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Cover: *Campanula formanekiana*

by Rob Proctor of Denver, Colorado

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Features

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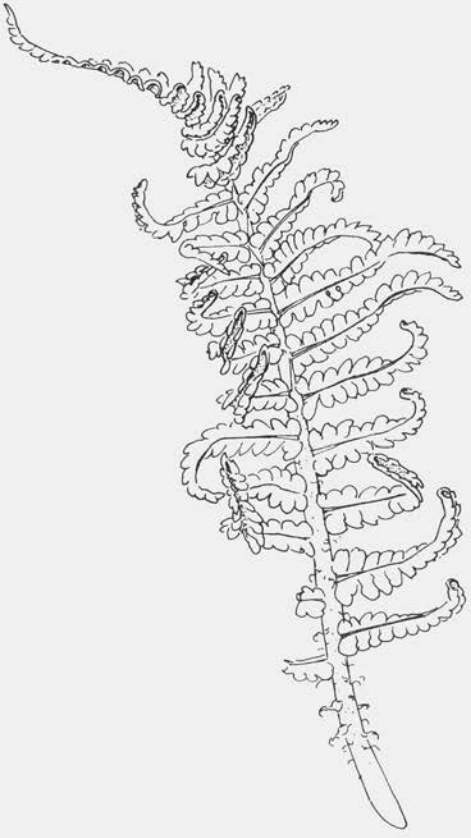


Dryopteris affinis 'Crispa Gracilis'

Ferns to adorn a Woodland Waterfall

by Judith Jones

Ferns suitable for woodland and waterfall gardens in the Pacific Northwest are legionary, even selecting only those under 2' in height. But a mere checklist of regionally suitable selections, however exciting, hardly addresses the needs of the majority of rock gardeners. Here ferns well suited to success in most of the temperate US are discussed, highlighting some new information on well known favorites, but mainly familiarizing you with newly available or little known varieties.

Let us begin with that elegant aristocrat, the maidenhair fern, *Adiantum pedatum*. The western maidenhair, *Adiantum aleuticum* (previously known as *A. pedatum* ssp. *aleuticum*) is more environmentally versatile and more variable in form than the eastern maidenhair, formerly *Adiantum pedatum* ssp. *pedatum*. The western maidenhair has a hand-like appearance to the blade rather than the circular fan shape of the eastern maidenhair. A full description and explanation of the architecture of the *Adiantum pedatum* complex can be found in Cathy Paris' article in *Rhodora* Vol. 93(No. 874):105-121. This article places all the previously recognized western subspecies of *A. pedatum* in a newly named species, *A. aleuticum*. Former subspecies are reduced to ecotypes.

I find that the western serpentine ecotype of *A. aleuticum*, formerly classified as *A. pedatum* ssp. *calderi*, is happiest in full sun in western Washington. In fact, when we have spore-grown plants of this serpentine ecotype in the nursery, they will languish and finally expire unless pulled out of the shaded greenhouse into a brighter area. This ecotype is more alluring to slugs, at least in our garden, than the typical *A. aleuticum* found in western Washington. We have a crested population which seems to have "sprung from the loins" of the serpentine ecotype, as these plants are only happy when grown in an exposed situation in nearly full sun. The cresting has not been a stable feature on all plants—some plants may not crest at all in some years, and in others not all the fronds are crested. Other individuals maintain the character consistently.

The dwarf ecotype of *A. aleuticum* (formerly *A. pedatum* ssp. *subpumi-*

lum) should be placed in a more protected situation. In nature it is only found growing close to coastal waters. The key to growing this little treasure is to remember that it rarely grows in spots that get hot. It always has "cool toes." From growing large populations of this plant, we have noted and set aside a number of plants intermediate in form between the dwarf and the typical western species. When we sow spore from these, we get predominantly normal and intermediate types, as well as some dwarf types. I believe this medium form to be what English fern growers refer to as 'Imbricatum', although assigning that name to it is fraught with difficulty now that the dwarf ecotype has itself been returned to the realm of cultivar status. So many names have been applied to the dwarf form since it was introduced to horticulture by Carl English that I have yet to determine what the first published cultivar name was. I suspect that 'Aleuticum' and 'Imbricatum' were used interchangeably for this plant. If anyone has any pertinent information about early gardening articles mentioning this dwarf, please contact me.

We find the intermediate form to be exceptionally sturdy as a nursery crop, as it has stouter, shorter stipes than the typical species and is less prone to tangling with its neighbors when grown in close quarters. It withstands greater punishment from pelting rain and wind without being flattened. Plants reach about 15", with the pinnules only slightly overlapped. I can easily spot these medium types when sorting through hundreds of plants, although there are a few individuals that blur the distinctions. It is interesting to note that Dr. Paris mentions that in nature a range of intermediates also exists.

If you have the space to encourage a bit of maidenly romping, then you might seek out the invaluable groundcover *Adiantum venustum* that hails from the Himalayas. Although this fern has reportedly been found in British Columbia and is rumored to have been collected on the Olympic Peninsula by a renowned Oregon plantswoman, neither occurrence has been substantiated. I can trace the erroneous Canadian reference back to A. J. Macself's 1952 book *Ferns for Garden and Greenhouse* . Macself states that the plant was discovered in Canada by the author of the species, Don . However, this is not true. Neither T. M. Taylor, in his classic *Pacific Northwest Ferns and their Allies,* nor Cody and Britton, in their invaluable and thorough volume *Ferns and Fern Allies of Canada,* refer to any such occurrence. Unfortunately, this error has been repeated by many authors writing popular books on ferns.

The original type of *Adiantum venustum* was collected in Nepal in 1825. Ren-Chang Ching, in his immortal *Icones Filicium Sinicarium*, Fascicle 5, lists its range as northwestern Szechwan, northeastern Himalayas, and Afghanistan. There is a closely related species in West China, *Adiantum smithianum,* with which *A. venustum* has been confused, according to the author. Since *A. smithianum* is a very common fern in the mountains in the eastern Tibetan Plateau and northwards in China to the Shensi and Shansi Provinces, it would be intriguing to try this species also. The material that I have examined locally is certainly that of *A. venustum,* but it is always possible that spore was collected from *A. smithianum* and named in error. If those gardeners who have this fern would like to press a sterile and a fertile frond to send to me, I would like to see if we are all growing the same species. Since *A. venustum* is most often propagated by rhizome division and not by spore, it is most likely that all US garden populations are alike.

There is a lesson to be learned here. Thinking about the possibility that I might actually have overlooked A. smithianum because I assumed from a cursory glance that it was *A. venustum* fills me with chagrin. Very often if we are intimately familiar with a plant, we will casually identify it in another's garden without carefully noting the distinguishing key characteristics that definitively separate our known plant from its relatives. Gardeners may smirk when botanists stop to key out some plant whose identification seems obvious. Yet even if the plant seems to shout its identity, it is best to examine it closely before declaring its name. If you can confirm all the identifying details, then open your mouth and venture that it appears to resemble said plant. Following this cautious method may save you from having to recant a rash identification. As a bonus, you may begin to notice populational or geographical variations you didn't see before.

Enough historical and philosophical peregrinations! On to descriptive facts. The translucent, reddish crosiers of *Adiantum smithianum* arise in late February or early March in Seattle and magically coalesce into luminous, brilliant green triangles. Mature fronds are a dry, pale, glaucescent green. In autumn they bronze to a burnished copper with successive frosts. The tripinnate fronds have pinnules shaped like inverted pie slices with the tip at the base. Each pinnule is distinctly stalked with the rounded, flared edge cut into numerous, small, deltoid, acutely dentate teeth on the sterile fronds. The teeth are considerably less sharp on the fertile fronds, as the pinnule edges fold back to cover the sori, one to three in number. Since the rhizome is widely creeping, the fronds may be distant or prominent depending on the environment. This fern actually likes to have its edges agitated and will colonize much faster if disturbed than if left alone. When making divisions, you should rip it up into skimpy little rhizome bits and place them shallowly in a flat or wide pot in a friable soil mix. Large divisions often languish and expire. I managed to send a few clumps to the compost before figuring this out. Of course, then I bought a book which told me this very thing—after I had learned from my own disastrous experience.
Athyrium filix-femina.

Next on my list of reliable yet desirable deciduous ferns are selected cultivars of the English lady fern, *Athyrium filix-femina*. 'Minutissimum' is a miniature reflection of the species and forms lovely mounds of delicate, soft, golden-green fronds. It is chary with its spore production and aggressive colonization is not a problem with this simple little moppet. Incidentally, you have my permission to be rude to ignorant nurserymen who misspell *filix-femina* as "felix-femina," changing the meaning from "lady fern" to "happy lady," and to those who fail to get the ending on the descriptive epithet, 'Minutissimum' not 'Minutissima' to agree with the gender of the genus. *Athyrium* is neuter. "*Filix-femina*" is a noun, rather than an adjective, and so does not agree with *Athyrium* in its ending, but retains its own.

I have some charming percristate and grandicapital miniature forms that remain only two or three inches tall, but I have yet to sow their spore to see what percentage of parental-like progeny will result. One exquisite dwarf form that I have sown has delicately dissected pinnules set closely together with feathery, fimbriate edges and tips. This uncrested parent has yielded two distinct dwarf forms, as well as some larger, setigerate forms with fan-shaped crests. The dominant form to appear is a lovely, lightly fimbriate, congested

form with demure apical and pinnae cresting. In the other form the congestion is lessened, and the pinnae flair out to ruffled fans with fimbriate edges at the tips completed by a fully flared apex reminiscent of cotillion petticoats. I like to think of these little gems as my 'Fancy Fronds Strain'.

One Victorian lady fern that always had gardener appeal is *Athyrium filix-femina* 'Frizelliae', the so called Tattling Fern. Mrs. Frizell found this fern in 1857 on her property in Ireland where "it grew between two boulders so fast and with so little soil, that it was with great difficulty my husband removed it." The pinnae are reduced from the normal size and shape to almost flat fans, which when measured are from fan apex to fan apex only half an inch wide. 'Frizelliae' forms may range in size from a demure 6" to the more usual 12-15". Since this introduction to Victorian gardens, many crested and grandicapital forms of it have appeared, but none have the quaint charm of the original uncrested type.

The biggest problem with many Victorian cultivars is that they do not come true from spores, although they may maintain some of the parent's character. *Athyrium filix-femina* cultivars are particularly notorious for their widely varied progeny. 'Frizelliae' is like the proverbial little girl who "when she was good she was very very good, but when she was bad, she was horrid."

The key to growing and buying unstable fern variations is to be wary and educated. Find out in advance what a given variety should look like. If a specimen has defective pinnae with parts missing or is inconsistent in character, do not purchase or accept it. Also, know your supplier. Ask if she practices selective culture, eliminating poor forms. If the grower evidences surprise at such a practice, be a bit skeptical about the product, unless you know from experience how to select for yourself.

Even though I promised not to whet your appetite with "iffy" items, I have to push the parameters for this neat ground cover, since one of my faithful customers, Jim Rugh of Northboro, Massachusetts, confidently states that *Blechnum penna-marina* 'Cristatum' survives in zone 4 quite faithfully. It is difficult to say whether the cresting further dwarfs this already small species or this crested form is a sport of *B. penna-marina* var. *alpinum*, found in the alpine areas of the South Island of New Zealand. Brownsley and Smith-Dodsworth don't recognize such a varietal distinction, only remarking that the fern is widespread and occurs from lowland to high alpine areas. We were delighted to have a chance to entertain Dr. John Braggins of Auckland University last summer, and he remarked that as a boy he had at least four to five different sized forms of *B. penna-marina* in his garden!

'Cristatum' is painfully slow from spore, but once it is in the garden, it creeps about just as successfully as the unadorned species. The pinnate fronds emerge reddish-rose in the spring and color to chocolate in winter. In this crested version, the apex of each frond is flared like a half-open fan. In midsummer the fertile fronds arise well above the 3-4" sterile fronds with folded segments suspended like the roofs of Chinese pagodas. Although I encourage customers to place this fern in quite a bit of sun in the Pacific Northwest, I would recommend that gardeners in less cloudy climes give it a somewhat sheltered spot.

Dryopteris is a vast genus with many of our most easily grown, consistent garden performers. Worldwide we see many species that have a marked

morphological affinity for one another, which reduces their value from a commercial standpoint. Even to the trained eye, the distinctions may come down to very fine technical points. While collecting such ferns is a great challenge to the aficionado, such an esoteric pursuit is not significant in the larger gardening picture.

In the big picture, however, we can appreciate a most singular dwarf variation of the golden scaled male fern, *Dryopteris affinis*, with "slender leathery divisions, curved hook-like at the tips." When I first photographed this fern in England, I couldn't help visualizing the caterpillar in *Alice in Wonderland* sitting atop the mushroom with his many limbs curved out to grasp his hookah. Although Dutch growers have been sending scores of plants to the US under the name 'Crispa congesta', the true Victorian name is 'Crispa gracilis'. In his 1888 handbook, *Choice British Ferns: Their Varieties and Culture,* Charles Druery describes this fern as having "the crisped character modified in a very singular way, the pinnules being bent back and then curved forward and sharply pointed." In his 1910 book *British Ferns and Their Varieties,* Druery relates that 'Crispa gracilis' was one of the two remarkable deviations raised by Dr. Lyell in 1866 from a sowing of a Welsh find, a densely compressed, crisped form. This dwarf is somewhat stiff and brittle and should be kept in a protected position, out of the way of foot and beast traffic and safe from loosely attached overhead limbs. 'Crispa gracilis' has very rigidly upstanding fronds of 8" that look good backed by the protection of a substantial rocky outcrop.

Polystichums are the precocious celebrities of the fern world with their predominantly wintergreen nature. They run the gamut from wee mites favoring rocky outcroppings in mountainous regions to larger, lush-fronded species favoring sheltered wooded regions. There is no lack of ideas or desire about which polystichums would be highly suited to rock gardening, but there is a lack of available spore-grown material. I am inordinately fond of our western American alpine species. However, they are a challenge from spore and producing sufficient numbers of reliable, garden-ready plants is not an easy task. The alternative of collecting material is not even an option as far as I am concerned. But given enough time to doggedly stay at the task, I feel that sooner or later we'll be able to find a plant or plants amenable to production and cultivation.

Such a plant is *Polystichum scopulinum,* a hybrid between *Polystichum imbricans* ssp. *imbricans* and *Polystichum lemmonii*, both desirable rock garden subjects in their own right, but both are slow and temperamental from spore. One of our foremost commercial fern growers in the Pacific Northwest has been able to grow *P. scopulinum* using traditional greenhouse fern sowing and growing procedures. The resulting progeny were a little more relaxed than their wild brethren, but once in the garden they began to take on the upright ladder look that makes them stand out in the wild. Closer inspection of the lanceolate frond reveals the unmistakable pinnate-pinnatifid to bipinnate structure. One can see the influence of *P. imbricans* in the pronounced auricle on the upper side of each pinnae, the so-called polystichum "thumb," which is deeply pinnatifid or even separate as a single pinnule. The pinnae edges have lobe-like teeth, mostly not bristle-tipped, showing its affinity to *lemmonii*. The size is suitable for the rock garden, ranging from 6-14", and it is best in rock crevices or at least with a rocky

mulch to keep the roots cool and the fronds free of splashed soil.

We have hardly begun to access all the Asian polystichums suitable as garden subjects. Many that we now grow commercially have been so successful because they are apomictic or apogamous. As pteridologists continue to scrutinize chemical and chromosomal make-up, it has become apparent that many Japanese ferns are in fact apogamous. To a grower, this translates into crops that develop faster and show little foliar variation from the parent and each other.

Sue Olsen, proprietor of Foliage Gardens in Bellevue, Washington has been responsible for dissemination of the next fern, which she grew from spore sent by Czech rock gardener, Zdenek Seibert. *Polystichum neolobatum* (sometimes spelled *neolobatum*) is a strikingly handsome fern known from Japan, China, Nepal, and the Himalayas. Although it can eventually reach 20-30", it is relatively slow-growing and so visually appealing that once you see it you'll find a space for it. The pinnae echo the overall shape of the lanceolate frond with its gradually acuminate apex. The blade itself is bipinnate and the upper pinnule next to the rachis is rigidly upright and large enough to overlap the lower pinnule on the pinnae above it. This plaited effect is enhanced by the stiff, coriaceous texture of the fronds. The traditional, deep, primeval green is overlaid with a silvery, opalescent patina that seems to have unplumbed depths. Even in the most severe winter tribulations, the fronds of this fern remain unconcernedly perfect.

Many woodsias seem to be variations on a single theme with bipinnate fronds that are hairy, scaly, or neither. They are so useful in the rock garden, with their very early spring growth complementing the early bulbs when all other foliage looks drab and winter-weary.

My favorite *Woodsia* hails from Asia and resembles a miniature western sword fern, *Polystichum munitum*. The pronounced auricle on the upper side of the pinnae next to the rachis echoes the classic polystichum "thumbs-up" look. The species name celebrates this delightful affinity with a most euphonious epithet, *polystichoides*. The pinnae are adnate (merged into the rachis), so they look like many ascending, oblong wings. The downy, silvery-white hairs on the pinnae are most noticeable on developing young fronds.

Perhaps there is a corner of your garden where the tree canopy is so dense that all the herbage fades into an indistinguishable mass. A small waterfall and pool surrounded by "scollies" and holly ferns would give light and detail to such a murky glade with bold, yellowy-green fronds.

Asplenium (Phyllitis) scolopendrium occurs in the British Isles, and Europe to Madeira, Asia, Mexico, and North America. Without a doubt, the "scollies" that are sold in the nursery trade are of British or European origin. Anyone professing to have North American material is either mistaken, or a cad who collected a rare and endangered plant. While the American hart's-tongue fern is cultivated with great difficulty, even from spores, the European hart's-tongue is easily grown, readily propagated by division, and quite uninhibited about self-sowing from spores under the right conditions.

Beginning from the understated elegance of a simple blade resembling a bayonet, this fern gave rise to more named varieties than any other species during the heyday of Victorian fern hunting and growing. It is certainly a spectacular sight to see the moist valley

basins of the County of Devon in England carpeted with swaths of swords up to 3' long and 4" wide. I've never succeeded in growing the species to this size in cultivation, despite our much-touted damp, cloudy Seattle weather. "Scollies" do like humid, shady places but prefer that their roots be surrounded by a well-drained soil incorporating sandy loam with a small proportion of peat and coarse sand. If you have acidic soil, it is best to mix in some limestone chippings. Lacking this most aesthetic of rock garden components, some bits of broken concrete or mortar, plentiful in urban areas, will do.

The simplest deviation from the typical "scollie" form is a forking at the frond apex. This is curious but lacks the appeal of those forms that crest repeatedly into flat, splayed-out fans, or bunched or twisted corymbs. In the Cristatum section, the frond initially divides about a third of the way down the apex, and these divisions in turn divide and then may terminate in crests or tassels. There is a section referred to as Ramosum, in which the fronds begin their division in their lower third and carry on division as in the Cristatum section. Sowing the spores of good forms will provide a range of forms, some good, some bad, some indifferent.

Lacerate forms are those in which the smooth edges are deeply cut giving a very jagged, irregular outline. In 'Laceratum Kaye' the tips of the jagged edges are slightly frilled, giving the ragged form a charming consistency. The standard reaction is that this 4" x 6" nest of ruffles is reminiscent of a leafy ornamental lettuce.

In the Marginatum group of the Rugosum section, the frond is narrowed considerably, with the edge becoming slightly ruffled or irregularly cut. The most characteristic forms will have a fleshy, raised ridge parallel to and just inside the frond margin, sometimes on both the upper and lower surface, but usually just the latter. The form most often seen is 'Marginatum Irregulare', where the frond is slightly wider, with lacerated edges. It lacks the pronounced fleshy ridges.

One novel variation of the marginate character combined with the ramose character is known as 'Keratoides'. The blade begins to branch just above the base and branches again in an irregular manner two to three times more, giving it a stag's-horn appearance. The narrow fronds have jagged edges, lending it a roughened antler finish, hence the name 'Keratoides', which means horn-like.

The most desirable "scollies" are in the sterile Plumosum section and are known as crispums. The frond is not divided in any way, but the surface is a series of closely set undulations like a goffered Elizabethan neck ruff. There were several named forms described at the turn of the century, but we only recognize a few today. There is a fertile crispum that is not as fine as the sterile forms but can at least be produced in large numbers. There is always the chance that a good sterile crispum will arise in the progeny. Division can be quite slow if you must wait for additional crowns to develop, but the "scollies" do have a mode of increase discovered in the mid-nineteenth century. The old frond stipe bases may be removed from the caudex with a knife or snapped off. These sausage-shaped bundles can be cut to about an inch in length, washed thoroughly, and laid inverted (cut-side down) on damp, sterile sand in a closed container. Given sufficient bright, indirect light, small, green pimples will appear and grow into tiny plantlets.

