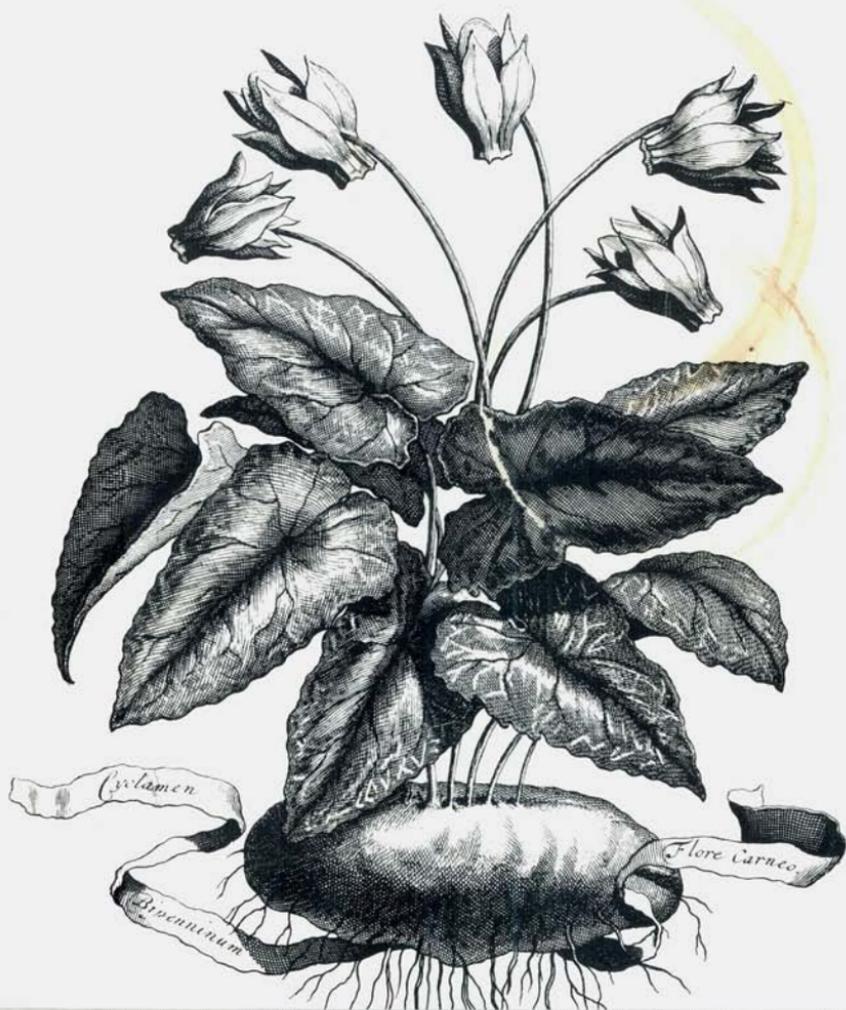


Bulletin of the
American Rock Garden Society

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Foreward

A number of members who knew Linc Foster well share their reflections on his contributions to gardening and the rock gardening world.

This issue also contains well researched articles on two different groups of plants. Cyclamen is covered in some detail by Nancy Goodwin. George Phair encourages us to grow Lycopodiums, the Clubmosses, and Selaginellas, the Spikemosses. Ann Lovejoy tempts us with a few of the wide variety of small bulbs, the "Mighty Mites" of Spring.

Gerald Klingaman sheds some light on seed viability... especially useful with collecting for the Seed Exchange in progress

now. Carole Wilder and Marcel Jouseau have compared 1978's Seed Exchange with 1988...and have given directions for supplying seed. Sue Olson offers some valuable insights on collecting...and cleaning...fern spores, the "invisible seed" for your own use or for sending to the Seed Exchange.

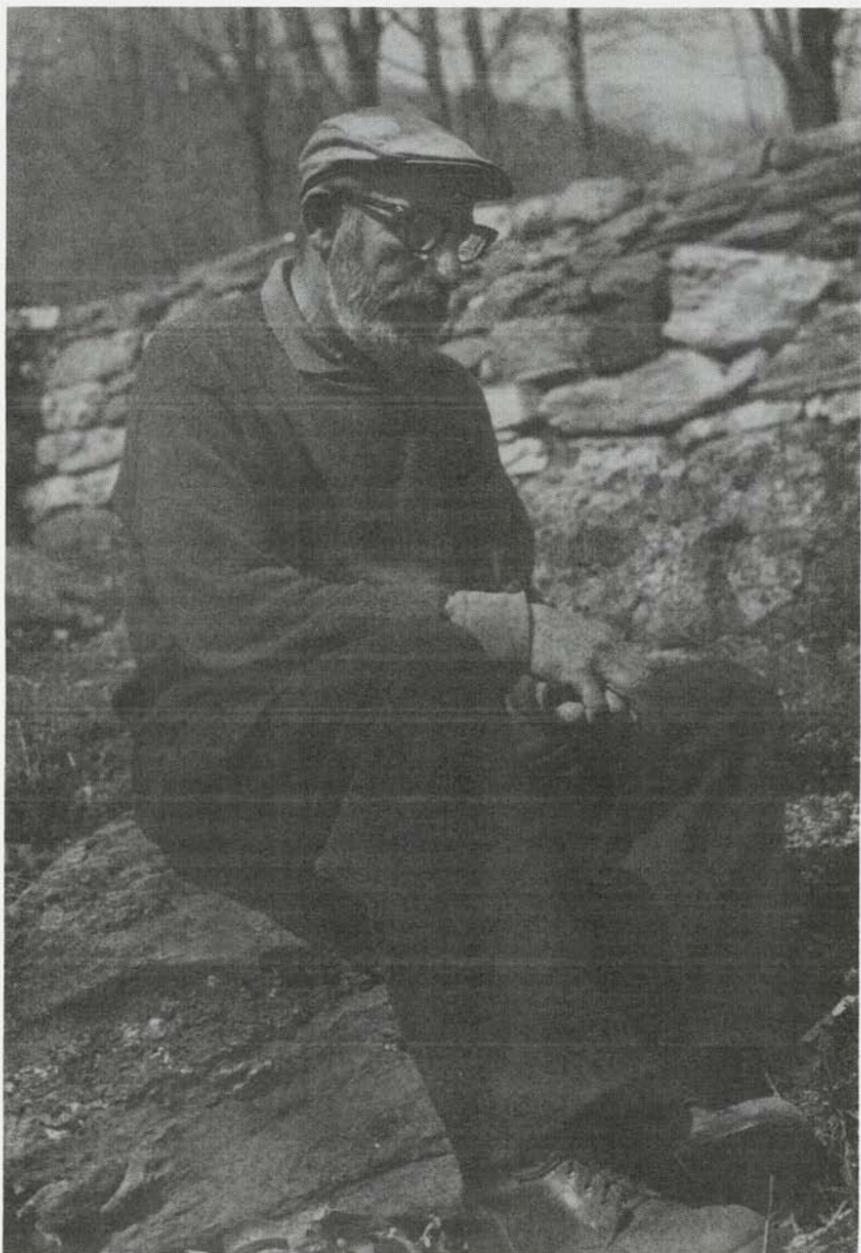
Geoffrey Charlesworth, with horticultural and linguistic legerdemain, rambles through the rock garden in summer. Wayne Kittredge builds a solar greenhouse while Thea Tweet and Nick Nickou contribute short pieces to add to our gardening pleasures.

Ted Marston

On the Cover: The cyclamen illustration is a copperplate from a Dutch horticultural Treatise by Abraham Munting printed in 1696. In its time, the book was a standard gardening work and was complete with scores of illustrations.

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H. Lincoln Foster

H. Lincoln Foster

February 12, 1906 - April 7, 1989

Where to start? Linc lived 83 full years, but I knew him for 17, a scant fraction of his lifespan. Although we can never know one another completely, since we are allowed only enough time to share fragments of our inner selves, I was lucky to witness a few facets of his personality. And Linc was certainly multi-faceted: teacher, writer, linguist, philosopher, poet, plantsman, conservationist, botanist, sportsman. His influence was immeasurable, touching many. He altered my life without even realizing it. His gentle humor and infinite patience nourished my love of gardening, and his gentlemanly wisdom sparked my commitment to the American Rock Garden Society.

Linc was born in Newark, NJ, in 1906. His family never dreamed that the grubby urchin with scraped knees from playing roller-skate hockey would become a horticultural legend. Graduating from Williams College in 1928, Linc taught English and Latin in Morristown, NJ, coaching baseball and playing ice hockey. Eventually, he moved to Connecticut where he founded and co-headmastered the Norfolk School in 1937.

After the school closed, Linc went to work for Ted Childs in 1943. Under the direction of Professor Harold Lutz, from the Yale School of Forestry, he began a

botanical survey of the 6,000 acre Great Mountain Forest in Norfolk, while growing tree seedlings for trail plantations and experimenting with rhododendrons in an effort to "...hybridize tender ones with the hardy ones so as to create hardy strains with greater variation in growth habit and flower color".

After almost five years, Linc decided to go back to teaching, but since he needed special education courses for the Connecticut public school system, he enrolled in Trinity College, Hartford. He expanded his curriculum towards a Master of Arts degree (conferred in 1953) and represented Norfolk in the State Legislature. From 1949 - 64 he taught English, Latin, and Earth Science at the Housatonic Valley Regional High School, still coaching baseball in his spare time. During this period, he made two detours. He took a year off to study Ecology and Conservation at Yale University under a Ford Foundation Fellowship. Then in 1962 - 63 his love of language led him to edit two textbooks, a critique of *Moby Dick* published by Macmillan Company and *An Anthology of American Poetry*, both of which were recently reprinted and are required textbooks in many high schools.

But his life, as we know him, began in December 1949 when he married

Laura Louise James (Timmy, as she preferred to be called), moved to Falls Village, and entered a partnership that lasted until Timmy's death last January. Together they spent almost forty years creating Millstream, six acres of gardens that blended so effortlessly into the mountainside that they seemed to have evolved from nature. In Timmy's words, they became infected with a rock garden fever in its most virulent form, plantsmanship, and spent every spare minute propagating, collecting, designing, hybridizing, and sharing.

Later, Linc wrote: "The actual day-to-day business of gardening is a private and rather solitary pursuit. This very fact is one of the charms and certainly one of the spiritual rewards of gardening... There are days when I purposely find chores in the remotest corner of the garden, away from the telephone, just to escape and be utterly alone with earth and sky and plants; yet there are few days when I would not welcome even there a devoted fellow gardener; to talk, to commiserate, to gloat, to share. Rock gardening is an especially private form of gardening. Each rock gardener's landscape is not like anyone else's. Beds of annuals, perennial borders, and shrubberies are predictable. There are only so many variations... Not so with rock gardening. Every rock gardener is his own botanist, horticulturist, and landscape designer."

Linc joined the American Rock Garden Society in 1943, began contributing articles to the *Bulletin* by 1945, and offered his services on every level throughout the years, participating in the organization of three different chap-

ters: Connecticut, New England, and Berkshire. In 1949 - 50, he ran the Seed Exchange and instituted the practice of assigning donor numbers to each entry - a feature unique to our Society.

In 1949 he was elected a Director of ARGS and served until 1955. Elected again in 1963, he resigned the following year to become President of the American Rock Garden Society from 1964 to 1968. In those four years he infused the Society with new vigor, implementing many procedures that we now take for granted: he encouraged formation of local chapters to unite gardeners across the country; he proposed formal awards to recognize those "...illustrious members of our Society who have made special contributions to rock gardening in America"; he instituted an Advisory Committee to guide policy; he created the *Bulletin Board* to handle supplemental information; and he oversaw publication of *The Rock Gardener's Hand Book*.

On an international level, Linc corresponded with gardeners all over the world. The Alpine Garden Society acknowledged his expertise by appointing him Honorary Local Assistant Secretary for the U.S.A. from 1964 until his death. In 1968 he and Timmy visited Czechoslovakia and gave talks at the Ministry of Education & Culture and the Prague Cultural House. Josef Starek reported the Linc showed slides of such typical American genera as trilliums and lewisias, as well as "...fine views of American mountains and countrysides...(we) were very happy indeed to hear valuable views on gardening and on the flowers, many of which were so far unknown.. Frankly

speaking, it was a very sad moment, indeed, for many of us when we said good-bye to Mr. and Mr. Foster."

In 1968 Houghton Mifflin published *Rock Gardening, A Guide to Growing Alpines and Other Wildflowers in the American Garden*, written by H. Lincoln Foster and illustrated by Laura Louise Foster. This is more than a botanical reference: the writing is lyrical, expressing Linc's conviction that life and nature are inextricably intertwined: "...think of the total picture you are creating...Let the setting of your plants be in terms of their immediate surroundings and especially in terms of the total picture that your particular parcel of land is expressing. Remember that this is your garden and your land. You will live intimately with it. You will work in it. If it pleases you, there is little doubt that it will please your visitors, because it will be constant with your land and with yourself."

Although Linc had many interests, he made an effort to contribute to all of them. He chaired the Falls Village Conservation Commission; moderated town meetings; presided over the Berkshire-Litchfield Environmental Council; led field trips for the Connecticut Botanical Society; and participated in plant societies around the world.

In spite of his innate reticence, Linc's expertise was recognized and rewarded. He won the first Charles Downing Lay Award for the Housatonic Valley Association, the Florens DeBevoise Memorial Award from the Garden Clubs of America, a Silver Medal from the Massachusetts Horticultural Society, and the Arthur Hoyt Scott Garden Award. And just last year he was honored with the

Community Award of Merit for contributions to the Town of Falls Village. Needless to say, he won every award the American Rock Garden Society had to offer (Citations appear in the *Bulletin*: 28 - 147, 37 - 137, 46 - 183).

In the preface to his book, Linc wrote, "This work has a modest purpose, which was difficult to keep before me because my enthusiasm carried me out of bounds." Luckily for us Linc's enthusiasm focused on rock gardening for over fifty years.

Buffy Parker, Darien, CT

Norman Singer once said that Linc was "our Guru". Linc looked slightly askance as though he wasn't sure whether it was a joke or not. But actually Linc was a spiritual leader, not so much by any verbalized philosophy but by his actions. He was a participant, not an onlooker. He asked questions and answered them. He took plants to meetings to show them and talk about them. As a grower he knew more than anybody, and he shared his knowledge and experience. Most of all he was an example to follow as a gardener. He never stopped clearing new areas and expanding his garden until the last year and this seemed to make it right for us to do the same. He never stopped sowing seed and hybridizing, collecting seed, giving away divisions and seedlings, propagating and distributing plants. We don't need to wonder whether it is OK to make another bed or sow a few more

packets of seed, Linc did it into his eighties. He was a teacher by exam-ple, a model gardener.

Geoffrey Charlesworth, Sandisfield, MA.

From the moment I set foot in your driveway, my gardening life changed. Of all the gardens I have visited, before and since, none has moved me as much as the one you and Timmy made. It was the outward physical expression of everything a garden is about: love, labor, knowledge, beauty, and the sheer fun of it.

Millstream was the garden, to me. And my woodland garden is, forgive the pun, a Foster child. In addition to untold inspiration, you wrote the book on garden generosity, and mine is full of reminders of your kindness. Thank you, belatedly, for all your many contributions to the patchwork of my life and garden.

Sidney Eddison, Newtown, CT

My very great sadness at learning of Linc's death was mitigated to some extent by the lifting of a concern that has worried me for months. How, I kept wondering, was Linc managing without Timmy? Linc and Timmy always seemed to me to be a single unity... who knows? perhaps they are once again. My recollections of them are so full of pleasure:

artistic, erudite, hospitable, wonderful gardeners and above all, perhaps, so full of fun.

My wife had once the honour of sitting beside Linc at a dinner in Seattle long ago, she was a little apprehensive, because her knowledge of plants was almost non-existent. She recalls it as one of the best experiences of her life... they were laughing before the dinner started and they were laughing long after it was over. I cannot say I knew them well, but years of correspondence bring a great sense of understanding, and the pleasure of spending a couple of nights with them at Millstream left me with an unforgettable memory of a truly wonderful garden and of a truly wonderful couple. The world of alpinists will be the poorer for their passing... and I do not just mean in the States, but here in the U.K., in Europe and everywhere where they made friends. That is everywhere!

