

Bulletin of the  
American Rock Garden Society



Volume 49 Number 4

Fall 1991

Cover: *Cirsium acaule* \_\_\_\_\_

Watercolor by Vickie Danielsen of Englewood, Colorado

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## Features

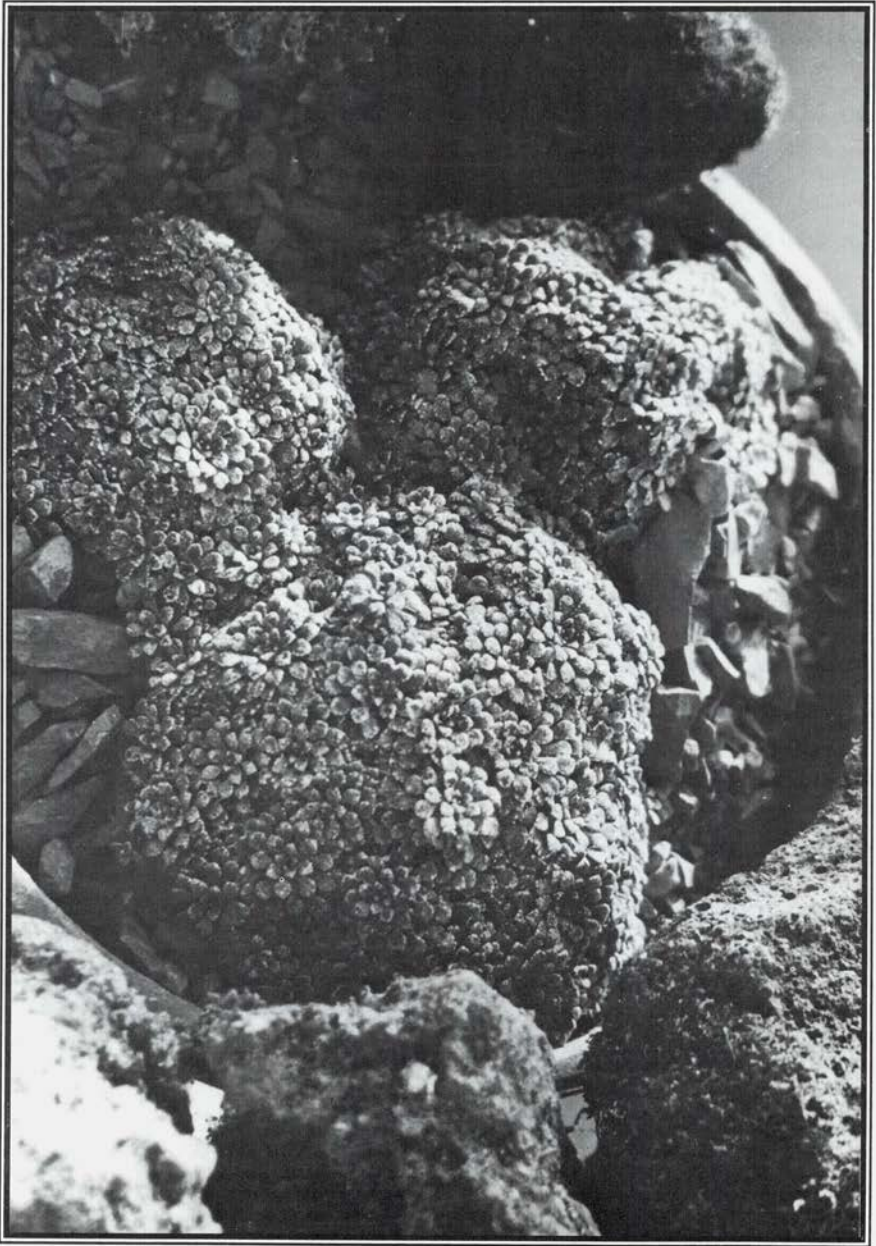
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*Saxifraga cochlearis* 'Minor'

# Silver Saxifrages

by Rex Murfitt

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I grow a dozen or so varieties of silver saxifrages grouped around some trough gardens. It is a pleasant planting of mixed sizes, some plants forming large, spreading clumps and others miniature carpets. Several plants have bold rosettes as much as 3" across while others produce masses of small rosettes less than half an inch in width. Together these plants make an interesting pattern, a lovely combination of shades of green and gray highlighted by a few golden clumps. Most of this large group of silver saxifrages are representatives of a few species, and include geographic forms, varieties, and natural and man-made hybrids.

The definitive definition of the group lies in its botanical classification within the genus *Saxifraga*. In 1916 the species were described under the section *Euaizoonia*—a Latin word which means everliving. Now the section that includes all the species discussed here is called Section *Ligulatae* Haworth (Section *Aizoonia* Tausch). The plants are described as forming leaf rosettes, usually so crowded together that they form cushions or thick mats. The leaves are fleshy or

leathery with usually conspicuous silvery incrustation. The concentration and arrangement of tiny beads of calcium carbonate along the leaf margins enhance the underlying leaf color, giving the whole plant a silvery look. This group may also be called incrustated saxifrages.

Why should we grow these saxifrages? Why do they have such appeal to gardeners? Without much doubt it is the silver color that first attracts us. The intriguing makeup of the individual rosettes and above all the symmetrical regularity appeal to some love of neatness and form found within rock gardeners. Furthermore, there is a wide variety of leaf shape and size, from short and broad to long and narrow, and some leaves curve inward, while others curve gracefully outward.

This group offers a great range of plants that will add variety and interest to the garden. Their symmetry and quiet beauty fit into any scheme, whether large or small. About mid-May, almost as a bonus, flower spikes begin to elongate from the center of the mature rosettes, arching out into panicles of chalk-white flowers often carried

on mahogany-red stems. One variety offers rose-red flowers, another delicate pink, a couple more lovely yellow flowers. Most species have flower stems in the 6-12" range although some species have spikes to 2' tall.

Silver saxifrages are not the easiest plants to grow in all garden climates. I am always dismayed when I hear them referred to as "lovely succulents." The leaves are rosulate and somewhat fleshy, but that is as far as the resemblance to sedums, sempervivums, and dudleyas goes. Whatever you do, get rid of any ideas that they respond well to droughty, sunny growing conditions. They demand far more skill and care than the average succulent. Even in favored Victoria, we have to disregard some of the cultural advice to be found in European books, particularly where they recommend sunny, dry banks and crevices. When grown under these conditions, even with several inches of prepared soil, the long, hot, sunny days of midsummer on our continent will damage them. Try to find spots where there will be some relief for at least half the day. A place that gets relatively cool morning sun is ideal. Prepare the spot with a good 6" of gritty soil enriched with a generous amount of leafmold and peatmoss, and after planting top dress with a few inches of stone chips to help keep the soil cool and moist.

Often summer produces more stress for these plants than any other season. Where I have a plant happily settled and growing attractively into its place in the rock garden, rather than move it and spoil its potential, I resort to shading with a screen of twigs, enough to give some shade during the hottest spells of summer.

There is a belief that silver saxifrages demand copious quantities of lime added to the soil for successful cultivation. I have heard it said also that lime will enhance the silver incrustation of

the leaves. Neither is true. Many lovely species originate from mountain ranges that are anything but limestone. Take *Saxifraga cotyledon*, for example. It comes from lime-free mountains, and some writers say that lime must not be used near it. The presence of some lime in the soil will not kill it, but do not go out of your way to add extra.

The only species that does totally dislike lime in any form is the rare *S. florulenta*, which grows in cool shade in the Maritime Alps. It is in its own separate subsection of the incrustated saxifrages, the *Florulentae*. This species is by no means silver and lacks any incrustation on its regularly arranged leaves. Reginald Farrer called this the "Ancient King" and goes on to write one of his glowing passages about it. Photographs of the large, flat, dark green rosettes can be found in older books and in the journals of the Alpine Garden Society. If ever you should have the opportunity to get a little seed, grab it. You can have several years of challenge and fun trying to produce the large, 6"-wide, monocarpic rosettes.

Looking through catalogs and books that mention silver saxifrages, one is soon inundated with lists of names, but to a large extent that is all they are—tantalizing names on paper. When samples of listed varieties from several sources are grown side by side, it is readily seen that many display such minute differences that they hardly warrant separate names. Furthermore, should you order one specific named variety from several suppliers, chances are you will receive as many totally different plants. This may not be all bad, providing you can identify what you have received.

All is not totally lost among this welter of names, as some order can be brought with a little study of the species and varieties described under the Section *Ligulatae*. Many of our plants

are from four species, *Saxifraga paniculata* (*S. aizoon*), *S. callosa* (*S. lingulata*), *S. cochlearis*, and *S. cotyledon*. There have been many changes in nomenclature in this group in recent years; in older books look for the names here given in parentheses. Each of these four species has features that will help in recognizing their differences.

Varieties and forms of *S. cochlearis* have no marginal teeth along their beautiful silvery leaves. Closer examination will show that these leaves also expand at the tip and curl back, so they remind one of tiny spoons. The flowers are chalk-white and borne on light, arching stems of mahogany-red.

I think *Saxifraga callosa* and its forms embody the very essence of incrustated saxifrage beauty. It forms spidery rosettes, irregular in outline, to 2" across. The leaves are long and narrow, blue-green, and richly incrustated. They are toothless along the margins and become spatulate at the tips. Younger leaves growing up through the mature ones give an uneven appearance that is very attractive. This species will have pure white flowers carried in gracefully arching plumes, at least 12", sometimes nearly 16". It cries out to be planted on cliff-like rocks. In the late 1940s several forms and superior selected forms were available, and what a joy they were.

*Saxifraga cotyledon*, although a very variable species, is quickly recognized by its broad, strap-like leaves beset with sharp, marginal serrations, like teeth of a saw outlined in silver. It is very distinct from the two species above. The rosette is usually quite robust and up to 9" across in some forms.

Regretfully, *S. paniculata* itself cannot be easily summarized as it is so diverse due to its wide distribution. This species may be found in arctic regions, Labrador, Ontario, Quebec, Greenland, Iceland, Norway, and the mountains of

south and central Europe. Many of its forms have been grown for many years and are still worth growing today. The size of different kinds will vary enormously from minute, silvery carpets to bold domes. Generally the leaves are heavily serrated and incrustated. In some forms, the leaves curve inward, producing an attractive, globular-shaped rosette. There is a range of greens through silvers and even a couple of quite golden ones. The most consistent feature is the relatively inferior flower color, from off-white to creamy yellow. It is only fair to acknowledge that these hues blend well with the pure white of other species, setting them off to great effect. This is true also of the red-spotted, pink flowers of *S. paniculata* 'Rosea' and the pale yellow ones of *S. paniculata* 'Lutea'. Both are worth having and easily recognized at flowering time.

I've mentioned the Ancient King, and here is a good place to pay homage to the most distinct Queen of Saxifrages, *S. longifolia*. There is a bit of confusion between the true species and a hybrid called *S. 'Tumbling Waters'*. Both are well worth growing and take several years to grow to the enormous silver rosettes we see pictured. This is good, because we have a few years to enjoy them before they flower. In both plants, rosettes die after flowering. 'Tumbling Waters' will produce offset shoots, a trait inherited from its perennial parent *S. callosa* var. *lantoscana* (now included in var. *australis*). *Saxifraga longifolia* is the other parent.

Most growers on this continent keep *Saxifraga longifolia* and 'Tumbling Waters' as pot plants, as it is easier to control cultural conditions. Start with offshoots and root in sand. Pot off into 4" pots and gradually keep potting into larger pots as the roots fill the pot. Guard against too much heat and



*Saxifraga* 'Tumbling Waters'

humid damp. It is well to spray with fungicide periodically as the plants are susceptible to some fungal attacks.

There are two tiny species that would grace any alpine collection, no matter how difficult to obtain. The minute *S. caesia* is a perfect miniature replica of a typical silver saxifrage, each tiny leaf bearing lime pits. The leaves form perfect rosettes no more than an eighth of an inch across. It is so close and compact that for many years it was classed as one of the cushion saxifrages of the Kabshia section. It was switched back to the silver saxifrages by Kohlein in 1984; Webb and Gornall (1989) consider it to belong to Section Porphyron on the basis of chromosome number and several other considerations. If you are lucky enough to have a plant and get it to flowering size,

you will see that the upright stems bear several flowers per stem, white and typical of the incrustated section. I grew it for a few years on a piece of tufa and so was able to move it in and out of the alpine house as weather dictated. I finally lost it when I let it dry out too much. I have little hope of replacing it.

Read Fritz Kohlein's tantalizing account of this species in his book *Saxifrages*.

Just as lovely on a much smaller scale is *S. valdensis*, a tiny clump of silver-gray rosettes bunched together and as hard as concrete. The true plant has tiny leaves about a quarter of an inch long with a blunt wedge at the tip. Although each leaf rolls back at the tip, they do not have the spoonlike tips of the small forms of *Saxifraga cochlearis*. The flower stalks are up to 5" high, the reddish stems carrying white flowers in an open head rather than a spike or panicle. Many gardeners grow a plant they believe to be *S. valdensis*; but unfortunately the true species is very rare in cultivation on this continent. The plant most often masquerading under this name is in all probability our old and trusted friend,



*S. paniculata* 'Minutifolia'. The popularity of this latter plant started over 60 years ago when Clarence Elliott and Reginald Farrer introduced it from Monte Baldo in northern Italy under the name *S. aizoon* 'Baldensis', now generally accepted as a synonym of *S. p.* 'Minutifolia'. Since *valdensis* and 'Baldensis' both mean "from Monte Baldo", it is not surprising that the misuse of the name persists.

The attractive, flat, silvery mats of congested rosettes of *S. aizoon* 'Baldensis' are a fairly regular sight in rock gardens today. Each rosette is bright gray-green and well-silvered. The rosettes are less than half an inch across, less under lean conditions. The flowers are on reddish stems about 2" tall, and are creamy, not pure white and in panicles. This little plant has a good constitution and does well in crevices, screes, or troughs.

I have never grown the true *S. hostii*; it is not easy to acquire and there are many imposters. Luckily, I have a friend in Vancouver who has access to wild-collected alpine seed from Europe, and she is very generous with seed and plants. I have grown *S. hostii* var. *altissima*, a large variety, from seed that she gave me. The resulting plants have thick, leathery, strap-like leaves of dark gray-green, quite different from most of the other species. They have heavy serrations along the leaf edges. I am hoping to see crimson blotches appear at the base of the leaves this winter. This variety is supposed to produce 18" flower spikes with pink-spotted white flowers. It grows very well in a crevice in a fair amount of sun and may well turn out to be a valuable addition to the collection.

*Saxifraga crustata*, or at least its name, has been in cultivation for a long time. While we may grow many hybrids

of this species, the true species is not rated highly by most writers, mainly because of the dingy white flowers. Some admit that the foliage is at least silvery. The few plants I have grown from collected seed show long, narrow, toothless leaves, light gray, soft-looking, and slightly compressed into upright rosettes. The plants have a light, airy look that is very attractive.

It is bad enough trying to come to grips with the true species, but when it comes to the hybrids from the wild and gardens, the waters become very muddied. While there are many choice selections to be found among the hybrids, many have such subtle differences between them that it is impossible to be really sure. They could be sorted out if there was access to a good, reliably named collection where comparisons could be easily made, but from single plants and books identification is a very inexact game. The best advice is to resist the descriptions and romantic cultivar names of the older collectors and start with kinds that are easily recognized.

Among the many hybrids 'Whitehill' stands out on account of its easily recognized, dark gray, silver-edged leaves, each with a striking red splash on the reverse. The rosettes are about 1" across and grow into pleasant mats. At flowering they are smothered with 8" stems of creamy white flowers. This selection has a good constitution and is not an overpowering spreader. 'Whitehill' is the name of a garden in England where I suppose it originated. The hybrid 'Kathleen Pinsent' is easy to spot when its sprays of delicate pink flowers open on their 12" stems. As they mature they pass through several shades of pink to almost pure white, giving the whole plant a charming effect. It, too, is a safe variety for choice locations in the garden, as it is not inclined to be dominating. Some

say it has a poor constitution. I find it wise to keep a few rooted rosettes on hand for insurance. It is interesting to know that this chance seedling in the alpine house of Commander Pinsent won an Award of Merit from the Alpine Garden Society in 1934.

Another of the very few yellow-flowered silver saxifrages is 'Esther', which has the graceful stems typical of its parent *S. cochlearis* and the pale yellow flowers of the other, *S. paniculata* 'Lutea'. For some reason I am very partial to this variety, although one well-known writer on the genus does not rate it too highly. Perhaps the yellow does fade quickly, but in the right company this plant is an asset in the saxifrage garden. It grows into compact pads of tightly packed rosettes usually 1.5-2" across, the pale, gray-green, effectively edged leaves reflecting both parents.

Finally a word about the popular *S. cochlearis* and its forms. This species has been crossed with practically every other species of silver saxifrage, and some marvelous plants have been produced. Unfortunately, they are all so similar that they are impossible to describe! However, regardless of the accuracy of the names, some of the hybrids with spoon-like leaves must be grown, including 'Burnatii' and 'Francis Cade'.

How does one go about getting a collection together? What varieties could you grow first? Part of the secret is knowing what the good varieties are before you start. A little more reading and research will help enormously. For many of us, mail-order nurseries are an important avenue to explore. Check through all the lists of available plants that you can. You can also write to the nursery asking about specific plants even when they don't have them listed. Sometimes a nursery has so little stock that it doesn't list the plants in the cata-

log, yet the owners will sell one or two on request of a good customer. Correspondence with other collectors sometimes produces excellent results and often leads to productive relationships. Little side rosettes appear on the plants in May and June and make excellent cuttings. When carefully packed, these travel very nicely through the mail.

What about raising saxifrages from seed? No one will be surprised to hear that getting accurately named plants from garden-collected seed is very uncertain. Nothing will turn out as expected. After all, many of the hybrids originated in gardens! On the other hand, it is fun to grow wild-collected seed from Europe. Even then there are no guarantees, as wild plants hybridize in the mountains, too.

Good luck in your efforts. It would be great to see silver saxifrages come back into fashion. I know that somewhere tucked away in gardens and nurseries are many of the old and desirable varieties, just waiting for renewed interest to be propagated and distributed again. If we create a demand for these plants, we can leave the rest to the nurseries.

Photos by the author.

Rex Murfitt lives and gardens in Victoria, British Columbia. He trained at W.E.Th. Ingwersen's Birch Farm Nurseries in Sussex, England, and later started Stonecrop Nurseries with Francis H. Cabot at Cold Spring, New York. He is particularly interested in classical alpines, from saxifrages to the true alpines of North America.

