Diary of A Primroser
by Cy Happy
Tacoma, WA

The rock garden study weekend in Vancouver, B.C. — 300 strong — got us off to a good gardening year. We renewed friendships, saw a lot of good plants and heard fine speakers. For primrosers there is always a good bit of information, and it's good to be updated on other sorts of alpine and woodland plants.

Herb Dickson, with help from a few APS members, put together a large display of primulas. It attracted a lot of attention and some new members. This is just one of a great many things that Herb does for APS. Where does he find the time? Heather, his energetic granddaughter, is a big help at the nursery and at the garden show booths.

Don't forget to send $40 Canadian for next year's study weekend in Victoria, B.C., to Carmen Varcoe, 5450 Old West Saanich Road, Victoria, B.C. V8X 3X1.

Good Spring Shows
This year I made it to the Victoria, B.C., show and the APS national show at Tacoma. On April 12 the Tacoma Mall people set up tables in the main entrance. It was Friday afternoon, and the plants started coming in. Tables filled rapidly. Two good floor displays and an active sales table appeared like magic.

Whatever the scene lacked in comfortable, serene surroundings was in part offset by the number of plants sold. It was a good show with a wide range of plants displayed.

I like to check the old familiar trophies to see who won them this year. I went back to the trophy table three times before I found the polyanthus trophy. It had been given to the old julie hybrid Butterball, a beautiful plant loaded with yellow bloom — but not the big poly I expected.

Plant Lovers Sing Too
The annual banquet was fun. The talks were light, and they were followed by a classy sing-a-long led by two banjo players.

At the show Orv Agee won his share of trophies. He really does a nice job with the alpine auriculas. His gold center Winifrid was great.

We always enjoy going to Victoria. Taking advantage of two-nights-for-the-price-of-one offer, we stayed at the charming old Oak Bay Beach Hotel. The chef is superb. I had truly memorable Dover sole, a great meal from beginning to end.

The next morning we entered the show building on Elgin St. It is a big and airy church hall. Last minute adjustments were being made prior to judging, but there was time to greet our good friends who make us feel so much at home.

I joined Sybil McCulloch for the primula judging. There was a good range of species and garden hybrids. The primula trophy went to George Nation for a fine P. aureata, a yellow cushion in the petiolares group. Best polyanthus was a vivid magenta cowichan. Many fine auriculas were shown by Maedythe Martin, including some lovely pastel garden auriculas originally from the garden of the late and much missed Tacoma member Helen Clarke.

Need Growing Rules
Judging has no end of problems, and alpine garden societies are loaded with purists. The question raised at Victoria was, "Should a plant entered as an outdoor
garden subject be garden grown, or can it be hurried along under basement
grow lights and be bench in pristine, slug-free condition?"

Two plants at Victoria were examples of the problem. George Nation entered a
rampant, glorious — a two-foot mound of glowing, rain-spattered,
slug-chewed pink. Two tables away was Reba Wingert’s perfect Calceolaria
darwinii. It didn’t look in any way forced or drawn. Beautifully grown in an ideal
container, it was virtually faultless. Reba is one of the most skilled growers I have
ever known. (George is one of the worst groomers!)

Where do we draw the line between garden grown entries, garden grown
plants potted up and protected a week or two before the show, plants subjected
to the modified rigors of an alpine house all their lives, and questionable category
plants brought into early bloom under grow-lights? It seems to me the show
schedule should clearly state the rules in each class. It would make the judges’
job a lot easier.

Test for Turkey Grit

Several times I’ve listened to the Issaquah boys, Doonan and Pearson, recom-
mand #2 turkey grit (has to be granite) as a major ingredient in their soil mix.
Finally I got some in Canada and tried a mix of two parts granite grit, one part
pumice, one part spaghnum peat. It’s sterile, water goes right through, and
nutrients must be added with watering.

For me, watering was a problem. The answer to infrequent watering turned out
to be a product called Viterra II hydrogel, a gelatin-like product that captures
water and releases it as the plant needs it. Just a tiny pinch of the powder
sprinkled near the bottom of the pot kept a water reserve where the roots could
get it. I seem to recall a similar product called Water Lok. Wonder what the boys
would think of this? Must ask them.

Choice Plants Survived

Several choice primroses seemed determined to die in regular soil. I potted
them in the granite-grit mix. After a few weeks of indecision, all but one made a
nice recovery. They are making healthy new root systems and will be able to
support a good show of flowers next year, but will need timely feedings.

Doonan and Pearson had a beautiful P. auricula in full bloom growing in the
grit mix. It was smaller than usual, compact and in excellent alpine character.
Think I’ll try some of the miffy doubles in this mix.

Speaking of difficult primroses, old named varieties are often reluctant to adapt
to new conditions. Grit mix might be the answer, especially during the transition
period.

Some Good Results

My little greenhouse has always been too hot in summer. Paint-on shadings
helped some, but not enough. Finally this year I went to the local tent and awning
supply where, for $20, I bought enough 60 percent sunscreen shade cloth to
cover the entire greenhouse. At last it is reasonably cool. The plants are enjoying
screened sunlight. The greenhouse was my Christmas present in 1936. It’s about
time I got it going right.

We had a visit from your editor and wife, Richard and Carolyn Critz, and found
them much to our liking. I took them to the extensive Wagner garden, where
they exhibited vast knowledge of alpine plants and rhododendrons.

The true test came when Dick and I did my absent son’s 90-customer paper
route. Dick performed cheerfully and with a good deal of hustle. He passed
with flying colors!

The First APS Round Table

Raising Primulas From Seed

by Richard Critz
Rosemont, PA

The following represents a ‘verbatim’ report of a Round Table discussion which
never actually took place at all! Information and material for it was solicited last
fall, by mail, and the responses were woven into the make believe dialogue you
will read here. The actual words of each ‘speaker’ however are used exactly
(whenever possible) and are always enclosed in quotes. Preparing this report
has been arduous, but we hope you will both enjoy it and find it a useful future
reference. If your response is favorable we may attempt other Round Tables
in later issues. Why don’t you write and let us have your comments on this one,
as well as your suggestions for topics and participants next time?

RLC: Good evening ladies and gentlemen and welcome to our round table on
seeding methods for primulas. We all appreciate your willingness to share, we
really do, and look forward a little later to your words of wisdom.

But before introducing our impressive panel of experts I’d like to take just a
few moments to tell both you and our audience why we are here just now and
what we would like to accomplish.

The genus Primula contains more than 500 species, and a much larger number
of hybrids. All species can be raised from seed (if available) and even many of
these hybrids come true with sufficient regularity to make seeding a worthwhile
method.

To those who decide for the first time to experience the satisfaction of raising
primulas from seed, it is confusing to discover that hardly any two growers agree
on the proper ‘modus operandi.’ In such matters as seeding mixture, size and type
of containers, pre-treatment of seed, time for planting, and many other details
of the process there are wide differences of practice. One very successful grower
of lovely primulas once said right out loud, “Bosh! I just sow my seed out under
an apple tree and let it grow.” Another wrote me recently, “After more than
30 years of growing from seed I have developed a system that works for me with
very little care after planting. I need that. But there are as many different methods
as there are people who grow primulas from seed. If you find a system that
works for you, stick with it.”

Now I know and you know that a million articles have appeared on the subject
of primula seeding. But as Editor of this Journal I still get requests for information
on this subject — numerous requests. Hence our Round Table, an attempt to
bring together the practices and opinions of our best growers. While it is
doubtless true that a book could be written about the specific requirements of
each species, we hope that what follows will enable every grower — especially
the new grower — to devise a step-by-step procedure for him or her self that
not only fits the particular conditions under which (s)he works, but will insure
reasonable success with this large and varied plant genus. Along the way we will
try to pick up significant variations for specific species — exceptional soil needs,
time of sowing, temperature requirements, and so on.
Is your game plan clear, distinguished panel? If so, may we proceed to introduce our guests.

Mr. Joe Kennedy hails from Ballycastle in County Antrim, Northern Ireland. His interest is in breeding primulas. He does about 150 crosses a year and grows-on a thousand resulting seedlings to flowering. Of these more than 90% are discarded. In the Vernales Section he works with doubles, jack-in-the-greens and hose-in-hose. He makes crosses among the Asiatics and the various Auriculate species. Though he has a number of old named clones, he does not consider himself a collector per se.

Rosetta Jones lives and works with her husband Alan in Kent, WA. The Jones' are specialists in double acaulis, which they hybridize and raise at their small nursery. Rosetta has done considerable study in genetics and brings a keen understanding of what is happening to her work. Needless to say, her plants are beautiful.

Florence Bellis is one of the great ones in American horticulture. Her important hybridizing program at Barnhaven, near Portland, OR, begun in the 1930s, resulted in a new race of hardy and beautiful polyanthus, created a deep and abiding interest in the U.S.A. for the genus Primula, and resulted — through her writing — in the formation of the American Primrose Society in England, the Scottish Rock Garden Club, and of course, the APS.