Roy Elliott, Birmingham, England

Linc Foster has stayed in my mind for many years, as has Timmy. I met them in the 1960s under unusual circumstances, at a soiree that could not have been better directed by Madame de Stael. I was planning to have dinner one evening with Gertrude (Bunny) and Phil Foster, who published *The Herb Grower* magazine. Bunny said there was going to be an informal family gathering later at her brother-and sister-in-laws', and she invited me to come along. Such get-togethers were apparently not rare.

The discussion at Millstream that

evening involved a dozen-or-so Fosters of different generations and degrees of inlawship. It ranged the field -- international news in the paper that day, the baseball season, the environment (without using that word) and a newly published anthropology book, from which Linc read.

Linc guided the evening, but the stentorian voice was absent, and he asked questions of everyone, even the outsider in the midst of the family. Rather little was said about plants directly. This was an American time warp, with the focus on the evening on ideas. I had the feeling that the ghost of Jefferson, perhaps even of Voltaire, was secreted in the room. The room had been transformed into a salon for a few very special hours. The conception of the infinite perfectibility of man was for the moment still alive and well represented in Falls Village, Connecticut.

Frederick McGourty, Norfolk, CT

At heart a benevolent teacher, no one was more generous with his knowledge and possessions, or more kindly toward the innocent whether an ignorant gardener or a destructive deer. Linc accepted, in fact revered, the natural world and did everything within his power to protect it and increase the perception of everyone with whom he came in contact in this regard.

Yet one of the most remarkable of his qualities was his overriding mod-

esty. One never encountered any competitiveness in his acquisitions of new plants for his garden. They were there because he was enchanted by their qualities and wanted to know more about their growth or because he sought to discover if they might survive our harsh New England climate. In his pursuit of new species from a genus he knew such as the various phlox, saxifraga, rhododendrons and plants from other continents, his efforts were always towards new knowledge obtained. His reward in the joy of growing new varieties he then shared with others. We all remain blessed by his labors.

ARGS will never be the same without Linc and Timmy's presence yet this legacy will manifest itself in keeping alive within all of us the curiosity, modesty, generosity and industry tempered with a delightful humor which marked their lives together at Millstream.

Elodie Osborn, Salisbury, CT

We have lost a great and dear friend. There are hundreds of us who have marvelous memories of Linc and "Millstream". Memories are the things that help us over our grief as I think back to this kind and gentle man leading and making us into a truly great society.

The Delaware Valley Chapter was the first new chapter in many years, and when we were formed some twenty two odd years ago it never would have happened if it hadn't been through gentle persuasion, great kindness, and unex-

celled leadership.

I had this stranger in my home over a weekend and at the end of the weekend he and Timmy had become close and dear friends. Through the years he nurtured us and was always in the background - the rock that indeed was the American Rock Garden Society.

Dear Lincoln, rest in peace and God be with you.

Lee M. Raden, Phoenixville, PA

H. Lincoln Foster has made such an imprint on our lives that it is impossible to compress into a few words the true value of his influence as a scholar with an innate interest in the people around him.

My earliest memories of Linc stem from the first visit he and Timmy made to the Northwest many years ago. He brought with him ties from East Coast members of the American Rock Garden Society thus unifying the geographically separated units. He made us more aware of the aims of the ARGS and gave us strong incentives to foster good rock gardening even as he joined us in appreciation of our native flora. His book, *Rock Gardening*, has been a reliable reference work reflecting the wisdom he gleaned in years of research and keen observation, especially in the development of Millstream. It is the first reference we cite for any beginning rock gardener.

We are ever grateful for the privilege of having known Linc, the friendly man who led our Society wisely and

well and who shared his knowledge unstintingly with all who sought his counsel. Eternal thanks!

Frances Roberson, Seattle, WA

On the entrance wall to Lincoln Foster's terrace at Millstream, there is a planting of the three *Ramondas*: *myconi*, *nathaliae* and *serbica*. I always asked for an exposition on the differences among them, partly because I always needed it and partly because Linc did it with obvious delight in this horticultural exercise. I recall another time at a Connecticut Chapter's plant show when I stood alongside two experts who were arguing over whether a plant labelled *Androsace carnea x pyrenaica* was true. "Let's ask Linc", I suggested. When Linc came over and said "I brought that plant into the show" there was no longer any debate; and we all listened to another mini-lecture on *Androsace* done without the slightest condescension. We needed no further definition. It is this great accepted authority that we have grievously lost.

In the months before he died, Linc and I were working on a project which obviously pleased and interested him. After Timmy's death he discovered an incomplete manuscript detailing the history of Millstream, their wonderful garden, whose name appears in so many hybrids (*Androsace x pyrenaica* 'Millstream' among them). Linc was anxious to see if the manuscript was publishable and during one of our visits he asked if

I could look into it. As the "onlie begetter" of Geoffrey Charlesworth's book I had had a late bloom as an author's representative and, indeed, Linc ultimately appointed me as his "literary agent". Timmy's manuscript, being incomplete, was not publishable on its own and we came up with the idea of a companion section of selected writings by Linc and by Timmy taken from ARGS Bulletins, AGS Bulletins, The Connecticut Plantsman and other ARGS and AGS publications. It would be profusely illustrated with Timmy's exquisite drawings and would be in essence a Foster Reader.

All the time we were working on

this, it was clear that Linc would not live to see it come out and indeed it was always a tussle between trying to involve him in decisions and trying not to tire him. There was an especially poignant moment when he said he felt he was "melting away". The final manuscript was being typed when he died.

Millstream: Enthralled By A Garden by Laura Louise & H. Lincoln Foster will be published by Atlantic Monthly Press and is scheduled for publication in mid 1990. It is characteristic of Linc that he stipulated that all of his royalties from the book shall go to The American Rock Garden Society.

Norman Singer, Sandisfield, MA.



Linc and Timmy Foster at Millstream

Building A Solar Pit Greenhouse

Wayne Kittredge

Rather than an advocacy to build your own subterranean solar powered alpine house, this is a story of how my need for protecting non-hardy alpine plants, led to my building such a structure.

At the New England Flower Show several years ago, the local ARGS chapter had on display, a wood framed glass alpine house, well crafted and with the appearance of costing more than the ordinary person could afford. I had thought of starting from scratch with glass lites and building my own frames, but even though I'm skilled as a picture framer, the amount of effort involved added to the cost of glass and lumber, seemed as costly as buying the prefab version. While considering how to go about building an affordable alpine house, I came across a book about solar greenhouses, and decided that the pit version seemed best suited to answering my needs. So, I dug a pit, three feet deep with ten by ten foot walls. I dug a 45 degree undercut of the south facing wall and placed a 4 x 8 foot sheet of plywood (wrapped in plastic to keep out moisture) against the soil roof, using standard 2 x 3 studs for support. The lites were simple wood frames coated with plastic on both sides. That structure amounted to a large underground cold frame which though relatively

effective was not completely cold proof. The amount of space available was far from adequate, but it was a good test of how a pit greenhouse might perform.

After losing several really fine plants in the pit cold frame, I began to plan in earnest, and it could be argued that I spent too much time designing the style of framing to use, wavering among quonset hut to huge cold frame and standard house design. Finally I settled on the "A" frame as the easiest and cheapest effective structure. Summer slid right by while I designed on paper, and the pit walls slumped towards the middle of the pit. I spent a week or so restructuring the walls to near vertical, then to keep them in place I plastered hyper tufa cement right against the soil walls, using a rectangular trowel to spread the cement evenly about an inch thick. Then I placed a footing at the top edges of the walls and went back to working out the fine details on paper, autumn was approaching too rapidly. The cement walls have held up for four years now and should remain in place.

Using scrounged lumber probably didn't make the carpentry work any easier, but it was what I had available. Squaring the studs resting on the footing was an experience which took longer than it should have because the pit was not perfectly square. The studs hang

over the footing in a couple of places, though not severely. Being an experienced picture framer I had every intention of making the base frame just that precisely square. Using warped lumber shorter than the walls soon gave me a better concept of the kind of tolerances I'd have to accept. The rest of the structure went rather fast until I got the final peak of the roof. Because my lumber was shorter than the distance from base to peak I decided to make a separate peak pitch, which turned out to be more work than it was worth. It would have been much easier to have purchased the correct length lumber and keep the same pitch from base to peak.

For covering the frame I chose ordinary 4 mil clear plastic as it was the cheapest alternative and relatively easy to install. With autumn speeding towards winter I was getting anxious to get it done. Just before that though I was given some pieces of solar fiberglass, so I took the time to put that on the south wall, it was like putting a jigsaw puzzle together and took longer than I would have liked. The weather however, smiled on me and it remained warmer than normal through November into December while I placed plastic over the rest of the structure, inside as well. Two layers of plastic create a "dead" air space which is supposed to retard cold air infiltration. Sealing the plastic at the bottom of the stud framing with foam rubber would enhance that effect.

Finally the door and window were framed and installed, the door framing covered with thin plywood and plastic, the window with plastic on both sides of the frame. The door swung out and because of condensation on the inside

of the door, an ice dam soon formed on the door jam, making it impossible to close the door tightly without first chipping away the ice which formed each cold night. Chipping the ice from the jam was not easy and did damage to the wooden jam. The next spring I added an inner door which swings to the inside, a simple braced frame covered both sides with plastic. Now the condensation drips onto the cement coated walls and the outer door jam remains ice free and tight. The inner door jam covered with foam rubber adds another insulating barrier against cold drafts.

The neighborhood children were the first occupants of the new pit house, but they tired of it quickly as there was little to do other than jump around a bit and make some noise; 100 square feet is really not so large as it may sound or look like from the outside, but it was a novelty and the kids could hardly wait to get in and have some fun. Later the troughs and pots of half hardy plants were carefully placed as to solar orientation and best use of available space, another jigsaw puzzle. I ran out of time and benevolent weather before I could build shelving inside. The first winter was typically cold and snowy with outside temperatures dipping into the minus numbers frequently. Inside, the thermometer registered below freezing only three times with a low of 26 degrees F., which of course is lower than some half hardy plants can take and I did lose a few to the frost. However, for an unheated alpine house I was very pleased with the results. Last year I added benches to three of the walls, suspended, rather than on legs for two reasons: to keep the slugs from sliding

up the legs for a quick snack, and to keep the floor space as open as possible. Troughs are bulky awkward bulks, making arranging them difficult enough without stout bench legs getting in the way. The shelves get all the individually potted plants making more room on the floor for troughs. A small electric heater with built in fan was added this year, on its lowest setting keeps the pit a uniform 40 degrees F.

My pit alpine house is presently

stuffed and I'm feeling the need for another one. Moving all that soil is somewhat daunting though, so I'm considering going only two feet deep with the pit, our soil seldom freezes that deep. Soil below the frost line is uniformly about 55 degrees F. year long, which is one of the main reasons for building a pit style alpine house.

Wayne Kittredge, lives in North Reading, MA.

Cyclamen Revisited

Nancy Goodwin

Cyclamen are members of the *Primulaceae* family, having among their cousins primulas, soldanellas, douglasias and dodecatheons. Although superficially the family members don't always resemble each other, at a glance it is possible to see the similarity of cyclamen to dodecatheons. These genera are grouped together because their flowers have one pistil, five stamens and a persistent, five lobed calyx. They usually have five corolla lobes, too; however, six-petaled flowers are relatively common.

Compared to some of their relatives,

cyclamen are easy to grow provided they have a partly shady site and excellent drainage. More tubers are killed by excess water than by all other factors combined. The most critical time for them to be relatively dry is summer when they should be out of the reach of watering systems and other artificial irrigation. They are often grown successfully against the trunks and roots of trees; they are found in beech woods throughout Europe showing again their preference for dry conditions throughout the summer. I grow most of mine in

my rock garden, which is located under a large white oak, and on a hillside on which are growing dogwoods, hickories, beeches and oaks. I have continued to experiment with other locations and have found cyclamen happy under a large *Magnolia acuminata*, at the northern side of a relatively low building, and even in dense shade under a flowering almond.

There are probably more species which bloom in fall or winter than in other seasons, which is why I consider that the year begins in late summer when *Cyclamen hederifolium* begins to produce its delicate, sometimes-fragrant flowers in shades of pink or white. I often find its forerunners throughout the summer - May 31 being my record for the earliest bloom, but it is sometime in August when there are more flowers than can be counted on both hands. Each flowering stalk rises to about 5 or 6 inches and supports one flower with its petals flung back long before the leaves appear. In fact, it is the appearance of the leaves which signals an end of the flowering period. *C. hederifolium* is one of the most variable species. There are variations in the shapes of the leaves from long, tapering ones to true ivy-shapes, with markings varying from solid green to almost completely silvered. I have never seen one without at least a slender green outline to the edge of the leaf, but they may exist. The one often listed as 'Bowles Apollo' has a spectacular ivy-shaped leaf with a large amount of silver and an overcast of rosy red. Seeds bearing this name often appear in seed lists, but the true thing is very rare. I am fascinated by the extraordinary variation in the size of the leaves, which

may be anything from about 1 inch to 5 1/2 inches long, and I have an ever-increasing collection of representative examples in my garden. This is one of the easiest species to grow in upstate New York or Texas, and is the one to start with if you haven't grown them before.

Appearing at about the same time as *C. hederifolium* and similar in most ways is *C. africanum*. The differences are slight, but there is one decisive test: *C. africanum* is not hardy below 20 degrees F. Because these two species are among the very few which will cross breed, the problem of identification is compounded. In general *C. africanum* has stems which rise directly above the tuber or at a slight angle. The leaves are thicker, often with coarse teeth along the edges. Even the flowers are larger than most *C. hederifolium*; to my knowledge there is no record of a pure white form, though there may be one out there somewhere. For a number of years I suspected that I had one, but when I discovered that it was hardy, I concluded that it was a hybrid with *C. hederifolium* as one of the parents. *C. africanum* is best kept in a cool greenhouse, and will grow rapidly filling the largest pot within about 6 years. I have found some fantastic forms of this species, one of which has a wide mouth at the opening of the flower and 20 or more petals.

C. graecum is another of the late summer-blooming cyclamen. Generally flowers may be expected from late August through October, and the velvety, heart-shaped leaves begin to appear at the same time. Superficially, it resembles *C. hederifolium* most closely having the same auricles at the base of

the corolla lobes and flowers of similar colors. Upon closer inspection you can see stripes of a deeper shade going from the mouth into the actual petal, and deep violet anthers. This is one of the few species which thrives in sun. In Greece it can often be found growing in crevices of rock outcroppings where the thong-like roots grow deep to find the necessary moisture. It is necessary to find as tall a pot as possible to accommodate these roots, and even then it is common to find them coming out at the bottom. I am not certain how hardy this species is, but it came through our terrible winter when the temperature went to -12 degrees F.

The fourth of the fall-blooming species is *C. rohlfsianum* and it is a spectacular one, which is worth every effort to grow. It is reportedly not hardy and thus far I haven't had enough stock to test this for myself. The leaves are spectacular and very large and the often-fragrant flowers most closely resemble those of the dodecatheons with the style and stamens exerted from the mouth of the corolla. This is one of the few species which I dry off completely in the summer, giving it no water from sometime in May when the leaves yellow, signaling the onset of its dormant period, until late July, when it is set in a pan of water to moisten the soil and tuber and start another cycle of growth. Even during the active season it receives water only upon demand. The plants are variable in leaf shape and color, which spans deep to medium green.

The delicate flowers of *C. cilicium* bridge the gap between the fall and winter flowering species. It is a lovely thing

sometimes with spectacularly variegated spoon-shaped leaves which appear with the flowers. The faintly scented flowers vary from a pure white with no color at the mouth of the corolla to deep magenta with a darker blotch at the mouth. There are no auricles at the base of the petals. This species is not as easy to grow as many because it needs a site in part sun and can stand very little water in summer. It should be placed out of the reach of watering systems and at the base of deciduous trees where sunlight is abundant during the time of active growth. I am uncertain just how hardy it is but suspect that it will grow well at least in Zone 5.

Blooming at about the same time with an even more elegant flower is *C. mirabile*. The beautiful twisted petals are fimbriated at the tips and are joined at the mouth by an upright collar about 1/8th of an inch high. The color varies from near white to medium magenta and there is always a blotch at the base of the petals. The leaves are similar to those of *C. cilicium*, but more angular, and on many plants the new growth has rosy overtones. It seems to prefer similar growing conditions to *C. cilicium* and I think it just as hardy.