# American Sedums in Czechoslovakia

by Vaclav Plestil

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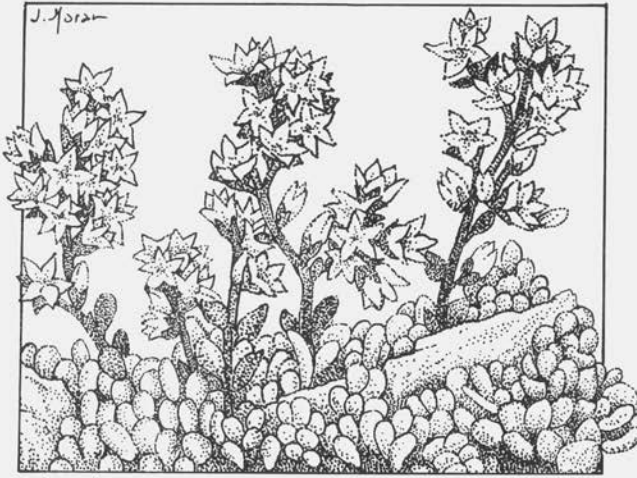
Sedums of the New World were neglected for many years here, but in the last decade, particularly thanks to members of ARGS—these very lovely and modest plants, as well as many alpine and other plants native to the US, have been introduced to our rock gardens. Many advanced alpine gardeners look at the sedums with some disregard as plants for beginners, assuming they are very easy to grow and often become weedy. I want to apologize to these plants. Many of them are very modest and graceful, and many are also far from easy and do present a challenge even to the experienced grower.

My first American sedum was *Sedum pulchellum* Michaux, brought home from the nursery of Mr. Cestmir Bohm, Sr., at Prague in the fall of 1958. This lovely Virginian species with four-parted flowers and characteristic terete leaves of vivid green sprinkled with red dots did grow for me for several years in the open. But one very wet winter it died, and since then I have not been able to get this plant again. Seed under this name from various European botanic gardens usually produces the European *S. reflexum* or

another widely grown, green-leaved species. It seems that here in my conditions *S. pulchellum* was on the border of its hardiness limits.

Another plant widely grown here for a long time is *S. oregonum* Nuttall of the Northwest, popular as a ground cover, very decorative, and not too invasive. In the last few years a red-leaved form of unknown origin has appeared, less dynamic in growth, and bearing in summer reddish to salmon-colored leaves that turn to dark green with the coming of late autumn.

Until the late 1960s *S. spathulifolium* Hooker and its several forms and cultivars such as 'Cape Blanco', var. *purpureum*, and var. *pruinatum*, were scarcely grown here. Now these plants have become very popular both for the open garden—where they present no problems to the grower—and in troughs. It was probably Suendermann's nursery, best known as a very renowned source of the porophyllum saxifrages, that first introduced *Sedum* 'Lebende Stein', a very slow growing, probable hybrid of *S. spathulifolium* with *S. obtusatum* A. Gray. Can somebody provide proper information on



*Sedum obtusatum*

the history of this plant? *Sedum* 'West Pascoe', cited in Praeger's monograph of the genus, also belongs to the *S. spathulifolium* group. I do not have this plant; it is probably now lost from cultivation.

*Sedum obtusatum*, although a California plant, I obtained one very rainy afternoon as cuttings from Mrs. Edith Dusek in Graham, Washington. Mrs. Dusek had it planted on the north side of a very small hill, the remainder of which was home to several penstemon hybrids of the *Penstemon rupicola* group. She told me to protect it from scorching sun and to plant it into a crevice or a scree on a gentle, north-facing slope. This I did. I remember several colonies up to 10" wide which we found with Wayne Roderick near Tioga Pass. There the plants had a rich set of buds. Another colony of *S. obtusatum* I saw several days later in the northern Sierra Nevada. It was on a scree covered with light scrub near Cisco Grove; here it had buds, but the plants were not so tight in habit. The same year I got some seed of this plant from both ARGS and Ron Lutsko of Lafayette, California, and these

produced nice plants, too. In 1988 some plants bloomed, but not those planted on the north side; these did grow and increase well, and the leaves and the relatively long internodes were nicely glaucous green—but no flowers appeared. Rooted cuttings tried in a sunnier spot were tinged with red in summer, as are many other species, and bloomed.

About the same time I got some seeds of

another closely related species, *S. oregonense* (S. Wats.) Peck, which when not flowering looks very similar. To be certain of having the true species I have ordered it from various sources, including the Berry Botanic Garden in Portland, Oregon, and the ARGS seed exchange. Seedlings did not bloom until last summer, and I am sowing the wild seed again, as I had mixed two species in the plantings. *Sedum oregonense* needs a very dry spot over the summer and fall, as it has a distinct summer dormancy during which growth stops for two months. It is native to Oregon.

Also in this group, even geographically as it comes from southern California and northern Baja California, is a true jewel among the stonecrops, *Sedum niveum* Kayser. I lost it last winter, and it is still very rare in cultivation. I got a little seed of this tiny and dainty plant many years ago. I do not remember now if I got it from Margaret Williams or Wayne Roderick. From these seeds several plants were planted in a moderately acidic part of the rock garden. The epithet "*niveum*" suggested to me that this very tiny plant's rosettes may dislike hot, sunny places,

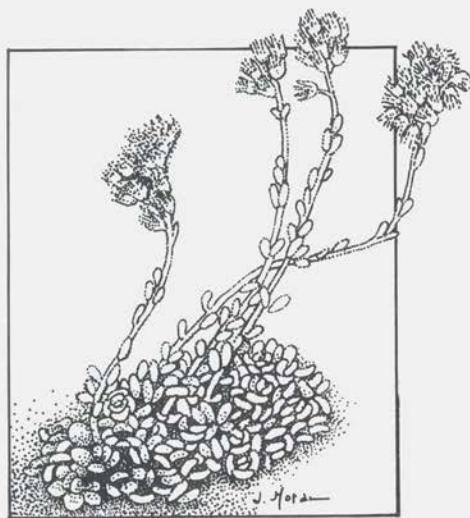
and it probably will—as do all sedums—demand very good drainage. A tiny seedling planted in a saddle of one small ridge in the garden open to the west survived the best, and the plant was there for many years. Everybody who saw it wished for a cutting, and I gave away many over the years whenever there was enough plant to be cut. This sedum is slow-growing. After I took several small cuttings last fall, the winter proved fatal.

*Sedum purdyi* Jepson, the spathulate-leaved Californian species, is in several gardens here, but I myself have not tried it. Now I have a little seed. Another desirable species of this alliance that I never find on seed lists is *S. yosemitense* Britton (*S. spathulifolium* ssp. *anomalum*). Does somebody grow this plant now?

The name *Sedum palmeri* S. Wats., a true Mexican species, presents a bit of a challenge to us. This is a typical representative of the subshrubby Mexicans with flat rosettes of leaves. To my surprise I now have a little seed from the Botanical Garden of Rouen, France, and am looking forward to seedlings. This species is considered the hardiest of the Mexican sedums and has proven quite hardy in Dublin, Ireland; see Praeger's notes. Why should it not be hardy even in Turnov, Czechoslovakia, where the winters are usually less moist than those of Dublin?

Having remembered one Mexican species, I must not forget the very lovely and enjoyable sedums from Arizona, for me always connected with my friends Sonia Lowzow Collins and Sally Walker. Why? The first of them, *Sedum stelliforme* S. Wats., is really a very diminutive, compact plant resembling the shrubby true Mexicans. I would say that this lovely, white-flowered sedum had paid by its diminutive size a penalty for its exodus northwards from the ancient region of the god

Kukulcan. If you do not have this plant, try to get it somewhere as it is one of the "musts." Its rosettes form, under suitable conditions, a dark green, tight cushion usually not more than 3" across. It grows easily everywhere in dry enough conditions and is excellent



*Sedum laxum*

for pans and troughs. Its small, starry, white flowers yield a surplus of beauty. The second plant is *S. griffithsii* Rose (syn., *S. wootonii* Britton var. *griffithsii* Kearney & Peebles).

The New Mexican and Arizonan *S. cockerellii* Britton is so very graceful, a tiny and white flowered plant, which tolerates a bit more moisture than the previous species. It seems to prefer a little protection against the hottest sunshine at noon here. When planted in the hottest places the plants stopped growth in summer. Although they did also bloom in September, they were less vigorous in growth, scarcely increasing and turning reddish in all parts. This species does best on a gentle slope facing east. Clumps that have become too dense should be divided each year. This is another plant that

I can recommend even for troughs.

A most popular sedum here is *S. stenopetalum* Pursh. Of course, it is known also under its synonym *S. douglasii* Hooker. It is easy everywhere in dry, sunny spots. This species is perhaps most decorative as young plants in their second year when they form semi-globular, tiny, dark green cushions about 2" in diameter. The next year the size doubles, and the flowering stems appear. This is easily distinguished from all other similar sedums by its vegetative "propagules" on the flowering stems, which fall to the ground in late summer and quickly produce roots. For its small size, usually not exceeding 4" in height, it is also to be recommended for the smallest rock gardens and pans. It is widely distributed in nature, from California to British Columbia.

*Sedum lanceolatum*, native to most of western North America, I saw in 1986 in Colorado. At high elevations it was flowering in early July and at the highest elevations still in bud, where it was tinged with red from the intensive insolation. Its leaves became grayish-brown at that altitude. But later at about 2800 m in the Platte River Canyon, I found several plants in seed among *Antennaria*, the ubiquitous *Erigeron flagellaris*, *Castilleja*, and *Oxytropis lambertii*. These seeds became the source of a group of my plants. Another plant is raised from seed collected in Alberta. The Canadian plants, grown in the same conditions, are less gray on the leaves and more robust, about 6-7" tall when flowering, while plants from Colorado are only 3" high and are more compact, smaller in all parts. But both these plants belong to the typical variety *lanceolatum*.

Thanks to Betty Lowry I have a most graceful species that forms wide carpets in age. It is one of two opposite-leaved species, *S. divergens* S. Wats., coming

from Betty's collections in the Washington Cascades. This became one of my favorite sedums, easily growing everywhere on acid substrates and quite adaptable to both colder and quite hot places. It is fast increasing but not invasive. In partial shade it is a little shy in flowering, as are the majority of sedums.

A second sedum with opposite leaves, *S. debile* Wats., I still have not acquired although I would very much like to try it here. It grows from Nevada to Wyoming. So also does another closely allied, but alternate-leaved, cushion-forming plant, very nice with its finely papillate leaves, *S. leibergii* Britt. of the northwestern US. Judging by their home range, neither of these species would be too difficult here.

The last North American sedum we do grow is *Sedum nevii* from the eastern US. This seems here to prefer more mesophytic conditions (having average moisture) and also a bit richer soil mixture with a small proportion of humus. For most of my sedums I use nearly pure mineral soils—as for cacti. I do not grow this species in full sun. Its fine, flat, bluish-green leaves are welcome in small rock gardens. Here it grows slowly, very far from being invasive. Sometimes the pale brownish-leaved form appears in gardens, very nice and appreciated for its unusual color. It is labelled as variety *bhutanicum*. I do not know why, when this lovely species of the American Ozarks has nothing to do with Bhutan. In any case, the plant is worth having in the garden. I like it very much. Its counterpart, *S. tematum* Michaux, which does not form such dense clumps, has not been grown here.

Drawings by Lisa Moran

Vaclav Plestil is a leading European authority on American alpenines. He gardens in Turnov, Czechoslovakia.

# Hormones for Fast Germination

*by Bob Stewart and Brigitta Presley* \_\_\_\_\_

Are you tired of staring for months and years at bare seed flats covered in chicken grit? Frustrated that the only green things to be seen are the algae, mosses, and liverworts, with not a cotyledon to be seen? If you have always thought that there must be a better way, read on: instant germination is at hand.

This is a preliminary report on research being conducted by us on the use of plant hormones to promote seed germination. We have decided to publish our early results because initial trials with some species were so striking that we felt that we must share them. We also hope that these results will inspire others to get involved in this research. Only positive results are reported here, since they are much easier to interpret than negative results. Where no seed germinates the seed may have been sterile, a hard seed coat may have prevented water uptake, or perhaps the wrong concentration of hormones was used. In theory, our approach should work with any seed once concentrations are adjusted.

The premise of our work is that during seed dormancy chemical changes

are occurring in the seed. Either germination inhibitors (dormins) are being broken down, or growth-promoting substances are being synthesized, or more likely a combination of both. It may be that germination takes place when the level of promoters is high relative to the level of inhibitors. It should be possible to "trick" the seed by resetting its internal clock through supplying an excess of growth promoting hormones. These would normally be present at a time when the proper warm, cold, and light requirements had been met by the natural environment. In the laboratory forced germination is accomplished by treating seeds with gibberellins, cytokinins, or both.

Gibberellins are plant hormones that are responsible for a number of different growth effects. They cause cell elongation resulting in long internodes and tall plants. They also seem to be present in most germinating seeds and may well be essential for germination. There is some data in the literature to suggest that gibberellin levels change when seeds are stratified at low temperatures.

Cytokinins are plant hormones responsible for breaking the dormancy

of axillary shoots and for the formation of adventitious buds and somatic embryos. (Adventitious buds are those that arise from any part of the plant, rather than in "expected" places. They can form on leaves, roots, or shoots, and often arise from the callus tissue that forms when a plant is wounded. The shoots that form on an African violet leaf cutting, as if out of nowhere, are a good example.) Cytokinins are widely used in plant tissue culture. Early attempts at tissue culture used naturally occurring cytokinins found in the liquid endosperm of coconut seeds (coconut milk). Cytokinins cause cotyledons to expand, and there is some reason to believe that they counteract the effect of abscissic acid (ABA).

Abscissic acid is a naturally occurring growth substance that is classified as a dormin. High levels prevent germination; normally this chemical breaks down during stratification. ABA also plays a role in leaf drop and the winter dormancy of buds. Soaking non-dormant seeds in ABA will inhibit their germination. Perhaps this may be of use for long term seed storage.

It has been reported in the literature that cytokinins may compete with ABA for the same binding site. Norm Deno, in a personal communication, questions the validity of this work, and we tend to defer to his judgment on matters of chemistry. However, if cytokinins are applied to dormant axillary buds which are supposed to be suppressed by ABA, they will force a shoot in short order. This gives them great potential for training bonsai, or forcing some extra shoots for cuttings, or just making a plant more bushy. It has also been proposed that cytokinins have a permissive role in germination and work by enabling gibberellins to function. It is certainly clear that cytokinins will break some dormancies that gibberellins alone will not. The research is complicated by the

fact that both cytokinins and gibberellins occur naturally in seed, making it impossible to separate their effects. In our research we used cytokinin BA (6-benzylaminopurine), but we plan to do further work with Zip (N6-[2-isopentyl] adenine), which is biologically more active and a little less toxic to plants. Zeatin would be better still, since it is the main naturally occurring cytokinin in seed. It is very expensive, however. There are many different gibberellin analogs, but the only inexpensive, widely available one is GA3, gibberellic acid. Many of the other gibberellins are metabolized into GA3 by plants. Nevertheless, they may prove more useful than GA3 itself in the future.

Our treatments are as follows: Seed is placed on a small square of aluminum foil with a few drops of solution of either gibberellic acid, BA, both, or plain water (used as a control). We then fold up the foil and let the seed sit until it has swollen. Usually this is just overnight, but in some cases several days may be needed. Very hard seed coats may need to be physically punctured. Hard seed coats, especially when present in fine seed, greatly complicate the experiments. We next let the seeds dry BRIEFLY so that they can be sown without sticking together. We prefer to sow into 96-cell inserts (plug trays) filled with a soilless peat and perlite mix, such as regular Promix or Sunshine potting mix (not the seedling grade mixes). We cover the seed with chick starter grit and place the trays under lights at 70°F. This is the same general method we use for the germination of easy seeds in the greenhouse. Direct sowing of one or two seeds to a cell avoids the tedious task separating roots during transplanting. The 96-cell inserts are a good balance between smaller plugs that require great care in watering and larger pots that use too much valuable greenhouse space. If you don't mind trans-



## How to Prepare Seed Hormones

To prepare solutions, remember that 1 milligram per liter equals 1 part per million (1 ppm). Therefore, 1 gram of a chemical added to 1 liter of water produces a 1000 ppm solution. 1 gm added to 500 ml equals a 2000 ppm solution. If you buy your chemicals in 1 gm portions you will not need a balance scale to weigh them. Or contact your local school or pharmacist and have some portions weighed for you.

If you have trouble dissolving the cytokinins, place the chemical in a small container and add dilute hydrochloric acid a drop at a time. Stir for several minutes after each drop. When the cytokinin dissolves, add water to bring the total volume up to that desired. Be very careful handling the acid—wear safety glasses and do not splash. Do not heat these chemicals, and store them in a cool place.

planting, you may place the seed on a piece of filter paper that has been moistened with the hormone solution and plant the seed as soon as the root emerges. Brigitta has the patience for this, but Bob much prefers the direct sowing method.

To date we have tried these treatments on a number of species, and in some cases the results have been striking. One of the greatest successes has been with gentians. When treated with gibberellic acid at 200-1000 ppm, seed of all the species tested, American, European, and Asiatic species have all given positive results in 1-2 weeks. We have not yet had the opportunity to try any New Zealand or South American species. If anyone will send us seed of *Gentiana scarlatina*, we would love to try it. Treatment with a mix of cytokinins and gibberellins works just as well or maybe in some cases a little better than one hormone alone, and the plants remain much more compact than

We mix fresh solutions once a month, but this may not be necessary.

parts per million (ppm)	grams of chemical	liters of distilled water
200	1.0	5.0
200	0.2	1.0
200	0.1	0.5
500	1.0	2.0
500	0.5	1.0
500	0.25	0.5
1000	1.0	1.0
1000	0.5	0.5
1000	0.25	0.25

when treated with gibberellin alone. Plants treated with cytokinin alone show some germination but less than the other groups. The control group, just treated with water, showed almost no germination.

These treatments are just as effective with the difficult campanula species, including *Campanula allionii*, *C. tridentata*, *C. cenisia*, and campanula relatives such as *Edraianthus pumilio* and *Phyteuma comosum*. Proper hormone concentration is essential to success as we discovered in the case of *P. comosum*. Treatment with 500 ppm gibberellic acid had no effect, but with treatment with 1000 ppm germination began in 5 days. Preliminary results with a number of species would seem to indicate that the harder the seed is to germinate, the higher the concentration of gibberellic acid that will be required to stimulate germination. In the case of *Gentiana verna* we treated samples with 200, 500, and 1000 ppm

gibberellic acid and found that the germination rate was directly related to the concentration. That is to say, doubling the concentration doubled the number of seeds that germinated. At 200 ppm there was very little germination; no germination occurred in the water control. We leave it to the reader to determine the optimum concentration, but we hope that anyone experimenting will keep us informed of the results.

