in England (species and hybrids in section *Porphyrion*), and from Beryl Bland in England (species and hybrids in section *Ligulatae*). Presently hundreds of saxifrages flower here every year, starting with the *Porphyrion* section very early in spring and including our "own" *Saxifraga oppositifolia*. A bit later, section *Saxifraga* puts on quite a show. In midsummer, plants in section *Ligulatae* flower profusely, including our own *Saxifraga cotyledon* and the wonderful *S. callosa*.

Southern Hemisphere. We call this section "Southern Hemisphere," but actually the majority of plants seen here are from South America, mostly from Patagonia. There are a few from New Zealand and South Africa, but these collections are not well developed yet, although hopefully the selection will increase in the years ahead.

South America has a lot to offer in the form of beautiful and exciting plants. Species from the genera *Calceolaria, Calandrinia,* and *Oxalis* have been particularly accommodating. *Calceolaria biflora* has become a commonly grown perennial in Tromsø. *C. fothergillii* and *C. uniflora* are somewhat harder to please, but still well established in the Botanic Garden. We also grow a number of *Calceolaria* species which, so far, have not been identified. About five species of *Calandrinia* seed around, the most attractive being *C. rupestris* and *C. skottsbergii*.

Then there are the wonderful *Oxalis* species (and a few hybrids). The commonly grown *O. adenophylla* is easy and flowers profusely each year. Equally beautiful *O. enneaphylla* flowers in shades of white and glossy pink. Exquisite *O. loricata* is a great rarity. The most beautiful (and variable) of them all is probably *O. laciniata* (photo, p. 101). We now have a number of forms of this wonderful plant in Tromsø, but not all of them are growing in the Botanic Garden yet.

One of the "showstoppers" in the South American collection is *Azorella trifurcata*, whose Norwegian name translates as "Rubber-pillow." The green, spreading cushions of this plant are amazingly attractive.

Finally, let me mention some delightful monocots. *Olsynium biflorum* is a relative newcomer here. Fragrant, carrying relatively small, white lilylike flowers with marked purple-brown stripes, it has lots of substance and character. There also are some sisyrinchiums here, most with smallish flowers in white or blue, but one attractive species (as yet unidentified) has larger, long-lasting yellow flowers. The rather inconspicuous *Tristagma nivale* is a plant of more interest to the botanist than to the lover of flashy alpines, but it is charming—and it seeds around, which is always a delight.

Potential and future

In summer 2004, the Arctic-alpine Botanic Garden celebrated its tenth anniversary. Major quality improvements were made on that occasion. First, the long-awaited new staff building was completed, improving the work conditions of the summer staff. Second, a new main entrance with a parking area was constructed. Third, three very large and forty smaller signposts were erected to inform visitors about the layout and the collections.

Although much remains to be done regarding planting and correct naming, the collections and plants in the Garden had never been better than during summer 2004. This pleased us greatly, since the culmination of the celebration was the international symposium "Alpines on Top of the World," which I organized. Seventy external participants from 10 different countries came to Tromsø during July 1–5 to join around 30 local participants at 17 lectures on alpine plants from all over the world, given by 12 top international speakers. It was a great success, and an event which made clear to us, and to our visitors, the tremendous potential this botanic garden has.

So what are the future prospects? While there is no doubt that the garden's potential is great, there is no hiding the fact that at the time of writing (January 2005) there are numerous black clouds in the sky. The four major issues can be summed up as:

1. Lack of adequate funding for annual operation.
2. Lack of a nursery.
3. Too few staff, at one director and one gardener. (In addition, hired summer staff, mostly students from the university, has been reduced lately to an inadequate level.)
4. Since I plan to retire as director at the end of 2005, the problem of finding a successor to handle the numerous tasks connected to running a botanical garden will soon become acute. A misfit here could quickly put the garden on a declining path.

These four critical issues have been expressed to the university. How, or if, they will be resolved remains to be seen. After having lived with and for the Arctic-Alpine Botanic Garden in Tromsø for almost nine years now, I sincerely hope that the future will be as bright as this botanical garden deserves—indeed, as the University of Tromsø, the city of Tromsø, northern Norway, and all my fellow international rock and alpine gardeners deserve.

Finn Haugli became director of the Arctic-Alpine Botanic Garden in Tromsø, Norway, in 1997, having been professor of molecular biology at its parent institution, the University of Tromsø, since 1971. He has lectured widely in Europe and on a NARGS-sponsored tour in North America. He will be the keynote speaker at the NARGS Annual meeting in St. John's, Newfoundland in July 2005. He can be contacted at Overlege Meyers Veg 12. N-9013 Tromsø, or by e-mail at finn.haugli@c2i.net or finnh@tmu.uit.no.

Romanian Mountain Flowers

Răzvan Chişu

Romania lies in the southeast of Europe and is therefore at the crossroads of many climatic influences: continental in the north and east, Mediterranean in part of the south, and maritime in the west. There are also many types of soils and forms of topographic relief. All these factors influence the variety of species that grow within Romania's borders.About 3700 species of flowering plants are found in Romania, with different origins: European, Asiatic, Pontic (from around the Black Sea), Mediterranean, Atlantic, Siberian, Pannonic (centered on Hungary), and Balkanic. There are also relicts from glacial periods, cosmopolitan species, and a number of endemic ones. The mountains of Romania are especially rich in biodiversity, with a good share of endemics, relicts, and rare plants. (A useful book is Vasile Ciocarlan's *Flora Ilustrata a Romaniei*, published in Bucharest by Ceres Press, 1990.)

The Carpathian Mountains are mainly divided into two sections: the northwestern side, comprising the Tatras and the Slovakian mountains, and the southeastern side, of which about 80 percent lies in Romania. The eastern Carpathians (in relation to the central Transylvanian plateau) are of medium height, with the highest peak, at 2303 meters (7485 feet), in Rodna National Park. This park includes many peaks and ridges that are over 2000 meters high, but it is not visited by tourists as much as other mountains in Romania.

On the high peaks grow plants like *Saxifraga carpatica, S. bryoides, Pedicularis verticillata,* the endemic *Phyteuma vagneri, Soldanella hungarica* subsp. *hungarica,* and *Papaver pyrenaicum* subsp. *corona-sancti-stephani,* which likes to dwell in loose scree. Another endemic species is a plant which, because of its highly variable nature, has been classified as either *Silene, Viscaria, Melandrium*, or *Polyschemone*, and is now known as *Lychnis nivalis*. Growing only in the Rodna Mountains, it has forms with either pink or white petals, and single or double flowers. It grows in grassy patches at about 1800 to 2200 meters. It seems to be of ancient origin—a glacial relict, and possibly the ancestor of *Silene* species. Other species growing here include *Veronica baumgartenii, Pinguicula vulgaris, Hieracium aurantiacum, Campanula serrata, Viola biflora, Achillea schurii,* and *Saxifraga corymbosa* (photo, p.

105). Along trails one can find the minute rosettes of *Sempervivum montanum* subsp. *montanum,* which in August are topped by pink flowers.

If we climb lower down into the shade of fir and beech woods, we encounter the endemic *Dentaria glandulosa*, *Ranunculus carpaticus,* and *Symphytum cordatum*, and plants like *Pulmonaria rubra* and *P. filarszkayana,* both with red petals.

The rest of the eastern Carpathians is lower in elevation, with many woods, mineral springs (remnants of old volcanic activity), and cold swamps and bogs which house many plants at the southern limit of their distribution, or relict species.

The southern side of the Carpathians has the highest peaks (2543 meters/ 8265 feet in the Făgăraş Mountains), and also the most spectacular scenery. This range is sometimes called the Transylvanian Alps. These are massive mountains of crystalline rock, with few passes and many peaks over 2000 meters. The main subranges here are the Bucegi, Făgăraş, Parâng, and Retezat-Godeanu mountains.

Bucegi Natural Park is easily accessible by train from Bucharest to Sinaia and Buşteni , whence we can take a cable car up to 2000 meters. There we encounter the endemic *Saxifraga mutata* subsp. *demissa,* which has a pyramidal inflorescence much smaller than that of the type species; *Campanula carpatica* subsp. *bucegiensis* with flowers of pale pinkish lavender (photo, p. 103); a pink form of *Dianthus spiculifolius*; several species of *Gentiana*; and cushions of *Draba* and *Androsace.* Other finds include the alpine gem *Eritrichium nanum* subsp. *jankae* and *Saxifraga corymbosa* var. *luteo-purpurea,* with purple-pink dense hairs on the flower spike. *Dianthus glacialis* subsp. *gelidus* (photo, p. 106) is a Romanian mountain endemic, and *D. tenuifolius* is also seen; the first grows at higher elevations, either on loose sandy soils together with *Anthemis carpatica* var. *sericea* and *Artemisia petrosa* or on grassy patches, while the second grows in some of the beautiful gorges that cut through these mountains. At lower altitudes in some valleys grow the Balkan endemics *Viola declinata* (photo, p. 102) and *V. dacica.*

Near the Bucegi Mountains lies the ridge of Piatra Craiului, the home site of that gem of pinks, *Dianthus callizonus.* These are the most difficult to explore among the mountains in our country; the 22-km-long ridge is very abrupt and inaccessible in some places.

The Făgăraş Mountains are crossed by a road built during the communist era, so it is easy to travel by car to the highest peak in Romania, Vârful Moldoveanu. Around the glacial lakes in the Făgăraş grow mountain plants such as *Rhododendron kotschyi* (I was told by Romanian shepherds that its flowers make a flavorful marmalade; photo, p. 106*), Silene acaulis, Soldanella pusilla, Plantago gentianoides,* and *Saxifraga pedemontana* subsp. *cymosa*, a plant of shady, cold, wet places, under overhanging rocks (photo, p. 105). *Ranunculus glacialis* and *R. crenatus* are two more species that like cold, wet snowmelt places. The endemics here are *Silene dinarica, Aquilegia transsilvanica, Primula baumgarteniana* (closely related to *P. wulfeniana* of the Alps), and several species of *Hieracium.*

One place with a high diversity of *Hieracium* species is Retezat National Park. This is one of the most beautiful parks in the country, with more than 60 peaks over 2200 m and with more than one-third of Romania's glacial lakes. Besides the common alpine plants found in all Romanian mountains, there are several

endemic species and varieties, including *Papaver pyrenaicum* subsp. *corona-sancti-stephani* var. *retyezaticum*, the blue *Oxytropis pyrenaica* subsp. *retezatensis*, *Centaurea retezatensis*, *Draba dorneni* (found long ago in just one place near the Retezat peak), and *Pedicularis baumgartenii*.

The western side of the Carpathians has a median altitude of 1000 meters; it is very fragmented and has a diverse mineral substrate. The main sections are Munţii Banatului, Munţii Poiana Ruscă, and Munţii Apuseni.

The southern limit of the Banatului Mountains is the Danube. Here there are several reserves that protect an interesting flora, with many endemic elements as well as species also found across the border in Yugoslavia and Bulgaria. Flowering in May is *Iris reichenbachii*, 10 to 30 cm (4–12 inches) tall, with bright yellow flowers. On the cliffs overhanging the Danube at Porţile de Fier and Defileul Dunării is the tall, yellow *Tulipa hungarica*, which also has a scented subspecies. It flowers in April. Also flowering in spring are white-flowered *Cardamine graeca*, *Daphne laureola*, and *Syringa vulgaris*, which grows either in small colonies or as a low forest at Ponoarele near Baia de Aramă.

A Romanian endemic also found in Mehedinţi County is *Primula auricula* subsp. *serratifolia*. This subspecies has strongly toothed, farinose leaves and flowers in April through June. Other species of interest here are *Minuartia capillacea*, *M. frutescens*, *Dianthus pinifolius*, *D. giganteus* subsp. *banaticus*, the succulent *Veronica crassifolia* and *Campanula crassipes*, and pink *Convolvulus elegantissimus*.

Although the western Carpathians lack height, they are rich in gorges (*chei* in Romanian), caves, and other limestone karst phenomena. Such places in the Apuseni Mountains include Cheile Turzii, Cheile Râmeţului, and Cheile Intergalde. Here we can find *Dianthus simonkaianus* with tight cushions of rigid leaves and white flowers born on long stems, and *D. spiculifolius*; *Paronychia cephalotes* growing on the rim of Turzii Gorge; *Centaurea atropurpurea*, a tall species with dark red flowers; *Allium flavum*; and *Leontopodium alpinum* (Edelweiss), which in Intergalde Gorge grows at about 400 meters, the lowest altitude at which this species is found in Romania. Other interesting Romanian endemic plants are *Hepatica transsilvanica*, *Crocus banaticus*, and the scented *Viola jooi*, species that have long been cultivated in rock gardens and have proved highly successful there.

The most convenient way to get to Romania is by air; there are several international airports receiving flights from western European cities. Inside the country, access to mountain areas can be gained by train (train service is cheap and on time, but not always up to Western standards, especially the short-distance, second-class lines), or by rented car. Camping is not a problem (except in strict scientific reservations, one can camp almost anywhere), and there are also chalets and, in larger mountain resorts, hotels. There is also an increasing number of well-equipped, friendly rural boarding houses. So when you plan your next plant-hunting holiday, keep Romania in mind!

Răzvan Chişu is a young Romanian horticulturist with a keen interest in botany and alpine plants. He is continuing research on the ecology of alpine cushion plants, which was the subject of his B.Sc. thesis.

Hellebore Hybrids

Jim Metcalfe and Audrey Metcalfe

Hellebores (*Helleborus* spp.) are members of the family Ranunculaceae. Sixteen wild species have been identified. Those whose home territories are contiguous or overlapping frequently hybridize in nature, and many more hybrids have been created by breeders. Our purpose here is to discuss the parentage of each recognized hybrid, its characteristics, and its use in the garden.

Helleborus species vary greatly in the structure, markings, and color of their foliage and flowers, in their growth and dormancy patterns, and in their ability to accept pollen from other species. One classification divides them into "caulescent" species, whose flowers and leaves grow on the same stalk (*H. foetidus, H. argutifolius,* and *H. lividus*), and "acaulescent" species, whose flowers and leaves develop on separate stalks (*H. cyclophyllus, H. orientalis, H. odorus, H. multifidus, H. torquatus, H. dumetorum, H. atrorubens, H. croaticus, H. purpurascens, H. viridis,* and *H. thibetanus*). This classification has been helpful in predicting successful crossing between species, but it does not include *H. niger* and *H. vesicarius*.