Cyclamen intaminatum is one of the most delightful of the species. It is a tiny thing with small, elegant, white or palest pink flowers with delicate gray stripes. Until I saw it, I thought it would look dingy. The leaves are somewhat round and vary from green to spectacularly variegated forms. In the greenhouse this species may bloom at any time, from late spring on, but in the garden it waits until the temperatures have begun to fall. I am growing this

outside on a relatively steep bank near a beech, so it has excellent drainage, winter sun and no extra moisture in summer.

In the greenhouse, *C. cyprium* begins to bloom in fall continuing into winter. A mass of the delightful white, sweetly-scented flowers can perfume a large area. The leaves are anything from solid green to green with bright white markings. Most of the flowers have a distinctive darker marking at the base of the corolla; however, I have thus far found two albinos. I have cross-pollinated them in hopes of reproducing them. This species is unfortunately not hardy with me in Zone 7.

Before the previous three species have finished blooming a few precocious flowers of *C. coum* usually appear. This is a large and difficult group to sort. It is generally accepted that there are two distinct subspecies: *C. coum* subsp. *coum* and *C. coum* subsp. *caucasicum*. The former is what is most easily grown and what results from most seeds available in seed exchanges. You can find them listed under an assortment of names: *C. atkinsii*, *C. hiemale*, *C. roseum*, *C. vernale*, *C. orbiculatum*. Some of these names may lead you to expect the following forms: *C. atkinsii* should have flowers larger than the type; *C. roseum* should have rose-pink flowers. There are a few collectors numbers worth watching for: EKB 371 (or Nymans) has silvered leaves with a small margin of green and flowers of an unusual shade of medium rose-pink. The pewter leaf form lacks this outline of green. The leaves are fairly round and vary from solid green, which is the rarest in the wild, to completely silvered. They begin to appear in fall as the tem-

peratures drop and the brilliantly colored flowers are present from December through March depending on the temperature. There is an albino form of *C. coum* but I haven't had one yet. The white forms I have all have either deep purple or rosy carmine blotches at the mouth of the corolla with a brighter white area below that. The flowers may be delicate pink, to deepest magenta with a darker maroon to nearly black blotch at the base of each petal, and many are fragrant. The flowers themselves can tolerate temperatures of about 10 degrees F. without damage, but below that only new buds will open. *C. coum* is extremely hardy, growing from southern Canada to the deep south. The most exciting selections I am working with now have flowers with shaded petals which are generally dark at the edge of each corolla lobe, and many of which have no lighter marking below the dark blotch at the base. This form does not seem genetically stable at this point, so I am crossing shaded plants with each other and plan back crosses for future generations in hopes of stabilizing this exquisite characteristic.

C. coum subsp. *caucasicum* occurs in the eastern most parts of Turkey and the Caucasus and is reportedly less hardy than the western forms. Often, but not always, the typical lighter area below the dark blotch at the base of each petal will be the same color as the petal itself. The leaves are more heart-shaped, and the flowers are larger. Here, too, you can find numerous pseudonyms: *C. vernum*, *C. ibericum*, *C. elegans*, *C. abchasicum*, *C. circassicum*, and *C. adzharicum*. The only one which has any real, generally accepted meanings

is *C. elegans* and this is a particularly fine form found by Jim Archibald.

One of the most elusive and difficult of the winter-flowering species is *C. parviflorum*, a tiny plant with small, extremely fragrant flowers ranging from near white to deep rose-violet. They lack the lighter area below the dark blotch at the base of each petal. The leaves are somewhat rounded and are without the variegation of *C. coum*. It is extremely hardy, but does not want to be completely dried off in summer. It is probably best grown in a trough in shade or in a cool greenhouse for the flowers are usually less than an inch above ground.

Another of the winter-flowering group is *C. trochopteranthum*, and delightful it is with fragrant flowers ranging from light pink to deep, rich rose. Because the petals are twisted, standing out from the base of the flower like propellers, it looks larger than *C. coum*, but is equally hardy. The leaves look rather like those of *C. cilicium* for they are generally longer than they are wide, and are often beautifully marked with silver spots. This species used to be listed as *C. alpinum* and sometimes seed-exchange seeds will be found under this name. The problem is that this spurious name also may refer to *C. intaminatum*, so you are just as likely to get that instead.

We are testing *C. libanoticum* outside in several gardens this winter to determine how hardy it is. Because this is a very warm year, it won't be a good test, but at this time (February) the leaves and flower buds look as good as the ones in the greenhouse. It begins to bloom in December or January and continues into

spring. This is a large-flowered species, with medium pink blooms and a distinctive bird-in-flight darker marking both inside and outside the base of the corolla. The leaves are gray-green, often with bright white markings.

One of the most spectacular of the winter-flowering species is *C. pseudibericum* with relatively large rose-purple flowers and variable leaves, some of which have spectacular areas of white. Plants under collectors' numbers are sometimes offered in seed exchanges. ACW 664 is an especially desirable one which should produce pale pink flowers, although I have never yet had such. This is a hardy species although I don't yet know how much cold it can take. It has survived -12 degrees F. with only an inch of snow here.

Some of the most beautiful winter flowers are produced by the wild *C. persicum*. These are tender plants unable to stand temperatures lower than 26 degrees, but are happy in cool houses or greenhouses. The elongated, slender, often-twisted petals are usually white or pink with darker markings at the base, and the flowers are generally fragrant. The leaves may be silvered, green or with varying degrees of variegation. It is from this species that most of the hybrids have been developed and I personally don't think they have improved on the species plant.

There are three spring-flowered species which are probably closely related. These are three of the few species which will inter-breed. *C. creticum* has particularly lovely white or palest pink flowers and angular dark green leaves sometimes marked with silver. It is a rare plant which demands shade, and



Cyclamen hederifolium (Page 158)

Pamela Harper



Cyclamen purpurascens (Page 158)

Pamela Harper



Cyclamen coum (atkinsii) (Page 158)

Pamela Harper



Cyclamen Pseudibericum (Page 158)

Pamela Harper

has surprised me by surviving our winters.

C. balearicum blooms also in spring and has fragrant, white flowers, often with delicate, fine pink lines on the petals. The pewter colored leaves are often marked with silver and lack the angles of *C. creticum*. Although often listed as tender, this, too, has proved hardy in Zone 7. It readily crosses with the other spring blooming species.

C. repandum is a more complex species, having within it several subspecies. The type, *C. r.* subsp. *repandum* has elegant, medium pink, fragrant flowers in March and April here. The extent to which it is hardy in this country is not yet known, but I suspect that it will grow in areas much colder than zone 7 because it requires deep planting in full shade and because it doesn't appear above ground until the worst of the winter weather is over. Here the ivy-shaped leaves begin to appear in February and as soon as the heat of summer arrives the plant goes underground for the next nine months. There is a form with pure white flowers which is reportedly not hardy. I don't yet have enough to risk testing it. *C. r.* subsp. *rhodense* is also reportedly not hardy, but is untested by me. It is distinguished by leaves which are splattered with white or silver, and white or palest pink flowers with a darker pink zone around the mouth. The other subspecies, which isn't hardy, is *C. r.* subsp. *pelopon-nesiacum* and it has leaves similar to the Rhodes form, but pink to dark pink flowers.

Summer is enriched by the fragrant, rose-pink flowers of *C. purpurascens*. The leaves are as variable as most species with plants having anything from

dark green to silver with exquisitely variegated forms between. This is perhaps the hardiest species of all, and will probably grow in the coldest sections of mainland U.S. It wants a well-drained shady site and deep planting, for it has the briefest dormancy requirement of all, producing new leaves just as the old ones fade. There is considerable confusion over the Czechoslovakian form with dark green leaves, often offered in seed lists and a few nurseries as *C. fatrense*. At this point botanists agree that this plant does not merit separate species status.

There is one other species although it will be several years before it is available. This is *C. somalense* recently discovered in Somalia. As it is described, it sounds to me like a combination of *C. persicum* and *C. rohlfianum*, and won't prove to be hardy.

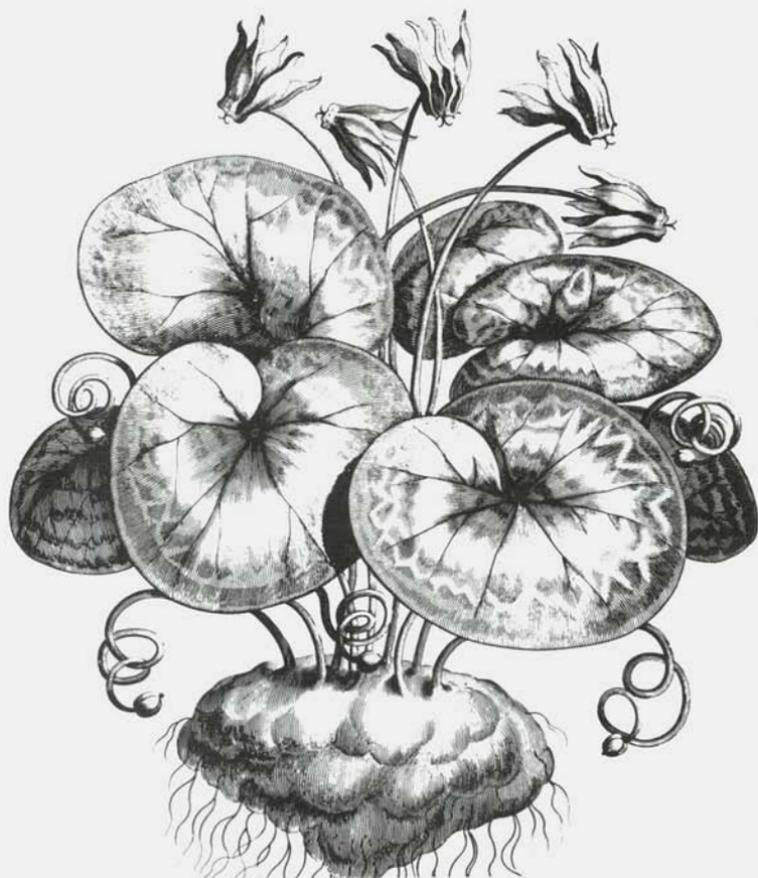
Cyclamen are now considered plants in peril and are on Appendix II of the Endangered Species List. This means that a CITES permit is required for exporting or importing them. There are a few species which are allowed to be collected although Turkey has now agreed to limit its exports to 1,000,000 tubers. As reported, this limit was exceeded by 600,000 last year. Unfortunately it is very difficult to identify a dormant tuber, and so many of the rare species are dug and destroyed each year. Few of the dormant tubers recover from their collection, and thus the wild population is growing smaller. There is no excuse for even the most avid collector to purchase these plants. Seed growing is simple and there are a few nurseries now selling seed grown stock. I have had over 90% success in growing plants

from seed exchange seeds by the following method: Soak the seeds for 6-24 hours in warm water. Drain and plant in a gritty mix, covering with about 1/4 inch of soil or grit. Place the pots in total darkness and expect germination to begin in about 6 weeks. Of course, the very best results can be expected from sowing your own fresh seeds, and if this is

possible no soaking is required.

By growing all of the species of Cyclamen, it is possible to have flowers at every season of the year.

Nancy Goodwin, Hillsborough, NC has been Chair of the Piedmont Chapter of ARGS and is proprietor of Montrose Nursery. She specializes in growing Cyclamen.



The Seed Exchange

Carole Wilder & Marcel Jouseau

The seeds have finally been planted and now we can reflect on the past year's seed exchange program. The article by Betty and Ned Lowry on the 1978 and 1979 seed exchange programs gives us an opportunity to see if ten years later the plants popular then are still popular. Table 1 shows the top 50 plants for 1988 and 1978. Seventeen plants in the top 50 in 1978 failed to repeat in 1988 but would have made it in the top 100. The following four, however, almost fell into oblivion: *Rhodothamnus chamaecistus** (15 requests), *Dicentra cucullaria* (21 requests), *Aquilegia scopulorum* (26 requests) and *Primula minima** (28 requests). Newcomers, not available in 1978, and seeds not available in 1988 seem to explain most of the differences between the two lists.

We thought it might be interesting to investigate whether there are differences in the preference of foreign and US members. Given time and space limits we limited our investigation to requests

from Japan and the United Kingdom, the two largest foreign member groups outside North America. Table 2. shows plants in decreasing order of preference. It appears that overseas members are gamblers, giving their top vote to an undefined species of *Paraquilegia*.

Members tend to concentrate their requests on a few choices. Some 350 plants went unrequested in 1988 and over 3000 had less than five requests. The 12 most popular genera (based on the average number of requests per species listed): *Adonis*, *Hepatica*, *Arisaema*, *Lewisia*, *Acantholimon*, *Cyclamen*, *Corydalis*, *Edraianthus*, *Aquilegia*, *Primula*, *Campanula* and *Clematis* accounted for nearly 25% of all the first choices. Somewhat surprising was the poor performance of such genera as *Penstemon*, *Potentilla*, *Allium*, *Erigeron*, *Gentiana*, *Hypericum*, *Lychnis* and *Silene* which, with the exceptions of one or two popular species had very limited appeal.

Table 1. Comparison of the Fifty Most Popular Plants - 1988 & 1978

1978		1988	
<i>Allium narcissiflorum</i>	62	<i>Adonis vernalis</i>	57
<i>Androsace helvetica</i>	102	<i>Androsace helvetica</i>	64
<i>Anemonella thalictroides</i>	63	<i>Anemonella thalictroides</i>	
<i>Aquilegia Jonesii</i> x		(double white)	95
<i>saximontana</i>	153	<i>Aquilegia Jonesii</i> *	230
<i>Aquilegia scopulorum</i>	62	<i>Aquilegia nivalis</i>	59
<i>Arisaema japonicum</i> *	65	<i>Aquilegia Jonesii</i>	

1978

<i>Calceolaria darwinii</i>	134
<i>Campanula piperi</i>	130
<i>Campanula</i> <i>portenschlagiana</i>	69
<i>Campanula raineri</i>	94
<i>Cyclamen ciliatum</i> 'E.K. Balls'	69
<i>Daphne cneorum</i> 'Eximia'	73
<i>Dianthus callizonus</i>	63
<i>Diapensia lapponica</i> *	73
<i>Dicentra cucullaria</i>	64
<i>Dicentra peregrina</i> v. <i>pusilla</i>	95
<i>Dicentra peregrina</i> v. <i>pusilla</i> f. <i>alba</i>	78
<i>Douglasia laevigata</i> v. <i>ciliolata</i> *	75
<i>Douglasia laevigata</i> v. <i>ciliolata</i>	61
<i>Edraianthus pumilio</i>	76
<i>Erigeron aureus</i>	65
<i>Gentiana ornata</i>	68
<i>Gentiana verna</i>	82
<i>Geranium argenteum</i>	87
<i>Glaucidium palmatum</i>	68
<i>Glaucidium palmatum</i> 'Album'	66
<i>Iris gracilipes</i>	62
<i>Jeffersonia dubia</i>	95
<i>Lewisia cotyledon</i> 'Sunset Strain' (apri.)	62
<i>Lewisia pygmaea</i>	68
<i>Lewisia rediviva</i> 'Alba' *	61
<i>Lewisia rediviva</i>	63
<i>Lewisia tweedyi</i>	114
<i>Lewisia tweedyi</i> *	131
<i>Paraquilegia grandiflora</i>	86
<i>Phlox bifida</i> (miniature)	86
<i>Potentilla nitida</i> 'Rubra'	67
<i>Primula minima</i> *	72
<i>Primula parryi</i> *	75

