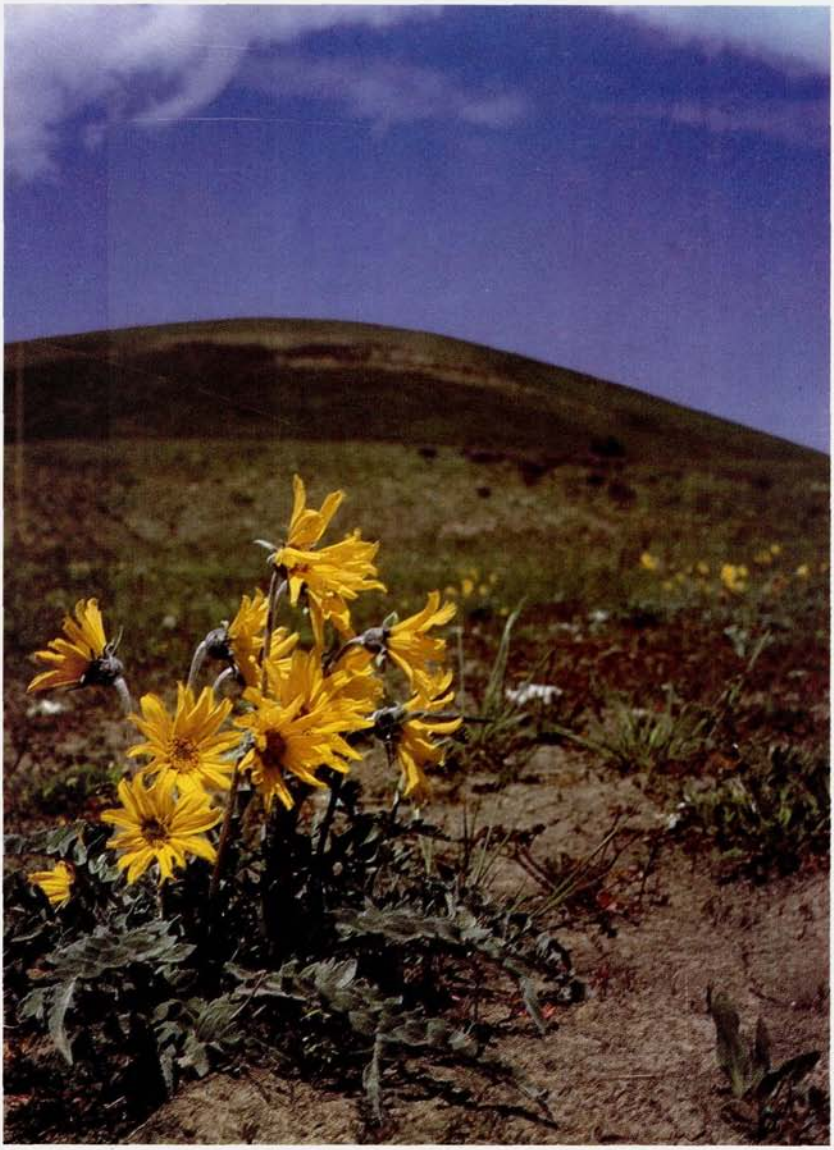
Bulletin of the
American Rock Garden Society



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Annual Meeting (Columbia-Willamette) 1988

Cover Photo: *Balsamorrhiza incana,* Big Horn Mountains
John F. Gyer, photographer

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Bulletin of the American Rock Garden Society

Flowers of the Friendly Mountains

John F. Gyer
Clarksboro, New Jersey

The prairie was, as usual, hot and sun drenched as I searched the cliffs and dry runnels near Cuny Table for the lacy pattern of Fairburn agate or a scrap of fossil oreodont bone. I found nothing of significance, but the gravel tracks I traveled were lined with dense masses of orange *Sphaeralcea coccinea* and the prairie cone, *Ratibida columnifera.* One sand hill was a veritable forest of *Yucca glauca* and the gumbo muds of the deltas beneath the table escarpment erupted with the blooming rosettes of *Oenothera caespitosa.* That night the prairie treated me to a sky full of lightning and self–luminous thunderheads that drifted slowly eastward until they faded into the horizon.

In 1959 the West seemed open, welcoming discovery. It probably still does to eastern youngsters who venture into its back country for the first time, but the back country seems smaller now. Then the Powder River Basin of Wyoming was more known for its namesake river running "an inch deep and a mile wide" north to the Yellowstone. Gillette was a smallish town at the edge of an open pit coal mine. Even the mine was a small affair, although it exposed a 100–foot–thick coal seam, which has now made a great arc of land from the Powder River Basin north and west to the Beartooth escarpment into one of the most important energy resources in the nation. The mines now are churning the shortgrass prairie into vast spoil piles laid aside to cover the mined–out strip with dirt that once again can be clutched by the roots of grass. Revegetation will likely be successful, but it is uncertain when or if the native plants will return to claim their land. Plants such as *Lewisia rediviva, Phlox hoodii, Liatris punctata, Oxytropis sericea, Astragalus spatulatus,* and *Arenaria hookerii,* are being pushed into hills at the basin edges where some may nestle in pockets in the spongy red rock called scoria, a natural clinker formed when an ancient coal seam burned.

The basin's coal was once live plants growing in vast swamps and delta lands. There were lush forests then. Now there are great stone trees 6 feet across that stand under the prairie hills just where they stood when they were buried in volcanic ash. The ash came from the west as a mammoth cloud that drifted east with enough density to suffocate and fossilize grazing herds in what is now Nebraska. But new trees and swamps returned. They in turn were buried and turned to coal as the mountains to their west rose 2 miles high. From the Powder River Basin, the traveler now first sees these mountains as a rime of white on the horizon, tentative, uncertain whether to become billowing cloud or to remain below to roof the earth. They are exciting and mysterious, a welcome change from the sun–parched summer of the basin.

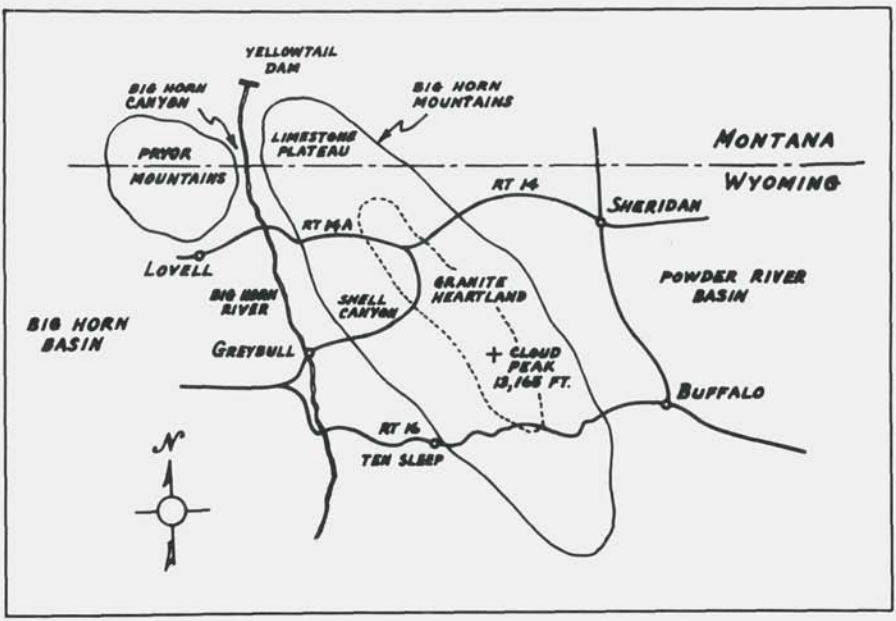
I had come west to climb them, but when I got there the highest summits were drowned in snow or barren except for a few lichen crusts on broken rock. They spoke to me of lightning strikes and wind, baking sun and ice. But between the prairie and the peaks I found a Persian carpet of life with designs that tell an interwoven story of time and stones, of air and light, of plants and animals and man.

For the Big Horn Mountains, the story woven into their slopes began about three billion years ago when granite rocks first formed the mountains of the time. They wore away until a shallow sea spread across their space and laid down mud where trilobites could swarm. Coral reefs eventually overgrew the mud and are now the massive cliffs of dolomite and lime that characterize the northern Big Horns. New mountains rose beneath the coral and drained the aging sea as new seas formed where mountain rivers carried stone and

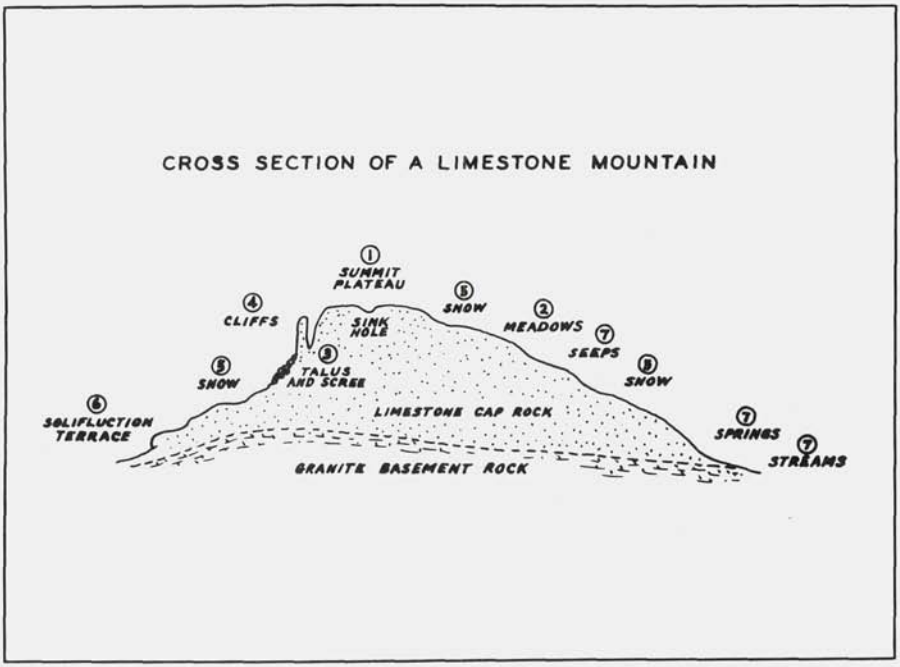
soil to start the cycle once again.

About 10,000 years ago, the cycle phase was one of waning ice and wetter times. In the basins near the Big Horns, the mammoth and the giant bison were hunted by the first Americans. I like to think it was they who built the ceremonial wheels of stone in the northern Big Horns. The most elaborate of these is on Medicine Wheel Mountain where it lies alone beneath an upturned bowl of sky. Archaeologists have found that its stone cairns mark the rising of stars that signal the year's turning into summer. The Old Ones and the Indians who followed hunted the summer meadows of these mountains for elk and deer. They camped there to escape the parching heat of the basins. The settlers who displaced them came to the mountain meadows to pasture their sheep and cattle, to search the mountain streams for gold, and to cut the timber for their railroad.

As I wandered through the mountains, I began to marvel how the rocks and animals and man were bound together by the plants that grew upon their slopes. Only plants can take minerals from the rock and soil, mix them with light and rain and air to produce sustaining food for man and animals. These plants must survive a constant struggle against cold, drought, and wind. The adaptations they evolved are both functional and beautiful. These plants fascinated me, but I quickly learned that if I wanted to watch some grow in my New Jersey garden I would have to learn their needs and change the



Map of Big Horn area



garden to suit them. These plants were not going to change to suit my garden.