The most holly-like of the Asian Cyrtomiums is the least cold hardy. *Cyrtomium falcatum* 'Rochefordianum' is widely sold in the house plant trade for its ability to thrive with

low light and humidity levels. The pinnae edges are raggedly incised and supposedly resemble the leaf margins with stiff, spiny teeth of *Ilex aquifolium*. If you are familiar with this fern, you can envision the genus collectively, for they all have once divided fronds with the pinnae usually falcate, and some have a prominent bulge (auricle) on the upper side next to the rachis. *Cyrtomium fortunei* most closely resembles *C. falcatum* in overall appearance; the most obvious difference is that the former has a dull metallic finish instead of a hard, shiny gloss on the narrower fronds. It can also have more than twice the number of pinnae, and the edges are generally entire, although occasionally they are minutely toothed. There is a form designated as *C. fortunei* var. *intermedium* by Tagawa, which has half the number of pinnae pairs. The pinnae are of greater breadth and length than in the typical form. Combined with a more relaxed, floppy habit and lighter green color, this variety is quite different in appearance from traditional *C. fortunei*. Both of these can reach more than 2' in height, so if your needs are a little more downscale, you might seek out *Cyrtomium lonchitoides* from China. This fern is very similar in appearance to *C. fortunei* but has chubbier, more ovate pinnae rather than the falcate ones of the type. Though stiffly erect in the manner of *C. fortunei*, *C. lonchitoides* has very short stipes, making it appear as an ascending rosette. All of the above cyrtomiums seem to require quite alkaline soil. Lime should be added if excessive yellowing occurs or distorted new fronds arise. All the members of this genus require constant moisture during the growing season but need a moderately loose soil so that they are not too soggy in the winter.

My two favorite holly ferns are the least fussy of all the ones we grow in terms of both nursery production and garden performance. *Cyrtomium macrophyllum* is a real stunner, with lemony-green, shiny fronds of oversized pinnae, only two to eight pairs per frond. There is no auricle on the narrowly ovate, smooth-edged pinnae, so that all the visual emphasis is on the huge terminal segment. This can be entire or three-cleft. Although *C. macrophyllum* can attain frond lengths of 16", the weight of the large, leathery pinnae pulls the frond down, resulting in a habit more horizontal than vertical.

The most striking features of *Cyrtomium caryotideum* are its lime-green coloration, akin to that of the newly emerging tips of conifers, and the serrate-edged pinnae with elongated, tail-like tips. There are only three to six pairs of pinnae topped by a terminal pinna cleft into two or three sharp segments. Although the fronds have an opaque patina, the light coloration makes the intricate vein network charmingly conspicuous.

Although ferns must compete with the glitz and glamour of the transient flowers of assorted angiosperms in the garden—and even in the color photo section of this publication—they are indispensable to the integral garden portrait. If you look closely at waterfall gardens you admire, you will note that ferns are often the cohesive force uniting other herbaceous elements. They are the very essence of what gently cascading water relays to our senses—life-renewing serenity.

Drawing by Jean Emmons.

Judith Jones is proprietor of Fancy Fronds, a mail order fern nursery in Seattle, Washington.

Ten Primulaceae of the Pamir

by Josef Halda

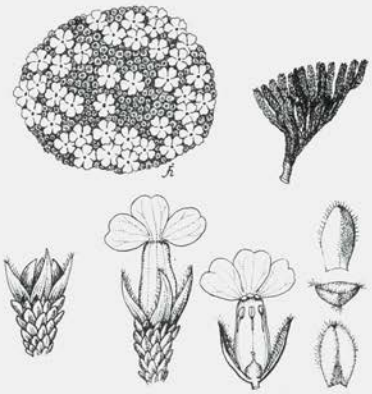
The Pamir, part of the eastern Himalaya, is the third highest mountain system in the world, with the highest average altitude, approximately 5000 m. It is about 500 km long and 400 km wide and lies mostly in eastern Tadjikistan and western China, with a small part in eastern Afghanistan. The highest peaks are Kongur Tagh (7719 m), Kongur Tebe Tagh (7595m), and Mustagh Ata (7546 m) in the eastern section, Pik Komunizma (7495 m), Pik Lenin (7134 m), and Pik Korzenevskaja (7105 m) in the west. Eastern Pamir, because it is so arid and so windy, is quite without forests—the whole country is steppe or high alpine desert without any snow cover throughout the cold winter (to -50°C). Western Pamir is much more glaciated—the largest glaciers are in central Transalai, northern Zulumart, and in the Akademia Range. Pamir means desert in the Kirghiz language; in Persian it means the roof of the world.

In the high Pamir are the roots of the huge Pyandz River (also called Amudarja, or the ancient Oxus), which divides the Pamir from Hindukush on the south and west and empties into Lake Aral. The Indus River drains the southern range; the eastern range is drained by the 2000-km-long Tarim River, which runs into Lake Lop Nor.

The Pamiroalai lies between Tien Shan and the Paropamiz, and is mostly in Tadjikistan, with a smaller part in Kirghizia and Uzbekistan. The Pamiroalai is about 600 km long and 150 km wide. The highest peaks are Pik Ak Terek (5881 m), Cimtarga (5487 m), and Min Teke (5484 m).

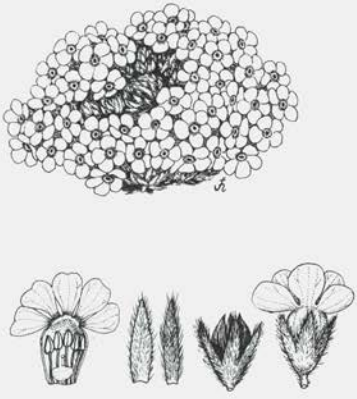
The Paropamiz (or in Afghan, the Kopet Dagh) lies in Afghanistan, with only the smaller northern part in Tadjikistan. It is an intermediate mountain system about 450 km long in the northwestern part of Afghanistan, between Kopet Dagh and Hindukush. The highest part is east of Herat (3594 m).

Androsace bryomorpha (photo, p. 199) is an outstanding member of the Pamir flora. But as a member of the genus *Androsace* it is not typical. Its corolla tube is very long and narrow, the seed is tiny and black, and its habitat is very much the same as that of many dionysias. These are some of the reasons why Ovczinikov transferred it



The stemless flowers with relatively large calyces are white and after pollination become slightly pink. The corolla tube is very long for androsaces, more than twice as long as the corolla lobes. Tiny capsules contain only a few dark, almost black seeds, which are also tiny, not typical of androsaces. We brought home some cuttings from our last trip, but the plants did not live long. In the summer of 1991 we collected seeds from six different localities. I hope someone will be more successful at growing them. This species definitely needs a careful *Dionysia* culture and a lot of patience. But—it is something!

to the genus *Dionysia*. Its grows in the Vanch River Valley and the Yazgulem River Valley, and is not too rare. For a long time only one locality was known—Lipsky's type locality—on white marble at the confluence of the Matraun and Odudi rivers (the Matraun River is a tributary of the Yazgulem, itself a tributary of the Pyandz). Everywhere else there are huge screes below the cliffs; only at the confluence does the marble descend close to the water. There it is possible to reach *A. bryomorpha* without any difficulty. But if you climb up the screes to the huge walls—and those screes are not so comfortable for walking—the *Androsace* is everywhere. We collected it at the head of the Vanch Valley at an altitude of about 2200 m on black marble (which is quite an unusual color), in the entire Yazgulem and Matraun Valleys at 2200-2800 m, and in the Odudi Gorge close to the Odudi Glacier at 3400 m. It forms very tight little cushions. The plant shown in the photograph is the biggest individual I ever saw, about 15 cm across. Plants are mostly less than 10 cm across. The tiny, imbricate leaves are hairy and create rosettes each 2-3 mm across.



Androsace caduca is one of my favorite plants. It makes very dense and very hairy cushions, which are so colorful in blooming time. The fresh flowers are pure white with deep yellow eyes; after pollination they have a purple eye. Then the flowers turn to pink, and later purple. Because the flowers are borne over a period of time, you can see all colors on one plant. The flowers persist for long time and are relatively large—in some forms more than 1 cm across. This species inhabits the whole Pamiroalai and Pamir, growing on exposed ledges and in stony fields. In

the garden it doesn't need special conditions but grows rapidly from seed or cuttings. Plants from Pamir are smaller and have tighter rosettes than those from Pamiroalai. The plant in the drawing, collected in the Fan Mts. at about 3600 m, is a large-flowered type, more robust. In 1991 we collected seeds at eight different localities, from the western Pamiroalai to eastern Pamir.

Androsace akbaitalensis is a widespread species that inhabits the whole Tien Shan, Pamiroalai and Pamir Mts. In Tien Shan and Pamiroalai it grows in subalpine and alpine zones (3200-4000 m); in the Pamir much higher (3800-5600 m). It has larger cushions, 50 cm or more across, and these are composed themselves of hairy rosettes 1.5-2.0 cm across. The flowers are in single umbels on short stems, although some forms are almost stemless. Tien Shan's populations have mostly creamy yellow flowers, Pamiroalai's are pale yellow, and Pamir's mostly yellow, sometimes deep yellow, which make a very unusual show. The plant in the drawing, collected in the central Pamir, alt. 4750 m, is a pale yellow, heavy blooming form. The form with the biggest petals, collected in the Turkestan Range up Kumbel Pass, at about. 4300 m, has pale yellow flowers too. The small-flowered form, from the eastern Pamir, northern Alicur Range, at about 5400 m, has bright yellow flowers. This species is very easy to grow from seeds or cuttings, and doesn't need any special care.

Primula flexuosa belongs to the section Oreophlomis (as do *P. rosea, P. clarkei,* etc.) and inhabits stony slopes, grassland between boulders, stream edges, and similar cool habitats at middle or higher elevations (2400-3200 m) in only few locations in the eastern Pamiroalai and central Pamir. The plant in the drawing, from the central Pamir, the Centralnyj Masif under the Fedtschenko Glacier, at about 3200 m, was taken from the edge of a cave close to a waterfall, where conditions are very humid. These plants were quite tall as a result. In open places plants are more compact, with fleshy, bright green leaves mostly without petioles, and with stems less than 10 cm tall. Flowers are lilac-pink, or sometimes rose or white—each locality has a special form. In the mountains at higher elevations *P. flexuosa* is replaced by the high alpine, moisture-loving *P. warshenewskiana*. It is a great treat to see mountain slopes with *P. flexuosa* in full bloom! In the garden it is a very tolerant plant and doesn't need any special care. Our collections contain several different forms.

Dionysia gandzhinae, the closest relative of the northern Afghanistan *D. hedgei*, grows on a small limestone range above the village of Gandzhino in southwestern Tadjikistan, in the northern Paropamiz (photo, p. 199). It inhabits mostly northern, northwestern, or northeastern vertical cliffs and walls, between 1800 m and 2400 m, often on overhanging rocks. It forms tight cushions 10-15 cm across, much smaller than those of *D. involucrata,* which reach up to 50 cm across. *Dionysia gandzhinae* is quite glabrous, and mostly without any farina. *Dionysia involucrata* is glandular hairy with yellow farina on the leaves and stems. Leaf rosettes of *Dionysia gandzhinae* are less than 1.5 cm across and are bright olive green. (See drawing for shape and size of leaves and bracts.) Flowering in April and May, its seeds are mature in August. The large bracts are pale olive green, the flower color pale lavender-blue, very unusual. Flowers are tiny, 7-8 mm across, with yellow eyes turning dark violet-blue. Seeds are similar in shape to seed of *D. involucrata* but are a little bit small-

er. *Dionysia gandzhinae* is probably the rarest member of the Primulaceae in Central Asia. We have been on Gandzhino Dag three times (in 1978, 1985, and 1991) but have found only three populations, each with no more

than 50 plants. The plant in the picture from our herbarium was the biggest plant of the whole known population. Seed from 1985 germinated well, but probably all died in the many gardens to which it was sent. This species is much more sensitive and requires better, more intelligent care than *D. involucrata*, which grows in moister conditions. I hope growers will be more successful with the seed that was offered in my 1991-92 catalog.

Dionysia hissarica, which belongs to the section Anacamptophyllum, subsection Scaposae, has a very special and rather unhappy history. Lipsky, who named the species, had an incorrect drawing, which was used again and again in botanical literature and did not improve the plant's reputation. But it is such a wonderful plant! When you see thousands in full bloom on cliffs and walls, mostly under overhanging rocks, the cushions with pretty, large, deep yellow, fragrant flowers, you must be cross at people who write without hesitation about matters outside their knowledge. Sometimes it is better to say, "I have not seen it," or, "I do not know it."

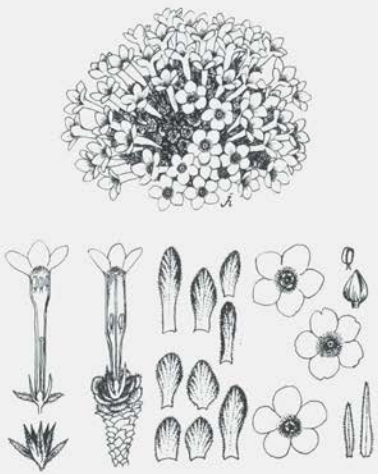
Dionysia hissarica (photo, p. 198) is a much bigger plant than any other dionysia. Some cushions on cliffs above the Lower Chandiza River are almost a meter across! But most are no larger than 50 cm across, especially at higher elevations, where they make dense tufts of hairy, pale green rosettes. The leaves are usually smaller than the bracts, and the stems are very short at blooming time, but much longer in fruit, and curved under new rosettes that develop immediately after blooming. This was probably the reason why Lipsky supposed that the flower stems hang down. I am almost certain that he did not have a plant in full bloom, but rather one slightly past bloom. The new shoots grow very fast and cover the

fertile stems, so that a few weeks after blooming the fruits are not visible. If you want to see a fruit, you must search inside the cushions, under the new growth. The seeds are themselves very different—tiny, globose, and black.

Dionysia hissarica is not too sensitive in cultivation, basically like *D. involucrata*, maybe needing slightly drier conditions. Our plants were happy for almost five years in our greenhouse but were killed by broken glass and rain through the hole in one summer night. The home of *D. hissarica* is the western Pamiroalai, Uzbek Hissar, basically the whole Chandiza River Valley including all its tributaries, from 1200-2800 m altitude. It is very easy to find it, once you know that it grows on purple limestone cliffs, not on sandstone, as Lipsky stated, on any exposure, the same as *D. involucrata*. Plants are largest on northern or eastern exposures, and those in full sunshine are most compact, and bloom most heavily. In 1991 we collected seeds of this species at six different localities. Plants from higher elevations are much smaller and more compact.

Dionysia involucrata (photo, p. 197) from the western Pamiroalai is a well-known species, grown in Czechoslovakia since the late 1960s. It is probably the most tolerant *Dionysia* in gardens, growing outside and setting seed without any problem. In nature it grows in crevices of limestone cliffs throughout the valleys of the Varzob River and its tributaries at altitudes from 1400 m to 2900 m. It blooms from May to July. It belongs to the section Dionysiastrum, subsection Involucratae (same as *D. gandzhinae*), and its closest relative is *D. hedgei*. The flowers are mostly pink or rose, but it is not too difficult to find white-flowered forms in nature or garden seedlings. Seeds germinate freely, and seedlings grow rapidly in adequate conditions and bloom mostly in the second year. But slow-growing plants are longer-lived than faster-growing ones that have been given a lot of nutrients. In the open garden this species needs good drainage, a vertical crevice, protection against heavy rain, and not too much shade. Our plants love full sunshine and quite a dry summer. This year we collected seed from ten different localities. Plants from higher elevations are mostly smaller, with darker flower color.

Dionysia tapetodes belongs to section Dionysia, subsection Bryomorphae, and it is the species with the largest distribution. It is widespread from Turkmenistan (Kopet Dagh), and northeastern Iran to Afghanistan and Tadjikistan (Pamiroalai, Zeravschan Range, and possibly the Turkestan Range too). The first plants we collected, from the Zeravschan Range, 25 km east of Aini, at about 2900 m., were dense, yellow-blooming cushions with white farina and grew on a few dolomite walls. In 1985 we found some populations deeper in the mountains without any farina and one population with yellow farina in the Fan River Gorge, altitude 3300 m, on dark limestone rocks. A month later on same trip, around Kumbel Pass in the Turkestan range, we saw a lot of cushions, probably also *D. tapetodes*. There the plants were fairly high on the cliffs, and we were not able to climb because our ropes and other acces-



sories had been stolen. But it is possible that this was a different plant, maybe a new species in the genus, who knows? *Dionysia tapetodes* belongs among the more tolerant species, and forms from high elevations are quite hardy outside. Seeds germinate well for many years—60-70% of a batch of 10-year-old seed germinated—and we have had the same experience with *D. involucrata* and *D. gandzhinae*. In the garden, *D. tapetodes* needs the good drainage of vertical or covered crevices and a fairly light soil.

Primula lactiflora of Section Cortusoides is another member of the Primulaceae from the Zeravschan Range. It inhabits cold rock ledges, walls, and islands of tiny shrubs in screes at higher elevations (2800-3500 m), but around streams it descends much lower (1800 m). The plant in the drawing was collected around one of the smaller streams, tributaries of the Fan River, at almost 3500 m, growing around wet dolomite walls and between large, mossy boulders in deep, soil-rich scree. This species has a very poor root system (the roots are, by the way, very fragrant) and a tiny winter bud. The leaves are dark green and not deeply palmate, with hairy petioles. Slender stems bear 1-3 umbels of big, white or creamy flowers with purplish tubes and dark throats. Tiny capsules contain a few black seeds. *Primula lactiflora* is a tolerant species that needs similar conditions to those required by other members of Section Cortusoides—*P. cortusoides*, *P. sieboldii*, etc. Propagation from seed is easy and division in early spring is not difficult. In the garden, it needs rich humus (leaf mold) with a lot of gravel and conditions that are not too dry. In too much shade it doesn't bloom well.

Primula geranophylla is another species from Gandzhino Dag. It grows in moister conditions—under cliffs and in partial shade under big junipers (*J. seravschanica*) in dry, stony grassland, with big acantholimons, various *Eremurus*, blue *Geranium collinum*, and many other species. *Primula geranophylla* grows mostly as single crowns or forms little clumps of small winter buds. Flowering occurs during April and May, but some plants are still in bloom in late June in the colder, moister conditions under overhanging rocks or on the edges of caves, where water drips from the cliffs, condensing in the night and creating a much colder microclimate. Leaves borne on long, hairy petioles are palmate, dark green, and pale beneath. Flowering stems are slender, glabrous, and 10-20 cm high, with 3-6 pale rose or pink, dark-eyed flowers. This little beauty, which belongs to the section Cortusoides, Subsection Geranioides, is still very rare in gardens.

Drawings by Jarmila Haldova

Josef Halda is an avid plant explorer and proponent of crevice gardening. His garden is in Czechoslovakia. He has published a comprehensive book on the genus *Primula*, available for $45 from Tethys Books, 2735 S. Pennsylvania, Englewood, CO 80110.

Dionysia involucrata

Arabis alpina var. *brevifolia* (p. 184)

photos by Josef Jurasek

Potentilla pulvinaris (p. 184)

Acantholimon bracteatum var. *capitatum* (p. 182)

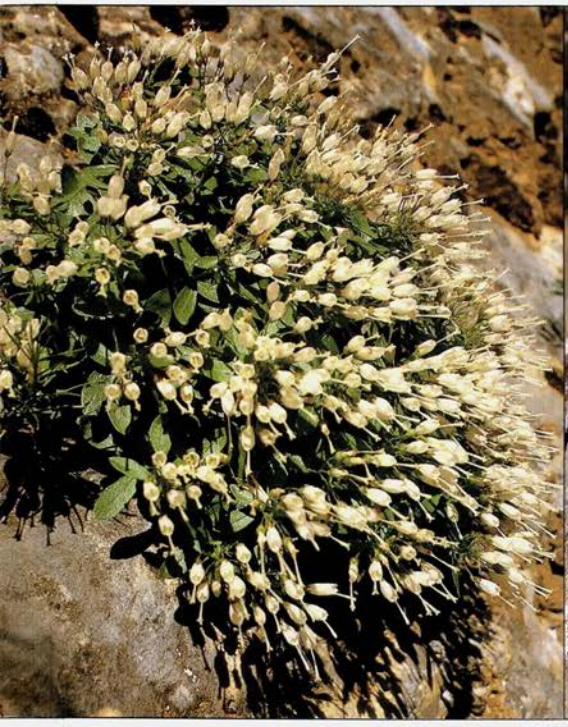
Veronica caespitosa var. *caespitosa* (p. 183)

photos by Josef Jurasek

Dianthus brevicaulis (p. 185)

Potentilla lignosa (p. 181)

Campanula myrtifolia (p. 184)



Pterocephalus pinardii (p. 185)

Draba acaulis (p. 184)

photos by Josef Jurasek

Omphalodes luciliae ssp. *cilicica* (p. 183)

Campanula aff. *hakkiarica* (p. 182)

A Dozen Gems from Turkey

by Zdenek Zvolanek

You can meet the first if you explore the marvelous limestone mountains of Eastern Anatolia between Lake Van and the Iraqi border. Crevices, fissures, and narrow pockets are homeland to one of the best alpine shrublets, *Potentilla lignosa*. Thick, white branches contorted as bonsai are appressed to rocks and smartly decorated with silver-coated, green, pinnate leaves. The oldest specimens are up to 60 cm across and, I suppose, remember the glory of the Ottoman Empire a century ago. Beautifully arranged, pure white blossoms with red anthers are solitary and sessile. The plants bloom in cultivation in May. The habitat of this attractive plant is from 1800 m up to 3200 m above sea level, only on rocks facing the morning sun. We collected cream-colored, hairy seed above Karabet Pass in the Kavussahap Mountains. It was early September, and we saw a spattering of flowers. The seed is quickly dispersed across a dozen mountain ranges of Kurdistan by fresh, cool, permanent winds.