Another big success has been with *Dionysia*, where 95% of the seed treated with 500 ppm gibberellic acid germinated in 5 days and less than 5% of the control group ever germinated.

*Androsace* has germinated at a 90% rate in as little as 3 days, and we have also had good results with *Soldanella* and *Primula*. *Primula parryi* has germinated 100% in 5 days when treated with 500 ppm gibberellic acid. Primulas were one of the few groups that showed toxic reactions to cytokinins. At 50 ppm BA roots were inhibited and at 200 ppm there was no germination. This is not all that surprising, since tissue culture levels of these compounds are in the range of 2-10 ppm. Therefore, with cytokinins, less may be better.

*Aquilegia jonesii* x *A. saximontana* germinated 90% in 10-14 days when treated with 500 ppm gibberellic acid. *Glaucidium palmatum* germinated 100% in 7-10 days at 500 ppm gibberellic acid. All penstemons we tried responded, but in the case of some of the easier species the water controls also germinated. More difficult species like *P. cardwellii* only germinated when treated with gibberellic acid or a mixture of gibberellic acid and cytokinins. *Lewisia*s responded positively, including *L. tweedyi*, which is always slow to germinate and normally needs a period at 40°F. *Lilium duchartii* germinated 100% in 1-2 weeks when treated with 500 ppm gibberellic acid, as did *Nomocharis*. The latter also germinated when treated with 50 ppm BA and with a mixture of gibberellic acid and BA.

We would like to thank everyone who sent seed for these experiments, particularly the many outstanding growers of Czechoslovakia. Research is continuing, and if you would like to contribute you can help by informing us of any successes or failures you might have. Or if you have some excess seed you would like us to try, please send it to us.

Chemicals can be obtained from Carolina Biological Supply, 2700 York Rd., Burlington, NC 27215, (tel.:1-800-334-5551) or Sigma Chemical Company, PO Box 14508, St. Louis, MO 63178 (tel.:1-800-325-3010).

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Bob Stewart owns and operates Life Form Replicators, a 68-acre nursery and tissue culture operation on the Red Cedar River in Michigan. Brigitta Presley operates Perennial Plantation, another nursery. A word of warning about the plant hormones discussed here: An unforeseen consequence of their use has been an engagement between the two researchers working with them. Bob and Brigitta plan to be married February 14.



*Campanula oreadum* (p. 262)

photos by Josef Haldá

*Chamaecytisus depressus*

*Viola striis-notata* (p. 263)





*Draba athoa* (p. 264)

photos by Josef Halda

*Trachelium jacquinii* (p. 263)





*Saxifraga scardica* and *S. sempervivum* (p. 263)

*Aubrieta gracilis* (p. 263)

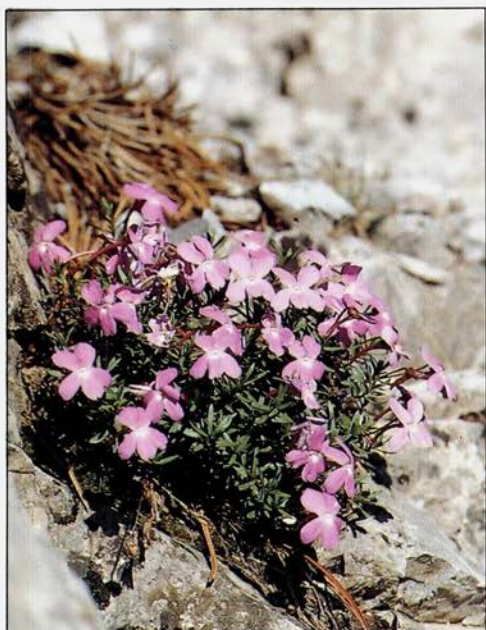




*Jankaea heldreichii* (p. 261)

photos by Josef Halda

*Viola delphinantha* (p. 262)



*Alyssum handelii* (p. 263)



# Plants of Mt. Olympus

by Josef Halda

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The flora of Mt. Olympus of Thessalia in northern Greece is very rich and diversified. This is due to a range of altitude from just above sea level to 2917m at its highest point. It is very difficult to choose just a few species to describe from the more than 1500 vascular plants that grow in this region.

Probably the most famous plant of Mt. Olympus is a gesneriad, *Jankaea heldreichii* Boissier (photo, p. 260). There are many stories about this plant—how to grow it, how to propagate it, and how difficult it is in cultivation. Its compact, white-hairy rosettes are very smooth and soft and are visible from long distances on the limestone cliffs and boulders where they usually grow. The lavender flowers of the *Jankaea* will be finished blooming by the end of April at lower elevations (350m), while plants of the higher elevations are still under winter snow cover. At 2500 m plants can still be found in flower at the end of August.

These plants prefer damp, shady rocks, but you often may see very large individuals on the south slopes of cliffs, together with the attractive ferns *Ceterach officinarum*, *Asplenium*

*trichomanes* and *A. ruta-muraria*, and many other interesting plants, including *Campanula versicolor*, *Inula verbascifolia*, *Teucrium chamaedrys*, *Asperula purpurea*.

*Jankaea* does not want too much soil—as is normal in chasmophytes. It is able to grow and survive in moss or on stones alone, or in crevices with not much humus or leafmold. Competition from other more invasive plants, such as grasses, teucriums, *Phlomis*, *Verbascum*, *Campanula*, *Cornus*, *Corylus*, *Acer*, etc., is probably a reason why *Jankaea* inhabits only walls and steep stone where the others cannot survive. Plants produce many seeds—in a single capsule there are thousands of very tiny seeds, which are easily dispersed by air movement.

In culture, competition from different algae, mosses and liverworts is dangerous for seedlings, which are hardly more than 1 cm in diameter for the first year. Seedlings that survive the first year will grow faster the second and may be transplanted without difficulty. A good soil mix for seedlings as well as for mature plants is 1 part leafmold from *Corylus* or *Fagus*, and 1 part very



small limestone particles. Slugs love the tiny, tasty seedling morsels and often finish our duties in growing them. The method of watering is very

important in seedling survival. All watering should be done from the bottom of the pots, since water standing in the center of the rosette can be fatal, especially during the dormant season. The plants are in danger when they are dry, as they need constant moisture throughout the year. In nature they are able to survive some dry periods during the summer, but they have good connections with subterranean moisture. Although they look quite dry, they have enough energy to start growth in the next rainy season.

Seedlings will bloom the third or fourth year under optimal conditions, but in poor conditions it may take many years for them to bloom. The color of the flowers varies from pale lavender to pale purple or violet. I have seen white flowered plants only once in my life. On the rockery, plants need vertical crevices or small, protected indentations with an overhanging lip exposed to north, northwest, or northeast. Plants must have good drainage—one reason that a vertical growing position is better than a horizontal one. A rich soil using composted cow manure with old beech leafmold will produce rosettes more than 20 cm in diameter.

Propagation is by leaf cuttings, basically the same method as for African violets (*Saintpaulia ionatha*). The leaf must not be too old. Under plastic bags the leaves make roots very quickly, in about a month, and in three months the cuttings will produce a few little side rosettes.

*Viola delphinantha* (photo, p. 260) grows a little bit higher, at moderate elevations (100-2600 m), mostly on east, northeast-, or north-facing rocks and cliffs, where there is little competition. This is one of only three woody violas in Europe. It inhabits deep little terraces or very tiny crevices in walls that are not too moist. It makes a woody taproot and has many leafy stems with tiny, dark green leaflets. Big (2.5cm), single flowers with long spurs are mostly pink, but sometimes purplish and rarely white. Fruits grow very quickly (as in all violas), and they open about one month after pollination. Seeds are very distinct from all other non-woody violas; they are long, narrow, and pale brown. Most other *Viola* species have seeds that are globular or elliptic and more or less yellow.

*Viola delphinantha* is a long-lived species—in acceptable conditions you can find 30- to 50-year-old plants. In a garden this species is mostly killed by conditions that are too moist or by slugs. Propagation is very easy from fresh seed or half-soft cuttings in June.

*Campanula oreadum* is one of the most beautiful *campanulas* (photo, p. 257). It grows on rocks or walls that are not too moist and are exposed mostly to the north, northeast, or northwest, often in cold gorges. Multiple rosettes of fleshy, glandular leaves create small, dense clusters. Generally the flowers are borne singularly, rarely in twos or threes. They are held erect and have a long, tubular corolla, mostly dark blue-violet, but it is possible to find pale blue- or white-flow-





ered plants. Fruits contain many flat, yellow-brown seeds that germinate mostly the second year. Being a long-lived species, its seedlings bloom later—usually the third or fourth year—and they are very sensitive to overly moist substrates. Beware, as slugs like the young leaves and often also the flowers and flower buds.

*Omphalodes luciliae*, unlike *C. oreadum*, indulges in moist, wet, stony walls and terraces in higher and alpine elevations,



exposed to the north, where it creates clusters sometimes to 30 cm in diameter. Leaves are broadly lanceolate, an unusual bluish green, a little fleshy. Brilliant blue flowers are plentiful on stems 10-15 cm long. After pollination big, triangular seeds 2-3 mm long develop, which, if fresh, germinate very quickly, the first week after sowing. In the garden, this species needs a cold, north-facing crevice, with plentiful moisture. It is possible to propagate from cuttings using the outside rosettes, which will root quickly in a light peat-sand substrate.

*Trachelium jacquinii* grows on dry, sunny walls and rocks at lower elevations, where under good conditions it creates big clumps up to 30 cm in diameter (photo, p. 257). Pale blue, long, tubular flowers, clustered in tight globes at the ends of leafy stems appear in June, July, and August. In the garden it needs a warm crevice facing east, south or west. Seeds are very tiny, and it is best to sow them directly in the desired position. Slugs, again, are very dangerous for seedlings and for bigger plants, too.

*Dianthus haematocalyx* ssp. *haematocalyx*, a bright purple-flowered species, grows on rocks and stony

grassland in middle and higher elevations, where it creates cushions or carpets 15-30 cm in diameter. The flat, black seeds germinate easily, but for more desirable, dwarf, large-flowering forms, it is better to propagate by cuttings after bloom.

Often *D. haematocalyx* grows together with the robust *Jovibarba heuffelii*, which has big, pale, bluish-green rosettes to 20 cm in diameter and pale yellow, tubular flowers on leafy, succulent stems 15-20 cm high. In the garden it grows easily anywhere in sunny, warm places with rich, stony soil. It does not create outside rosettes, but big, mature rosettes split every year into two, sometimes even three, rosettes. Propagation by seed is much quicker than by division. Seedlings grow quickly and bloom, under good conditions, the second year.



*Edraianthus graminifolius* also often grows with *Dianthus haematocalyx*, *Jovibarba*, *Teucrium montanum* and *T. aureum*, *Iberis*



*sempervirens*, the white-flowered *Centaurea pindicola*, and many other attractive plants. *Edraianthus* creates rosettes with dark green, long, narrow leaves, with many long outside stems carrying globes of pale violet, tubular flowers, which do not quite open. This species grows easily from fresh seed everywhere where the soil is not overly moist.

*Gentiana verna* ssp. *pontica* grows at higher elevations on snow fields and in deep, moist alpine pastures that are covered by snow for a long time each



with cushions of *Saxifraga scardica*, blooming white or pale pink, or little clusters of purple-violet *Saxifraga sempervivum*, the green-blooming rosettes of *Beta nana*, or the dwarf white- or pink-flowered *Corydalis parnassica*.

In alpine scree, you can see a special community with dark blue flowered *Veronica thessalica*, purple *Linaria alpina*, white *Achillea ambrosiaca*, the tiny yellow flowers of *Euphorbia capitulata*, white *Cerastium theophrasti*, big carpets of lilac-pink *Aubrieta gracilis* (photo, p. 259), yellow-flowered *Alyssum handelii* with silver-gray leaves (photo, p. 258), and in moist scree the charming *Viola striis-notata*, with big, pale lilac or pink flowers and tiny, fleshy, dark green leaves (photo, p. 257), together with *Ranunculus brevifolius* with ornamental bluish leaves and bright yellow flowers with reddish calyxes.

Rocks and cliffs at alpine elevations have some special species; one of these, *Saxifraga spruneri*, inhabits steep, often vertical walls, creating big cushions up to a meter in diameter. It has glandular leaves, stems, and calyxes, and tiny, creamy white flowers. At lower elevations it grows under "roofs"—rock overhangs—that provide protection against rain and moisture.



year. It creates cushions 15-20 cm in diameter. In the mountain spring these are full of bright blue flowers that shine between the grasses and stones, together

*Saxifraga spruneri* is easy from seed, but seedlings grow very slowly and after the first year are hardly bigger than 5 mm in diameter. Cuttings are not tolerant of moisture and thus must be kept dry. *Arabis bryoides* creates tight, dark green cushions with almost stemless, pure white flowers, often with yellow-blooming *Draba athoa* (photo, p. 258), greenish-yellow *Saxifraga moschata* or dwarf, white-blooming *Arenaria cretica*, that creates big carpets 40-100 cm in diameter. Fresh seeds of *Arabis* germinate quickly and it is possible to make cuttings in early summer, too.

*Potentilla deorum* inhabits the highest summits, growing on sunny-faced rocks, creating small clusters of silver-hairy leaves and pale yellow flowers on longer 8-10 cm stems. *Potentilla* often grows together with *Saxifraga scardica*, creating a special association.



These are just a few of the wonderful plants that grow on Mt. Olympus. Most of these are not yet available through the horticultural trade, but hopefully they will be as soon as people become aware of their vast potential and ask for them.

Drawings by Jarmila Haldova.

Josef Halda is an energetic and ambitious plant explorer from Czechoslovakia.

# Gardening in Pine Duff

by Jeanie Vesall

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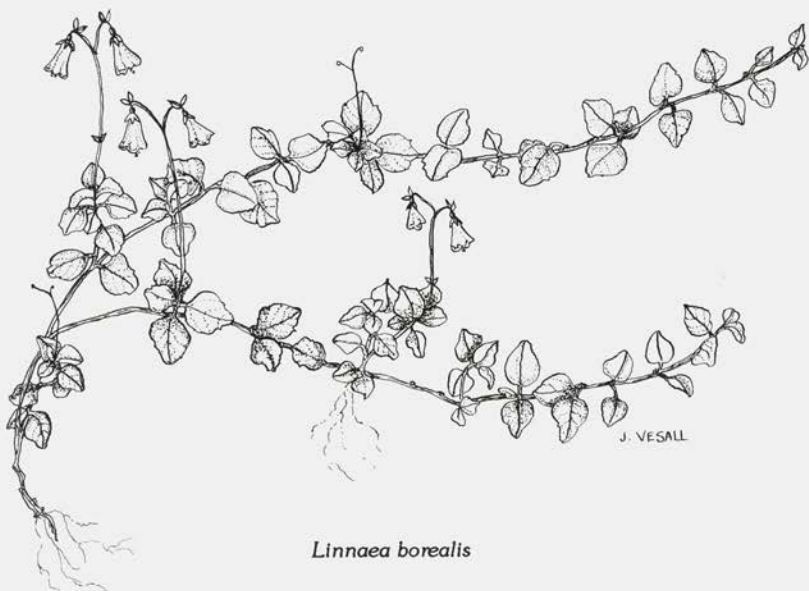
Far northeastern Minnesota rises from the shore of Lake Superior. The granite hills are laced with streams and shrouded with dark forest—part of the boreal forest, the largest, most northerly forest on earth. Conifers dominate the landscape. But it is the carpet of plants growing in the duff of evergreen needles beneath the trees that has always attracted me.

I had been saving a special place in the garden for the plants that form this carpet. Our wooded property has large red and white pines planted over 40 years ago among oaks and birches. Many of the gardening books I have read regard the ground beneath coniferous trees as a gardener's nightmare. Christopher Lloyd, in *The Well-Chosen Garden*, writes that the dark, dry, rooty areas under certain trees should be left bare and that we accept this as "no more of a disgrace than a balding head." I chose a different option. I built a special garden for boreal plants beneath a large red pine and made it the centerpiece of the rock garden.

The pine duff garden was a special project for three years. Finally, when it

was the garden I envisioned, lightning struck, and the centerpiece of the garden was mortally wounded. We nursed the 46-year-old tree as it lost clumps of needles into the garden below. Many of the plants began to suffer even before we made the decision to remove the pine. How could everything have gone so wrong? The lightning was surely the fatal blow, but had I contributed to the decline of my garden, let alone that magnificent tree? Before I would try another pine duff garden, I needed to understand the factors that influenced the success of trees and other plants in a coniferous forest. I turned to study the ecology of the boreal forest.

Northern Minnesota has the largest area of boreal forest in the lower 48 States. It is a region of long, cold winters and short summers. Much of the yearly precipitation falls as snow during the six to seven months of wintry weather. Lake Superior supplies moisture, and as a result heavy amounts of snow accumulate. In some regions of boreal forest, such as the subarctic interior of Canada, precipitation amounts can be quite low. Yet



*Linnaea borealis*

because of the low rates of evaporation in the cold climate, the interior of the boreal forest is damp.

For almost half a million years, glaciers exposed and scoured the granitic and metamorphic bedrock underlying this forest. Soils have had little time to develop since the glaciers' last retreat 10,000 years ago. Amazingly, many of the plants, even the coniferous trees, are able to tap enough nourishment through fractures in the rocks to cling to life.

Evergreen trees have an advantage over deciduous species in this northern environment. Leaves are photosynthetic factories. The needles of conifers are shed gradually throughout the life of the tree, not all at once each fall. During warm spells in early and late winter the needles may be able to carry on photosynthesis. In spring, the foliage does not have to be fully regrown, and the trees are immediately ready for the short growing season. These persistent needles are covered with a waxy cuticle that helps conserve moisture during the

winter or in periods of drought. The most hardy species, including jack pine, white and black spruce, and balsam fir, have a system to clear the liquids from within their cells when the temperature goes below  $-40^{\circ}\text{F}$ . This prevents potentially destructive ice crystal formation within the cells.

Conifers are also at an advantage on the poorly developed, infertile soils of the far north. The nutrients they absorb from thin soils are conserved in their evergreen foliage. Many herbaceous and shrubby plants in the boreal forest are also evergreen. This strategy has helped these plants survive the limitations of northern climate and soil composition.