Anita: Regarding viability, if I'm dealing with just a few seed, I go ahead and plant them all; but if I'm putting in a lot of seed, I count out a specific number of seeds to test. I put them between two wet paper towels and place them under mist (or seal them in a plastic bag) for two weeks at 50-60 degrees F. If they've germinated, I count the percentage. If nothing has germinated I drag out the big magnifying glass and go at them with a scalp.
After the seed ripens and is dropped or picked, the outer layer of this soft skin, enclosing the embryo and its close-packed lunch, begins to harden into a protective seed coat. Within this ever-hardening case the infant plant lies entombed, waiting the time to germinate and grow. Its breathing — yes, it breathes — slows to imperceptibility as the stored oxygen diminishes and the carbon dioxide builds. Finally, the tiny life lies suspended in anesthetized sleep."

RLC: Gosh, that was beautiful Florence. You ought to publish it.

**STORING THE SEED**

I noticed that you mentioned storing the seed. Anyone have ideas on that?

**Bernard Smith:** "I sow the seed as soon as possible." Primula seed is not long-lived and any laying around in high heat and humidity can reduce its viability still further. As a rule I try to sow seed within the year of collecting.

**Joe Kennedy:** I agree. "I sow primula seed immediately, regardless of the time of year. If I have to delay, I keep it refrigerated."

**William Holt:** I find that seed collected and stored cool and dry can be kept until the following spring. On sowing it will germinate readily. The one exception seems to be the Petiolaris Section. With these species most growers say the seed should never be allowed to dry, but should be sown as soon as it is ripe, with germination following in a couple weeks. That any attempt to store this seed is almost sure to end in failure.

Others, like M. A. Stone, in a recent Scottish Rock Garden Journal noted that the "petiolaris are not as difficult to raise from seed as all that. We have a number of species from wild-collected and dried (!) Himalayan seed."

**Anita:** The petiolaris are a problem, Bill, and I'd like to add a word about another toughie — *Primula rosea*. "I dry rosea seed about 4 days, then refrigerate it, cold but not frozen. (I never allow primula seed to freeze.) I just germinated P. rosea seed that was 3 years old! But I know that if I had let it sit around in a warm room for just a month it would be quite dead."

RLC: The consensus then is that if seed cannot be sown at once it can be stored?

**Florence:** Yes. Seed will live for years if kept cool, air-tight and dry. Place the packets in a tightly covered screw-top glass jar (glass does not draw moisture as plastic does), and store in the refrigerator, away from the freezing compartment. "A quart jar holds many packets and takes little room in its corner where the temperature stays around 40 degrees F. Scientists now believe that low temperatures either destroy some chemical that inhibits germination, or generates one that stimulates it. This may be, but long experience has taught me that airtight, dry, cold storage prolongs the life of the embryo, and without that live embryo no seed can germinate.

"The large amounts of seed produced at Barnhaven were cured in paper bags strung on lines in the attic until the husks had dried enough to shell. At the end of each day of shelling the seed was stored in tobacco cans and refrigerated around 40 degrees F. in a large metal box with tight fitting lid. What seed I produce now is cured the same way and stored in packets in airtight glass jars. What seed I buy — flowers other than primulas and vegetables — I order in winter as soon as the catalogs arrive. By ordering early the seeds are guaranteed some time in cold storage, and, of course, are on hand when soil and weather are just right. Most packets contain more seed than I can use in one sowing, so I paper-clip the opened packet, dating the sowing, and return it to its place in the jar. I continue to draw on these same seed as long as they last, for a year or two, and they always germinate just as well as fresh seed."

**Steven Kelley:** Interesting. Florence, that you should say that. I remember an article once by Ralph Balcom in which he noted that some seed, including auriculas, seem to require a resting period before planting. To satisfy his curiosity Balcom devised a test using 3-year-old seed. If I remember correctly, he used 3 different techniques of pre-treating the seed, as well as planting some untreated. While the untreated seed yielded only 35% germination, one of his pre-treatments yielded 68%, making it abundantly clear that most of the seed was still viable. When moisture, and the other factors essential for germination — optimum temperature, and air — were properly supplied, the inevitable chemical processes were activated and the embryo resumed its active life.

**Florence:** I'm wondering if Ralph kept his seed cool, airtight and dry. If so, he should have had nearly 100% germination since auricula seed, like most primulas, is long-lived.

"Scientists now believe that the encased embryo could survive indefinitely on the food stored for it were it not for protein deterioration and respiratory failure. When moisure, and warmth penetrate the seed coat before the seed is planted, the embryo responds as it would to normal germinating conditions and uses up the stores its mother packed for its first rooting and leafing." This can happen in a normal heated room. "Consequently, when the seed is planted the food and oxygen have been used up and the infant is dead, or not enough remains to support it until it can root and support itself. The life of certain short-span seeds, has been prolonged as much as 50 times their normal expectancy when kept dry and airless in cold storage. Long-lived seeds sleep safely for years."

**WHEN TO PLANT**

RLC: All of which brings us to the question of when to plant. What is the best time to plant primula seed?

**Herb Dickson:** "I start planting during January in the warm comfort of my heated basement. I do as many as I like of an evening, and then set them right out in the weather. The natural conditions seem to help germination, and when everything is right, the seeds come up."

**B. Smith:** "As soon as my seed are ripe I harvest and plant. That's usually in September."

**J. Kennedy:** "Most of my seed is sown about this same time, although I have sown up into late November. This seed germinated very well indeed, in February. For me, spring sowing from the seed lists does not germinate nearly so well."

**W. Holt:** "One cannot generalize over the whole primula range. But I sow vernales and others outdoors in July and August, and indoors from Christmas to the end of February, using bottom heat." This heat seems to give the process a boost, especially when the seed have been frozen during the winter.

**Anita:** I find it varies by sections. I try to consider the native habitat and what the plants do in nature. "Most primulas ripen their seed in early summer and do best if sown soon after collecting — from early to mid summer. That way, plants big enough to withstand the winter will be produced before dormancy comes. With summer flowerers it's best to keep the seed, cool and dry of course, for spring sowing. Any bought seed may be a year old and should be sown immediately."

Lots of people recommend sowing as soon as seed is ripe, but except for a very few difficult species, this is not really necessary, and can be downright detrimental to good germination. I remind you all of Florence's statement that a dormant period..."
mays produce germination-enhancing chemical changes. Often, storing seed dry until December, or even April, will lead to better results.

Rosetta: "Seed planted from January to March will produce good plants by fall and flower the following year." Fresh doubles seed do well at this time, but I understand that in a warm climate these do better if sowed earlier — say October through February.

Kelley: Like Anita "I like to think of the normal cycle in the wild. While I have planted in both fall and spring with nearly equal success, I note that published research suggests that many seeds need a cold period before they will germinate. You know, successive freezing and thawing."

RLC: Heavens, we have some diversity here! On the strength of what we’ve heard would it be safe to say that primulas will germinate just about any time you put them in the ground?

Florence: Perhaps they would Richard, "but in a large operation a tight schedule had to be kept. I always sowed the first week in March, transplanting began 5 or 6 weeks later, fielding out 6 weeks after transplanting — to assure deep-rooted plants by frost. This tight control depended upon exact performance of the seed. And exact performance was accomplished by pre-treating the seed — for the sole purpose of quickly softening the hardened seed coat. One method uses hot water, the other imitates nature by freezing and thawing the seed. These two methods have become standard practice since I discovered and introduced them in the 40’s. Before that, hard-coated seed used to be scarified before sowing, a process of rubbing the seed gently between sheets of fine sandpaper to thin or break the coats. This process often killed more embryos than it delivered, since a very light touch is needed, and many gardeners, including myself, feel that if a little is good, more is better. Besides scarifying, some zealous seedsmen built a small fire over stubborn seed after sowing. Before the 1940s the only other attempt to hasten germination that I know of was in 1600 when Sir Francis Bacon steeped some seed in claret, some strong Madiera. It was not a success.

"Fresh seed, sown in spring and summer should NOT be pre-treated. The seed coat is still soft and the embryo vulnerable. If anything is used to hasten germination of fresh-picked seed, it should be tepid water only, and then only once when watering in. It is after the seed coat has hardened with the passage of time that pre-treatment is advantageous in bringing on quick and thorough germination. The hot water method is the simplest of the two. The water should be hot but not burning to the hand — between 115 and 120 degrees F. when you lower an ordinary thermometer into your filled sprinkling can. Then, very thoroughly water the seeds you have just planted, using your finest rose to prevent bunching. Repeat once a day for the next day or two with 110 degree water. Thereafter use tepid or cool water as needed to keep the seeding medium moist. If you use a soak tray the water can be cold, warm or 115 degrees, but after the pot or flat has been lifted from the tray, give the overhead application as just described.

The freezing and thawing idea came to me after watching a dear old friend take her bottles of hard-to-germinate seed into the mountains every fall and abandon them to the elements for 4 or 5 months. She retrieved the cache in spring as soon as the snow allowed and sowed them at once. That seed germinated magically, soil-less mixes? Let’s have a show of hands. That’s just over half. And the rest of you plant lovers from all over the world.

