NATIVE PLANT SOCIETY of OREGON

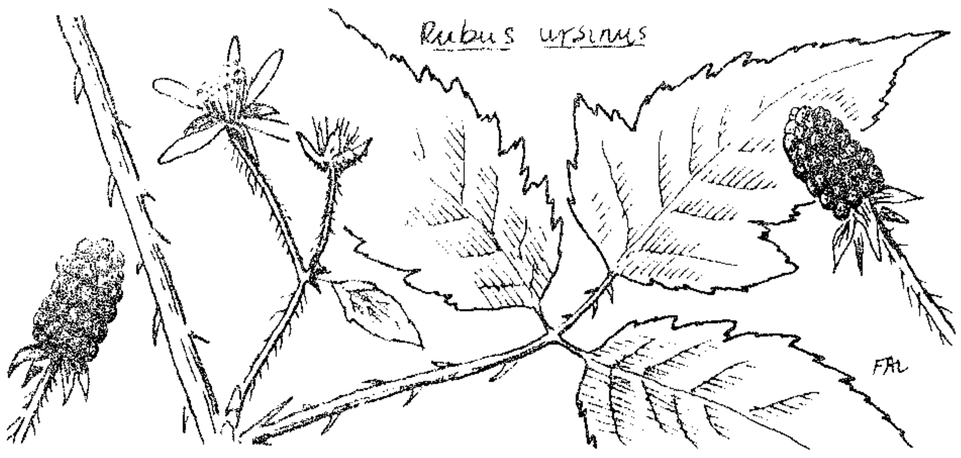
•OBJECTIVE•
To increase the knowledge of members and public in identification and conservation of the native plants of the Pacific Northwest.

Vol. XII No. 11 November 1979

DUES DUES DUES DUES DUES DUES DUES

The Editors would like to remind you that you will need to renew your membership in the society January 1st.

Dues are payable to your chapter treasurer (or the state treasurer if you are an at-large member).
The amount is going up to $7.50/year, or if that is not enough we have several new categories that you might consider if you wish to express a deeper commitment to the aims and purposes of the society: Sustaining $25.00, Patron $100, Life $500.
Another thought. Consider a membership as a Christmas gift to someone who shares our interest in the Native flora of Oregon!



PLANT FAMILY PROFILES
by Herm Fitz

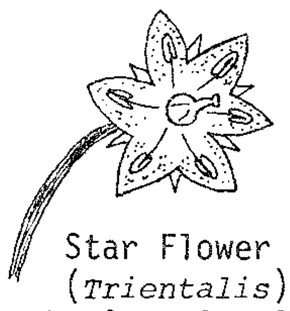
Introduction

So that they may come to know the plants better, many people would like to increase their skills in plant identification. A great leap forward can be made by learning the KEY CHARACTERS of each family, which then allows one to observe a flower and often to know instantaneously to which family it belongs. Keying it out then becomes a much easier task, for there is no need to run it through a laborious family key!.
Plant families have consistent themes running through many, if not all, of their species. These similarities are most often based upon the flower structure, but may include growth form, leaf structure and position, inflorescence type, or perhaps unique features found only in a single family. When the latter occurs, it is possible to place a plant in a family by observing a single feature; more often a combination of just a few features will identify the family.

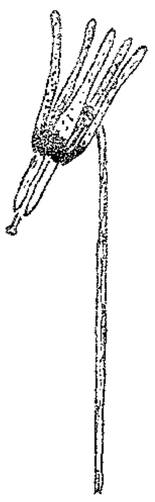
Characteristics of the flower that may be used to identify a family are the numbers and arrangement of sepals, petals, and stamens, the number and degree of union of pistils, the position of the ovary, the number of chambers (locules) within the ovary, and the type of placentation. Fruit types may also be characteristic in families.

The Primulaceae - PRIMROSE FAMILY

The Primrose Family is not large, but is rather widespread over the world, on all continents but most abundant in the Northern Temperate zone. About 700 species in 25 genera are found throughout the world; 10 of these genera are represented in the Pacific Northwest and Oregon itself. The most familiar are the Shooting Star (Dodecatheon) of moist bogs, meadows or streambanks, Star Flower (Trientalis) of woods and bogs, and Scarlet Pimpernel (Anagallis arvensis) of lowland valleys and coastal areas. Less often encountered are Douglasia (Douglasia) of rocky ridges in the mountains, and on ledges, the Wallowa Primrose (Primula cusickiana), Oregon's only Primrose, the Loosestrife (Lysimachia) of bogs, swamps and lakes, the Fringed Loosestrife (Steironema) of damp meadows, Saltwort (Glaux) of saline soil in inland salt marshes and meadows, Chaffweed (Centunculus) of lowland vernal pools, and Androsace (Androsace) of mountain rock gardens.