Helleborus ×hybridus, the Lenten Rose

A rich array of native hellebores extends in a band across southern Europe, from France in the west, eastward between the Black Sea and the Mediterranean, and across Turkey to the western shore of the Caspian Sea. This band contains at least twelve species of hellebores, several with subspecies and many with overlapping territories. Except for *H. niger, H. argutifolius*, and *H. foetidus*, all are acaulescent, and among the latter natural hybridization occurs frequently. This suggests common ancestry, but there is wide variation among the acaulescent species in foliage structure, leaf patterns, and the occurrence of summer dormancy; moreover, their flowers vary widely in form, size, and color. Recognition of the potential to create hybrids by controlled crossing of these species probably occurred around 1837, when purple-flowered *H. orientalis* plants were introduced into Germany and England. The plants that resulted from these crossings came to be known as "Orientalis hybrids," but so many other species have

been involved that emphasis on *H. orientalis* as the dominant ancestor is misleading, and the plants are now called *Helleborus ×hybridus*, known commonly as the Lenten Rose.

The multiplicity of species in the ancestry of these plants makes it impossible to predict the outcome of a single crossing. Even self-pollinated flowers usually produce some offspring with flowers which differ in color from those of both parents and varies among plants of the new generation; the same is true of foliage and growth habit.

Flower color, form, and size were the first characteristics to interest breeders. Great diversity in colors and color patterns soon resulted, with efforts toward perceived perfection continuing to the present. The result has been the production of plants with flower colors ranging from pure white to a purple that is almost black. These colors are often so intense, varied, and appealing compared to those of the species and natural hybrids that naming individual clones was an irresistible temptation, and some of these named plants appear as illustrations in articles and catalogues to this day, although many have in fact been lost to cultivation. However, the heterogeneous ancestry of these hybrids means that exact duplicates of a particular clone can be obtained only by dividing the woody rhizome of the original or of one of its earlier divisions. This necessity severely limits the availability of these splendid examples of selective breeding, at least until tissue culture is common. In the meantime, growers offer seed strains that will produce flowers of predictable color, color pattern, and size.

Development of a seed strain usually requires at least several generations of selection and hand pollination. Each generation can take three years or longer from the initial cross-pollination or self-pollination of selected flowers before pollen from the resultant cross becomes available. Furthermore, self-pollination, a regular step in establishing a strain, threatens hybrid vigor, so outcrossing between individuals of different ancestry is usually necessary to produce strong plants. Because of the time, effort, and nursery space this process requires, plants from a named strain are more expensive than those whose flower characteristics cannot be predicted.

The flowers of hellebores are almost always comprised of five sepals, which together correspond to the calyx in other genera (for instance, the green covering of a rosebud). The petals of the hellebore flower have become nectaries: small and funnel-shaped, they form a ring within the sepals and around the reproductive organs of the flower and secrete nectar attractive to flying insects. This probably improves the chances of pollination, a particularly worthwhile modification in this winter-flowering genus.

Occasionally in nature the nectaries in all flowers of a *H. ×hybridus* plant are enlarged, sometimes reaching the size of the embracing sepals. The resultant flowers are designated "semi-double' or "anemone" if the nectaries' enlargement is less than complete, and "double" if restoration to petal size appears to be fully achieved. At our Honeyhill Farms Nursery, pollen transfer between double flowers has, in more than a hundred pollinations by hand, resulted only in plants that all have double flowers. This has been true whether the recipient double

flower is self-pollinated or receives pollen from another double-flowered plant. Crossings between semi-double flowers of different plants and self-pollination of semi-double flowers result in some offspring with double flowers and some with semi-double flowers; the same is true of crossings between a double and a semi-double. Finally, pollen transfer from a double to one with normal-sized nectaries has not, in our experience, produced any offspring with double flowers; some of the offspring have partially enlarged nectaries, and others show no enlargement. These findings are consistent with the hypothesis that the size of nectaries in *H.* ×*hybridus* is controlled by a group of genes. When all of the group are present in all of the offspring (as in the case of crossings between double flowers), the resultant plants produce double flowers; when none or only some of the group of genes is present (as in some crosses between semi-doubles and in all crosses involving a single), the resultant plants are never double-flowered.

In most Lenten Rose flowers, the small nectaries are green or yellow. In semi-double and double flowers, the enlarged nectaries generally adopt the color and color pattern of the surrounding sepals. When exceptions to this generalization occur, the flower is especially striking.

It is interesting to speculate on the introduction of the genes that control the size of nectaries (or petals). Double flowers are known to occur among wild *H. torquatus*. One double-flowered *H. torquatus* plant, named 'Dido', is accepted as one of the parents of the "Party Dress Group" from Blackthorn Nursery. These are *H.* ×*hybridus* plants whose double flowers have petals and sepals with a distinctive shape, each tapering to a point. A second *H. torquatus* plant, 'Aeneas', is credited with parentage of other double-flowered hybrids. The English grower Helen Ballard recorded the occurrence of double flowers in two plants of *H. multifidus* subsp. *serbicus* in the garden (that formerly recognized taxon is now placed in the species *H. torquatus*). We are tempted to credit *H. torquatus* with the introduction of one or more of the "doubling" genes into the *H.* ×*hybridus* line, but other sources cannot be ruled out.

Helleborus ×*hybridus* is the favorite hellebore group of most gardeners, no doubt because of the wide range of flower colors and forms; the flowers are also larger than those of most other hellebores (2–3 inches/5–7.5 cm in diameter), nodding when they first open but tending to turn upward as they mature through the season. The large, palmate, deep green leaves vary in shape and texture but remain attractive through summer into autumn. Plants range in height from 15 to more than 24 inches (37–60 cm). When planted about 18 inches (45 cm) apart, they will grow vigorously in soils with a wide range of composition and acidity. They have a reputation as shade-loving plants but will accept sunny locations when watered to compensate for the exposure and, if transplanted from shade, allowed to become accustomed gradually to stronger light.

The Lenten Rose makes a good evergreen accent plant when set alone among shrubs, under trees, or in a perennial bed. If garden space permits, they can be stunning planted in a group and perhaps combined with other plants, such as early-blooming bulbs and rhododendrons that complement their flower color.

Winter weather—wet, windy, and often frosty in western Oregon, where we garden—can be tough on the big leaves of these hybrids, so in December or January, when the new flower stalks can just be seen above ground, we cut off the old leaves. The flowers, which appear here in early February, now get center stage until the new leaves emerge in March.

Helleborus ×hybridus, once established in the garden, requires little care. Plants respond well to being mulched with compost each spring if you are careful not to cover the crowns. In pots of generous size, they thrive when given dilute liquid fertilizer once a month.

These hybrids are generous in their production of seed which, if left undisturbed around the mother plant, will germinate in eight or nine months. The seedlings are not easily identifiable to the uninitiated until the true leaves emerge, so delay weeding and cultivation around the mature plants. Many hellebore seeds lose their viability in storage, though a packet of stored seed generally produces a few plants, sometimes a year or more after sowing.

A favorite hellebore can also be divided when multiple crowns develop. This is best done in September. Dig a generous root ball using a garden fork rather than a spade (to minimize root damage) and wash the roots completely free of soil with the jet of a hose. Then cut the tough rhizome with a sharp knife, leaving several new white roots and several leaf buds on each division.

Helleborus ×sternii (*H. lividus* × *H. argutifolius*)

Helleborus lividus is one of the caulescent group (flowers and leaves grow on the same stalks). Its natural territory is confined to the Balearic Islands off the Mediterranean coast of Spain. It is a compact plant with dark green leaves with three leaflets, long and pointed with smooth edges. They are carried on pink or red stems with a pattern of silver veins; our favorites have leaves with purple undersurfaces. The small flowers range from green tinted with pink that is especially striking on the outer surface of each sepal, to wine-red on both surfaces of the sepals.

The two other caulescent species, *H. foetidus* and *H. argutifolius*, grow widely in western Europe, including the Balearics. No hybrids of *H. foetidus* are known to occur naturally, but crosses between *H. lividus* and *H. argutifolius* occur frequently in gardens; indeed, it is increasingly difficult to find plants that are "pure" *H. lividus*. The hybrid is called *H. ×sternii* (photo, p. 107). Its best representatives combine the compact charm, pink-tinged or red flowers, and lovely marbled leaves of *H. lividus* with the vigor and a trace of the saw-toothed leaves of *H. argutifolius*. They are fertile, and we select for leaf pattern, red stems, and pink flowers in breeding them. Since these desirable traits are derived from *H. lividus*, we have recently tried to emphasize them by backcrossing *H. ×sternii* with *H. lividus*; early results are promising with regard to compactness, nicely patterned leaves, and deep rose stems and flowers. They have survived 15°F (–9°C) in our garden and thrive in full sun.

One of the best strains of *H. ×sternii*, the "Blackthorn Group," is of English origin and is one of only two *Helleborus* hybrids to have received the Award of Gar-

den Merit from the Royal Horticultural Society of Great Britain. The other hybrid award recipient is *H.* ×*nigercors*.

H. ×*sternii*'s value is partly in the year-round beauty of its leaves and stems. It will grow in full sun or deep shade. It offers a wide range of size, from 12 to 24 inches (30–60 cm) in height and breadth. In late January a cluster of flowers, each about 2 inches (5 cm) in diameter, begins to form at the tip of each colorful stalk; the period of bloom extends into April. New growth develops as the old flower stalks age, so the old growth can then be cut off at its base. *H.* ×*sternii* can also be grown in pots, where a regular application of dilute liquid fertilizer is recommended. This hybrid is fertile and, like other caulescent hellebores, does not have the well-developed rhizome of the *H.* ×*hybridus* group, so we seldom propagate it by division.

Helleborus ×*nigercors* (*H. niger* × *H. argutifolius*)

Helleborus niger is justly famous as the beautiful "Christmas Rose," but it is difficult to grow in many regions. However, when crossing endows its descendants with the vigor of *H. argutifolius*, they are among the sturdiest and most striking hellebores in our garden. (The name of the hybrid combines *niger* with *corsicus*, a synonym of *H. argutifolius*.) They flower generously, sometimes producing a mound of white blooms tinged with green, each flower about 3 inches (7.5 cm) in diameter. One clone, 'Honeyhill Joy' (photo, p. 109), which has now been tissue-cultured, broke our determination not to name any Honeyhill plants. It (like some plants from other nurseries) bears a spire of outfacing flowers, white with an occasional pink tint and a central green stripe on each sepal. The flowers of these hybrids, like those of *H. niger*, develop close to the crown of the plant and rise as they open.

H. ×*nigercors* ranges from 12 to 18 inches (30–45 cm) in height. Like those of all interspecies hybrids, its characteristics fall in a spectrum between those of the parents. Its leaves are deep green and tough, but they vary in shape from resembling those of *H. argutifolius*, pointed with saw-toothed edges, to those of *H. niger*. The blooming period is longer than that of most hellebores.

We recommend placing *H.* ×*nigercors* as an accent plant in a prominent spot in the garden. These plants simply want to grow and bloom, and they will do so in sun or shade; we compensate for more sun with more water.

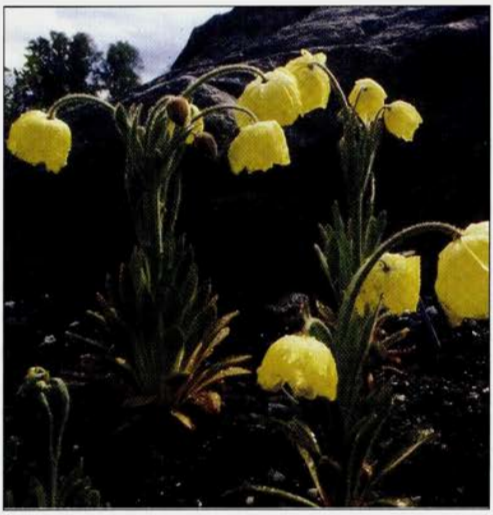
Until recently propagation has depended upon careful division of the rhizome, but tissue culture has now been accomplished. Additionally, in rare instances pollen transfer between *H. niger* and *H. argutifolius* results in plants that produce and accept pollen. Our experience is limited to one such occurrence; the resultant plants have the vigor of *H.* ×*nigercors* and will accept pollen from themselves or from *H. niger*. Their pollen will also fertilize *H. niger* to produce vigorous offspring.

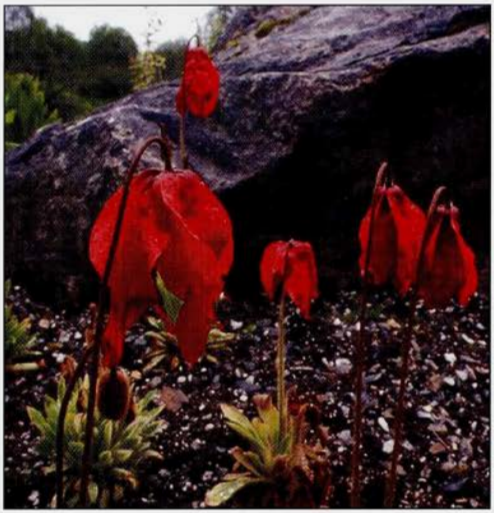
The dramatic setting of the Tromsø Botanic Garden (p. 83) enhances *Saxifraga juniperifolia*, above, and *Primula luteola*, below. (Photos, Finn Haugli)

Primulas revel in the cool, moist climate of Tromsø. Above, *Primula ioessa*; below, *P. denticulata* color forms. (F. Haugli)

More spectacular *Primula* plantings in Tromsø: above, *P. sonchifolia*; below, *P. strumosa*. (F. Haugli)

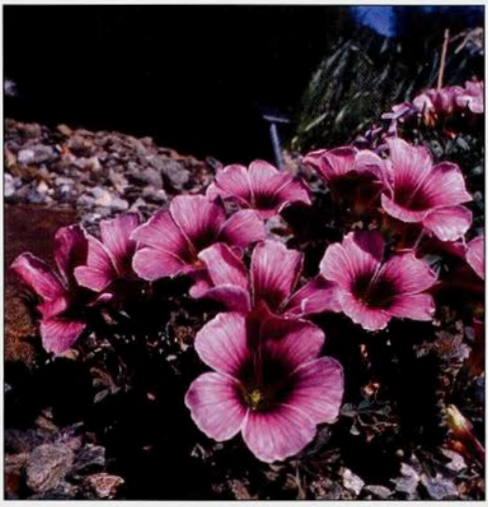
Alpines at Tromsø: above left, *Cremanthodium reniforme* (p. 84); above right, *Iris latifolia* (p. 85); below left, *Meconopsis pseudointegrifolia*; below right, *Meconopsis punicea* (p. 84). (F. Haugli)





Erythronium sibiricum (p. 85) at Tromsø. (F. Haugli)

Tromsø suits *Oxalis laciniata* from Patagonia (left; p. 87) and *Townsendia rothrockii* from the U.S. Rocky Mountains (right).