1988

(white form)	52
<i>Arisaema sikokianum</i>	145
<i>Calceolaria darwinii</i>	63
<i>Campanula raineri</i>	68
<i>Campanula piperi</i> *	107
<i>Campanula cenisia</i> *	93
<i>Campanula</i> <i>portenschlagiana</i>	64
<i>Claytonia megarrhiza</i> *	59
<i>Clematis texensis</i>	54
<i>Collomia debilis</i> *	53
<i>Corydalis cashmeriana</i>	132
<i>Corydalis ambigua</i>	73
<i>Cyclam. trochopteranthum</i>	56
<i>Cyclamen rohlsianum</i>	59
<i>Dianthus microlepis</i>	56
<i>Dicentra peregrina</i>	95
<i>Douglasia montana</i> *	63
<i>Edraianthus pumilio</i>	65
<i>Eriogonum thymoides</i> *	54
<i>Eritrichium nanum</i> *	104
<i>Eritrichium howardii</i> *	95
<i>Gentiana sino-ornata</i>	61
<i>Geranium argenteum</i>	68
<i>Glaucidium palmatum</i> (blue)	54
<i>Hepatica nobilis japon.</i> f. <i>variegata</i> (p/pic)	59
<i>Hepatica nobilis japon.</i> f. <i>variegata</i> (rose)	55
<i>Iris gracilipes</i> 'Alba'	53
<i>Iris nicolai</i> *	60
<i>Jeffersonia dubia</i>	61
<i>Lewisia tweedyi</i> *	109
<i>Lewisia tweedyi</i> 'Alba'	115
<i>Lewisia tweedyi</i>	57
<i>Lupinus lepidus lobbii</i>	63
<i>Mertensia alpina</i>	81
<i>Paraquilegia</i> sp. *	166
<i>Penstemon acaulis</i>	95
<i>Phlox hoodii</i> *	90

1978		1988	
<i>Primula rosea</i> x <i>clarkei</i>	74	<i>Phlox diffusa</i> *	59
<i>Rhodothamnus</i> <i>chamaecistus</i> *	78	<i>Phyteuma comosum</i>	96
<i>Saponaria ocymoides</i> ' <i>Rubra Compacta</i> '	73	<i>Primula parryi</i> *	56
<i>Shortia galacifolia</i>	108	<i>Primula deorum</i> *	56
<i>Shortia soldanelloides</i>	92	<i>Pyxidanthera barbulata</i> <i>brevifolia</i> *	52
<i>Shortia soldanelloides</i> <i>v. ilicifolia</i>	61	<i>Shortia galacifolia</i>	79
<i>Silene hookeri</i> *	63	<i>Shortia uniflora</i>	62
<i>Soldanella pusilla</i>	60	<i>Shortia soldanelloides</i> <i>v. ilicifolia</i>	77
<i>Thalictrum kiusianum</i>	61		
<i>Trillium grandiflorum</i> ' <i>Roseum</i> '	71		
<i>Viola pedata</i>	83		

* From the wild

Table 2. 1988 Top Ten Choices From U.S.A., Japan & United Kingdom

USA	Japan	United Kingdom
<i>Arisaema sikokianum</i>	<i>Paraquilegia</i> sp. *	<i>Paraquilegia</i> sp. *
<i>Phyteuma comosum</i>	<i>Aquilegia Jonesii</i> *	<i>Anemone tschernjnewii</i> *
<i>Paeonia tenuifolia</i>	<i>Anchusa capensis</i> ' <i>Blue Angel</i> '	<i>Eritrichium howardii</i> *
<i>Arisaema japonicum</i>	<i>Alstroemeria hookeri</i> *	<i>Crocus vallicola</i> *
<i>Edraianthus pumilio</i>	<i>Alstroemeria pygmaea</i>	<i>Crocus abantensis</i> *
<i>Arisaema wallichianum</i>	<i>Callianthemum anemoides</i> *	<i>Erythronium howellii</i>
<i>Jeffersonia dubia</i>	<i>Daphne alpina</i>	<i>Lewisia rediviva</i> *
<i>Crambe cordifolia</i>	<i>Eustoma grandiflorum</i> *	<i>Lupinus lepidus</i> v. <i>lobbii</i>
<i>Iris gracilipes</i> ' <i>Alba</i> '	<i>Globularia cordifolia</i> ' <i>Alba</i> '	<i>Anemonella thalictroides</i> (dbl. white)
<i>Lewisia tweedyi</i> *		<i>Trillium rivale</i> *

The exchange program has steadily grown over the years and the 1988 exchange was the largest to date with 1940 members requesting seeds, a 40% increase over the 1978 program reported on by Betty and Ned Lowry (Table 3). Approximately 46% of the entire membership requested seeds, demonstrating the importance of the program to the members. 75% of the 1,000 or so foreign members participated in the exchange, of whom 32% were donors. But only 35% of the 3,000 U.S. members participated and 20% donated seeds.

Table 3. A Comparison of The 1978 and 1988 Exchange Programs

	1988	1978
Seed applicants	1833	1308
No. of 1st Choices	47940	39264
Total packets distb.	49000	31348
Total plants offered	5813	3496

With the growth of the program there has been a concomittant increase in the effort necessary to make the program successful. Typical is the increase in the size of the list which has begun to strain the ability of the program to produce and mail a catalog within reasonable cost. In 1988 the list weighed a hair under 2 oz., the point at which postal charges increase by 40% for overseas airmail and domestic mail. The cost of the exchange program has been maintained through such measures as printing on the lightest paper U.S. printers will print on and by putting the maximum number of lines per page. To change the size of the print to something a little easier on our tired eyes would require an

increase of five dollars per order.

The human dimensions of the program are also staggering considering that the program is entirely run by amateurs, who for the most part had to work for a living. The 1988 program required close to 5,000 hours of labor provided by 40 volunteers. Table 4. provides a summary of the labor requirements for major tasks.

Table 4. 1988 Exchange Programs Labor Requirement

Tasks	Hours
Catalog preparation & mailing	350
Plant names verification	250
Packeting seeds	1500
Setting up for distribution	350
Filling orders	900
Data entry of seed requests	100
Managerial duties*	1250

* an all-encompassing description for tasks ranging from sorting / storing donated seeds, ordering envelopes for seeds, checking printers, licking stamps, opening seed orders, correspondence...to cajoling volunteers.

Hardly were the last extra seeds shipped to the various chapters for their own distribution than the first seeds for the 1989 distribution were arriving from New Zealand.

Looking towards the 1989 Seed Exchange Program we look forward to an even greater participation of members. How can we make this program better and easier? The computer list now

contains some 8,000 plant names, so fewer names than last year will need to be entered, but of course we are looking forward to your seed donations to challenge us and provide for an even greater selection. In 1988, the mailing of the seedlist to Czechoslovakia appeared to be replete with problems with so many of our friends not getting the list or only in late February. As the lists were all sent a few days before Christmas via airmail, it is very distressing and we welcome any suggestion that would prevent such problems in the future,

Members can improve the program. Obviously the seed selections can be increased or improved. Few seeds are required to participate as a donor. When as few as five seeds are needed to make a packet of the more highly demanded seeds, one could satisfy 10 requests with only one seed head or capsule. Early mailing of seeds will also ease the job of getting the seed list out. By October 27, 1988, four days before the deadline for the seeds, only 2/5 of the seeds had been received. One of the authors (MJ) developed blisters on the right hand in the rush to enter data to meet the printing deadline. Obviously seeds cannot and should not be sent until ripe and dry; however, perhaps an earlier mailing of the list of seeds which mature late would assist in diminishing the stress of getting the catalog to the printer. MJ is forever grateful to the donors who sent

a very legible, alphabetical listing of seeds contributed. Careful checking by the donors of the names and other information on their packing list to insure that it coincides with the information on the individual seed packets would eliminate some difficulties with checking names and preparing the list. A few minutes saved on checking and entering each donation repeated several hundred times saves many hours of volunteer labor.

While the program is much work, it is also a wonderful opportunity for friendships and togetherness; Jean Stevens' recreation room (the 1988 Seed Distribution Center) still resounds with laughter and jokes. The winter just flew by. The mail did not just bring work but lots of kind words, cards, good wishes and photographs that warmed up the heart of the Minnesota volunteers. Many thanks to you. The authors are especially grateful to the wonderful member from Czechoslovakia who sent a small gift of seeds of *Gentiana oschtenica* (a yellow-flowered verna-type gentian), an absolute treasure. We all look forward to your participation in the 1989 Seed Exchange and hearing about your success stories.

Carol Wilder, Hastings, MN, is Chair of the Seed Exchange and Marcel Jousseau, St. Paul, MN, computerized the records.

Seed Exchange Guidelines

1. Seed will be accepted only until November 1, 1989. No seed can be listed after that date. OVERSEAS MEMBERS ONLY...Please try to mail before October 15. (If seed is not ready to be shipped at this time please send us an alphabetical listing of your seed and ship the seed later.

2. While we appreciate any amount of seed you send, a minimum of 5 different kinds of seed suitable for rock gardens is the requirement to receive donor privileges of 10 free packets and your order filled first.

3. Send clean, dry seed of suitable rock garden plants early. We are glad to have several mailings rather than have a large collection at a late date.

4. Use envelopes no larger than 2" x 4". As few as 5 seeds of a variety will be accepted. One envelope of this size contains enough seed to fill our requirements. Do not send large quantities of seed.

5. Mark each envelope with the botanically correct name, where collected if wild, and all written legibly.

6. Make an alphabetical listing of botanically correct name and information identical to that which is on the seed packet. Make listing on a piece of paper approximately 8" x 10". (Small cards and pieces of paper are hard to work with.) Be sure to list all seed packets being sent.

7. Identification of plant species should be done when possible. However if this cannot be done, give genus name and a brief description. Height & color.

8. Group envelopes together alphabetically with a rubber band, place this in a mailing envelope along with your alphabetical list.

9. Be sure your name and address is clearly written on the alphabetical list and on the outside of the envelope.

10 All current members will receive a seed list catalog.

11. Send Seed EARLY to...
Carole Wilder, Director
ARGS Seed Exchange
221 West 9th. Street
Hastings, Minnesota
55033 USA

Collecting Fern Spores

Sue Olsen

It was not too many centuries ago that botanists, accustomed to the obvious polliniferous fertilization system of seed plants, were baffled by the reproductive life of the ferns. Fanciful science concluded that ferns propagated by means of an invisible seed (presumably from an invisible flower!) and contributed to some wonderful myths regarding this family of plants. Indeed, even Shakespeare refers whimsically to the invisible fern seed and its mystical properties which by the then popular "Doctrine of Signatures" would render the owner invisible. (It would be fun!)

We have, however, long since learned that ferns reproduce in a very scientific fashion. The "invisible seeds" are spores, almost microscopic, which gather systematically into sporangia which in turn are grouped as sori on the fern's leaf, better known scientifically as the frond.

Mother Nature has devised a marvelous system for the preservation of her species...berries have their birds, cyclamen their ants and for the ferns and their spore it is the wind. (Although we are all enhanced by the ARGS seed exchange!)

When dispersed, fern spore that falls on a suitable habitat will develop into prothallia, which look like miniature lily pads, or more distressingly like liverwort. These in turn reproduce sexually to produce a new generation, sporo-

phytes, or baby ferns. The entire process is known as the alternation of generations.

Five millions years ago when ferns were the dominant plants on earth (and providing nutrients for today's fossil fuels) they faced little competition. The primitive spore was carried unprotected in leisurely random on the fronds. Today's osmundas with their separate or distinctive fertile segments, and short lived spore are direct ancestors of the ancient species. However, with the advent of seed plants and increased competition for living space, evolution required more efficiency from the ferns. Over time ferns came to protect their sori with its precious cargo of spore by locating it on the underside of the frond. The spore, however, was still released simultaneously, such as in today's polypodiums, and their populations continued to decrease both in proportionate numbers and in the size of the mature plant. Consequently, greater refinement was required, and evolved in the form of an indusium or membranous covering of the sori on the underside of the fronds. The indusium comes in various shapes and is a critical notation in the identification of fern genera, but for the purpose of this article it is sufficient to note that it is a thin membrane covering the sori. As it lifts, the spore is slowly dispersed and as this takes place gradually from the lower pinnae to the upper

pinnae on the frond, the potential for successful perpetuation of the species is significantly increased.

All of the above is but introductory to the specifics of gathering fern spore whether you intend to become invisible or to share your species with fellow fern enthusiasts. There are two important stages in harvesting spore... collecting and cleaning. It is relatively simple to collect most seed when ripe, but to gather spore at the most opportune time requires careful monitoring of the developing sori. As the spore of the primitive species such as an osmunda is viable for only a very brief period and not suitable for a seed exchange, I will direct my comments towards the more advanced species, particularly those with an indusium. These can be observed without supplemental magnification, although a hand lens is helpful to the initiate and microscopic viewing is fascinating. In brief, the protective indusium will completely encase the juvenile spore. As it matures, generally from early July on into the fall, the indusium will begin to lift up like an umbrella releasing its dust-like contents. When you have sori that appears ripe, a slightly raised, but still visible, indusium exposing tiny dark beads around the edge, pick a frond (or if in doubt a pinnae) and lay it between any hard surfaced white paper (tissue is too fine and wax paper is lethal). When dry, fresh spore should drop within 48 hours and you will get a lovely pattern

of nature on your paper layout.

With many species, you will also get chaff. Pinnae or fronds that are picked too late in the season will primarily drop only chaff and what may appear as a good harvest is actually useless. **Chaff does not germinate!!!!!!** Which brings us to step 2...cleaning. Spore has the consistency of dusting powder or the chalk residue at the bottom of our old fashioned blackboards. It is light in weight and floats about much like smoke (in fact, a good sneeze will send it on its way!) In the interest of seed exchanges and/or spore exchanges the old fashioned "invisible seed" will not do. To be sure you are truly contributing spore, and to ease the life of the exchange director (not to mention the recipient), the spore can and should be separated from the chaff. Simply take your collection paper, tilt it slightly, and tap it gently. It may be alarming to notice how much material is falling away, but that will be the chaffy debris which is of no use to anyone. (Practice this first on a common native, and not a coveted imported treasure!) That which does not roll away will essentially be pure spore, "visible seed," with the potential to germinate, and when it comes to seed / spore exchanges that which we would most like to give and receive. Happy harvesting!

Sue Olsen, Seattle, WA, is a specialist in propagating and growing ferns.

Enkianthus perulatus compactus

Nickolas Nickou

From Japan, mother of many of our finest ornamentals, comes a magnificent miniature - *Enkianthus perulatus compactus*. It is a dwarf form of *E. perulatus*, which is in the Ericaceae - a family that has supplied us with some of the choicest woody plants. The diversity is remarkable...from the spectacular rhododendron to the diminutive Cassiope and Phyllodoce - and the truly miniature *Arctericia nana*.

The normal form of *E. perulatus* will be six or eight feet tall in 25 years. It is multi-stemmed and has an attractive silvery bark. The lanternlike white flowers are borne in great profusion before the leaves emerge and the autumn foliage is brilliant red. The mature plant is as fine a shrub as can be found in our gardens, but unfortunately it is rarely seen.

Far less common but a perfect woody

plant for the rock garden is the compact form. It is attractively twiggy in winter and is a compressed edition of the described species. The emerging leaves rapidly hide the flowers but this is an inconsequential shortcoming. In about 20 years, the compact form will be approximately 12 inches high and 18 inches wide. It takes at least eight to ten years to bloom, but even as a youngster, it is a welcome accent in the rock garden. It is best grown in a raised bed so it is close to the eye. Plant it in full sun in a soil that would keep a rhododendron happy.

Seedlings from the plant vary considerably so propagation must be by cuttings. Get one now and your grandchildren will inherit a treasure.

Nickolas Nickou lives in Branford, CT.

The Rock Garden in Summer

Geoffrey Charlesworth

New England summer follows swiftly on the heels of Spring. The magnificence of late May and early June is continued into July, as the rock garden remains colorful without apparent effort, and there are enough species that continue even into the hot days of August. Perhaps the garden ceases to be a blaze of color but it never loses interest completely. The genus *Dianthus* bridges Spring and Summer and early June sees the genus at its height. *D. alpinus*, *callizonus* and *glacialis* give up early but *D. erinaceus*, *nardiformis*, *neglectus*, *gratianopolitanus*, and *pavonius* grace the rock garden into July and in the border or larger rock garden *D. lumnitzeri*, *amurensis*, *gigantea* and forms of *plumarius* will be flowering. At the edge of the woodland a few weedy ones are willing to oblige - *D. deltoides* and *armeria*. The bright colors of *D. chinensis* look best with other annuals.