When a perennial plant drops it ripened seeds in the warm months they either germinate at once to root before frost, or hang back waiting for spring. Those wintering over are subjected to periods of freeze and thaw, which work on the hardened seed coats, preparing them for germination as soon as the weather moderates.

This action can be duplicated in a week or two in the freezing unit of the refrigerator, and it takes less time to do it than to tell how it is done. About two weeks before sowing, open your seed packet and drop enough water on the seeds to float them. Paper clip the packet closed, and bundle your packets together, wrapping in plastic to keep the moisture in. Put the whole thing in the freezing unit and forget it for 3 or 4 days. As in nature, there is no set time. After this short period take the plastic-wrapped packet from the unit and, without opening it, put it on the kitchen window sill for a day or night to thaw. Then, open up, and to each individual packet add a few drops of water to keep the seeds wet. (You will find that they have absorbed all or most of the previous amount.) Rewrap (in your plastic) and re-freeze. Within the span of about 2 weeks repeat this procedure 2 or 3 times. Seeds will germinate right in the freezing unit if kept there too long.

On the final thaw, be prepared to plant them. Open each packet and let the seeds dry at room temperature for just long enough to roll free, usually less than an hour. No longer! Sow at once and water in lukewarm water.

On old or very difficult seed the combined methods often bring a surprise. I once tried it on some primrose seed that had been in cold storage for ten years. After freezing and thawing once I sowed and watered in at 110 degrees F. There was no time to re-freeze because the seed showed signs of germination after the first thaw, and quickly produced an embarrassment of seedlings. (We had planned for spotty germination only.)"

Steve: I have read of these methods of pre-treatment Florence, but it is good to hear them again, and so well. I want to emphasize their use with old seed. There seems to be no danger of injuring the seed with the hot water, provided a maximum temperature of 120 degrees is not exceeded. The freezing and thawing has been debated. For example, I recently read the following: "Sowing a seed with a cold requirement, and putting it into a deep freeze in an utter, total waste of time as the seed will experience no dormancy-breaking cold at all. The water in the compost (or medium) will freeze at once and the seed be exposed to intense drought conditions, which will assure that it remains deeply dormant, inactive, and insensitive to the cold. It will merely age and slowly lose its capacity to germinate.

It is, anyway, a complete illusion that frost is necessary for the germination of seeds having a cold requirement. Indeed, as noted above, if frost is unduly prolonged it may delay achieving readiness-to-germinate by locking up the water. Temperatures around or below 40 degrees F. (5 degrees C) for the requisite period are quite adequate."

Florence: "I'm sorry, Steve, but that's not true. I devised both pre-treatment methods for one purpose only - to hasten germination by suffering the hardened seed coat, in order to control germination behavior. I have used one or the other, or both, as a matter of course every year for nearly fifty years."

RLC: I take it the rest of you are pretty much in agreement? No serious dissent?

Dickson: "First and most important, I start with a sterile medium. I used to bake small batches of soil in the oven and mix in peat, vermiculite and sand. As I grew more seed I acquired an electric sterilizer for my soil mix. Then, as I got older
and lazier, and good prepared mixes became available, I used them and doctored with my own ingredients according to the species I was planting.

My basic rooting mix is (roughly) 2 parts pumice, 2 parts sand, 2 parts garden loam and compost mixed, ½ part peat moss, ½ part perlite. To this I often add enough lime to get a pH of 6 to 6.5, and some slow release fertilizer.”

The Primrose Society has published other seed mixes from time to time, most of which use soil. What they say basically is that any mix is good provided it is porous in texture and not too rich in plant food. One article says the medium should be “loose and friable so that water will drain through readily, yet retain enough to stay moist.” You can use anything you have to do this — leaf mold, compost, sand, peat moss, vermiculite, etc. in any combination that will give you the proper degree of friability. This may be tested by squeezing a handful of the moistened mixture and noting whether it falls apart when the pressure is released. Another good test is to fill a pot with the mixture, compress it moderately, and note whether water soaks through it rapidly and disappears from the surface within a few seconds. If not, it is wise to add extra coarse sand until it does. Then, of course, the soil mix should be sterilized. This is important.

Home gardeners have thought out mixes of their own. Some use equal parts of soil and perlite, and some mix soil with vermiculite. The vermiculite mix would improve with some coarse sand, or ¼ minus, or perlite.

Sphagnum moss used to be a popular seeding medium, but is seldom used any more. Because of its water holding nature, coarse sand or sharp rock mixed with it should be an improvement. I have used straight Canadian sphagnum after pre-soaking and draining, packing it firmly to the top of a shallow flat with very wide air space beneath. I have since learned that an expert amateur I know, working independently, has devised the same medium and soaking procedure like mine and Brian, too, stresses sterilization.

Anita: “The seeding mix must provide 3 things, physical anchorage for the plant, air drainage and constant moisture. At present I’m using a commercial mix too, of peat and volcanic rock. For candelabras I like sifted loam instead of the commercial mix.” I often go by the feel of the mix. It has to be loose and friable.

Properly picked and stored seed cannot help becoming healthy seedlings when air and water circulation is good, when there is a cool sun sweep and the seeding medium is not nutrient rich. A lean bed is appropriate for germinating seeds and infant seedlings since they can use only the food stored for them until their first true leaf appears soon after emergence. There is a choice of lean mediums: those with soil, those with no soil and no nutrients. The old standard mixture is loam, peat moss that has been thoroughly soaked and drained, and course concrete sand — the 3 mixed in equal amounts. This mixture has enough sponge to retard drying, and the air and water circulation is fairly good — but I often add a little ¼ “minus (which is crushed rock measuring from ⅛” down to particle size) for more openness. Packaged soil substitutes are sterile and usually nutrient free. There is bagged vermiculite which is mineral in origin (it is expanded mica) and perlite, a mineral-less volcanic rock exploded like popcorn under high temperatures. Vermiculite’s platelike structure is similar to that of clay, and it holds large amounts of water, which perlite with its simple smooth surface cannot do.

Since I have not used soil substitutes I consulted a nurseryman who has. He relieves the problems of each by mixing vermiculite and perlite in equal amounts. He sows his seeds on the dry mixture, barely covers them with vermiculite, and then places the flats in a soak tray. He waters from the bottom to avoid washing the mix around, which can bunch or bury the seed. He believes that water coming up through a dry mix anchors the seed better than sowing it on a wet mix. After a thorough soak he transfers the flats to parallel 2 x 4 “tracks” which allow a great deal of air space beneath. I have since learned that an expert amateur I know, working independently, has devised the same medium and soaking procedure and will use no other. I’m anxious to try it next spring.

Home gardeners have thought out mixes of their own. Some use equal parts of soil and perlite, and some mix soil with vermiculite. The vermiculite mix would improve with some coarse sand, or ¼ “minus, or perlite.

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Incidentally, before I’m finished, I word a short word about soil sterilization. Since I was not equipped for it I never did it. And recently I’ve learned that certain microorganisms in the soil multiply their numbers more than 5 times within a few days after soil sterilization. So what is the point of it if air and water circulation is poor enough to attract the disease producing organisms. Sterilization alone does not guarantee immunity.”

SOWING THE SEED

And now we come to the heart of the matter — sowing the seed. Suppose we stick with our Europe-America division. It seems to work out well. Europe?

Kennedy: “I use 4” deep boxes, about 18” x 14” for large seed sowings,” or round plastic pots (thoroughly cleaned 3½” to 5” pots, depending on seed quantity) for smaller sowings. I fill to within an inch of the top with a good growing medium and press it down lightly with the fingers. I top this with about ⅛ of my seed mix and tamp that too. Next, I water the compost, not too much — it should be just moist and no more — and spray the surface with a copper compound, using a fine spray. Seed is sown thinly and evenly, and always left uncovered. In fact primula seed should never be covered with any depth of soil,
since many species definitely need light to germinate. There are no species known to prefer dark for germination, so on no account should a layer of opaque paper be placed over the pots. Next, I immerse the pot till the surface is wet. When you lift the pot from the water the seed are drawn tight against the soil, “set” I call it. Often I spray the surface again with the copper compound and put the pot in a clear plastic bag, securing it with a plastic-covered wire. This makes additional watering unnecessary until after the seed germinate. It prevents the compost from drying out — a common cause of failure.

Holt: Yes, primula seed is very sensitive to drying out during germination. If there is insufficient moisture during this critical period, germination can be very poor or fail completely. One way to reduce this danger is to put a ¼” layer of wetted milled sphagnum moss on top of the seed compost before sowing, and sow the seed directly on this. (Incidentally Jack Drake says never water seeds from above, but always by immersion from below.)

After I plant my seed (always in flats) I take “an empty, same-size seed tray, and upturn it over the seeds as a cover; this in turn has a brick placed on it to prevent dislodging. When the first seeds sprout we water again with Benlate, and apply a very thin coating of the seed compost over the seeds, and replace the covering tray until the seedlings come up through the compost. Then of course the cover comes off and is replaced by a fine netting, polyethylene or glass cloche for protection.”