Balkan endemics in Romania (p. 90): above, *Ramonda nathaliae*; below left, *Viola declinata*; below right, *Viola jooi*. (Photos, Râzvan Chișu)

Cheile Turzi, a gorge in the Romanian mountains—a paradise for plant-lovers. (R. Chișu)

Two bellflowers of the Romanian mountains (p. 90): *Campanula carpatica* and *C. cochlearifolia*, both popular rock garden plants.

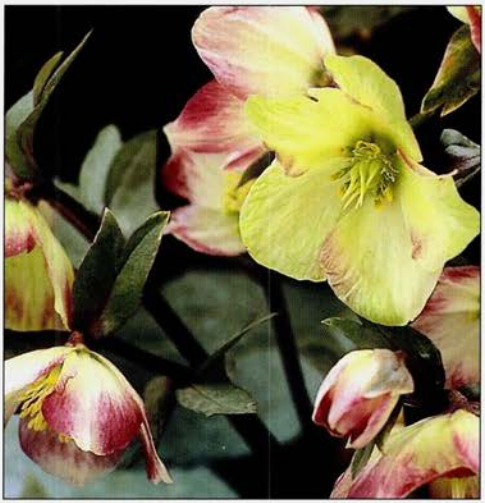
Corydalis solida (above) and *Epimedium alpinum* carpet Romanian woodlands. (R. Chişu)

Saxifrages of the Romanian mountains: above, *Saxifraga pedemontana* subsp. *cymosa* (p. 90); below left, *Saxifraga federici-augustii*; below right, *Saxifraga corymbosa* (p. 90). (R. Chișu)

Dianthus glacialis (right) and *Myosotis alpestris* subsp. *pygmaea* in the Romanian mountains (p. 90). (R. Chișu)

Rhododendron kotschyi (p. 90) is a showy Romanian shrub.

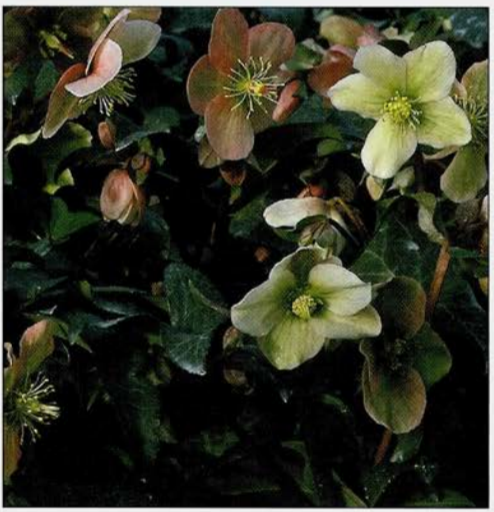
Natural hybrid hellebores growing at Pine Knot Nursery. Above, *Helleborus ×sternii* (p. 95); below, *H. ×ericsmithii* (p. 113). (Photos, Dick Tyler)



Hybrid hellebores: above left, Pine Knot hybrid 'Briar Rose' (p. 114); above right, double form raised at Honeyhill Farm; below, two Honeyhill color forms. (Photo 1, D. Tyler; others, J. Metcalfe)

Helleborus thibetanus (p. 114) emerging in the garden of Jim McClements, who won the grand prize in the 2004 Photo Contest with this image.

Left, *Helleborus* ×*ballardiae* (p. 113); photo, D. Tyler); right, a form of *H.* ×*nigercors* being introduced as 'Honeyhill Joy' (p. 96); photo, Terra Nova Nursery).



Plants along the Blue ridge Parkway: above, *Orchis spectabilis* (p. 122) and *Orobanche uniflora* in Pisgah National Forest; below, *Trillium undulatum* (p. 119) on the Mt. Pisgah Trail, and *Iris verna* (p. 120) on the Flat Rock Trail. (Photos, Thomas Clark)

Androsace alpina (p. 142) in the Dolomites, showing both pink and white forms. This image by David Sellars won honorable mention in class 2 in the 2004 Photo Contest.

Castilleja levisecta, a rare species being grown for restoration (p. 128). (Photo, B. Lawrence)

Gardening on hard surfaces, the subject of George Schenk's new book reviewed on p. 144, is exemplified by Ev Whittemore's "table on a stump." (Photo, E. Whittemore)

The stately monocarpic *Michauxia tchihatchewii* (p. 118). (Gerald Taaffe)

Helleborus ×ballardiae (*H. niger* × *H. lividus*)

As with other interspecies hybrids, there is wide variation in the appearance of the plants from this cross (photo, p. 109). The most attractive (to our eyes) display flowers similar in size and conformation to those of *H. niger* but with a delicate pink flush on a cream upper surface; the sepals are usually tinged with green on the inside, and their outer surface may also show a pink flush. The leaves are similar to those of *H. niger* but have a distinct venous pattern. This hybrid is reputed to be unable to survive cold weather, but it has tolerated temperatures down to 15°F (–9°C) in our garden. It is usually regarded as sterile, but Helen Ballard recorded some successful self-pollinations and showed that the pollen of some plants was viable by using it to back-cross successfully onto the seed parent, *H. niger*. However, propagation is usually accomplished by rhizome division.

These are rather diminutive plants, usually no more than 15 inches (40 cm) tall, so they need a special place in the garden in order to be noticed in winter, preferably in a partly sunny spot. They are said to perform well in pots with regular fertilizing.

H. ×ericsmithii (*H. niger* × *H. ×sternii*)

As might be expected when parentage involves three species, there is great variability in the results of this cross (photo, p. 107). However, some are excellent plants with large (up to 4 inches/10 cm in diameter), long-lasting white or pink flowers, often with a green central stripe, on stout stems. The leaves are dark green, patterned and shaped like those of *H. lividus*, with a hint of saw-tooth on the edges and with wine-red stems. Our favorite plants are compact, smaller than either parent—no taller than 14 inches (35 cm) and with about the same diameter. They are generally more vigorous than *H. ×ballardiae*, presumably because of the *H. argutifolius* in their ancestry. The cross is generally considered to be sterile, so propagation is achieved by careful division of the rhizome. However, as with the other *H. niger* hybrids, in rare instances the cross between *H. niger* and *H. ×sternii* produces fertile offspring.

Selected specimens of *H. ×ericsmithii* make excellent pot plants with regular applications of dilute liquid fertilizer. They do best, in the garden or in pots, with several hours of sun daily.

Recent interspecies hybrids

This section has kindly been provided by Dick and Judith Knott Tyler of Pine Knot Farms in Clarksville, Virginia.

There has recently been an explosion of interspecies hybrids. The availability of *Helleborus thibetanus* and *H. vesicarius* has given us new material to work with,

and breeders are having a field day. *Helleborus vesicarius, H. niger,* and *H. thibetanus* are significant in that they will cross with species previously considered to be not closely related. *Helleborus niger* can be considered a "bridge" between species and has crossed with *Hh. foetidus, viridis, vesicarius, thibetanus*, and possibly other species. *H.* ×*sternii* will potentially cross with *H. vesicarius* and *H. thibetanus* since it crosses with *H. niger*, which will cross with both. *Helleborus* ×*ericsmithii* and *H.* ×*nigercors* are thought to be sterile, but one occasionally hears of a fertile plant which, if genuine, would open new avenues for breeding, perhaps with one of these two newly available species.

***Helleborus* 'Pink Ice'.** *Helleborus niger* has been crossed with *H. thibetanus* to produce an unusual and very interesting plant. The first recorded cross was done at Ashwood Nurseries by Kevin Belcher. Named 'Pink Ice', this new hybrid was introduced at an R.H.S. show. It bears silvery pink flowers in branched clusters, each flower 2 inches (5 cm) across, on plants 12–15 inches (30–40 cm) tall. 'Pink Ice' appears to be sterile, so new plants must be produced by division or tissue culture.

***Helleborus* 'Briar Rose'** (photo, p. 108)**.** This cross between *H. niger* and *H. vesicarius* was also first shown by Ashwood Nurseries, bred by Kevin Belcher. 'Briar Rose' has foliage that is the bright celery green of *H. vesicarius* but is evergreen like that of *H. niger*. The flowers are larger than those of *H. vesicarius*, approximately 1–1.5 inches (2.5–3.8 cm), creamy white with a wide rose rim around the outside of the flower. *Helleborus vesicarius*, an unusual hellebore from Turkey, interests breeders who would like to incorporate its large, ornamental inflated seed capsules into new hybrid plants.

Helleborus thibetanus

Not many years ago, few people had seen *Helleborus thibetanus*, native to China and formerly known only as illustrations and dried herbarium specimens. When the borders began to open, it excited growers worldwide (photo, p. 109).

In a manner similar to that of many North American woodland ephemeral perennials, *H. thibetanus* emerges from dormancy in late winter, flowers, is pollinated, sets seed, and goes dormant by mid to late summer. Its flowers are approximately 2 inches (5 cm) wide, ranging from pale silvery pink to darker pink, often veined in a darker shade of pink. The foliage is thinner in substance than that of many other hellebores and paler green, with finely toothed margins. Plants stand approximately 12–15 inches (30–40 cm) tall and are of similar diameter when mature. The seeds are round and black, usually produced in only two carpels (sections of the capsule), although occasionally a plant has one or three carpels mature. Seedlings appear with a single true leaf instead of the pair of cotyledon leaves seen in other species.

IN CONCLUSION, we hope we have informed you and interested you in hellebore hybrids, already popular in larger rock gardens, especially those that merge with

woodlands. In addition, we have tried to suggest our own excitement about this increasingly fascinating genus. Our decades-long involvement with these plants has allowed us to glimpse the glory and ingenuity of Nature's design, and for this we are especially grateful.

Reading and Sources

To learn more, read *Hellebores* by Graham Rice (London: Cassell and Royal Horticultural Society, 2002).

Honeyhill Hellebores raised by the authors are available at local sales mentioned at <honeyhillfarmsnursery.com>.

Dick and Judith Knott Tyler's Pine Knot Nursery, hellebores available by mail, is at <pineknotfarms.com>.

Russell Graham, 4030 Eagle Crest Road NW, Salem, Oregon 97304-9787, 503-362-1135.

Heronswood Nursery <heronswood.com>.

Edelweiss Perennials, 29800 S. Barlow Rd., Canby, OR 97013.

Jim and Audrey Metcalfe raise their hellebores at Honeyhill Farms Nursery in Portland, Oregon, which they open to the public by appointment during hellebore flowering season each winter.

Tiny Tumbleweeds and Other Once-Blooming Plants for the Rock Garden

Gerald Taaffe

The word "monocarpic" means "fruiting once," and it is a useful word for gardeners to know. It embraces annuals, which flower, go to seed, and die in one growing season; biennials, which make leafy growth their first year and flowers and seeds their second, then die; and some plants that take even longer to build up strength for their climactic and only flowering. Although authorities often prescribe that the rock garden is the place for long-lived little perennials and shrubs, most practical rock and alpine enthusiasts do not exclude monocarpic plants (often shortened to "monocarps") on principle. Here are a few particularly valuable ones.

Androsace lactiflora is among the often overlooked monocarpic plants that have given my Zone 4 rock garden in Ottawa what I like to think of as a natural, unplanned look. This modest annual helps fill the spaces between slow-growing perennials and woody plants, while other monocarpic plants step briefly into the garden spotlight before disappearing and making room for new and different effects. An additional virtue of the few that I name here is that, except where noted, they are easy from seed, with no need of a cold period.

I've grown very fond of *Androsace lactiflora*, although it seems to rank alongside the similar or identical *A. chaixii* and *A. septentrionalis* as the least honored of the cultivated species of its genus. In spring, its prickly-looking volunteer seedlings sprout by the tens of dozens, ready to grow into narrow-leaved rosettes, none wider than 2 inches (4 cm), each with several wiry 6–10-inch (15–25 cm) scapes topped by umbels of small white flowers. I rogue out many of the shallow-rooted seedlings, but a few dozen always make it through to September, when they shrivel into ping-pong-ball-sized tumbleweeds that disappear with the first gust of wind.

Together with self-sowing (and weakly perennial) alpine poppies, *Androsace lactiflora* brings a meadow-like harmony to an area that includes such disparate elements as summer-blooming gentians, *Viola pedata,* and various *Cyclamen* species, with accents of spreading *Indigofera decora* 'Alba,' a dwarf form of *Ulmus parviflora,* and a slender clump of flaming red *Lilium concolor* var. *strictum.*

More of a feature player in the rock garden is *Androsace albana*, another once-blooming species, with attractive 4–5-inch-wide (10–12 cm) rosettes of succu-

lent-looking scalloped leaves that tend to curl into intriguing tubes. The inflorescence, which for me has always appeared only in the second year, is a showy, many-flowered head of large white or pink-tinged flowers on sturdy 4–6-inch (10–15 cm) scapes. It self-sows rather sparsely and, in this climate, has been known to disappear entirely after an especially severe winter.

Still showier is *Townsendia parryi,* best-looking of the North American "Easter daisies" that I've tried, with tight, low-lying rosettes of silvery, spoon-shaped leaves, and, on very short stems, large yellow-centered daisies of light violet. Grown in a sunny sand bed, the flowers hold their own among neighbors that include *Lewisia tweedyi, Phlox kelseyi,* and *Prunus prostrata.* Sown early under lights, it has sometimes produced somewhat smaller flowers the first fall, but it normally blooms in early spring of the second year, produces lots of seed, and then expires.

Sedum pilosum is one of two little biennials that bring an extra glow to troughs and the rock garden foreground. Rightly called the real beauty of its immense genus, it's as neat as a birthday-cake decoration, with a flaring head of pink flowers on a 3-inch (7.5-cm) stem that springs from a single tiny sempervivum-like rosette. What strikes me first about the other, the gentian relative *Centaurium chloodes,* is the glossy, lacquer-like finish of its small pink flowers. They appear for a long time in mid and late season over wispy 2–3-inch (5–7.5 cm) plants and, unlike the sedum, may bloom the first year from an early sowing.

Sedum caeruleum may also be worth a try. The one time I planted this annual and not unattractive western Mediterranean native was under lights, and it alarmed me by taking only a few weeks to grow into a 6-inch (15-cm) tangle of thin stems with tiny blue flowers that soon spilled over into adjoining flats. Next time it will be sown outdoors, on a trial basis, someplace where excessive self-seeding isn't likely to be a problem.

I don't at all regret indulging for a few years in a dense and rapidly expanding patch of the pretty pink-flowered annual *Phuopsis stylosa,* of the Rubiaceae or madder family, which is as close as anything can be to an Instant Rock Garden. It has what Will Ingwersen, in his *Manual of Alpine Plants*, tactfully calls "a curious musky scent" that makes pulling out excess plants a memorable experience. It blooms in summer, after the rock garden's first flush of color.