In the Big Horns, as elsewhere, plants grow in habitats that are dependent on the interplay of geology, exposure, temperature, and moisture. To me, geology dominates the other factors for it determines elevations, drainage, and the mineral nutrition available in the soil. Geologically the northern Big Horns are like a layer cake of dolomite and limestone set upon a granite cake stand. A slice through this layer cake mountain suggests that there are seven habitat types that help classify the needs of the mountain plants: the summit plateau, meadow areas of varying degrees of dryness, scree and talus slopes, sheer cliff faces, snow pockets, solifluction terraces, and springs and seepage areas. Although each of these habitats has its typical plant community, there are broad overlaps. Plants are opportunists: if they find a favorable place, they will grow there.

Summit Plateau

The summits of the northern Big Horns are open, wind–swept, rolling areas that are the remains of caves. Caves form as limestone is slowly dissolved along lines of weakness by snowmelt and rain. In this way the caves grow until their roofs collapse and form sink holes. Eventually the sink holes join

together to form linear depressions. At cliff faces the rock between the collapsed caves falls as talus and leaves sculptured columns that form one part of the cliff face habitat. Where cliffs have eroded and their talus has rotted into soil, the summit habitat gradually is transformed into meadows.

The most intriguing plant at these elevations is *Selaginella densa.* Like all plants there it grows slowly and hugs the ground. Over the last 12,000 or so years since the glaciers left the area, it has probably been the main plant responsible for the development of the soil profile. Its remains help bind together a very fibrous alpine peat which makes up the top 3 to 6 inches of the established soils near the summits. This peat layer does three things for the plants: it holds some of the moisture from the brief summer showers, it prevents frost heaving because of its open fibrous structure, and it insulates roots from high temperature while warming the crowns because of its dark color.

The moisture held by the peat is of prime importance here. In the winter, winds blow most of the snow away from the summits. What little is left sublimates from solid to vapor in the intense sun and rarefied air of 9000 to 10,000 feet. The plants have made adaptations for this cold desert environment. The nailwort, *Paronychia sessiliflora,* forms near perfect cushions. Chickweed, *Cerastium beeringianum,* has developed woolly and exquisite large flowers to attract the few pollinating insects that fly at these altitudes. Although many cerastiums overgrow in gardens, their habit in this alpine environment is far more orderly. Woolliness to protect the plant from desiccating wind and the intense alpine sunlight is probably most highly developed in the alpine forget-me-not, *Eritrichium nanum. Douglasia montana* protects itself against desiccation by fleshy sedum-like leaves. *Aquilegia jonesii*'s survival technique employs waxy and tightly clustered leaflets. *Oxytropis parryii* grows in the lee of rocks, which protect this dwarf from the drying wind. *Astragalus minor* keeps out of the wind by clutching the ground. It forms single plant carpets that are only an inch high, but a single plant can cover over 2 square feet. It sets seeds slowly. Each pea-shaped pod contains but a single seed, yet it is one of the few summit community perennials I have seen actively colonizing a disturbed mineral soil habitat.

The insulating value of alpine peat is important in the short growing season. Measurements of soil temperature showed that at 6 inches below the surface in July, the soil was about 69 F., but at 2 inches below a clump of *Silene acaulis,* the temperature was 75 F. and at the soil surface in the sun it was nearer 80 F. The cool temperature at depth and the warm surface temperature allows plants that are used to arctic conditions to grow happily in these mountains. *Dryas octopetala* is such a plant. It covers acres of some of these mountaintops, but it grows best on north slopes and where sinkholes provide basins for snow to collect and give more moisture.

Meadows

Where the slopes are less steep, more snow collects and the habitat changes into that of meadows. The more lush growth here crowds out most of the cushion plants; frost heaving is more noticeable and produces occasional open soil habitat. Burrowing rodents are more active.

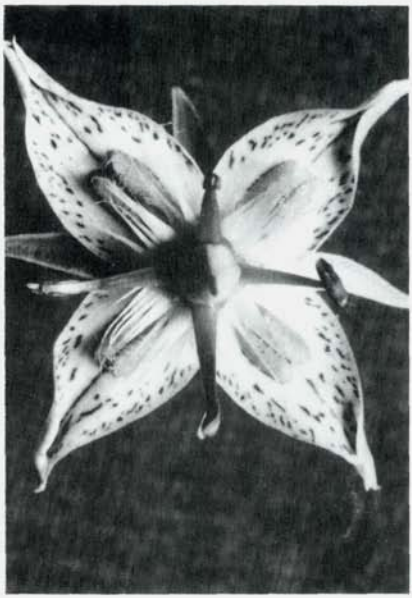
Sheep graze these meadows. Sheep herders who tend these flocks live in Conestoga–type wagons. They park them on ridges from which the sheep herder and his horse watch across square miles of meadow. Sedges and a few grass species give this turf a carpet–like aspect. These plants are heavily grazed by the sheep and stand high in economic importance to the ranchers. The most spectacular plant of this habitat is the alpine sunflower, *Hymenoxis (Rydbergia) grandiflora.* This plant provided some interesting hours of wandering and observations. I had expected these plants to be perennials, but mature plants showed no evidence of new crowns or of dormant buds that would develop into crowns. Instead, young plants of varying size grew in the areas of soil disturbed by frost or rodents. This species is the alpine equivalent of a garden biennial. Botanists say such plants are monocarpic. Monocarpic plants can grow slowly over several seasons from a seedling to a rosette with enough energy reserve to spurt into bloom, set seed, and then die. *Townsendia parryi* uses this technique and produces magnificent blooms that show off to advantage against the weathered limestone.

Ipomopsis globularia forms lovely snowballs of bloom from its silky rosettes. The green gentian, *Frasera speciosa,* can grow as a rosette for over a decade before it blooms. When it does, its square flowers are both unusual and beautiful.

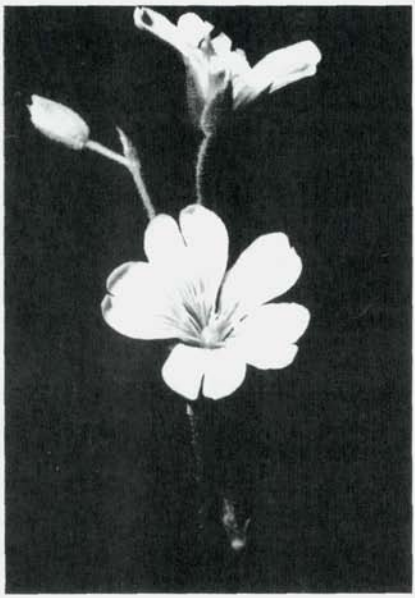
Most meadow plants are true perennials. Some, such as *Senecio werneriaefolius,* form new rosettes each summer at the end of short stolons. These bloom the next year and in their turn produce another set of stolons to carry on the overwintering rosettes. The pearly everlasting, *Anaphalis subalpina,* is another successful stolon former.

Rhizomes are modified stems that grow along the ground or work their way beneath the surface of the soil. American bistort, *Polygonum bistortoides,* grows on slender stalks which rise from such rhizomes. In mountain meadows it is sometimes so thick as to coat the landscape in a dancing white mist.

Other perennials in the alpine meadows survive by producing clusters of rosettes that grow from a single crown. The whorled penstemon, *Penstemon procerus,* forms crown clusters fully a foot in diameter covered with 18–inch stalks of blue blossoms tiered like the roofs of a slender pagoda. In the coolness of the moister areas of alpine peat, sky pilot, *Polemonium viscosum,* uses short stolons to produce next year's crop of bloom. This plant



Frasera speciosa Photos by author



Cerastium beeringianum

is generally deep blue to purple, but the occasional albino forms are crystalline gems. Prairie smoke, *Geum triflorum,* a dominant plant of the suballpine meadow community, is another example. The blooms of this plant never open wide. They require insects, probably bumblebees, to actually wiggle through the petals to get at nectar and pollen.

Bumblebee pollination is mandatory for most of the *Pedicularis* species. *Pedicularis crenulata* forms large patches in meadows where it grows saprophytically on the grasses and sedges. The heads have a fine spiral rhythm. In section can be seen the way in which the anthers hold the pollen in the head where it can be dumped on the back of vigorously foraging bees. *Delphinium nelsonii* is another bumblebee plant. This form grows only about a foot high and does best in disturbed areas near a snowmelt seep where it can receive plentiful moisture in a cool spring. But it must dry out completely in the summer as it carries over a small dormant tuber.

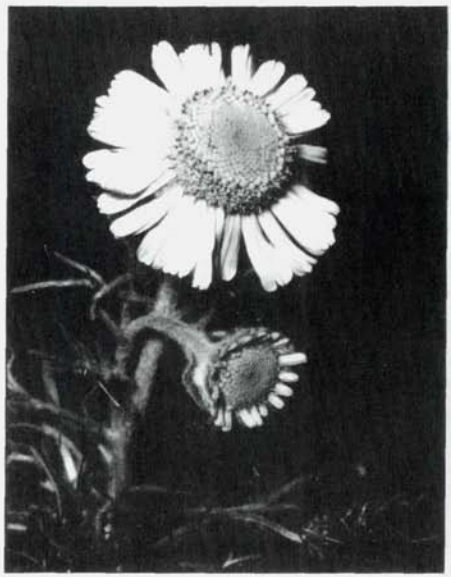
The beautiful and delicate *Lithophragma glabra* is another bulb former. It appears to come easily from seed, for in disturbed areas dense clumps form where seed capsules have fallen to the ground. The entire plant is only about 4 inches high. Spring beauty, *Claytonia lanceolata,* is a corm forming plant which can cover the meadow in its season, but it quickly withers to live out the dry summer underground. It blooms just after the snow melts and as the gopher "eskers" emerge. The eskers are a major mechanism

for the production of disturbed soil habitat in alpine meadows. Shooting stars, dodecatheons, grow from fleshy roots that join at a dormant bud only an inch or so beneath the surface. They carpet the meadow in their season. The most common here is *Dodecatheon pauciflorum* which occurs in both red and occasional white or pink forms.

The viscous geranium, *Geranium viscosissimum,* survives from year to year in the form of buds on a woody crown. It is a late bloomer that produces magnificent maroon red blossoms with a two–day sexual cycle. The first day they open and their anthers shed pollen to passing insects. By the next day the anthers have dropped and the stigma opens to receive pollen from another flower.

Tap rooted plants are common in the drier meadows. I have seen an arenaria root that burrowed over 4 feet into the ground in search of water. The balsam roots are a beautiful group of tap rooted composites of the drier meadows. *Balsamorrhiza incana* is, in my estimation, the finest garden prospect of this genus. In the meadow sods the dandelion is also common and competes with the native false dandelion, *Agoseris glauca.*

the yellow violet, *Viola nuttallii,* grows in disturbed areas near snowbanks where frost heaving is severe. Its underground stem is densely lined with dormant buds. These buds continue the plant's growth even if the main leaves are removed by grazing or frost heaving. The sugar bowl clematis, *Clematis*



Hymenoxis (Rydbergia) grandiflora

Geranium viscosissimum

hirsutissima, develops clusters of stems from similar underground buds. It produces urn–shaped blooms with darkly colored sepals. As the seed matures, the enclosing sepals dry and the silky styles elongate into seed heads called "old man's beard."

The meadows are a delicately balanced community. Legumes, members of the pea family, are a very important and prominent group of plants in this balance. In addition to providing beautiful masses of color and form, their roots host nitrogen fixing bacteria. This is important because nitrogen fertilizer cannot be derived from rocks. It must come from the air, either fixed by lightning and deposited by rain, or fixed in the soil and freed by the slow decomposition of vegetation. The legumes and their associated bacteria are responsible for much of the biologically fixed nitrogen. Lupines are the most obvious legume. These plants range from 2 to 3 feet high in the more fertile areas to the dwarf *Lupinus caespitosus* in the disturbed soil areas. This lupine is particularly well adapted for drought because of its long tap root and the dense hairiness of its crown. In addition to size variations in the lupines, there are variants in flower color. Pink occurs occasionally. Rarely a pure gleaming white will stand out in an alpine meadow.