No matter what the environment, the type of soil influences the species of plants it supports, and the plants play an important role in the formation of the very soils in which they grow. Soil formation involves physical, chemical, and biological processes. It begins with weathering and chemical alteration of rock. Plants begin to root into this

weathered material. As they grow and die they leave behind organic materials that support a population of soil organisms. These soil organisms turn plant and animal debris into humus by the process of decomposition. Through mineralization, microorganisms ultimately turn humus into simple chemical compounds that living plants can again absorb. These chemicals further alter the soil as they combine with rainfall.

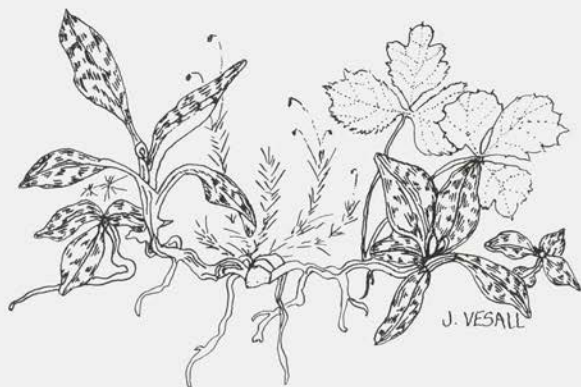
The woodland gardening I was most familiar with was done under deciduous trees, in particular oaks and birches. A wide variety of plants accepted the soil conditions under these trees. In order to successfully grow the boreal plants, I needed to know how conditions under conifers differed.

In a deciduous woodland, the humus that forms is called mull. The litter layer is decomposed readily and forms only a thin layer over the mineral soil. This environment supports a large number and variety of soil organisms. Bacteria are the main decomposers. Some of the bacterial species are capable of nitrogen fixation, that is, converting nitrogen from the atmosphere to an organic nitrogen compound that is returned to the soil and can be used by plants. Earthworms, common in these soils, ingest the litter and deposit the castings on the surface. The castings are higher in total nitrogen, organic carbon, calcium, magnesium, and phosphorus than the soil the worms take in. In addition, the worms mix and bind the mineral soil with the humus. The final soil is a fertile, well-mixed loam.

In the boreal forest, the type of humus that forms is called mor. A thick litter layer of needles from the conifers builds up over the acidic soil. Conifer needles may take three years to fully decompose. Both their cutaneous coating and high cellulose content slow the process. The acid reaction of the soil and the cold climate slow the rate of

decay by retarding the growth, number, and activity of microorganisms. At the level of decomposition, the humus forms a dark layer on top of the soil. It does not become interspersed with the gravel or sands common in glaciated areas. Fungi are more abundant in these cold soils than bacteria and carry out most of the decomposition. Saprophytic fungi feast on dead or inert materials. Mycorrhizal fungi form mutualistic relationships with the roots of living trees. Their white, threadlike strands, mycelia, increase the water- and nutrient-absorbing surface of the roots. While many forest trees have mycorrhizae, they play an important role in these nutrient-poor soils. Bacteria associated with the roots of alders (*Alnus*), a common understory shrub in the coniferous forest, are capable of nitrogen-fixation. However, their total contribution to the fertility of the soil is insignificant because of the domination of conifers.

Finally, I had a clue to the decline of my duff garden—earthworms. Last fall, I removed a wheelbarrow load of worms and their castings from the path near the red pine. In less than two years, they had completely changed the soil under the pine. No longer was there the characteristic heavy litter layer over a thin humus layer. The soil had no distinct layers. The worms had mixed everything together. It resembled the deep, fertile loam of the nearby deciduous woodland gardens. During the construction of the original garden, the natural humus layer under the red pine was disturbed. To rebuild an acidic humus layer, I had worked peat moss, chopped pine needles, rotted pine bark, granite grit, and oak leaf mold into the sandy soil to a depth of 6-8". I'm sure the oak leaf mold enriched the bed and helped attract the worms, and they further incorporated the organic materials into the subsoil. The higher fertility



*Goodyera repens* var. *ophioides* and *Coptis groenlandica*

coupled with our warm summers may have allowed a different group of soil microorganisms to take hold. Such a change could bring in plant diseases or interfere with the mycorrhizal associations of the trees or the herbaceous plants. The pine and the boreal plant beneath it, accustomed to relatively infertile soil, began to decline soon after the worms took over the bed.

I have started to develop another pine duff garden under several large red pines. Where the natural litter and humus layer remained undisturbed, this time I have planted directly with no "improvements" to the soil. Where the litter layer had been raked away, I added a thin layer, barely 2-3", of chopped pine needles, sphagnum peat moss, and some granite grit to keep the soil from compacting during planting. None of this supplemental material was dug into the soil. Instead, I placed it on top of the acid sand that forms the base soil. Only pine needles are used as a mulch to protect the new plantings. No fertilizers are used. I did scatter a small amount of sulfur at planting to boost the acidity. In time, a natural litter layer should accumulate, and I hope the low fertility will keep out the earthworms. I

can't alter the influence of the weather. The heat of our summers might limit the lifespan of some of the boreal plants as much as the soil structure.

The main plantings in this new area are representatives of the northern coniferous woodlands of Minnesota. These same species will grow in a peat garden, but they have a natural affinity for the conditions under the pines. It is important to keep these mostly evergreen plants watered and

misted on hot days until they take root. I have found that they will endure considerable dryness later. Many boreal plants grow as fine-rooted, running stems barely anchored to the sphagnum moss. They benefit from a short stay in a pot of peat and sand to increase the root system before planting in the garden.

*Linnaea borealis*, symbol of the boreal forest, has been most successful here even in the sunnier areas. It continues to spread and flowers freely. One of my favorite plants, *Polygala paucifolia*, will need several seasons to recover from the loss of the original pine duff garden and the resulting transplanting. The same is true for *Epigaea repens*. For both of these plants, I loosely pin down some of the stems into the duff to encourage rooting. *Mitella nuda* was too successful. It grew over, under, and around the smaller plants. Some of the other species that like it under the pines are *Cornus canadensis*, *Clintonia borealis*, *Mitchella repens*, *Pyrola* spp., *Moneses uniflora*, *Goodyera repens*, *Coptis trifolia* var. *groenlandica*, *Arctostaphylos uva-ursi*, and *Gaultheria procumbens*.

Two other species have given me trouble. *Gaultheria hispidula* hung on for a while. I plan to try establishing it on a rotten, moss-covered log completely out of the sun. A small patch of pipsissewa, *Chimaphila umbellata*, grew best when totally neglected at the far reaches of the garden under a pine. As soon as I move it to a place of honor, I lose it.

I am not a purist about growing only our native plants. The pine duff suits other species as well. *Shortia galacifolia* and *Galax aphylla* grow and flower, although they are slow to increase. Since many of the boreal species have small, intricate flowers, I have added a few exotics for more show. *Iris gracilipes*, a beautiful white or lavender-flowered species from the wooded slopes of Japan, prefers the well-drained soil under the pines. *Cyclamen fatrense*, one of the few cyclamen to survive our zone 4 conditions, remains perennial and flowers during late summer. Several species of soldanellas grow despite their alleged need for limestone. I wedge ramondas and haberleas into rock crevices, and their foliage benefits from the umbrella effect of the pine needle canopy. This is also true for *Lewisia tweedyi*. The pines protect our plants from the rains, and the pine needle mulch acts as a

wick, carrying away additional moisture from the crowns. Eventually, the heat and humidity of our summers necessitate spraying the lewisias with a fungicide and removing small side crowns for cuttings.

An assortment of shrubs and ferns serves as a background for all the small, mat-forming species. Small, hardy rhododendrons grow near a sunnier edge of the beds. Dwarf hemlocks (*Tsuga*), *Abies balsamea* 'Nana', *Microbiota decussata*, *Betula nana*, and *Vaccinium* spp. are tolerant of the heavy shade of the conifers. Most ferns grow well in these conditions. Two favorites are *Woodsia ilvensis* and *W. oregana*, both native to the coniferous woods. Weathered granite boulders and fractured, dark gray rocks to form crevices, moss covered logs, and moss cushions pinned to the soil add the finishing touches to the pine duff gardens.

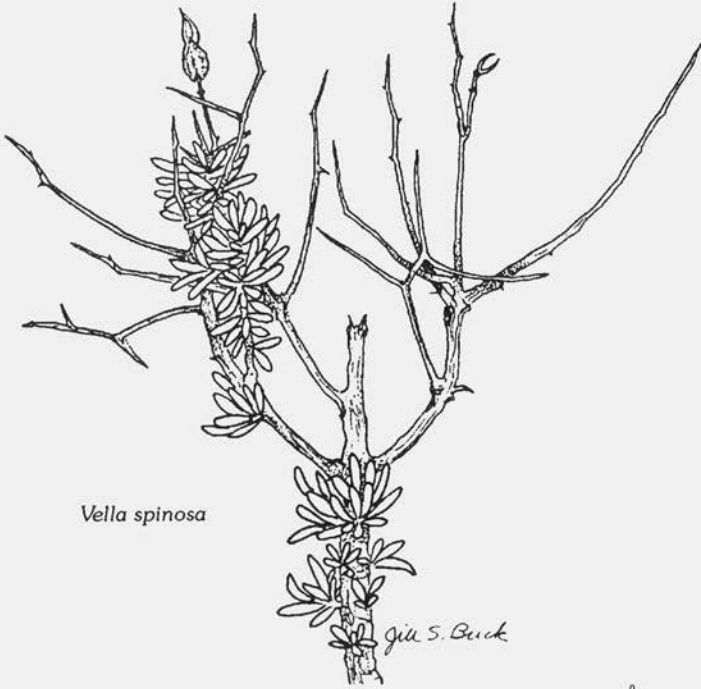
The needle-covered ground under pine trees is not destined to be a barren wasteland. Beautiful plants from northern Minnesota's coniferous woodlands are naturally suited to this unique habitat. The gardener need only learn to respect the intimate connection between plant and soil to grow a garden beneath the pines.

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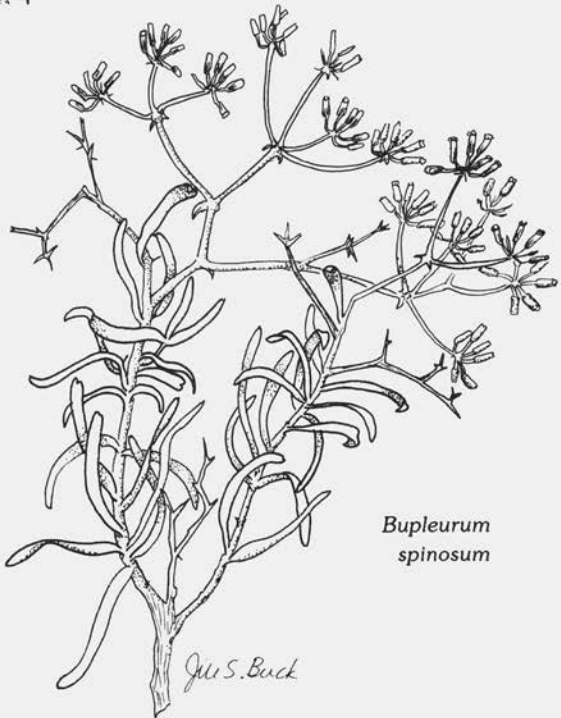
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Drawings by the author.

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*Vella spinosa*



*Bupleurum spinosum*



# Prickly Charmers

by *Panayoti Kelaidis*

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I doubt if the Trapp Family would ever have tripped so blithely through a steppe or Mediterranean landscape carpeted with thorny shrubs. Plants that have the wherewithal to defend themselves seem to strike terror in the hearts and hands of timid gardeners. Spines, bristles, glochids, prickles, thorns, and their infinite permutations serve not only to repel herbivores and pests, they can torment the hand that would cultivate them. And yet anyone who has lived in a desert or Mediterranean landscape seems to develop a nostalgic love of these and other plants that are somewhat unfriendly on first acquaintance. They are an acquired taste.

Take the prickly alyssum (*Ptilotrichum spinosum*) of the western Mediterranean mountains. You see it in a friend's garden, a symmetrical mound as densely blooming and compact as annual alyssum, only the plant is a gnarled shrublet a foot across and a decade old! Most gardeners never notice that it is one of the spiniest of garden plants. This Spanish and Moroccan alpine is a fine example of acanthamnid spination, a term botanists use to describe the crumpled

chickenwire-like armature so many plants in Mediterranean climates seem to have developed independently in unrelated plant families. Acanthamnid plants occur in dry climates on all hemispheres, although their numbers and proportion are much higher in that vast floristic region that stretches from Portugal and Morocco in the West all the way to the dry rainshadow of the Himalaya 4000 miles to the east.

For years it was assumed that spininess in Mediterranean plants was an evolved adaptation to intensive grazing by herbivores. One would assume that wherever grazing animals gather in greatest numbers, plants would resort to their most defensive posture. Various clever botanists noted that those regions on earth where herbivores occur in the largest numbers—the savannahs of Africa and India, the pampas of South America, the Great Plains of North America, and the grasslands north and east of the Black Sea in Asia—are in fact not particularly rich in spiny plants. So other explanations are often proffered to rationalize spininess in plants: maybe spines provide shade, or a mathematically calibrated mesh to

condense fog or dew for a little added precipitation?

Few gardeners will stay awake nights worrying about the etiology of spines: what intrigues one more after a while is the dramatic architecture of spiny plants. Plants that have the acanthamoid, chickenwire habit will often form a billowy shape as they mature, and many have tiny evergreen or silver leaves that give them year-around interest in gardens. These rounded mounds can perform much the same function in a dry rock garden as dwarf conifers—providing a permanent framework around which evanescent alpiners bloom and disappear. Most spiny plants have deep taproots, a water-thrifty character, and never grow into large plants. Therefore they never become the maintenance nightmare that not-so-dwarf conifers are apt to be in time.

Let's consider a few of the commoner spiny plants that you can grow from seed or obtain from rare plant nurseries. *Ptilotrichum spinosum* 'Purpureum' may be the best known in traditional rock gardens. The typical form of this makes a lavender-purple mound that glows with flowers for upwards of a month in late spring in Colorado. This color combines well with practically any other hue, particularly the yellows, whites, and pinks so common in late May and early June. It loves hot, sunny climates and limy soils, so don't be surprised if it looks a bit drawn and unhappy planted among rhododendrons or in shade. There must be attractive white forms of the species, but here I must confess that the only ones I have ever seen or grown are a rather dingy white, not nearly as attractive as the dark lavender cultivars. Seed is occasionally offered in exchanges, but cuttings are the only way to perpetuate the fine purple forms.

Several other species in this genus are cultivated from time to time, and

most are characterized by a spiny habit. *Ptilotrichum macrocarpum* has provided showy white flowers in the Rock Alpine Garden over the course of many years. It tends to form a lower, flatter mound with less attractive spines but is still a year-around silver shrublet that makes a permanent addition to sunny, limy gardens. The flowers are only a centimeter across, but they are that papery white perfected in so many crucifers. They're produced in such profusion that a colony makes quite a statement in the late spring garden. *Ptilotrichum cadevallianum* is similar, smaller in size, larger in leaf, and less brilliant in bloom. Likewise, *Ptilotrichum lapeyrousianum*.

Connoisseurs of spiny plants eventually discover *Vella spinosa*. This remarkable shrublet is also a crucifer, although very different in its effect. It also grows in the Iberian Peninsula in rocky habitats at somewhat lower elevations. *Vella* has slightly coarser spination and deeper green, rough-textured leaves that give it a dark presence in the garden which contrasts delightfully with silver-leaved plants. The flowers, produced over much of the spring and early summer, are four-petaled stars that have been called straw yellow by some and biscuit yellow by others. The flowers have a brassy, moonlight glow that looks different in every light—a fascinating addition to the sunny rock garden. Even the fruits of this plant strike a distinctive note: rather than the flat siliques so typical of crucifers, *Vella* forms swollen, one-sided capsules that are interesting in their own right.

In both southern Spain and the highest reaches of the Atlas Mountains of Morocco, the spiny alyssum often grows with two superficially similar plants in altogether different families. The hedgehog broom is a legume. *Erinacea pungens* has far heavier spines and shrubby habit than the

alyssum. It can grow over a foot in height and broader, making a dramatic mound in a large rock garden. Unfortunately, large specimens are almost as rare as hedgehogs in North America. After a number of years, if it is happy, lavender-blue, butterfly-like blooms cover the plant in May and June. Collecting seed from a mature plant is a task undertaken only by masochists and devoted nurserymen. Cuttings are no substitute, as they root slowly and erratically, and the resultant plants are painfully slow to mature.

Superficially, the spiny umbel, *Bupleurum spinosum*, looks much more like spiny alyssum than its hedgehog broom associate. It is fascinating to see what different morphological features each plant seems to select to form the spines. In the *Bupleurum*, the twiggy petioles that produce the flowers transform into naked, gray-green spines as the seeds are shed in late autumn. In the garden in Colorado *Bupleurum spinosum* blooms several months after its alpine associates. The first flowers open mid-August, and peak bloom occurs a few weeks later. The seed doesn't ripen until after heavy frosts. Like other bupleurums, the flowers are chartreuse umbels that leave novice gardeners cold. The color combines surprisingly well with the reds, purples, oranges, or yellows that are common in the garden in late summer, and so makes a valuable addition. Several plants of this have survived -25°F weather two years in succession with no damage whatsoever—it is one of the very hardiest spiny plants.

The mint family is particularly abundant and diverse in the Mediterranean region. *Teucrium subspinosum* is one of the few of this family that produces a modest spiny armature. This compact germander rarely grows more than 5-6" tall in cultivation; an old plant may grow nearly a foot across. The pastel

lavender-pink flowers are a perfect size to complement the tiny leaves and twiggy habit of this slightly tender shrublet from the Balearic Islands off the coast of Spain. I find this subtle plant irresistible, and I am constantly propagating bits to test for hardiness in the Rock Alpine Garden. From time to time a plant survives the winter, but I cannot recommend this plant for outdoor culture in USDA zone 5 or colder. Nevertheless, Paul Maslin grew this out-of-doors for many years nearby in the "Banana Belt" of Boulder, Colorado. Perhaps germ plasm from higher elevations in Majorca would produce a reliably hardy plant?