Campanulas, Adenophoras, Symphyndras and Codonopsis give us whites, greys, blues and purples. There are difficult scree plants *C. zoysii*, *piperi*, *raineri* and *betulifolia*; standards of the rock garden and wall garden *C. garganica*, *tommasiniana* and *cochlearifolia* and scores of middling difficulty. If you grow campanulas from seed every unfamiliar name is suspect until proved not to be a version of *C. carpatica* or *rotundifolia* or worse still of *C. rapun-*

culoides or *persicifolia*. You need to be either hopelessly tolerant or anxious to fill your empty acres if you plant *C. punctata*. I sometimes think plants are called aggressive because that is the emotion inspired in the gardener who ultimately has to curb their invasions. Biennial plants such as *Symphyandra Hoffmannii* whose glorious display of enormous creamy white bells enchants us through the summer can produce rosettes that casually obliterate their neighbors. You have to learn rosette recognition and ruthlessly pull out plants wherever they could be a nuisance, but leave enough plants in the right places to ensure next year's display. Some campanulas, alas, are perennial and in addition to producing vast quantities of seed speed underground coming up for air in the middle of a peony or a rhododendron. If this happens no amount of pulling out individual plantlets will rid you of the excursion center for further travel. You may have to dig out the hotel plant and remove every bit of resident root. *C. alliarifolia* and *C. punctata* are familiar adversaries. There are plenty of biennial campanulas everybody should grow at least once. Some are difficult, but a showoff for impressionable visitors and give a long period of pleasure, some come back year after year but never become a nuisance. Try *C. sartori* in a scree, *C. lyrata* in a rock garden, *C.*

incurva in a prominent place in a large rock garden but give two feet of spreading room for its crowded crown of big bells. Grow *C. medium* for a border and *C. pyramidalis* for a patio pot (feed it heavily if you can bring it through the winter). Both are spectacular with luck and care.

Every rock gardener sooner or later specializes and you ought to have a collection of summer blooming species of one genus. How about delphiniums or aconitums? You could segregate them at the edge of the wood. The trouble with collecting one genus is that you sow the seed of a dozen different species in February, you get seven germinations, five of these give you plants ready to put out in the fall. Four survive the winter and bloom in the summer; of these two are identical and you don't know which name is correct, one is misnamed and the fourth has lost its label. You have to be prepared to build up your collection slowly - don't be discouraged by this gloomy scenario. Besides you should pin your hopes on several genera. So try also species Peonies, Composites, Silenes and Gentians. If you can grow bulbs go in for Liliums and Alliums for summer bloom. *L. superbum* and *L. canadense* are our local lilies and among the best in the world. They grow in full sun or dappled shade and their only limitation is their edibility - from foot high buds to eight inch deep bulbs they are preferred food of deer, mice and chipmunks. The latest protective device (after failing with hair, soap, urine etc.) is tough plastic bird netting draped over the base of a clump. Anything that prevents access to deer also keeps people away and the physical inconvenience of

uncontrollable netting is unattractive, as is the close up view of this jumble of "invisible" plastic. But if you can grow lilies at all you could also grow *Nomocharis saluenensis* and *Cardiocrinum (Lilium) giganteum* and then you would be close to Paradise.

A genus we all grow is *Aquilegia*. These are notoriously difficult to keep pure, so grow them from seed collected in the wild. And don't attempt to give positive identification to any unmarked plant in your or anyone's garden, especially if it is not in flower. An extremist would say that you should never grow aquilegias from garden collected seed, but seed labeled *A. bertolonii* for instance will probably be on the small side, on the blue side and on the elegant side and probably would not disgrace your garden unless you had an impeccable reputation for being right about the names of the plants you grow. Aristocratic plants such as *A. Jonesii* and *A. saximontana* provide endless hours of discussion about their authenticity.

But rock gardeners are more likely to leave their gardens in Summer than in Spring. This is a good time to visit other people's gardens. We visit before the memory of our own vivid display in May has faded so seeing a garden past its peak gives one a false sense of superiority. We are not influenced by any memory of its recent splendor. We repress these odious thoughts and immerse ourselves in the new garden's potential, subtly planning the owner's next move. "Why not move the larch to the center of the lawn"; "Isn't it time to pick up and divide those overcrowded colchicums?"; "I'd make your next bog here", and other superfluous advice. Or we play the one-

upmanship game: "I used to grow that" implying "I no longer think it worth while growing" and obscuring the true meaning: "It died". Or "I have the one with the variegated leaf", "I only grow the dwarf form,". But most negative thoughts are overshadowed by feelings of admiration and an incomparable feeling of good will generated by the shared experiences of rock gardening. The gardener by our side is showing his/her work of art and the "advice" and commentary that we attempt is no more than a coverup for our inability to verbalize these feelings.

When we head for the mountains we usually leave the garden for a week or a month at a time. Where do gardeners go in the summer? Washington folk have the Olympics and share the Cascades with gardeners from Oregon, Montanans can go to Glacier, the Denver crowd can climb around on Mt. Evans. Southern gardeners go north, Easterners go West, the British go to France and Spain, the Czechs go to Romania and Russia, New Zealanders go to the Rockies, the Japanese go to North Carolina. Seed collectors, photo-graphers and botanizers from all over the gardening world go on uncomfortable treks to Turkey, Kashmir and Hokkaido. Native plant groups fan out in Nevada and Montana. The Scottish Rock Garden Club journal reports that 75% of the people you would meet on a certain ridge near Wengen would be rock gardeners. It is safe to say that anyone above 10,000 ft. in Colorado looking down rather than up is probably a rock gardener.

How can these people leave their gardens?

Well, to go anywhere requires weeks

of preparation. You obviously can't leave a weedy garden and you have to see that the seedlings are safe. That much is minimal. If you have an automatic sprinkler you can arrange all the pots of transplants, the sprouted pots not yet transplanted and the unsprouted pots within the orbit of the sprinkler, program for a daily sprinkling then you can leave them without a care. Or can you? Your ears are glued to every forecast hoping for rain the day you leave and intermittent showers for the following two weeks. If this is your hunch it would be wrong to overwater and return to drowned plants in soggy soil. If there is no rain at all while you are away then once a day for fifteen minutes isn't quite enough. The situation is tense - shall you cancel the trip after all? - or shall you lose face and ask a friend to look in? - you bought the computerized water regulator just to be independent of your friend's unreliable favors. If you don't have an automatic system, the worry is unbearable; you might just as well bid your seedlings (and six months of anticipation) a fond goodbye and resort to all-purpose prayer. If you are in the habit of watering the garden too, the problem is that much worse and no matter what you do a good prayer will come in handy.

And when you return you find chaos. As you drive up to the house you see long grass where lawn used to be - the relief at finding the house still standing passes quickly into anxiety about the nonvisible part of the garden. A quick run around confirms your worst fears. The garden has been engulfed - mostly oxalis. That is the most pervasive and showy of all the summer weeds. Later you find that enormous flat mats of

euphorbia and portulaca have gone to town on every path and in every bed, and wherever grass meets earth there is a dense band of rumex. The whole garden is uniformly green. Did you leave a plant in the greenhouse. It is now a brown twig with a few shrivelled leaves lying on the soil. The pots in the cold frame look dry and a few of the leafier plants are wilting. The ground around the automatic sprinkler is sodden, under the first pot you lift is a large slug. A more careful look around the garden reveals dead buns and browned mats. It takes a week or so to recover your sang-froid and accept your losses gracefully. The first glimpse was the worst; once the weeds have gone, and the dead things have been removed and the shrubs and mats trimmed you can put your losses into perspective. Five *Dianthus alpinus* died but there are still three left. And not all the transplants of *Penstemon rupicola* dried out. The only things gone completely are the campanulas, codonopsis and phyteumas, the oxytropis and the delphiniums - every one eaten by slugs. Don't throw the pots out though, sometimes there is enough left of the stub for it to sprout again - the roots are O.K.

Anyway your car or your suitcase is loaded with plants pressed on you by kind gardeners from distant parts. Or you have returned with eighty packets of seed collected on the trip. Most of them say *Aquilegia? Jonesii, Silene sp.,? Composite*, or sometimes just "?". You even forgot where you collected it. If you brought back cuttings or plants they are probably a soggy pudding in a plastic bag - you rush these into a first aid sand bed even before you check the house for burglars. A week after you return and the

balance sheet is complete you are glad you went on the trip. Not only for the precious souvenirs of Mt. Hood or Big Horns but because seeing plants in the wild gives you an insight into your own garden. Seeing somebody else's garden gives you encouragement and new ideas. Bringing back seed gives you the best reminder of the mountains - the pleasure will last one full year minimum and maybe a lifetime. You can also share that pleasure with others in the seed exchanges and have perfect strangers all over the world bless you for having been to Idaho and having brought a new *Physaria* into cultivation.

Summer is seed collecting time in the garden too. Every dry day you go the rounds with scissors and plastic containers to collect the bounty. And of course summer is the time you are grateful for the annuals, for reliable, slowly changing color - the curse and the blessing of annuals. Grow even the fickle ones that collapse after the first flush of flowers. Too few annuals come back a second year. Perhaps they miss the desert conditions they have in nature. But their seed production is usually sufficient to let you repeat the ones you want a second year. It is always the homeliest that self sow. Big exceptions are *Nigella*, *Iberis* and annual *Delphinium*. A few others come back but rather stingily.

Summer is the time to put into effect all the ideas that were churning through our minds last Winter. The original plan will never mature, but some parts of it will be set in motion adapted to the realities of space / cash in hand / availability of materials. Perhaps a bog, a path through the woodland area or a new bed. Maybe a collection of containers, a bulb

frame or even an alpine house. Summer is also planting out time. There is no best chronological time for this. If the earth is dust dry of course planting out is taboo, but often August sees a series of thunderstorms or the remains of a hurricane. So when the ground is moist enough and if no major drought is imminent you can plant out all the plants from the mail order nurseries that had to be put into cold frames for the summer. And there will be plenty of seedlings from seed sown in February just ready to put out - look for roots coming out of the bottom of the pot and trying to grow into the sand in the cold frame. If your July has been spent making a new bed you will have the extraordinary pleasure of filling a large blank area instead of the usual trying to fit forty plants into twenty unsuitable places. If you have the right plants you could even restrict the bed to plants from one geographic location or plants of one color or one genus or family. Usually these great ideas go overboard as soon as you have plants with nowhere to put them and you discover a little vacant space in your special bed. In succession we have first polluted and then abandoned a cactus bed, a primrose bed, a silver and gray bed, a blue and white garden, a lily bed and a bog plant location. Eventually they all became just rock gardens.

Late summer is when Colchicums start blooming but that event is part of a complex of changes in weather, air and trees and in the gardener too that is usually thought of as Fall. Before that happens we see the heat of summer re-

treating and a group of plants in bloom that are by no means left over from Spring. *Silene schafta* spreads its magenta riches; Alliums come out in profusion (*A. tchaihachewii*, *caeruleum*, *cyathophorum*, *flavum*, and at the very end *Allium thunbergii*, *Caloscordum neriniflorum* and *Lycoris squamigera* share the stage with the Alliums. The mint family produces some good summer bloomers, *Origanum pulchellum*, *Teucrium webbianum* and *T. subspinosum*. There are composites from the Southeast - *Marshalliamohrii* (pretty) and *Echinacea pallida* (quaint). *Linum flavum* makes a fine show and *Erigeron glabratus* has been blooming since June. Gentians, mostly the larger ones, proliferate in August - *G. septemfida*, *asclepiadea*, *fischeri* are lovely. Some of the others are welcome only because we think we need anything we can get at this time of year. *Eryngium bourgatii* flowers late and there are prickly spheres of seed on the other Eryngiums. *Cassia marilandica* and *Santolina neapolitana* are pretty large for a rock garden but would be good background plants for this season.

As summer slides by even the mosquitoes leave us and New England luxuriates in sensual days and gentle nights. Oxalis may be a nonstop pest but there will be a day near the middle of August when we sit outside under the maples and say "Bother the oxalis".

Geoffrey Charlesworth, Sandisfield, MA, is continuing the series on "The Rock Garden Through the Year."

Some Mighty Small Bulbs

Ann Lovejoy

All across the country, autumn brings gardeners to their knees, doing homage not to the splendors of the season, many as they are, but to spring. We crawl about under shrubs and trees, circling the driveway, following each path, planting spring glories by the bagful. Most of those bags hold the magnificent border tulips and daffodils whose portraits are splashed across the covers and front pages of every glossy catalog. Those of us who prefer the delicate, the exquisite and the minute must flip impatiently to the back pages of those catalogs to find the minor bulbs, a loose knit and largely unrelated clan that includes crocus and scilla, alliums and fritillaries. The term encompasses a whole host of delightful and mostly diminutive spring bloomers, many of which offer years of effortless bloom in return for benign neglect.

Considering the ephemeral nature of big tulips and daffodils in most gardens, it is odd that the long lived minor bulbs, so rewarding and self sufficient, should be so little regarded. Perhaps because of their dismissive catch-all name, perhaps because they are seldom used effectively, perhaps because a few are such ardent self sowers (notably certain muscari and scilla species); whatever the reason, minor bulbs have never managed to capture the attention and respect of American gardeners.

This is a shame, for the species bulbs are far lovelier than their blowsy hybrid

sisters. For those who insist on effect - and a taste for display is nothing to be apologetic about - minor bulbs can create unmatched displays throughout the spring. In our old farmhouse garden, the aging apple trees are skirted in February with thousands of soft blue *Crocus Tomasinianus* that have colonized over the years in the long orchard grass. March brings the golden bunch, *C. ancyrensis*, in nearly equal numbers, along with quantities of unnameable natural hybrids that have made this garden their home.

Snowdrops, both plain *Galanthus nivalis* and *G.n.* 'Flore Pleno', the ruffled double, mingle with the drooping green-figured bells of *G.n.* 'Viridapicis' beneath old hedges. A bevy of grape hyacinths, from the fragrant, sea-blue *Muscari viridis* to the inky, navy blue *M. neglectum*, *Pseudomuscari azureum* in robins' egg blue, the periwinkle *M. botrioides* and the bicolored *M. latifolium*, marine blue at the bottom of the spikes fading to sky blue at the top, haze the shrubbery with moody tints. The crisp, white Grecian wildflower, *Anemone blanda* 'Alba' is joined by the deep blue *A.b.* 'Atrocoerulea' and warm pink *A. b.* 'Rosea', the delicate, starry *A. pennina*, creamy blue with whirling foliage, and many forms of the cheerful willing wood anemone, *A. nemorosa*.

Fritillary fans will want all the various named forms of the charming checker lily, *Fritillaria meleagris*. Where the

type plant has flowers of smokey purple and lavender tweed, 'Aphrodite' bears bells of creamy white, large and glimmering in the light shade it loves. 'Artemis' is a heathery blend of lavender-grey, purple and green, 'Charon' the bloomy black of prune plums, and 'Poseidon' a dusky fuchsia pink flecked with chocolate. Other species which appreciate shade include *F. acompetala*, a small, nodding species with large, curving bells of olive to goldy-green with a bronzy sheen, and the slightly taller, late blooming *F. camschatcensis* with dangling bells of mysterious purple black.

Since we have acres to cover, we knowingly admit some species bulbs that spread with a great good will. Were our space more restricted, we would plump for less fecund types and plant them with more restraint. As it is, we plant old favorites and connoisseur's treasures in lavish quantity, often tucking a hundred bulbs or more in each chosen site. Whether planting by tens or by hundreds, we set bulbs closely, giving each cluster a few smaller satellites for a more natural look. (If we waited a few years, many of the bulbs would do this for us, but having just left our very dear city garden, we wanted something wonderful to happen right away in this one, to make up, if just a bit, for our loss.)

Now, each small tree, each major shrub hosts a young colony of golden winter aconites, of blue or white muscari, of species crocus or hybrids like the milky pale 'Cream Beauty' or the purple and bronze stained cups of 'E.B. Bowles'. These early bloomers are interplanted with erythroniums and dodecatheons,

alliums and fritillaries that bloom in late spring or into early summer. By the time the summer leaf canopy is fully formed and their sunlight is cut off, the minor bulbs are entering dormancy. Under the leafy shrubs and perennials, their fading passes unnoticed, and they are largely forgotten until a new spring recalls them to life.

The following companies have a firm policy to sell only field or nursery grown species bulbs and plants.