Germination of such seed is not a great problem in cultivation. The seedlings are not in stress after potting into a substrate with 60% grit and 40% sand and loam. My three-year-old *Potentilla lignosa* is quite happy growing on the edge of a large trough in Prague. The plant creates compact mats 8 cm in diameter and a centimeter tall. It is bravely suffering the heavy pollution of this capital of Czechoslovakia together with me.

The area south of Lake Van has the climate of a continental semidesert. Local alpines are protected by snow from December to May, and the snow is practically the only source of water for their growing season. During spring, summer, and fall there are usually a few short rain showers. It is promising that this dwarf shrub has accepted our annual rainfall of 40 cm (18") and our hard winter frosts without any protection. I am obliged to Jim Archibald for his valuable information about Karabet Pass and its inhabitants. *Potentilla lignosa* (photo, p. 177) was first introduced by Otakar Vydra, who brought cuttings from Tadjikistan in central Asia. From these I produced a plant in 1986. This form, occurring on vertical cliffs together with *Dionysia involucrata*, has creamy white flowers and is more robust than the same taxon in Turkey. Josef Halda reports yellow flowers of *Potentilla lignosa*

collected in other localities in Tadjikistan at 1800 m elevation. Seed of this marvelous relict shrublet was distributed by Czech collectors in 1991, the Tadjikistan form by Josef Halda, the Turkish form by Josef Jurasek, so I believe that it will quickly be acclimatized to American gardens.

The same shady, cool, northeast-facing limestone cliffs are occupied by *Campanula* aff. *hakkiarica* (photo, p. 180). This choice, caespitose, perennial alpine has its *locus classicus* in the Cilo Dag, the highest mountains in the Hakkari Massif. The plants I observed in the Kavussahap Mts. match the description of this taxon in the *Flora of Turkey*. Here, above tree line, its flowering stems ascend to 5 cm, and one can enjoy a wealth of colorful, cylindrical flowers. These are very variable in size and color. You can find pale blue, dark blue, purplish-blue, and nearly violet, too. It is just what a rock gardener is looking for. The biggest flowers are an inch long, the flowering stems one- to three-flowered. The elegant rosette leaves are glabrous and acutely dentate, 10-30 mm long and 5-12 mm broad. Shiny brown seed germinates the first or second year after sowing. Plants are long-lived in lowland gardens, slowly developing their leaves, so that you can expect only a few flowers on young tufts. This campanula fills long crevices in its natural localities, so we can try to propagate it by taking divisions of older specimens. My one plant is content in a flat trough planted behind a large stone. It has spent our mild, rainy winter without protection. All the seed collected in the Kavussahap Mts. was offered for sale under the name *C. bornmuelleri*. This is closely allied to *C. hakkiarica*, but differs in some morphological characters (yellow seed, flowering stems usually one-flowered, leaves crenate-dentate and hirsute on both sides, 5-20 mm by 3-7 mm). Because *Campanula karakushensis,* with very similar botanical characters, was also described in this area, there may possibly be hybridization of the three species. Broader botanical study is recommended to determine with certainty the correct name of this taxon.

A third saxatile plant, *Acantholimon bracteatum* var. *bracteatum, is* from the alpine tundra above Karabet Pass. This is the only species of the genus with flowers produced in round heads. This attractive inflorescence rises only 2 cm above compact silver mounds; the flowers are bright pink. This variety climbs across rock and calcareous fell fields up to highest summits at 3050 m elevation. The oldest specimens form hemispherical polsters about 50 cm in diameter. They grow in full sun in heavy soil with no trace of humus and enjoy cold winds. I have killed dozens of seedlings in light gritty substrate on hot, humid summer days.

When I collect seed of acantholimons, I never forget to check the shape of the part under the "parachute." If it is pretty fat, I am sure of its viability. Thin, twiggy seed (up to 1 mm broad) is thrown out immediately. Only a few plants set viable seed, and even here you have to discard 60-70%. In countries with mild, wet winters it is better to sow seeds of acantholimons in early spring to prevent rotting or frost-kill of seedlings. *Acantholimon bracteatum* from the Kavussahap Mts. has a smaller sister growing in the Palandoken Mts., north of Lake Van. Its name is *A. bracteatum* var. *capitatum* (photo, p. 177). This breathtaking variety forms buns up to 20 cm across with nearly sessile flower heads. The calyx is white, the petals bright pink. Here at about 2750 m elevation, it grows on steep walls of igneous rock.

To complete this brief information about these three plant stars of the Kavussahap Mts., I must mention some alpines that share their cliff community. The crevices with

east exposure are filled with shiny green, succulent rosettes of *Rosularia sempervivum* ssp. *kurdica*, a handsome species with pale, rose-white flowers on 10 cm stems. Here also is probably the best gypsophila, *G. adenophylla*, forming small, green mats with nearly sessile, rose flowers. Tiny fissures in the rocks display suffruticose gray cushions with sessile, blue flowers belonging to *Veronica thymoides* ssp. *thymoides*. Exposures with full sun please the rare alpine shrub *Cerasus brachypetala* var. *bornmuelleri* with its carmine buds, pink flowers, and edible red cherries. Its strong branches are up to 20 cm tall, and the spreading shrubs resemble their close relative from Yugoslavia, *Prunus prostrata*. *Campanula coriacea* appreciates the same sun-baking but does not grow above tree line. Plants from 2100 m are only 5 cm high in bloom. Lilac trumpets are borne freely above a dense tuft of small, unusually thick, pubescent leaves. Those calcareous cliffs have a rich flora from which I must mention two valuable plants. *Scutellaria orientalis* ssp. *virens* forms compact mats of crenate, serrate, hairy leaves. Its pretty yellow flowers are held 5 cm above the rocks. Very rare are the dark green cushions of *Acantholimon reflexifolium,* with rose-pink flowers on short spikes. Perhaps it is rare because its leaves are as soft as an armeria and goats like to eat them. My German partner, Rudi Weiss, has found a better name for them—"softolimons."

For six more gems, we move to the central Taurus Mts. to Ala Dag. These "Mountains of God" really are divine, and I am prepared to meditate there again in September of 1992. When we start to climb the 1830 m between steppe and the summits, we are welcomed by the sky-blue flowers of *Omphalodes luciliae* ssp. *cilicica* (photo, p. 180). Its small tufts of green-glaucous leaves are seen only on shady, cold, vertical cliffs. The flowers, 15 mm in diameter, are larger than those of their relatives which charm visitors to the Olympos Mts. of Greece. In the open garden, we imitate its habitat and plant our seedlings in holes in tufa rock, facing north. This chasmophyte is only for experienced gardeners.

The Ala Dag Mts. share a semidesert climate with the Kavussahap Mts. of Kurdistan. All rocks here are an attractive but very hard limestone. We explored this area in 1986. My partner was the skillful Czech plantsman, Josef Jurasek. When we climbed steep screes at an elevation of about 2400 m, we discovered a suffruticose, stoloniferous perennial not yet in cultivation. Josef determined it later to be *Veronica caespitosa* var. *caespitosa* (photo, p. 178). Flat cushions about 30 cm in diameter are hidden in early spring by sky blue, dark blue, or purplish-blue flowers. Blooming cushions are up to 3 cm tall. Its spreading stems are crowded with silver-green leaves with hairy edges and an almost leathery texture. This taxon was known only from herbarium specimens. The botanist Siehe collected it at this location in 1911. We knew *Veronica caespitosa* var. *leiophylla,* whose *locus classicus* is in Lebanon, from many books and from occasional cultivation. It has stemless, pale lilac flowers on hemispherical cushions up to 10 cm across, and it is not entirely hardy on the Continent. Nor does it bloom freely. *Veronica caespitosa* var. *caespitosa,* from crevices and stable screes above tree line, is hardy as a bone with us. It enjoys any sunny place in the garden with an ordinary soil mixture, and it is covered with flowers for half of April. In my opinion, it is the best veronica of the entire genus for small rock gardens.

The local cliff community here has another charming member occupying eroded ledges: *Androsace villosa* var. *congesta* (photo, p. 197). Its congested, silver-

hairy rosettes create mats up to 25 cm in diameter. The rosettes are only 5 mm across, and the flowers are relatively large, solitary, and nearly sessile, with yellow eyes and white petals. The eyes fade to pink as the flowers age. It is not an easy androsace to grow in my lowland, urban alpine garden. Josef Jurasek collected seed of this delightful plant in 1991 and offered it for sale: that was a wonderful opportunity to grow a choice, new alpine.

At this altitude the shady parts of cliffs are decorated with hard cushions of a yellow-flowered kabshia, *Saxifraga kotschyi*. The sunnier positions are the habitat of another gem, *Potentilla pulvinaris* (photo, p. 177) In 1986, I overlooked this beauty, because in summer its silver-pulvinate buns look like young specimens of taller potentillas from calcareous mountains of Bulgaria and Greece. Actually, its silver-white, hairy, trifoliate leaves are nearly hidden in springtime by large, golden yellow flowers. Some plants are now in the gardens of Josef Jurasek and Ota Vlasak, but for quicker distribution into our own troughs it is important to collect ripe seed in good amounts. Josef Halda collected seed in the western part of the Bolkar Dag massif.

Arabis caucasica (*A. albida*) is common in our gardens, and all the more experienced owners of small rock gardens share it over the fence to their neighbors. I was surprised at how smart and valuable the variety from the Turkish high alpine regions is, *Arabis alpina* var. *brevifolia* (photo, p. 177). We saw it in screes above 2750 m, but the best plants were in narrow crevices. The pure white flowers are larger than those of ordinary varieties, and its smaller, broader leaves are fairly thick. In the wild, flowering stems reach up to 5 cm tall, and the plants form compact mats about 12 cm across. In my short experience, this variety keeps its dwarf habit in cultivation at low elevations, and the seedlings bloom the second year.

When we climbed the limestone mountains of the Central Taurus Range in September, we were excited by beautifully shaped mounds of *Draba acaulis* (photo, p. 180) offering hundreds of capsules with ripe seeds. This truely saxatile alpine could look from a distance like a miniature version of the commonly known Caucasian *Draba polytricha*. But after closer inspection, we saw many differences. Its rosettes are maximally 5 mm in diameter and hairy, varying in color from pale green to silver-gray. The compact cushions of the oldest specimens reach 40 cm across. It is a marvelous experience to see these alpines blooming on summits above 3300 m elevation. In our lowland dungeons, *Draba acaulis* is shy-flowering if it does not have sun all day. Deep golden flowers have good size, and a little seed is set sporadically. My best plants are on tufa rocks. This most charming draba was lost from cultivation, and we re-introduced it via the attractive seed list of Jim Archibald in 1987.

For the last three selected gems, we go close to the ancient Cilician Gates, to the giant limestone massif Bolkar Dag in the Central Taurus Range. At an altitude of 1800 m, among open forest of *Cedrus libani*, west of the village of Horos, are interesting outcrops and cliffs above the broad bed of a brook. Josef Halda and Josef Jurasek discovered here a desirable miniature campanula. On dry vertical surfaces of the cliffs, in fissures facing north and east, are tiny buns smothered with a wealth of long-tubed, whitish flowers. In my opinion, this is *Campanula myrtifolia* (photo, p. 179), a close relative of *C. busseri*. This dwarf, caespitose, suffruticose plant does not resemble classic campanulas in flower but has strangely

shaped blooms with protruding styles. In the past, this taxon was described as both *Trachelium myrtifolium* and *T. tauricum*. I am not sure if this species is now in cultivation. At the end of August when I visited this locality, seed was not available.

We rock gardeners badly need alpines that flower over a long period in the summer months. I have found *Pterocephalus pinardii* (photo, p. 177) a very rewarding plant for every beginner, because it blooms freely from June through the end of summer, regularly producing a small number of flowers. In its native habitats in the Central Taurus Range, it occupies crevices of boulders at about 1800 m and grows in fell-fields up to 2700 m. This ability to survive both in steppe conditions and in the alpine tundra is very valuable in cultivation. I grow it without any particular care. This *Pterocephalus* shares cliff communities with *Campanula myrtifolia, Pelargonium endlecherianum, Cyclamen cilicium,* and the compact shrubs of *Satureja montana. Pterocephalus pinardii* belongs to the Dipsacaceae family. It has large, sessile, flat flowers. Plants are elegantly color-coordinated—the pale rose-pink inflorescences are offered up on compact, green-gray mats. In open, light, calcareous soil my three-year-old plants are about 40 cm across. We can easily propagate them by dividing older mats. Should you need to propagate a large number of plants, I recommend that you select viable seeds, those with a thick body under their parachutes.

The last gem for crevice-gardening we discovered in the alpine tundra of the Bolkar Dag massif. It occurs sporadically on vertical, east-facing, marble cliffs with *Draba acaulis,* although its main niches are in fell-fields and the stable screes of the coldest cauldrons. The name is unknown from the famous rock garden writers, so it is my pleasure to introduce to you *Dianthus brevicaulis* var. *brevicaulis* (photo, p. 178). This species is a classic alpine dianthus, less than 5 cm high in flower, and with small, green, linear leaves forming tight tufts. The largest specimens in the wilderness are about 15 cm across, and this variety retains its habit in cultivation. A very exciting task would be selecting the best plants in full bloom in the late spring. There is marvelous variability in size, shape, and color of the flowers. Of course, selecting new cultivars among seedlings raised from seed is also heaven—or the land above the trees. This variety of *Dianthus brevicaulis* seems to me more difficult in cultivation than the European alpine pinks. Do not use humus in your soil mixtures, and use minimally 60% grit. Do not plant it in south exposures, but offer them, please, cool root comfort.

To select twelve aristocratic saxatile alpines from the wealth of Turkey is very easy and just enough to slake the thirst of keen rock gardeners. To add more now might dull your appetite for another installment in a future article.

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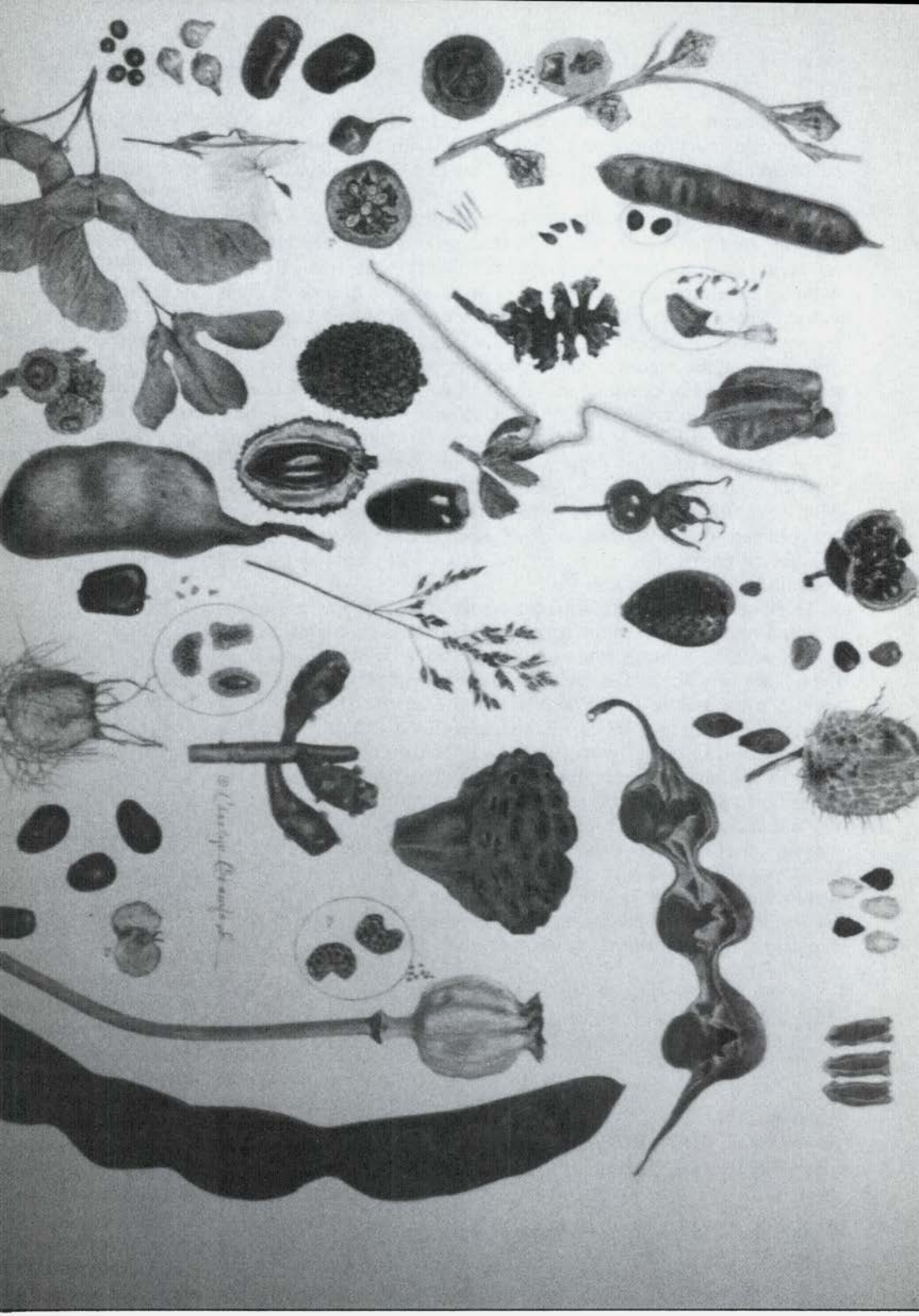
Zdenek Zvolanek gardens in Prague, Czechoslovakia. He has long been one of the leaders of Czech rock gardeners and is a central figure in the Prague flower show. He operates a small nursery and travels widely observing alpines and collecting seed.



Looking at Seed

by Geoffrey Charlesworth

In the process of sowing several packets of seed, have you ever wondered as you sprinkle the seed on the compost, "Is this really what it says on the packet?" There are six possible answers: Maybe, Maybe Not, Probably, Probably Not, Definitely, Definitely Not. Sometimes you can be sure that one of these answers is true. One of them is nearly always false: "Definitely" is usually the wrong answer, unless the packet says something vague like "Compositae," in which case it *may* be right. A look at some elementary properties of seed may help with the problem. Making allowances for no botanical training, little power of observation, and limited memory, you can add your own inadequacies to mine and look for patterns as we sow seed.

The first two names of a plant, its genus and species, are given on the basis of certain kinds of similarities amongst groups of plants. Individual plants of a group of *Silene acaulis* growing on a mountain differ from each other just as people do in size, age, prosperity, and genes, but because to us they look much more like each other than do people, we think of them as "the same thing." A group of *Silene acaulis* individuals on a different mountain, maybe in a different country, may differ dramatically enough that they are considered a different race, or even a different subspecies, but still would be considered to be *Silene acaulis* because of well documented similarities. The set of plants we call *Silene hookeri* is obviously different from *Silene acaulis*, with totally different leaves, habit, habitat, distribution, flower color, and flower size, and yet the two species are enough alike that even a casual observer seeing them in flower would want to call them both silenes. Silenes differ from *Dianthus* in even more radical ways, visually as well as botanically, and we all think we could distinguish between the two genera if we had a representative of each in front of us. To state the difference in words, we would probably have to defer to Botany and look under Caryophyllaceae, the family to which they both belong, in *Hortus III* or a botanical text book. Part of the description of the family has to do with the organs of reproduction of all its members, and since seed is the end

result of reproduction as far as plants are concerned, you are entitled to expect that plants in the same family would have similar seeds.

This seems to be a useful way to look at the seeds you are sowing. Ideally you would like and expect different genera in the same family to have different kinds of seed from each other; your greatest hope is that seed of different species can be readily distinguished from each other. If so, you are out of luck. Whatever trained botanists can deduce from looking at seed under a microscope or examining the interior of seed at great magnifications, with the naked eye we can merely recognize crude differences, and we would have a good deal of trouble describing or remembering them. I have never come across any reference to a study that compares seed variation in the same way that other plant parts are compared. Nevertheless, a few unsophisticated conclusions may be drawn from superficial eyeballing. We can look at size, packaging, shape, color, and texture. But remember to mistrust generalizations and be prepared for exceptions to any and all conclusions reached.

Take alliums, for instance. According to *Hortus III* these are members of the family Amaryllidaceae, which includes *Galanthus, Leucojum,* and *Narcissus*. When I think of allium seed "in general," I remember it as black, shiny, and smooth. If it was dropped on a table, it would tend to roll off. But then I also remember that the size of seed of species of *Allium* can vary considerably. We never expect seed like dust, nor seed as large as a pea. Although the seeds can be almost perfect spheres, they are sometimes chunky with definite edges, and I have seen one species that was flat with a papery edge. (This didn't germinate so I still don't know for sure that it was an allium.) You would certainly suspect seed of being wrongly named if it was light brown dust. You would also know it was wrong if you found thorns amongst the debris, or if it arrived enclosed in a sticky berry.