I have read of other ways to do this, Richard, and I’d like to review one of them briefly now. It’s based on the theory that most primula seeds germinate best at temperatures below 25 degrees C. (75 degrees F). At temperatures above 25 degrees C. almost all primula species need light to germinate. So, although it may not be optimum for all species, a temperature fluctuating between 10 and 20 degrees C. (50 and 68 degrees F) will give good germination of almost all primulas and should be the norm to aim at. Fortunately these conditions are easy to achieve in shaded frame or cool greenhouse, April through September, or even into October. Although the seed do not need light, it is best to allow light access just in case.

Another temperature requirement, especially for old seed, is for stratification, a period of cold to break dormancy. The optimum time for this is around 4 weeks, much longer and the awakened seed may go back into dormancy again. 4 weeks at 5 degrees C (41 degrees F) in the presence of moisture is about right. The best way to achieve this is to sow the seed on a moist compost, wrap the pot in a polythene bag and put it in a fridge. Then remove into a well-lighted, warm room and keep moist. Germination should follow shortly.

RCL: Great. That gives us something to work with. All right now, Americans. Do you do it any differently?

Anita: “I do my seed in the greenhouse to keep away varmints, and where I can watch them every day. I look at the seed trays every morning using a small hand-glass. If any mold appears I mix ¼ teaspoon of Benlate in a quart of water and spray everything. I also keep a fan running to create a tiny windstorm in the moist air. Air washing over seedings is good therapy for possible fungal disasters.”

Dickson: “I use 4½” square plastic pots instead of flats or boxes for psychological reasons. Because when transplanting I can do one pot in a limited time where I might hesitate to start on a whole flat. This way I can at least get some transplanted when they should be. I fill my pots to the top and then press down about ⅜” below the rim. I wet this, and plant, and then cover with about ⅜” of vermiculite for large seed (auriculas and polyanthus) or just the merest dusting of vermiculite for fine (vialli, reidii, etc). That’s to keep the cover from lying directly on the seed. Because I cover all pots with a piece of cotton cloth (old sheets) cut to fit, then put a few grains of coarse chicken grit on the cloth to hold it in place. I water lightly with a fog nozzle, and set my pots outside on benches in full sun, wind, snow and rain.

The cloth cover serves several purposes. It helps keep the surface moist, it keeps the birds from eating the seed, it keeps heavy rain from washing the seed out, and it makes it easy to water my near 1000 pots in a hurry with the hose when it doesn’t rain. I take the cloth off when the seed starts germinating.”

Incidentally, Richard, I have brought along two or three methods for sowing which were published in earlier issues of the Bulletin. I thought they might be of interest here. Would you like to hear about them?

Dickson: Here’s one by Maude Hannon which appeared way back in 1968. She writes, “We have tried many methods but prefer to plant in clay pots and sink them into the soil outside before the winter freeze. We cover these with old burlap sacks so that rain and watering will not disturb the seed, and so that there is adequate ventilation. When the weather warms the little seeds will begin germination. We uncover them and place a pane of glass over, tilted a little for circulation.

In our seeding mix we use Blue Whale, up to ½ if procurable, along with regular peat, sand, loam, etc. We believe that Blue Whale, the 100% organic soil builder and conditioner, with its antifungal action, has helped us maintain our record of never having damp-off or disease in the seed pans.”

Here’s another — from J. E. Mason, dated 1968. “On the 12th of September I silted some rotted alder wood (any rotted wood would probably do), placing the material ¼” deep on a brick which I had previously set in a pan of water. The water was ¼” deep with the brick in it. I left the whole assembly for several days till I was sure the proper moisture was being maintained, and then scattered polyanthus seed on the wood screenings. I then placed some of the dry screenings in a pepper shaker and sifted it over the seed, barely covering them. The whole thing was then left in a temperature of 60 degrees F. Three days after planting the seed began to germinate, and in 6 days I had the best germination I ever experienced. By October 24 the whole pan was ready to transplant.”

And here’s the prize — a unique method developed by Marge Edgren and used by many of her friends. “If you have no greenhouse, why not try a sandwich bag! I have raised a surprising number of vigorous rock plants, including some difficult primulas, without benefit of leafmold, loam, sun, or compost. Here’s how I do it.

When seeds arrive I prepare 2 sandwich bags for each packet, each containing half an ordinary paper towel folded into a small pad and well moistened with water. Half the seed is sprinkled on top of the pad in each bag. Then the bag tops are folded down, labelled and stapled shut. Both are left to await germination, one on a shelf at room temperature (65 to 70 degrees F), the other in an ordinary refrigerator (35 to 40 degrees F). No attempt is made to control light during this time.

Seed in the warm bags generally germinates first — some in a few days, others at intervals from 2 to 6 weeks. And of course, some take months. As soon as germination occurs in any warm bag, the corresponding package in the refrigerator is removed to room temperature, and, in nearly all cases, germination follows in due course.

The refrigerated bags generally do not begin to germinate for several weeks or months, bit occasionally one sprouts after only a few days in the cold. After
In the cold I generally take all bags out into the warm room for a week or two. Many will germinate during this trial period. But those which do not are returned to the cold.

Most seeds in a bag germinate all at once, but not always. Sometimes they keep coming for several weeks or months and I try to be patient about that.

If seeds under cold treatment germinate first, naturally, the warm bags are refrigerated immediately, even if they look rotted and moldy. A surprising number will come through.

The length of time bags are kept around awaiting germination depends somewhat on the rarity and desirability of the seed. I have kept some for a year or two.

There are both advantages and disadvantages to the method:

ADVANTAGES
1. Very little time and space are wasted on seeds that do not germinate.
2. Seeds are protected from natural disasters between planting and germination.
3. Treatment of successfully germinated seed can be repeated exactly in subsequent years.
4. Rates of germination can be determined almost exactly.
5. Seeds requiring cold treatment can be started at any time.
6. No pit house, frame or other special construction is necessary.

DISADVANTAGES
1. In planting seed must be handled twice.
2. Lack of soil factors, temperature fluctuations or other unknown natural condition may prevent some perfectly good seed from germinating.
3. There is a distressing amount of mold and bacterial growth on the torelling and seeds; disagreeable, but in most cases it does not interfere with the germination and growth of seeds. No measures need be taken to control it.
4. Rates of germination can be determined almost exactly.
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On second thought, I will add something about air. "When we put seed into the soil we know that it needs moisture, but often overlook its need for oxygen. When the rains continue to saturate the soil seeds die for lack of oxygen, which wet soil excludes. When we sow or cover too deeply, the shoots run out of food and water before they can emerge. I do not cover primula seed, for nowhere are germinating seeds and seedlings more dependent upon a brisk circulation of air and water than those grown in flats or pots under controlled conditions. Without it, damping-off fungi can wipe out an entire planting in a few hours. In the nursery I grew 200,000 seedlings a year. They were grown in roofed but otherwise open sheds, surrounded by young trees and thickets. So I had to learn to propagate in an air-reared pocket. What I learned held all the simplicity of a miracle.

After losing two benches of germinating seed to bread mold and damp-off one spring, I began sowing them as close to the bench top as possible for the greatest speed drip-away. The water condenses on the sides and circulates back into the soil, sustaining the seedlings until they are ready for pricking out.

The bottle cuts easily with scissors. Punch a hole in the side with a knife to insert the scissors and then cut the bottle carefully in two, leaving about 6" for the bottom. Next, cut the top back so that the lower edge fits inside the bottom part. This is important, so that water as it condenses will run back down in the medium. Do not put drain holes anywhere. And keep the cap on, but not tightened. This allows air in but keeps algae and fungi spores out.

The whole thing makes a mini-greenhouse that can accommodate up to 50 seeds.

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RLC: Fascinating! Can anybody top that?

Rosetta: Richard, I can try. "Failure of seed to germinate is often due to drying out after the seed has taken in water and is no longer truly dormant, but before any sign of life can be seen. A seed starter made from a 2 liter plastic bottle can eliminate this problem. Once the medium is moistened and planted, one never has to water again. The water condenses on the sides and circulates back into the soil, sustaining the seedlings until they are ready for pricking out.

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Rosetta: Double seed can take a little longer — ten days to 6 weeks, or more — and germination is almost always uneven. I transplant the first seedlings, disturbing the container as little as possible. Then I may water again with hot water (120 degrees F). There may be 3 successive germinations, with the actual doubles often being the slowest to start. Polyanthus is apt to germinate faster than acaulis.

"Actually I think germination depends on the temperature. In a cool greenhouse with only a heat cable it may take 6 weeks. That’s in late fall or winter. But if the temperature is 50 to 60 degrees outside it may take only 3 weeks. This is for the vernalis group. Some species take longer."

Smith: I sympathize with your feelings, Florence, but for one reason or another some of us feel we simply must take chemical measures against the possibility of fungal disasters. "My seed often has bits of chaff in it which sneaks in fungal spores. A routine watering with Benlate, diluted according to the package directions, usually takes care of that."