SUPPLIERS

Van Bourgondien Brothers,
245 Farmingdale Road,
P.O. Box A,
Babylon, New York 11702
1-800-645-5830;
NY residents call 1-800-832-5689

Significant discounts on large quantities. Excellent quality, nice selection for a mainstream catalog. Full color catalog, FREE.

Dutch Gardens
P.O.Box 200
Adelphia, NJ 07710
(201) 780-2713

Large or group orders welcome, 10% discount on orders over \$70. Excellent quality, selection varies, some treasures. Full color catalog, FREE.

Hylseeds
P.O. Box 157
2180 AD Hillegom, Holland

Wholesale only, but available to anybody who can muster a large order (no cash minimum, but there is a 220 lb. minimum freight charge). No catalog; two lists each year (spring bulbs / fall planting, summer bulbs / spring plant-

ing). Order in lots of 100 and up. Terrific quality, selection, prices, even with freight added on.

Ann Lovejoy, Bainbridge Island, WA, has recently moved to a country garden from a small city garden.



Several Leucojums

A Look at Seed Viability

Gerald Klingaman

Receiving the ARGS seed list in late winter is one of the highlights of my gardening year. Of course the real fun begins when the seed packets arrive and the spring planting has been made. Every rock gardener has his or her own special way of treating the seeds to maximize germination and insuring a good supply of special plants for the garden. Being somewhat pessimistic, I only plant half of the seeds of a particular species, retaining the others in case of a crop failure. It is a good idea to date all seed packets, even the commercially purchased packets, for future reference.

With the seeds planted, now we wait. It is easy to visualize thousands of us stooped over, peering closely at flower pots and flats as we await the first signs of germination. Seedlings, as if by magic appear, giving us a much needed winter lift. But next to the pots where germination seemed so easy, stand empty spaces where the hoped for treasures never appeared. Since I have been participating in the seed exchange, my percentage of "no shows" usually varies between 20 and 30%. Sure, we have been told to be patient and wait, maybe for as long as a year for complicated dormancy requirements to be satisfied. However, my success rate usually does not improve tremendously after the seed pots spend a stint of 2 or 3 months in the refrigerator crisper or a winter in the

cold frame.

Several factors could account for the failure to germinate. My lack of understanding of, or inability to provide, the exact germination requirements is probably the most frequent cause of poor germination. Other possible problems include the failure of the plants to set viable seeds, or the loss of viability of the seed lot in storage.

Just how long will seeds remain viable, anyway? Stories about the discovery of viable wheat seeds in some museum exhibit or just opened Egyptian tomb are completely false. Where grain catches have been found in tombs, the seeds were completely carbonized and incapable of germination.

The oldest known seeds to germinate are probably those of the Indian water lotus (*Nelumbo nucifera*) which were discovered in a peat bed buried 2 feet deep in a formation 41 feet above the water level of the Pulantien River in southern Manchuria. These seeds were unearthed in 1923 and nearly all germinated. The estimated age of the seeds depends on who investigated the question - guesses ranged from 120 to 50,000 years. Carbon 14 dating indicated the seeds were about 1040 years old, plus or minus a couple hundred. Two seeds were shipped to the National Waterlily Garden in Washington, DC in the 1950's where they germinated. One of the

seedlings is still being grown commercially.

An even older account was reported in the literature in the 1960's when a mining engineer in the Yukon found seeds of the arctic lupine in the permanently frozen burrows of a collared lemming, a species no longer found in the region. Through a series of estimates, the seeds were judged to be 10,000 years old. However, as is often the case with good stories, closer examination revealed that other rodents used the burrows and the seeds had only recently been deposited.

Examples of long storage life under controlled conditions can be found in the seed literature. The results of a test conducted on a lot of old seed shipped from Kew Gardens to Melbourne, Australia in 1856 illustrate this point. The seed lot, consisting of over 1400 species, was locked away in a closet and forgotten until discovered by A. J. Ewart in 1908. Only 4% of the seed lots germinated after 50 years of storage. Of these 36 were in the Leguminosae, 4 in the Malvaceae, 2 in the Euphorbiaceae, and the rest in miscellaneous families.

Perhaps the best known controlled experiment where seeds were placed in the soil for storage was W. J. Beal's weed seed study at Michigan State. In 1885 Beal buried seeds of 21 herbaceous and 2 woody species on a sandy knoll on campus. Seed lots were dug up every 5 years until 1920 when it was decided to space the removal to 10 year intervals to extend the length of the study. After 50 years seeds of *Brassica nigra* and *Polygonum hydropiper* made their last attempts at germination while *Oenothera biennis*, *Rumex crispus* and

Verbascum blattaria were still germinating 30 years later. Mulleins showed for the last time after 90 years. No wonder it is so hard to get rid of weeds from the garden.

The common denominator for the species which survived long periods of storage was their ability to survive the desiccation of the embryo. These species produce what scientists call "orthodox" seeds, that is they tolerate drying to moisture contents of below 10% and they will survive freezing conditions. Fortunately, most of our rock garden plants fall into the orthodox group. This group contrasts with "recalcitrant" species, those plants producing seeds which will not survive drying below 30% moisture content and cannot be frozen. What factors make some orthodox species survive longer than others is a question for debate. Table 1 gives the expected storage life of some common orthodox flower species when stored at room temperature. Five main theories have been advanced to explain seed deterioration in storage. They are: 1.) depletion of local food reserves for the embryo; 2) accumulation of toxic compounds or growth inhibitors in the embryo; 3) breakdown of the triggering mechanisms which bring about the first stage of embryo awakening; 4) oxidation of lipids, especially those in the cell membrane; 5) development of hydrolytic enzymes which could lead to denaturing of proteins in DNA and other cellular constituents. It seems likely that some seeds may deteriorate in one manner while others may follow a separate path to the same end.

The first two theories, if they are correct, necessitate respiration in the

seed. Does a dry seed in storage respire? As the seed matures on the plant, water leaves the seed and the moisture content and respiration decreases rapidly. As the seed becomes dryer and eventually reaches 10%, respiration falls lower and lower until it is no longer detectable. Most researchers feel that at some point the moisture content is so low the respiration stops and the seed is in a state of suspended animation. Others feel that respiration never stops, but proceeds so slowly it cannot be detected. According to this theory, eventually the supply of soluble nutrients found in the embryo (usually 4 or 5% of the weight of the embryo) is depleted and the seed dies.

The last three theories rely on a slow degradation of cellular constituents involved in the germination process. To me the one that seems most plausible of the group is number 4, the oxidation of lipids (fats and oils). Species which store their food reserves primarily as lipids usually do not store well. The oils oxidize (turn rancid). Evidence for this theory can be found in the observation that storing oil seed crops in an oxygen-free atmosphere greatly extends their life. Cell membranes have a lipid component which could be similarly vulnerable to oxidation. Upon hydration, cells which have undergone membrane oxidation would leak cytoplasmic fluids and soon die.

The most critical variable affecting seed storage life is considered to be seed moisture content. It has been estimated that for each 1% reduction in the seed moisture content, between the range of 14 and 5%, storage life will double (Harrison).

The average relative humidity level

in much of the eastern U.S. is around 70% in September and October when most ARGS members are cleaning their seeds for the seed exchange. Because of the hygroscopic nature of starch, the primary storage constituent in most seeds, equilibrium with atmospheric moisture is reached at around 12 - 14% moisture in the seed. If the species stores its food reserves as a lipid, the moisture content is usually 10 - 12% at equilibrium because of the storage tissue's lack of affinity for water. If the seed cleaning operation is conducted in a basement, the equilibrium moisture content will be higher. Conversely, if cleaning is done in the attic, it will be lower.

Storage life for orthodox species is usually very short when the moisture content is above 15%. Drying seed to low moisture levels does not reduce germination until the 5% moisture level is reached, and even then this is only reported on large seeds which begin to develop cracks in the cotyledons. Seed moisture content of 2 - 3% is considered the minimum moisture content for most species. Equally damaging for seeds in storage is fluctuation in seed moisture content, explaining why many seed houses now use foil or plastic lined seed envelopes for packaging. Before seeds can be sealed in moisture proof containers or packages they must be dried. The USDA has established maximum moisture content specifications for most flower seeds sealed in moisture proof packaging, with most species having between 5 and 7% moisture content at packaging.

Storage temperature is the second environmental factor which affects seed storage life. Harrison estimates that for

each 10 degree F. decrease in temperature, between 120 degrees and 32 degrees, storage life will double. The highest temperature that a seed will tolerate depends on duration. Few species will tolerate exposure to extended temperatures of 160 degrees F., but short durations are not harmful. One common scarification technique used on hard seeded legumes is to drop the seeds in boiling water and allowing it to cool. The lowest temperature that seeds have been exposed to is that of absolute zero, - 460 degrees F. Many species have been exposed to absolute zero with no apparent damage as long as the moisture level was below 10% when the seeds were frozen. Theoretically at least, seeds stored at this temperature could be stored indefinitely.

Now, how does all of this relate to storing the seeds I save each year from the seed exchange? Again Harrison comes to our rescue with another rule of thumb to govern the interaction between moisture and humidity. It is the 100 rule. It states that the sum of the temperature in Fahrenheit and the relative humidity should not exceed 100 if one wishes to optimize seed storage life. According to this rule, seeds would have a comparable storage life if stored at 10% relative humidity and 90 degree F. temperature or 40 degrees F. and 60 % relative humidity.

Let's look at the location readily accessible in the home and see how they stack up with regard to the 100 rule. Room conditions usually have an average temperature of 70 degrees F. with the humidity around 30 to 50% in the winter and 60 to 70% in the summer. The refrigerator usually runs around 40

degrees F. with the humidity 80 to 90% in the crisper area and slightly lower in the main part of the unit. The home freezer usually runs around 0 degrees F. with a humidity of 10 to 20%. The first two conditions exceed the 100 value set by Harrison. Freezer conditions provide the most favorable storage conditions readily available around the home.

If room temperature conditions are used, the seeds should be stored in a moisture proof container. The seeds should have a moisture content below 7% when sealed in the container. This can be achieved by sun drying the seeds in a low humidity area or by carefully lamp drying. Glass jars with screw tops or plastic refrigerator containers with snap-on lids work well for holding seed packets. Enclosing a desiccant, such as silica gel, calcium oxide or calcium chloride, with the dried seeds at sealing has proven successful in extending storage life under warm temperature storage.

If refrigerator conditions are used, the seeds need drying below 10% moisture only if stored for more than 5 years. Usually sealed containers provide better results than open storage under refrigerated conditions. If the seeds are stored in the freezer, either open or closed storage is satisfactory. Drying is not necessary, because freezing tends to desiccate the seeds. As a point of reference, the Plant Germplasm Preservation Research Unit at Fort Collins, CO, stores their seeds with moisture conditions of 4 - 7%, in sealed containers at a temperature of 0 degrees F. This government unit stores seeds for long term germplasm preservation. They expect 15 years' storage life from most plants

before there is a noticeable decrease in germination.

Keeping rock garden seeds in good condition for a few extra years requires little space in the freezer. With a little planning it should be possible to keep viable seeds of most species for years right at your finger tips.

1. Adapted from O.L. Justice and L. N. Bass, 1978. Principles and Practices of Seed Storage. Ag. Handbook No. 506.

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Gentiana clusii

Table 1. Storage life of various garden seeds when dried to at least 12% seed moisture and held at room temperature.

Genera that store 1-2 years

Anemone	Coreopsis	Nemesia
Aquilegia	Digitalis	Nigella
Arabis	Echinacea	Phacelia
Armeria	Geum	Phlox
Begonia	Helichrysum	Platycodon
Bellis	Heliopsis	Portulaca
Browallia	Heliotropium	Primula
Calceolaria	Heuchera	Salvia
Catharanthus	Iberis	Verbena
Cleome	Matricaria	Viola

Genera that store 2-5 years

Cyclamen	Linaria	Achillea
Dahlia	Lobelia	Ageratum
Datura	Lunaria	Alyssum
Delphinium	Lupinus	Amaranthus
Dianthus	Lychnis	Antirrhinum
Euphorbia	Nemesia	Asclepias
Gaillardia	Nicotiana	Campanula
Gilia	Papaver	Celosia
Helenium	Petunia	Cheiranthus
Helianthemum	Phacelia	Cineraria
Hesperis	Saponaria	Clarkia
Hibiscus	Scabiosa	Coleus
Impatiens	Solanum	Coreopsis
Iris	Tagetes	Cosmos

Genera that store more than 5 years

Alcea	Chrysanthemum	Limonium
Amaranthus	Ipomea	Linum
Aurinia	Kernera	Papaver
Centaurea	Lathyrus	Salpiglossis
		Zinnia

Fern Allies for the Rock Garden

George Phair

The genus *Lycopodium*, the Clubmosses, and the genus *Selaginella*, the Spikemosses, share attributes that are highly prized by rock gardeners, and gardeners in general, yet they have been largely overlooked. Their finely cut, highly distinctive foliage contrasts particularly nicely with the more leathery foliage of such small broadleaved, shade-loving plants as *Shortia galacifolia*, hardy cyclamen, partridge berry, creeping wintergreen, *Asarum* species, *Arum italicum*, and dwarf hostas. They are not invasive, and will coexist harmoniously with the plants listed above and many, many, more. Both genera include clump-forming, trailing and prostrate, or semi-prostrate, mat-forming members. Although most clubmosses and spikemosses require moist shade, a few members of both genera enjoy clambering over rocks in the sunny rock garden so long as shelter from the hot mid-day sun is provided. In short, they can serve a wide range of garden purposes, but are particularly at home in the shady rock garden, the shady border, the peat bed, or woodland.

The members of both genera tend to be slow to start new growth in the spring, particularly in dry years; instead they reach a peak in their new finery in mid-summer at a time when most flowering plants begin to look a bit tired.

The Clubmosses

Evergreen in shades of rich green the clubmosses weave some of the most elegant of natural carpets; the repeated patterns vary with the species from small diverging fans, to tiny Christmas trees and, at the opposite extreme, to single tufts, or groups of tufts, clad in bristle-like pointed leaves. The bright new growth accents the darker green older foliage. Most species bear erect cylindrical cones (*strobili*), singly or in groups, that enclose the reproductive sporangia and provide further ornamentation. A planting of several species will provide an interesting mixture of growth habits varying from radial to linear and serpentine.

With so much going for them, why are clubmosses so rarely, if ever, seen in gardens? The answer apparently lies in the common belief that they are difficult, if not impossible to domesticate - a point of view that has been perpetuated by most widely consulted garden encyclopedias. In blissful ignorance of these pronouncements by the "authorities", I started growing in my garden transplants of the species that frequent the extensive woods surrounding our home some 16 years ago, and have continued to do so with satisfactory results ever since. Some of the original clumps have increased in size by 5-fold, or more. Fortunately, the 4 species that

were available are not only widely diverse in growth habits, but are among the more attractive of the 21 species that make up the genus in North America (See Lellinger 1985). The four species according to the Lellinger's classification are *L. lucidulum*, *L. clavatum*, *L. digitatum*, and *L. dendroideum*.

These species range widely throughout North America and 3 of the 4 are found also in Japan. The authors of *The Flora and Vegetation of Japan* - (M. Numata, editor, 1974) describes clubmosses as adapting to habitats in Japan as widely different as the thin soils around volcanic fumaroles (*L. cernuum*) hollows of high altitude bogs (*L. inundatum*), open forest floor (*L. serratum*) and gravelly zones under alpine snow banks (*L. sitchense*). Their extremely wide natural range and ability not only to survive, but to prosper as well, in some of the harshest of natural environments suggests that clubmosses should not be particularly difficult to establish in the garden once their requirements are understood. Simply put, those requirements cannot be met in the standard herbaceous beds and borders with their neutral to alkaline loams and sunny exposures upon which so much of our garden lore is based.