Similar seeds to alliums could be expected from *Galanthus* and *Leucojum*, except in these the fruits really are berries and if you got fresh seeds there would be sticky pulp clinging to them. Some of this goo could remain after drying. *Narcissus* seed would also be like the allium type—black, round, shiny, smooth, and spherical—but only as a generalization. *Narcissus triandrus* seed, proving the rule, is dark brown, nearly round, and quite dull. Sometimes *Allium* is put in the family Alliaceae. The Royal Horticultural Society dictionary puts *Allium* in the Liliaceae, where there are other members, such as *Scilla*, with similar seeds.

A second example might be *Acantholimon*. Its family, the Plumbaginaceae, also includes *Armeria, Limonium,* and *Goniolimon*. The seed of this family is enclosed in the calyx, which is papery and doesn't release the seed easily. The "seeds" you get are mostly noisy parachutes, which sometimes contain viable seed, but are mostly junk. You sow everything and hope for the best. Seeds come from a head of flowers, in the case of *Armeria,* or a spike, in the case of *Acantholimon*. At first you might mistake them for Compositae, but the papery bracts are normally different from the typical, feathery pappus floating above the seed of a thistle or an aster. Some composites, though, do have papery bracts (for instance, *Psilostrophe, Raoulia*), that could get mixed up with Plumbaginaceae seed and confuse the identification. So with these genera don't expect clean, roly-poly seed, don't expect dust, don't expect silky or cottony appendages. Do expect crisp, rustling packets of what you hope is seed, still enclosed within the pointed end of the calyx.

First, a look at size classification to see if that is of any use. No gardener sowing seed is going to measure the diameter of a seed, much less take a sample and find the mean and standard deviation for the sample. The most we are willing to do is give a crude verbal description.

1. Dust-like seed: It doesn't rattle and is very hard to clean. It is easy to eliminate the larger pieces of debris but not to separate the real seed from the dust. Sometimes the dust, which comes from the crushed capsule, is a different color, so the seed is visible. Static electricity causes the seed to stick to the envelope, especially a plastic envelope, and you may want to put a spoonful of sand in the envelope and shake it up in order to sow it easily. You can't hope to sow seed like this individually or even uniformly, and again mixing with dry sand helps to spread it out evenly. Examples are orchids, *Trachelium*, and *Centaurium*. Just a little bigger is:

2. Tiny seed: This is easy enough to see, but there is usually plenty of dust present. The seed itself is audible as it rolls across paper. You can't pick up an individual seed, and you have trouble sowing it thinly. You also lose sight of it after it is sown unless it is a very different color from the compost. Either mix sand with it before you sow, or sow it on a thin layer of sand and don't cover, or do as I usually do. Sow on the compost and cover with the thinnest layer of sand you can manage. I do this so as not to break the rhythm of my method, even though I know better. A real danger is sowing too thickly, especially if you are germinating the pots indoors, because of the likelihood of damping off. Also, all corrective measures after germination, such as thinning or transplanting in clumps, are an extra nuisance. Examples of tiny seed include *Campanula*, *Physoplexis, Soldanella, Saxifraga, Meconopsis,* and farinose primulas.

3. Small seed: The size is between Tiny and Medium. It is very unsatisfactory to be unscientific but saves time. Instead of measuring, you form subjective classes of size with names with only comparative meanings. It means you can only communicate your opinions to people who understand your meanings. *Veronica*, *Phyteuma*, *Linaria* would be included in this group.

4. Medium-sized seed: By the time seed is the size of a pin head, you can see it after sowing. You can even place it by pushing it with your fingernail. But it is not easy to pick up a single seed between your finger and thumb. This would include larger primulas, but also alliums could be this small.

5. Medium Large: This would be between medium and large and would include *Cyclamen.*

6. Large seed: This is easy to sow. If you wanted to, you could place it exactly where you wanted it on the surface of the compost. The size would run from a plastic pinhead that holds a shirt together up to half the diameter of a fresh pea, or the size of a dried pea or lentil. You would also include cigar-shaped composite seed with or without the parachutes. You could include *Dianthus, Astragalus, Lupinus, Delphinium.*

7. Very large seed: Small peas up to avocados and coconuts. These could be picked up easily without fear of dropping and even sown singly directly in the garden, like a bulb. This is a good way to sow *Paeonia, Tropaeolum,* and some annual peas. Other examples are *Cardiocrinum, Lilium,* and many shrubs, such as *Cotoneaster* and *Rosa.*

You should be ready to object that my examples are unreliable and that you have seen larger campanula seed, smaller allium seed, and medium-sized *Paeonia* seed. But then you would be well on the way to recognizing the characteristics of different genera and could contribute your own observations. So here are a few examples to inspire your own personal list.

Parnassia palustris is dust-like. So is *Centaurium scilloides*, a member of the Gentianaceae. *Gentiana ciliata* is almost dust; *G. septemfida* and *G. verna* are tiny; *G. asclepidaea, G. froelichii, and G. cruciata* are small; *G. purpurea* is medium, light brown, and flat.

Trachelium rumelianum in the Campanulaceae is dust-like. *Campanula glomerata* is almost dust, *C. raineri* and *C. bornmuelleri* are tiny; *C. barbata* and *C. alpina* are small. No species of *Campanula* is much bigger. Also in Campanulaceae, *Adenophora* is small, *Edrianthus pumilio* is small, *Platycodon* is small.

Saxifraga: *S. umbrosa* is almost dust; *S. bryoides, S. luteoviridis*, and *S. ferdanandi-coburgi* are all tiny. Nothing else that I can remember is any bigger.

Sedum divergens is tiny, and I believe most sedums would range from dust-like to tiny.

Pratia angulata and *Notothlaspi rosulata* are two New Zealand plants with tiny, bright red seed.

Viola pedata and *V. eizanensis* are both small; *V. beckwithii, V. philippii,* and *V. hallii* medium.

Species of *Penstemon* range from small (*P. nanus, P. pumilus, P. laricifolius*) to medium (*P. caryi, P. yampaensis*) up to medium-large.

Lewisia rediviva and *L. tweedyi* are small.

Primula: the farinose species are mostly tiny; *P. bulleyana, P. glaucescens,* and *P. speciosa* are small; some primulas are medium. Also in the Primulaceae, *Androsace vandellii* is small, *A. pubescens, A. ciliata,* and *A. mathildae* are medium. One is always surprised to find such large seed from these miniature plants. *Douglasia laevigata* is also medium, and *Vitaliana* is large.

The alpine crucifers are either small or medium; *Draba ventosa, Arabis pumila, Thlaspi rotundifolia* are small. Medium are *Aethionema grandiflora, Physaria obtusifolia*, and some species of *Alyssum*.
Dianthus neglectus is small; so is *Silene elisabethae* (but *S. acaulis* is tiny). Other family members include medium-sized *Dianthus hungaricus* and *D. sylvestris*, *Cerastium latifolia,* and *C. unifolia.*

Of the Leguminosae (Fabaceae), *Trifolium* is medium large, *Lupinus caespitosus* is small to medium. *Lupinus nootkatensis* is large, like dried lentils; *Anthyllis* and *Thermopsis* are both large.

Phlox caespitosa, P. kelseyi, and *P. pulvinata* are all medium.
Zauschnerias are small, and *Epilobium fleisheri* is tiny and covered with silk.

These examples give us some information: Although neither family nor genus determine the size of seed, there is reasonable assurance that in some genera and in a few families there is a limited range of sizes that is characteristic.

Shape is a character that says even more about a genus than size. Describing shape, however, is yet more hazardous and subjective. You can make comparisons with familiar objects or use geometric objects as the basis of your description, but an irregular, three-dimensional object without reference points or planes is subject to interpretation from an infinity of viewing points. Add to that the variability of all natural objects, even when they nearly approximate spheres, cylinders, parallelepipeds, or planes, and you can see why shape is such an elusive property.

Lilium and *Fritillaria* are often flat disks with the fleshy seed surrounded by a papery ring as though a celestial elephant had sat on Saturn. Composites usually start life with a pappus like a shuttlecock, which can be resilient and bristly as in many thistles (*Cirsium, Onopordon*), or soft and squashy as in *Erigeron* and *Aster*, the extreme being some species of *Townsendia*, which never recover from getting wet and look like dirty dish rags. When the seed is ripe, the pappus of some species is easy to remove but troublesome to clean, so many times you are faced with pappus from which the seed has fallen off (*Cirsium, Onopordon*). The seed is at the bottom of the envelope. If the donor has done a good job of removing the pappus, the seed looks more or less the shape of a cigar or boomerang, sometimes short and fat, sometimes long and stringy, often with ridges, but sometimes smooth, and very variable in color. Some seeds are very reluctant to leave the receptacle on which they are sitting and don't seem to have any mechanism for distribution by wind. I am thinking of *Anacyclus* especially, whose seeds you have to wrench away from the head before you sow them. The flattish seeds are covered with a papery net even after they have fallen off, so you have to sow everything you find at the bottom of the envelope, because the seed looks like chaff. With composites in general, you may as well sow whatever comes out of the packet, because often the bristles and strings that arrive are easily confused with the seed. One seed director has nothing but contempt for people who don't clean composites properly, but I have never found it a bother to sow the junk with the good stuff. The only problem is when you aren't sure there is any good stuff in there.

Epilobium and *Asclepias* seed comes out of pods surrounded by silky hairs. Sometimes the cobwebs stick to your fingers (*Epilobium crassum*). The seed itself is not much like composite seed after the silk has been removed, and it fits into other categories if you receive the seed smooth and bare.

Another type of seed with extraneous baggage forms a section of the genus *Anemone*. The seeds are surrounded by a woolly material and seem to float in a cashmere shawl of creamy white. You can sow the whole shawl by laying it flat on the compost, and there is no need to separate the seeds. The family is Ranunculaceae. Also in this family is *Pulsatilla*, whose seeds are adorned with a long, feathery plume. If you lay a bundle of entangled seed on the surface, and cover with sharp sand and water (as I do), you can expect the moisture to manipulate the plumes so that some of the seeds pop above the surface. I usually cut off the most obstreperous tails before sending the pot outside. The genus is distinguished from *Anemone* by this feathery tail, and *Pulsatilla* is sometimes lumped with *Anemone*, so seed would be correctly labeled either way. *Clematis*, also in the family, has seeds very much like *Pulsatilla* in size and plumage. Some people insist on taking special precautions with these seed: either a) plant seed head down, tail up, or b) cut off all the tails before sowing, or c) both rituals.

Some members of the Rosaceae could be confused with pulsatillas. Both *Dryas* and *Geum* have plumes. Other members show wildly different features and generalizing about the seed of this family would be dangerous. Hairy seed is not unusual though. Anyone who has had rose seeds dropped inside his collar by a playful childhood friend knows the itching they can cause. Also like the woolly anemone seed is the seed of *Globularia*. This is the only genus in the Globulariaceae family that you are likely to meet.

The *Ranunculus* family is also highly varied. *Aconitum, Aquilegia, Delphinium, Eranthis, Helleborus, Hepatica, Nigella,* and *Trollius* tend to have medium-sized seeds, easily collected, easily sown, smooth and chunky. Some of them are slow to germinate and some difficult. *Ranunculus* itself is usually difficult, even though the genus contains a few obnoxious weeds. Like *Adonis*, the seed should be sown fresh, if you want to be sure of germination. By fresh, I mean the day you nudge it still green but just turning brown from the plant—not six weeks later after it sits in the mails. But in spite of this dire warning, there have been many cases of *Adonis* and *Ranunculus* producing a few plants from seeds sown in winter with all the others, after spending months trapped in a seed exchange.

With a magnifying glass you can tell more about seed. There should be a scar where the seed was attached to the walls of the capsule and a mark where the orifice was through which the ovule was fertilized. As the seed develops, these two marks either remain on opposite sides of the seed or move to positions close together. Different genera do different things, and an identification may be clinched if you can read these signs and understand them. One curved seed is the familiar bean shape. Members for the family Fabaceae, the legumes, are usually this shape. They are also medium to large, or even very large. So look for this type of seed from *Astragalus, Oxytropis, Lupinus, Anthyllis, Cytisus, Lathyrus,* and a host of shrubs, trees, and border plants. These seeds tend to germinate erratically and sometimes have to be saved for more than one year. Some people advise sand papering or otherwise abusing the seed coat, allowing moisture to reach the interior of the seed coat. If you only want one or two plants, simply transplant the first few to germinate. Occasionally, you find a stray seed will germinate later in the same pot. It seems strange that peas and beans, which germinate faithfully for grade school children and vegetable gardeners, are family members with *Astragalus* and *Oxytropis,* notoriously fickle in their behavior. Difficulty or ease of germination is not a family trait, nor even a generic trait. Compare *Campanula piperi* with *C. carpatica,* or *Aquilegia jonesii* with *A. vulgaris.*

Omphalodes takes its name from the fact that the seed is shaped like a navel. This is a raised medallion in the center of a disk-shaped seed. The Boraginaceae also include *Eritrichium, Myosotis,* and *Onosma.* None of these has really tiny seed, and some of the "nutlets" have hard coats surrounding the seed itself. Hence the name *Lithospermum* (seed like a stone), whose seed may need special treatment to germinate.

The lily family is highly varied in seed shape, including not only *Cardiocrinum* and *Lilium,* with large, flat seeds, but scillas (round, black, shiny balls) and *Tricyrtis* (small, brown, flattish seeds), so generalization is out of the question.

Crucifers have less variety in size and seed form. Drabas are small, brown, non-spherical seeds; alyssums are small

to medium, flattish disks of different shades of brown. *Aubrieta* and *Arabis* are similar to one or the other, but a bit larger than drabas.

Umbelliferae (Apiaceae) is a family where seed is sometimes unmistakable. Look for a large, flat, papery seed with a raised line, or two parallel raised lines lengthwise along the oval disk. This is probably a member of the carrot family. *Lomatium, Heracleum,* and *Orlaya* follow this pattern.

Other attributes of seed could be considered: color and texture. The color of *Viola* seed varies all the way from almost black to almost white, but I don't think the colors are uniform enough or definite enough to be used convincingly as diagnostic tests for species. This needs more study. Seed varies in color on its way to becoming ripe, and if collected at varying degrees of ripeness still more doubt would be cast on identification by color. The color of nearly all seed that I have seen resembles that of human hair in its infinite but subtle variability coupled with its limited range of weak, tertiary colors. Although there are colors you could call yellow, red, or blue, it would always be in comparison with other grays and browns.

Texture is worth noting in any description of seed, but again is a rather blunt instrument of identification. One can talk about surfaces as smooth, rough, hairy, woolly, and so on, but beyond that, it would be more sensible to magnify the objects and describe detail that the eye has trouble seeing, much in the same way that species of *Draba* are distinguished by the shape of hairs on the leaves. Such differences are invisible to most of us and will always remain too technical for the average gardener.

Finally, we are forced to the conclusion that recognizing seed is an extension of the power that gardeners cultivate for identifying species just by looking at the plant, whether in flower or not. After you have seen a plant many times, you no longer count petals (if you ever did), or compare color with a color chart, or take a ruler to measure height or petal length. You "know" by looking at it exactly what it is, in the same way that you recognize a friend. Sometimes you even know the subspecies or the horticultural variety. If we sowed seeds as frequently and as lovingly as we grow plants, we might know them just as well.

Drawings by Carolyn Crawford

Geoffrey Charlesworth annually sows over two thousand packets of seed at his garden in South Sandisfield, Massachusetts. Fortunately, not all germinate.

Recycling Materials in the Rock Garden

by Wiert Nieuman

It may come as a surprise that a country known for its flat, sandy landscape, the Netherlands, is home to one of the finest rock gardens in Europe. The Fort Hoofddijk branch of the Botanic Gardens at the State University of Utrecht is similar to many other public gardens, with a rock garden, a systematic garden, a wild or natural garden, tropical greenhouses, and a research section closed to the public.

Utrecht lies in the middle of the Netherlands, approximately 35 kilometers from Amsterdam, on the border of a sandy area near the Kromme Rijn, a small branch of the Rhine River. The soil consists of a meter and a half of very heavy river clay overlying pure sand. The nearest stone formations are in the Ardennen Mountains in Belgium, some 300 kilometers away.

Constructing a large rock garden is quite a challenge, because suitable rocks are almost nonexistent in the immediate area. The rock garden was first built in 1964 on the property at Fort Hoofddijk. The garden has about 12 meters change in elevation and is approximately 4,000 square meters. Stones from the Ardennen Mountains were brought all the way to Utrecht for use in the basic construction of the garden. The rock garden is divided into geographic sections devoted to North America, Asia, and Europe. Other areas feature mountain woodland plants, dry-loving plants, and an area which is more or less a scree.

Recycling Materials

For a couple of years, my staff and I worked on building a small alpine house that was placed 6 m deep into a slope. We surrounded it with planted troughs whose numbers kept growing until we no longer had enough area left to properly view them. A decision was made to dig away the slope on either side of the alpine house. In order to keep the rest of the slope from eroding, we built a supporting wall made entirely from recycled material.

Where to obtain rocks for this new special addition to the rock garden? Purchasing from a supplier would have been the easy solution, but instead we chose to use discarded materials in a creative, resourceful way.

Recycled material was chosen as we can get it at no cost, and it serves as an

example to the public of what can be done with this type of material. The walls on both sides of the alpine house were made from old concrete curb stone, roughly 35 cm long, brought from the city of Utrecht. Looking at the front of these walls, one can see all the interesting divisions and levels that give any stone wall its character. By placing pieces of old natural curb stone 15 cm out from the face of the wall, we created some very appealing lines integral to the design. The most exciting line of natural curb stone extends from the front of the terrace and continues along to the top of the wall (photo , p. 200).

In front of the alpine house and on one side, we built low walls from broken sidewalk tiles. The broken tiles are roughly 15 x 30 cm in size. Here also the division lines are visible from the front of the walls, where we have combined the broken tile with pieces of natural stone. In some places the wall is recessed 10 cm or more to create an interesting effect.

As a foundation for the wall, we used old curb stones laid parallel with the slope. This foundation is strong enough for our purposes. We then built the wall up from the foundation at an angle leaning back into the slope at approximately 10° to retain the rest of the slope. Pieces of curbstone were used to build the wall with layers of approximately 3 cm clay and sand in between to secure them. Here and there a small shrub or conifer was planted into the wall during construction. Out of ten plants so placed, only a single *Daphne alpina* did not survive.

Around the alpine house we also put up walls made from sidewalk tiles, built up from a foundation of curb stone, with allowances for a door leading inside. The tiles measure 30 x 30 cm. They can be easily broken into two pieces by setting one stationary tile on its side in a pile of sand and breaking the other with a firm strike against it. The broken tiles were then laid with a backward tilt, allowing water to flow back into the soil and be retained. When building a wall such as this, it is very important to leave enough soil between the layers of tiles for easy placement of rock plants later on.

Our last experiment with recycled materials in this part of the garden is alongside the troughs. After providing more space to walk around and view the troughs, we were able to turn our attention to further enhancing them. Against some of the troughs we used old roof tiles broken lengthwise, a half meter long. We placed these half tiles sideways, slightly out of balance. The result looks like a geological formation that has come to the surface of the earth. Between the tiles, which have been placed 2-5 cm from each other, we planted European primroses, such as *Primula spectabilis*, *Primula palinuri*, and so on. In the near future we will experiment with roof tiles and other concrete materials for constructing raised beds and other garden designs.

We did not do any planting during construction of the walls around the alpine house. While we have subsequently added alpine and rock plants, it is not our intention to totally cover the walls. The structure and line work of the walls must always be visible, since they add interest and texture to the garden. The plants we have used are *Haberlea, Clematis integrifolia, Daphne cneorum, Asplenium trichomanes, Saxifraga, Chamaecytisus,* and *Phyllitis scolopendrium.* Between the broken tiles against the alpine house we planted *Tanacetum densum* ssp. *amani, Acantholimon, Dianthus erinaceus, Eriogonum,* and *Thlaspi* in sunny areas. In shaded areas, we planted *Saxifraga, Vital-*

iana, some *Primula* species, etc. We used plants that had sturdy root balls, rooted cuttings, and seedlings without soil. In our experience, seedlings at a young stage have the best chance to survive, provided they are given enough attention the first weeks after planting.

Old stone and concrete materials can be very useful in a garden. In our case, we used them for a special area, but such materials can be used for making raised beds, dry walls, or walls for a bulb frame. In a place where stones are sparse, much can be done with recycled material at a very low cost. Cost, of course, is not the only factor; ingenuity and creativity lend a sense of satisfaction at having contributed to the good of the environment by using recycled materials to their best advantage. In Utrecht, we will do more with this material, and if we have new ideas, we will let you know. We would like to receive information about your creations!

Translated by Karen Lederer. Ms. Lederer is an American with many years of experience working as a landscape gardener and artistic adviser in her native New Jersey. She began working at the garden in Utrecht in 1990.

Wiert Nieuman is chairman of the Dutch Rockgarden Workgroup and is in charge of the rock garden at Utrecht. He has written many articles for Dutch gardening magazines and several books about rock gardening.

