pages 19-38 in Geology of Northern California, ed. by E. H. Bailey, California Division of Mines and Geology Bulletin 190, San Francisco) which contain serpentine. In the Sierra Nevada, the locations in Plumas and Nevada Counties are associated with a major serpentine-belt fault bordering on a layer of greenstone. (See McMath, V.E., Geology of the Taylorsville Area, Northern Sierra Nevada, pages 173-183 in Geology of Northern California.) Greenstone consists of altered basic igneous rocks which contain serpentine minerals. I have not seen a geological map of coastal Oregon and do not know if any serpentine occurs in that area. I would not be surprised if the mineral composition of the soil along coastal Oregon is very similar to the composition of serpentine soils.

Whittaker (The vegetation response to serpentine soils. Ecology 35:275-288, 1954) listed Darlingtonia as a familiar species in bogs and marshes on serpentine soil. Walker (Factors effecting plant growth on serpentine soils. Ecology 35:259-266, 1954) and Kruckeberg (Plant species in relation to serpentine soil. Ecology 35: 267-274, 1954) concluded that plants growing well on a serpentine area, above all else, must tolerate low levels of calcium in the soil. In addition, high magnesium, nickel, and chromium, low available molybdenum and major nutrients (nitrogen and phosphorus), and unfavorable physical aspects of the shallow soil must be tolerated, depending on the particular location of the area. An important factor involved in the strong correlation between the distribution of Darlingtonia and the occurrence of serpentine is the low soil fertility that is characteristic of serpentine. Darlingtonia can tolerate the conditions that accompany serpentine soils.

There are other features, in addition to the geological correlations, that regulate the distribution of Darlingtonia. The main factor is the availability of water. The bogs are all located in areas that have a continuous or near continuous supply of running water from upslope seepage. Few bogs that I have visited had standing water. An often overlooked geological feature is the local rock formations which must allow seepage to occur. Related to the availability of water are correlations in rainfall. The mean annual precipitation in the Sierra Nevada and the Klamath Mountains in the area where Darlingtonia grows is more than 40 inches and commonly exceeds 60 inches (Oakeshott, G.B., 1971, California's Changing Landscape, McGraw-Hill, New York) and in coastal Oregon approaches and exceeds 80 inches. Temperature does not appear to be a critical factor in the distribution of the species. Variations in temperature occur across the range of Darlingtonia. The plants grow well both in areas that have subfreezing temperatures as well as along the much milder coast. Certainly excessive cold or heat would be detrimental to the plants.

In California two large gaps occur in the distribution of this species. In the Klamath Mountains the break between Del Norte-Siskiyou Counties and Shasta-Siskiyou-Trinity Counties can be explained in several ways. Possibly a lack of suitable habitat is involved. However, there are areas that contain ultramafic rocks and the whole region receives sufficient rainfall. It is also possible that this area has not been sufficiently collected and that populations of Darlingtonia remain to be discovered. Of more significance is the break between the Klamath Mountains and Plumas County. Geologically the area is mainly volcanic in origin and relatively recent. (See MacDonald, G.A., 1966, Geology of the Cascade Range and Modoc Plateau, pages 65-96 in Geology of Northern California.) The rocks do not contain serpentine, and much of the area receives less than 20 inches of rain on a yearly average. Lack of available habitat is presumably the reason for this gap.

In conclusion, I would like to mention briefly a few points concerning the conservation of Darlingtonia. Several factors favor the opinion that the Darlingtonia bogs are in no immediate or foreseeable danger. Darlingtonia grows on serpentine soils that have low soil fertility, and subsequently no value as farm land. The bogs are often associated with rocky hillsides that make farming and grazing unlikely. Trees growing on serpentine are often stunted and are not sought after as timber. The absence of valuable mineral ores in serpentines make the possibility of mining remote. There are two areas of concern. Large-scale commercial harvesting of this species could decimate a population of Darlingtonia. However, without knowing where or how the plants are gathered, it is difficult to evaluate the total effect of commercial collecting. Damage to a bog by visitors is also a possibility. Excessive trampling in bogs results in crushed plants, especially the smaller Droseras and Pinguiculas, as well as in damage to the bog habitat. Care must be taken when visiting any of our natural bog areas to see that overuse does not result.