Michael Heim (1988) reporting for the University of Wisconsin - Superior's Lycopodium Research Group is, so far as I know, the first horticulturist to describe the successful domestication of clubmosses. With one important exception, his recommendations regarding their cultivation and propagation are in line with my own experience. These include highly acid (pH 4.0 - 4.5), moist, humus-rich soil. Protection from

the mid-day sun is essential to all species, and all-day shade is beneficial to most. A northern exposure is ideal. The best soil is normally that in which the clubmoss is found growing in the wild. Lacking such soil, Heim recommends a mixture of 3 parts silica sand and 2 parts leaf mold and / or peat moss supplemented by an occasional light feeding of a fertilizer designed for acid loving plants. To this I would add heavy feedings of any fertilizer and of quick release chemical types in general are to be avoided at all costs. The native soils in which the clubmosses are found are superior, among other things, in that they are already inoculated with the microscopic fungus that is beneficial to the clubmoss and essential to its sexual reproduction. Heim notes that the gametophytes are usually underground, are nourished by the fungus, and often require many years to form the sporophyte plant. As a result propagation by spores by the home gardener is generally impractical.

I disagree with Heim on the alleged "fatal effect of a significant amount" of clay in the soil, at least as it applies to clubmosses grown, not in pots but in the garden. Most soils here in the eastern Piedmont, including those that sustain large stands of clubmosses, typically contain very significant amounts of clay. In my experience, the roots of most clubmosses will extend well below the humus layer into that medium.

To those collecting clubmosses in the wild, I would add a note of caution. It is important that the roots of specimens, once they are dug, are not allowed to dry out during transport. One way to avoid that is to cover the whole

plant with damp peat moss, or damp humus, in the collecting basket. This is particularly necessary in the case of the trailing forms. In these cases the runners may extend for 12 feet, or more, with the roots heavily concentrated at the source, and only a few widely scattered along the length. On steep slopes these widely spaced roots probably provide support, rather than nutrition. In the tangle of runners and roots that commonly make up pure stands of the trailing types, it is commonly impossible to locate the root-bearing source of an individual runner. The collector then settles for a long section of runner, disconnected from its source, and having too few roots to maintain viability I believe this factor, more than any other, accounts for the alleged difficulty of cultivating clubmosses in general. Heim recommends a way around this difficulty. Cut a 5 inch section of the growing tip and lightly press it along its length into damp silica sand, leaving its top side uncovered. If the cutting is not allowed to dry out sufficient roots will develop to produce a healthy plant. This is also an excellent conservation practice since the wastage in collecting long runners with few roots is very high. Easier yet - pot grown plants of two of the clubmosses described in this article, *L. lucidulum* and *L. digitatum* (syn-*flabelliforme*), recently became available by mail order from WE-DU Nursery, the first nursery to offer clubmosses to my knowledge.

All clubmosses spread by extending horizontal stems, or runners, that produce the upright growth at widely - to narrowly - spaced intervals, depending upon species. In the clump-forming

types, such as *L. lucidulum*, the horizontal stems lie well below the soil surface, the upright growths are close-packed and the leaves are relatively large. The clump tends to spread radially, and the closely spaced upright stems may reach 8 to 12 inches in height. The resulting luxuriant foliage requires a higher uptake of water than does the foliage of the trailing types. At the opposite extreme, in trailing types such as *L. digitatum*, the horizontal stems tend to be fewer in number, lie at, or just below, the soil surface and produce more widely spaced upright growths that under average conditions reach a height of 3 inches or less. The leaves are very small. The plants tend to spread in linear to serpentine fashion. When transplanted the clump-formers are the easier to start, but are the first to die down in time of drought. In the case of all clubmosses, but particularly the clump-formers, a light moisture-retaining mulch is beneficial and in sites that are partly open to sunlight - it is essential. Oak leaves or pine needles are excellent for this purpose.

L. dendroideum and *L. clavatum* are intermediate in growth habits between the two extremes noted above, with *L. dendroideum* more closely resembling *L. lucidulum* and *L. clavatum* more closely resembling *L. digitatum*.

Lycopodium lucidulum, The Shining Clubmoss. The Shining clubmoss is well named. Its glossy green close-packed leaves are distinctly larger than in other clubmosses, and they reflect a glow that is almost fluorescent in its brightness. It provides a particularly pleasing contrast with gray-leaved and blue-leaved hostas. A clump former, its

upright tufted growth is said to attain heights of up to 12 inches in the wild, but for me, it seldom exceeds 8 inches. Unlike other clubmosses, it lacks strobili. The sporangia are concentrated in zones along the stems. Another unique feature of the Shining Clubmoss is tiny bulbils that form near the sporangia. According to Heim these bulbils will readily produce sporophyte plants identical to the parent if they are planted in moist soil, and are kept from drying out. Moisture is vital to the mature plants as well. In our woods, a pure stand of the Shining Clubmoss expanded from a 3 x 6 feet patch when first observed, to 8 x 40 feet in the course of several consecutive moderately wet summers, then disappeared completely by the close of 2 successive summers of record breaking drought. Plant in good light but full shade, in soil that has been heavily enriched with moisture-retaining humus and mulch well. *L. lucidulum* does particularly well in moist pockets in the shady rockery.

Lycopodium dendroideum, Round Branched Ground Pine.

Lycopodium obscurum, Princess Pine. Although considered to be separate species by Sellinger, the difference between these clubmosses are so small, that they can be distinguished only with difficulty even by the experts. Accordingly, for our purposes the two species are treated as one. Hortus III lists *dendroideum* as a variety of *obscurum*. To me these so called "Ground Pines" conjure memories of the cool serenity of the deep woods. Semi-clump-formers, the coniferous appearing upright growth with its dark green older foliage becomes highlighted in summer by the

very attractive bright green new growth, and ornamented by the light green to tan cylindrical strobili. The strobili are held above the foliage like so many candles atop the tiny Christmas trees. For me, the upright growth reaches 10 inches below ground, and the upright stems though more widely spaced than in *L. lucidulum*, are still close enough together to produce a relatively dense and compact mass of foliage. In my experience, the center of the original clump is apt to die out in 3 - 5 years after planting as the plant spreads outward on several sides, giving an imperfect "fairy ring" effect. Heim has observed similar growth patterns in *L. lucidulum*. After 16 years, my oldest plant of Ground Pines has completely died out, leaving a bare spot, but on 3 sides its progeny now partly cover an area of 8 x 12 feet. Over the years, Ground Pine has proved to be the hardiest of all my clubmosses, given shade and humus. It has performed well for me in the shady border, shady rockery, and woodland.

Lycopodium clavatum, Running Clubmoss. This clubmoss imparts a dynamic quality to the shady rock garden. Leaping from rock to rock, spanning the space between without touching the ground, its growing tip when held high emits the energy of a coiled spring or snake about to strike. *Lycopodium clavatum* is a trailing clubmoss, linear to serpentine in overall growth pattern, but locally spreading laterally to cover small irregular patches. The horizontal stems lie on, or above, the ground and give rise to irregularly spaced upright tufts. The leaves are small, narrow, relatively light green in color, and are drawn out into a hairlike tip that

is diagnostic for the species. Native to open woods, grassy areas, and rocky barrows (Lellinger 1985), the Running Clubmoss can take more sun than can the preceding 2 species. In the greater Washington, D. C., region, however, it is at its best when planted in the shade. In the cooler region to the north, it could be worth a try in the sunny rock garden, so long as its root-source can be sheltered from the strongest rays of the sun. As indicated above, the Running Clubmoss looks best when planted in the shady rockery, but it also does well in the shady border and is the best of all clubmosses for steep slopes.

Lycopodium digitatum, Fan Clubmoss. Lellinger reports that the specific name *digitatum* has priority over the designation *flabelliforme* by which the Fan Clubmoss has long been known. The Fan Clubmoss is a true trailer with scattered upright growth and generally linear growth pattern. The leaves, very small, awl-shaped and fused to the stems along 1/2 to 2/3 of their length, give the foliage a "wiry" appearance. Its leaves are less glossy than those of the 3 species already described. In this region at least, the Fan Clubmoss seems to have distinct sun and shade forms. The sun form grows on dry rocky banks and steep slopes that catch the morning sun. This form is distinguished by upright growth 2 inches or less in height, and commonly by a somewhat grayish tinge to its foliage. Transplanted to a moist humus rich soil in the shade, it takes on the characteristics of the shade form: the upright growth reaches 5 inches, or more in height, and the foliage colors a true medium green. The foliage of both types closely resembles that of Arbor

Vitae, and the name by which I knew it more than 50 years ago, "Running Cedar", remains a particularly apt designation. Its long runners lie on top of the soil, or in the overlying leaf litter. When planted in humus-rich soil pockets protected from the mid-day sun, the Fan Clubmoss is a likely candidate for the sunny rock garden. As it extends its trailing stems outward from the shade at their source, it will adapt to more and more sunlight.

Although I have not tried it, another form of Ground Cedar, *L. tristachyum*, may offer the most promise of all clubmosses for the sunny rock garden. A trailer, it resembles in a general way the Fan Clubmoss, but with its leaves reduced almost to scales, it is even more "wiry" appearing. Heim notes that "full sunlight suits it best and an extremely well drained site (i.e., a coarse silica sand) is a definite necessity. It does well in open situations near pines, or in the heath garden. This species tolerated greater heat and lower humidity than the other clubmosses."

The Spikemosses

In addition to numerous members of no great garden merit, the genus *Selaginella* includes species that are among the most notable in form, or in coloration, of foliage plants. These add an exotic accent to the garden without being unduly obtrusive. Of the 34 species that are native to North America according to Lellinger, relatively few have been domesticated. Taking the genus as a whole the most garden-worthy members originated in the orient, and are not widely represented in the nursery trade. As a result the gardener is largely dependent upon a few small

mail-order nurseries of types specializing in unusual plants in which the stock comes and goes according to the demand. A list of the sources I have used in the past is presented at the end of this article, but I can make no predictions as to their current stock. No doubt there are other sources. Keep looking. Part of the fun for any serious gardener lies in the quest.

Selaginella species that are outstanding for form are upright plumous types. Those that are outstanding for color tend to be more trailing, cushion forming, or intermediate types. I have garden-tested 12 species, of which 8 have proved to be viable here in the southern part of the Mid-Atlantic States. The testing period includes 1 abnormally cold winter together with 2 exceptionally dry summers. All 8 species thrive in shade, or part shade. Two of the eight can also take considerable sun and should adapt well to the sunny rock garden if given protection from the mid-day sun. To minimize winter damage, I mulch the roots of all Spikemosses lightly with oak leaves, and for the first several years after planting invert a flower pot over the above ground parts of small plants for the duration of cold weather. The Spikemosses can be readily propagated by strewing cut segments of the stems over moist sand in a pot, covering the pot with glass, and storing it in a well lighted site out of direct sunlight.

Plumous Types

Selaginella involvens, Chinese Lace Fern Spikemosses. Tallest of my *Selaginellas* with gracefully arching fronds up to 20 inches long, it has a fern-like delicacy that belies its toughness. Unlike ferns, its resilient plumes will

withstand wind and hail. The main stems branch 3 to 6 inches above the base to form the individual plumes. The plumes are broad and taper outward to a point. The red brown main stems, are only sparsely clothed with leaves and as a result are clearly visible. A 5-year-old clump will produce no more than about a dozen plumes, and these are held high with none flopping on the ground. Compared to other plumous *Selaginellas*, the overall appearance is one of "airiness" - a most attractive plant and distinctive as well.

Selaginella caulescens.

According to *Hortus III*, *S. caulescens* is not known to be cultivated, and all material cultivated as *S. caulescens* is *S. involvens*. Whether my *caulescens* is the taxonomist's *caulescens* I do not know, but one thing is certain - it is markedly different from *S. involvens*. My 4 year old specimen of *caulescens* is a much dwarfier, denser, more compact plant. Unlike *involvens* the individual fronds begin to branch only 1 to 1 1/2 inches above the base and expand to lengths of 9 inches, or less; the main stems are green but their true color is largely concealed by a heavy covering of leaves. As in *involvens* the plumes taper outward and arch gracefully but with a difference - there are 30 or more to each well grown clump giving an overall feathery appearance. Most plumes are erect, or semi-erect, but a few will be flat on the ground. The new growth has a bit more golden cast than is true of *involvens*, but the difference fades by midsummer. It forms a neat, upright little mound.

Selaginella stauntoniana, 'Eco Mt. Emei', Golden Spikemoss. A lovely

plumous spikemoss having short, very broad fronds up to 4 1/2 inches wide at the base, and up to 6 inches long. The plumes have a much more golden cast than do those of *caulescens*, and the gold tends to be retained throughout the growing season. The close packed leaves clothing the main stem and stemlets turn an attractive cinnamon brown to golden brown that further enhance the prevailing green-gold of the outer leaves. A neat, shapely, dwarf, the Golden Spikemoss will light up the shady rockery, or forefront of the shady border.

Trailing Types

Three trailing types of *Selaginella* are not as eye-catching as the preceding plumous types, but they form shapely cushions and mats that fit nicely into nooks and crannies in the shady rock garden. *Selaginella* species? sold by Siskiyou Rare Plant Nursery in the recent past has very small, rounded, yellow green leaves borne on upright branches that rise one inch or less above the creeping stems. The wiry creeping stems are clothed with leaves on both sides, but not on top, or bottom. It forms a small dense mat. *Selaginella sanguindentata* var. *compressa* has yellowish green leaves borne on 2 inch high, close-packed erect stems, rising from creeping stems that are only partly clothed in leaves. Those leaves, however, are longer than the others, and turn golden brown in color. It forms dense very low cushions. *Selaginella rupestris* has tiny bright green leaves, almost awl-shaped, borne on many-branched erect stems up to 2 inches high rising from horizontal stems clothed with leaves that as in *S. sanguindentata* var. *compressa* turn golden brown. Forms

looser, more irregular mats and looser low cushions than do the two trailing types previously noted. A native to the eastern and central parts of the United States and Canada, it grows in open locations on cliffs, on rocks or on sandy to gravelly soils. It should adapt well to the sunny rock garden.

Selaginella apoda. Differs from the above 3 trailing types in growing almost flat to the ground with exceptionally bright green very small leaves borne on weak stems. A well grown mat of *S. apoda* is a pretty sight. Growing almost spontaneously and in great profusion on the walks and under benches in greenhouses, it can be a rather fickle performer in the garden unless constant moisture in the soil can be assured. Given sufficient moisture, it will tolerate considerable sun.

Selaginella uncinata. Most vigorous of *Selaginellas* under conditions of its liking, the trailing *S. uncinata* is also among the most eye-catching. Its foliage has a unique iridescence unseen in other foliage plants, and, when fresh, its color changes with the angle of light, and local moisture levels from blue through blue-green to emerald green. The most intense blue color tends to be shown by the new growth particularly that lying flat on moist ground. Good light, but full shade is necessary not only to bring out, but also, to retain, the strong color. An open northern exposure is excellent. The older foliage where it catches the sun will lose much of its color and start to bleach by late summer. I leave the bleached foliage in place on such plants over the winter to shade the remainder of the plant, then shear it off the following spring. An oak leaf mulch



Lycopodium lucidulum (Page 190)

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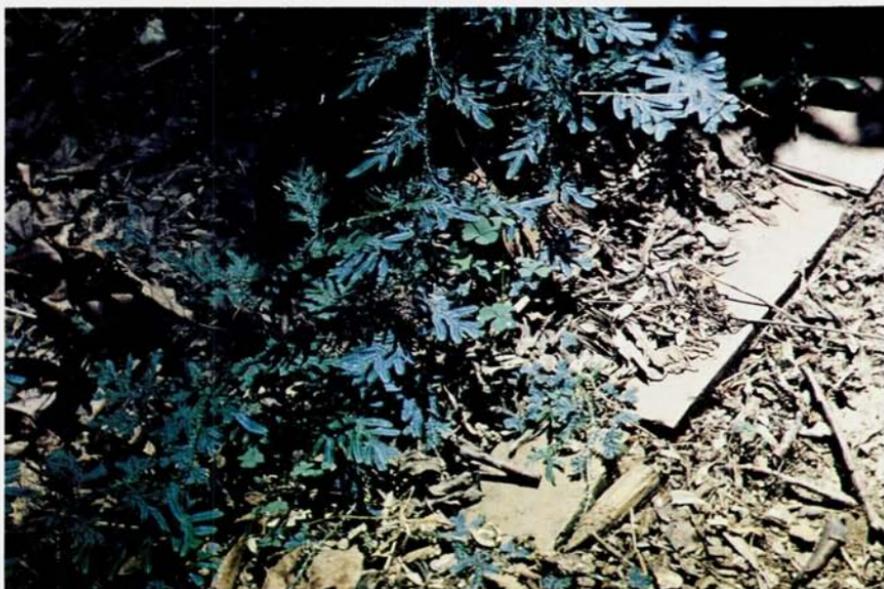


Lycopodium clavatum & *Lycopodium dendroideum* (Page 190) George Phair



Selaginella involvens(Page 190)

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Selaginella uncinata(Page 190)

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lightly covering the entire plant will provide additional protective shade.