Few plants seem to delight the intellectual curiosity of average people more than a spiny, shrubby dwarf mullein or a spiny dwarf chicory. Practically everyone knows the weedy mullein and chicory of waste places, and neither plant would seem by any stretch of the imagination to beg admission to a rock garden. But, in fact, there are a number of tiny mulleins that make fine rock garden plants. Only *Verbascum spinosum* from a few high mountains in Crete produces spiny armature, however. Seedlings form wavy, silvery rosettes that soon sprout the first twiggy spike covered with tiny, lemon-yellow flowers. In warm, dry climates this can form a miniature shrub a foot or more in height, although in Colorado it rarely lives more than two or three years before succumbing to the cold of winter. A seedling with habit intermediate between the Cretan species and a larger flowered mullein from Western Asia occurred spontaneously in the alpine section of the Royal Horticultural Society's garden at Wisley. This was subsequently named for the curator's wife, Letitia Aslet, and 'Letitia' is much showier and longer-lived—a delightful acquisition for a rock garden. It roots readily from cuttings,

forming a mound a foot in height and almost two across when ideally suited. Since the cross appears to be sterile, the plant blooms far longer and more heavily than its fruitful parents. Purists will still insist on acquiring the Cretan endemic, which is definitely the spinier plant.

The spiny chicory is likewise somewhat tender in Colorado, although it will bloom the first year from seed if started early enough in a greenhouse, and it makes a wonderful addition to an alpine house. The early rosette is a deep, steely green like the larger chicory only with a neat, almost prismatic indentation on the leaves that makes them decorative in their own right. The twiggly shrub gradually grows to 6-8" tall and broad, producing myriad blue miniature blossoms much like the roadside chicory in color and shape. Unfortunately, these bloom best in the late afternoon, evening, and early morning; I rarely saw the flowers when I grew this plant at work, but it's perfect in the home garden for the commuter. In an irrigated garden, flowering occurs throughout the summer. Collecting the tiny seed capsules among the spines is a task known to inspire colorful language. Like the weedy chicory, the spiny dwarf is edible and frequently collected to be eaten as a potherb in Greece. If you decide you don't care for it in the garden, boil it up and serve with lemon and olive oil!

The spiny chicory is particularly abundant in the eastern Mediterranean Basin, where it occurs over a wide altitudinal range and in many ecosystems. *Drypis spinosa* is far rarer in nature, appearing sporadically on cliffs in the Balkan peninsula. This plant doesn't produce an armature like the others, but seems to have a variety of spiny tips on leaves and flower bracts alike. The foliage makes a fine mounded cushion resembling its traditional alpine cousins in the pink family like

*Dianthus* or *Arenaria*. The flowers are unlike any other plant in the vegetable kingdom, however: frilly white petals are produced in two neat ranks forming an absurdly symmetrical rectangle. Several people have noted that in bloom this plant has a whimsical and unmistakable resemblance to stadium lighting, something I would hesitate to mention in print if I had noted it only myself. I doubt if the timid souls who insist on common names are still reading this far into this article, but if one has, may I suggest the common name of "stadium light flower" for the modest *Drypis*? It produces its starry modules over much of the growing season. Unfortunately, the flowers glow only in the daylight hours—otherwise its future in sports arenas would be more promising.

Plants with chickenwire armature may be largely restricted to the Mediterranean floristic province, but thistles seem to grow everywhere. Not just Scotsmen but under pressure *everyone* will concede the architectural beauty of thistle rosettes and their glowing, bristly blossoms. Even the weediest sorts remind me a little of *Acanthus*, which after all inspired the ancient Greeks to design their most elaborate and poetic capital for their columns.

Many thistles are naturally variegated, adding to their value as foliage plants in the garden. Even the nasty prickliness that annoys us so much when we try to remove these plants without gloves is a trait I have come to appreciate more and more as curator of a public garden. There are certain places in the garden where the public insists on creating short cuts. Wise designers are supposed to plan paths there, but sometimes, in the interest of art or science, you may not choose to accede to logic and need to repel people or pets. May I recommend *Cirsium spinosissimum*? As the Latin

suggests, it is considerably spicier than its cousin, bull thistle (*Cirsium arvense*). It is also biennial, and forms almost as big a rosette as its weedy counterpart. It is nevertheless a *bona fide* alpine, found in high pastures throughout the European Alps. Unlike its weedier cousins, the rosette of the spiniest thistle is little more symmetrical, more variegated, more thorny, nastier—and irresistible. Few plants attract more comment than this foliar extravaganza in a garden. The unbelievably spiny rosette and its possible applications are reason enough to grow this plant, but I must tell you that all thistles have an added bonus. Their blossoms are the preferred source of nectar for swallowtail butterflies. When the spiny thistle is in bloom, it is rarely without two or three swallowtails perched atop its yard-high stems, and I have counted dozens of butterflies, sometimes four or more species, hovering over my colonies at a time.

A yard-tall *Cirsium* is out of place in most alpine gardens, but another member of this genus is trim enough for fastidious tastes. *Cirsium acaule* has been confused with *Carlina acaulis* (another outstanding alpine thistle discussed below). The short-stemmed rosette is similar, although somewhat greener in the *Cirsium*. The rich purple flowers are perfect miniatures of the bull thistle, however, and are produced for weeks on end in early summer. In rich soil, *C. acaule* can form a large, handsome clump almost a foot across with several crowns and dozens of stemless flowers, although in scree it is generally half that size. Either way, this abundant alpine of the high Alps makes a fine, restrained, and long-lived addition to the alpine garden.

No matter how fascinating in foliage and bloom, a thistle going to seed eventually becomes unkempt and can frighten farmers and delicate garden visitors. I

must confess that I usually cut fruiting stems and remove biennial plants as the flowers fade and the swallowtails lose interest. I doubt that the choicer thistles would ever become pests in the garden even if you let them go entirely to seed. A few self-sown seedlings are always welcome, but dead-heading and removal are time-honored ways to keep vigorous seeders from becoming a nuisance. Who could blame you for taking such a precaution?

Most visitors to the Rock Alpine Garden at Denver Botanic Gardens notice the giant rosettes of *Onopordon acaulon* that I allow to plant themselves here and there strategically through the whole garden. The broad, mealy-white leaves are dramatically toothed, each tooth ending in an emphatic spine—this is a plant that is noticed in the garden. It is similar in effect to the better known *Silybum marianum*, or St. Mary's thistle, which is however more variegated and often larger. Both are biennial with stemless flowers just as attractive to butterflies as those of other thistles. *Onopordon* is found wild in the western Mediterranean region, while *Silybum* grows throughout the Mediterranean and has naturalized many other places as well.

There are a few thistles that not only are not weeds but qualify as choice alpine. Three genera of plants closely related to *Cirsium* are found on alpine summits of the Mediterranean. Each of this trio actually consists of a pair of species of almost equally outstanding merit for the garden.

The best known of the choice thistles are the high alpine thistles of the Alps, *Carlina acaulis* and its cousin, *C. acanthifolia*, which has more deeply cut leaves. These are favorite plants of hikers in the Alps and are universally praised in rock garden books, where they occur far more frequently than in gardens. Neither species is difficult to

grow, and they have persisted for upwards of eight years for me so far in the garden. It must be their unfortunate association with thistles that prevents them from more frequent cultivation. Both species have deeply cut rosettes quite similar to a compact bull thistle in overall appearance (plenty spiny enough to endear themselves to psychopathic mentalities). Their merit lies in their immense lavender flowers sparkling like ground-level fireworks. These come in midsummer when the garden needs a pick-me-up. Once the precious fluff of seed is released, the empty, brassy involucre forms a huge cup in the center of the rosette that is almost as lovely as the flower heads. It will last all winter if you can keep dry flower arrangers away from it; it is irresistible for anyone given to that practical hobby. I have only had a single self-sown seedling of these choice plants in all the years I have grown them, a dismal track record for a thistle.

I have yet to meet anyone who could resist the alpine thistle of the Atlas mountains. *Carduncellus rhapsodicoides* and its congener *C. pinnatus* both grow at high elevations in the mountains of Morocco where they form neat, waxy tufts 4-5" across that eventually clump up into multiheaded mounds. The almost succulent foliage is always trim and neat. Visitors to our garden always notice these and ask where they can get them. Plants do produce seed and can be divided, but never quite fast enough to satisfy the demand. Even avowed thistle haters make exceptions for these aristocratic plants. I would be hard-pressed to say whether I preferred *C. rhapsodicoides* or the even thistlier *C. pinnatus*. The former has smooth, dark green leaves with a bristly edging of hairs, while the latter is dramatically slashed and cut, like, well, like a snazzy, high-class thistle. If these have a fault, it is that their

luminous, lavender flowers that glow with an almost extra-terrestrial beauty only last for a few days. The slowly developing buds are almost as showy, however, for weeks and months before flowering, and the seed head is quite respectably attractive as well.

The final pair of thistles also comes from high mountains, this time in Turkey. Most members of *Jurinea* are rather coarse plants of marginal horticultural interest, but the two varieties of the closely allied *Jurinella moschus* are outstanding alpine recently introduced by Josef Halda and a few other Czech collectors. *Jurinella* is a small genus largely distributed in western and central Asia. *Jurinella moschus* v. *moschus* has more coarsely cut foliage of a waxy texture and unusual blue-gray color. The flowers are lavender shaving brushes produced at ground level beginning in March and on and off to May. *Jurinella moschus* v. *pinnatisecta* is undeniably showier, with a much larger flower like a turquoise sea urchin over a filigreed rosette. Josef Halda believes that they are so distinct that they might well be regarded as separate species rather than varieties. Either one would be a thistle admissible to the most polite company of alpine.

There are still cacti and the hedgehog domes of a hundred kinds of *Acantholimon*, the bristly hemispheres of *Onobrychis cornuta* and *O. echnida*, roses, and the steely blues of *Eryngium*. Spiny plants have much to offer the rock garden in bloom, leaf, and architectural beauty. Let's grasp their utility firmly and without fear, however gingerly we weed around them.

Panayoti Kelaidis has been rock gardening for the past 30 years in and about Denver, Colorado. Over the years he has grown thousands of species of plants and has learned to love the peculiar and the prickly, as well as more accessible alpine.



Chowder Ridge (pp. 285-289)

Photos by Ronald Taylor

*Vaccinium deliciosum* (p. 286)





*Phacelia sericea* (p. 288)

photos by Ronald Taylor

*Anemone drummondii* (p. 286)







Striping of vegetation on Chowder Ridge (p. 287)

*Castilleja rupicola* (p. 287)

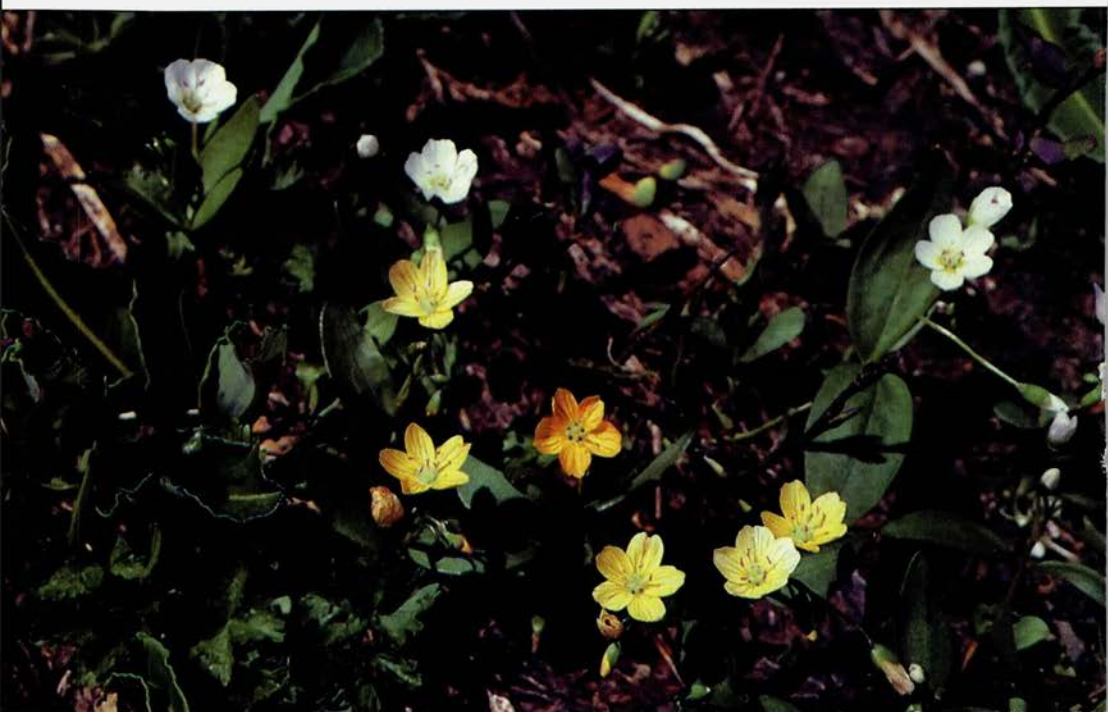


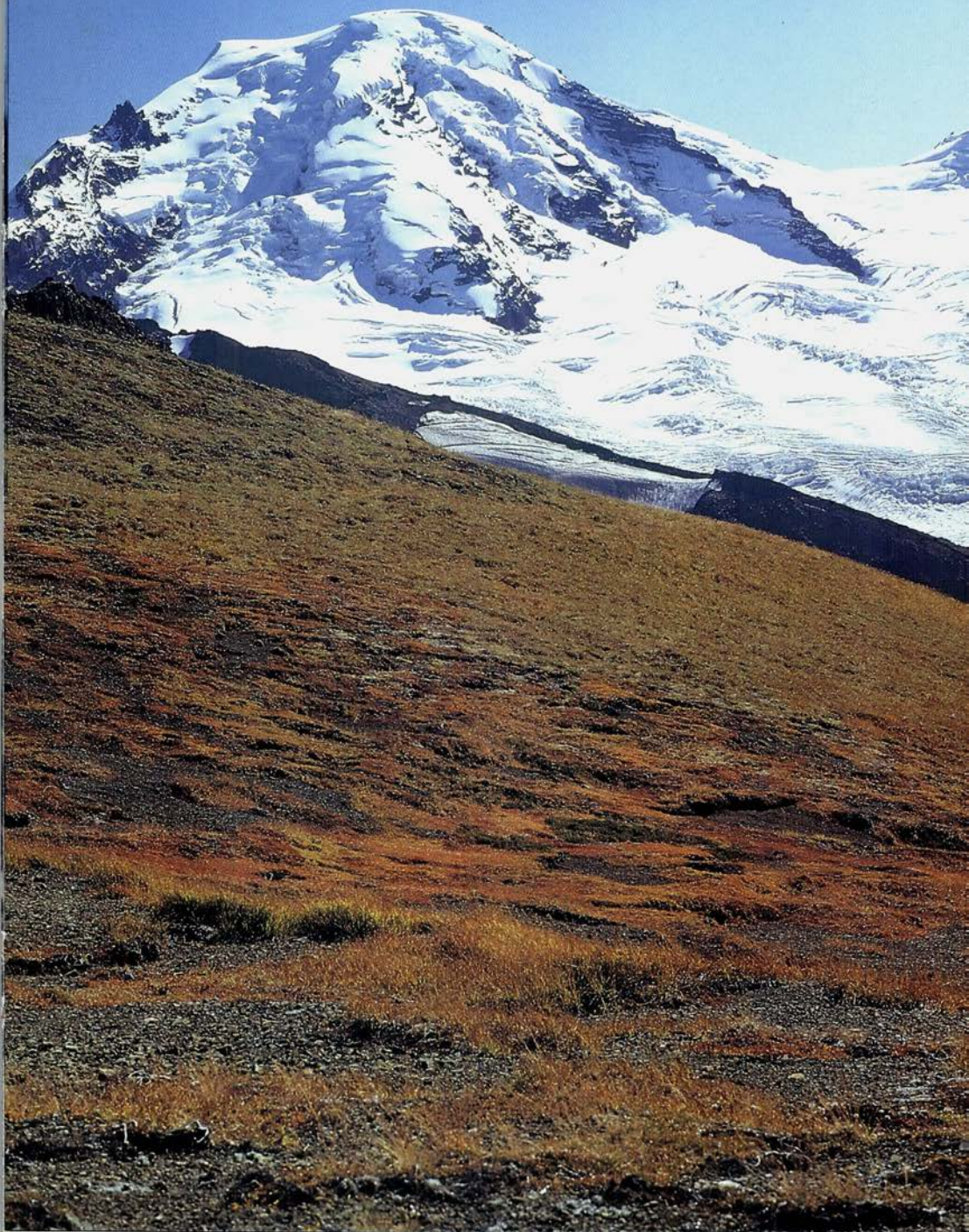


*Haplopappus (Tonestus) lyallii* (p. 288)

photos by Ronald Taylor

*Claytonia lanceolata* var. *chrysantha* (p. 289)





South slope of Chowder Ridge with Mt. Baker in the background (pp. 285-289)



*Saxifraga oppositifolia* (p. 287)

Photos by Ronald Taylor

*Silene acaulis* (p. 287)





Sunset and moonglow over Mt. Baker

*Cassiope mertensiana* (p. 289)





*Potentilla fruticosa* (p. 287)

Photos by Ronald Taylor

*Mimulus tilingii* (p. 286)



# Chowder Ridge, An Alpine Showcase

*by Ronald J. Taylor*

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**T**he North Cascades is one of nature's masterpieces with its many panoramic vistas. Although beauty is an individual interpretation, no one can fail to be impressed by the grandeur of the lofty mountains and the striking contrast between the greenery of the forests, the multi-colored wildflowers of the alpine and subalpine slopes, the brilliant white of the snow, and the scarred, pale blue of the ice fields. To this setting are added the many lakes and the sparkling streams that cascade downward to form the rivers below.

The crown jewel of the North Cascades is the Mount Baker Wilderness of Washington State. Chowder Ridge, a major part of this wilderness, contains the largest area of continuous alpine vegetation. The ridge crest is approximately 3.2 miles long and is oriented from northwest to southeast, butting against the west slope of Mount Baker. The elevation varies from approximately 6500' to over 7500', the highest point being Hadley Peak. Near the center of Chowder Ridge and perpendicular to it, running toward the north, is Cougar Divide. Expansive subalpine meadows and scattered tree

clumps occur in the area of the "T" formed from these joining ridges. These meadows are lush and strikingly attractive with their array of colorful wildflowers. Wild animals are frequently observed as they move between forest and meadow or feed on the lush meadow vegetation. Blue grouse are often heard but seldom seen as they emit their low basal calls from the shelter of tree clumps. The shrill whistles of marmots pierce the thin mountain air as sentinels warn of approaching danger. The burrows of marmots characteristically mark the meadows, especially in dense vegetation below snowfields. Pikas are common inhabitants of coarse talus slopes and rock outcrops. Deer frequent the region, grazing on the meadow vegetation or browsing on the shrubs in and around tree clumps, but never wandering far from the safety of the continuous forest. Mountain goats range from the upper limits of the forest zone to the alpine slopes of Chowder. Bear forage through the area, especially in autumn when the huckleberries are ripe. Finally, everywhere there is evidence of small rodents such as the heather vole

which burrows beneath the snow leaving long dirt mounds, nests of dried plants, and latrine piles.