Book Review

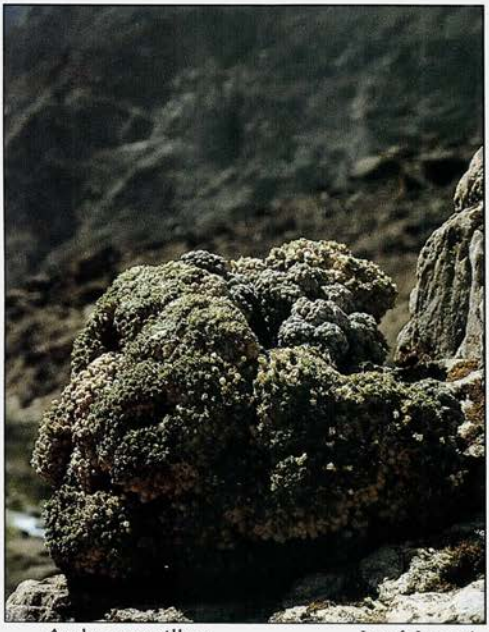
Rotstuinen, by Wiert Nieuman. 1991. Zomer & Kuening: Ede (Netherlands, Antwerp (Belgium). 8 x 10.5"; 143 pp., 122 color photos, 26 drawings. ISBN 90 210 0084 9.

Here is an excellent text that delivers exactly what its subtitles promise: rock gardens, ideas, possibilities, constructions. The author shows that a rock garden is above all a setting of choice for one's own plant collections. That being understood, he will not discuss the plants, their specific beauty or requirements, but show and explain many ways of rock gardening.

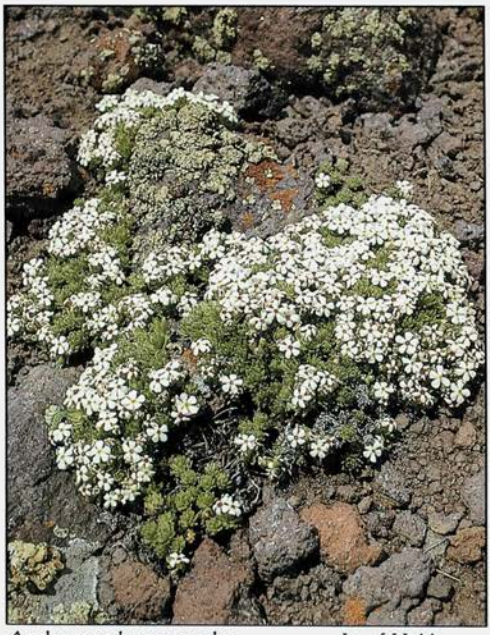
He lets us benefit from his considerable personal experience. Every aspect of practical rock gardening is dealt with clearly and concisely. Old principles are clearly explained, but not without a gentle and discreet dusting. For people who have heard that all the stones should be of the same sort, he shows what can be done combining two or more very different kinds of rocks. For the gardener who thinks that there is only one correct way to place rocks, he produces a few counterexamples of great beauty. Of course he deals with the "traditional," "naturalistic" rock garden, but he devotes as many pages to walls, raised beds, troughs, containers, roof gardens, etc. For the serious beginner, there are chapters on safety during construction, labels, collecting and storing seeds, propagation. The drawings are very helpful, and the many color pictures illustrate and complement the text in the most felicitous way.

The book is written for today's gardener and it will have considerable value for all who are not blessed with natural outcrops and ledges on their property, but have to bring in stone from far away.

As the title indicates, this book is written in Dutch. One can only wish that an English translation will be published soon. —J.M.



Androsace villosa var. *congesta* (p. 183) Josef Jurasek

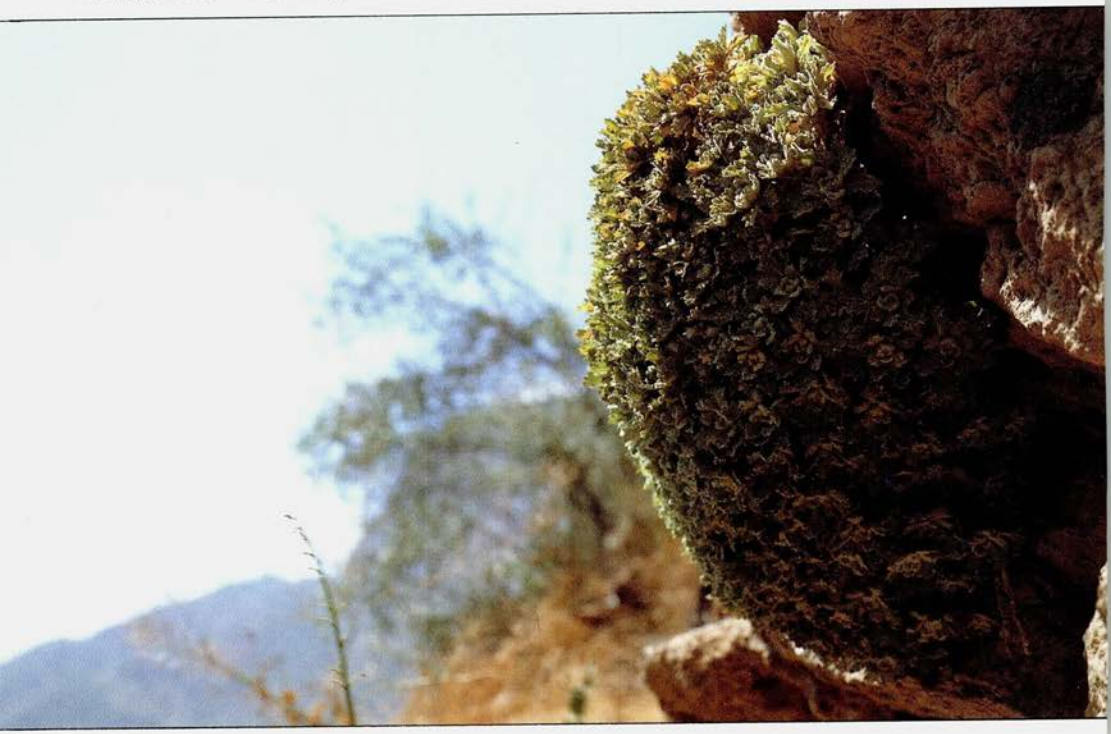


Androsace bryomorpha (pp. 171-172) Josef Halda

Dionysia involucrata (p. 175) Panayoti Kelaidis

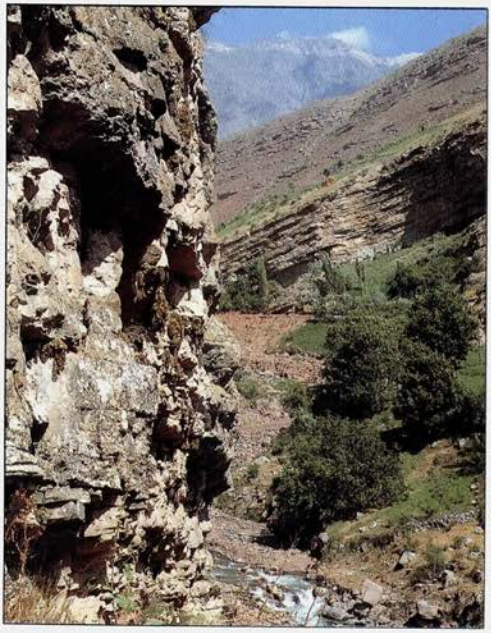
Kandiz Gorge, habitat of *Dionysia hissarica* Josef Halda

Dionysia hissarica (p. 174)

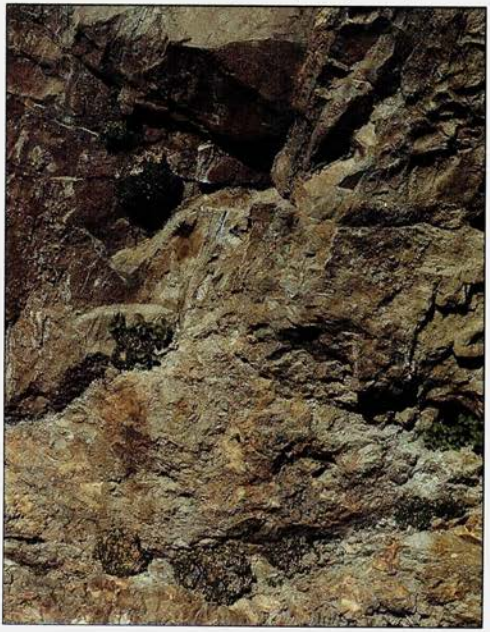


Gandzhino Mountains, habitat of *Dionysia gandzhinae* (p. 173) photos by Josef Halda

Sionea Gorge,
habitat of *Dionysia involucrata*



Miatrum Gorge,
habitat of *Androsace bryomorpha* (p. 171)



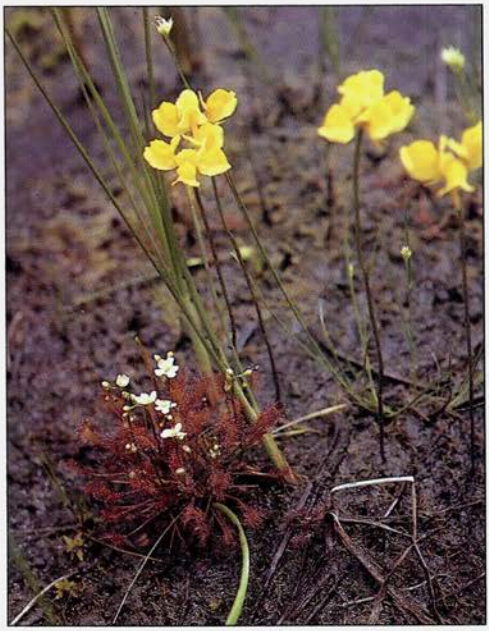
Alpine House at Utrecht Botanic Gardens, showing rock work with recycled materials (pp. 194-196)

Wiert Nieuman

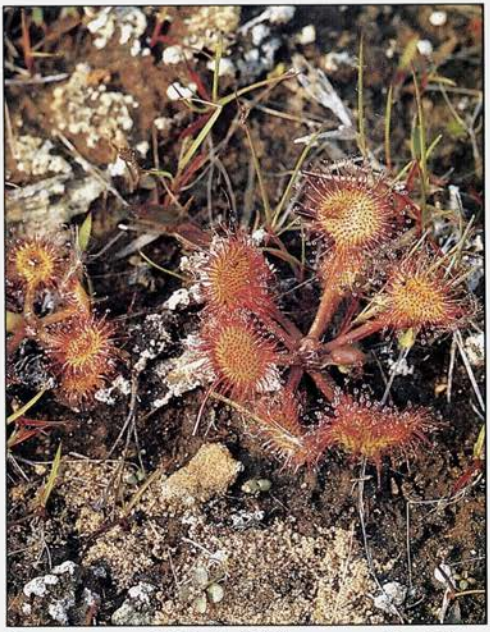
Trough display and plantings of primulas in rockwork below

photos by Wiert Nieuman

Rock wall (pp. 194-196)

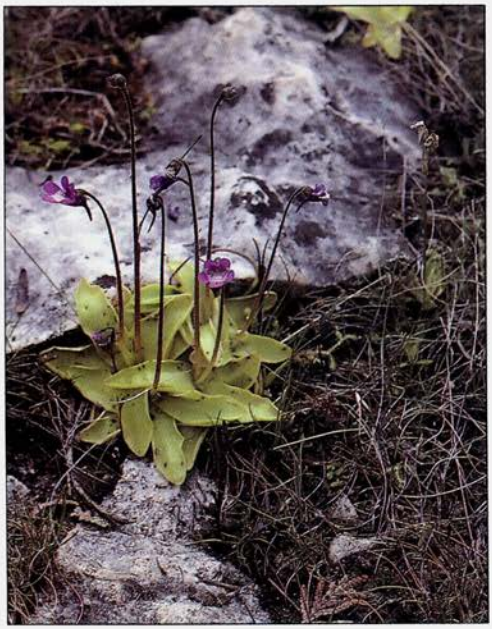


Utricularia cornuta (p. 208), *Drosera intermedia* (p. 207) Hugh H. Iltis

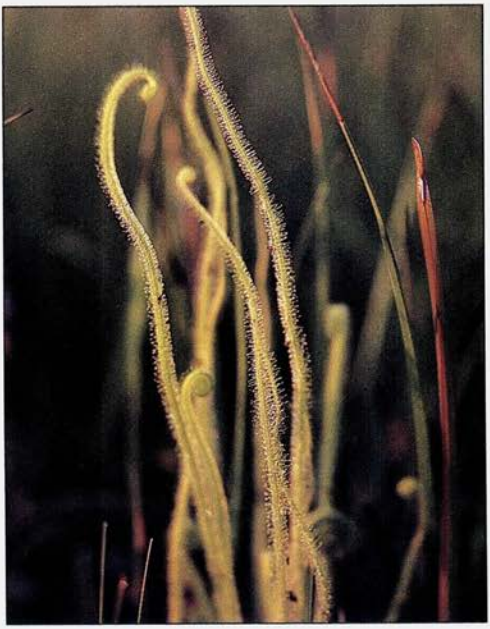


Drosera rotundifolia (p. 207) Fred Case

Pinguicula vulgaris (p. 206) Fred Case



Drosera filiformis var. *tracyi* (p. 207) Ted Cochrane



Utricularia inflata, near Pembroke, Georgia (p. 208) Ted Cochrane

Dionaea muscipula (p. 205) Fred Case

Carnivorous Plants for Bog Gardens

by Frederick W. Case, Jr.

Most hardy carnivorous plants suited to a bog garden are small, delicate herbs easily lost in other vegetation. They may best be grown in beds of sphagnum moss or on damp peat and sand, but must be kept weed free. Instructions for preparing such a sand-peat or sphagnum moss garden have appeared in the ARGS Bulletin, Vol. 50(1) Winter, 1992. If you already have a waterlily pool, an adjacent sphagnum bog is especially easy to construct. It is particularly appropriate, for fine sphagnum bog mats most frequently develop on margins of small lakes and ponds. Construction details for the siphon system that controls water levels appear on page 206. For a natural look, grow a few other bog plants with the carnivorous plants.

Perhaps the most remarkable carnivorous plant is the Venus' flytrap, *Dionaea muscipula* (photo, p. 204). Limited to a small region along the Carolina coast, it is nevertheless fully winter hardy in central Michigan. Protected by law from commercial collection in the wild, it is easily propagated by leaf cuttings and is readily available commercially as a propagated plant. The leaf resembles a vegetable beartrap, complete with jaws, teeth, and touch-sensitive triggers. The remarkable traps, often deep red in color when grown in full light, will form, function, deteriorate, and replace themselves all summer when planted in sphagnum or wet sand and peat. The flowers, borne in clusters on a fairly tall scape, are white and not showy. Venus' flytraps resent encroachment by other plants and must be kept free from shade and competition.

Although less familiar than the above species, butterworts (*Pinguicula*) can be fascinating. These plants trap insects with yellowish, greasy-sticky, "flypaper" leaves whose margins roll upward, making saucer-like containers for trapping digesting fluids. One American species, *Pinguicula vulgaris,* is fully winter hardy, but when winter approaches forms a winter bud that is poorly attached to the soil and unfortunately very attractive to rodents. The other species from America are from the southern states or Mexico and Central America. Some have large, showy leaf clusters, and most have highly attractive, violet-like blooms in

A Siphon System For the Bog Garden

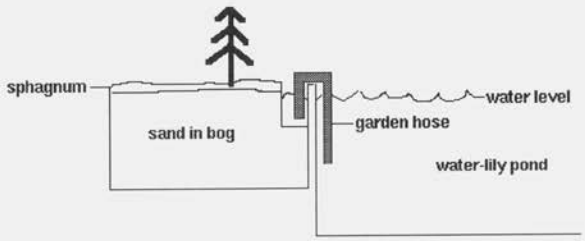


Fig. 1

In each corner closest to the pond, sink a deep plastic flower pot with many small holes in its sides and bottom and a diameter big enough to accommodate your hand easily.

Place a short length of plastic garden hose in each pot to serve as the siphon. One end of the hose is in the pot, the other in the pond.

To start the siphon, fill the hose completely with water, removing all the air bubbles. Stopper both ends (a paper towel and a thumb work well as a stopper) and place the hose in position, each end below the level of the pond's surface, before removing the stoppers. This allows the water to flow into the pot and the water in the pot and the pond to stay at the same level.

As long as the pond is at its proper water level, the bog will maintain its moisture. If the water in the pond drops, chlorinated or well water can be added to it and any detrimental substances will be sufficiently diluted so that they will not harm the sphagnum.

by Roberta Case

purple, lavender, yellow, or white. In warmer areas, any of the southern types is garden worthy. I have not tried them outdoors in Michigan.

The various species grow on wet sands, marl (a lime, peat, and muck mixture) beds, and among bog mosses. The arctic-alpine species, *P. vulgaris* (photo, p. 203), *P. alpina,* and *P. grandiflora,* frequently cling to damp, mossy rocks. They are particularly appropriate to rock garden bogs. Grow butterworts from seed on wet sand and peat, propagate from leaf cuttings on the same medium, or hope that the plant "does its thing" by producing tiny bulblets at the leaf tips which drop off and produce baby plants. This latter habit is the reason the northern and alpine butterworts typically occur in large overcrowded clusters over large areas of bog or alpine tundra.

Sundews (*Drosera* spp.) are of world-wide distribution and vary from quite large to very tiny plants. All produce leaves with sticky, protein-sensitive, glandular tentacles arranged in rosettes. Insects attracted to the leaves become entangled in the tenacious glue on the tentacles. First the tentacles, then the entire leaf enfolds the victim and digests it. A few species produce filamentous or spatulate leaves, but most produce a more or less round leaf on a short petiole. Flowers, quite small and not showy, in white or pink, appear in succession on a fairly tall, scorpioid raceme. The charm of the plants lies in the glistening "sun dew" fluid of the tentacles, the reddish tones of plants grown in strong light, and the structures related to the carnivorous habit.

Some American species of the Southeast may not be winter-hardy northward. The best for outdoor cultivation, from or tolerating acid soil habitats, include *Drosera rotundifolia, D.*

intermedia (photos, p. 203), and *D. filiformis* var. *filiformis*. Two other northern species, *D. linearis* and *D. anglica*, require a marl habitat very difficult to produce and maintain in a garden format. They also occur sparingly and enjoy legal protection in many parts of the world, including the Great Lakes region.

Like the butterworts, droseras make peculiar winter buds consisting of packets of folded, unexpanded leaves called hibernacula. While more firmly attached than those of *Pinguicula,* they can be easily displaced or eaten by rodents.

Round-leaved sundew, *Drosera rotundifolia,* a circumboreal species, is easily obtainable and easy to grow (photo, p. 203). It tolerates neutral to acid conditions readily. We grow it on wet sand and peat, and it sometimes occurs spontaneously on our sphagnum beds. A 2-3"-diameter rosette of numerous ping-pong-paddle-like leaves, with each paddle the size of a fingernail, characterizes the species. Leaf color is yellow-green to reddish-pink flushed. Rather inconspicuous, small, white flowers on a very tall stem (up to 10") bloom over a long summer season. Individual plants seem short-lived in cultivation but usually seed about.

Spatulate-leaved sundew *(Drosera intermedia)* is similar to roundleaf sundew in size, but has longer petioles slightly smaller and usually deep red, and characteristically spatulate leaves. Spatulate-leaved sundew prefers distinctly acid and very wet peats. In Nature, it nearly always grows on bog mats right at the edge of the water, in the most treacherous of spots, on exposed beds of pure peat. In the Southeast, a somewhat more vigorous form is openly aquatic, growing in the shallow waters of ditches and pond margins. Flowers occur on a 4" spike, in white or pale pink. Although said by "experts" not to occur, we have found hybrids between this and *D. rotundifolia* in several Michigan bogs. They are larger, much like *D. anglica*, but bright red and showy—in a diminutive way.

Thread-leaved sundew, *Drosera filiformis* var. *filiformis,* is a distinctive species occurring on the Coastal Plain from New Jersey to Texas. Of the two varieties, only var. *filiformis* is reliably winter-hardy in the North. This variety bears erect filamentous leaves, up to 10" high, green or reddish, and covered with sticky hairs. The quite attractive flowers occur in white or pink. The southern var. *tracyi* (photo, p. 203) usually has greenish yellow leaves. To see these plants *en masse*, glistening in the sun of a seepy hillside bog, is an experience to be remembered. This and several other species of sundew propagate easily by means of leaf cuttings or even cut pieces of leaves placed upon wet peat in a closed glass dish or jar.

Seed of the entire group, when available, can be sown on sand-peat mix or on live sphagnum in a closed jar (with light) or sown on the site in the garden. Some species' seed may require stratifying before it will germinate. The best garden effect, with all sundews and butterworts, occurs when the plants are grown in clumps or large clusters.

Known as bladderworts, species of *Utricularia* are a cosmopolitan group. Both aquatic and terrestrial species occur. Most have rather showy flowers, vaguely resembling those of snapdragons, in bright yellows, pinks, purples, whites, or combinations of these colors. The leaves of aquatic forms are small, dissected, and bristle-like. The carnivorous traps, borne among the leaves, consist of small, bladder-like sacs, each bearing a valvular lid and several hair-like triggers. Microorganisms touching these triggers are sucked into the traps and digested. Unfortunately, the north-

ern, reliably hardy aquatic species tend, in cultivation, to run to too much vegetative growth, often clogging the pond. Getting them to produce their showy flowers is another matter, and one we have not yet solved!