Originally native to China, *S. uncinata* has escaped from cultivation and has naturalized itself in parts of the deep south. Long considered to be restricted in its outdoor cultivation to warm climates, *S. uncinata*, in my opinion could be worth a try in areas as far north as Philadelphia given careful consideration to microclimate. I base that optimistic judgment upon its well documented vigor once it has settled in. As an indicator of that vigor, my original small plant of *uncinata* obtained in June 1984 has expanded to form a broad mound 12 inches high in the center, and 36 inches long by 30 inches wide. It has yielded 3 divisions that now form sizable plants as well - all this in spite of the extreme dryness of the past two summers. By way of insurance in the colder regions cuttings of *uncinata* can always be wintered over in the cold frame.

Selaginella tamariscina. The cultivated forms of *S. tamariscina*, the products of centuries of devoted selection by the Japanese, must be seen to be believed. Growing upright to 6 inches or less the foliage of the closely packed dense tufts are strongly mottled in colors of red, orange, yellow, and green-like "tiny Persian carpets" to use Harold Epstein's description. These are the jewels of the genus, but like precious jewels they need a degree of protection that the average garden or rock garden cannot provide. One of the traditional plants of Japan venerated by the Japanese over the centuries, the processes of selection that have produced the wonderful colors have so depleted the life-

sustaining chlorophyll as to make them unduly finicky. This vulnerability contrasts with the exceptional hardiness of the wild parental form of *S. tamariscina* which flourishes as far north in Japan as the relatively cold island of Hokkaido (Ohwi 1965).

I learned the hard way. Some 12 years ago I imported 4 of the cultivated forms of *S. tamariscina* from a dealer in Japan. Like other traditional plants of Japan, they bore imaginative names. They were planted with much care in what I thought to be a particularly suitable spot in the shady rockery. None made it through the winter. Later, I learned from Barry Yinger the secret of their cultivation. These little gems are treated strictly as pot plants in Japan, and they must be over-wintered and dried-off in a cool dark closet at temperatures above freezing. The conclusion is that they demand a controlled environment such as the shaded alpine house can provide. For those who have the facilities the cultivated forms of *S. tamariscina* present a stimulating challenge.

Selaginella martensii variegata. This is another unusually attractive *Selaginella* that failed to make it through the winter for me. Considering that it hailed originally from Mexico, its demise was not entirely unexpected. A shapely, low-growing, semi-upright plant, its leaves are liberally splashed and / or margined, silver-white. This is another promising candidate for the shady alpine house.

List of the sources from which the *Selaginella* species described in this article were obtained:

Eco-Gardens, P.O.Box 1227, Deca-

tur, GA 30031.

Logees Greenhouses, 55 North Street, Danielson, CT 06239

Siskiyou Rare Plant Nursery, 2825 Cummings Rd., Medford, OR 97501

WE-DU Nurseries, Rt. 5, Box 724, Marion, NC 28752

Wildwood Gardens, 14488 Rock Creek, Chardon, OH 44024

Woodlanders, 1128 Colleton Ave., Aiken, SC 29801

T.Niizuma, 6-10 Yamate-2-Chome, Nakasugi, Takarasuka, Hyogo, 665 Japan

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Something From Nothing, Almost

Milton S. Mulloy

Sedums are beneath the notice of some, not everyone's cup of tea admittedly. Perhaps this disdain comes from their being so easy, because - as some would say - they offer no challenge. With some like *S. Sedum dasyphyllum* all one needs do is to scatter the tiny leaves where one wants them to grow and, before long ... presto! new plants and so Cheers! It is still a source of wonderment to me, after many years, that a minute scrap of tissue - seed, or in this case, leaf - leaf the size of a flake of finely ground pepper will, when dropped in, say, mid-June, into a crack in crazy-paving, take hold in raw ground and by Hallowe'en have put on growth sufficient to carry it safely through the winter unprotected. So there's no challenge? Maybe not, but there sure is mystery. And for the novice, abundant encouragement: a nearly instant response to first efforts can only be a welcome stimulus to wider explorations.

Not quite as instant as the above, but in my own experience just as sure-fire and effortless is *S. Sieboldii*. This among the Sedums is, along with *S. caucolicum* a close second, my personal favorite, both being late-fall bloomers, in good pink, and long-lasting brighteners of the pervasive end-of-season drabness.

Putting the garden to bed for the winter offers recurring opportunity to propagate these two (and surely, there are others for the inquirer). Instead of dis-

carding onto the compost pile the scraps of tired, weather-beaten stems and leaves, I filled a 5 x 7-inch tray about half-full of a mix of coarse sand and commercial potting soil (about 2-1) and topped that with about an inch of fish-tank sized gravel, then buried the cut ends of those stems in the gravel and put the lot on a shelf in the unheated garage. This was at Thanksgiving time, plus-or-minus. Sometime after the first of the new year I remembered the flat and found just at the surface the tiniest blue-green buds. Since then a watering or two when the weather has been mild (and I have remembered). Now, right after St. Patrick's Day, to speed up this microscopic growth, the tray has come into the house and under lights. Within 24 hours those minute buds had doubled their stature and currently, a week later, stand at a sturdy one-inch height. With restrained watering and very weak fertilizing (5-10-10) for encouragement, they appear well on the way: come planting time, I expect they'll be ready for the open garden; or potted up, should become admissible contributions to the Chapter's mid-summer Seedling Sale. Something from nothing, indeed! Short of sitting in the shade and vegetating, nothing could be easier. Satisfying, too! Eventually, for cosmetics, the old withered stems come off.

Milton S. Mulloy is from Cheshire, CN.

Growing in the Path

Thea S. Tweet

A number of years ago when the greenhouse was built, we decided to gravel the wide paths along the length and at the back leading past the patio to the remainder of the garden. The gravel was held in place by a concrete block edging softened on the shady side by primroses and on the sunny side by lavender.

The gravel was a bit stark but a very serviceable pathway for the many loads of plants, soil and pots moving in and out of the greenhouse during the summer months. The gravel layer was perhaps more minimal than it should have been and at first proved hospitable to the occasional dandelion or purslane, easily removed.

To our astonishment a colony of baby tears (*Helxine*) appeared one summer in the gravel in front of the primroses. Obviously escapees from the greenhouse where they had been allowed to ramble on the floor between the paving blocks, they found not only a summer, but a permanent home out of doors, surviving even sub-zero winters. (We think they self-seed.) Thousands of bright green, tiny leaves formed irregular bays and peninsulas where there is

no foot traffic. We find it an altogether charming prospect.

About the same time some seedling muscari appeared among the gravel, flourished and bloomed, reminding us of the rocky hillsides of Greece in the spring. Of course, they were allowed to remain.

Lacking a real rock garden on our flat, suburban property, we began to realize the potential of establishing sturdy, rock garden plants that like a lean, gritty, environment. Soon we had *Aethionema*, *Alyssum saxatile*, *Arabis alpina* and *Phlox subulata*. By scraping enough gravel aside to provide a pocket of soil sufficient for a single plant, we have both provided a very satisfactory home for a favorite alpine and top-dressed the gravel as well.

The limits of plant intrusion have been reached or it will no longer be possible to move the wheelbarrows around for maintenance, but what a transformation there has been of an area adjacent to the patio that formerly looked like a parking lot and now looks like a garden.

Thea S. Tweet is from Rochester, NY.

Book Reviews

The Rock Garden and its Plants. Graham Stuart Thomas, \$34.95. Sagapress / Timber Press.

This is a fascinating book which everybody who thinks of himself or herself as a rock gardener should read. It is an exciting history of one very well defined style of gardening that is now in a state of flux diverging and diversifying from a canon that Mr. Thomas describes and probably espouses. Its history is lovingly and extensively chronicled and the reader is made to feel part of that history. Geology and especially the geology of the British Isles plays an important role in the story and a North American reader may need a map of the British Isles handy to follow the discussion. This is rewarding in itself but also throws light on the British obsession with Greensand, Portland stone, Ingleborough limestone and so on and their relevance to gardening (and architecture).

The history follows a line from grottoes and artificial caves to the classic great rock gardeners of the first half of the twentieth century. These are the gardeners we now associate with the very rich or with institutions. There is a moment for the passing of a "great art" and a plea for its restoration and preservation. The US reader must recognize this point of view and not mistake Mr. Thomas's thoughtful advice for dogma. He is dogmatic but only about this ideal garden that he describes as "natural". If, like me, you cannot afford the expense

of the transportation of massive boulders, or, like me, you have scores of lesser ones already on your property, or, like me, your climate and your vision are different from mid-century UK you can still enjoy the experience. There is an emphasis on the people of rock gardening, the plant collectors, the nurserymen, the propagators, the landscape architects. Included are people we know so the history almost becomes current events even though information on very recent plant exploration is skimpy. In fact a mild complaint would be the depressing conclusion that Mr. Thomas reaches on page 137, that "we are beginning to come to an end of the alpine plants of the wide world which are prepared to put up with our weather". This ignores the recent influx of plants from Western US, South America, Turkey, Central Russia and China. We haven't mastered them possibly, but we haven't yet started thinking of the supply as exhausted. The seed lists are increasing in length every year especially that of ARGS. Even in the US there are still *Physarias*, *Eriogonums*, *Penstemons* to be tried out.

The illustrations are lavish and apt, the black and white photographs are more successful illustrating geology than plants. All the color illustrations are reproductions of paintings, some antique (Farrer's water color of *Primula agleniana* is lovely), some recent; I am glad he included his own water colors. There are no photographs of plants in color. His

advice on design and culture is sometimes provocative but always useful. I appreciate the aesthetic measuring stick used to judge these gardens in which rock is paramount even though it is in conflict with my own ideal of rock gardening.

The historical part is followed by several chapters on rock gardening with and without rocks (scree, alpine lawn, alpine house, past gardens, containers) and what to plant where. There are no lists of plants with descriptions but the index combines plant list, cultural information and location in the text in a novel way. This is the place where you will find which plants are illustrated.

This is a very beautiful book and deserves to be looked at as well as referred to. You will even find photographs of Frank Cabot's, Ellie Spingarn's and Harold Epstein's gardens. Don't worry about this being a book by an English gardener writing for English conditions, there is enough information and useable ideas for gardeners everywhere, and it covers different material from any other book on rock gardening.

The book is available from Timber Press, 1-800-327-5680. 999 S.W. Wilshire, Portland, OR 97225.

Geoffrey Charlesworth

useable manual of this sort, for the authors manage to present quantities of scientific and botanic detail within a workmanlike, readable text. While not definitive, this book examines the saxifrages of North American and Europe in depth, with less exhaustive sections on the saxifrages of the Orient and Africa. Gardeners are well served by the ecological notes illuminating specifics of habitat, culture and garden preferences of these fascinating plants. The color plates of plants in the wild, though unequal quality, are considerably better than the black and white reproductions scattered throughout the book.

Gardening With Dwarf Trees and Shrubs. Andreas Bartels, Timber Press, \$32.95, cloth.

This well organized compendium will make a fine reference for those who want more texture and year round visual interest in their rock gardens. The smallest species salix, a host of penstemons, genistas from *horridula* through *pilosa* and beyond, hebes and minute rhododendrons are here in fetching array. Here is a splendid introduction to the possibilities, with plenty of information on culture and propagation for beginners or advancing gardeners.

The Crocus, Brian Mathew, The Royal Botanic Gardens, Kew, in association with Christopher Helm and Timber Press, \$50.00, cloth.

A Manual of Saxifrages. D.A. Webb and R. J. Gornall, Timber Press, \$57.95, cloth.

It is lovely to encounter a solid,

When the firm of David and Charles recently reprinted E.A. Bowles' classic crocus manual, many of us sought it out avidly. It was disappointing to find that it can only be enjoyed as a charming period piece. Delightful as it is to browse through, it is crammed with misnomers and inaccuracies maddening to the serious crocus buff. Mathew's masterwork, in direct contrast, lacks the warm, immediate language that characterizes Bowles' writing, but offers instead a thorough, scholarly revision of the genus that proves accessible to the layman as well as the expert. The close to 100 color plates are botanical classics chosen to amplify the text, which they do admirably.

Ann Lovejoy

A Sierra Club Naturalist's Guide: Southern New England Neil Jorgensen, Sierra Club Books 1978. \$15

When rock gardeners read a description of a new plant, an important consideration is "How can I grow it in my garden?" What is involved are the preferences of the plant for sun or shade, sandy soil or clay, acid or alkaline pH. Most gardeners are able to accommodate a spectrum of ecological niches. But an understanding of how the plant grows in the wild can aid in adapting it to the garden. This is the book to explain and describe the southern New England—landscape and plant communities. About 20% of the book is de-

voted to animals, and the other 80% is of interest to gardeners who grow plants native to this area.

For example, the section on the oak forest describes first the general appearance and soils of this type of forest. Then it has separate sections on the hilltop, midslope and low slope communities. It then goes into more detailed descriptions of dogwood, Mountain Laurel, and the American Chestnut. It continues with the subshrubs and herbaceous plants of the oak forest, the ferns and club mosses. There is then a section on the mixed mesophytic community.

There are similar sections on Postagricultural Lands, The Sand Plain Community, and a very extensive section on Wetland and Watercourse Communities.

This may sound rather dry and academic. As someone who enjoys walking through the woods, along a stream or through a swamp, I find that an understanding of how and why increases my pleasure. 'I want more than a superficial 'Oh, look at the pretty flower!' approach. This book explains simply and thoroughly how the land was shaped by the glaciers, how the rocks, soil types, weather, fire, and time, cause different plant communities to form. The more common indicator plants of each community are described. There are a few color photographs, some black and white photographs, and some sketches, it is not a wildflower guide, but an introduction to the ecology of the area—J.G.

Laurentia Minuta

Wayne Kittredge

The specific name of this little member of *Campanulacae* is very apt, its foliage being about the size and shape of *Houstonia caerulea*, the whole being shorter and more condensed. The flowers are slightly larger than the Quaker Ladies on shorter but equally wiry stems, the overall effect being definitely elfin. The flowers have a wide margin of mid blue following the asymmetrical outline (typical of many *Lobelias*) and a pure white center with two prominent stamens of gold at the mouth of the corolla tube. In my garden each little clump had as many as a dozen flowers open at one time, continuing to produce flowers for as much as two months in spring with a repeat in autumn. In a more capable gardener's hands each clump could conceivably produce as many as fifty flowers at a time.

Several years ago, I had *Laurentia* self sowing in the garden, but in spite of assurances that it is perennial if kept

going inside under lights overwinter, the mature plants I brought in never survived. I kept it going for three years by sowing its utterly minute seeds inside in March and planting out the seedlings in late April. One year however, thinking erroneously that this little treasure was now firmly ensconced in my collection as an annual, I collected only five seed capsules. Apparently there was no viable seed set in any of the capsules, so I had lost it, but did not panic as I had given seeds to friends and to the ARGS seed exchange and felt confident that I would be able to get it back without undue difficulty. Just the opposite has proven to be the actuality as I've not seen it listed in the seed exchanges of three Alpine societies, nor have any friends come through. To my aesthetic bias, *Laurentia minuta* is worth collecting seed of and sowing yearly, more so than many of the annuals which I'd prefer not to be without.

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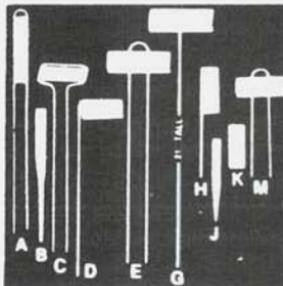
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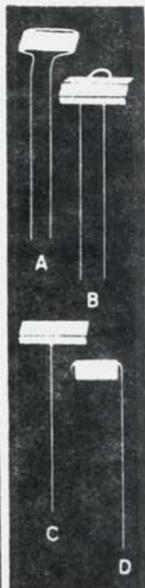
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