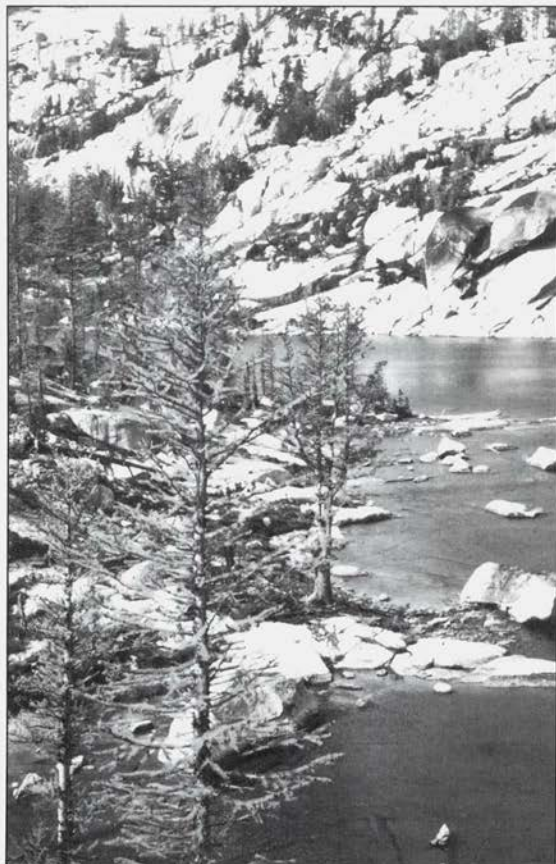
The north slope of Chowder Ridge is steep and covered above by permanent or late melting snow fields toward the west, and by the Mazama Glacier adjacent to Mount Baker. Vegetation is sparse on this expansive slope except toward the base, as noted above, and where the scree, talus, and rock outcrops are interrupted by benches appearing as islands of dwarf shrubs and stunted mountain hemlocks and subalpine firs (krummholz). From a distance, the north slope is indeed spectacular with its contrasting colors and rugged topography. The foothills immediately above Cougar Divide are

blanketed by Cascade huckleberries (*Vaccinium deliciosum*, photo, p. 277) which have brilliant fall colors of red, orange, and yellow. The purple fruits of these 6" shrubs are as delectable as the Latin name suggests. A prominent, mat-forming associate of the huckleberry is partridge foot (*Luetkea pectinata*). This low herb has attractive small flowers in dense, terminal clusters, and divided leaves that resemble the foot of a partridge.

The scattered dwarf shrub communities at middle elevations on the north slope are dominated by red and white heather (*Phyllodoce empetriformis* and *Cassiope mertensiana*, photo, p. 283). Associated plants represent a mix of subalpine and alpine species. Among the former are the conspicuous subalpine daisy (*Erigeron peregrinus*) and broad-leaf lupine (*Lupinus latifolius*). On wet scree slopes the unusual and attractive Tolmie's saxifrage (*Saxifraga tolmiei*) is a frequent inhabitant. Along streams formed from melting snow, the beautiful alpine monkey flower (*Mimulus tilingii*, photo, p. 284) can occasionally be seen.

An unusual attraction of the north slope is the fossil fauna, primarily clam shells. It was because of the abundance of these fossils that Chowder Ridge got its name. The ridge is largely of sedimentary origin but has andesitic deposits associated with volcanic eruptions of Mount Baker. Alpine glaciers of the Pleistocene period were also involved in forming and shaping the ridge.

The crest of Chowder narrows progressively from the northwest toward the southeast, developing into a series of

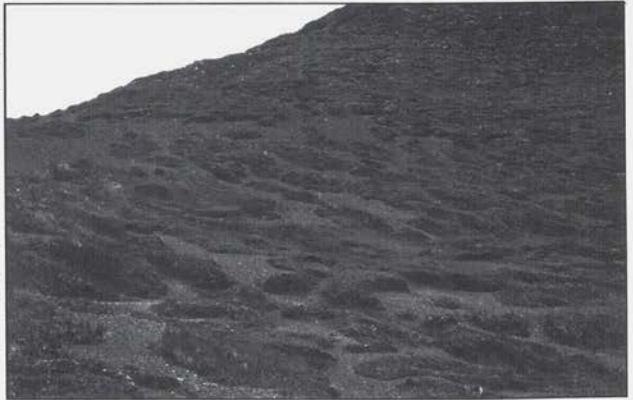




spire-like pinnacles around Hadley Peak and toward Mount Baker. Along this southeast section of the ridge, the south slope is uniformly very steep and covered primarily by loose talus. Here the vegetation is sparse and floristically depauperate but still interesting. The predominant species is shrubby cinquefoil (*Potentilla fruticosa*, photo, p. 284) which spreads to form broad and often spectacular mats. Other very attractive mat-forming plants of this area are Drummond's anemone (*Anemone drummondii*, photo, p. 278), smelowskia (*Smelowskia ovalis*), spotted saxifrage (*Saxifraga bronchialis*), and Davidson's penstemon (*Penstemon davidsonii*). The unusual purple saxifrage (*Saxifraga oppositifolia*, photo, p. 282), a species uncommon to the North Cascades, occurs in abundance here, growing as if painted on vertical rock walls and cliffs—an unlikely habitat for a flowering plant.

While the east half of Chowder has spectacular topography with Mount Baker in the background, the west half is an alpine showcase. The ridge crest consists of a series of rounded prominences and shallow depressions. The south slope remains steep but largely covered with vegetation. The various erosional phenomena that shape and characterize alpine areas are conspicuously evident. Solifluction with mass sloughing of soil occurs along some of the steeper drainages on the south slope. Near the crest, wind scars and blow-outs are frequent. Here the dominant plants are dwarf shrubs, including Cascade willow (*Salix cascadiensis*) and crowberry (*Empetrum nigrum*). Since

these shrubs spread along the ground, rooting at the nodes, they tolerate the high winds and resist uprooting. On scree and gravelly slopes, the small rocks have been sorted by percolating water and gravity. Here the vegetation is arranged in long stripes 9-18" wide, each stripe separated by about 3' of scree material (photo, p. 279). Cushion plants dominate these vegetation stripe



#### Erosion Patterns

communities, with some of the most common species being moss campion (*Silene acaulis*, photo, p. 282), spreading phlox (*Phlox diffusa*), cliff paintbrush (*Castilleja rupicola*, photo, p. 279), and a variety of grasses and sedges. Frost heaving is evident where the soil is rather well developed on shallow slopes supporting herb-field communities discussed below.

The most widespread community types on the western half of Chowder are herb-fields, fell-fields (cushion plant communities), and dwarf shrub communities. Fell-fields occur along or near the ridge crests and are characterized by scattered cushion plants separated by a rocky substrate. These communities are the rock gardens of the alpine zone with their spectacular assortment of cushion plants. The stereotype cushion plant of tundra areas in North America, *Silene acaulis*, achieves its greatest



Solifluction

abundance in these fell-fields. The flowers are tubular, restricting the nectar rewards to long-tongued insects. Individual plants may be pistillate, staminate or perfect (hermaphroditic). Perhaps the most common cushion plant of Chowder is *Phlox diffusa*, another species with tubular flowers. *Saxifraga bronchialis* is also very abundant, forming large mats that become senescent in the center and along the trailing edge, leading to fragmented cushions often of unusual shapes. An alpine form of the prairie lupine (*Lupinus lepidus* var. *lobbii*) is common here and reflects the volcanic influence in the orogeny of the ridge. Other conspicuous species of the fell-fields include: an alpine ecotype of field chickweed (*Cerastium arvense*); two species of stonecrop (*Sedum divergens* and *S. lanceolatum*); field crazyweed (*Oxytropis campestris*), the favorite forage species of bumblebees; vari-leaf cinquefoil (*Potentilla diversifolia*), one of the favorite food sources of syrphid flies; silky phacelia (*Phacelia sericea*, photo, p. 278), an extremely attractive plant with its dense clusters of bright blue flowers and exserted purple anthers contrasting with the gray-green, silky, fern-like

leaves; alpine goldenrod (*Solidago multiradiata*); Lyall's goldenweed (*Haplopappus lyallii*, photo, 280); and *Saxifraga bronchialis*, with its brilliantly spotted petals, obvious only under close examination. Two uncommon fell-field species, rare south of Canada and Alaska, are *Gentiana glauca* and *Aster sibiricus*.

Herb-field communities are characterized by having more or less continuous vegetation comprised of a rich assemblage of plants with a cushion or matted habit. These communities occur along the ridgetop and gentle south slopes where the soil is relatively stable. The most conspicuous species of these herb-fields include *Phlox diffusa*; *Potentilla diversifolia*; *Oxytropis campestris*; *Solidago multiradiata*; an alpine form of yarrow (*Achillea millefolium*); small-flowered (but beautiful) penstemon (*Penstemon procerus*); bellflower (*Campanula rotundifolia*), a very attractive form of the species with unusually large flowers; and a variety of graminoids (sedges and grasses). It is within these communities that the northern fairy-candelabra (*Androsace septentrionalis*), can be found. This is the only annual plant known to occur on Chowder Ridge, and although it is small and inconspicuous, it deserves honorable mention when discussing alpine wildflowers.

Dwarf shrub communities of the alpine zone have close floristic affinities with the subalpine heath communities, but differ in having a predominance of yellow heather (*Phyllodoce glanduliflora*). This species frequently

hybridizes with the red heather in mixed communities, producing a pale pink-flowered intermediate. Other dwarf shrubs include some combination of *Salix cascadiensis*, snow willow (*Salix nivalis*), *Vaccinium deliciosum*, *Cassiope mertensiana*, and *Empetrum nigrum*.

There are other habitat types on Chowder Ridge. These include rock outcroppings and rock crevices. The former are marked by a colorful combination of crustose lichens and a few specialized flowering plants, such as Payson's draba (*Draba paysonii*), a dense cushion plant with a brilliant display of bright yellow flowers. In rock crevices alpine sorrel (*Oxyria digyna*) is a regular inhabitant.

There are also small pockets of subalpine vegetation in protected sites along the ridgetop. A conspicuous representative of these sites is Cusick's speedwell (*Veronica cusickii*), an unusually attractive member of the genus. Also, a plant of unusual beauty found in these refugia is the yellow-flowered form of spring beauty (*Claytonia lanceolata*, photo, p. 280). This rare color form has traditionally been treated as a separate variety (*Claytonia lanceolata* var. *chrysantha*).

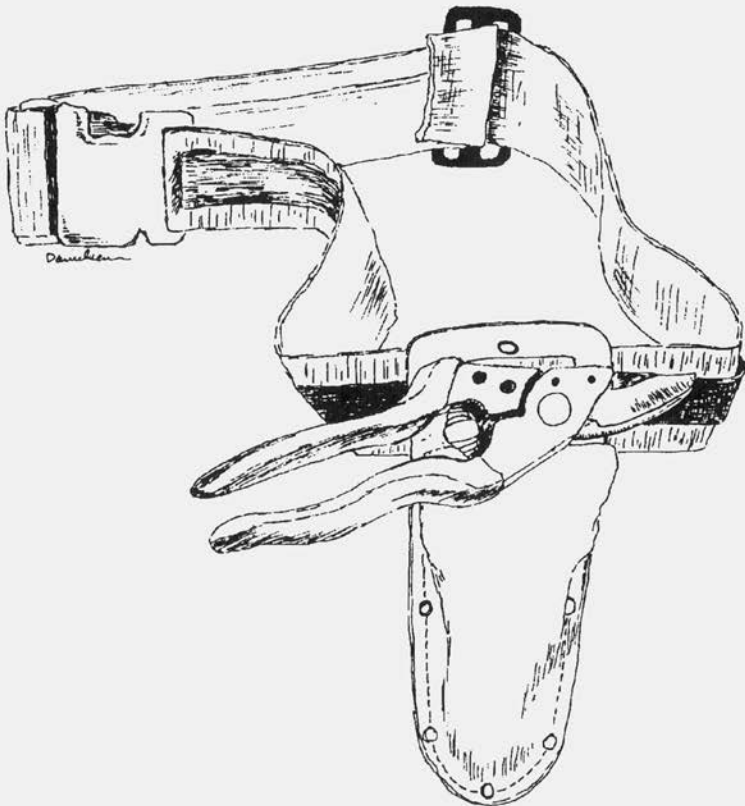
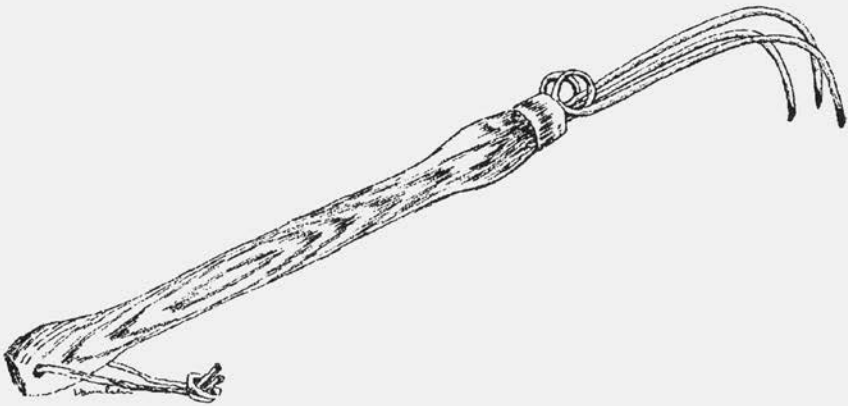
Although many animals spend part of their life in the alpine zone, few live there the year round. Those animals most often associated with the high treeless slopes of Chowder Ridge are mountain goat and ptarmigan, the latter as fearless as the former is wary. The ptarmigan is a master of camouflage with white plumage in winter and gray in summer. Even during the time of molt, its white and gray colors match those of its world of boulders. Nevertheless, the ptarmigan is frequently observed, often with several chicks.

In spite of its awesome beauty, the alpine area of Chowder Ridge, like the alpine zone everywhere, is a hostile

environment. Unlike the animals, the plants cannot seek shelter during adverse conditions. They must have special morphological and physiological adaptations to survive. They must be generalists, in the sense that they tolerate the extreme and variable climatic and adverse soil conditions. Many have a cushion habit, providing protection from wind and desiccation yet concentrating solar energy at ground level and warming the roots. Most plants are covered with silky hairs, which form an insulation layer against rapid temperature change and water loss during hot and windy summer days. And, finally, all must be metabolically in tune with the unpredictable, non-rhythmic climate conditions.

Chowder Ridge is not easily accessible. It can be reached from Skyline Divide, a six-mile hike terminated by a scramble up the rocky west end of Chowder, or from Cougar Divide, a five-mile hike terminated by traversing a very steep north slope snow field. Both routes have their ups and downs, mostly ups. Neither should be attempted earlier than July 4th. Skyline and Cougar Divides are accessed from the Mount Baker Highway, east of Bellingham, Washington. Visitors should check in at the Glacier Ranger Station en route.

Ron Taylor is an avid outdoorsman who divides his time away from his professional responsibilities between working on his 5-acre "plantation" and hiking in the North Cascades. He and his wife Gloria raise native and cultivated trees, shrubs, and flowering herbs. Chowder Ridge is his favorite montane retreat, both for research and relaxation. He is the author of four field guides: *Sagebrush Country* (with Rolf Valum), *Mountain Wildflowers of the Pacific Northwest* (with George Douglas), *Rocky Mountain Wildflowers*, and *Northwest Weeds*.



# Tools I have Loved, Lost, and Thrown Out

by *Sandy Snyder*

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For ten years I have been acquiring gardening tools. Now I have two sheds and a garage full of all the hand tools for gardening that I might ever want. I have learned that I need only a small closet full of these to garden enjoyably and with efficiency. This little tool closet would contain shovels, trowels, cultivators, and a very good pair of pruners.

Think carefully about what you want a tool to do for you before you buy. Does the tool have the specifications a tool must have for you to use it easily? Most tools are too good to just throw out, so whatever does not really fit you and your needs will clutter the tool shed for years.

There are hundreds of different kinds of shovels. Usually the shovel's shape determines the specific job that it can do. Shovels come in many different shapes, sizes, hefts, and qualities. Consider yourself lucky if you went out and bought the correct shovel for you and your needs the first time. And luckier still if it is serving you well after many years. My first shovel was perfect for me but I broke it—because I didn't know how to dig properly.

Digging is a skill that I didn't realize I didn't have until I acquired it. I am an expert on shovels now because I have broken so many as I was learning how to dig. Most people won't stop work and get another tool when they run into a root or a rock, and so they use the shovel for a multi-purpose tool. That's how most shovels break.

The most important thing is to have a shovel that is weighted so that you can handle it easily with a load of dirt. Too heavy a shovel tires you too easily and becomes cumbersome. If the shovel is too light or too small it will not be efficient. You won't be able to get into a rhythm. The grip should be of the proper diameter and the handle should be the right length—so that it is not always getting in your way even though you are the one using it. The perfect shovel is different for each gardener and for each job. Your size and strength and your preference for heft are factors.

The time to buy a shovel is when you need one. The shoveling job you want to accomplish dictates the type of shovel you should buy. Are you spreading dirt or digging holes? For spreading



dirt you want a wide, flat shovel. For digging holes you want a pointed spade. Do not buy a shovel because the price is right or because you might need one someday. I guarantee that just because you have that shovel, the appropriate job will never present itself. The bargain shovel will hang around for years getting in the way.

Another reason not to buy a shovel is because you like the color of its sturdy fiberglass handle. You may justify the shovel's price because the handle is so state-of-the-art it will never break. The handle is important because shovel handles seem to break regularly during the first few years when a person is enthusiastically learning to dig. If the colorful shovel does not satisfy you by having the right digging angle, the right weight—so that you can lift easily and still get the job done—and the right size for you, you won't use it. You might start wishing this expensive shovel would break just so you could throw it away.