The terrestrial bladderworts fare better in cultivation. If grown on sodden peat in full sun, these plants *may* flower. *Utricularia cornuta* (photo, p. 203) produces 6-10" naked stems with large, yellow flowers. Entire acres of bog can be yellow with the blooms in northern Michigan. But in captivity, it seldom blooms. A small-branched species with quarter-inch flowers blooms all summer in our pitcher plant greenhouse but not outdoors. *Utricularia inflata* (photo, p. 204) would be particularly fine in a bog pond, as it produces a ring of floats looking for all the world like tire spokes, from the center of which arises a short stem of showy, large yellow blooms. For us it grows lavishly but steadfastly refuses to flower.

American Pitcher Plants

Among the most spectacular plants for the bog garden are the native American pitcher plants (Sarraceniaceae). Ten species, more or less (experts don't entirely agree), grow mostly in the southeastern United States. Surprisingly, all are completely winter-hardy in central Michigan provided that they are planted in the ground in suitable soil. Even the native *Sarracenia purpurea*, which ranges into Newfoundland and northern Canada, will not regularly survive our winter in a pot or other above-the-ground container.

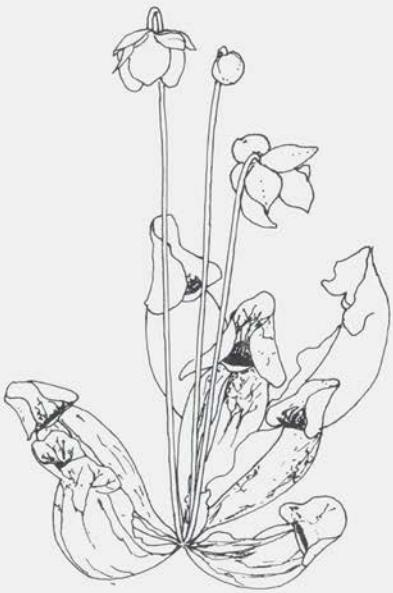
Three species of pitcher plant, *S. oreophila, S. jonesii,* and *S. alabamensis,* are listed as Federally Endangered species, and although they are easily grown and extremely hardy, ought not to be attempted unless you have a source of seed or can obtain divisions legally from cultivated plants. All others can currently be had from seed or from nurseries. It is worth the effort to ascertain that the plants you purchase truly are propagated and not collected from wild populations by unscrupulous dealers.

It is the leaves of pitcher plants that attract the most attention. The leaf is a remarkable passive insect trap and is often highly colored as well. Leaves of each species are variations on one basic theme. The leaf is hollow, cone-like, or trumpet-shaped, upright or decumbent. To one side of the leaf orifice is a complex hood which aids in attracting insect victims and which also acts in the trumpet-leaf types as a rain hood. As rain would dilute the digestive fluids within, or its weight would tip over the trap allowing insect victims to escape, the hood is channeled so as to carry the rain away and down the back of the pitcher to the ground. Glands on the hood margin secrete attracting fluids both tasty and narcotic to insects. Baited paths entice insects under the hood and down into the trap. The intoxicated insects ultimately fall into the trumpet to be digested and provide the nitrogen to the plant which it cannot obtain through its roots from bog soils. Another feature of the trap leaves is the presence, in many species and most hybrids, of large amounts of anthocyanin pigments. These, in mature, well-lighted leaves, provide the rich red and maroon colors, often with orange or yellow pigment overlays, that make these plants such spectacular garden subjects.

Pitcher plants demand constant moisture. They will not develop the best pitcher shapes nor spectacular coloration unless planted in nearly full sunlight. These are plants that do double duty, for not only do the leaves of some species and most hybrids color fantastically, but in spring the plants

produce large, colorful flowers in maroons, reds, yellows, pinks, or oranges. Most of the taller, trumpet-leafed varieties tend to be deciduous if frosted heavily—indeed *S. flava* and *S. oreophila* pitchers tend to go down in late summer, and new pitchers are not produced that season. In *S. leucophylla,* occasional pitchers appear all season, even though it, too, makes flat, non-pitchered, evergreen leaves called phyllodia that winter over. Natural clump formers, these plants will increase in size for years if happy. *Sarracenia purpurea* and *S. psittacina* are decumbent, more or less evergreen species suited to poolside, or they can even be grown on a block of peat in open water. Grown in too-shady conditions, pitchers distort and do not develop their brilliant colors. Hybrids between the species occur frequently in the wild and show characteristics of both parents. Complex hybrids, natural or man-made, can be spectacular!

Propagation of all species is easy, by rhizome division much in the manner of iris, or by seed. Fresh seed, at first waterproof, germinates slowly. I sow the seed on a very wet sand/peat mixture in a clear or white, one-gallon plastic bottle (such as restaurant relishes come in), seal the bottle with the cover, and place in a very bright, warm place. Germination can be immediate or take up to a year. Seed remains viable for two or three years at least. Old seed from which the oils have volatilized germinates rapidly. Fresh seed will not germinate until after fungi have digested the oils in the seed coat. Cold stratification sometimes enhances germination but is not absolutely required. Growth at first is slow, but once the plants make pitchers big enough to trap food, growth speeds up. Carnivorous plants generally cannot tolerate feeding at the roots: fertilizers kill! But growth can be speeded by putting diluted fertilizer into



the pitchers. Properly fed seedlings mature very rapidly.

Of the group, *S. flava, S. purpurea* var. *purpurea*, and *S. minor* are relatively easy to cultivate out-of-doors in bog or poolside gardens. *Sarracenia flava* is particularly showy, for the leaves have an overlay of soft butter-yellow over the underlying green. In general there are two types, those of the Carolinas, which tend to have dark maroon veins running the length of a tall, relatively slender pitcher and show only a little purple coloring in the throat; and the populations from western Georgia, Florida, and Alabama, which have stockier pitchers in bright yellow-green, with a broader, wavy-margined hood. These pitchers bear a brilliant, large, maroon-red patch in the throat that glistens with bait glands. Spectacular color forms, including plants with all red pitcher-tubes, occur. All *S. flava* varieties we have tried are winter hardy in central Michigan.

Showiest of all pitchers are those of *S. leucophylla,* with dark red veins in

the upper third contrasting sharply with the snowy white or pink-flushed, translucent, background tissue. Maroon-red flowers are produced on yard-high stems before or with the first spring pitchers. Individual crowns sometimes produce only one or two large pitchers at a time. Therefore, this species ought to be grown in clumps for a good show. Pitchers do not last all season, but new ones are produced after heavy rains or after the previous leaves have trapped much food. In late summer, this species, like *S. flava* and *S. oreophila,* produces spear-like, flat, evergreen winter leaves

The most unusually shaped pitcher occurs in *S. psittacina*. In this fairly small, evergreen, decumbent species, hood and tube are fused into a single structure, a bulbous trap. The opening is constructed much like a minnow trap, with a funnel-like opening into which insects crawl, but from which they cannot exit. In profile, the entire upper pitcher is reminiscent of the beak of a parrot, hence the specific epithet *psittacina,* meaning parrot-like. The entire bulbous leaf bears translucent white windows to light the trap inside.

Cobra plant, *Darlingtonia californica,* found in a limited portion of northern California and Oregon, can be startlingly dramatic in the wild, for in its native serpentine bogs, it frequently produces 30 inch-tall and remarkably "snakey" pitcher-traps. This advanced pitcher plant, instead of producing the hood as a rain hood, as do the sarracenias, has the pitcher so expanded and twisted that the orifice itself is positioned downward under the inflated back of the leaf. The hood, now hanging downward, becomes a forked tongue-like appendage covered with bait to lure the insect up and into the opening of the leaf. To further entice insects to enter, the upper leaf is full of translucent windows that admit light. Many insects will not enter dark places in daytime.

Darlingtonias are stoloniferous, often forming massive colonies following watercourses down mountainsides in the Siskiyous. But it is also at home in inter-dunal bogs along the coast. So remarkable are the colonies that *Darlingtonia* is one of a very few plants to have wayside parks set aside for it in its native area. The flowers, borne singly on tall stems, are in greens and dark maroons and only moderately showy, although large.

Cobra plants possess only moderate winter-hardiness. In our area, we cannot keep *Darlingtonia* outside, yet at one time there was a garden colony well established along a stream at Highlands, North Carolina (pers. comm.). It might prove sufficiently hardy for outdoor climates in milder coastal areas of the United States. It is sold by garden centers occasionally. Seed is treated like *Sarracenia*, but development is very slow. Still, it is uncommonly interesting and attractive. Give it a try!

Carnivorous plants hold great interest and charm: not only their flowers, but their leaves are spectacular in color and structure. They are real show-stoppers! If you are going to grow them, make a real effort. Do expect to lose a few before you get the growing techniques down pat. Take the time to prepare suitable soils, meet their light and moisture requirements, and you will be richly rewarded.

Diagram by Roberta Case; drawing by Panayoti Kelaidis

Fred Case and his wife, Roberta, garden near Saginaw, Michigan. They specialize in terrestial orchids and in plants of wild, wet places. Watch, too, for an upcoming article on trilliums, another of their passions.

Unraveling the Secret of *Primula kisoana*

by Norman C. Deno

In every garden there are plants that are special. Perhaps they remind one of an old friend. Perhaps they were a treasured gift. Perhaps they just grow well or are particularly beautiful. Perhaps there are more complex reasons, and that brings us to *Primula kisoana*.

I first saw this plant in Anita Kistler's garden, where it formed yard-wide mats by its habit of producing adventitious root buds. It was a nice plant, although not too impressive, as the flowers were an indecisive lavender, the flower spikes were somewhat scattered and mixed into the foliage, and there were only a few flowers per spike. I was still in my "salad" years, trying to grow everything, and primulas were included. Ultimately, about fifty species were flowered from seed, but it became evident that only a few were really suited to the climate in central Pennsylvania. Foremost among these was *P. kisoana*.

Primula kisoana belongs to the Cortusoides section of *Primula*, and a few words about this section may be useful. The Cortusoides primulas are divided into those with leaf veins pinnate and those with leaf veins basal and palmate. The pinnately veined group include *P. cortusoides, P. kaufmanniana,* and *P. sieboldii. Primula cortusoides* grows well enough and flowers profusely, but its short life and failure to set seed naturally (no insect pollinator) prevent it from forming self-sowing colonies. *Primula kaufmanniana* has been grown in quantity several times from seed from Russian botanical gardens, but it has always mysteriously died after producing two or three true leaves. *Primula sieboldii* is, of course, a great treasure, with its many variations. There is some natural seed set, thanks to the hummingbird clearwing moth, and there are a few self-sown seedlings. Seeds labeled *P. polyneura, P. geranifolia, P. heucherifolia,* and *P. jesoana* have been flowered from seed, but the plants usually display both pinnately and palmately veined leaves, possibly because they are a complex mixture of garden hybrids, and, in fact, they all were pretty much alike except for flower color. Some have been long-lived and have become permanent residents. This brings us back again to *P. kisoana,* which always has basally veined leaves.

The mediocre lavender form of *P. kisoana* was grown here for years, until the appearance of *Asiatic Primulas,* by Roy Green. Green states, "Takeda describes this species as one of the most beautiful, rare and interesting of the Japanese primulas. Its distribution is confined to south-western Japan and it is quite a rare plant, even in its native habitat. *Primula kisoana* has from time to time been in cultivation in Britain, but always transiently. Cultivated plants do not appear to set seed, and propagation was always uncertain. It is doubtful if the species still remains in cultivation."

These stirring and inspiring words about the most beautiful, rare, and interesting primula being out of cultivation presented a challenge, and attempts were made to set seed by hand pollination. All attempts failed. The species is self sterile, which accounts, at least in part, for the fact that *P. kisoana* seed does not appear on the seed exchange lists in recent years. The next phase of my program was to secure every clone available. An order from Japan yielded a white form and a rose form, both under the label *P. sikokiana*. A trip to Linc Foster yielded two more clones. A kind member in Connecticut sent another, but all further attempts to obtain new clones were fruitless.

With this start of at most six clones, every flower was hand pollinated using a needle. The needle was jammed down every flower tube and across the pistil of every pin-eyed flower. Miraculously, a modest amount of seed was set. However, the traditional germination methods failed to germinate a single seed. The project was about to be judged a failure due to non-viable seed, but hand pollination was continued the next year, and now the seed was subjected to a wider variety of germination techniques. To come to the final result, the only way that any seed has ever been germinated has been by collecting seed in late September (it ripens late), dry-storing the seed for six months at room temperature, sowing the seed on moist paper towels wrapped in a polyethylene bag, and placing it 8" under fluorescent lights. A timer attached to the lights is set to give 12 hours on and 12 hours off each day. There are apparently two sets of germination inhibitors in this seed; one set is destroyed by dry storage, and the second set is destroyed by light. They must be destroyed in that order. Germination takes place in two to five weeks at 70°F under the lights.

The germinated seeds are lined out in pots of surface-sterilized soil and placed in polyethylene bags. The bags are closed with a wire "twistem," but they are not absolutely sealed; a slight opening is left at the top. They are placed under fluorescent lights attached to a timer and set for 12 hours on and 12 hours off each day. The seedlings are left in the polyethylene bags for six months, during which time they require absolutely no care of any sort. The bags are not even opened at any time, although it is prudent to check them from time to time to see if water is needed. There cannot be a more carefree way to grow seedlings. After six months, the bags are gradually opened over a week or two to accustom the seedlings to lower humidity. The seedlings grow vigorously and make good size plants. They are big enough for some to bloom the next year. The seedlings are set out in fall after a rain, as they require a full winter for vigorous growth the next year.

This was the first species ever found to require dry storage and then light for germination. It was at a time when my eyes were opening to the multiplicity and complexity of photo effects in seed germination. It was a thrilling time and

a thrill to solve the secret of *P. kisoana* germination. It is amazing that freshly collected seed given the same treatment under lights fails to give a single germination, and none germinates under any combination of dark treatments. In fact, such treatments soon killed the seed.

The hand pollinations and seed germinations were repeated in the two following years, and seed from three successive years has been germinated. Always the seed germinated under the one unique set of conditions, and this has been checked with controls every year. Some of the seedlings from the first two years have now flowered. The flower colors range from white through pink to rose red. The flowers are carried in two to three whorls, with typically five flowers to a whorl. These large flower heads are already approaching *P. obconica* and *P. sinensis* in general appearance, and this resemblance is enhanced by the large, furry, palmate leaves. There is a tendency for the petals to be too narrow, and it is hoped that the breeding program will lead to broader-petaled flowers. The potential seems there for developing clones rivaling *P. obconica* with the added advantage of zone 5 hardiness.

Primula kisoana has a number of advantages from a garden standpoint. The leaves remain in good condition until frost, so that it can be used for landscaping. The plant seems ideally suited for the climate of the eastern United States, and it grows vigorously. Superior clones can be rapidly propagated by the adventitious root buds. These adventitious root buds conveniently appear 4-6" away from the parent plant, so that colonies develop that are not overcrowded at their center. The flower size, flower head size, and color variation can likely be improved by breeding, and it seems that breeding programs have not been conducted on this splendid species, probably because of a lack of understanding of the highly specific requirements for seed germination. The flower heads are held boldly upright, so that it makes a better landscape plant than many primulas.

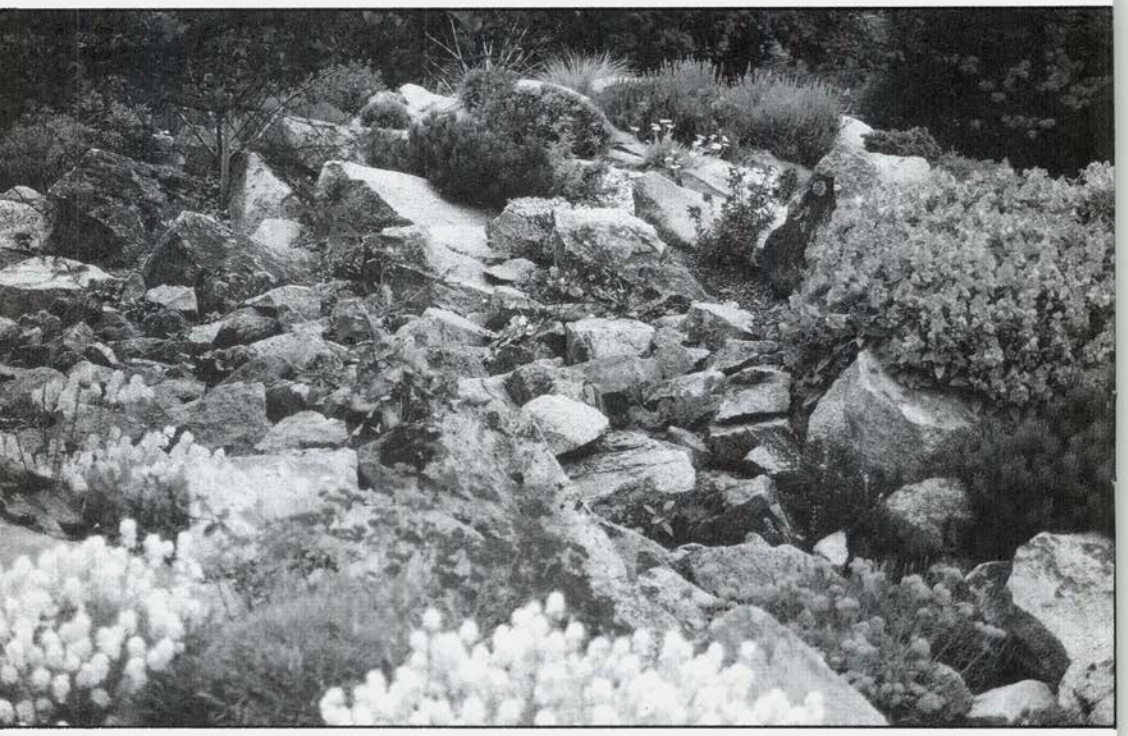
Primula kisoana does require summer shade and summer moisture, although it can recover remarkably from a wilted state with a little moisture. As more forms become available it should become one of the most popular garden primulas in the eastern US. An excellent color photograph of *P. kisoana* appeared in the *Bulletin of the American Rock Garden Society* Vol. 49:98 (1991).

Norman Deno lives and gardens near State College, Pennsylvania. Norm has recently published *Seed Germination, Theory and Practice*, available from him for $15.50. For details, see ad on page 236.

Gustafson garden

Ramona Osburn

Phyllis Gustafson



A Crevice Garden in Oregon

by Phyllis Gustafson

The first crevice garden built by Josef Halda in the United States, in Central Point, Oregon, takes some explaining. I love to tell the story to all who come to the garden. Even without having heard the tale, those who pass by know they are seeing something different from other rock gardens, and they often comment on it.

In July of 1986, when Josef Halda first visited southern Oregon, the discussion got around to the crevice gardens that had been introduced by Otakar Vydra in his talk the week before at the Interim International Rock Garden Plant Conference at Boulder, Colorado. Josef explained that he himself constructed his first crevice garden at age of 14 at his grandfather's garden. At this age he was already an enthusiastic rock gardener and corresponded and exchanged seed with Lawrence Crocker of Siskiyou Rare Plant Nursery. Josef wanted to see his collection of alpine plants outside, growing in the garden, not as pot plants on a bench in the greenhouse. To this end, he decided to build a rock formation similar to the ones on which he had observed the plants in nature.

Josef's present garden at his home in Sedlonov, Czechoslovakia, is about 20 years old. Some of the rocks are "8-man rocks" and were moved with the help of many friends. Over the years he and his wife, Jarmila, have had many other Czech rock gardeners stay at their home where they studied Josef's unique style of garden construction.

Building rock gardens is a fine art, and the more natural the garden looks, the greater the achievement. Gardens should not try merely to copy nature, which is so often chaotic and disproportionate in effect. Certainly, the rock gardens I've seen created by Josef do not look like miniatures of the High Tatras. Yet when you look at them, they look natural. The reason: They represent all that we think of as the best in nature—serenity, balance, and harmony. The crevice garden looks like a very large outcrop that has fractured into many separate rocks still lying together with just a tiny bit of soil between them.

When Josef arrived at our home, he found a large, freshly built garden at the edge of the street, wrapped around the lawn in front of the house. I had just

finished a five-year project, creating a garden that I could enjoy from the house while the town could enjoy it from the street. It is constructed from local granite and good sandy loam. The section next to the driveway was the last area built. I had just finished it before leaving for Boulder. Josef could hardly wait to get his hands on the rocks, and since I was not satisfied with the work, I was more than happy to let him tear up the rock construction I had just finished. He was to build just enough to show me how it was done; then I was to complete the garden.