The point vetches, *Oxytropis* sp., have keeled petals that come to a point. These plants generally grow as multiple crowns from a single tap root. They are beautiful in flower, leaf, and habit. *Oxytropis albiflorus* is also particularly fragrant. It gives the air over acres of mountainside the perfume of fresh honey as if just cut from the comb. Its relative, *O. saximontana,* thrives in disturbed soil areas and loose sod nearly to the summit. In areas where it seeds freely, it tends to produce color variation. In acidic granite areas near Cloud Peak the common legumes are dwarf clover, *Trifolium nanum* and its relative, the larger and more lax *T. parryii.*

Talus and Scree

Talus and scree slopes are essentially extensions of the meadow environment onto the steeper, less stable slopes found at the foot of cliffs. The steepest slopes have a mineral soil mixed with rock debris which is in slow continual downhill motion. The steepest moving slopes support few plants. *Physaria vitalifera* is a spectacular exception. Its inflated seed pods give it the name "bladder pod." It has adapted to this environment by growing a new crown each year a little farther downhill from the one it had the year before. In this way its head walks with the moving slope while its feeder roots remain fixed several feet farther uphill. Should its crown be sheared off, it always has dormant buds farther back on the roots that can produce another.

On the more stable slopes, *Phlox pulvinata* develops into attractive mats. Although it is common in open meadow areas where it forms a layer of snow–

like blossoms, it seems to seed most freely in disturbed areas, where color variations can occasionally be found.

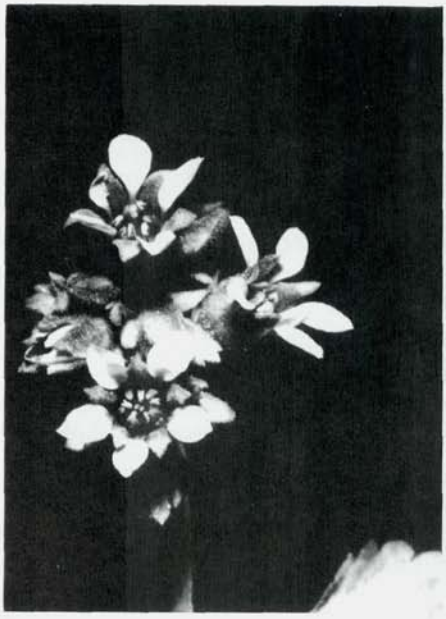
The alpine clematis, *Clematis pseudoalpina,* is a vine that runs just beneath the surface of the peat pockets or through the stone mulch of the talus areas. Here it forms beautiful compact leaf clusters with nodding recurved blooms. In section, the graceful arch of the petaloid sepals encloses the long feathery styles. The camas lily, *Zygadenus elegans,* finds these habitats to its liking. This bulb produces a very fibrous coat that seems to protect it from severe desiccation in the summer, and seed pods that glow like burnished gold in the autumn sun. Wild onions also like this habitat. The blooms of *Allium brevistylum* are individually small, but the heads are graceful. The nodding onion, *A. cernuum,* is common on dry consolidated talus slopes. Shrubs and wind–dwarfed trees grow between the boulders. Currants such as *Ribes setosa* are attractive and common, but their thorns are a hazard to hikers. In cracks in the boulders of these slopes *Corydalis aurea* is comfortably at home as its roots wander in search of spots of moisture and nutrients.

Cliff Faces

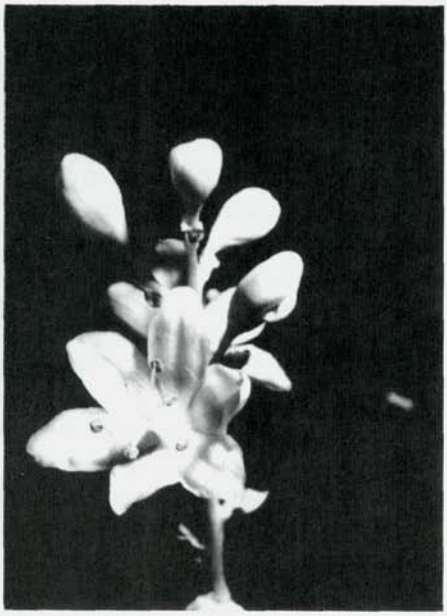
Even the austere climates of the alpine limestone cliffs support a specialized group of plants. In some areas the melt water from higher snow banks seeps into the porous rock and waters ledges and the contact stone where the talus begins. Over the years these special areas have built up layers of humus that range from a few inches to several feet deep. These constantly watered, shady, humusy ledges are a habitat of *Primula parryii.* Large clumps of this plant in bloom are a glorious sight. In eastern gardens it is difficult to grow, perhaps because of high soil temperatures; in the mountains when it is in full bloom the soil temperature was no more than 50 F. Low soil temperature means low growth rates for fungus and bacteria.

In cracks on the cliffs themselves grows the most lush member of this cliff face community, *Telesonix (Boykinia) jamesii.* Although vertical faces may be festooned with its greenery, it is almost never found in the talus soil, yet on the cliffs, even the smallest solution pocket in rock will have a plant struggling to survive. Ledges provide more foothold for plants than cracks. On them the alp lily, *Lloydia serotina,* thrives and shows off more spectacularly than in the summit community where it is common.

Lower plants give some cliffs great character and begin the process of soil formation. One lichen forms a brilliant orange crust on rock as it slowly dissolves the rock particles and eventually produces a film of humus where mosses can grow. Some mosses prefer granite boulders; others are more at home in cracks in the limestone cliffs. Ferns can take root on the soil



Telesonix (Boykinia) jamesii



Zygadenus elegans

prepared by the lichens and mosses. Flowering plants such as pussytoes, antennaria, often trail after the ferns.

There are three shrubs of the rose family found in these mountains. They are petrophytum, kelseya, and the familiar dryas. Petrophytum and kelseya are found only in the most severe cliff face habitats. *Kelseya uniflora* grows at the higher elevations and very slowly forms cushion mats as its roots seek out moisture and nutrients in this severely dry and alternately cold to hot habitat 8000 to 9000 feet above sea level. Somewhat lower, and much more prolific, is *Petrophytum caespitosum* which carpets boulders in the talus slopes of the great canyons draining the Big Horns. Its relation to the rose family can be seen in its spiraea–like blooms.

Snow Bank Community

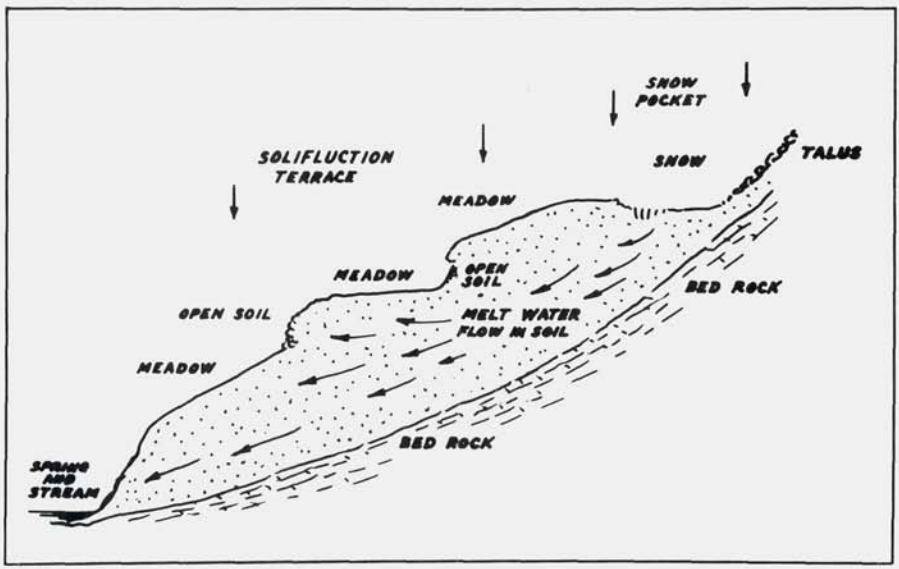
In sheltered areas, often at the foot of cliffs or in sink holes, snow collects in the winter and lingers long into the summer. These areas produce a distinctive wet habitat. As the snow begins to melt, pink algae, mainly *Chlamydomonas nivalis,* begins to grow on its surface. As the snow withdraws, the little ranunculus are the first of the ground species to jump into bloom. The pasque flower is not far behind. By the time the snowbank has melted away in the sun, it has begun to spread its feathery seeds to the wind. These

moist areas also provide the habitat for *Mertensia alpina,* a very lovely short-tubed species of bluebell.

Solifluction Terraces

When snow pockets form on a slope they push down on the soil with all their accumulated weight of winter. As they melt, water saturates the soil beneath and the clay base they rest upon slips slightly downhill. This forms a bowl-shaped basin for the snow, and a container for its melt water. As this water seeps downhill, it is under pressure from the height of the water above. When the pressure is great enough, water separates the soil particles, breaks through the sod of the meadow, and a small glacier of soil and sod begins its journey toward the basin below. These soil glaciers go by the name of solifluction terraces. They are major sources of disturbed soil habitat in these mountains.

Plants that struggle against competition in other habitats have an easier life here. The wallflower, *Erysimum asperum,* can take root along with *Lesquerella montana* and *Eritrichium nanum,* beautiful and garden worthy plants. Another species, *Eritrichium longissimum,* is recognized by some authors. They both grow in these terraces and differ mainly in the length of their flower stems. *Eritrichium nanum*'s flowers rise about 2 inches, while *E.*



Snow pockets and solifluction terraces

longissimum sends its blooms soaring to between 4 and 6 inches. The larger alpine forget-me-not, *Myosotis alpestris,* can also be found here. The open soil is a seed bed for winter annuals such as *Draba oligosperma.* A minute annual of the phlox family, *Gymnosteris parvula,* also prefers these open soil sites. The entire plant is but an inch and a half tall. It develops, blooms, and sets seeds all in one short alpine season.

Springs and Seeps

At the level where limestone meets the impervious granite, the water from melting snow appears as springs, seeps, and streams. In open areas these springs sport the white marsh marigold, *Catha leptosepala.* This is one of the earliest plants to bloom, and the first flies of the season carry its pollen from flower to flower. At the drier edges of the wet area is the globe flower, *Trollius albiflorus.* In open bogs the smallest alpine annual, *Konigia islandica,* is scarcely larger than the mosses that surround it.

Often seeps are associated with clumps of trees, and at the edges of these shady areas the elephant's head, *Pedicularis groenlandica,* can be found. Its twisted blooms are curved just so bumblebees can effect pollination. Near the pedicularis, *Ozymelis stauropetala* sparkles in the grass and the brilliant *Castilleja rhexifolia* provides a splash of contrasting color. In some seeps *Habenaria dilatata* waves its green candles of bloom in the breeze. In others, the related and very fragrant *H. hyperborea* may be found. At the edges of wooded seeps the shrubs *Ledum glandulosum* and *Ribes lacustris* form dense thickets. The western twisted stalk, *Streptopus amplexifolius,* is at home in the shade.

In the acid spongy humus of the woods floor are the two listeras, *Listera cordata* and *L. auriculata.* The smaller of these twin-leafed orchids grow so thickly that there is no place to step around them. On rare occasions the ram's head orchid, *Calypso bulbosa,* is found blooming in black humus. The small *Habenaria obtusata* lives in the mossy banks. The little bishop's cap, *Mitella pentandra,* shares this habitat. Shaded banks sport the gem of the pyrola group, *Moneses uniflora.* The pure white blooms of this plant sparkle beside the streams that keep the soil temperature evenly at 50° F. in mid July. Others that like cool, moist seeps and stream banks are the pink pyrola, *P. asarifolia,* with glistening blooms held a foot above its evergreen rosette; *P. secunda,* its style like an elephant's trunk; and P. minor, a small circumboreal plant with a short style reminiscent of that of *Moneses uniflora.* The western grass of Parnassus also appreciates this habitat. Its gleaming blossoms open well after the pyrolas have gone to seed. The twin flower, *Linnaea borealis,* can add a fairy carpet to the woods floor. Its twin blossoms were a favorite of Linnaeus and are a favorite of mine. *Geranium richardsonii* enjoys the drier edges of this habitat.