As a rock gardener, the shovel I find that I use most often after

the garden has been built is one that I have heard called a lady's shovel. It is long handled, has a pointed tip, and is terrific for moving large and small perennials, digging bulb holes, and planting in hard soil.

Another perfect shovel for the rock gardener is the poacher's spade. Originally this small, sturdy shovel was used by the squire's estate workers who walked the land at dusk looking for rabbit holes. A swift cut of the spade would open the warren and flush out the game. This well-balanced, sturdy tool works as well in the garden as it did in the field. The best source I know for this shovel is Smith and Hawkens, for about \$50.

As for trowels, there is a great selection. There are fat and skinny ones. The one you choose depends on the job. For a rock garden, I prefer the long, skinny variety that is sleek and not too fat to grip. I hate a trowel with a fat grip. Again the balance of the tool is important. But the most important thing is that the trowel should not bend when you are digging with it. The cheap ones *always* break—usually right in half at the base of the blade. Sometimes they bend and sometimes they break at the weld. The quality of construction is very important. Sometimes you will buy a rugged trowel that is simply too heavy and rough to use. The trick is finding a delicately balanced trowel that retains its strength.

By the way, a quality hardware store or garden center, or a worthwhile mail-order house will refund your money if you break their tool in normal use. I have broken many tools and I always take them back. One retailer has discontinued a whole line of tools because of my experiences.

You might think that the cultivator, or scratcher, is a tool that would be easy enough to buy, and that it would satisfy your requirements even if you gave no

thought to how and what you will use it for. It is made to do exactly what the name implies, scratch around in the soil. But think again. Do you need a long-handled one that has the advantage of allowing you to stand up and fluff the soil around the plants at the edges of the path? Or a short-handled one that allows you to sit down but still look as if you are working? For me, the real benefit of a long-handled scratcher is that when you are on your knees you can cultivate most beds without stepping into them. With the short-handled scratcher you have better control and manipulation. You have to make up your mind whether both sizes are necessary in your tool shed even though all of the work could be done with either one. I like having both in my collection because I can never predict how the weather or my mood will determine my approach to gardening, and either may dictate my choice of handle.

Scratchers have many different prices. Some look cheap—and they are—but they still do the job well. Others look as if they should never be touched because they are so shiny you don't want to get even a finger print on them, much less dirt. I have finally discovered the most important thing to look for when buying scratchers: Buy one with a little curl included into thin, strong, wire-like prongs. This tool is like a dream compared to the others. It is an old-time tool that seems to have been re-introduced into the market. It is light, sturdy, and springy. Lumps of clay cannot clog it. Its handle is longer than average for a short-handle cultivator. And if you can find it on sale, it can cost as little as \$3. At the better garden shops it is usually priced at \$13. The only disadvantage of this tool is that its handle is made of a dark wood and its springy thin wire prongs are black. If you leave the tool lying somewhere in your garden, it is difficult to find. That

is why I like to tie a hot-pink plastic bow on most of my tools. This tape identifies them as mine and helps in relocating them. However, it does detract from the sleek appearance of a fine tool.

A good, sharp pair of pruners is a pleasure and a necessity if you are a gardener. The blade should be made of good steel so that it will easily take a sharpening edge. Even if you know how to sharpen, it is very difficult to sharpen pruners made of poor steel. You should be able to disassemble the pruners and replace the blade after it wears out. I find the best pruners are in the \$30 range, and I particularly like Felco. Felco has many different shapes and styles to suit your preferences; all are of high quality in that price range.

I bought a good pair of pruners for \$30 and then lost them the next day. I went through several pairs of pruners this way, each time scaling down the price. Finally I asked myself why I was putting up with such a cheap, shoddy pair of pruners, if this was the tool I needed most and most often. The answer was that when I was finished using my pruners I had no place to put them but my back pocket. This was not satisfactory because they were not safe there. They fell out easily. The blade cut through my jeans. They punctured and ripped my truck upholstery because I forgot I had them in my back pocket. So I bought a leather scabbard that I could attach to my belt. It kept the garden pruners handy when I needed them and provided a quick, safe place to carry them when I did not need them. This arrangement more or less worked unless I forgot to wear a belt on my jeans. Then I would have to stuff the bulky scabbard *and* the pruners in my back pocket. This is not very practical, and it hurts if you are wearing tight pants!

If I forget to take the scabbard and the pruners off my belt when I have finished

gardening, people look at me in a strange way. Once I went to the grocery store after gardening. My jacket was just covering the top of the pruners. While pushing the grocery cart around the aisles, I felt someone following me. I turned around and was asked by a security officer if I was carrying a gun. Incidents like this are embarrassing.

Sometimes it takes an awkward situation to motivate a solution. My solution was a colorful gardening belt made of 2"-wide webbing. I thread the pruner scabbard through the belt. The whole ensemble snaps on and off easily with a quick-release, black plastic 2" belt buckle. I like this arrangement because it is so easy-on and easy-off. When I go out to garden my most-used tool is at my side. When I go to the grocery store, it is hanging on its hook in the potting shed.

The newest tool I would allow closet space for is the Cordless ClipQuik by Weedeater. If your rock garden has cushions and mats the ClipQuik makes short work of cutting off the ragged stems left on a dianthus or thyme after it has gone into seed. It is a small machine held in one hand and is much easier to control than a weedeater designed for edging lawns. This machine has a rechargeable battery and it may run out of power too soon if you have large areas to clean. But for a controlled cutting of small rock garden plants, I think it is perfect. The price is about \$23 at hardware stores.

#### A Few Mail-order Sources of Tools

Smith and Hawken, 25 Corte Madera, Mill Valley, CA 94941

Great Western Bag Company, 1416-18 No. Broadway, St. Louis, MO 63102

Kinsman Company, River Road, Point Pleasant, PA 18950

Woman's Work, PO Box 2547, Kennebunkport, ME 04046

Drawings by Vickie Danielsen.

Sandy Snyder is a great gadget collector and tester and has recently been hired to test tools. She gardens in Littleton, Colorado, and at Denver Botanic Gardens.

Garden equipment and accessories are usually not light, colorful, and fun. These tools were designed and manufactured for strong men who would do the real gardening work. Throughout history, women were not recognized as gardeners. There were weeding women, but they did not need much in the way of tools. *Gardening for Ladies*, by Jane Loudon, was published in 1840. It seems that it was a revolutionary idea for women to dig or do anything heavier than weeding or picking off a few dead blooms. "Digging was very laborious and peculiarly unfitted to the small and delicately formed hands and feet of a woman. If you do dig, you must take out only a little earth at a time when the ground is tolerably dry because of the danger of taking cold by standing on the damp earth." Jane could dig because her gardening husband made a specially sized shovel for her. It is surprising how little thought is given even today to making tools for less than macho people.

Now that there is no longer any stigma on gardening, no matter what your gender or station in life, and now that technology allows us to have light, durable tools, I want more. I want my garden tools to resemble sporting equipment, to look sleek and sexy, to be colorful and custom-designed to fit my size and strength. It's been done for backpacks, tennis rackets, and running shoes—why not for gardeners?



# Jovibarbas, I Presume

by Karen Harris

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Like the famous Dr. Livingston, *Jovibarba* has somehow gotten lost. Actually, it is not so much lost as hidden amongst the sempervivums, gone *incognito*. Many reference books and nurseries simply lump the species of *Jovibarba* with sempervivums. The physical resemblance of these two genera is striking. Nevertheless, *Jovibarba* is readily distinguishable.

The primary difference between the genera is that sempervivums have 8-16 untoothed petals (usually 11 or 12), and the flowers are star-shaped, while *jovibarbas* have 6- or 7-toothed petals and the flowers are distinctively bell-shaped. The two genera do have much in common. Both belong to the family Crassulaceae. They are all stemless, succulent plants that form fleshy, monocarpic rosettes. Plants increase by forming new rosettes at the tips of axillary stolons (except in *J. heuffelii*).

*Jovibarbas* thrive in the same kind of well-drained, gritty soil that the sempervivums require. Scree conditions and rock crevices suit them very well. Too much water will cause the rosette to rot. While both genera need sun, the sempervivums often hold their color

better with partial afternoon shade through the summer months, but *jovibarbas* need full sun to develop the most vivid coloring.

Five species of *jovibarbas* are generally in cultivation. *Jovibarba allionii* is from the southern Alps of France, Austria, and northern Italy. The small, round, yellowish-green rosettes are less than 2" in diameter when mature. The lanceolate, incurved leaves that make up these rosettes taper upwards to a point. Both sides of the leaves are covered with very fine hairs. A magnifying glass is sometimes needed to see this pubescence. This species rarely flowers.

*Jovibarba arenaria* is the smallest species, with pretty, star-shaped rosettes about the size of a chick pea. Adult plants are not much more than 0.5" in diameter. This species is indigenous to the eastern Alps of Austria and Italy. The bright green leaves flush red when given full sun. Again, the leaves have fine pubescence. It is not difficult to grow but the tiny size requires some special care as it is easily lost in the garden. Even in a trough it must be watered carefully or the minute offshoots will be buried by splashes of sand.



from different geographical areas.

Another prolific species is *J. sobolifera*. Native to more northerly areas of central and eastern Europe than the other species, *J. sobolifera* is a cheerful, bright green with distinctively incurved leaves. The leaves have cilia at the edges, but no additional

*Jovibarba heuffelii* does not reproduce by the usual offsets. To propagate this species vegetatively, the plant must be cut into pieces each with a section of the thickened rootstock attached. Rosettes do not die after flowering, and this species flowers relatively readily. The blossoms are pale yellow to cream. This is a highly variable species found throughout the Balkans with a wide range of forms that differ in color, pubescence, and size. All of the varieties have a growth habit that results in a neat hillock of rosettes. This can be a very effective focal point for small arrangements.

*Jovibarba hirta* was first described by Linnaeus in 1755. It is distributed throughout the eastern Alps and Hungary. Another highly variable species, it generally has larger and more open rosettes than the other *jovibarbas*. The rosettes are frequently stellate with dark coloring; leaves tend to be open and have a downy texture. These are quite prolific and produce numerous offshoots. This species is useful if you want to cover a relatively large area quickly. Several varieties are available

Sources include:

Squaw Mountain Gardens, 36212 SE Squaw Mountain Road, Estacada, OR 97023  
 Jim/Irene Russ Quality Plants, HCR 1, Box 6450, Igo, CA 96047  
 Porterhouse Farms, 41370 S.E. Thomas Rd., Sandy, OR 97055  
 Country Cottage, Route 2, Box 130, Sedgwick, KS 67135

Drawings by Jill Buck.

Karen Matthews gardens in Adams, Massachusetts.

hairs. A mature plant may reach 4" across and 2" high, so that the rosette has a somewhat flattened appearance. It rarely flowers. Its numerous offshoots are often referred to as "rollers", an apt name, as the small, round globes will break off and roll as far as they can. They root wherever they land and sometimes show up in rather unexpected places—especially if you have a kitten who discovers these little balls.

All of the *jovibarbas* are ideal plants for troughs, gritty scree areas, or containers. They are effectively displayed in the side pockets of large strawberry pots. I have noticed that the roots run much farther than one would expect. Pots for growing *jovibarbas* should be at least 6" deep, preferably deeper. Plants in smaller pots will languish. Potted specimens benefit from a soil change at least every other spring.

Anyone who enjoys collecting sempervivums would also undoubtedly find *jovibarbas* interesting. They are fascinating specimens and merit greater attention and recognition than they receive in contemporary rock gardens.



# In and About the Black Hills

by James H. Locklear

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No one has done more to open the eyes of gardeners to the horticultural potential of the Great Plains flora than Claude Barr. On his ranch near the Black Hills in South Dakota he started one of the first native plant nurseries in the United States, from which he distributed plants of the Great Plains to gardens throughout this country as well as overseas. His writings, which included numerous articles for the *Bulletin of the American Rock Garden Society*, brought well-deserved attention to the little-known plants of this region. His most lasting contribution, however, was his book, *Jewels of the Plains*, through which we gain access to his 70-plus years of experience with the flora of the Great Plains.

While Barr roamed from Canada to Texas in his search for garden-worthy plants, some of his best finds came from his own backyard—the Black Hills, the badlands, and the surrounding Dakota prairie. This region is host to a great assortment of beautiful, hardy plants, many of rock garden stature.

Viewed from the air, the Black Hills region is basically an oval-shaped dome rising out of the surrounding plains.

When these ancient mountains were uplifted, rock strata to the outside were pushed up and tilted on edge to varying degrees. Barr wrote with fondness of two areas of limestone that were exposed by this process, the Greenhorn limestone, which rings the outer perimeter of the Hills, and the Minnekahta limestone, which lies closer to the interior. While interesting wildflowers can be found throughout the region of the Black Hills, there are special concentrations of plants wherever these two areas of limestone are exposed.

At his ranch south of the Black Hills, Barr was nearest to exposures of the Greenhorn limestone. From a distance the escarpments and hills formed by these outcroppings, which lie between the forested Black Hills and the surrounding mixed grass prairie, appear barren and devoid of any interesting plant growth. Growing on the crests in gravelly soil, however, are a number of attractive rock plants.

Narrow-leaved musineon (*Musineon tenuifolium*, photo, p. 302) is one of the finer ones, with flat-topped clusters of bright yellow flowers held above low tufts of foliage in the spring. The dark

green leaves are finely divided, almost fern-like, making this an attractive plant even after it is finished blooming. The distribution of this member of the parsley family is centered in the Nebraska Panhandle and adjacent Colorado, South Dakota, and Wyoming.

Another special plant found on the Greenhorn is a little erigeron, *Erigeron ochroleucus* var. *scribneri* (photo, p. 302). Barr enthusiastically declared this the "crown jewel" of the plains daisies. Not exceeding 4" in height and only about 6" wide, this diminutive plant bears numerous gold-centered daisies with white ray florets during its spring blooming period. The variety *scribneri* is a dwarf phase of the species and occurs in rocky areas throughout much of the northwestern Great Plains.

One of the most striking plants found in the region is the leather flower (*Clematis hirsutissima*, formerly known as *C. scottii*). This beautiful, non-vining clematis, which is sometimes associated with the Greenhorn, produces dark blue, bonnet-shaped flowers that are borne on gracefully arching stems in the spring. Barr discovered a pink-flowered form that apparently has been lost to horticulture. This species is not unlike *C. fremontii*, which occurs on the limestone-underlain prairies of northcentral Kansas, except that its foliage is pinnately compound. Like many other plants in this region, the populations of this species in the Black Hills represent eastern outliers of a mainly Rocky Mountain-centered distribution.

Of all of the plants found on the Greenhorn limestone, none makes a more impressive show than the alyssum-leaved phlox (*Phlox alyssifolia*, photo, p. 303). This mat-forming phlox is covered with fragrant flowers over a long period in the spring and early summer. While it has a rather

large area of distribution within the northwestern Great Plains, *P. alyssifolia* displays its widest array of colors on the limestone areas associated with the Black Hills. Lavender is the most common color but pinks of various hues can also be found as well as whites and near blues. The flowers may be star-shaped with rather narrow petals or full-faced with wide petals. The flower size of *P. alyssifolia* is larger here than anywhere else in this species' range, being an inch or slightly more across. Edgar Wherry recognized this large-flowered Black Hills phase as a special subspecies, *P. alyssifolia* ssp. *abdita*, and listed it among those members of the genus "deserving wider horticultural use" in his book, *The Genus Phlox*.

Also occurring in the region are two other phloxes, plains phlox (*P. andicola*, photo, p. 303) and Hood's phlox (*P. hoodii*). Both have white flowers and a creeping habit and are smaller in size than *P. alyssifolia*. A joint research project involving the Dyck Arboretum of the Plains in Kansas and the University of Nebraska Department of Horticulture is evaluating the horticultural potential of these three species. Supported by a grant from the Perennial Plant Association, collections have been made of superior wild-growing individuals of each species. These will eventually be grown in field comparison trials along with three cultivars of the popular garden plant, *P. subulata*.

It is fitting that part of these trials will be conducted at the University's research station in North Platte, Nebraska, where Glenn Viehmeyer, an acquaintance of Barr and fellow explorer of the Great Plains flora, did his pioneering work in *Penstemon* selection and breeding. This work, along with other interesting projects involving Great Plains natives, is still being carried on at North Platte by Dr. Dale Lindgren.

The Minnekahta limestone outcrops closer to the interior of the Black Hills, in areas typically vegetated with open stands of ponderosa pine. This rock is itself quite attractive, having a pinkish-gray cast. It occurs at a number of places around the Hills and is conveniently exposed at the south entrance of Wind Cave National Park.

Weathered outcroppings of this limestone are another good place to find the large-flowered form of *Phlox alyssifolia*, which appears even more attractive against the pink backdrop. Blooming with it in the spring are nice patches of mertensia (*Mertensia lanceolata*), with drooping clusters of sunset-colored rose and blue flowers. Gray ragwort (*Senecio canus*) is here as well, its bright yellow daisies contrasting beautifully with its silvery foliage. In crevices in the limestone the little rock fern, *Cheilanthes feei*, can also be found.

*Potentilla concinna*, an herbaceous cinquefoil of dwarf stature, also occurs on the Minnekahta limestone. While only sporting its bright yellow flowers in early spring, its neatly divided foliage, silvery beneath and green to gray on top, makes it a beautiful subject throughout the growing season. Another early spring bloomer, *Anemone patens*, can be found growing in thin soil over the limestone. Known to many as the pasque flower, this plant is the state flower of South Dakota. Quite appropriately, the emblem of the American Rock Garden Society occurs here as well, in the form of the species *Dodecatheon pulchellum* (photo, p. 304). All this in just one corner of Wind Cave National Park! A checklist of the Park's flora is available from its headquarters.

While Barr found many treasures in the Black Hills, his perceptive eye was also cast upon the surrounding grasslands. In May and June the beautiful expanses of mixed grass prairie that roll

away from the Hills are the setting for numerous attractive wildflowers. Many of rock garden stature grow in spaces between the prairie grasses, including Nuttall's violet (*Viola nuttallii*), the yellow-flowered violet of the High Plains. False dandelion (*Microseris cuspidata*) is another that manages to find a place in the prairie turf, its dandelion-like flowers held aloft on stiff stems above a basal tuft of wavy-margined leaves.

In *Jewels of the Plains*, Barr spoke of the challenges of gardening in the tight, sticky clay soil that supports the prairie grasses of this region. He specifically mentioned the tendency of this soil, known locally as "gumbo," to cling to anything when slightly wet, particularly digging tools. I can attest to this, having personally experienced how gumbo can stick to vehicle tires when wet, turning them into oversized glazed donuts incapable of any sort of traction.