Star Flower
(*Trientalis*)
Note the Opposite Stamens

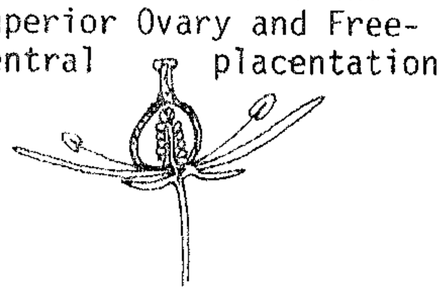


Shooting Star
(*Dodecatheon*)

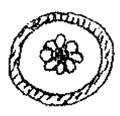
Why are all these plants included in the same family? What do they have in common? All are herbaceous in habit with simple, opposite or whorled (occ. basal) leaves. The flowers are perfect, having both stamens and pistils, and mostly 5-parted, with 5 sepals, 5 petals, united, 5 stamens, and a pistil of 5 united carpels. This pattern may be expressed as a floral formula: $Ca^{(5)}$ $Co^{(5)}$ S^{5} $P^{(5)}$ - which means that the calyx has 5 sepals, the corolla has 5 united petals, there are 5 stamens, and the pistil has 5 united carpels. Each family has such a formula, and the differences there serve to help identify each family. Unfortunately there are always a few odd-balls: in this case Trientalis with flowers 5 to 9 parted, and Glaux with no corolla at all! But remember, "it is the exception that proves the rule."

The stamens are opposite the petals; instead of arising between petals (alternate) they arise directly over them. This is an important character, since most families bear alternate stamens. The pistil is unilocular (with a single chamber), and has a superior ovary (borne above the rest of the flower parts) with ovules attached by free-central placentation. Flowers are borne singly or in clusters (racemes or umbels). Fruits in Primulaceae are dry capsules with few to many seeds.

Now the next time you encounter a 5 parted herbaceous plant with opposite or whorled leaves, with united petals, opposite stamens, and a 5-carpellary, unilocular ovary, also superior, with free-central placentation - you will know you have probably found a member of the Primulaceae - the PRIMROSE FAMILY.



Longitudinal section of Star Flower - Note the Superior Ovary and Free-central placentation



Cross-section of ovary with Free-central placentation

Rumor

We hear that 2 NPSO members have signed up for the Trip to Nepal with Ruth Hansen and Folkways International Trekking (see article elsewhere in this issue). That means $200 extra in the Treasury that we can use to further our good works.

By-Law Changes Approved

By a unanimous ballot (13 votes) the membership under whelmingly approved the amendments to the By-Laws of the State Constitution requested by the Board of Directors.

Hence forth the chapters will elect officers for the same term of office as the State Organization. This means that chapters will have elections for officers by April 1st of each year. The immediate past president will serve as an ex-officio member of the Board of Directors of the NPSO for one year following his/her presidency.

Those of you who have copies of the By-Laws should make the following changes.

Page 4. Article VIII Section 3. Add at end of the page: "The term of office of the chapter members will conform to the time schedule of the state officers."

Page 3. Article VI Section 1. Add at end: "The immediate past president of the NPSO shall serve as an ex-officio member of the Board of Directors for one year following his/her presidency."

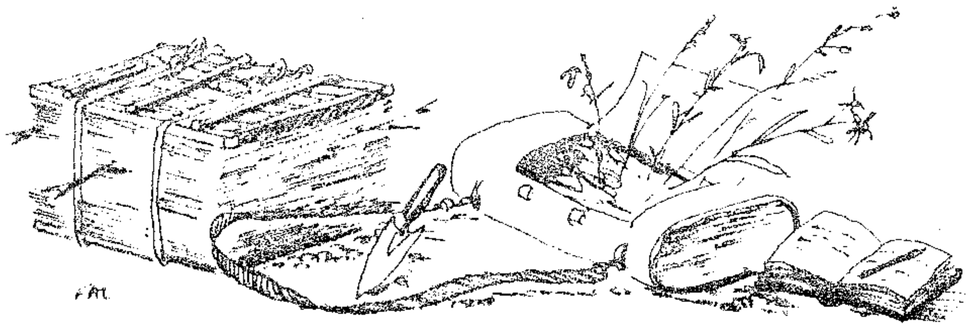
SEE NEPAL NEXT SPRING!

Don't forget, the Folkways International Nepal Natural History Trek is a great way to see Nepal's floral beauty and at the same time help out NPSO. Naturalist will be Ruth Hansen, NPSO Past President. And $100 of the cost goes to NPSO.

DATES: April 5-26, 1980 - - 22 days total, 12 days trekking
Naturalist leader: Ruth Hansen
Trek leader: David Christopher
Land Cost: $1,150.00 ($100 goes to NPSO)
Airfare: $1,367.00 (from San Francisco and subject to change).