Granite Areas

Where decomposing granite forms the major rock outcrop, as it does in the Cloud Peak area, the soil is generally acid. Ericaceous plants that could be found only in some of the acid bogs in the limestone country thrive here. *Kalmia polifolia* is a beautiful shrub, its blossoms bright pink versions of its relative, the eastern mountain laurel. The bearberry, *Arctostaphylos uva-ursi,* grows on cliffs in these acid areas and produces clusters of delicately colored blossoms. The arctic gentian favors more open areas near the summits. *Aster foliaceous* var. *apricus* is a very neat plant which tucks itself against summit rock.

Where snow melt accumulates on granitic basement rock it forms mountain tarns that drain into the valleys as splashing brooks. These streams are the habitat for the taller mertensias. In closeup, *Mertensia ciliata* shows its close relationship to the eastern Virginia bluebell. These stream edges also provide habitat for the alpine blue violet, *Viola adunca,* and the little yellow monkey flower, *Mimulus guttatus.* The streams and the lakes that they run into also contain, after a concentrated search, fine specimens of Rocky Mountain trout.

Lower Slopes

The sides of the Big Horns drop quickly from about 8000 feet to the basins at about 3000 feet. This produces sharp altitudinal zones. Plant communities that range from alpine to semidesert and prairie lie side by side. In the talus, as the descent begins, racemes of sweet vetch, *Hedysarum sulphurescens,* grow gracefully on shrub–like plants.

In the forest zone the parrot's beak pedicularis, *Pedicularis racemosa,* is parasitic on the tree roots. In some areas, *Vaccinium scoparium,* the red grouse berry, is a groundcover on the forest floor. The berries are good wildlife food and, if one is patient enough, they can be a sweet camper's dessert. The coral root orchid, *Corallorhiza maculata,* is saprophitic on decomposing wood while the pastel Indian paint brushes, forms of *Castilleja septentrionalis,* are semiparasitic on grasses that grow in the open areas of the forest. *Penstemon subglaber* frequents disturbed soil on the edges of this zone. Occasionally it can be found in a beautiful clear pink; the internal structure of each blossom on a stalk is even more graceful than the stalk itself.

Prairie species grow on the slope below the forest zone. The biennial *Chaenactis douglasii* should be an excellent garden subject. The dainty, nodding *Campanula rotundifolia* grows in a deep mulch of limestone chips. *Linum lewisii* is a favorite plant but only if one is an early riser as it drops its petals well before midmorning. For late risers, the prairie gentian opens

about noon. This gives bees time to warm in the sun before they forage into its blooms for nectar and pollen. The most spectacular plant here is the 7–foot–high crucifer, *Stanleya integrifolia,* the prince's plume. It is found beside the road but only in a narrow area of greenish soil derived from bedrock probably high in selenium. This plant is said to concentrate enough of this element to be toxic to stock. The blazing star, *Mentzelia* sp., opens in the dim light of evening when it can be pollinated by bats or night–flying moths. It is a member of Loasaceae, a largely tropical family of plants and is unusual because its seeds form only on the sides of its capsules. The brilliant *Oxytropis lambertii* thrives on the slopes as does the lovely *Penstemon laricifolius.*

Some plants span almost the complete elevation range of these mountains and give a long season of bloom. A mariposa lily, *Calochortus gunnisonii,* blooms early in the grasses of the lower slopes. Later it is found as high as the subalpine meadows. This lily is one of the true gems of the West. Dwarf goldenrod also spans the altitude range. It grows 8 inches high in the warm, dry sand near the basin, but only 2 inches high at the limestone summit. Asters and erigerons share this broad range with the goldenrod. The composites are often scraggly plants, but their blossoms are lovely. And their flower structure is a striking study in color and texture.

Where rivers have formed from the accumulated water of the mountain streams, clematis is found climbing over the branches of streamside trees. Occasionally a wild hollyhock, *Iliamna rivularis,* is found in the gravel of their floodplains. Here in the fall the twin–flowered honeysuckle ripens and the seed pods of the western false solomon's seal, *Smilacina racemosa,* glow like Christmas candy.

Beyond lies the semidesert prairie land where *Gaura coccinea* is an occasional inhabitant and wild gaillardia forms natural rock gardens on granite boulders. Rabbit brush, *Chrysothamnus viscidiflorus,* can be a cloud of gold in its season. A closer look shows its flower heads filled with golden trumpets typical of this branch of the composite family. A red castilleja shares with it these dry slopes.

The tansy aster, an annual, sometimes covers the semidesert soil of the Big Horn Basin. This great geologic bowl between the Big Horns and Yellowstone holds steep canyons and deposits of dinosaur bones, bentonite mines and oil, and rich farmland irrigated by water from the Cody Reservior to the west. As travelers move across this basin the Big Horn Mountains are left behind, but with local variation the interwoven pattern of its rocks and plants and animals is repeated in range after range. The patterns I have seen on the friendly slopes of the northern Big Horns have helped me appreciate the native plants that grow there. If you should venture into their range, I hope these patterns add to your enjoyment of the story they have to tell.

Rock Gardening In a Hostile Climate

William S. Folkman and Nell Folkman
Walnut Creek, California

Rock garden Bulletin articles are usually written by experts for fellow experts. I suspect, however, that many readers are not part of this elite group. Perhaps this article will provide the sort of if-he-can-do-it-I-can-too encouragement these readers might need.

Rock gardening in a place like Walnut Creek, California, does not really require wearing a hair shirt. Actually, it is not such a bad place. Located midway between the cold, damp fogs of San Francisco and the hot, dry furnace of the Central Valley, one might suppose that my garden would enjoy a pleasant combination of these two extremes. On the average, that is true. Unfortunately, our position is very much like the statistician's definition of an ideal situation: On the average, a person is very comfortable if his head is in an oven and his feet are in a refrigerator.

In Walnut Creek, we feel the cool marine influence for a few days, followed by a baking when Central Valley heat prevails. The contention between these two systems provides dramatic variety to local weather. It also provides a real challenge for the gardener. Every climate, no doubt, brings its own challenges, but coping with such opposites in tandem compounds problems. Like population growth, the problems seem to increase by geometric progression rather than by simple arithmetic ratio.

My interest in rock gardening took root during a sabbatical in Seattle some years ago. In that ideal climate for rock gardeners, I was goggle-eyed over the variety of saxifrages, marvelous dwarf rhododendrons, and other ericaceous materials that grow so easily. But, it seemed to me, these treasures were not the real interests of the Seattle natives. Their hearts were on the rain-shadow flora from east of the Cascades. Here were the plants that put their skills to the test. Here was *their* challenge.

In a Toynbeean sense then, we might hypothesize that gardens, like civilizations, develop in response to challenge. On the basis of these observations and with this firm philosophical foundation, I was prepared to begin rock gardening upon my return to the less hospitable environment of Walnut Creek. In my naivete, I paid little attention to Toynbee's further observation that challenges may be insurmountable and, as a consequence, *civilizations—and gardeners—may fail.*

I began my garden by trying to duplicate what I had seen in Seattle. That proved too challenging. Few of the choice plants I brought back with me survived. At this point, a less valiant gardener, or perhaps a less stubborn

one, might have called it quits.

Instead, I found succor from an unlikely source—the political scene. I took a lesson from two of our former governors: Brown and Reagan. From one, I learned the value of diminished expectations; from the other, benign neglect. I decided that to enjoy rock gardening in my situation, I must maintain some degree of emotional detachment. Plants come and they go. If a plant dies, and one is not too emotionally involved, the pain is kept within acceptable limits. If one perseveres, however, some things are bound to succeed, at least for a while. There's the joy!

My rock garden is located in front of our house—an area of about 20 by 60 feet that gently slopes down to the street—the only location in my yard at all suitable. (Gardeners who have to choose among a variety of sites on estates may not realize that many of us have been living with diminished expectations for a long time.) Gardening on a typical 1950s tract lot can be frustrating to a plant lover/collector. Soon, there is no room to put anything else. This is one reason rock gardening can be so satisfying. It doesn't require acres. I can have dozens of different specimens in the space formerly occupied by one common shrub.

Neighbors wondered about me when I dug up the front lawn I had previously tended so assiduously. When I mentioned rock gardening, they assumed the area would be covered with colored gravel in a typically Californian low-maintenance fashion. Many still do not understand.

To prepare for building my rock garden, I read everything I could find on the subject. My mind was awash with all the dos and don'ts. I absorbed some understanding of the basic principles of design and construction. I even had a fairly clear picture of the ultimate results I wanted to achieve. Now, I had only to adapt what I had learned to my own particular situation. Because of my hard adobe soil, I paid special attention to adequate drainage. I laid down a perforated sewer tile across the area upon which I planned to construct my mound, covered it with coarse gravel and then laid turves from my old lawn upside-down on top. Over this was to come my specially prepared soil mixture.

Visits to various local rock yards proved disappointing. They had rocks in a confusing multitude of assorted sizes, colors, and textures, but nowhere could I find the suitable river-run gravel I sought. I had to settle for separate purchases of sharp sand and a crushed stone sold locally as "Cinnabar." This stone, at least, had a nice warm color and I trusted that it would not prove as toxic as its name suggested. My store of compost was much too limited, so I had to buy some commercially.

The vital decisions finally made, one fateful Saturday I found my driveway completely covered with intimidating mountains of sand, stone, and compost. I suggested to the merchant that it all be run through his big cement mixer

Construction begins Photo by author

to make the job easier for me, but the look he gave assured me there was no point pursuing that suggestion further. No way out but to mix untold numbers of wheelbarrowfuls by myself!

After spreading a layer of the stone–sand–compost mixture over the area, I rototilled to partially mix this first layer with the soil beneath to avoid a sharp demarcation between the layers. Then I mounded the remainder into some resemblance of the contours I had envisioned.

A rock garden needs a few rocks, but a marble rock garden sounds a bit ostentatious. However, Travertine building stone from the same rock company proved as esthetically pleasing and as economical as any available. Its ocher, rust, and cream colors harmonized with those of the crushed cinnabar of the soil mix.

The gravel mix and rock placements created a long mound across the yard in front of the house, increasing the natural slope of the yard and providing another slope toward the house. A 6–foot grape–stake fence, which I built along the apex of this mound, provides a more harmonious background for the rock garden. At the same time, it gives a feeling of enclosure for the entrance to our house. (It also serves an important function which I will explain later.)

For some 30 years I was involved in sociological research. This entailed using all that is implied by the scientific method: objectivity, controlled observations, replication, probability analysis, and all that business. However, when

I'm gardening, I revert to a more basic and classic pattern which treats the universe as being composed of only the four elements: earth, fire, air, and water. My concern in gardening is, simply, to establish a harmonious relationship among these elements. The mound and fence represent one attempt to bring about the proper combination.

The soil mix and rock take care of the first element. The fence provides some control over the fire—the sun. Unfortunately, I get more shade in the wintertime and less in the summer when it is most needed, but it does help control the movement of air from the hot, dry winds of summer on the lee side of it.

Because our moisture comes in the form of winter rains, water must be supplied artifically during the long dry summer. The challenge is in getting the proper amounts of moisture in the right places at the right time. If I were content to confine my efforts to Mediterranean–type plants, this need would be minimal. Such plants need benign neglect to simulate the summer drought they require. Unfortunately, in providing for the needs of other types of plants, they sometimes get more water than they need and they succumb.