Little kids are especially fond of staying up until dusk on summer nights to watch buds of the light yellow flowers of *Oenothera triloba* expand visibly and then open with a soundless snap. In daytime, before the flower buds step into nature's phone booth to don their capes, this remarkable little evening primrose looks enough like a dandelion to be in mortal danger from weeders. Rather than perennial, as sometimes reported, I've found it to be a reliably self-seeding biennial that will flower the first year from an early sowing.

Slower to open but more sensational in effect are the 5-inch (12-cm), pale yellow flowers of biennial *Mentzelia decapetala.* They open at nightfall in mid and late summer and have a hauntingly sweet fragrance that lingers in the memory long after the flowers have faded. The downside is that it's big: up to 5 feet (1.6 m) high, not particularly good-looking plant, with seeds that need a month's cold

treatment and some luck for germination. The closely related *M. nuda*, with similar flowers on a smaller plant, may be less awkward.

Skipping over the better-behaved of the great variety of monocarpic bellflowers in the Campanulaceae, I'll close with *Michauxia tchihatchewii,* the ungainly but beautiful monster of the group (photo, p. 112). It adds a dramatic accent in my garden, along with yuccas and a large form of *Cytisus hirsutus*, to a relatively rough planting between the rock garden and a sand bed. It takes as many as 4 lackluster years before it lurches up suddenly to a bristly candelabra-like 4 or more feet (1.3 m plus), hung with abundant 3-inch-wide (7.5-cm), down-facing white flowers of startling appearance. The slender reflexed petals call attention to the stamens and long style dramatically exserted from a filbert-sized, apple-green ovary. This configuration may lack subtlety, but it's striking and, judging by the great quantities of seed produced, does the job of attracting pollinators.

Gerald Taaffe of Ottawa, Ontario, has contributed several articles to the *Rock Garden Quarterly* and is the coauthor of the new Timber Press book *Garden Plants of Japan*.

Flora of the Blue Ridge Parkway in North Carolina

Bobby J. Ward and Thomas Clark

Construction of the Blue Ridge Parkway in western Virginia and North Carolina was begun in 1935 using labor by the Civilian Conservation Corps (CCC), a jobs program that arose out of the Great Depression. By World War II, 75 percent of the planned 469 miles (755 km) of the Parkway had been completed in a road project designed to connect Shenandoah National Park in Virginia to Great Smoky Mountains National Park in North Carolina. After the war work was sporadic, and the park's final segment—the Linn Cove Viaduct skirting Grandfather Mountain near Boone, N.C.—was completed in 1987.

The Blue Ridge Parkway is a rural two-lane highway on which commercial traffic is prohibited. It is not a road to travel if you are in a hurry, as the speed limit is 45 miles per hour (72 kph). Many sections are closed, except to local traffic, during winter months when the Parkway is not cleared of snow, ice, or debris. The Parkway provides access to inviting hiking trails to nearby peaks and outlooks, pullovers, streams, and waterfalls, all under the canopy of trees. There are few distant vistas. Those willing to submit to its leisurely pace can see and experience the floral diversity of the southern Appalachian Mountains. That was why 18 members of NARGS participated in a spring 2004 wildflower expedition led by Lawrence (Larry) Mellichamp, biologist at the University of North Carolina, Charlotte, and Thomas (Tom) Clark, horticulturist at Mount Holyoke College in Massachusetts and then chairman of the Berkshire Chapter of NARGS. Using Asheville as the base for our day-long trips, we hiked through deciduous and coniferous forests off the Parkway, making numerous roadside stops. We also visited private and public gardens and shared convivial evening meals during the seven-day trip.

We left Raleigh on 9 May 2004. We first noticed that spring had lagged behind its typical schedule by nearly two weeks when we made our initial stops on the Parkway at Ravens Rock and Flat Rock Outlook: the trees were budding out, and the canopy had not yet closed in. There at 3500 feet (1066 m) elevation, we saw several populations of painted trillium (*Trillium undulatum*; photo, p. 110), a species with white, slightly recurved, wavy-edged petals with crimson venation near their bases—our first photo op on the trip. They were growing among New

York fern (*Thelypteris noveboracensis*), yellow-flowering *Viola hastata*, and wood anemone (*Anemone quinquefolia*). The canopy included *Magnolia fraseri* and the striped-barked maple (*Acer pensylvanicum*). Also near Ravens Rock, we first saw the red or stinking-dog trillium (*Trillium erectum*) and its white form. All forms, red, pink, or white, have a dark ovary. It's a striking plant. A short hike to Flat Rock Outlook ended in an exposed area of rock outcrop where Table Mountain pine (*Pinus pungens*) grew, stunted and distorted by the harsh conditions. The dwarf, clump-forming *Iris verna* was here, with rich purple flowers punctuated with a golden-orange crest (photo, p. 110). In some of the slightest fissures in the rock, *Corydalis sempervirens* found conditions to its liking. This annual species has rather succulent glaucous foliage and small pink-and-yellow flowers that appear over several weeks.

The parkway ranges from 650 feet (198 m) above sea level to over 6000 feet (1828 m), and we would encounter changing weather conditions: thunder and lightning, fog, and abundant sunshine under clear blue skies. With guidebooks in hand, taxonomic keys, and capable leaders, we were able to identify almost any plant (and rocks and birds too) that we encountered. Because of the various elevations, exposures, climate, and soil types within the Parkway area, there was much floral fodder for our eyes and cameras.

Mount Mitchell State Park (Burnsville, N.C.) is situated in the ancient Black Mountain Range, named for the dark evergreen forests of red spruce (*Picea rubens*) and Fraser fir (*Abies fraseri*) that cover its peaks, 18 of which are higher than 6300 feet (1920 m). Mount Mitchell, comprised of erosion-resistant igneous and metamorphic rocks, is the highest mountain in eastern North America (6684 feet/2026 m). Its name honors Elisha Mitchell who measured the mountain's height in 1857 and fell to his death on it. The flora and temperatures are similar to those of southern Canada; the record low temperature on the mountain, recorded in 1985, was −34°F (−37°C). Glaciers and cold temperatures during the Pleistocene Era (18,000 years ago) allowed many plant species to extend southward from Canada and the northeastern United States. As the ice receded, many of the typically northern species retreated northward and to higher elevations. In the southern Appalachians, spruce, fir, and several other types of trees are now restricted to the highest peaks, above 5550 feet (1691 m). For identification purposes, we were provided with the mnemonic, "Fir trees, flat and friendly; spruce sharp," a description of the needles.

During our scrambling on the mountaintop, we visited Mitchell's grave and saw *Sorbus americana*, *Amelanchier arborea*, and *Acer spicatum*, all in early bud stage. We gazed at the bare trunks of numerous Fraser firs killed by the balsam woolly adelgid, a European insect which caused major devastation beginning in the 1980s. Now seedlings are reappearing in the waste, and the slow process of forest regeneration is underway.

Craggy Gardens Recreational Area, at Blue Ridge Parkway milepost 364.1, north of Asheville, is a natural vegetation community called a heath bald, which consists of *Rhododendron catawbiense*, mountain laurel (*Kalmia latifolia*), *Rhododendron calendulaceaum*, and several blueberries (*Vaccinium* spp.). During our visit,

the mountaintops and hillsides overlooking the bald were dotted with white-flowering serviceberry (*Amelanchier arborea*). The local folk used to mark the beginning of springtime when the serviceberry bloomed, a meteorological signal that the ice and snow had melted, the ground had thawed, and itinerant preachers could once again hold church and burial services. Under the canopy of rhododendrons we saw *Heuchera villosa*, *Oxalis montana*, *Claytonia caroliniana*, *Dicentra canadensis*, and rock tripe lichen (*Umbilicaria* sp.).

The group spent an afternoon at the North Carolina Arboretum in Asheville, whose 424 acres (173 ha) lie within the Bent Creek Experimental Forest of Pisgah National Forest. It's fairly new, having been established in 1986 by the North Carolina General Assembly, and is managed by the University of North Carolina as an interagency facility. The arboretum continues to evolve but currently consists of trails, stream garden, heritage garden, holly garden, a pattern or "quilt" parterre garden, a professional landscape garden, and more. Outstanding is a superb bonsai collection, whose curator took the NARGS group behind the scenes to view this marvelous assortment, currently consisting of 100 trees, several grown from species native to the southern Appalachians. Another trip took us to the University of North Carolina at Asheville Botanical Garden, a 10-acre site of native trees, shrubs, and flowers, mostly in a woodland setting. It has a small rock garden featuring native plants.

Hooker Falls in DuPont State Forest near Penrose offered us a level, gravel-surfaced walk to see several waterfalls, and our guides pointed out tree species we were seeing for the first time: silverbell (*Halesia tetraptera*), horse-sugar (*Symplocos tinctoria*), Carolina hemlock (*Tsuga caroliniana*), and sweet or cherry-bark birch (*Betula lenta*), whose crushed leaves smell of oil of wintergreen. We walked slowly along the stream because there were so many shrubs attracting our attention: dog-hobble (*Leucothöe axillaris*), spicebush (*Lindera benzoin*), sweet-shrub (*Calycanthus floridus*), and silky dogwood (*Cornus amomum*). Among the groundcover plants were *Lycopodium obscurum* var. *dendroideum*, and two orchids—*Goodyera pubescens* and *Tipularia discolor*. We also saw *Viola walteri*, a southern species typical of dry woods. Hooker Falls was a "must see" site recommended by Ev Whittemore, who lives near the state forest. We added many plants to our list as we walked along the soothing, burbling stream.

The group gorged on a sumptuous lunch served by Ev and Bruce Whittemore as we admired their extensive garden (described in the *Rock Garden Quarterly*, Winter 2003, 61:1). The private native-plants garden of the late Tom and Bruce Shinn (Leicester, N.C.), now managed by their hospitable son and daughter-in-law, was another special treat for the group. As we ate snacks after the hillside woodland tour, we were shown the Shinns' silver bowl from NARGS as recipients of the Marcel Le Piniec Award in 1984.

A visit to the Cradle of Forestry in America Museum near Brevard was an important educational stop. George W. Vanderbilt, owner of Biltmore House, hired the famed landscape architect Frederick Law Olmsted to design the gardens and grounds while the house was being built between 1889 and 1895. Because of the extensive forested land around the estate (Vanderbilt had pur-

chased 80,000 acres/32,376 ha), Olmsted suggested hiring a forester. Carl A. Schenck from Germany was engaged; he recognized the need for forestry studies, founding the Biltmore Forest School in 1898. For the first time in America, students began studying the science and business of forestry under Schenck's tutelage until 1909. The U.S. Forest Service purchased the excess land from Vanderbilt's widow in 1914, and Pisgah National Forest was created.

Pisgah National Forest now consists of about a half-million acres of land surrounding Mount Pisgah (milepost 408.6), elevation 5721 feet (1744 m). The name "Pisgah" is biblical, the mountain summit from which Moses viewed the promised land. The forests here are high-elevation, mixed hardwoods with red oak the dominant species. We made two stops in the forest and added considerably to our knowledge of the local flora. The trees and shrubs include mountain maple (*Acer spicatum*), ironwood (*Carpinus caroliniana*), white ash (*Fraxinus americana*), and the once mighty American chestnut (*Castanea dentata*), which was nearly made extinct by introduced chestnut blight in the first half of the twentieth century. There were four species of rhododendron we admired: the beautiful and rare *Rhododendron vaseyi*, *R. catawbiense*, *R. maximum* or rosebay, and *R. minus*. The herbaceous layer of plants included *Trillium rugelii*, *Silene stellata*, *Streptopus roseus*, and *Impatiens pallida*.

At first glance, the Coontree Picnic Area in Pisgah National Forest seems an idyllic spot for a family outing, and it is, but it also proved very worthwhile from a botanical standpoint. Just a few feet from where we stepped off the bus, a group member spotted a tidy clump of *Orchis spectabilis* (photo, p. 110). We all quickly joined the queue to photograph this lovely pink-and-white orchid, whose flowering stems rise 6–8 inches (15–20 cm) above pairs of rather large, glossy leaves. Also at this site we found three species of trillium—*Trillium erectum, T. rugelii,* and *T. vaseyi*—as well as some that were likely hybrids. In an adjacent area, dangerously laced with poison ivy, we spotted yet another treasure: *Orobanche uniflora,* a clump-forming parasitic plant which produces smallish flowers of the most delicate lavender, almost white (photo, p. 110). Each flower rises singly to only 4 inches (10 cm) or so.

One of the most pleasing botanical stops was the roadside overlook toward Looking Glass Rock near Brevard (milepost 417), a 500-foot Whitesides granite monolith. In winter, water runoff causes its face to freeze into an icy, reflective visage. At this stop, we saw *Saxifraga michauxii*, *Hypericum densiflorum*, *Pieris floribunda* or mountain fetter-bush, the foamflower *Tiarella cordifolia*, *Claytonia caroliniana*, *Dentaria diphylla*, and the Indian paintbrush *Castilleja coccinea* punctuating sheets of pale blue *Houstonia serpyllifolia*. What a sight to see the cascades of Michaux's saxifrage hanging on wet rocks! Nearby, the half-mile hike to the top of Devil's Courthouse (milepost 422.4) gave us a commanding 360° view of the mountains.

So rich are the woods along the Parkway that stopping almost anywhere yields something of interest. At one such stop, the forest floor was carpeted by thousands of *Trillium grandiflorum* as far as the eye could see. This white-flowered species was past its prime, but the overall effect was stunning nonetheless. At

another unnamed stop, we searched a population of the typically bluish-purple-flowered dwarf larkspur *Delphinium tricorne* for a white form. It eluded us, but we did find lovely specimens of *Trillium vaseyi* with enormous maroon flowers growing among mayapple (*Podophyllum peltatum*), *Viola canadensis*, bee-balm (*Monarda didyma*), and towering stalks of the turk's-cap lily *Lilium superbum*, the latter two not yet in flower. Climbing into the trees high overhead was the stalwart vine that graces porches throughout much of the South, Dutchman's pipe (*Aristolochia macrophylla*).

Our trip notes show that we visited 14 named natural areas, and we identified 200 native plants as we absorbed the natural and cultural history and culinary delights of the region. We did not tally the numerous plants we saw, admired, and photographed in botanical gardens and arboreta or private gardens, nor the vast collection of outstanding plants we saw on the return trip to Raleigh in the gardens of NARGS members Wyatt LeFever of Kernersville and Graham Ray of Greensboro. The Blue Ridge Parkway is an American treasure. With its numerous pull-offs and spur trails, it provides easy access to a tremendous range of new species at seemingly every stop.