Rosetta: "Damp-off could be critical in my pop bottles, but I find that using a sterile mix just about eliminates the worry for me. If I’m in doubt however, Captain works very well. The Captain I mix with the seed, dry-roll it around to coat each. If fungal growth occurs after rooting I dust Captain or Lilly’s Rose Dust with fungicide in it over the surface."

Kennedy: "Just to be safe I lace my initial immersion bath with Benomyl, and when the flats are in their final position they are sprayed with a 1 in 25 solution of Algoxy by Mac Penney International to deter algae, liverwort and mosses. I spray the surrounding area, too."

Other things are used over here. Chilton recommends a liquid copper fungicide, easy to make up in small quantities according to directions on the bottle (1/3 teaspoon in a half pint of water). Make up a fresh solution each time you use it. Others use Phalton or Fermate diluted with water, or Natriphene.

Kelly: I agree with Florence. "Primulas rarely give me a problem with damping-off; they certainly rank among the most care-free in this regard. I’ve heard of drenching both seeds and medium in a fungicide, but have never taken such precautions."

Dickson: A rule I follow for good healthy plants is to keep seedlings growing fast.

RLC: We’ve already said a lot about most of the remaining topics on our agenda, but I think we should just touch base on each to make sure everything is covered.

LENGTH OF TIME FOR GERMINATION

How about length of time for germination?

Smith: "With such a huge genus and all the variable factors it’s hard to generalize, Richard. Anything from 5 days to 5 weeks would be quite normal."

I like the remarks Chilton made in this regard. They noted that with naturally occurring species, as many of our primulas are, there are built-in germination characteristics designed to ensure the survival of the species. Each separate seed therefore is programmed to germinate according to a particular set of circumstances. So naturally, you don’t expect every batch of seed to come up all at once — to do so in its natural environment is not in the plant’s best interest.

Kennedy: Quite so. "Germination is usually well advanced within 3 to 4 weeks, if you plant early."

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Kennedy: Quite so. "Germination is usually well advanced within 3 to 4 weeks, if you plant early."
Jesoana will germinate quicker (in a month) but with a generally poor germination. Cold is of no value.
Polyneura is easy, requires light, and takes about a month. Do not sow the seed fresh.

**VERNALES**

This vast section of sub-species and cultivars is generally easy. It does not need stratification but should not be germinated above 20 degrees C. (68 degrees F). Light is not necessary, but seed do best if kept uncovered. The seeds are highly susceptible to water stress, will promptly die without constant moisture. Veris and vulgaris seed should be planted only after a period of storage. Never sow fresh. They will germinate within a month, but results are very unpredictable. Juliae often germinate poorly, perhaps due to genetic instability. Eliator may take up to 3 months to sprout. It too yields variable results. Do not sow fresh seed. Polyanthus must be kept moist. They germinate generously and the seed will remain viable 7 to 10 years if properly stored.

**PETIOLARES**

These species come from high regions of western China and the Himalayas. For best results seed should be sown fresh (even green) in June — July and pricked out in August. The 10 or so species in common cultivation will all germinate freely if sown fresh. If seed are older, try a combination freeze/thaw, hot water treatment. You may get some results. If the seed fails to germinate, keep it up to 3 years away, just in case.

Aureata is ballyk about germinating, even when fresh. 4 weeks at 5 degrees C. helps, after which try hot water. Most growers say petiolarid germination should not be attempted above 20 degrees C. and some say not above 7 degrees C!

**BULLATAE**

Only forresti, which seldom sets seed, is commonly grown, and germination of its seed is slow and erratic. We do not know what it wants, but cold does not seem to help.

**FARINOSAE**

This largest section of the genus, having around 80 species, is mainly Asiatic to North European with a few species from North America and even the extreme tip of South America. In general these are the easiest of all primulas to germinate — they will respond to any reasonable primrose treatment. Even so, seed pans should be kept for 2 years, especially of rare kinds. The high altitude kinds be kept for 2 years, especially of rare kinds. The high altitude kinds (capitellata, involucrata, gemmifera, etc.), seem to appreciate stratification. Give them the freeze/thaw treatment. Fauriae, frondosa, modesta, sibirica yield good quick germination.

Involucrata is quick too, but often a poor rate is realized. Algida and auriculata give reasonable germination, especially from seed gathered in the wild.

Capitellata and lutea take up to 3 months. The former sets few seed. Clarkei too sets little seed and may take more than a year to germinate. Be patient with it.

Farinosa is variable. It does not respond to cold the first year, but often does respond to over-wintering with good germination in year 2.

Gemmifera, scotica and warshewenskiana often show rather poor germination. Be sure to store correctly.

Inayattti is variable, and little is known of its needs.

Rosea shows good germination in 1 to 2 months if its seed are sown as soon as ripe. Old seed may take a year or 2 unless pre-treated with freeze/thaw and hot water.

**DENTICULATA**

Denticula or erosa germinate readily in light and warmth. But they do best in alternating temperatures of 10-15 degrees C. to 20-30 degrees C. Seed need not be fresh; cold does not help.

**CAPITATAE**

The only cultivated species P. capitata germinates well and quickly with no special treatment. It is even indifferent to storage temperature.

**MUSCARIOIDES**

The four commonly grown species, all from the moist Tibet/eastern Himalayas area, are short-lived. Luckily all produce abundant, easily germinated seed.

Concholoba and muscarioides germinate easily and well, especially under mist, usually within a month.

Bellidifolium is the easiest of all.

Vialis can be difficult and is best sown fresh. Alternately, the seed can be stored cold overwinter and sown in March. If this fails, try the freeze/thaw method.

Keep sown pots at least 2 years before discarding.

**SOLDANELLOIDEAE**

Only four of these beautiful but difficult species are grown nowadays. They are high Himalayan and appreciate a cold treatment. Since plants are short-lived in the lowlands, they should be sown yearly. Seed gathered in the wild works best.

Cawdoriana — cold definitely improves the generally poor germination.

Flaccida (nutans) sets copious seed that takes 3 months to appear, if planted fresh. Freeze/thaw older seed.

Reidi or reidi var. williamsii does well if sown fresh. Older seed needs freeze/thaw and takes a year or more to germinate.

Sherriffae yields only fair germination — try cold.

**ROTUNDIFOLIA**

Rare gambellana and rotundifolia are difficult. Germination is often poor and exact requirements not well known. Seed from the field does better, sometimes quite well. Cold over-winter treatment is advised.

**NIVALES**

These difficult species come from western China or the Himalayas. What seed are obtainable germinate readily enough, but the resultant seedlings often promptly die. Seed seems to benefit from a 6 months or more storage period.

Light is not important.

Sino-purpurea and sino-plantaginea yield good germination after storage, within a month. Cold does not help, but light is apparently essential.

Melanops yields reasonable germination within a month. Cold does not particularly help.

Chionantha yields variable germination, taking about 2 months and freeze/thaw after storage helps.

Macrophylla — germination often poor. Cold helps.
PARRYI
These species set little seed, and that germinates poorly. Neither ellisae, parryi
or rusbyi needs cold to germinate, but little else is known of their requirements.
On the other hand they sometimes produce 100% for no apparent reason.

SIKKIMENSIS
Moisture loving primulas from the eastern slope of the Himalayas. The copious
seed germinate freely with little special attention, either fresh or stored.

S. alpicola and chumbiensis — good quick germination, especially under mist.
No cold needed.

S. florindae and ioeassa also germinate well, but appreciate the freeze/thaw
method. Both take about a month.

S. secundiflora and sikkimensis like light and cold in which to sprout. Old or fresh
seed do well.

S. waltonii is easy too, but takes up to 2 months. It likes a warm temperature in
which to germinate, around 25 degrees C.

PROLIFERAE
This large section is mostly found in western China, and all species require moist
conditions. They are easy to germinate, but have special requirements. In general
store seed for some months before sowing and provide cold and light for germination.
Temperatures alternating between 10 and 20 degrees C. are better than
constant high temperatures.

S. beesiana, bulleyana and burmanica are the easiest. They will germinate well
under most conditions.

S. aurantiaca, chungensis and cockburniana — fresh seed give poor germination.
Light helps for aurantiaca, but cold is not needed. Both cold and light are
best for the other two.

S. aurantiaca from stored seed sprouts well in about 2 months, the other 2 may
take up to 3 months. The hot water treatment is good for cockburniana.

S. anisodora takes up to 2 months to sprout and often does poorly. It does not
need cold.

S. poissonii and serratifolia are easy under most conditions.

S. smithiana does well, even when fresh. Above 20 degrees C. it needs light, but
alternating temperatures, as with most primulas, obviates the need for light.

S. japonica and pulveruienta are easy if seed is 6 months old. Alternating tempera-
tures below 20 degrees C. are best.

S. helodoxa should be stored, sown in April or a little later, for warmth.

GRANDIS
The sole species, grandis, germinates well under most conditions.

AURICULA
The species of this vast section from the European Alps are fairly consistent as to
germination requirements. Most do best with cold, as might be expected.

S. allioni — fresh seed germinates well.
S. auricula — fresh seed germinates well and quickly, without cold, but if this
fails try the freeze/thaw method.

all the rest — only fair germination, even with cold, which is a help. Use both
freeze/thaw and hot water treatments. Fresh seed may germinate immediately.