In spite of this, I still have my impossible dream. In addition to the dwarf rhododendrons that first captured my interest, I want to have the standard rock garden plants. Impossible or not, I have had some successes. Many of them might not be worthy of notice to gardeners more favorably situated, but they have given me a great deal of satisfaction.

One of the advantages of California gardening (we do have some) is the early spring. Instead of waiting until April or May, already in January we get warm, sunny days scattered among the winter rains. On the sunny side of the fence the tiny purple and white faces of *Crocus tomasinianus* lift to catch the warm sun; pink and yellow are added when *Aethionema* 'Warley Rose' and *Potentilla nevadensis* bloom together, and the spring tapestry is begun.

The palest tint of pink is provided by *Tulipa tarda.* This was one of those pleasant surprises that gardening sometimes brings. The bulbs had been part of my first plantings, but I had forgotten them when they became overgrown by a "dwarf" baccharis. Relieved of this over burden they have flourished.

Blues and whites come with *Aquilegia saximontana, A. flabellata* 'Nana–alba,' and *Arenaria montana,* accented by *Scilla peruviana.* Low buns of a phlox cultivar, *Dianthus freynii,* and *D.* 'La Bourbrille' contrast with the taller gray foliage of *Eriogonum crocatum* and its bronze flower heads left over from last fall. (It doesn't start blooming again until late April.) Buckwheats, as a whole, are rewarding and a selected compact form of *E. ovalifolium,* with sulfur–yellow blossoms, is especially satisfying.

Among the other early bloomers are *Edraianthus dalmaticus* and *Anacyclus depressus,* the latter with a delicate, bright green wheel–like

pattern accented with tight red buds and beautiful white daisy-like flowers. The usual purple of *Pulsatilla vulgaris* contrasts with a lovely deep red form grown from seed.

On the shady side of the fence, delicate yellow *Narcissus* x *juncifolius* is the earliest bloomer, along with bright yellow *Ranunculus gramineus,* a low diminutive plant when it first blooms though later on it tends to get a bit leggy. The gray-blue balls of *Globularia cordifolia* and its tight green mat make it choice for this area. *Raoulia australis* likes it here, but some of the other raoulias haven't done so well. A mat of blue *Campanula portenschlagiana* and the darker blue of a very dwarf form of *Sisyrinchium bellum* mix with the pink cushions of *Saponaria ocymoides* 'Rubra Compacta,' *Asperula suberosa,* and *A. pontica* to make a beautiful carpet by the side of our entrance walkway. It is accented at one corner by an iris seedling grown as a Louisiana iris, but which looks more like a Siberian iris instead.

Many plants, in our climate, do better in troughs or pots. They can more easily be sheltered from the heat on our extremely hot days or covered during excessively long rainy periods during winter. Some of my troughs have been made of hypertufa using the usual mixture. Others are styrofoam containers which have been coated with latex paint, then sprinkled with sand while still tacky. A paint color that approximates that of the sand is desirable, otherwise the background may be conspicuous in spots where the sand covering is thin.

A beautiful spring display is made in one trough by *Polygala calcarea, Rhodohypoxis baurii,* and *Sedum spathulifolium* 'Cape Blanco' ('Capa Blanca'). In another, the pale yellow *Jasminum parkeri* and the brighter, more golden yellow of *Helianthemum oblongatum* are a wonderful combination. *Lewisia cotyledon* and *L. leana* do well in deep ceramic pots.

In the back yard, along with troughs and pots, there is a small half-shade garden spot inhabited by such plants as *Phlox bifida,* a beautiful orange-red *Geum* x *borisii,* a contrasting blue *Iris douglasiana,* and a lighter West Coast iris hybrid that some years blooms from November to May. *Cyclamen hederifolium, Scilla siberica,* and a lovely lavender clematis (an unknown seedling 1 to 1½ feet in height) provide more delicate shades of color. *Hypericum kelleri* is an exceptionally low, delicate groundcover in this area. Its scattering of yellow flowers are well displayed, lying close against an attractive green mat.

Besides construction of habitat and selection of plants, gardening style is perhaps another aspect of rock gardening that needs to be looked at. Some rock gardeners prefer to be plant collectors. Their gardens become plant zoos with specimens carefully planted in the right habitats and tended assiduously without much attention to the overall design of the garden. Our rock garden is our landscape; it is important to me to pay attention to the esthetics of

gardening.

In addition to making a habitat suitable for cultivating plants, I like to choose rocks that go well together and enhance the looks of the plants. It is important also to consider how the garden will look throughout the year.

A garden is expected to be beautiful when a carpet of flowers puts on its annual spring display. But what of the rest of the year? The Japanese say that you are fortunate when you visit a garden after the flowers have bloomed, for then you are able to see the garden. For this reason, besides planting together those flowers which make a pleasing combination while blooming, I also place plants in terms of the color and texture of their foliage. Some plants are chosen for their foliage alone and are placed to provide pleasing contrasts of color and texture. Mats and cushion plants are used together to create contrasts in heights. Some plants are grown for attractive seed heads. Dwarf conifers and other larger plants such as *Lavandula stoechas,* at strategic points, help define angles and shapes in the garden and provide dramatic points of interest.

Rock gardening, as practiced in England, has come to be synonymous with alpine gardening. However, as was suggested by Thomas H. Everett at the ARGS Fiftieth Anniversary meeting, perhaps we in the United States need to rethink our definition of rock gardening to include those rocky habitat plants which do well in climates and seasons different from those found on high mountains. I find there are many choice plants in this category which do extremely well in our hot, dry climate and make a valuable addition to any garden. (The beauty of many of these plants was seen on the Fiftieth Anniversary tours, and more will be introduced at the International Conference this summer in the Rocky Mountains.)

The Australian section of the youthful University of California, Santa Cruz Botanical Garden contains some small shrubs that appear to have merit as additions to the mild climate rock garden. Three years' experience shows that they do well here, but they have yet to be tested by one of our cold winters. They thrive in the lean rock garden soil mix and provide additional interest and color for a much longer period of time—some of them year round. *Tetratheca ciliata* and a *Brachycome* species provide a lively pink against the delicate, white *Tetratheca thymifolia. Kunzea parvifolia*'s shiny, dark–green leaves make its blossoms look even whiter. The deep, yellow throats of the lavender *Dampiera diversifolia* make this a spectacular plant. *Hibbertia fasciculata* is a wonderfu, bright yellow.

We need not neglect the traditional alpines, but it should be worthwhile to consider these other plants as well, for they can provide an additional interest and challenge to rock gardeners and extend the benefits of membership in our society to a larger, more varied group of marvelous plant enthusiasts.

European Notebook:

In Search of *Primula allionii* — Part 2
Easter Sunday in the Alpes Maritime

Paul Halladin
Geneva, Switzerland

Once again we venture forth into one of our favorite mountain regions, the fascinating Roya River valley in the Alpes Maritime in southern France. This is the only reported station of the choice and possibly even rare *Primula allionii.* On this occasion we at least have a little inside information, thanks to an ARGS member who was kind enough to provide us with the name of someone who had recently taken photographs of this primula in its natural habitat. The ensuing correspondence resulted in a description of one location in the Roya River valley and also a possible second station near the French–Italian border. The recommended time for a visit to the Roya River location was late March or early April, therefore we chose the Easter weekend in 1986 for our third visit. Our first visit was in early March 1985, which was possibly a little too early to see flowers. (See ARGS *Bulletin,* Vol. 43, No. 3.) The second visit was in October 1985. It was primarily intended to be a seed collecting trip, but was also another serious attempt to locate *P. allionii.* We were totally unsuccessful on both of these trips in spite of what we felt was a rather thorough search.

This elusive plant was still not too easy to find, even though we had a fairly good description of the locality. It cannot be seen from the roads even with high powered field glasses. It is necessary to climb through heavy underbrush and up some fairly steep slopes to reach the rock formations on which it grows. This was part of our problem. We had not been venturesome enough on our earlier trips. One must really see this country close up in order to be able to understand why one must hesitate to tackle the heavy undergrowth and the often treacherous footing over very unstable rock formations. In many places the stone is of a type that crumbles or breaks apart easily when one tries to step on it in order to reach a higher elevation. A novice plant explorer could certainly use some light mountain climbing gear to feel secure here. We would recommend a strong nylon rope, some pitons, and a hammer at the very least, as well as a strong staff about 5 feet long and 1¼ inch thick fashioned of a tough wood such as oak or hickory. It would be most useful as a brace when traversing rugged terrain and also in holding back thorny bushes when passing through underbrush.

We are always somewhat concerned about venturing too far from any

road and possible help because it is all too easy to become trapped in a situation from which there is no way out except by risking serious injury. This area is so rugged that one can venture inward less than 50 yards from the road and be completely hidden from sight. Many of the steep cliffs do not appear too difficult to climb because there are many places for hand and footholds, but the stone can sometimes crumble away at the slightest touch, so one could easily be stranded for a very long time.

Just as we were leaving our car to embark on our explorations, a colorful local resident about 75 years old approached us and started a conversation in a friendly manner—an unusual situation in that most people in this region will say little other than a polite *Bon Jour.* This man was so friendly that we decided to tell him why we were there. He took one look at the picture of this famous primula in one of our French field guides, and without hesitation offered to guide us to its location.

We took a rather circuitous route because he also wanted to show us his retirement home which he had just built during the last 2 years. High up above the road and the valley, in a location that could be reached only on foot, he had built a tiny one-room cabin with only one door and one large double window. After we were invited in, he pointed through the open window and said, "I do not have much in the way of material possessions, but I have a view that is priceless," and so he did, for one could see without obstruction for miles in a panoramic sweep on this clear and sunny, perfect Easter Sunday. Far below was the winding valley of the Roya River, to each side steep hills crowned by barren rock outcrops, and clinging to the side of one steep slope, a centuries old, tiny village with its rosy-colored roof tiles. Far away near the horizon were the snow-capped peaks on the French-Italian border.

After we left his tiny cabin, he took us through his own vegetable garden—mostly onions, garlic, and herbs—perched on terraces built into the hillside over 400 years ago by one of his ancestors. We were then guided through heavy undergrowth and over rocky outcrops, ever climbing on up until we reached the base of some very steep limestone peaks, too steep for us to climb. Here, above the 2500 foot level, was *P. allionii* the object of our quest, more beautiful and certainly far more plentiful than we had dared hope.

The cliff faces were literally studded with dozens of pink cushions all tightly adpressed to the cliff face and all in full bloom—a truly spectacular alpine display. Over 50% of the cushions were beyond our reach, so we could only estimate their size, but it appeared that the majority of the cushions were 3 to 8 inches in diameter. Virtually all were covered with blossoms that hid most of the foliage.

Closer examination of the few plants within reach revealed that they appeared to be growing in pocketlike crevices in the face of the cliff on almost

vertical surfaces. Higher up quite a few were under slight ledges or overhanging protrusions of stone. Every stone pocket that we were able to test was bone dry; in fact, all of the stone surfaces were bone dry. There was no evidence of running water from above, from possible snow melts earlier in the season, yet there was not even the slightest sign of wilting anywhere. All the plants appeared to be quite healthy.

Every plant that we were able to observe closely had rosettes and leaves with a tightly packed or compressed growth habit, more so than any we had ever seen in cultivation. Additionally, the dried leaves and seed pods of previous seasons appeared to be retained for at least 4 or 5 years. These old dried leaves were quite hard and rigid and none were observed as those in cultivation, soft and often covered with gray mold. It was difficult to examine the stone pockets in which this primula grew because the leaf structure of the plant was so dense. However, as nearly as could be ascertained, there was no soil in any of these stone pockets, just a tiny amount of what appeared to be bits of stone from the cliff itself together with the dust–like disintegrations of old primula leaves—all bone dry.