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Smoke in the Water: Increasing Germination of Difficult Species

Michael K. Young

The early-winter activities of wild-plant growers are an endearing obsession. Seed lists and catalogues are pored over, selections made, and orders sent. When the seed packets arrive, potting mixes are stirred and sterilized, containers cleaned and filled. For many plants, the next step is simple: put seeds in a pot, water, offer light, and stand back. Other species require that the gardener provide conditions akin to those encountered in a species' natural setting, such as cold-moist stratification to mimic enduring a temperate-zone winter or scarification to imitate passing through a bird's digestive tract. Like closet alchemists, we are only too willing to cycle pots through heat and cold, load the refrigerator with petri dishes and Ziploc bags, or apply synthetically derived hormones in hopes of prompting germination. And now gardeners open to experimenting have another option: smoke.

By the early 1990s, botanists working in fire-prone landscapes in South Africa and Australia recognized that smoke improved germination of many species. The effect also applies to plants from comparable habitats in Spain, California, and the intermountain and Great Basin grasslands of North America. Frequently, exposure to smoke not only increases the rate or amount of germination, but it is the *sole* treatment that breaks dormancy in these species. And though one would not consider most garden vegetables a germination challenge—or as coming from very flammable sites—lettuce, celery, and red rice also show positive responses to smoke.

Of what significance is this to rock gardeners? Many of the plants we admire are natives of lands apt to ignite, such as the Rocky Mountains, Cascade Range, Sierra Nevada, and Great Plains, and are the evolutionary survivors of repeated exposure to fire and its byproducts, smoke and heat. In some species (e.g., *Ceanothus*), heat is necessary to break the seed coat, and gardeners have long used boiling water treatment as a surrogate for heat from fire. For species unresponsive to this approach, a reasonable hypothesis would be that smoke treatment might enhance or speed germination. Unfortunately, very few tests have been done on the American flora; commercial and home horticultural applications are far more common in South Africa and Australia. Even there, maddeningly

idiosyncratic approaches have led to few specific guidelines specifying how much smoke, for how long, for any species. There is hope that these answers will be forthcoming, because Australian researchers have recently isolated the compound responsible for inducing germination, butenolide. Still, they suggest that it will be 3 to 5 years before a standardized synthetic product appears commercially. In the meantime, here are some general rules for the impatient and intrigued.

First, what kind of smoke works? It seems that just about every kind of burned plant material—leaves, stems, and wood, dry or green, even paper—is effective, because the active compound is released by the combustion of cellulose. Cigarette smokers, however, should not rejoice that the greenhouse can now serve as an indoor smoking facility, because there is evidence that cigarette smoke inhibits germination of a few species. Nevertheless, tests with the wild tobacco *Nicotiana attenuata* showed that it positively responded to smoke from its own tissue.

Perhaps more interesting to those with Rube Goldberg in their lineage is how to apply smoke. Many researchers built fires in large chambers to smoke the seeds directly, and anyone with a home smoker can replicate this treatment. I'm sure that a campfire somehow could be manipulated to produce the desired effect. Note, however, that the seeds must remain cool, not toasted. In any event, try not to invite too many questions from curious neighbors or spouses; your fantastical story will convince them that what's being smoked is not intended for the rock garden. And in case you're wondering, one paper written about this effect for a serious scientific audience is titled "Up in Smoke," although the authors manage to avoid citing Cheech and Chong.

Although some scientific trials exposed a mix of soil and seeds to smoke, applying smoke to the potting substrate alone also succeeded and avoided overheating the seeds. Similarly, top-dressing seed pots with smoked grit could ensure that seeds receive exposure to butenolide when watered. For those who use a refrigerator to stratify seeds, one technique might be to apply smoke to coffee filters, then place seeds inside them before moistening and chilling them. Several available commercial products consist of paper impregnated with smoke and other "substances" promoting germination (see Sources). To use, place the paper in a dish with water and soak the seeds for 24 hours.

A third approach is to suck the air from smoke chambers through water, then immerse seeds in this fluid. This has been the most popular research technique, and garden products based on this method have been developed in South Africa and Australia. They appear to be of limited availability in the United States and are probably prohibitively expensive, partly because it is costly to ship water across the ocean. Instead, a visit to most grocery stores provides an adequate substitute manufactured via the same method: culinary Liquid Smoke, sold in the condiment section. To produce it, large combustion chambers are filled with wood that is heated at temperatures sufficient to produce copious smoke, which is bubbled through water or condensed. Interestingly, these manufacturers probably exercise far greater control over the concentrations of smoke in water

than most experimenters have, and experiments with Liquid Smoke might be more repeatable and reliable. Unsurprisingly, germination scientists have tested these products, too. Even though many such products contain additives such as color, vinegar, and preservatives, germination was equally enhanced in tests of several brands.

As with most things except hummingbirds and spring, too much smoke is worse than too little. Most studies concur that exposure to smoke for too long or at excessive concentrations inhibits germination, although this effect may be reversible; that is, watering the seeds eventually removes the inhibitory effect. Direct smoke exposure of about one hour worked for many species. Liquid Smoke is extremely acidic and will probably kill anything directly exposed to it undiluted, but one-hour exposures in 1:100 dilutions were often successful.

At this point, you might wonder if all the fuss is worthwhile. I did, so last winter I conducted a germination test with 54 species, most native to flammable western U.S. landscapes. All species were wild-collected by myself or commercial seed vendors in 2003, and I assumed all were viable, although incomplete complex physiological processes, such as after-ripening, may have limited germination in some species. In late January 2004 I sowed seeds on the surface of a 50:50 blend of Sunshine Mix #1 (a commercial potting mix) and decomposed granite, then topped each pot with chicken grit. Seed pots were 4-inch Ray Leach Cone-tainers (see Sources), narrow conical containers designed for conifer propagation but widely adopted by native plant nurseries for growing tap-rooted herbaceous species. There was one control and one smoke-treated pot for each species, both containing the same number of seeds. Controls were watered with lukewarm tap water and smoke-treated seeds were watered with a 1:100 dilution of Wright's Liquid Smoke (roughly 1 teaspoon in 2 cups of tap water), placed in a 55°F (12°C) room to imbibe for 48 hours, then moved into an unheated garage in which temperatures fluctuated between 28° and 42° F (−2° to +7°C) to stratify. I reapplied the appropriate types of water again in mid-February, then moved the seed pots into an unheated greenhouse in early March.

Some species germinated very well regardless of the treatment and others poorly, but overall I achieved a statistically significant increase in germination of about 10%. Although my experiment was not designed to identify whether particular species were affected by the smoke treatment, the results suggested especially favorable responses in a few species, such as *Argemone pleiacantha*, *Monardella odoratissima*, and some *Eriogonum* species, whereas germination may have been suppressed in *Papaver miyabeanum* and *Oxytropis sericea*. Were I to repeat this experiment, I would increase the number of applications of smoke water because my treatments probably did not approximate a 1-hour soak, but even so, this home experiment demonstrated that the effect of smoke on germination is real.

So why not try it yourself? Because we know very little about the timing, duration of exposure, and concentration of smoke that will optimize germination in most species, failures will be many and confusion a regular companion. Other tests have found that some garden-worthy members of the genera *Chaenactis*,

Festuca, *Penstemon*, and *Salvia* respond to smoke treatments. But only true plant fanatics (you know who you are) are likely to experiment with the myriad species favored by NARGS members, and breakthroughs in germinating especially difficult species await the adventuresome. In the meantime, I can picture a barbecue with two curmudgeonly rock gardeners brandishing small, coffee-colored bottles, heatedly arguing the merits of hickory versus apple smoke flavoring for seasoning their baked beans . . . and germinating eriogonums.

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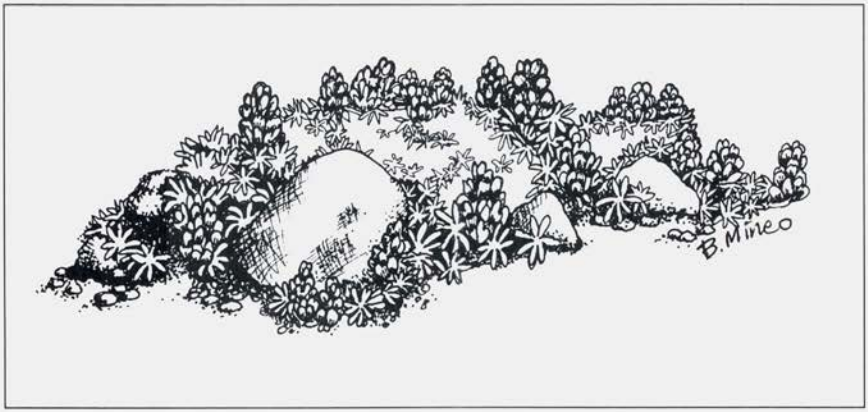
Michael Young gardens on a dry half-acre in Missoula, Montana, with a fondness for Penstemon, Eriogonum, Oxytropis, and hummingbirds. His occupation as a fisheries scientist takes him throughout the Rocky Mountains each summer and lately has provided ample opportunity to observe plant response to wildland fire.



Lupinus aridus subsp. *ashlandensis*, drawing by Baldassare Mineo

Growing *Castilleja* for Restoration and the Garden

Beth A. Lawrence and Thomas N. Kaye

Introduction

They have been described as "nearly impossible to cultivate in a garden" (Art 1990), with "many problems associated with growing them from seed" (Borland 1994). *Castilleja* species are historically a notorious, even mysterious, group of plants to propagate, eluding growers for years. These false allegations arise principally because of the parasitic nature of the genus. Species of *Castilleja* are hemi-parasites, benefiting from but not requiring a companion host species in order to successfully establish themselves in a garden setting. Nevertheless, successful germination and seedling establishment do not require the presence of a host species. We have successfully grown more than 3000 individuals of golden paintbrush (*Castilleja levisecta*), an endangered perennial endemic to the Pacific Northwest, for restoration purposes. To facilitate propagation of common *Castilleja* species by wildflower enthusiasts, we here share our experiences growing this rare beauty.

Castilleja is a charismatic and colorful genus commonly known as "Indian paintbrush" or "painted cup," and is a member of the figwort family (Scrophulariaceae). There are approximately 200 species, the majority found in western North America. Paintbrushes are hemi-parasites ("half-parasites"), attaching themselves to the root systems of other plants via structures called haustoria (physical connections between roots) to obtain water and nutrients. Hemi-parasites can grow successfully without a host, but greenhouse studies have shown that providing a host plant results in larger plants that are more likely to flower (Kaye 2001). Other hemi-parasitic members of the figwort family include *Orthocarpus* (owl-clover), *Pedicularis* (lousewort), and *Cordylanthus* (bird's beak).

Castilleja levisecta (photo, p. 111) is a federally listed threatened species with only 11 populations remaining within its historic range. Although it once grew from the coastal bluffs and islands of British Columbia to the Willamette Valley of Oregon, it is thought to have been completely extirpated from the state of Oregon and from southwestern Washington. Golden paintbrush has limited capacity for natural dispersal and colonization of new sites, necessitating a strategic reintroduction plan (Caplow 2004) to support its long-term viability.

We have established experimental populations throughout the Willamette Valley in an effort to determine which seed sources and habitat types are appropriate for large-scale reintroduction endeavors.

Castilleja levisecta propagation

Our success with this plant is attributable to careful attention to seed collection, germination, and seedling establishment. The techniques are tailored to the production of several hundred individuals at a time but can be altered to accommodate smaller-scale production. Although our experience with growing *Castilleja* is limited to a single species, we believe that our techniques may be useful for other species. As members of the U.S. Fish and Wildlife Service's 'recovery team' for this species, we observe the guidelines developed by this group and laws governing endangered species, and urge gardeners not to collect any material (including seeds) of this and other federally listed endangered plants. There are many other *Castilleja* species to grow in gardens.

Successful propagation begins with timely seed collection. Mature paintbrush capsules hold many small seeds—in *C. levisecta,* up to 300. It is easiest to collect the entire capsule and remove the seeds later. We collect ripened capsules late in the growing season (August or September) from a large number of individuals when capsules begin to split at the tip and the seed is easily shaken out. Place the capsules in dry envelopes until further processing. Accurately labeling the envelopes with seed collection information (species, date, location, etc.) is important. We clean our seed under a dissecting microscope, but it can also be done on a light table or in a well-lit room. Under magnification, paintbrush seeds are remarkable! A reticulated membrane, reminiscent of a sponge, encloses the embryo. The function of this unique seed coat is not clear, but may facilitate uptake of water by the embryo. Separate the seeds from debris and store them in a dry envelope in a freezer until sowing.

Seed viability is critical to successful germination. Viable *Castilleja* seeds have a robust embryo, visible with the microscope, within the seed coat. Small, shriveled embryos likely indicate nonviable seeds. The viability of *C. levisecta* seeds varies with source population and maternal plant. Certain source populations have germination rates up to 90 percent, others as low as 20 percent. The genetic diversity of the remaining plants within small populations may play a role in this variation. Also, *C. levisecta* seed viability may decline with storage time. Research by Jane Wentworth at the University of Washington showed that seeds stored dry at 5° C for three years did not germinate, while seeds stored for two years had 13 percent germination, and one-year-old seeds had 47 percent germination. However, seeds stored at the Berry Botanic Garden for more than three years have shown high viability, with germination rates up to 90 percent. These seeds were stored in a low-temperature and humidity-controlled seed vault, where thousands of rare and endangered plant seeds from the Pacific Northwest are kept for future conservation efforts.

Many plant species of temperate climates require a period of cold, moist conditions ("stratification") for proper germination, and golden paintbrush is no exception. We place the seeds on moistened germination paper in lidded plastic dishes, remoistening the paper as necessary throughout stratification. You could use moistened paper towels inside a plastic bag or plastic refrigerator container; maintaining proper moisture under sanitary conditions is crucial. We place the dishes in a cold, dark room at 5°C for 6–8 weeks, followed by a week or two of postchill incubation in a growth chamber set at 25°C/15°C with 12 hours of fluorescent lighting. This procedure typically results in 50–95 percent germination for *C. levisecta*, depending on the seed source. Seeds from some populations germinate prior to postchill incubation and can become etiolated ("stretched") if left in the dark and cold too long. Home growers may be successful using a refrigerator for the cold treatment, and placing seeds in a warm, well-lit area for post-chill incubation.

Once the radicle (first root) and cotyledons (first leaves) have emerged, it is time to get those germinants in soil! At this point, the seedlings are very fragile and need extremely tender handling. We tried using tweezers to remove seedlings from the paper, but we believe that this technique may have damaged the slender germinants, likely only a few cells thick, as we saw high mortality within the first few weeks of growth. A less destructive approach we have used is to pick up the seedling with the tip of a plant tag or pencil and then gently place it in a small depression on the soil surface, lightly covering the radicle with fine soil. While soil-radicle contact is important, we recommend against planting too deeply or compacting the soil excessively. Each seedling is placed in one cell of a plastic cell-pack. Because this species grows in sandy glacial deposits in its native habitat, we use a well-drained soil medium amended with time-release micro and macro nutrients. Additionally, we use a liquid fertilizer (15-30-15) during watering every other week.