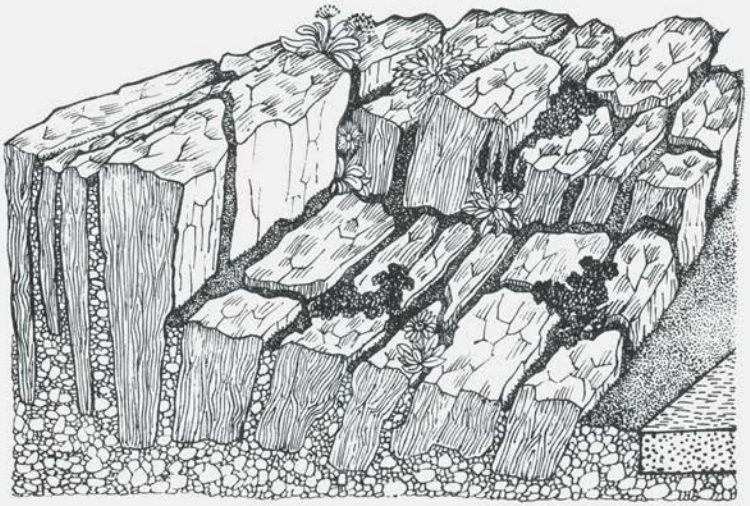
For the next three days, we worked every moment that we did not have another engagement. Many people had traveled west after the conference, and at times we had a gallery of ten or more visitors watching us. It was a chance for many from the US and elsewhere to see just how this style of rock garden is built, and how the rocks are set so that they relate to each other.

Josef started at ground level, arranging the soil in the general shape of the future garden. He set the first rock with a flat face at a 20% angle from the driveway and facing west. The rock had four even sides, almost square, and was set with the largest surface almost vertical, so that the crevices formed are straight up the slope. The top surface was then tipped on a 10° dip to the north. The whole garden has a slight dip to the north so that the plants can have some relief from the western sun. The next seven rocks were of the same general size and shape as the first and were set, one to the south of the first and then three above each of these two. The front (western) faces of these eight rocks are all on the same plane, as if set with a transit. See Figure 1. The next rock, large and flat, was set on edge at the 25° slope but about 18" higher, with a 4"-wide face looming above the first rocks. More rocks were then set above it, giving the effect of a cliff.

As he worked, Josef kept the 10° dip to the north and the 25° slope to the west, but sections of the garden are higher or lower, as if lifted by natural forces over a long period of time. As Josef says, you strive for "variety within order." As you walk around the garden, the view changes, but the consistent slope and angle of the rocks give unity to the picture.

While Josef lifted and placed rocks, I shoveled in fill soil. After a section of rocks was set, I filled the crevices with soil as he instructed. We used small sticks and rods to poke the soil in, until all the pockets were filled but not packed hard. This assures the healthy growth of plants and also makes the rock-work solid. You can stand anywhere on the garden without the rocks shifting. In fact, to best see the plants, you *should* walk on the garden. You will find that every rock is solid.

We soon ran out of material. With the help of my husband, we hauled in many loads of rocks as big as the two men could maneuver into the pickup. Luckily, we could get more rocks from an area being developed into a park not far from our house. I also got three pickup loads of 3/4" crushed rock to use as fill under some of the largest stones. The soil I originally purchased for the garden is good, sandy loam without a trace of clay. I was concerned that this soil was a little too fine in texture and would hold too much water, but Josef told me that if the crevices are a foot or more deep, there is no need to worry. After 5 years, I must agree. Where I changed the soil in the crevice to a light peat or sandy mix, I've lost plants. There is so little soil in each crevice that lighter soils are more likely to dry out at some time before the plant roots can reach the lower soil. Only after I returned the richer loam, with a small amount of added grit, a mixture with more capacity to hold moisture,



did the plants thrive. Using this heavier, fertile soil sounds contrary to most advice for growing alpines in the usual rock garden. However, in crevices the roots seek their way down along the sides of the rocks and drainage is excellent. And because there is so little soil, it must be nutrient-rich to provide enough food.

Some of the rocks we had were three-sided, and I wondered what Josef was going to do with the first one he used. He placed it at the edge of the outcrop and set it with the longest face uphill, away from the driveway and parallel to it. A large rock of irregular shape was placed with matching face parallel to it, and then two slender, triangular rocks added to form a long, narrow rectangle of one height. This combination provided a crevice at 45° from the general angle of the rest of the rocks, which adds much interest to the finished work.

The top of each crevice is filled with crushed granite and small rocks that match the large rocks in color and texture. The outer edges of the rocks forming large crevices are "mortared together" with clay soil. The clay is made into a mud and pressed into the opening between the two rocks and the line of the soil below. Long, thin rocks are then pounded into this mortar with a hammer to make a solid wall; plants can be inserted if you desire. Then the crevice is back-filled with good soil. This is topped with half an inch of crushed granite and small rocks that match the large rocks in color and texture. This smooth, hard surface retains moisture in the soil below and lets excess water run off during heavy rains. With the neck of each plant protected from the many soil pathogens present in any loam, the plants soon spread onto the rock surfaces, free of the fungi so lethal to plants native to rocky places.

When the garden is watered, little water is wasted and not much is needed. I water for about 10-15 minutes every third or fourth day in the summer. The small amount of water needed is another advantage of a crevice garden in our dry summer climate.

Limestone and sandstone are Josef's favorite rocks to work with and are most suitable for crevice gardens, but neither are available here. Luckily, his third choice is granite, the rock in his own garden. Many of the my rocks had mosses and lichens already growing on

them, which gave the garden an aged look immediately after construction. Barren rocks were washed with molasses or buttermilk or a liqueur of manure. This is enough nourishment to start the growing process of the lichen and give the rocks a weathered look.

Josef always wants to work with the largest possible rocks. He believes that one large, suitably shaped rock is better than many small ones. However, groups of small rock within a garden of large, well-placed stones add more variety. In my garden, a space was left about the width of one large rock all the way through the garden. When I inquired what was to happen there, I was told, "You will see." The last afternoon I was asked if we could go to the rock gathering site, so in 95°F weather we set off. When we got there, I was instructed to help pick up stones that were long and narrow, about 2-6" wide and 12" long. With a nice batch, we returned to the garden. These rocks were placed in "the rough scree area," the open space that had been left. Each rock is set one behind the other in shingle style, on about a 30° slope. I was instructed to place plants with a need for scree conditions in this area and to fill the holes between the rocks with sand or a mixture of sand and small rocks. I find it is a good place for plants with long, carrot-like roots. A large collection of *Lewisia cotyledon* is in one part of this scree, while some cacti occupy another. This is the only place I've ever grown *Lewisia rediviva* successfully. It is also an ideal place for *Silene hookeri , Dicentra oregana,* and some of the shrubby penstemons.

Josef has instructed everyone he has built a crevice garden for to plant seed directly in the crevices where you want it. When the plants develop, the roots go straight down along the rocks and can find their way into the narrowest crevice. Plants will thrive in this situation. If you plant even small seedlings in very narrow crevices, the roots will never be as well arranged as if they grew there. The plant will be set back while the roots try to adjust. While it is hard for those of us used to planting for an instant effect, it is far better to wait for a seedling to grow than to have plant after plant reject a site because they have had their toes cramped in a tight crevice. A plant with an established root ball, even a small one, will be very difficult to place into a crevice. The roots get broken or twisted. If they have grown straight down and are surrounded with soil, they do not dry out at some later date. In the fall or early spring, I have planted potted plants in the small openings where four rocks come together. These areas are a restful contrast to the crevices and are treated as small screes. I make a mixture of soil, grit, and water and pour it into the opening. Then, with as much soil removed as possible, I put in the plant and fill the hole half full with the mixture. I then add some water, then more soil and more water. This "mudding in" technique assures that large pockets of air are not left between the rocks where the roots will later dry out. Plants are also less likely to wilt during the first few critical days after planting.

At first, planting on the crevice garden was difficult. I had trouble visualizing the plants in place as the rock formation itself was so satisfying. When I did plant something, it was often painfully small—or it outgrew the scale of the garden in three months. Finally, small areas in the garden became plant communities, the plants in each area planted to complement each other. Another problem with the crevice garden: it faces west with a tarmac driveway below in a summer climate where temperatures often reach 100°F in the

summer and the humidity is very low. I have found that the plants that do well do very well, for example the persistently blooming *Daphne jasminea.* But many campanulas and other plants from cooler regions perish from the continued heat of our long summers. Winter losses are nil. I now feel that the trick is to find plants that originate in areas with the same long summers that we have here. The total number of hours of sun on this garden in a summer is often too much for plants that have only two or three months of warm, sunny weather at home. Root temperature could be another problem for plants grown in climates warmer than their homes, but this may not be a problem on the crevice garden. The size of the rocks used and the size of the garden both help prevent the internal temperature from becoming too extreme. In our region, cool summer nights help cool the rocks and soil before another blasting day.

Some of the plants that grow best here are from the Mediterranean, Asia, and the steppes of western North America. In the area not reached by the sprinkler system, two chasmophytes, *Eriogonum* and *Acantholimon,* make a lovely spring picture as they weave their blooms into a single mosaic of reds, yellows and pink. I grow a good, deep yellow form of *Eriogonum umbellatum* from the Siskiyou Mountains and an exotic red form of *Eriogonum umbellatum* var. *polyanthum* from Alturas, California (photo, p. 223). Other eriogonums now growing in the crevice garden include *E. wrightii* ssp. *subscaposum*, *E. sphaerocephalum,* and the very easy form of *E. ovalifolium* from Mt. Eddy, California. The last has white-felted, spoon-shaped leaves that overlap in flat rosettes no more that three quarters of an inch across. It makes solid mats which slowly expand. *Eriogonum ovalifolium* and *E. umbellatum* are increased by cuttings. The others have been grown from seed generously given to me by friends. At present I only grow *Acantholimon glumaceum, A. venustum, A. lycopodioides*, and an unknown species introduced with last year's seed from Ercias Dag. An occasional seedling does appear, and I have found that they must stay wherever they may come up. In this garden, I have not yet moved one successfully, although I have succeeded in another garden where I could dig up a large area.

Two more genera that thrive on the crevice garden are *Helianthemum* and *Origanum.* I have chosen only small *Helianthemum nummularium* hybrids, colorful in hot gardens. They include, 'Bright Spot', 'Amy Barring', 'Orange Surprise', and 'Fire Engine', the last with tiny double red flowers on a 3", wiry shrub. None of these is over 4" high. The spread can get larger than I want, but a little pruning keeps them in check. These are the smallest and best blooming cultivars I have found of the large number of hybrids available. *Helianthemum oelandicum ssp. alpestre var. serpyllifolium* is a neat, fine-stemmed, 2" shrub, with tiny, dark green leaves and a plethora of tiny, bright yellow flowers. Seed of *Helianthemum apenninum* var. *roseum* was collected by Josef and sent for me to try. It blooms for the longest period of the lot, and the flowers are a fantastic, clear, soft pink. As Josef said when he saw it, "It is acceptable." The plant does need a good, hard shearing in late autumn, and then it is ready to perform for the next spring, summer, and fall. Origanums are quite popular here on the West Coast, and with good reason. They bloom in that late summer season when an extension of color in the garden is most appreciated. They should be grown from wild collected seed or, better yet, cuttings of known plants, as they hybridize easily.

Origanum amanum is the smallest of the tribe, with its 2-3" stems and tiny, shiny leaves. It has long-tubed, violet-pink flowers and blooms in profusion without the usual bracts. This herbaceous plant needs to be dug and divided every third year or so to keep it in good health. While *O. rotundifolium* has large, round, lime-green bracts, those of its magnificent hybrid 'Kent Beauty' have a deep pink blush. *Origanum scabrum* (*O. pulchrum*) has long, light rose, hanging inflorescences that remind one of shrimp. These make a wonderful pattern hanging from near the top of an almost vertical wall facing east. The small shrub *O. microphyllum* was planted near the driveway and seems to enjoy the reflected heat. The pink flowers on this are small and bractless but appear in abundance near the tops of the fine, wiry stems dressed with tiny, gray-green leaves. My favorite plant on the crevice garden is *O. tournefortii,* which does not start blooming until late September. The green leaves covered with long hairs feel like an angora sweater. The stiff stems stand straight for about 8", and long strings of burgundy bracts hang down with lavender flowers peaking out between them. The colorful bracts hold through frost or rain for two months or more. This year, it still looked nice on Christmas Day.

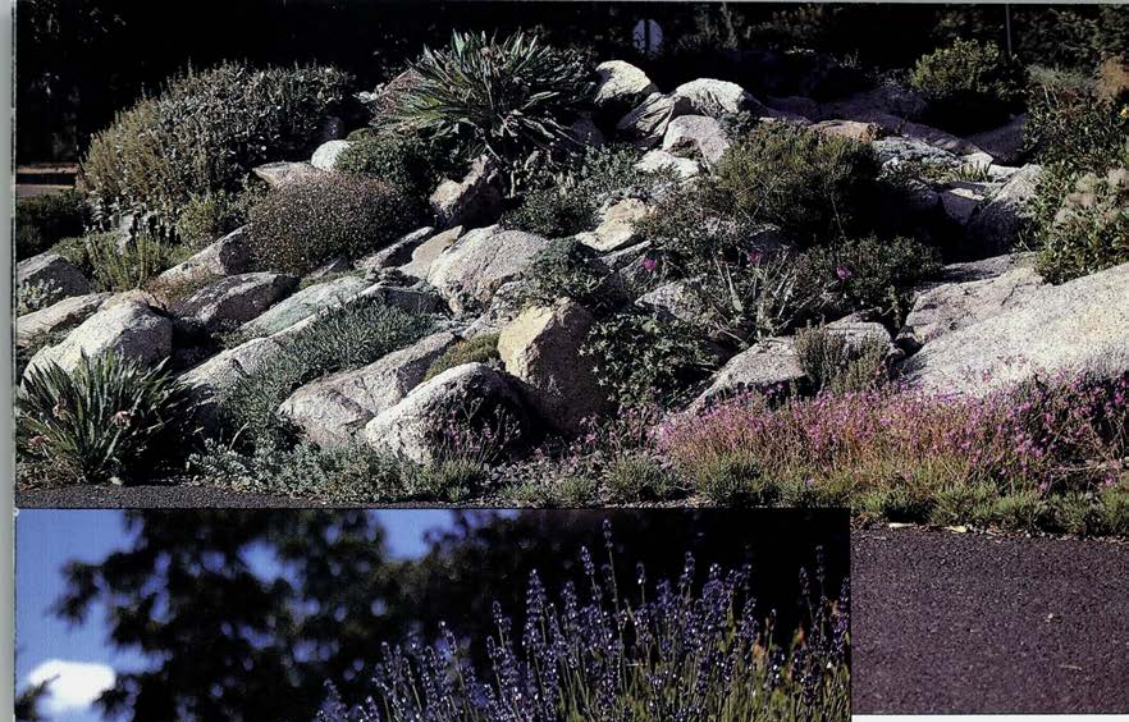
Plants now thriving in the crevice garden include townsendias, teucriums, and tiny *Talinum okanoganense,* which seeds around. Asperulas prosper with only a pane of glass over them in the rainy season. *Verbascum dumulosum,* at a yard across, has gotten so big and grows so fast that I have to prune it more than any other plant. Along with *V.* 'Letitia' and X *Celsioverbascum* 'Golden Wings', it gives the garden long periods of clear yellow flowers in the spring and again in the fall. Enjoying the heat of the west side of the garden are three ferns: *Pellaea brachyptera,* which has filled the length of a 18" crevice; *Cheilanthes tomentosa* with 8", white-woolly fronds; and *C. fendleri,* of the same size, but with greener fronds. To my joy, near the bottom of the very large rocks facing north, where no sun ever hits, two good size plants of *Ramonda myconi* bloom each spring.

I seem to be a continuous plant collector and will try any plant that comes my way. This does not give the garden a calm, serene sense of Order but rather of the Chaotic Theory, with your attention jumping from one point to another. To slow down the confusion and unify the garden, large pads of *Artemisia assoana* are being encouraged all across the west side of the rock work. This is a challenge; the artemisia seems to die out in the center and move at will into other cervices. New cuttings are continually rooted and I hope soon to have enough white areas among the gray rocks to entwine the whole.

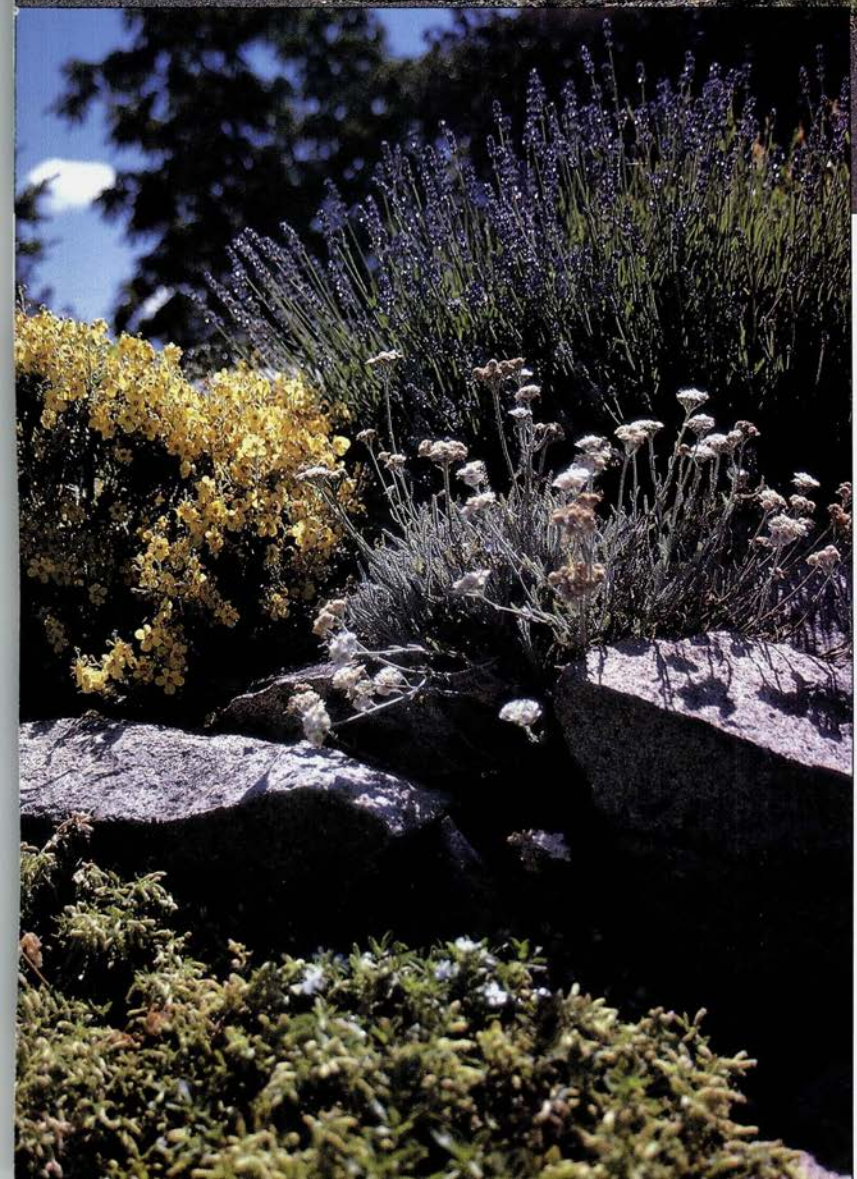
A friend from the far north once said, "You do not have a classic alpine garden but a Mediterranean rock garden." I was at first offended but upon refection decided that she was not only right, but that I should be delighted. I grow what will grow in this garden at this latitude and altitude in our semi-desert climate. The selection of plants from the steppe areas of the world is wide, and the combinations endless. It shall be a joy for many years to come, trying all the possibilities on this beautifully built crevice garden.

Drawings by Jarmila Haldova

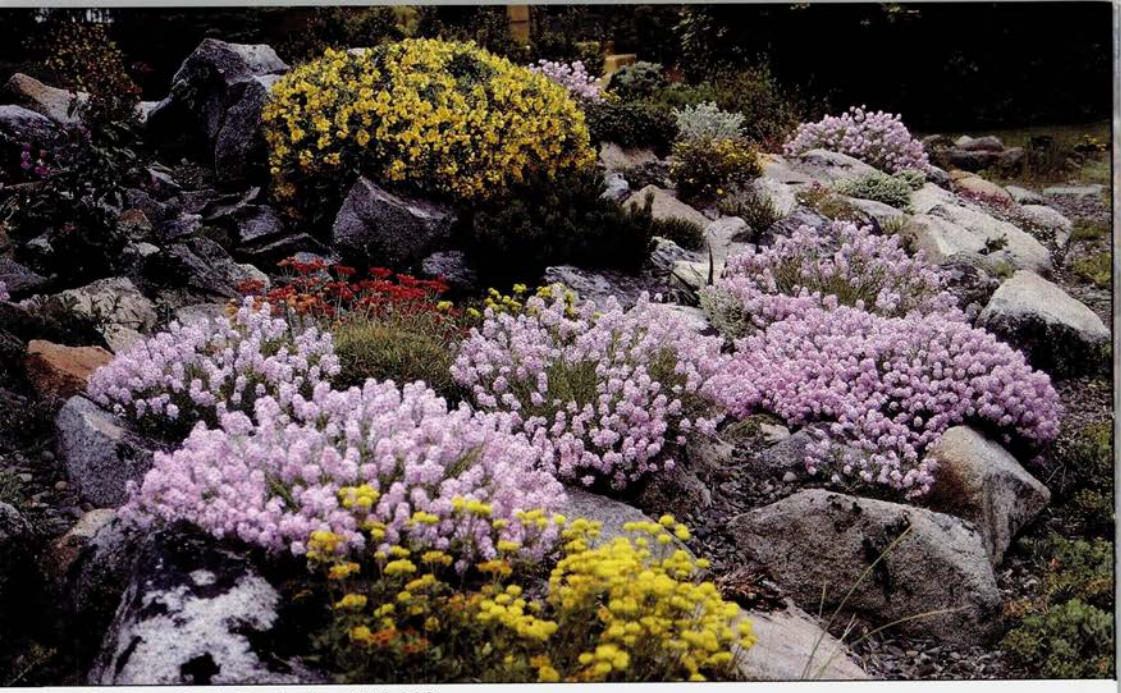
Phyllis Gustafson got a start in rock gardening 20 years ago with five plants given her by Lawrence Crocker. Three of these are mature, lovely plants today in her garden in Central Point, Oregon.