Anyone who has grown this plant in an alpine house would have to be astonished by the growing conditions here on this cliff. For us, during the 10 years that we grew and observed various *P. allionii* plants in the eastern United States, it was considered a somewhat fussy alpine house plant. It required regular watering during the warmer months or it would wilt quickly. It could not tolerate moisture on the leaves except for very short periods. It did not do well in overly lean soil mixes, and supplemental plant nutrients had to be applied in order to achieve even half the blossoms observed here. It could not take the sun at all between 10 A.M. and 4 P.M. from late April to the end of September in New Jersey, and yet it required strong light conditions in order to bloom well. It had a tendency to do very poorly in August under conditions of high humidity, so we usually found a way to keep it in an air–conditioned room whenever the humidity was over 80%. Yet here it was on a southwestern facing cliff (one of several orientations), exposed to the full sun and thriving. The daytime temperature in this region climbs well over 95 F. in the summer on sunny days, according to our guide.

The limestone on which *P. allionii* grows appeared to be somewhat similar to tufa in several ways: it was porous, but not so porous as tufa; it contained very few visible long crevices or fault lines; and it had some small hollows or pockets in its surface, although there were relatively few in comparison to most tufa. This stone appeared to be considerably harder than tufa and had a surface texture as harsh as the most coarse sandpaper. The roots of *P. allionii* must be able to penetrate deeply these limestone formations in order to maintain the plant in such good condition. (According to Farrer, the roots can be longer than 3 feet.) Yet with virtually no rainfall from April

Primula allionii Photo: Margaret Halladin

to October, according to local people, it is hard to see what would keep these high, exposed rock formations from completely drying out unless there is some other way in which the plant obtains the water that it needs. A possible source of moisture during the summer might be nighttime condensation. Could the root system over develop and become a type of water storage system for the plant? Or could the hairy, sticky glands on the leaves play a role in enabling the plant to survive in such a place? It is known that some plants use sticky substances to trap insects. Other plants have developed fine hairs on their leaf surfaces apparently to retard moisture loss from wind, heat, and full sunlight. However, it is unusual to see both hair and a sticky substance on the same leaf, in particular when careful observation indicates that this plant does not trap insects either in cultivation or in its native habitat. Incidentally, there was no sign of insect or mollusk (snail or slug) damage on any leaf or flower of those plants we could closely observe.

This primula apparently has adapted itself to some rather difficult conditions by using a method, or combination of methods, not too well described in the existing literature. It certainly merits further study, particularly in regard to its unusual leaves.

Contrary to the observations of Farrer, who mentions finding small ferns growing in the same pockets with the primula, there were no competing plants present in any of the pockets that we saw. In most cases there were no com-

peting plants within 5 or more feet. At and above the level at which the primula grew was an absolute minimum of plant life, consisting mostly of an occasional very small, stunted juniper.

The *P. allionii* colonies were found on various cliff faces, principally facing southwest, southeast, and east or east northeast. Each colony was well separated from the others. There appeared to be no particularly favored orientation. Although one could detect a slightly better appearance on plants facing east northeast, the differences were very minor. Perhaps ten to as many as thirty individual plant cushions would be found in one area, then another grouping would be located on an adjoining cliff face as much as 50 feet away. However, no plants were found anywhere outside of a fairly small range. Again contrary to Farrer's observations, we did not see any plants of *P. allionii* growing anywhere except in hard stone. There were no seedlings at the base of the cliff. All plants were located well above any possible soil. The peaks of these rock formations were only 10 to possibly 20 feet above the point at which the topmost primula grew.

The type of limestone found here can be seen in many other places in the Roya River valley. This might lead one to speculate that there may be other places in this region where one might find similar colonies including some that may never have been discovered. *

Others who have written about *P. allionii* have mentioned that this is a primula species of great variability. This point was certainly borne out here in this station. We noted not only variations in flower shape and blossom size (¾ to 1⅛ inch diameter), but also many minor variations in color tone, when viewed close up, as well as minor differences in the size and shape of the usually white flower throat and corolla. Viewed from a short distance all the cushions except for a very few dark forms appeared to be superficially the same basic color, an attractive rose pink. There were marked differences in leaf size and appearance. Some leaves were totally without indentations, others had pronounced toothing, and some only on the very tip of the leaf. The largest leaves were as much as 2 inches long and ½ inch wide, but most leaves were considerably smaller. There were also marked differences to rosette stem size among different plants. This was difficult to determine precisely, because the cushions were too tightly grown or too dense to permit careful measurements in this regard, but it was obvious that leaf rosette stems on some plants were over twice the diameter of those on other plants, even though these plants were found within a few feet of one another on the same rock face. In one case the flowers also differed slightly. Our observations were quite limited by our climbing abilities. We were able to examine only the few primulas that were within reach, and then had to exercise extreme care to avoid damaging the plants.

Another variability was noted in the dry, old seed capsules. There

appeared to be at least two quite different types in regard to shape. Some plants seemed to have old seed capsules from previous years that remained partially closed and still contained seeds of past seasons. We were able to collect eight such seeds. Two appeared to be still fresh (one germinated within 2 weeks of being sown), but the other six, apparently from a much older seed pod, were completely desiccated. Another nearby plant had dried seed pods of a different type that were completely opened, seedless, and splayed out in a star–shaped form. On one rosette stem we were able to identify the dry, old seed pods from four previous seasons.

Seed production by this plant appears to be regular and plentiful judging by the large number of old seed pods, but subsequent germination must rank very low because of the terrain. There were few enough pockets on the various cliff faces that we observed, and the majority already contained plants. Since this primula was not found sharing a pocket with any other type of plant and with almost no empty pockets remaining, the possibility of seed germinating and surviving must be very remote. One could even surmise that in some years not a single seed managed to develop into a plant. In fact, we did not see a single plant that could have been a 1– or 2–year–old seedling. All the plants appeared to be more than 4 or 5 years old. Nowhere in this particular location did we see any *P. allionii* that could have been as old as the ones Reginald Farrer wrote about in his book *Among the Hills:* "One unbroken cushion more than a yard across...an aged plant...that may have been contemporary with George III."

* Note: Subsequent to the completion of this article, information was received from two members of SAJA (Societe des Amateurs de Jardins Alpins, the Rock Garden Society of France) who are quite familiar with the Roya River valley. It seems that the SAJA members in the south of France sponsor a field trip during the last week of March in some years, primarily for the purpose of viewing the spectacular cushions of *P. allionii.* They mentioned that it can be found in a number of locations on both sides of the Roya River from the area around Saorge to as far north as the Col de Tende. However, their group preferred to visit a location near Saorge accessible to four–wheel drive vehicles. They also indicated that *P. allionii* is more abundant than generally believed. The problem is accessibility, not rarity. The majority of the places where it can be found range from very difficult to reach to almost impossible except for experienced climbers with proper gear. Additionally, some of the more remote localities at higher elevations may have deep snow over all approaches which effectively prevents anyone from viewing the cushions at a time when the flowers are present.

A Selection of Alpine Plants on Stamps—It is unusual for a country to honor an alpine plant by portraying it on a stamp, and it is even more noteworthy when six alpine plants have been so honored in a series.

In 1985 the tiny Principality of Monaco issued a series of stamps commemorating six plants endemic to the Maritime Alps. A committee composed of directors of the Parc Mercantour (a large national park of France encompassing a substantial part of the Maritime Alps) and directors of public botanic gardens in the southern part of France chose these plants. Of particular interest in their choice of that special treasure of the region *Primula allionii*, and also the choice of that most difficult plant *Saxifraga florulenta,* which is abundant in its preferred localities, but in cultivation frustrates almost everyone.

Three of these plants are found only in non-calcareous regions: *Saxifraga florulenta* (July–Sept, above 6000 feet), *Sempervivum allionii* (Aug–Sept, 4500–7500 feet), and *Silene cordifolia* (July–Aug, 4000–9500 feet). The other three, *Primula allionii* (Mar–Apr, 2000–3500 feet), *Berardia subacaulis* (July–Sept, 4500–9000 feet), and *Fritillaria moggridgei* (Mar–May, 2000–6000 feet), are found only in or near limestone. *F. moggridgei*, the only bulb in the series, is considered to be a yellow form of *F. latifolia.* A special variation of this can be found near Saorge in the Roya River valley.

– Paul Halladin

***Viburnum plicatum tomentosum* 'Fujisanensis'**—Like Vaughn Aiello (ARGS *Bulletin,* Vol. 42, No. 2, page 47) I was advised that this would be a miniature, so I grew it in a container for some years. As promised it did flower incessantly; one year of a very mild Seattle winter it bore scraps of "lace handkerchiefs" through December, January, and February. About 15 years ago my two plants were put into the ground with dramatic results. They shot up gradually to narrow, almost fastigiate, small trees, yet still trying to flower incessantly. One is now 12 feet tall! Seedlings are everywhere but there is no time or place to grow them on. Is anyone game for an experiment?

– Roy Davidson

Butterfly Weed: The Brilliant Asclepias

Mrs. Ralph Cannon
Chicago, Illinois

(Photograph by the author)

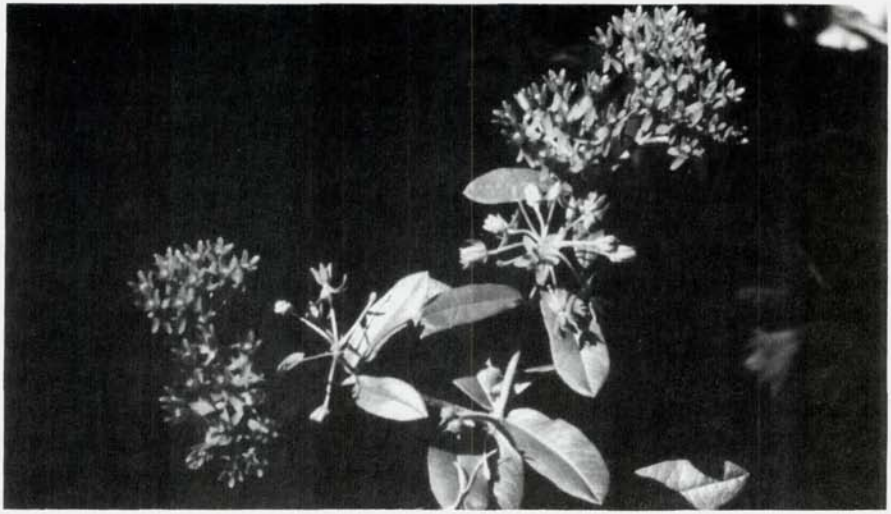
Species of *Asclepias* are commonly known as milkweeds because many of them contain a milky latex in the stems, roots, and leaves. Belonging to the Dogbane Order (Apocynales), the Milkweed Family (Asclepiadaceae) proclaims the possession of this genus and its native species. These herbs may all be thought of as butterfly magnets, and any plant that will encourage butterflies to display their glamour for our delight is to be welcomed. The scent of the flowers of this genus is powerfully wafted on the air and attracts many species of butterflies; a blossoming plant is frequently ashimmer with their wings.

Asclepias is particularly attractive to monarch butterflies *(Danaus plexippus)* as plants of this genus are the only food for their caterpillars. In March the monarch butterflies rouse themselves and begin to move northward from their southern wintering places. The female lays her eggs on newly emerged milkweeds wherever she finds them. Then in July, when the milkweeds are in bloom, the monarchs will besiege the blossoms to partake of the nectar flow. This showy butterfly appears only where it finds its food plant in the wild. There are many species of native *Asclepias* and they have immensely wide distribution. Practically every region in the United States has its own native milkweeds.

While all milkweeds are interesting, only about a dozen species have showy flowers that are of garden value. These are of easy cultivation, have attractive habits, are stately, have beautiful flowers with rich fragrance, and have ornamental seed pods or follicles. All are hardy and even if old plants should die in the winter, they can be depended on to renew themselves from self–sown seed. All are plentiful in nature and can be personally collected without interfering with conservation. Seeds from the wild are easily gathered for propagation.