Maintaining an adequate moisture level is critical during the first few weeks of growth. We flood-water our flats from below during that period so the soil becomes fully saturated and the seedlings are not injured by overhead spray. After 4–6 weeks, the golden paintbrush seedlings have 3–8 pairs of true leaves and an established root system, and are ready to be transplanted from their cells to larger 4-inch or gallon pots.

This is the right time to provide a host plant for *Castilleja* species. We have planted *C. levisecta* with several different host plants with varying success. Oregon sunshine (*Eriophyllum lanatum*), a composite, proved to be a better companion than Roemer's fescue (*Festuca roemerii*), or planting without a host. Other species have worked too, including *Potentilla gracilis* and *Sidalcea* spp. One cultivator has successfully grown this species with shrubs including *Symphoricarpos albus* and *Spiraea japonica* (Guppy 2004). We have been successful using host seedlings or rooted cuttings and planting them within a few inches of the paintbrush root crown. Overall, golden paintbrush plants that have a companion are larger and more likely to flower than those without. However, with adequate fertilizer, water, and light, we have produced flowering *C. levisecta* individuals without a

host within six weeks in a shadehouse (summer) and eight weeks in a greenhouse (winter).

C. levisecta experimental populations

Nine golden paintbrush experimental populations or "common gardens" have been established in remnant prairies and restoration sites throughout the Willamette Valley. Each common garden is composed of plants grown from seed from six of the remaining populations. Plants were grown in a greenhouse for three months prior to outplanting in March or November 2004. With the help of friends and volunteers, we planted a total of more than 2000 individuals into grids at each site. The transplants will likely form haustorial connections with whatever root system they encounter, as this species is not particularly picky about what kind of plant it parasitizes. We monitor each transplant and record information about its size and fecundity. We are also characterizing each site by examining the soil and vegetation community. Unfortunately, golden paintbrush is not only appealing to the human eye, but also to the palate of many wildlife species, including deer, elk, voles, and other rodents. Consequently, most of the common gardens have been fenced to keep out large herbivores.

Field mortality was very low overall during the first growing season—an exciting result in itself! Data from the 2004 growing season indicate plants from two populations in Washington produce significantly larger offspring that are more likely to flower than plants from other populations. This may be related to the high genetic diversity of these populations. Likewise, several common garden sites stand out as initial "winners," where the plants were larger and more likely to flower (regardless of the seed source). The plant communities of these successful sites are largely composed of native prairie species growing on relatively well-drained soils, while sites with lower transplant success are dominated by exotic grasses. The size of the plant at the time of planting is important too. Larger starts become larger plants after several months in the field. By following these plants in 2005, we hope to determine how the success of golden paintbrush transplants relates to where they came from, similarity of the environment of the common garden site to the source population, and the planting season.

Propagation of other *Castilleja* species

Perhaps the most challenging aspect of paintbrush propagation is how to stimulate germination. Despite common belief, *Castilleja* seeds do not require root exudates from a host plant to stimulate germination, as is the case for strict parasites. Germination variability, however, is the rule. Many species require moist, cold stratification, while others will readily germinate given moist soil. The requirements of 22 different species of *Castilleja* are summarized in Table 1. Notice that different researchers may report different germination requirements

Species	Requirements for maximum germination	Reference
C. affinis	None	Borland, J. 1994. American Nurseryman: 49–53.
C. ambigua	2 weeks moist chill at 5°C	Young, B. 2002. http://www.nativeplantnetwork.org
C. applegatei	3 to 6 months moist chill at 2°C, depending on source	Meyer, S.E. and SL. Carlson 2004. USDA Forest Service Proceedings RMRS-P-31.
C. chromosa	3 to 6 months moist chill at 2°C, depending on source	Meyer, S.E. and SL. Carlson 2004. USDA Forest Service Proceedings RMRS-P-31.
C. chromosa	1 to 3 months moist chill at 2–5°C	Borland, J. 1994. American Nurseryman: 49–53.
C. cusickii	5 months outdoor chill or 3 months cold moist at 2°C	Luna, T., D. Wick, and J. Hosokawa. 2004. www.nativeplantnetwork.org
C. exilis	1 month moist chill at 2°C	Meyer, S.E. and SL. Carlson 2004. USDA Forest Service Proceedings RMRS-P-31.
C. flava	3 to 6 months moist chill at 2°C, depending on source	Meyer, S.E. and SL. Carlson 2004. USDA Forest Service Proceedings RMRS-P-31.
C. foliolosa	None	Borland, J. 1994. American Nurseryman: 49–53.
C. hololeuca	None	Borland, J. 1994. American Nurseryman: 49–53.
C. indivisa	None	Borland, J. 1994. American Nurseryman: 49–53.
C. integra	None	Borland, J. 1994. American Nurseryman: 49–53.
C. lanata	None	Borland, J. 1994. American Nurseryman: 49–53.
C. latebracteata	None	Borland, J. 1994. American Nurseryman: 49–53.
C. levisecta	1.5 to 3 months moist chill at 5°C, depending on source	Kaye, T.N. 2001. www.appliedeco.org/Reports/Cale_research.PDF
C. linariifolia	2 months moist chill at 2°C	Heckard, L.R. 1962. Botanical Gazette 124: 21–29.
C. linariifolia	1 month moist chill	Butler, J. and C. Frieswyk. 2001. www.nativeplantnetwork.org
C. linariifolia	1 to 4 months moist chill at 2°C, depending on source	Meyer, S.E. and SL. Carlson. 2004. USDA Forest Service Proceedings RMRS-P-31.
C. linariifolia	None	Borland, J. 1994. American Nurseryman: 49–53.
C. miniata	3 months moist chill at 2–5°C	Borland, J. 1994. American Nurseryman: 49–53.
C. purpurea	None	Borland, J. 1994. American Nurseryman: 49–53.
C. rhexifolia	2 months moist chill at 2°C	Wick, D. and T. Luna. 2004. www.nativeplantnetwork.org
C. rhexifolia	3 to 6 months moist chill at 2°C, depending on source	Meyer, S.E. and SL. Carlson 2004. USDA Forest Service Proceedings RMRS-P-31.
C. sessiliflora	None or 1 month moist chill	Borland, J. 1994. American Nurseryman: 49–53.
C. subinclusa	3 weeks or longer moist chill in peat	Young, B. 2002. www.nativeplantnetwork.org
C. tenuis	3 months moist chill at 2–5°C	Bartow, A. 2003. www.nativeplantnetwork.org
C. wightii	2 to 3 weeks moist chill	Young, B. 2002. www.nativeplantnetwork.org

Table 1. Germination requirements of 22 species of *Castilleja*.

for the same species (such as *C. linariifolia*), indicating that requirements may vary among seed sources. In general, populations and species of *Castilleja* from warmer, drier climates have shorter chilling requirements and germinate more quickly than those from high elevations with longer winters. If germination information on your species of interest is not available, estimating the number of weeks the seeds are exposed to cold temperatures (around or below 5°C) in their natural environment may help approximate its requirement.

Castilleja species occupy diverse habitats throughout western North America, especially coastal prairies, subalpine rocky outcrops, and arid grasslands. Thus, growing requirements are likely to vary substantially among species. However, several general propagation methods have appeared in the literature. Well-drained soils, such as Sunshine Mix #4 Aggregate Plus or Fafard Growing Mix #2, have been used for several different paintbrush species. Heavy fertilizing, especially during the establishment phase, is critical. Several growers have amended their soil media with Osmocote (13-13-13) slow-release macronutrients, as well as with Micromax micro nutrients, to get high establishment rates. Additional biweekly fertilizing is suggested until the paintbrushes establish haustorial connections with host plants. Maintaining a moist, warm, light environment during establishment is essential, but everything in moderation, of course. During a heat wave of temperatures above 104°F last summer, we watched 2250 seedlings shrivel and die before our eyes! *Castilleja* seedlings are infamous for their high transpiration rates, which may be attributable to their hemi-parasitic nature. Misting or flood-watering from below is suggested for the first month of growth.

Choosing a host can be the most exciting part of *Castilleja* propagation. Paintbrushes are generally not highly host-specific, though they vary in their degree of parasitism. Composites, grasses, and legumes are their most common host types. In addition to supplementing the paintbrush with water and nutrients, some host plants (e.g., *Lupinus* spp.) play a role in attracting pollinators and may provide secondary compounds that protect the plant from herbivores (Adler 2004). The most appropriate host plants are native species found in the same habitat. Seedlings or rooted cuttings of the host plant should be planted within a few centimeters of the paintbrush seedlings about 6 weeks after germination. Allow the plants to grow together for 6–8 weeks before planting them out to ensure that haustorial connections have been made. Host plants can out-compete the paintbrush for resources, so keep the host in check by trimming it periodically if necessary.

Paintbrushes are a wonderful addition to any garden, and can attract wildlife too. Adult butterflies use them as nectar plants, while red-flowering paintbrushes are an open invitation to hummingbirds. Bumblebees are the principal pollinators of yellow, green, and purple-flowered paintbrushes. Many species of checkerspot butterflies (*Euphydryas* spp.) use *Castilleja* as larval host plants. *Castilleja levisecta* may have been the original host plant for Taylor's checkerspot, a rare butterfly endemic to the prairies of the Pacific Northwest. As populations of golden paintbrush diminished, so have those of Taylor's checkerspot.

There are currently eight species of *Castilleja* listed as threatened or endangered under the Endangered Species Act. Gardeners can play an important role in *Castilleja* conservation by developing propagation protocols of more common species, which, in turn, can help inform restoration efforts of rare species.

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The Muck Tub

Michael Peden

In the course of my efforts to unlock the secret of cultivating *Diapensia lapponica*, I have uncovered some effective horticultural methods involving the simplest of elements—methods that might put this and some other tricky alpines within reach of other rock gardeners. Using the concepts devised, I have created a couple of small experimental gardens that show promise as media for growing some difficult alpine plants. I have employed these methods for more than six years to keep species such as *D. lapponica* alive. They are certainly not an end, but they have been promising enough means to that end to share with gardeners who might try them in other climates and with different plants, or refine them further.

Diapensia lapponica is found at high latitudes and very high elevations in the Northern Hemisphere, growing from seashores to the alpine zone. It is a classic alpine cushion plant—actually, a minute shrub—with tiny, glossy leaves packed tightly together, topped by relatively large flowers whose five cream-colored petals are often flushed with pink. Its habitats are rocky, but its roots always plunge into moister conditions below; in tundra, for instance, the cushions may be seen perching on rocks with a woody stem reaching down to the soil below.

The muck tub is born

I'll begin with a description of the device that has helped make my experiments possible: the muck tub. Before I had a dedicated muck tub, I had a bathtub full of rotted wood and soggy peat, dubbed the bog tub, where I grew my first starts of *Andromeda polifolia* with great success. The spark of inspiration for the muck tub was struck on an autumn day in 1997, when, after hiking in the Adirondacks, I wound up with a couple of tiny sprigs of *Diapensia lapponica* that urgently needed a home. I'd previously tested *Diapensia*'s native soil with a home soil testing kit and knew it to be highly acidic. Therefore, I put a few chunks of crushed stone in a small plastic pot and went to the bog tub for a handful of its putrid, soggy contents simply because it was the most acidic medium on hand. I mixed the stone chunks and tub muck evenly in the pot and compressed it as much as

I could without bursting the pot. I then added some more material to fill the space created by this compression, followed by the little sprigs of *Diapensia*, compressing again to cement the cuttings in place. The result: I've been able to observe *Diapensia* in my garden for more than six years now.

End of story? Well, not quite. The muck tub was born: a system dedicated to producing soggy, stagnant, fermented peat—the finest thing for the experimental alpine gardener! Since 2000 I have been using tub muck in small, experimental garden construction projects, resulting in a cascade of enlightenment relating to soil temperatures, moisture content, drainage, and alpine soil conditions in general. The raised peat beds I've created and will attempt to explain here have been fascinating to watch.

Muck tub theory is straightforward: get peat waterlogged and sufficiently stagnant to use as an effective medium in rock garden construction. For this I used a 32-gallon plastic rubbish container to wet the peat in. Wetting compressed peat can be a challenge, so perseverance is a prerequisite. I used a shovel as a plunger and worked in small amounts of peat as the hose was running. Meanwhile, I added a few shovelfuls per container of rich compost, since the peat itself has little nutrient content. (How much compost or what other materials to mix in at this stage is still open to experimentation.) I found that nearly a full bale (3.8 cubic feet) of compressed peat could be mixed in one container. In the days following the initial wetting, as the stuff slowly soaked up water and sank, I was able to get more in.

Once I had the container full, I let the completely saturated contents sit for a long time: eight weeks isn't too long. Within this period the peat becomes thoroughly waterlogged, highly acidic, and, in theory, reduced in or devoid of potentially harmful chemical reactions or microbes. I believe that the muck is ready for duty when a shovelful removed releases the pungent pong of a stagnant pond.

I built three muck tub test gardens. The basic idea behind all of them was to create tight crevices between stones that would resist desiccation, even in drought periods. Another goal, of course, was growing *Diapensia* and a host of other fine plants that share its tastes.

The test gardens

The first garden was set less than a foot (30 cm) into the earth, with its summit just above lawn level; for the most part, it's a granite "sunken" garden. The second was built upon the sunken garden as a raised, slanted strata-style garden of sandstone that contains some calcium; I call the rock "Adirondack Tufa" because it looks mildly like the real thing. The third garden was built of granite and raised to 18 inches (45 cm) above the lawn. The summit of the "Adirondack tufa" garden offers the driest conditions, because of the porous nature of the stone, and the "plain" of the sunken garden offers the dampest conditions because of the solid nature of the granite and the low aspect. It also gets shade from the house, especially late in the season. I have yet to try the technique in

pure limestone but believe that could prove quite worthwhile. These are all "crevice gardens." They are all quite small—only a few square feet.

I built the sunken garden by excavating and removing 10 to12 inches (25–30 cm) of topsoil. I then placed granite stones (faceted, not round fieldstones) neatly together, stuffing all the spaces between them with tub muck. The stones were chosen and set so the top of the garden would be more or less level and could be covered with peat if desired, hiding the stones. I wound up with a 12-inch vertical root run, more or less. I then added the "Adirondack Tufa" section atop one corner of the new bed.