FIELD OBSERVATIONS OF DROSERA ARCTURI AND D. SPATHULATA IN NEW ZEALAND

by Peter Muller

One Saturday morning right after I had just received my license to drive, my father and I set out for Lewis Pass on the South Island. It took a while to get there but when we did arrive, we tried to follow instructions given to us by the director of the Botanic Gardens and we finally had to resort to asking where we might find the local sphagnum bog. Unfortunately, this fellow was not familiar with the name of the moss but he did happen to mention a small plant which he and his friends called "the fly-catching plant." It became immediately apparent to me that the plant he was describing was Drosera. He directed us to a place where the plants were growing. We passed it on the way up to the summit and had to go back about two miles where we parked our cars and climbed a small embankment up onto a natural shelf in the side of the mountain. I would imagine that in the past, this shelf would have been a collecting point for the run-off from melting snow. But in time, it had begun to fill with moss and in some places the water covered the moss so it could not be seen.

The Drosera arcturi plants completely covered the area and it was impossible to walk through them without stepping on them. Since this was December, the plants were at the height of their growing season and many hadn't flowered yet. They grew to a height of about 6 inches in some cases but most grew only to about 3-4 inches. The flowers were borne singly on one stem, and its height was not much higher than the surrounding leaves of the plant. The overall plant color was rusty brown.

As we sat down to have some lunch, I noticed that another Drosera, called spathulata, was growing in the same sort of soil in community groups but was not nearly as abundant. It seems that the surrounding cover (which is very sparse but enough to bury these small plants) is very steadily smothering them. These plants were also ready to flower and each one bore one or two flower scapes crowned by a small group of buds. Overall color was red for the leaves, flowers and buds.

All the plants I found were growing in direct sunlight and would get sun for most of the day. This would explain the red pigment in the leaves. No plants were found growing in the shade, and none were found to be growing in "perpetual" puddles or in excessive dryness. Also, during the winter, the plants would be covered with snow. I would grow these plants at temperatures under 70° F. since my experience with growing them is that any higher temperatures lead to disaster. Therefore, glasshouse conditions are not necessary, but the humidity must be high.

FURTHER HINTS ON GROWING ALDROVANDA

by J.A. Mazrimas

I would like to add further details to the excellent instructions given by Messrs. Ohtaki and Katagiri on growing Aldrovanda in culture. The main thing to remember is that these plants are sensitive to acidity, require a high nutrient diet in order to grow and branch often, and finally require fairly strong light to grow.

The first thing that I did when I received my plants was to make a suitable medium for them to grow in. This involved making a hay infusion or culture of microorganisms which include bacteria, Paramecia, Euglena and others. I found some dried grass, hay or straw and chopped it into four-inch pieces which I stuffed into a tall jar (a one quart fruit jar or large mayonnaise jar) and filled to the brim with boiling water. This is set aside in a warm room for about a week in which time the water becomes yellowish-brown and slightly cloudy. I also made a similar culture from stalks and leaves of dried cattails (Typha) which you find growing along most shallow ponds and ditches wherever water is present all year. Other water plants can be used too.

Next, I visited a tropical fish store and purchased a bottle of Brom thymol blue, which is a pH indicator dye. It is not necessary to buy the entire measuring kit since I'll tell you how to use it here. Also, it is a good idea to purchase some sodium biphosphate to regulate the acidity of the culture.

Then, I arranged a plastic shoebox, which you can purchase at most large department stores, in the following way: first, I placed a layer of washed sand followed on top by several handfuls of straw and cattail leaves from the culture. Then I poured about an equal mixture of the culture solutions until full. Now it is ready for the Aldrovanda. Place the box in a bright and warm area, about 50% sunlight for one-half day with temperature fluctuating between 90° F. in the day to 65° F. at night. It seems that the shallow depth (about four inches) and wide surface area provided sufficient air exchange to occur without the need for a bubbler. Next, I was ready to check the water's acidity.

I scooped a small sample of the culture solution into a vial or test tube and added 2-3 drops of Brom thymol blue solution. If the water turned yellow, then it would indicate the water was too acid and if blue, it would be too alkaline. When the solution becomes green, then acidity is just right which is simple to remember as you view the green plants floating in the water. As my solution aged, it had a tendency to turn alkaline and the water color darkened with increasing growth of undesirable algae. Fresh hay infusions are usually acid when ripe and so adding the correct amount will adjust the pH back to the "green" region. Also, a pinch or two of sodium biphosphate will also bring the pH back to the normal range.

One of the best ways to maintain the optimum pH of 6.2 is to prepare a peat moss infusion by pouring water over it and allowing to set overnight. Add enough of the resulting liquid