The brilliant–flowered *Asclepias tuberosa* is the finest garden plant of all the milkweed species. It grows in the wild from New Hampshire to Colorado and south to Florida. The vernacular name butterfly weed was well chosen because butterflies are almost always found hovering over the blossoms to sip their abundant nectar.

Asclepias tuberosa grows 1 to 3 feet tall depending on the variety and soil. The leaves are simple, lance shaped, alternate, short petioled, and carried on rough, hairy stems that branch at the summit. Fragrant flowers in loose



Asclepias tuberosa

corymbs occur at the branching tips of the stalks—flat-topped, glowing, usually orange-red clusters that will set your garden aflame during midsummer. These vivid flowers soar with a luxuriance of growth that seems almost tropical. There can be several weeks of difference in blooming time among plants from various places. As each has a long period of bloom, it is possible to have a month-long display from these plants, which are as pleasing as they are intense and never fail to excite comment.

This species has been separated into several varieties, one of which is *A. tuberosa lutea* with pale yellow flowers. *Asclepias* 'Sulfurea' has primrose-yellow flowers. Other forms have red or even bi-colored blossoms. *Asclepias tuberosa decumbens* has reclining stems instead of erect ones. Leaves may be opposite or alternate, linear to lanceolate to oblanceolate. *Asclepias tuberosa lanceolata,* sometimes given specific rank as *A. lanceolata,* has smooth stems instead of hairy ones and narrow lanceolate leaves instead of short petiolate ones. It has a more southerly distribution. These small differences, although interesting to a botanist, do not affect the garden merit of this species as much as color does.

Botanically, the structure of the flower is unusual. Lyman Benson in *Plant Classification* says, "The stamens are attached to the stigma so that the spaces between the anthers form grooves down the side of the compound structure, composed of stigma and anthers. The apex of the stigma is polished and slippery and when the insect alights, its legs are likely to slide down into the groove between the two portions of the adjacent anthers and be brought back up with masses of pollen hanging. These pollen masses are rare among

flowering plants."

After the flowering period and pollination, a few pods of fruit will form, each fruit a follicle. Each seed therein overlaps its neighbor and each is provided with a tuft of long, silky hairs which will serve as a parachute to waft it hither and yon. The follicles are more slender than in common milkweed. There are seldom more than two found on each stalk and frequently one of them is stunted. It is wise insurance to collect a few seeds for extra propagation. There will be plenty of seed in each pod from which to raise a new generation. Allow follicles to ripen on the plant and collect them just before or right after they split longitudinally. The seed color when ripe is bright brown.

Plants provided with maximum sunlight and sandy, gravelly soil with sharp drainage will delight for weeks. If pleased with their situation, they will perpetuate themselves by self-set seedlings. They do not enjoy clay soil or an over-shadowed position. As they are relatively bug and disease free, they are one of the most dependable, showy native plants that can be grown.

If plants are found in the wild, transplant either early in the spring or after flowering in September. They are difficult to move because of their deep tap root; therefore, the best size to transplant is the 1-year-old seedling. If these cannot be found, try growing from seed. Sow seed in spring in light, sandy soil. When the seedlings are 4 to 6 inches high, transplant them to their permanent location being careful to get the whole of the tap root.

Since *A. tuberosa* has a long tap root of a fleshy solid nature, it can be propagated from root cuttings. This is best done in the spring. Lift the plant, wash the roots clean, cut into 1½-inch segments, slanting the cut at the end toward the root. Insert the cuttings in a box of sandy compost with the flat upper end just at soil level. Then cover with a half inch of sharp sand. Soon the cuttings will send down new feeding roots and new top growth will appear. Pot up the new plants as with other cuttings, in deep pots. This will give flowering size plants the following year.

It is advisable to grow a few new plants every year in order to have plants with good vitality. It is also wise to mark, at the time of garden cleanup in the fall, the growing positions of the plants because *A. tuberosa* has a cautious approach to spring and starts growth very late in the season. Do not disturb it too early, but wait for its lazy appearance.

Though its brilliant orange color can be difficult to place in the garden, there are many situations where *A. tuberosa* can be used effectively: possibly as a single plant where an accent is needed in a key position, or scattered throughout a planting as they are usually found in nature, or grouped to produce a mass of color. They combine well with true blue as in *Delphinium chinensis* or with lavender blue and are superb among yellow flowers. A few plants growing with *Salvia patens* is a memorable sight. These late-flowering, handsome perennials are worthy of a conspicuous position in the garden.

In Wet Sand

Norman C. Deno
State College, Pennsylvania

(A companion paper entitled "In Dry Sand" appears in Rocky Mountain Alpines *published in connection with the 1986 Interim International Rock Garden Plant Conference in Colorado.)*

On the north shores of Lake Huron and Lake Michigan, a unique and beautiful dwarf vegetation develops on wet sand flats. These flats extend from the lake edge inland for several hundred feet interspersed with shallow pools of water. The flats are a few inches to a foot or two above the level of the lake and the water table is an inch or two below the surface. The vegetation consists of sedges and sparse grass intermixed with parnassus, fringed gentian, gerardia, Indian paint brush, and purple fringed orchis. It is dwarfed by the sterile medium. The fringed gentians are often reduced to a single flower on a sparse stem that can be as short as 2 inches. Farther south along the west shore of Lake Michigan, *Iris lacustris* and *Primula mistissinica* become more prevalent on similar wet sand flats. Still farther south near Kenosha, Wisconsin, is the Chiwaukee Prairie Botanical Preserve where *Dodecatheon media* still carpets wide areas.

Marvelous days have been spent walking on these sun-drenched flats with the limitless sparkling water of the lake ever at hand. These natural gardens were the initial inspiration for gardening in wet sand.

These natural wet sand flats have no drainage, yet the plants grow heartily which is amusing in light of the incessant calls for drainage throughout the rock garden literature. Observing these flowers led to the realization that drainage in itself is not the crux; a plant cannot really care whether water does or does not flow rapidly past its roots. What is critical is oxygen at the roots, in other words, a well-aerated medium. This is achieved in these wet sand flats by the extremely porous nature of the sand and the shallow rooting of the plants. The porous nature and constant moisture lead to rapid bacterial oxidation of organic matter so that it does not build up to create potential anaerobic conditions. The reason that the drainage dictum works so well is that well-drained soils will usually be well aerated, but deeper understanding evolves from focusing on the direct requirement of aeration rather than the indirect association of drainage.

Eight wet sand beds have been constructed over the past 10 years. It has not been long enough to try much variation or many plants so that the

experiences recorded here must be regarded as premature. For example, the first bed was constructed with a 10 inch depth of sand. This worked so well that no further experiment has been conducted on varying depth of sand.

The wet sand beds are constructed by excavating an area of typically 3 by 8 feet to a depth of a foot and placing concrete blocks in the excavation around the edge. The concrete blocks are the standard type used in constructing the foundations of buildings and houses. The remaining depression is lined with a double layer of water–tight black polyethylene plastic and filled with either masonry or concrete sand to a depth of 10 inches. The edges of the plastic are trimmed for appearance sake and the bed filled with water up to the surface of the sand. The bed is now ready for planting. It is imperative to fill with sand and not to add any soil, peat, or organic matter. Such organic matter would start rotting and lead to anaerobic conditions which would be fatal.

The rainfall here is about 45 inches a year, and this is usually sufficient to keep the water table close to the surface. Water has been required on rare occasions when there was no rain for 2 or 3 weeks. No plant food or fertilizer has ever been used. Perhaps a little mineral fertilizer might have been of benefit, but the growth of the plants has been adequate without it.

It should be possible to construct wet sand beds from a variety of water-tight plastic containers. A plastic tub 2 feet in diameter was not very successful because it dried out and needed frequent watering to keep the water table up. The larger plastic pools of a depth of a foot or two which are popular as wading pools for children should work either free standing or sunk into the ground, but they have not been tried.

Turning to experiences with the plants, the outstanding success has been with certain primulas. Two of the eight beds are devoted to hybrid swarms of *Primula rosea* crossed with *P. clarkei* and *P. warshenewskiana.* One bed contains *P. japonica,* one mixed candelabras, one *P. denticulata,* and one is half *P. mistissinica* and half primulas of the sibirica section. Hand pollination is required for seed set on the *P. rosea* hybrids. The seed is sown from the barely ripened capsules directly on the wet sand bed, and cotyledons appear in 3 days. The seed quickly loses viability; seed purchased or obtained from seed exchanges is largely DOD (dead on delivery). This may comfort members who have been unsuccessful with such seed. The only answer is to have the whole seed capsule mailed just as the capsule starts turning brown. That is the way *P. rosea* was started here.

The *P. rosea* hybrid swarms show much variation. The stoloniferous nature of *P. warshenewskiana* seems to breed out, but many seedlings show its nearly sessile flower habit. At the other extreme are flower stems as much as a foot tall. Flower color varies from dark rose pink to pale pink, with no whites as yet. The older plants can be divided, as they increase at a moderate

rate by offsets. The plants appear to live indefinitely in the wet sand, a contrast to their fleeting nature in soils, even moist soils.

The most pleasant surprise has been the success of the sibirica group of primulas. Experience is limited but the future looks bright: *Primula pamirica* is in its third generation, *P. yargongensis* is multiplying rapidly by offsets but has not flowered yet, and *P. involucrata* looks promising in its first year. I would welcome exchanging any clones of the siberica section as it is intended to grow them in quantity.

As for the rest of the farinosa group, *P. mistissinica* makes solid mats by the sprouting of adventitious root buds from the shallow spreading roots. A few *P. frondosa* and *P. modesta* look promising.

As expected, the candelabra primulas do well. What was surprising was that *P. japonica* was so vigorous with six whorls of flowers being typical. *P. denticulata* is somewhat dwarfed by the sterile conditions, however, though the plants with single flower spikes have a special attraction and seem to be more permanent than the great cabbages that develop in our woodland soils. Both primulas can be readily propagated by broadcasting seed onto the wet sand.

One of the original objectives of the wet sand beds was to grow the beautiful eastern *Trollius laxus* which was once collected within a few hundred yards of our house. That was in 1860. It has not been seen in over a hundred years. *Trollius laxus* is rare and intolerant so that its success in wet sand has been much appreciated. Subsequently, it has been found that it will grow in moister places on our limestone slopes; however, the wet sand beds were the fountainheads for the colonies here. One hint: *T. laxus* does not like competition. Other members of the buttercup family would probably do well, but space cannot be spared.

Rhexia virginica has done well, but shows a preference for half shade. This is an appropriate place to record that the wet sand beds have been largely placed on the south side of deciduous trees where they get sun about half the day. One of the reasons for this is that such locations dry out in summer and look bare and forlorn. The wet sand beds being insulated from the tree roots are little oases and allow gardening in a place that might otherwise be wasted.

Iris lacustris and *Dodecatheon media* have been grown on a small scale. Mossy saxifrages do well, but only a small test space is spared since they also do well on our limestone slopes. A few *Lobelia cardinalis, L. siphilitica,* and *Iris prismatica* do well. *Mimulus luteus* overran one small bed and was discarded.

The experience with gentians is limited and confusing. Initially there was optimism because stands of *Gentiana linearis* and *G. rubricaulis* grow on inland lake shores in the Upper Peninsula of Michigan and *G. andrewsii* lines

several hundred yards of shoreline by a small lake near State College. *Gentiana andrewsii* does grow and bloom in wet sand but shows chlorosis. *Gentiana saponaria* and a *G. decumbens* type (grown from seed labelled *G. linearis*) suffered severe root rot.