There. That was a huge, but I hope worthwhile, digression. And now, let's get
back to our questions.

HOW LONG TO SAVE A FLAT OF SEED
How long, ladies and gentlemen, do you save a planted flat or pot of seeds before
giving it up for lost?

Kennedy: "If germination fails to take place I would keep the containers intact
for a year — if the seed was important. Moss, liverwort and algal growth are then
problems, and 'caking' of the surface of soil-based compost. I treat some for these.
The containers are kept moist, always. And this is worth noting: even when
seedlings have emerged, it doesn't seem to matter if they become frozen hard.”

Jack Drake says that no pan should be disposed of until it is at least two years old.
The Chilton people say the same thing, and note that they have had many
seed coming through after this period.

Rosetta: "I keep my containers moist for 2 or 3 months. Then, as summer comes,
I set them aside and let them dry out. Some varieties will then come up in the fall.

Others are covered and left outside to freeze and thaw. This may do the trick and
the seed will sprout the following spring if watered and cared for." I'm not one to
save a long time.

Kelley: "I will generally keep seed trays a whole growing season, if they don't
germinate as expected. Since I usually plant primulas in January, this means
keeping them around until fall. If there's no action by that time they get un-
ceremoniously heaved toward the compost pile. I'm not at this point growing
anything so rare that I might want to fiddle around with alternate methods of
germination if the first fails.”

FROM SOWING TO GERMINATION

RLC: Bernard, you haven't said anything lately. How do you treat the sown pans
of seed while awaiting germination?

Smith: Richard, "I leave the trays on the bench in the garage (which is also my
potting bench.) I cover them with a plastic propagator cover until germination
takes place. Then, I remove the cover.”

Speaking of Jack Drake, if I recall he places his pots in a cold frame or cold
greenhouse (it's late winter) and covers them with newspaper. (Doretta Klaber
used to do it this way too). But plenty of air is allowed. The pots are examined
every day for germination, and to see if further moisture is required. Pots are
never, never allowed to dry out. The important thing is to keep the seeds shaded
and out of the direct sunlight.

Dickson: I want to repeat what we just heard — never let your seed pans dry out.
Keep them moist, but not soggy. I have my pots on a bench outside with light cloth
covers on. These cloths come off when the seed starts germinating, and I start to
water from the bottom, I try to avoid sprinkling with water from above at this
stage — maybe an occasional fine mist when I'm in a hurry. And I wait until they
really need it. Then I give them a real bottom soaking. Keep the pots in the shade
with good air circulation, protected from the drips, the beating rains and birds.
These last are a major enemy of new seedlings. The seedlings need good light,
but not strong sun. If they begin to spindle I give them more light and air.

Rosetta: "I have a greenhouse and my pop bottle containers are plunged in a
bench with heat cables. But in the house one could put the seed pans on shelves
under fluorescent lights.”

A friend of mine in Pennsylvania completely encloses his seed pots in poly-
ethylene bags and puts them on a north window sill. After the seedlings come up
the bags are gradually opened as true leaves appear.

TRANSPLANTING

RLC: Now, before we finish let's have just a word or two about transplanting and
caring for the seedlings. Herb, when do you transplant?
Dickson: "I transplant soon after the first set of true leaves develop. I use flats with drainage in the bottom and filled with my standard growing medium — 1 part garden soil, 1 part sand, 1 part peat, 1 part perlite or crushed tufa. I separate a few seedlings at a time for planting so they won’t dry out. I set the seedlings one inch each way, as deeply as I can without covering the base of the leaves. I keep my flats well-watered and in partial shade till they’re ready to plant out in their bedding plots."

Ralph Balcom used to say (Winter, 1969) "Space seedlings 2" each way and dust the undersides of leaves every 2 months to keep aphids in check."

RLC: Herb, you told us earlier about Marge Edgren and her method of seeding in sandwich bags. What's the rest of that story?

Dickson: Wait a minute . . . Let me find my notes . . . Ah — here we are. Marge says that the medium in which she plants her germinated seed is a soil-less one, composed of equal parts of sphagnum peat, perlite, sand, fine granite grit, and course granite grit. In the absence of feed stores, gravel or crushed rock can be substituted for the grit, but the quantities should be maintained.

Only germinated seeds are planted. The rest are left in the bag to sprout later. Germinated seeds are lifted off the wet paper towel with tweezers; or, if the seedlings are numerous, and the plants strong growers, they are spread rapidly on top of the medium with the fingers. This is admittedly the most cumbersome part of the process.

Planted pans are covered loosely with transparent plastic film (Saran Wrap is fine) and placed immediately under fluorescent lights in the basement. The tops of the pans are placed very close to the lights, usually within an inch, to promote fast compact growth of the seedlings. The pots are turned every day to shake down condensed moisture and to circulate air around the plants. Plastic covers are removed just as soon as the first true leaves appear.

The lights used — 4-foot tubes — are always in pairs: one warm white and one daylight. Growlux are not necessary. These lights are left on all the time, 24 hours a day.

Since there are no nutrients in the planting medium a complete liquid house plant fertilizer, mixed according to directions on the box for soil culture, is added to all waterings. The temperature at soil level averages 75 degrees F, and the fluorescent light is all the light plants get till they reach flowering size. This occurs with sensational rapidity. For instance, *Primula minima* has been flowered as early as 4 months after germination, *P. frondosa* 7 months after germination.

Best of all, mature plants can be transplanted outside after only a few days of daylight acclimatization in a shady place outside.

RLC: Sensational! Florence, why don’t you summarize your practices for us. I’m sure no-one here has raised more primula seedlings than you.

Florence: "The mechanics of transplanting from the lean seedling mix to a growing-on mix is basically the same as the preparation for seeding. Pots or flats should have wide cracks or holes, planted containers should be elevated for air and water circulation in a good air sweep; and I still put 1/4" minus in the bottom before adding about 2" of a good growing mix. This is tamped down, filled, and tamped again to just below the container edge. If you buy sacked potting soil or mix your own, don’t add concentrated fertilizers at this point, organic or inorganic.

"Some gardeners transplant before the first true leaves, and, though tedious, this is alright, even though the plant cannot take up nourishment or make sugar until that true leaf appears. However, when using a mix with no nutrients, transplanting in the cotyledon (the seedleaf) stage is necessary. Since the soil in my standard mix carries some nutrients it is easier for me to wait for the first true leaf or two and I understand that some gardeners wait an entire season to transplant, if the seedlings are not too crowded.

Before lifting seedlings loosen the soil beneath them with a carving fork or ice pick to prevent root breakage, but loosen and lift only a few at a time to avoid drying. My dibble is my forefinger, and I make a hole deep enough to take the roots hanging straight down. The hand holding the seedling positions it with crown at soil surface while the dabbing finger and its thumb press roots and soil gently together. Space plants about 2" each way.

As soon as each container is planted, water in or tray soak. Place in the shade for a few days, then give them sun in the cooler hours. "Elevate for drip-away and keep them moist but not wet. Occasionally cultivate lightly, after watering, with a kitchen fork. That’s all there is to it, Richard."

RLC: Thank you Florence.

Now, does anyone have a final word? We have about exhausted out topics for this season.

Smith: "Systems in the United Kingdom and the United States vary — we have seen that. But we can all agree I think that home raised seed or plants are better."

Dickson: I want to emphasize that the basic requirement of any system is continual moisture.

Holt: Herb is right about the moisture. It’s the key. "Many people use too shallow trays or pans for sowing primula seed. These can dry out quickly at the vital stage. I prefer trays or pots not less than 3" deep.

Then, gardeners like you and me, often buy various seeds ‘Just to try this or that this year.’ This is a mistake, and will lead to disappointment, unless one studies the requirements of the resultant plants and can provide the right environment. The vernalis primroses are the exception — they should be in every garden."

Kelley: "Two related points I can’t stress enough. First, the novice should not be discouraged. Though ‘more learned’ folk may seem to have some answers to some questions, it’s through years of experimentation, learning from others, and making many errors themselves that they find themselves with advice to offer. There is no one right way to go about all this. Just get going!

Second, keep meticulous records of everything you do, not only regarding planting seeds, but also, how things are going in the garden — what plants do well, what plants don’t make it. No, you will not remember in 1986 what you did to attain success in 1985. Records will be your most valuable asset as you proceed from year to year, and will keep you from repeating errors.