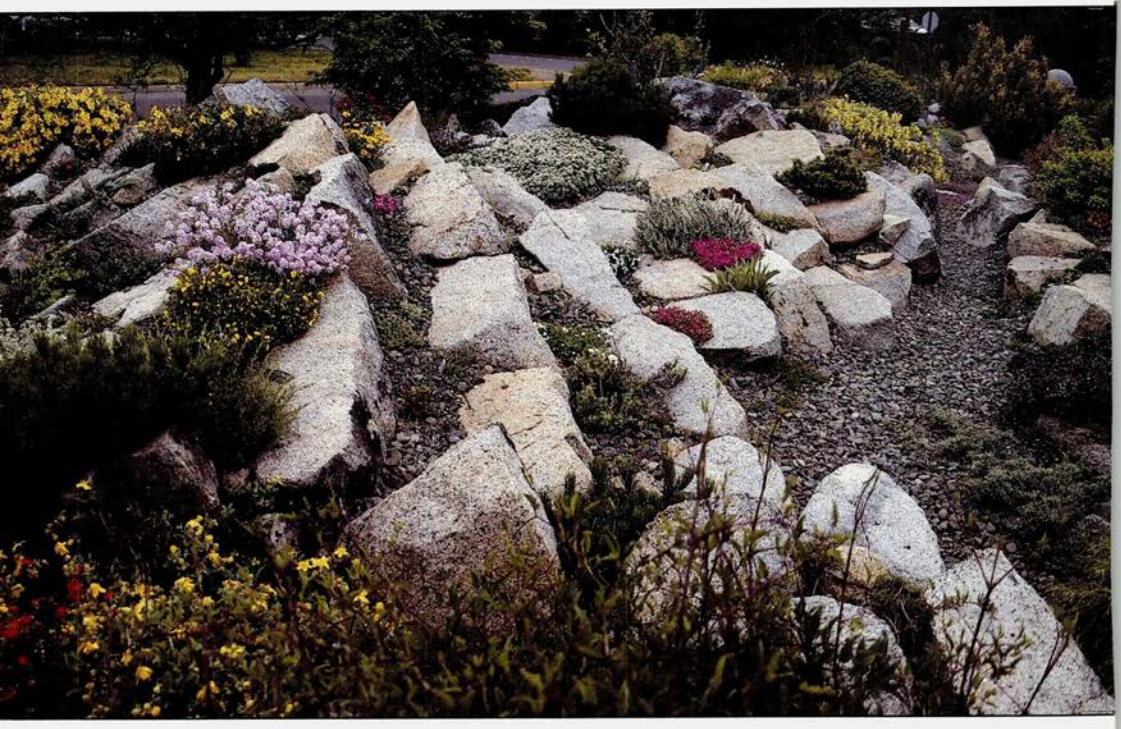
View of Gustafson garden from driveway (pp. 215-220)



Phyllis Gustafson

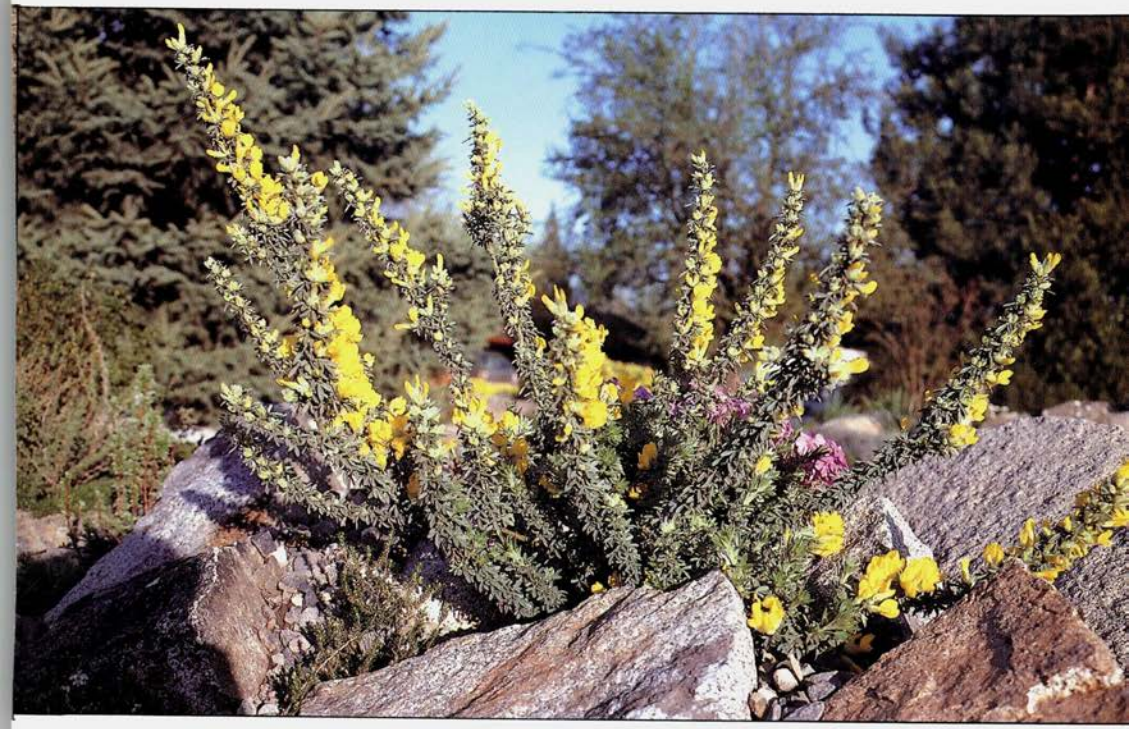


Gustafson Rock Garden (pp. 215-220)



Eriogonum umbellatum var. *polyanthum* 'Alturas Red' (p. 219) photos by Phyllis Gustafson

Chamaecytisus eriocarpus (C. *absinthioides*)



Lilium tenuifolium Norman Deno

Lilium pumilum

The Mystery of *Lilium tenuifolium*

by Norman C. Deno

It is well to state immediately that the two lilies are two distinct and separate species, despite the fact that both *Index Kewensis* and *Hortus III* treat *L. tenuifolium* as a synonym of *L. pumilum*. The purpose of this article is both to unravel the mystery surrounding these two lilies and to bring to the attention of ARGS members the beauty and rock garden potential of *L. tenuifolium*. The impetus for this article was the recent offering by Josef Halda of seeds of the true *L. tenuifolium*, which he points out is not *L. pumilum*. This is the first time that seed of *L. tenuifolium* has been offered in years, and even years ago when the seed was available for a short time, it was listed under a false name, as we shall see. Before attempting to unravel the mystery and confusion, it is well to describe the two lilies, paying particular attention to their similarities and differences.

Both species have long, linear leaves with no appreciable broadening anywhere along their length. The leaves are concentrated on the middle half of the stem, with a relatively bare stalk near the ground and no leaves in the inflorescence. Both have orange-red flowers of identical color, and both have white bulbs with relatively few scales. Both species are native to eastern Siberia, but they do have different distributions in nature which for the most part do not overlap.

The differences between the two species lie in the flowers, the time of flowering, the time the seed matures, and the distribution in nature. The flowers of *L. tenuifolium* are nearly flat, with only the outer third of each tepal recurved slightly, whereas the flowers of *L. pumilum* are tightly recurved. The flowers of *L. tenuifolium* face outwards horizontally, whereas the flowers of *L. pumilum* face directly downwards. These two characters make the flowers of *L. tenuifolium* appear larger. *Lilium tenuifolium* is dwarfer in stature with 2' being about the maximum height and ten flowers being about the maximum per stem, whereas *L. pumilum* at its most vigorous can be twice as tall with twice the number of flowers. The flowers of *L. tenuifolium* are asymmetric, with the lowest tepal separated from the other five by a wider space on each side, whereas the flowers of *L. pumilum* are radially symmetric. This asymmetric character of the flowers of *L. tenuifolium* is found in only one other lily in my experience, and that is *L. tsingtauense*. *Lilium tenuifoli-*

um flowers at the end of June here, and this is three weeks later than *L. pumilum*. The seed matures in late September, fully a month after the seed of *L. pumilum* ripens.

Lilium tenuifolium is perhaps the best of all lilies for the rock garden. However, several problems prevent it from achieving widespread popularity. Like *L. pumilum*, both the bulbs and the capsules are eaten by chipmunks, and the lower stature of *L. tenuifolium* makes it more vulnerable to fruit predation. Thus, the abundance of chipmunks in eastern North America makes it difficult to maintain stands of *L. tenuifolium*. The flowers do not last long, each flower remaining open for about four days. Individual bulbs are not long-lived and rarely does one bloom more than three years before disappearing, presumably from either basal rot, mosaic virus, or chipmunks. This means that bulbs must be constantly raised from seed. Natural insect pollinators are not present here, so that the flowers must be hand-pollinated to set seed. For such a small lily, the seedlings do not develop rapidly, and it is three to four years before the first flower can be expected from seed. Finally, the confusion with *L. pumilum* inhibits the recognition of *L. tenuifolium*.

The following is my attempt to reconstruct the complex history of *Lilium tenuifolium*. In 1812, *Les Liliacees* was published. This contained 486 watercolor paintings by Pierre-Joseph Redoute, who was perhaps the greatest painter of plants of all time. The paintings were made in the period 1802-1812 and were of plants blooming in the royal gardens of France. One of the paintings (no. 192) was named by de Candolle as *Lilium pumilum* and given a botanical description. The painting shows a plant with a single flower. Although the plant was undoubtedly painted with great accuracy, it was blooming for the first time with a single flower. The plant illustrated is an immature specimen and is not typical of a mature plant of either *L. tenuifolium* or *L. pumilum*. In particular, the flower portrayed is somewhat intermediate between those typical of the two species. These paintings were not generally available until 1982, when Michael Joseph published a reprint of 109 of the paintings from *Les Liliacees* in London under the title *Lilies and Related Flowers*. The text, by Brian Matthews, titles the plant *L. pumilum*, and the description applies to that species. In 1986, a book entitled *A Redoute Treasury* was published by the Wellfleet Press in the United States, which reproduced 468 of the paintings from Redoute's originals (18 had been lost over the years). Curiously, the text, written by Peter and Frances Mallary, retitles the painting *Lilium tenuifolium* with a subtitle *Lilium pumilum*. Incidentally, a copy of this was sold in a two-minute auction at Sotheby's for $5.5 million, the highest price ever paid for a book in America and the tenth highest price ever paid for a work of art.

Although *L. pumilum* became a common garden plant over the years, *L. tenuifolium* remained unknown until about 60 years ago. The story is this. The early years of this century were the golden years of gardening. This was the time when the discoveries of Forrest, Farrer, and others were being sent back in quantity, and everyone was eager to try out new things. There was much importation of bulbs from Asia, and bulbs of *L. pumilum* were often collected and exported to the US. Sometime in the 1920s or '30s, *L. tenuifolium* appeared in plantings of *L. pumilum*. It was assumed to be a form or hybrid of *L. pumilum* and was named *L. pumilum* 'Red Star'.

Seed of *Lilium* 'Red Star' soon began appearing in the seed exchange of the

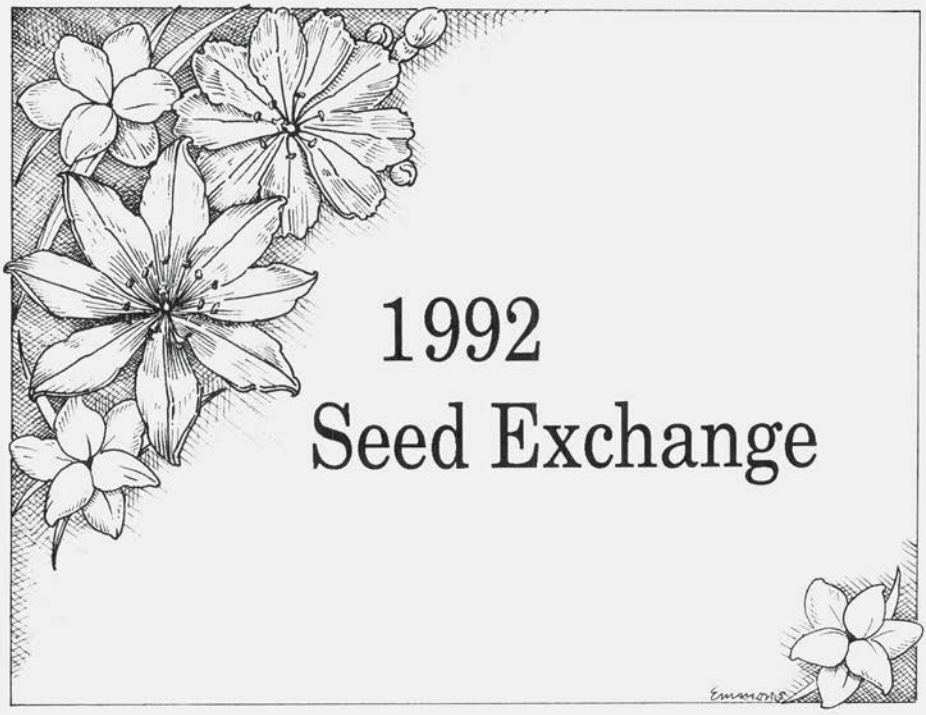
North American Lily Society, and many lily enthusiasts grew this charming plant. Much of the seed came from a Clara Bangs in Nebraska. She wrote a note stating that 'Red Star' was a hybrid between *L. concolor* and *L. pumilum*. This was reasonable in that both were dwarf lilies, and both bloomed at the same time. However, two things puzzled me about this lily. One was that it had none of the characteristics of *L. concolor*. Secondly, it bred absolutely true, showing little, if any, variation. I came to the conclusion that *L. pumilum* 'Red Star' was in fact an unnamed species. Over the years, this lily seemed to have died out in cultivation, and at present I do not know of anyone else growing *L.* 'Red Star'. At least, it no longer appears in the seed exchange lists.

Other growers were also suspicious that *L.* 'Red Star' was not a *L. pumilum* x *L. concolor* hybrid and set out to make deliberate crosses of *L. concolor* and *L. pumilum*. A number of articles were published in the *Bulletin of the North American Lily Society.* All found that the crosses differed markedly from *L.* 'Red Star', and there was unanimous agreement that *L.* 'Red Star' was *not* derived from *L. pumilum* x *L. concolor*. Curiously, none of these articles went on to make the obvious conclusion that *L.* 'Red Star' was a species different from *L. pumilum*.

The matter came to a head three years ago when Josef Halda came up for a visit with several members of the Delaware Valley Group of the ARGS. A most pleasant day followed, which we'll always remember for Josef's sitting by our trout stream, saying "Paradisus." As is the custom of such visits, the evening was devoted to showing slides. Knowing Josef Halda's wide knowledge and extensive field experience in Siberia, I deliberately put on a slide of *Lilium* 'Red Star' and asked him if he knew what it was. He became much animated, jumped up, and said, "That is *Lilium tenuifolium*." ARGS members who know the two of us can imagine the excited conversation that followed. The gist of it was that Josef had seen both *L. pumilum* and *L. tenuifolium* in the wild, knew them well, and was cognizant of their different distributions in the wilds of Siberia.

As a result of our conversations, I went to the library for a thorough search. Two groups of articles were relevant to the mystery. The first included the aforementioned articles in the *Bulletin of the American Lily Society* on the deliberate crosses of *L. pumilum* with *L. concolor*. The second group consisted of two articles in the *Bot. Zhur.* (in Russian with an English summary). One describes *L. pumilum* with maps of its distribution, and the second does the same for *L. tenuifolium,* thus clearly defining them as separate species. Unfortunately, the article on *L. tenuifolium* was in a volume that was not in the Pennsylvania State College library. To add to the confusion, Volume III of *Flora USSR.* covers *Lilium* but describes only *L. tenuifolium*.

Obviously, Josef Halda and certain Russian botanists could write a more definitive article. I have continued to grow *L. tenuifolium* for 40 years and through at least seven generations. It breeds absolutely true with little discernable variation. It is not known whether it would cross with *L. pumilum*. Such a cross would have to be made with deliberately stored pollen of *L. pumilum,* because *L. tenuifolium* flowers three weeks later. It is really rather a bother to keep *L. tenuifolium* going because of its short life and the chipmunks. With the seed becoming available in Josef Halda's list, and the potential for seed to come from my own plantings (it germinates immediately at 70°F), perhaps you would like to try this charming and beautiful dwarf red lily, which has such an interesting history and whose recognition by *Index Kewensis* is still to come.



1. *Seed will be accepted only until November 1, 1992.* Late-ripening seed will be accepted after that date if an alphabetical listing has been received before Nov. 1. Overseas members, please try to mail before October 15.

2. *Any amount of seed is appreciated. To receive donor privileges, submit a minimum of 5 different kinds of seed suitable for rock gardens.* Donors receive 10 packets of seed in addition to their basic orders.

3. *Send clean, dry seed as early as possible.* As seed continues to ripen, send several mailings. After your first donation, you will be issued a donor number. Please include this number with subsequent mailing. Do not use last year's number.

4. *Use paper envelopes no larger than 2" by 4" (5cm x 10cm).* One envelope this size filled with seed is likely to be sufficient for our requirements. As few as five seeds of a variety will be accepted if the seed is very rare. Use separate envelopes for each kind of seed.

5. *Mark each envelope clearly and legibly with the botanical name in BLOCK CAPITAL letters.* If collected in the wild, please state the location where collected, altitude, etc. If only the genus name is given, please include a brief description, such as height and flower color. Please make every effort to verify the accuracy of the names.

6. *Make an alphabetical listing of the seed species sent.* If handwritten,

use block capitals; typewritten lists are easier for us. Please submit the list on standard 8 1/2" by 11" paper with your name and address clearly printed on each sheet.

7. *Group envelopes alphabetically, checking to be sure that the seed envelopes sent match the list.* Secure the envelopes with a rubber band and enclose in a padded mailing envelope with the list of seeds.

8. *Be sure your name and address are clearly written on the outside of the mailing envelope. Ask the postmaster to hand cancel the envelope.*

9. *All members of ARGS will receive a seed list. Thank you for helping us to make this event an overwhelming success!*

Mail Seed Early to:

Pat and John Bender
Directors, 1992-93 ARGS Seed Exchange
4123 NE 186th Street
Seattle, WA 98155
USA

ARGS Coming Events

1993 Eastern Study Weekend

The Watnong Chapter of the American Rock Garden Society
Presents

OBSESSION

Hilton Gateway, Newark, NJ January 29, 30 and 31, 1993

FRIDAY, JANUARY 29

GEOFFREY CHARLESWORTH AND NORMAN SINGER:
THE SEEDS OF OBSESSION

SATURDAY, JANUARY 30

JAMES WADDICK PhD is inspired by *IRIS*
MARK MCDONOUGH adores *ALLIUM*
BARRY YINGER embraces *ASARUM*
EDITH EDDLEMAN is bullish on *BULBS*
RICHARD WEAVER PhD elevates *EPIMEDIUM*
NANCY GOODWIN celebrates *CYCLAMEN*
HOWARD PFEIFER PhD: *OBSESSION'S HARVEST*

SUNDAY, JANUARY 31

RICHARD WEAVER PhD loves the*LESSER KNOWN LILIACEAE*
GWEN KELAIDIS is batty about *BUNS FOR BERMS*

BRING YOUR OBSESSION TO OUR SESSION

A • R • G • S BOOKSTORE

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The Alpine House*, Robert Rolfe	$22.00
Alpines*, W. Ingwersen	$45.00
Alpines in the Open Garden - NEW, Jack Elliott	$23.00
Alpine Wildflowers of the Rocky Mountains*, J. Duft & R. Moseley	$7.00
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Bulbs - NEW, by John Bryan	$80.00
Botany for Gardeners*, by Brian Capon	$23.00
Campanulas*, by Peter Lewis & Margaret Lynch	$22.00
Cuttings from a Rock Garden*, by H. Lincoln Foster & L.L. Foster	$23.00
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Back issues of the ARGS Bulletin are available. Following items are postage paid: Decal—ARGS Dodedcatheon, $1.25; "Seeds-3 methods," $2.50; "Troughs-construction and plants," $3.50; Library Binders, $6.00, $7.00 overseas. This is only a partial listing; most titles listed in the last issue are still available, as are many additional books.

Please mail inquiries and orders to:

Ken Nitschke (517) 835-4325
American Rock Garden Society Bookstore
1071 South Acaule Lane, Midland, MI 48640 USA

Please print name and address clearly. Your zip code, postal code, and country must be included. Allow 8-12 weeks for overseas shipment. All orders must be prepaid in US dollars by check on US bank or by int'l. money order. No credit cards. Add postage and handling:

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