Experiences with native terrestrial orchids are of special interest. Our own efforts are dwarfed by those of Paul Keisling of Worcester, Massachusetts. He uses wet sand beds exclusively, particularly with peat and sphagnum on the surface. The great clumps of *Cypripedium candidum* and *C. reginae,* both the American and the Japanese pogonia, Calopogon, and others is an education. He treats the plants every few weeks with antifungal agents which is the other half of his success.

The experience with *Spiranthes cernua* is instructive. Seed from local plants was broadcast on a wet sand bed. The next year rows of rosettes developed in the form of a Y within a 2-foot diameter. The seedlings had grown exactly over an old *Iris versicolor* rhizome that had died from attack by borer and had rotted. The following year they bloomed in little rows and then died. This shows once again the necessity of certain specific fungal activity in bringing along orchid seedlings in the wild. The fleeting nature of the colony is also typical of natural colonies around here.

There is much more to be learned about wet sand beds. At the least they are the answer to growing certain moisture-demanding plants. They also are a more productive way to use some areas that dry out in summer. No attempt has been made to landscape with them, but they could substitute for the little pools one sees except for one drawback: the wet sand beds harbor colonies of mosquitoes. These would be disastrous if placed beside your favorite patio or veranda.

Mrs. Alice Hills Baylor writes, "I wish to highly recommend G.K Fenderson's new book *A Synoptic Guide to the Genus Primula* to all who are interested in this handsome plant family. It is a meticulous work, long overdue, and will be a guide and authority for years to come."

Homeoclimatic Planting Design in the Semi-arid West

Aaron Shamberg
Denver, Colorado

(Aaron Shamberg is a landscape architect with an interest in rock gardening and semi-arid planting design. The ideas he presents here on homeoclimatic planting have challenging application in any climate.)

In the foothills of the Rockies, we live in a semi–arid climate of bright sunshine with predominately cool and dry winters and very hot summers. Vistas of the plains to the east and the mountainous skyline to the west are distinctly striking, despite the hindrance of urban smog. Uncharacteristic of the ecological conditions of this region are the lush landscapes resulting from high water use with plants imported because of their adaptability to moist conditions. The somewhat formal and repetitive effect of expansive green lawns, hedges, and large tree and shrub plantings has design roots in Europe and, more recently, the East Coast. As a design solution commonly used by landscape architects, this "green room effect" relates very little to the geographical scale and climatic temperament of Colorado. If anything, it temporarily creates the illusion that one has escaped the constraints and opportunities of the semi–arid West.

The "green room" is an expensive, labor intensive effect to maintain; therefore, many home owners have turned to replacing large areas previously devoted to sod and converting them to plastic and gravel pastures. This decreases not only maintenance cost but esthetic return as well. The trade off, while unacceptable to all gardeners and landscape designers, is finding increasing popularity.

As the availability of water lessens, more pressure will be placed on the landscape to utilize less water. Landscape amenities are generally considered luxuries in the scope of human well being. Unlike musicians and artists, landscape architects generally do poorly in times of economic depression. The green room effect will be the first to suffer as its plants are placed under increased stress due to lack to water.

As the cost of maintaining and irrigating the green room becomes more prohibitive, the responsibility of providing viable alternatives to the gravel pasture will be on the botanists, horticulturists, and landscape architects. While the botanists and horticulturists harbor the most detailed understanding of plant geography, habitat, and growth characteristics, it is the landscape architect's role in society to implement plant design and use.

Within horticultural circles, we are seeing the rock, alpine, and desert horticulturists creating new possibilities of planting designs by distributing plant materials from differing global geographic areas with similar isothermic and climatic conditions. This important concept has recently been termed "homeoclimatic planting." It has been widely used in temperate and maritime climates but has only been in discussion recently in terms of arid, semi-arid, and alpine climates. Only within the last years have western botanists explored or re-explored and obtained samples of plants from remote parts of China, the Soviet Union, Iran, Turkey, and parts of South Africa. This research has dramatically increased the plant palette available to landscape architects in the drier climates.

For appropriate planting designs using a homeoclimate concept to become widely understood and used effectively, horticulturists and gardeners need to become more proficient in design. Landscape architects need to become more educated in horticulture. In addition, the nurserymen would benefit greatly by facilitating these avenues of education. (The Siskiyou Rare Plant Nursery in Oregon is an example of one nursery that has been introducing plants appropriate to homeoclimatic design in our region.)

Landscape architects in drier areas need to rely less on irrigation and maritime plants. They must renew their knowledge of the increasing number of native species in the nursery trade and the increasing availability of homeoclimatic species. Those who limit their enthusiasm to native species are greatly limiting their opportunities, as well as a true integration of human ecology.

Following are some suggestions of homeoclimatic genera hardy in the semi-arid West and listed from one of their native locations: Europe/Asia: *Crocus, Ephedra, Iris, Scutellaria;* New Zealand: *Ericaceae;* North America: *Amorpha, Arctostaphylos, Dalea, Eriogonum, Penstemon, Phlox, Shepherdia;* Mediterranean: *Campanula, Cistus, Dianthus, Lavandula, Origanum, Thymus;* South Africa: *Delosperma, Helichrysum.*

On the other hand, a knowledge of plant taxonomy or propagation does not alone lend itself to the creation of beautiful gardens or planting designs. Rock gardeners and horticulturists should be educated in principles of landscape and garden design theory in order to ensure a successful use of appropriate plants. The mere use of plants does not ensure a successful design; however, plants often bring vitality to areas that otherwise would seem lifeless.

It was once stated that gardens to houses are like clothes to people. Just as one would not ordinarily wear a tuxedo when digging or overalls at an elegant function, some gardens will more appropriately dress a house or office than others.

In order to design the appropriate garden one has to clarify and define

one's concept of garden. Concept development is the first stage of good design. Many ecological, historical, cultural, and esthetic questions can be asked. Horticulturists need to ask these types of questions to help achieve an enduring design of good quality: is this garden site serving as a background to something else, or a frame to another view? Is it a long thoroughfare, or a focal point? Is it meant to be literal, symbolic, or suggestive? What is the nature of the surrounding environment? Is it open or dense, dark or light, warm or cold, calm or turbulent, full sun, practial sun, or shade? What is the style of the surrounding architecture? Is it rustic, adobe, oriental, Victorian, high–tec, 50's brick, or ranch style? What are the color schemes? Do we want to contrast or harmonize with them? Is one season to dominate the bloom? How many stories is the existing structure? What is the relationship to adjacent owners?

There are many questions that need to be asked before a design can adequately stand up to reality. Very few designers reach the level of designing great gardens on pure intuition. Most of us need to define realistic parameters before we close our eyes and let the design come to life.

Book Review

The Primulas of Europe and America by G.F. Smith, B. Burrow, and D.B. Lowe, Alpine Garden Society. Available from ARGS Bookstore, $22.75.

As a primula nut, I have been eagerly awaiting the publication of this book. At last it has arrived and I am not disappointed.

This is a more than fitting companion volume to Roy Greene's *Asiatic Primulas,* with Duncan Lowe's beautiful line drawings of almost every species, sketches of plants in their natural habitat, distribution maps, and seventy–six color plates.

The plant descriptions are very detailed and make engrossing reading, but for North American readers, the section on distribution is a little overdone. This is not really surprising as this book is intended chiefly for the British gardener with easy access to those high mountains.

Thank goodness the main text is in alphabetical order, rather than being arranged taxonomically, especially since the authors are following the latest revision of the genus which uses many unfamiliar section names. The descriptions take up just over half of the total 250 pages and, in addition to distribution, cover such points as altitudinal range, habitat (very useful, this; it is a good guide to the conditions to emulate in the garden), and a very complete description of the plant—everything from rhizome to seed capsule.

The coverage is thorough and goes into all the various subspecies and varieties recognized by modern taxonomy. An appendix at the end of the book gives the synonyms for the species and natural hybrids covered.

The chapter on identification, though short, seemed very easy and clear during a winter reading. Only time will tell. The only way to find out the efficiency of a key is to use it. Since I can never remember for long the difference between revolute and involute, the glossary is most useful.

Hybrids are well covered; those that occur naturally are followed by the ones created by man. As the authors point out, they did not intend to list every cultivar ever named, but included the better forms which are suitable for growing in an alpine garden. Here they are grouped taxonomically, by section, with the individual species and their major forms listed and described. Additionally the artificial hybrids produced by interspecific crossing are given. The exception to this format is *Primula auricula* where such a large number of show and alpine forms have been produced that they would have overwhelmed this book.

In the vernales section, there are extensive lists of forms of what I suppose I will always call *P.* x *juliana* (now *P.* x *pruhoniciana*), of double primroses, Jack–in–the–greens, hose–in–hose, and other types that are rarely available in North America.

The final chapter on cultivation is a gem of conciseness. Again it uses the section format, since often the plants have similar cultural requirements. Thus, "Section FARINOSAE. Most members of this group are easily grown in a well drained soil with plenty of available moisture in the growing season. They are normally raised from seed although plants with multiple crowns can be divided....Some are short lived in cultivation and it is prudent to keep a reserve of young plants going to replace those lost."

Margaret Earle (whose breeding work with *P. allionii* is mentioned in this book) had an article in the September 1985 A.G.S. *Bulletin* which ties in beautifully with this chapter, expanding the range of *P. allionii* cultivars and illustrating many of those described.

One must keep in mind the difference in climate between Britain and most of North America when reading some of the culture notes. Their comments on over–wintering plants do not always apply, especially in areas with good snow cover. And, naturally, they have no words of wisdom on the care of primulas in the hot, muggy days of summer.

All plant lovers, and especially all primula lovers would do well to add this book to their collections. I am sure it will be THE reference work on European and American primulas for many years to come.

– Trevor Cole

Omnium-Gatherum

Plants to know and grow—Omphalodes, why doesn't anyone write or even talk about Omphalodes anymore? There are members of that genus elegant and pure enough to melt the heart of the most fastidious gardener. The blossom is the thing with the choice *Omphalodes* species. They need to be contemplated, at leisure, and at eye level. And gypsophila? Anemonellas are being noticed again. What about some of the other largely forgotten and neglected genera full of unsung joys? Surely being impossible to grow or being one of only three plants in existence are not the only qualities to endear a plant to a gardener. Do a deserving plant the favor of bringing it to light in the "Plants to Know and Grow" column starting in the Fall issue.

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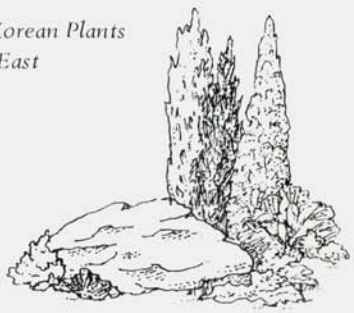

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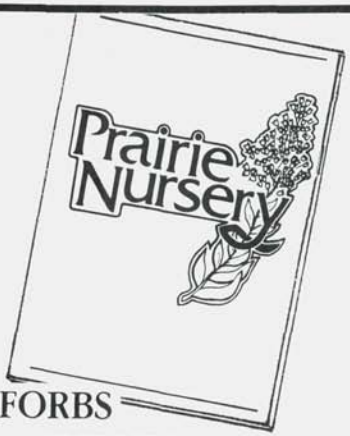

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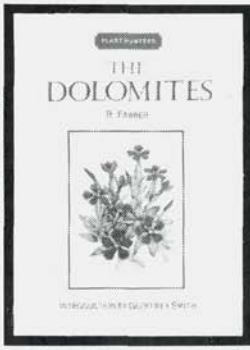

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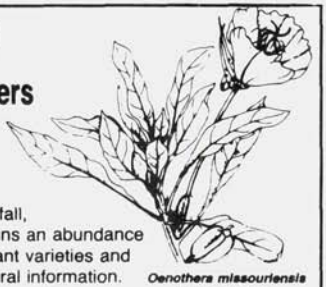

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