I built the third garden on the surface of the lawn with no prep work other than throwing down a layer of rotted wood chips. Easy! I chose granite stones, longer than thick or wide, but variously faceted (ideally, completely angular) to facilitate tight crevices, and I set them on end because I wanted this garden to aspire toward the heavens. Setting a stone on end breaks the "rule" that every stone in the rock garden must appear individually stable; in fact, the entire construction becomes stable only after several stones are set in a tight group. This form of vertical crevice garden construction promises to be valuable because it offers both the stony environment that rock plants like and the most direct access for roots to the cool earth straight below. The longest stone in this construction is about 18 inches (45 cm) long, the maximum finished height of the feature. Ideally, every stone sits with its base on, or better in, the cool ground. That is, there is no vertical stacking of stone as is usual in wall building. Every stone will act as a potential conductor, carrying the cool of the earth up to the surface of the rockery during the heat of the day, and plants will be guaranteed a relatively cool root run. Both the granite gardens were built in this fashion.

Using a solid, top-to-bottom, continuous stone construction also reduces the chance of malicious air pockets being included in the work; air pockets can create a break in the capillary action drawing moisture within the rockery, making it impossible to keep crevices adequately moist in normal summer conditions. During drought periods, a properly constructed crevice garden should be able to draw on moisture from the ground it sits on. Thus, it's a good idea to build structures for growing alpine plants on ground that never goes completely dry. I now believe that large, expensive drainage schemes are unnecessary, and people who live in at least vernally moist areas have an advantage when it comes to growing many alpines.

One *very* important point in the construction of these gardens was the attention I gave to working in or physically "stuffing" muck tub peat into the crevices, so that the whole became a solid mass of peat and stone. It can be tricky filling small crevices with this compost. I added it as I built, but I also crammed it in later using various tools, including fingers. I figured that the muck must be *extremely* compressed into all crevices, or the garden would likely fail. High compactness promotes capillary action within the construction while foiling rapid surface evaporation. Critical moisture is replaced during drought from deep within the construction and from the ground beneath only if the interior fissures of compost are unbroken and tightly interwoven.

So if you want to employ this technique as I have, cram, cram, cram! The process should be exhausting! If you are not a physical wreck upon completing the task, then you are both younger and stronger than I, or you haven't done it correctly. If you want to grow *Loiseleuria procumbens* (a frequent companion of *Diapensia* in the wild), heed the foregoing.

The natural parallel to this technique surely must be found in mountain meadows the world over, where decayed roots and other organic material form humus and peat, and the crumbling mountain itself provides the stone structure. I assume that copious alpine moisture keeps these two basic elements intact and very much apart as it rinses the soil, washing away excess salts, clay particles, and minerals not locked up by the roots of the plants.

This is a simplification, but possibly an accurate one. I suspect that if you took a clump of soil from under a plant of *Eritrichum aretioides* and mixed it with water, you'd see relatively little cloudiness. I suspect that the alpine environment is very "clean" in this sense. Consider a *Petrophytum* or other true chasmophyte living just on pure rock and the organic environment its own roots have created over the decades. Without the ideal conditions for establishment in pure rock, it is only peat—the humus or compost part of contrived rock garden soil—that will get such a plant going in cultivation.

How are the gardens doing after a couple of years in service? Note that I've tried very few plants in each situation and will never try all the potential ones:.

Worth noting on the original "sunken" crevice garden are various *Cassiope* species; *Empetrum nigrum* from the Adirondacks; three western collections of *Kalmia microphylla*; and *Loiseleuria procumbens*, *Vaccinium uliginosum*, and *V. vitis-idaea* var *minus*, all from the Presidential Range in northern New Hampshire. They are all quite healthy and currently growing strongly. I've also planted a *Diapensia* and a few dwarf rhododendrons.

On the raised granite garden I've taken slightly more liberty and not given in to failure after burning up an *Androsace vandellii* or two. This garden gets a lot of sun and has altitudinal aspects. As yet, nothing grows on the very summit, a lofty 18 inches above the surrounding plains. Just down from the summit is a fair specimen of *Eriogonum ovalifolium* var. *nivalis*. I worked a little extra granite grit into the top of the pocket before planting this tiny treasure. I grew the South African gem *Helichrysum milfordiae* in a northwest-facing crevice for a summer, but it was not tough enough for our winter. *Douglasia laevigata* is a notable success, although only subsp. *ciliolata* has taken to date. It came from the "Adirondack Tufa" garden, where part of it still struggles. Surprisingly, I've given a couple of penstemons a new lease on life by moving them here; the dwarf *P. rupicola* 'Myrtle Hebert' is actually doing well for once, as are *P.* 'Dragon Tail' and *P. davidsonii* 'Rampart White'. The ultimate fate of *Diapensia lapponica* is still weighed in the balance on this garden. I put one out in spring 2003, and as of spring 2005, results have been encouraging. It is not a plant that reveals its feelings easily, and it is extremely slow-growing; *Loiseleuria procumbens*, growing at half an inch or more a year, leaves it in the dust. I amended the lower slopes of this little mountain with rotted wood chips and 2-inch crushed stone, keeping the rock/organic simplicity but making

conditions more scree-like. Of note here are a cushion *Phlox* from the Cascades, *Penstemon arizonicus*, *P.* 'Purple Haze', *P. crandallii*, and a gorgeous *Phacelia sericea* from Colorado that bloomed richly and set many offsets early but ultimately struggles, as many of these western tuft-formers do here—perhaps confused by the addition of three months to their growing season. *Artemisia alcockii, Dryas octopetala* 'Grandiflora', *Phyllodoce*, and ×*Phylliopsis* also grow well here.

In some ways, the "Adirondack Tufa" garden has been the most trouble. I think the problem stems from the difficulty of stuffing the crevices between the rough stones tightly enough with muck. They tend to dry excessively and there may be poor nutrient availability or excess leaching. Thus, and partly because of my failure to experiment more, the summit is nearly barren, but certainly notable are *Androsace chamaejasme* and *Douglasia montana*. The androsace has been better here than anywhere else I've tried it and has increased well for this obstinate little plant. On crevices in the flanks of this little mountain are *Heuchera bracteata, H. hallii*, a small *Arnica* from Colorado, and *Corydalis elata* (though I have yet to truly satisfy any blue corydalis). *Wulfenia carinthiaca* has taken to a spot at the very base of this garden, and I think the technique has merit for growing *Telesonix jamesii*. The cooler north and east wall has been given over to the most experimentation. It adequately grows *Haberlea, Primula minima*, *P. allionii* hybrids, and *Ramonda*. *Paraquilegia anemonoides* is doing all right, but I'd like to see more from all of them. I think this is where an entirely limestone/peat-muck garden in a little more sun would make a big difference. Overall, I think it is safe to say that a pure peat bed will satisfy relatively few plants because so many of them demand at least a little calcium.

Nevertheless, there have been some notable failures on these gardens. Foremost are gentians. Only the Himalayan hybrid 'Alex Duguid' has shown any desire to grow. A couple of alpine willows disappeared rather quickly too. *Epilobium latifolium* died slowly. The sunken crevice garden was designed with *Meconopsis betonicifolia* in mind, yet it has not thrived there. Dodecatheons seem insecure, but a lagging *Primula rosea* has improved. The soil condition or lack of calcium is apparently improper for the laggards, but this is rock gardening with its many challenges, and there is much still to be learned.

So what does the future hold? Before I seriously began dabbling in these raised peat beds I planted a *Castilleja* from New Mexico in an earlier attempt at a peat bed. It grew for three years and even bloomed once—pretty encouraging! I believe that the pure and simple stone/peat techniques may aid in *Castilleja* cultivation. [See the related article in this issue.] Perhaps some of the world's many fine little saxatile orchids may respond to these techniques? It is such thoughts that should keep us experimenting in the rock garden.

Michael Peden gardens on a level, acidic, sandy acre in Willsboro in northeastern New York state. It is quite wet in the spring, and even swampy after heavy spring rains but can become dusty in the droughts of July and August. See http://users.westelcom.com/stoneweaver for more on Michael's experiences.

Growing Lewisias in a Soilless Medium

Hewett Blackman

I joined my local chapter of the Alpine Garden Society in 1995, after I had to retire from working owing to multiple sclerosis; I've since joined NARGS too. The local AGS chairman welcomed me and invited me to see his garden and alpine house, giving me many plants he had grown from exchange seed. This gave me an exciting new interest that I could pursue despite my disability. We also visited a nursery growing lewisias. Though I doubted I could succeed with them, I asked the grower, Matthew Ruane, whether I could help in the nursery in exchange for learning to manage and propagate these wonderful little plants. He agreed and showed me how to collect seed and clean the stock plants. We became good friends, and I went to the nursery every Monday for eight years—and I dedicate this little article to him. Now I'd like to share the method I use for these favorite North American native plants.

I start the seeds in a soilless medium of 60 percent peat and 40 percent granulated Grodan. The latter is a product made in the Netherlands by Agrodynamics, whose representative, Vee Kjoelhede, explains it as follows: "The raw material is basalt and chalk, melted at 1600°C. The lava is blown into a spinning chamber which pulls it into fibers . . . We pack the fibers into a mat and cut Grodan slabs and cubes from it, and package the stonewool granulate in bags." Grodan is used mostly in hydroponics and is sold in North America in 40-pound bags. Plenty of information on the product can be found on a website, <http://www.hydroponics101.com/w44199.asp>. It comes in two forms, water-repellent and absorbent; I use the repellent type. To every 10 liters of the peat/Grodan mixture I add a level teaspoon of slow-release (6 months to 1 year) granulated fertilizer, one teaspoon of lime, and one teaspoon of base fertilizer. If vine weevils are a threat, you can also add an appropriate systemic insecticide at this time to prevent the dreaded grubs enjoying your plants.

I use small flats, known in England as "half trays," to sow the seed, so the seedlings have plenty of room to develop for their first six weeks. Fill the tray, or a smaller container, with the sowing mixture to about a quarter-inch from the top. Level it but *do not compress it.* Top the compost with a layer of fine crushed grit, sprinkle the seeds onto it, and water them in with a fine rose. They need

plenty of air to germinate. Seed is usually sown in late September to produce flowering the following year. (Exchange seed should be sown as soon as received.) Stand the tray outside in a safe place for moist, cold stratification if you live in a temperate climate; those in cold northern regions may need to use a cold greenhouse or frame for this.

Germination should occur in early spring. Keep the seedlings under cover with good light and air circulation. When necessary, irrigate them by placing the tray in a container of water and letting it absorb what is needed; don't leave it there more than about 20 minutes, once a week. Excess moisture at this stage will cause damping off. You can add copper sulfate to the water to help prevent this disease. Lewisias don't like stagnant water: when my pond overflowed once onto an area of well-drained soil, lewisia seeds there germinated but the young plants soon gave up the ghost.

To transplant the seedlings, I tip the whole tray onto the bench and knock off the surplus compost. I combine two parts of the sowing mixture with one part Grodan to use for growing them on. I plunge the first-year plants in their pots in damp sand to moderate temperature and moisture. Don't firm the compost in the pots at any stage. In September, I give the small plants a half-strength solution of potash (potassium sulfate) to help harden them off for winter and encourage flowering the following spring.

I use a large tray system to water the plants, standing the pots in water for about 20 minutes and then placing them in a wire-bottomed tray to let surplus water drain before the pots are returned to the plunge. Keep deciduous lewisias moist but not wet. Don't water *Lewisia rediviva*, *L. disepala,* or *L. maguirei* until they begin to green up (which happens in October here). Many lewisias in the wild are under snow cover all winter and awaken with the spring snowmelt.

Hewett Blackman gardens near Wrexham in northern Wales. Write him at <patpablackman@patpablackman.fsnet.co.uk>.

Plant Portrait

Androsace alpina

DAVID SELLARS, Surrey, British Columbia

It was our first trip to the Dolomites. We had completed the circuit of the Tre Cime di Lavaredo and marveled at the electric-blue *Gentiana verna* and light pink *Potentilla nitida* clinging to huge blocks of white limestone at the base of the three towers. The next day we traversed the famous Bindelweg and were astonished by the beauty of *Eritrichium nanum* hanging on the black cliffs—hundreds of delicate plants, each more lovely than any we had seen in the North American Rockies. After the first few days, we were satiated with the extravaganza of glorious plants and felt we must have seen it all.

The next day we sought a quieter, less crowded area, even if that meant fewer interesting alpine flowers, and settled on the head of the Ciampac valley above the Val di Fassa, just south of Canazei. This is an area with intrusions of volcanic rock, and the black, craggy peaks looked like the hills of northern Scotland. The Ciampac cable car whisks you up to 2170 metres (7050 feet). The meadows beyond are carpeted with pale yellow *Pulsatilla alpina* subsp. *apiifolia*, a characteristic plant of acidic soils.

As we followed a narrow trail around Sas de Roces and the peak's northern ridge, Croda Negra, we were startled to come across a black crag painted with both pink and white forms of *Androsace alpina* (photo, p. 111). It was the dominant species all over the cliffs on the northeast-facing slopes of Croda Negra at 2500 metres elevation. The delicate, globular, pale green leaf rosettes set off the mats of tiny flowers. The igneous rocks were encrusted with lichens, and the plants grew as superb single specimens on the rock face with no visible soil, and without competition from other plants. It looked as if a creative gardener had set them in crevices to brighten the lichened black rock. This was the first and only time we saw *Androsace alpina* in the Dolomites.

As we crossed over a pass to regain the Ciampac valley, the clouds drew back and we had a sudden view of the Marmolada that Reginald Farrer described as "looking along the rind side of the melon slice in your plate." Farrer wrote that the pink form of *Androsace alpina* does not occur in the Dolomites, so he proba-

bly had not been on the Croda Negra. In 1913 the access to the wilder places of the Dolomites was far more limited than today with the modern plethora of cable cars.

Androsace alpina occurs only in the European Alps, and according to George Smith and Duncan Lowe in *The Genus Androsace* (Alpine Garden Society, 1997), there are only a few colonies in the Dolomites on igneous intrusions. Smith and Lowe note that it is not seen in cultivation as frequently as it should be, given that it is a relatively vigorous plant. However, it does not do very well in the alpine house, which gives it the reputation of being difficult. These authors say that it has recently been grown in scree beds in the open with winter protection from rain and does very well, flowering abundantly and growing as a tight dome though never achieving any great size. Having seen *Androsace alpina* growing so spectacularly in King Laurin's Garden, we are now determined to try to grow it in the coastal climate of British Columbia.