One plains wildflower that seems to flourish in this difficult soil is *Oenothera caespitosa* (photo, p. 301), known appropriately as the "gumbo lily." It is one of the few plants that can grow in the raw clay soils of the badland formations that are scattered throughout southwest South Dakota. The large, white flowers of this evening primrose open up around sunset and begin to wither the next morning. On cloudy mornings they will remain open for longer periods of time.

Another species that takes gumbo in stride is crested beardtongue (*Penstemon eriantherus*). This species can be found growing in barren badland soils as well as among the grasses of the prairie. Reaching 8-12" in height, it bears dense, elongate clusters of lavender flowers in the spring. Each flower has a spreading lower lip which displays a dense growth of gold-colored hairs.

Some of the best displays of wildflowers in Claude Barr country are

found on the tops of the rocky hills and buttes that here and there rise above the prairie. Almost any of these will have the draba milkvetch (*Astragalus spatulatus*) present, floating dozens of purple blossoms above little mounds of foliage. Depressed nailwort (*Paronychia depressa*), a more lax-growing relative of the cushion-forming *P. sessiliflora*, is also common. Alpine bladderpod (*Lesquerella alpina*) is equally abundant in rocky habitats in the region, producing numerous bright yellow flowers over low mounds of silvery, spoon-shaped leaves.

While found only occasionally in South Dakota, silver-mounded miner's candle (*Cryptantha cana*, photo, p. 301) is rather common to the south in the Nebraska Panhandle and adjacent parts of Colorado and Wyoming. With attractive silvery foliage and sparkling white, gold-centered flowers, this low-growing plant is one of the most beautiful wildflowers found in the region. Barr called it the gem of its genus.

One May morning, some 40 years ago, Barr found what must have been his most treasured discovery. At an isolated rise called Limestone Butte, not far from his ranch in Fall River County, he came across a little cushion-forming milkvetch that he had not encountered before. With silvery, three-parted leaves and rose-colored blossoms, it resembled *Astragalus tridactylicus*, a species of the Rocky Mountain foothills in northeastern Colorado and southeastern Wyoming. Barr was able to propagate this plant and later offer it through his mail-order nursery, Prairie Gem Ranch.

Eventually some of these plants were obtained by Rupert Barneby of the New York Botanical Garden, an international expert on the genus *Astragalus*. Barneby, who was familiar with *A. tridactylicus*, had some question about the identity of Barr's plants and requested that Barr supply him with pressed speci-

mens. This he did and Barneby was able to determine that, indeed, these plants were not *A. tridactylicus*; they were instead a species new to science. Thanks to Barneby's discernment, Barr now had a new name to list in his nursery catalog—*Astragalus barrii*!

In the midst of Barneby's technical description of *A. barrii*, published in a scientific journal in 1956, is a warmly-written tribute to Claude Barr: "It is a pleasure to associate this delightful little *Astragalus* with the name of Claude A. Barr, keen observer and successful cultivator of the prairie and badlands floras, who through the medium of his nursery at Prairie Gem Ranch near Smithwick has done much to introduce to gardeners here and abroad the beauties of the native vegetation."

Today Barr's milkvetch (photo, p. 304) is known to occur in southwest South Dakota, northeast Wyoming, and southeast Montana. Its restricted distribution makes it one of a small number of species that are truly endemic to the Great Plains. Most of the populations of this attractive little plant occur in the Powder River Basin country of northeast Wyoming, but even in this area it is not very common. In South Dakota it is known from only a handful of locations; I am glad that one of these is Limestone Butte and that Claude Barr was there exploring one spring day. It is fitting that one of the most beautiful species in the flora of the Great Plains should be discovered by and named for the man who so loved this region and its plants.

For information about the Claude A. Barr Memorial Great Plains Gardens, write director Cynthia Reed, Great Plains Botanical Society, PO Box 461, Hot Springs, SD 57747.

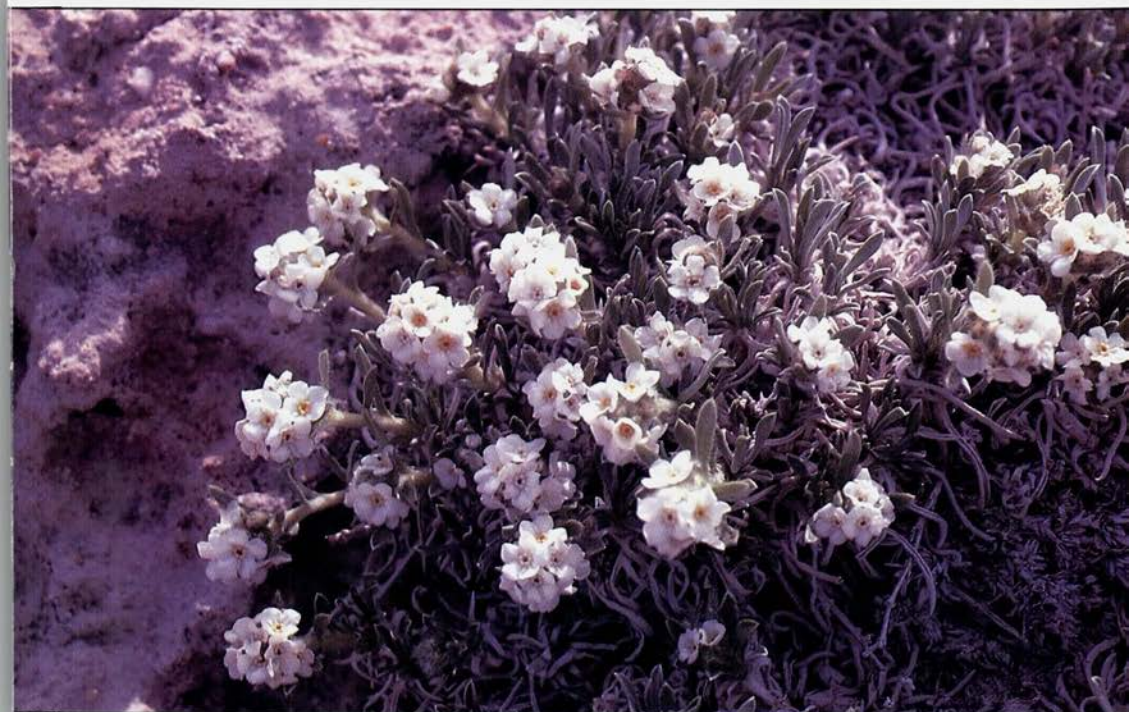
Jim Locklear is director of the Dyck Arboretum of the Plains at Hesston, Kansas.



*Oenothera caespitosa* (p. 297)

photos by James Locklear

*Cryptantha cana* (p. 298)





*Musineon tenuifolium* (p. 295)

*Erigeron ochroleucus* var. *scribneri* (p. 296)







*Phlox andicola* (p. 296)

*Phlox alyssifolia* (p. 296-297)





*Astragalus barrii* (p. 298)

*Dodecatheon pulchellum* (p. 297)



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# Awards

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## Marcel LePiniec Award

### J.C. Raulston

In the 1940s, a wheat farm on the prairies of Oklahoma was the world of nature that J.C. Raulston first explored, and a childhood fascination with flower and seed catalogs was his introduction to the lore and lure of plants. As loving director-caretaker of the eight-acre North Carolina State University Arboretum, J.C. even now has maintained his wonderment and has



vastly expanded the Arboretum's plant collection to some 7000 taxa from at least 45 countries since its opening in 1976. Through teaching, research, extension service, and a plant evaluation program, he has single-handedly galvanized horticulture and the plant nursery industry in North Carolina. Further, his continuing emphasis on special, non-native plants that are potentially adaptable to culture in this country has influenced and inspired others far beyond the borders of the Southeast. In short, he has catapulted the Arboretum from a secret garden into a center of national renown.

Some of the plants that J.C. has introduced to nurserymen and the gardening public through the North Carolina State University Arboretum are species from a Korean collecting expedition in 1985 with Barry Yinger, who was then with the US National Arboretum. These include *Patrinia scabiosifolia*, *Scilla scilloides*, *Styrax japonica* 'Sohuksan', *Vitex rotundifolia*, *Viburnum awabuki* 'Chindo', and *Hosta yingeri*. Species that the Arboretum has highly promoted include the evergreen ground cover *Ardisia japonica* 'Chirimen'; *Nandina domestica* 'San Gabriel' and 'Alba'; *Rosa* 'Petite Pink' (Scotch rose) and 'Snow Carpet'; *Prunus mume*; *Delosperma nubigenum*; various cultivars of *Hippeastrum* and the now ubiquitous fastigate Leyland cypress, X *Cupressocyparis leylandii*. Two unusual introductions by the Arboretum include *Liquidambar styraciflua* var. *rotundiloba* (a fruitless sweet gum) and *Lagerstroemia fauriei* 'Fantasy' (a selected red bark crape myrtle from one of the five plants that originated from a Japanese collection distributed by the US Arboretum in the 1950s). During the last decade under J.C.'s helmsmanship, nurserymen have been the beneficiaries of some 200,000 propagation cuttings annually and a staggering 45,000 plants representing over 250 taxa from distributions through the Arboretum.

To spend a day following Dr. J.C. Raulston is to exhaust oneself from the sheer magnitude of his energy. His travel calendar and speaking engagements are consistently over-extended. He tallies up more flight mileage than some airplane pilots. He never boasts of his many visits to botanic gardens, arboreta, or horticul-

tural production areas even though they have included all 50 US States, 55 countries, and some 600 public gardens. In his horticultural peregrinations, J.C. has driven at least 35,000 miles throughout North Carolina to teach university extension evening classes for landscape and nursery professionals. His car is usually generously filled with plants (and associated soil) scooped from gardens, backyards, and the errant side trips of various plant pilgrimages.

Last year, J.C. reached one of those typically unrelished decennial birthday milestones, and a surprise celebration flooded his house with scores of students, former students and friends. His guests spoke of occasions when J. C. touched their lives as teacher, advisor, listener, and dispenser of sage advice. Although a horticultural scientist by formal training from undergraduate work at Oklahoma State University through graduate work at the University of Maryland, this Renaissance man is equally comfortable at the theater, an art exhibition, or a symphony as he is in quest of the sole remaining species of *Cercis* is missing from the Arboretum's collection.

We are fortunate—indeed rich—to be contemporaries with such an indefatigable plantsman, teacher, and friend who is an aesthete in both nature and art. For these reasons, the American Rock Garden Society is pleased to present to Dr. J.C. Raulston the Marcel LePiniec Award for unrelentingly contributing to the diversity of plant material in our gardens and landscapes.

—Bobby J. Ward

## Marvin E. Black Award

### Ted Kipping

Surely all his many friends throughout the ARGS will be pleased to learn that Ted Kipping has been chosen as the first recipient of the Marvin E. Black Award. For many years Ted has had an important influence on local and national ARGS meetings. His exciting ideas for coordinating themes, his broad acquaintance with interesting and appropriate speakers, and his extensive knowledge of plants in the wild as well as in cultivation, have made him an indispensable source of inspiration for large conventions and impromptu gatherings. He played a major role in involving the Western Chapter as host for Western Study Weekends and has always been a creative force in planning their programs. He accepted the 1990 ARGS annual meeting for the Western Chapter and planned its basic concept of field trips at Lake Tahoe. He has made numerous trips to give slide shows promoting these rock garden meetings.

Always concerned with spectacular presentation, he has sought out the latest in audio-visual technology to help speakers communicate with ease and precision, and to delight the eye with a feast of images. He is well known throughout the plant world for his excellent photography and has contributed countless slides to editors worldwide. His tempting pictures reproduced in a myriad of books, maga-



zines, and journals have done much to promote the cause of rock gardening. As an active participant in numerous and varied horticultural societies, he has made valuable contacts with a broad spectrum of people, spreading his knowledge of rock gardening to them and bringing their valuable expertise within our circle.

For many years Ted has held monthly potluck-slide show meetings in San Francisco. All kinds of plant enthusiasts are invited to speak and attend. It is quite a popular local event, and editors have recruited photos and articles from presentations there, while clubs have discovered speakers for their programs.

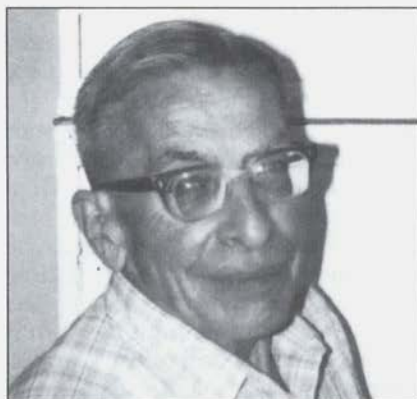
Ted attends almost all the local, regional, and national rock garden meetings, as well as those of other plant societies. At these gatherings he is always meeting new people, introducing gardeners with similar interests, and getting ideas for new meetings. May it be with strangers on a mountain trail, friends on a garden tour, or honored guest speakers at an international conference, Ted is always stimulating others with his enthusiasm for the plant world. He is one of our members best qualified to receive this honor. His award is well deserved indeed.

—Margery Edgren

## Award of Merit

### John Wurdack

Dr. John Wurdack's association with plants has been lifelong and has two distinct aspects. As a professional botanist, he has had a distinguished career as a taxonomist, field botanist, herbarium curator, and expert in the Melostomataceae. John has been associated with the New York Botanical Garden and the Smithsonian Institution, where he currently serves as herbarium curator. His remarkable career has spanned over 40 years and includes numerous collecting trips to South America and the Caribbean, over 130 professional papers and field collections of tens of thousands of plant specimens including many previously undescribed species and genera.



Our interest in John's botanical activities is, however, more focused upon his avocation: seeking out and growing rare and unusual plants for the garden. When not traveling in South America, John has searched out and collected seed of large numbers of rare plants of the southeastern United States, many in their type localities. Long before there was a list of endangered species of plants, John was distributing seeds and seedlings of plants like *Iliamna corei*, *Echinacea tennesseensis*, *Zephranthes simpsonii*, *Clematis albicoma*, and its rare and beautiful shale barren subspecies *Clematis a. ssp. coactilis*, along with *C. addisonii* and *C. versicolor*.

Other southeastern plants that John has grown and distributed include—and this list is by no means complete—species of *Hexastylis* (or *Asarum*), *Trillium*, *Rhoxia*, *Tradescantia hirsuticaulis*, *Nolana alabamensis*, *Croton alabamensis*, *Sedum pulchellum*, *Talinum* species, and Tennessee cedar glade endemics including *Leavenworthia*, *Psoralea subacaulis*, and the near endemic *Hyper-*

*icum frondosum*. His current interest in the genus *Arisaema* and other fascinating Asian woodland plants makes a visit to his garden an excursion in the unusual.

John has been a stalwart in the Potomac Valley Chapter, regularly contributing rare and unusual plants to our plant exchanges and serving as chapter chairman. He has served as program chairman for three winter study weekends, lining up speakers and topics for our education and pleasure. His wide acquaintance with botanists, horticulturalists, gardeners, and plantspeople has been a great asset.

For his unflagging interest in the American Rock Garden Society for over 25 years, for his service to the organization, for his friendly assistance on matters botanical and for his many contributions to our gardens, we are pleased to present this Award of Merit to John Wurdack.

—Donald Humphrey

## Edgar T. Wherry Award

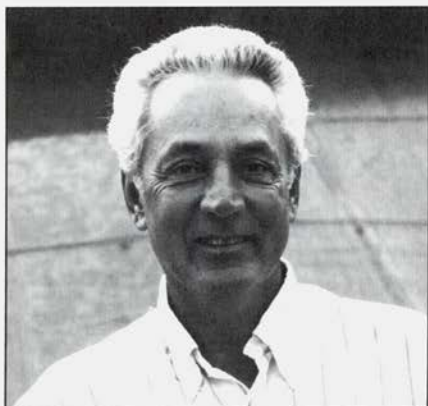
### Richard Jaynes

The Dr. Edgar T. Wherry Award, which may be awarded for outstanding contributions to the study of the flora of North America or the introduction of such flora into horticulture, was bestowed upon Dr. Richard Jaynes of Connecticut. Dr. Jaynes received his BA from Wesleyan University and his PhD from Yale. Dr. Jaynes has previously received 13 awards from various botanical, horticultural, agricultural, and scientific organizations for his work in chestnut trees and laurel. He was employed at the Connecticut Agricultural Experiment Station for 25 years as plant breeder and horticulturalist and in that time published over 100 papers. Many of his publications deal with the propagation of *Kalmia*, *Castanea*, *Pieris* and *Rhododendron*. He resigned from the Experiment Station in 1984 to continue his work with *Kalmia*, do consulting, grow Christmas trees, and establish a small nursery.

Dr. Jaynes is the leading authority on the American chestnut and its hybrids. The two nut tree books he edited (1969, 1978) were and are the most comprehensive references available on the culture of nut trees in the United States. Work that he initiated with colleagues on biological control of chestnut disease is still being actively researched. The world authority on *Kalmia*, he has released most of the new cultivars now being commercially propagated, primarily by micropropagation. His research on *Kalmia* is in large measure responsible for the increasing popularity of this American native. He is the International Registrar for *Kalmia* cultivars.

Here we add the Edgar T. Wherry Award to the many other laurels that Dr. Jaynes has earned.

—Harold Epstein



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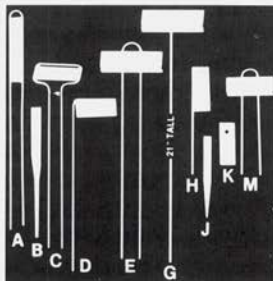
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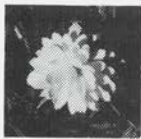
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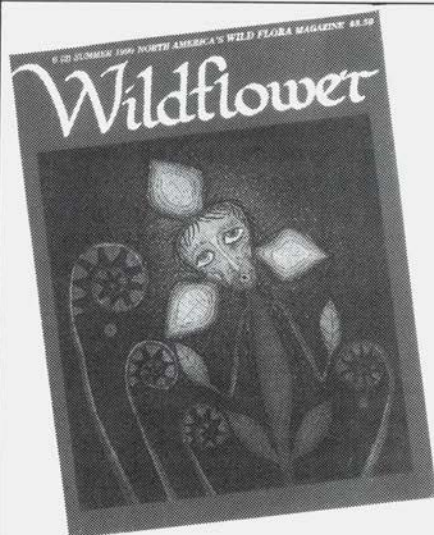
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