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Nutrient Deficiency Symptoms On Primula

by Wayne Mortensen and E. Jay Holcomb

Primula x polyantha has become a widely grown pot plant, but one with numerous fertilizer recommendations. Perry (1980) recommended weekly fertilization with a balanced, low analysis fertilizer such as 10-10-10 or incorporation of a four-month slow release fertilizer into the growing media. Park (1982) recommended the addition of a complete fertilizer (4-12-4 or 5-10-5) to the growing media at final potting or a biweekly application in solution. Summersun (1980) suggested fertilizing infrequently at 100 ppm* of nitrogen (N) and potassium during fall, none in winter, and then increasing as buds become visible in spring. However, Summersun (1982) suggested transplanting primroses to a growing mix containing dolomite, calcium carbonate, treble superphosphate, fritted trace elements plus vermiculite for potassium. The fertilization would then consist of a 300 ppm of N solution until mid-October or November, reduced N to 150 ppm as a starter solution and thereafter fertilization adjusted to plant growth. Boodley (1981) reported that calcium nitrate should be alternated with 20-20-20 and applied at a rate of 150 ppm N at every irrigation. From these divergent fertilizer recommendations, it is difficult to develop a fertilization program that will permit the growth of primroses with no nutrient deficiency symptoms.

Primroses grow well at cool temperatures and use minimal greenhouse space; thus, allowing for efficient production of high quality plants. At these cool greenhouse temperatures, symptoms develop on the primroses which appear to be nutrient deficiency; however, the symptoms of nutrient deficiency in primrose have not been described. Since primroses are grown at cool temperatures (39-45°F or 4-7°C), metabolic rates are low and nutritional deficiencies are slow in developing visible symptoms. Thus the objectives of this work were to describe nutrient deficiency symptoms on primroses and to suggest plant analysis ranges for several plant nutrients.

The study examined six of the essential elements and their associated deficiency symptoms. N, P, K, Ca, Mg, and Fe were chosen since they are required in relatively large quantities, and are nutrients that growers may have difficulty supplying at appropriate levels.

Nutrient solutions described by Bergman (1980) were used to provide a complete nutrient solution as well as solutions which were deficient in either N, P, K, Ca, Mg, or Fe. Following germination, seedlings were placed in one quart containers which contained a continuously circulated nutrient solution, which was either complete or minus N, P, K, Mg, Ca, or Fe. The growth chambers that were used for the primroses were maintained at 68°F (20°C) and the solution temperature was 64°F (18°C).

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with a quantum flux density of 325 Em⁻²·sec⁻¹ from fluorescent lamps. Relative humidity varied between 40 and 60%. Conductivity and pH of each solution was monitored at weekly intervals.

**Nitrogen**

*Primula x polyantha* plants grown in N deficient solutions rapidly became chlorotic. Leaf veins became discolored and eventually turned black. These symptoms were evident 14 days after transferring the seedling to the N deficient solution. In order to observe N deficiency symptoms on more mature plants, seedlings were transferred to a complete solution for several days, then transferred to the N deficient solutions. Using these techniques seedlings grew past 4 days and symptoms on more mature plants were observed.

Visual symptoms of nitrogen deficiency on larger plants were chlorosis of the new growth. Chlorosis and marginal necrosis developed on mature leaves. Although the necrosis and chlorosis occurred on older leaves, there were few leaves actually affected. Premature flowering was observed on some plants, possibly as a result of nitrogen deficiency stress.

Root systems of nitrogen deficient plants developed long tap roots with little or no branching, but a good white color. Secondary roots were short and stubby. Most plants that grew past the 14 day stage developed to a saleable size and recovered from nitrogen deficiency with the addition of N to the nutrient solution.

**Phosphorus**

Phosphorus deficient plants did not develop visible symptoms rapidly. It is assumed that stored P had the ability to supply the plants needs for an extended period of time. The first symptom to appear was a bronzing of lower leaves, followed rapidly by new growth curling inward and development of foliar tip necrosis. The next development was vein browning and subsequent collapse. Premature flowering was also observed.

Small, fibrous root systems developed. Black veins also developed in the roots followed by root collapse.

**Potassium**

Potassium deficient plants developed chlorotic lower leaves within 14 days. New growth expanded to about one-half of the normal size and began to curl inward. Leaf margins developed a severe curling or rippling. Lower leaves eventually became completely necrotic. Several plants in the K deficient treatment suddenly wilted and never recovered.

Roots of K deficient plants were extremely short and stubby with some exhibiting a brown color that preceded root collapse.

**Calcium**

Plants grown in a Ca deficient solution developed a pale green color which was quickly followed by a blackening in the root near the transition zone. This blackening appeared to be a destruction of the cell walls and middle lamella. The crown developed adventitious roots, which subsequently exhibited blackening.

Plants grown in 20, 40, 60 ppm Ca all developed similar symptoms; however, visible effects were delayed as the concentration increased.

**Magnesium**

Older leaves slowly developed interveinal chlorosis and eventually tip and marginal necrosis appeared. As Mg supplies from older leaves became exhausted, leaf margins of new growth began to curl under as the leaf arched backward.

Root systems of Mg deficient plants exhibited an unusual growth pattern. The main tap root grew until Mg deficiency symptoms on leaves appeared, then adventitious roots began to grow vigorously as the tap root began to die. These adventitious roots then remained as the new primary set of roots. The original tap root blackened near the top and eventually collapsed.

**Iron**

Iron deficiency symptoms, which developed within 7 days, appeared as chlorotic new growth which eventually became completely white. White colored new growth eventually became necrotic as a result of insufficient chlorophyll. Mature growth showed slow chlorotic development, beginning at the margins and progressing to the mid vein. The addition of 0.15 ppm of Fe to the solution allowed marginal recovery of the plant within four days with complete recovery noted in seven days. Leaves that had become completely chlorotic did not develop to normal size; however, the plants did develop to a saleable size.

Lack of iron in the nutrient solution had no observable effect on root development of color.

**Leaf Analysis**

Analysis of the elemental content of plants was used to determine nutrient ranges. Plants were harvested and analyzed at different stages of growth to ascertain nutrient levels during the growth period. Sample plants were also obtained from a Pennsylvania greenhouse operator (Ashcombes, Inc., Mechanicsburg, PA) to determine an elemental range for primroses grown under commercial conditions. Mean optimum, deficient, and commercially observed elemental contents are presented in Table 1.

The proposed optimal values were determined by calculating a range of values which contained 85-90 percent of the values obtained from all experimental plants except those in deficient solution. The deficient values were obtained by determining the average value obtained from plants grown in their respective deficient solutions. In most cases, deficient plants were showing deficiency symptoms. The maximum value was the highest observed value from plants in all solutions.

Comparison of commercially grown plants to the proposed standards indicated that nitrogen, phosphorus, calcium, and magnesium were within optimal ranges developed for *Primula x polyantha*. Potassium and iron were above optimal ranges developed for *Primula x polyantha* suggesting that the optimal range may be broader than proposed by this study, since no toxic effects were apparent at the uppermost levels in the ranges used.

**Summary and Conclusions.**

Visual symptoms of nitrogen, phosphorus, potassium, calcium, magnesium, and iron deficiency on *Primula x polyantha* were developed, recorded and discussed, providing an account of nutritional deficiency development.

Analysis of leaf tissue of *Primula x polyantha* provided a basis for determination of deficient and optimum contents for the six elements studied. Comparison of these values with a commercially grown crop, with no obvious deficiency symptom, provided a sound basis for nutritional recommendations for *Primula x polyantha*.

Use of the findings of this study by commercial growers should enable them to identify and correct nutritional deficiencies and provide a means of more efficient production at cool growing temperature.

**Literature Cited**

Table 1. Proposed plant analysis values for the deficient and optimal ranges for *Primula x polyantha* grown in solution culture. The highest observed values and commercial sample are also shown.

<table>
<thead>
<tr>
<th>Deficient</th>
<th>Optimum</th>
<th>Highest Observed</th>
<th>Commercial Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen (%)</td>
<td>1.51</td>
<td>2.50-3.30</td>
<td>3.30</td>
</tr>
<tr>
<td>Phosphorus (%)</td>
<td>.22</td>
<td>.36-0.81</td>
<td>.97</td>
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<tr>
<td>Potassium (%)</td>
<td>1.56</td>
<td>2.11-4.22</td>
<td>4.73</td>
</tr>
<tr>
<td>Calcium (%)</td>
<td>.18</td>
<td>.62-1.01</td>
<td>1.66</td>
</tr>
<tr>
<td>Magnesium (%)</td>
<td>.09</td>
<td>.20-0.42</td>
<td>.54</td>
</tr>
<tr>
<td>Iron (ppm)</td>
<td>.60</td>
<td>78-155</td>
<td>211</td>
</tr>
</tbody>
</table>

Averages of the other elements (ppm)

<table>
<thead>
<tr>
<th>Element</th>
<th>Deficient</th>
<th>Optimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manganese</td>
<td>49.70</td>
<td>87.67</td>
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<tr>
<td>Copper</td>
<td>6.45</td>
<td>8.67</td>
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<tr>
<td>Boron</td>
<td>3.95</td>
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<tr>
<td>Aluminum</td>
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<tr>
<td>Zinc</td>
<td>38.55</td>
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<tr>
<td>Strontium</td>
<td>12.8</td>
<td>16.0</td>
</tr>
<tr>
<td>Lead</td>
<td>5.9</td>
<td>10.70</td>
</tr>
<tr>
<td>Silicon</td>
<td>40.35</td>
<td>269.0</td>
</tr>
</tbody>
</table>


(Editor's note: For the following, we are all indebted to Joe Dupre, Jr. of Anacortes, WA.)