Rick Lupp, who operates the famed Mt. Tahoma Nursery just southeast of Seattle, writes: "*Androsace alpina* is not one of the easiest androsaces I have grown. I find it difficult to keep for more than two years, but it will often set seed when brought to bloom. I grow *A. alpina* in plastic pots, from seedling size to maturity, in a very gritty mix. Care must be taken at all stages of growth to protect the plant from aphids, which are difficult to spot among the tiny, tight foliage. I keep my pots in the open during the growing season but move them under cover in winter. A bright position in morning sun is best both in the open and under cover. Avoid hot sun, as the plant will usually collapse and die when grown in too much heat."

References

Smith, George and Lowe, Duncan. 1997. *The Genus Androsace.* Alpine Garden Society.
Farrer, Reginald. 1913. *The Dolomites: King Laurin's Garden.*

Books

Gardening on Pavement, Tables, and Hard Surfaces, by George Schenk. Portland: Timber Press, 2003. 192 pp., 109 color photos. Hardbound, $29.95. Available from NARGS Book Service.

Reviewed by CARLO BALISTRIERI, New York Botanical Garden, Bronx, New York

"Nature always wins" is a truism evident in every urban area where tree roots heave concrete sidewalks, ferns grow from mortared subway embankments, and sidewalk cracks are colonized by weedy pioneers that completely cover slabs if not wrenched from their footing.

It should surprise no one that plants will grow nearly anywhere there is the slightest amount of substrate in which their roots can gain purchase. Most gardeners fail to recognize the opportunity this awesome natural power grants us to expand our plantings and our creativity. To assist us in taking advantage of this gift, George Schenk has written *Gardening on Pavement, Tables, and Hard Surfaces.*

Schenk bends nature's winning ways to his will, creating gardens where no one before has thought to look. He attacks with uncommon creativity and vigor, and nature declares a draw.

Gardening on impenetrable surfaces, Schenk creates small (and not so small) wonderlands. His goal must have been like that he ascribes to the builders of the Hanging Gardens of Babylon: to create the illusion of arrival in paradise in a desert setting of "eye-puckering glare and mineral hardness." The metaphor is more apt for most cityscapes than is that of the "urban jungle," at least from a botanical standpoint. This makes gardening on hard surfaces an important adjunct to more familiar gardening models.

Schenk's inimitable style emanates from every page, and he is very readable. Is there anyone who doesn't list his *Moss Gardening* as one of their all-time favorite gardening books? He has a knack for turning arcane and narrowly focused subjects into engrossing themes—a publisher's dream.

Plants grow in the damnedest places. Schenk instructs readers in the art of making the most of what you've got. I've long harbored ambitions to turn underused asphalt into garden space (without the backbreaking work of removing

old paving)—the ultimate "take back the earth" gesture. Perhaps more than any others, rock gardeners are uniquely qualified to use such situations. Schenk brings specialized techniques to the masses, with specific instruction in methods that may still be considered out of the mainstream.

His ideas are especially suited to city dwellers. Schenk makes space for gardens appear where none existed before. I can no longer complain that I have no dirt to play in. Even those who don't have a "yard" even in the city sense of the word are likely to have hard spaces on which to grow a wide variety of plants.

Pavement, walkways, rocks, railings, stumps, logs, and tables are all adventures for the garden designer. Schenk creates gardens in as little as 4 inches of soil, although deeper beds widen the plant choices available. He warns that the plants, like those grown in pots, will be less hardy than when grown in open ground.

Schenk provides plenty of plant lists and how-tos. Don't be put off by the fact that he gardens in four far-flung cities with nearly perfect climates, or by his photographs of bromeliad and succulent arrangements that would be impossible outdoors in much of the temperate zone. Schenk's advice and horticultural daring will serve all gardeners well if they adjust their plant palettes for local climates and are willing to play and experiment. It's the principle that counts.

Flora Alpina, by David Aeschimann, Konrad Lauber, Daniel Martin Moser, and Jean-Paul Theurillat. 3 vols. Berne: Karl Haupt, 2004. €190.

Reviewed by HUBERT AGBACK, Uppsala, Sweden

Flora Alpina is a concerted effort to produce a photographic flora of the plants of the main range of the Alps, in some ways similar to the very successful *Flora Helvetica* by Lauber and Wagner. The key contributor, the photographer Konrad Lauber, is also responsible for the majority of the photos in *Flora Helvetica*. Many of those photos are reproduced in *Flora Alpina*, but at a larger size, making them even more effective. The photos are intended to permit identification without reference to the text description, and in most cases, this attempt succeeds admirably.

Of the three volumes, two contain photos and information, and the third has an index to names, including synonyms and common names in five European languages. The introductory comments and explanations of coverage and data are in German only. The work totals more than 2600 pages and weighs over 5 kilograms, and thus it is hardly a pocket guide! The entries comprise 4491 taxa, all with photos. In some cases more than one photo is provided to show important details. In all there are said to be 5933 photos (I didn't count them). The publisher's price of 190 euros is not really expensive for this monumental work, in my opinion.

There are four plants depicted on each right-hand page, with text information and distribution maps on the facing left-hand page. In many cases (about a quarter of them), a small drawing points out some crucial detail of the plant.

The alpine ranges covered include mountains in Germany, France, Switzerland, Liechtenstein, Italy, Austria, and Slovenia. Within this there is a regional subdivision creating 55 areas. For example, the Swiss mountain area is subdivided into 13 areas which coincide with the 13 mountain cantons. As auxiliary areas, the Pyrenees, French Central Massif, Jura, Vosges, Schwarzwald, Carpathia, Apennines, Dinarides (former Yugoslav mountain area), Balkans (Bulgaria and Romania, but not Greece and Albania), and Corsica are also included. Endemics of these auxiliary areas, however, are not found in this work.

For each plant, distribution is mapped by coloring of the appropriate areas, including the auxiliary areas. Within the central area, all plants—not only mountain plants—are included. Strictly speaking, the work includes not only alpines but also plants that happen to grow within in the borders of mountain areas, which also include some lowlands.

The book relies on information collected in 13 basic floras of these regions, in addition to the authors' own work. Each plant is listed under its currently accepted botanical name. The synonyms are listed, and if there are many synonyms, there is a reference to a separate synonym list. There is a list of names in German, French and Italian, and in many cases also English and Slovenian.

As far as I can tell, the coverage is fairly up to date. For example, the recently described *Primula* species *P. recubariensis, P. albenensis,* and *P. grignensis* are included. In some cases there is considerable deviation between *Flora Helvetica* and *Flora Alpina* in that the latter tends to favor more recent nomenclature and conforms better formally to the International Code of Botanical Nomenclature. Although many recent name changes are reflected, there are also instances where such changes are not acknowledged, for example for the orchid genera *Orchis, Nigritella*, *Gymnadenia,* and others, where considerable name shuffling has taken place. Besides the botanical names, each plant is also tagged with an ID number—for example, 63.13.33 (*Potentilla nitida*), where 63 stands for the family, 13 for the genus, and 33 for the species.

There is coded information on whether the plant is a perennial, biennial, shrub, or tree. Other codes indicate eight categories of life forms (geophyte, chamaephyte, etc.), seven plant types, eighteen categories with data on size of reproductive organs (flower diameter or length, etc.), nine ecological categories, seven categories of preferred soil type, five of elevation distribution (nival, alpine, subalpine, montane, colline), six of preferred soil moisture type, three of nutrition level preferences, and threeof soil pH preferences. Flowering periods are given as well as codes for preferred growth zones (66 different zones are specified). There are also data on association with other plant types.

The photos are almost exclusively taken in the wild, though in a few cases the authors had to rely on photos of herbarium sheets or published drawings when authentic wild material was not available.

This should be an indispensable work for those interested in European alpine flowers, very useful for their identification and their cultivation. From the detailed data on growth preferences, much can be deduced about their needs in the garden, even if experiments and observation will still be necessary. I'm no

expert botanist, and professional criticism must await the verdict of specialists. For the amateur alpine plant lover, this is indeed a gold mine. It will certainly be a cherished companion on my next foray into the Alps, but not in my knapsack!

The only regret I have is that the textual plant descriptions found in *Flora Helvetica* are missing here. If the authors had left out the common names in the various languages, there would have been ample space for this. Therefore, many identification problems will require additional information from local floras and other sources.

Books Briefly

By the Editor

Books of peripheral relevance to rock gardening have arrived recently and are described here for the benefit of readers whose interests extend to these subject areas.

Crocosmia and Chasmanthe by Peter Goldblatt, John Manning, and Gary Dunlop (Royal Horticultural Society and Timber Press, 2004; 219 pp.; hardbound, $29.95) is a volume in the RHS "Plant Collector Guides" series. Two of the authors, Goldblatt and Manning, are also responsible for the distinguished *Color Encyclopedia of Cape Bulbs*, and have described or revised many South African taxa, especially in the Iridaceae, the family containing *Crocosmia* and *Chasmanthe*. This book covers eight species of the former genus and three of the latter, as well as the popular horticultural hybrids of *Crocosmia*. Chapters describe botanical history, plant structure, ecology, evolution and classification, and cultivation. This is an authoritative reference on two groups of plants deservedly popular as border subjects in warm-climate gardens.

Plants from the Edge of the World: New Explorations in the Far East by Mark Flanagan and Tony Kirkham (Timber Press, 2005; 312 pp.; hardbound, $39.95) is an account of the authors' expeditions to East Asia in search of new material for the botanic gardens at Kew and Wakehurst in England. Their emphasis was on trees and shrubs, though they mention a few other woodland plants in passing. The book is derived from their journals, narrated in the present tense and with unhappily minimal editing. It may interest readers planning similar travels to the region, and professional growers of trees, but others are likely to find it tedious. The photographs, reproduced in color throughout the text, are not particularly good and many are too small to illustrate pertinent details.

Enter the 2005 Photo Contest

Prizes for first place in each category are one-year gift memberships in NARGS for the recipient of the winner's choice, and a grand prize of a fine illustrated book. Please include a cover letter with your name, return address, and a list of entries sent. Please ensure that it is easy to match the information on your slides, prints, or digital files with the list!

Each person may enter up to 10 photos per class, as prints, slides, or digital files on CD **(not e-mailed!)**. If submitting your entry on CD, please include a list *on paper* with the names of the files for each item. Send all entries to the Editor: Jane McGary, 33993 S.E. Doyle Road, Estacada, OR 97023, USA. The deadline for receipt of entries is **September 1, 2005.**

All slides and prints submitted will be returned by November 2005, except for award-winners to be published in the 2006 volume of the *Rock Garden Quarterly*, which will be returned later. By entering the contest, you grant NARGS the right to publish your photograph one time in the *Rock Garden Quarterly* and to post it on the NARGS website; you retain copyright.

Labeling. Write your name on each item sent; for prints, write the information on a paper label in pencil and stick it on the back. Be absolutely sure your *name* is on *every* slide. It is helpful to include your name in the file names of digital images, e.g. "Anderson.Pyrola.asarifolia."

Prints. Home-processed digital prints may not be of sufficient quality to be competitive, despite high-quality original images. Do not send *framed or matted* prints.

Digital images. Be sure that your digital files can be opened in a Windows XP Pro system using Adobe Acrobat, Photoshop, LView Pro, or other Windows application. The best results are obtained with high-resolution ("fine" or "very fine") jpeg or tiff files. Each image must be submitted as a *separate file* with a unique name.

Classes:

Class 1: Portrait of a plant in the wild. Image should be centered on the plant, but extreme close-ups are less desirable than photos showing the entire plant.

Class 2: Natural scene featuring wild plants. The plants should be clearly visible, but this is to be a "scene," not a "portrait"; that is, a broad view of the habitat should be shown.

Class 3: Portrait of a plant in cultivation. Extreme close-ups are less desirable than views of an entire plant. Plants illustrated should be *suitable for rock gardens* in the broad sense.

Class 4: Rock garden scene, showing both landscape and plants. Vignettes of small areas are often are more artistic than a broad view; however, this is not the class for "portraits" of individual plants.

We look forward to seeing your photos!

NARGS Coming Events

Annual Meeting

July 14–17, 2005

"Newfoundland and Labrador: Rock Garden of the North Atlantic."

Host: Newfoundland Chapter,Holiday Inn, St. John's, Newfoundland.

Registrar: Bodil Larsen, 141 Lower Rd., Outer Cove, NL A1K 4B7, Canada; <blarsen@mun.ca>; info:

http://www.nfldrockgardensociety.homestead.com/Introduction.html

N·A·R·G·S BOOK SERVICE

REVIEWED IN THIS ISSUE

Wildflowers of Wyoming, Diantha States & Jack States. Field guide to wildflowers common to Wyoming. Dichotomous key. Arranged by family with color photographs for identification. 254 pp. $15.00

The Genus Paeonia, Josef J. Halda and James W. Waddick. Botanical illustrations by Jarmila Haldová. Documents 25 species and 40 subspecies and varieties. Also includes genus *Glaucidium*. Information on growing with an account of soil considerations, hardiness, propagation, and diseases and pests. Stunning botanical paintings. 227 pp. $28.00

COMING THIS SPRING FROM TIMBER PRESS

Consult the Timber Press website, www.timberpress.com, for additional details.

Witch Hazels, Christopher Lane. Introduction to *Hamamelis* with detailed descriptions of species and hybrids. Info on how conditions affect rate of growth, size of plant, leaf retention, and flower color. 264 pp. Due February $28.00

Plants from the Edge of the World: New Explorations in the Far East, Mark Flanagan and Tony Kirkham. Entertaining travelogue illustrated with color maps and photographs that will appeal to travelers and plant lovers with an interest in the rich flora of the Far East. 312 pp. Due March ...$32.00

Seeds: The Definitive Guide to Growing, History, and Lore, Peter Loewer. Blends science and hands-on experience while addressing the concerns of seed raisers and collectors. Advice on buying, storing, germinating, soil and transplanting. 240 pp. Due March $15.00

The Nature of Plants: Habitats, Challenges, and Adaptations, John Dawson and Rob Lucas. Explores plants' adaptation to the challenges of their habitats. Plants that use other plants, the love-hate relationships with animals, and the hidden associations with bacteria and fungi. 314 pp. Due April $32.00

Heucheras and Heucherellas: Coral Bells and Foamy Bells, Dan Heims and Grahame Ware. Background on the wild species and their development into the selections and hybrids of today. 220 pp. Due May $22.00

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BOOK SERVICE

The Jade Garden: New and Notable Plants from Asia, Peter Wharton, Brent Hine, and Douglas Justice. Guide to 130 little-known ornamental trees, shrubs, and perennials from Asia. 300 pp. Due June $28.00

Native Plants of the Northeast: A Guide for Gardening and Conservation, Donald J. Leopold. Profiles of nearly 700 species of native trees, shrubs, vines, ferns, grasses, and wildflowers from the northeastern United States and eastern Canada. 308 pp. Due March $32.00

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