The term parts per million (ppm) is one which most gardeners do not understand, and which probably fewer than 1% could calculate. Even nurserymen rely on charts or automatic dials to provide 200 ppm of N, or whatever.

There is a simple way of calculating ppm which requires only two pieces of information, plus a hand or desk calculator. First, there are 6 teaspoons to a liquid ounce (by volume). Second, you must know the % of active ingredient in the material you are about to use. For example, a 20-20-20 fertilizer contains 20% each of nitrogen, phosphate and potash.

(Aside, but don't get off the track. The calculator (not absolutely necessary) will make the following mathematical steps a lot easier. Now, suppose you want to apply 200 ppm of your fertilizer, follow me step by step: (1) There are 128 ounces in a gallon. At 6 teaspoons per ounce that's 768 tsp./gallon. (2) 1/768 (the reciprocal) is 0.0013037. Multiply that by a million and you get 1303.7 ppm — IF THAT 1 tsp./gallon IS 100% PURE.

(3) If not, multiply 1303.7 by the % of active ingredient in your material (say the 20% N for the fertilizer mentioned above). This would give you 260.74 ppm.

(4) 75% of that 260.74 ppm would be 195 ppm — close enough to your 200 ppm for primula growers. Most assortments of kitchen measuring spoons include Vi tsp. So put 2 tsp. plus 1/4 tsp. of the fertilizer in your gallon of water and start to use.

Caution: If the % or active ingredient is either very low or very high, and/or if the ppm is critical, you should add a fifth step.

(5) Go back and redo all your calculations to be absolutely certain. (Thanks, Joe — that's handy!)
SHOW STUFF

We finally made it thru another year — thank goodness!

Now is the time to make decisions for next year shows. One of the reasons there were so many problems this year was that most everyone kept putting show plans off until the last minute. The good fairy does not do all the things that need to be done. WE have to do them. There are many things that need to be done months in advance in order to hold a good show and divide the work load more evenly.

A Show Chairman is needed now to get the ball rolling. I think Co-chairmen are an even better idea. If something should happen to one person the other one can carry on with much difficulty.

A Schedule Chairman can start now working on a cover, starting to get ads and deciding on remaining schedule contents. More ads are needed to help pay for printing.

A Trophy Chairman can start now collecting donations (either money or objects) and looking for suitable awards to buy. We need 26 for the trophy table plus smaller awards for blue ribbon winners not on the trophy table.

The Ribbon Chairman can order the ribbons now to get it out of the way and then help the trophy chairman gather the awards.

The Judges Chairman should have the judges chosen by January, if possible, so judges can work the shows into their schedules. The judges lunch can be arranged long in advance, too.

The Placement Chairman can start now by making new division, section and class signs and lining up 2 more good workers to help place.

The Publicity Chairman can start now by getting addresses up-to-date, finding new sources for free advertising, etc. Magazine advertising is done in October to make sure the announcements get in the right issues.

Sales Chairmen can start now by getting growers to grow specific species of a specific type of plant for next year sales. We need to have a wide variety of good-looking plants in all price ranges. This year we had an excellent selection. I’ve never seen it better. Edna’s signs added a touch of class.

Education Chairman can start now by gathering written materials for the education table, planning mini-demonstrations and perhaps writing up a new sheet on general planting and seeding of primulas. Someone needs to be at the education table at all times to prevent books from walking away like they did this year.

CHANGES NEED TO BE MADE. Sales were down this year. There simply weren’t the number of people in the mall as was expected. Also, the mall management didn’t follow thru with their part (no skirting late and little advertising). Theft was also a problem this year. It is time to look for a new place to hold our shows. NOW. Perhaps a different approach. A one day show would save time and energy. Majority of plant sales are on Saturday anyway. Or hold a show/education table only and a sale later on. There are a lot of possibilities. NOW IS THE TIME TO DECIDE.

In spite of all the problems a lot of good things happened at this year show. Many of the newer members and members we don’t often see (and even non-members) pitched right in and helped. Thanks to all of you for a good job. I appreciate your help. I do, I did and I will in the future.

I believe there will always be unexpected problems putting on a show. However, if the show is planned well, long in advance of actual show time, the problems will be held to a minimum making it more enjoyable for everyone, especially the Show Chairmen.

We need willing, able workers. New ideas and talk are nice but follow thru is the important factor here. Everyone is capable of doing something at or for the show.

Thank you — all of you,
1985 Show Chairman,
Irene Buckles

NATIONAL PRIMULA SHOW AT THE TACOMA MALL, APRIL 13 & 14

The 1985 National Primula Show was outstanding in the opinion of all concerned: participants, judges, visitors (from as far away as Montana, Iowa, Pennsylvania), attendees and plant customers.

For the second consecutive year, the Tacoma show was staged in the Tacoma Mall, the major mall in the area. The setting was the same as last year: high ceiling, white support columns, excellent natural lighting in the large T-shaped entry showed off the plants to perfection. More tables were required this year because there were 200 more plant entries than last year. Plants were on long draped tables in the passageway used by shoppers walking between various sections of the mall. In addition there were two floor displays in the immediate display area. One floor display was made by five members of the Tacoma Chapter. It included a water fountain, small trees, shrubs, and over 50 assorted primroses — a lovely sylvan garden. The second floor display consisted of eleven concrete troughs containing primroses and/or various companion plants.

Much greater interest was shown in the show this year. It is estimated that about 2500 people, some 700 more than last year, stopped to look very carefully at the entries and floor displays, ask questions of the hosts and hostesses, examine the trophies and winning plants, visit the APS membership table and buy plants. Staging the show at the Tacoma Mall has greatly improved the exposure of primroses to the general public.

The rush for plants (primroses not normally available to the general public) was indicative of the interest. About 1,130 plants were sold compared to last year’s 450 plants.

Ruth Houston of Spring Hill Farm, Gig Harbor, WA manned our education table and many interested visitors came to this table.

Five new APS memberships were received. Many people took applications.

In addition to the local membership, the chapters and affiliates from Washington and Oregon provided enthusiastic support and large numbers of beautiful entries that contributed to the excellence of this National Show. (A team of photographers who plan to do a special TV program on flowers and gardens in the future spent several hours taking special pictures of our plants.)

There was a total of 511 entries in the Show. 3 teams of judges were kept hard at work most of Saturday. Our sweepstakes winners were Larry and
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Publications
Back issues of the Quarterly are available. Order from the secretary. Manuscripts for publication in the quarterly are solicited from members and other gardening experts, although there is no payment. Please send articles and photographs to the editor at 1236 Wendover Ave., Rosemont, PA 19010. Advertising rates per issue: full page $60; half page $30; quarter page $15; eighth page and minimum $10. Submit advertising to the editor.

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A WORD ABOUT "I" AND "WE".

The Tacoma Chapter of the American Primrose Society has just staged one of the most beautiful Primrose shows. I have received countless compliments on what a splendid show I put on. This is what brings me to write this note.

Our show was not an "I" effort, it was a "we" show. I would like to take this opportunity of publicly thanking my Society for their outstanding support and effort in putting on this show. Anyone can do anything they truly want to do, but when everyone works together, both the product and the people benefit. Had it not been for the hard work and cooperation of all, we would not have been able to provide such a pleasure for all who came to see.

I wish other Chapters to know that no matter how small they are, they can have a show if they pull together.

If it hadn't been for my very fine show chairman, and his very patient wife, who organized the inside workings, the members, and their families, who did the physical work and the committees, clerks, and judges, who put all things where they belonged, and last but definitely not least, the Tacoma Mall people who treated us like Royalty, all this "thing of beauty" would never have been possible. I am just very glad I was a very small part of it all.

SEED EXCHANGE

Well, at long last the Seed Exchange mailings have been completed, and I am in process of lining up available seed for the coming year. I hope past donors, and donors-to-be will remember us this year in their gleanings.

Linda Bailey with 115 points, followed by Irene Buckles in second place, Cy Happy and Herb Dickson tied in third. All told, it was a delightful and effective Show.

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President’s Message

Dear fellow members,

I will introduce myself briefly: My folks nearly always had a garden which I was allowed to weed and spade. My father was from England and with his brothers and sisters help brought Grandad Smith over from England. Grandad and his first son, my Uncle Jack, were good gardeners in the family. The rest just gardened.

I am an amateur gardener growing plants for fun. Primroses are my favorite flower of spring. I grew primroses from seed for a number of years before I joined the Primrose Society.

One of my enjoyments is going to flower shows. This year I helped at four Primrose Shows:

- Tacoma Primrose Chapter, Tacoma, WA
- Eastside Primrose Society, Kirkland, WA
- Washington State Chapter, Tukwila, WA
- Lewis County Primrose Society, Chehalis, WA

Each show also had a plant sale. These plant sales are the only place the public has to purchase primula species and unusual primula. The Show at Chehalis had an especially nice selection of Cowichans for sale.

Hopefully, people buying plants at our show sales will get the urge to join us in the Primrose Society.

Sincerely,

Albert Ross Smith