Description - - Spring in Nepal: the forests of rhododendron cover the hillsides with hues of red, pink, and white blossoms. Our trekking route will abound in Primula, orchids, and Berberis as well as the cultivated terraced fields of the Nepalese. Our trail follows the Bhote Kosi River which happens to be along the migration route for many species of birds. Our foreground will be fir, hemlock and bamboo as we move toward the 12,500 foot pass and the view of the Langtang, Gosainkund and Ganesh ranges. Our trek naturalist will be fielding questions and pointing out many of the natural wonders of the area.

For information and to reserve your place on the trek, contact: Folkways International Trekking, Inc., 14903 S.E. Linden Lane, Milwaukie, OR 97222. Phone: (503) 653-5882.



BOTANICAL PIONEERS

(Editors' Note: We are pleased to begin a series of articles on early botanists with this piece by Mariana Bornholdt on W.D. Brackenridge. We hope these articles will give historical perspective to NPSO botanizing and conservation activities. Your comments and requests are, as always, most welcome.)

W. D. Brackenridge: Assistant Botanist of the Wilkes Expedition
by Mariana D. Bornholdt

William Dunlop Brackenridge (1810-1893) was born in Ayr, Scotland, and received training as a gardener in Edinburgh and on the continent in Poland and Berlin. Coming to America in 1837, he secured employment with Robert Buist, a commercial florist in Philadelphia, then the intellectual capital of the United States. The following year, Brackenridge was selected to replace Asa Gray, the eminent author of Elements of Botany (1836), as Assistant Horticulturist on the United States Exploring Expedition, commissioned by Congress in 1836 to examine and survey the South Seas and the Pacific.

Also known as the Wilkes Expedition, for its leader, Commander Charles Wilkes, U.S. Navy, this enterprise was one of the most ambitious, and expensive, national undertakings of the American midcentury. Constituting an intellectual declaration of independence, as it were, the purpose of the expedition was to establish America as a full partner with European nations in the development of world science. Consequently, the original plan emphasized American participation and American authorship of all related publications. This resulted in appointment of some incompetents, such as William Rich, "Botanist", so described by Gray in a letter to Hooker. It also was later to deny recognition to foreign participants, such as Brackenridge, and frustrate many of the American scientists who participated, as well.

Under Wilkes' command, two sloops of war, the Vincennes and the Peacock, set out with four support ships from the East Coast in 1838. They arrived in the Pacific Northwest off of Cape Disappointment in May of 1841, by way of Cape Horn, the Antarctic, and Hawaii. Other "scientific gentlemen" aboard included Charles Pickering, "Naturalist"; Titian Ramsey Peale, "Naturalist", mineralogist James D. Dana; and an "Artist", Alfred T. Agate, "particularly engaged in making drawings of living plants".

The United States Exploring Expedition, or "Cruise", as Wilkes called it, took five years, most of which was spent exploring the Pacific Ocean, including a 1000 mile cruise of the Antarctic Coastline. Under Wilkes' command, the Wilkes remained in the Pacific Northwest six months, putting in at Fort Nisqually, near the present site of Tacoma in Puget Sound, Fort Vancouver on the Columbia, and San Francisco Bay, before returning to the East Coast with his two remaining vessels. During this time, three land parties to explore the interior were detailed by Wilkes, in addition to one undertaken to Fort Vancouver led by Wilkes himself. Brackenridge, alone of the scientific personnel, accompanied all three detached parties, collecting seeds and plant specimens and keeping a daily botanical journal.

The importance of botanical exploration to the expedition is underscored by the magnitude of the collection brought home. Over 10,000 species of plants were collected and more than 50,000 specimens, including over 100 living plants, as well as innumerable seeds and bulbs. A total of 1218 specimens were collected in Oregon and 519 from California, most of them by Brackenridge.

The first excursion, from May 17 to July 15, 1841, crossed the Cascades north of Mt. Rainier and explored eastward as far as Walla Walla, Washington.

The second excursion, from July 19 to August 31, 1841, explored western Washington south to Fort Vancouver.

The third excursion, September 2 to October 28, travelled up the Willamette Valley, crossed the Umpqua River, and traversed the Siskiyou Mountains. The party sighted Mt. Shasta on September 29. Then they continued south to the Sacramento River. It was somewhere in the "California Mountains" that Brackenridge discovered a new species of "Sarracenia," later renamed Darlingtonia californica, the California pitcher-plant. The party finally reached Yerba Buena on October 28, 1841, and the waiting boats from the ship. The Vincennes and the Peacock, all that remained of Wilkes' command, thereupon set sail for home, arriving on the East Coast in 1842.

U.S. Navy established the western boundary of the Army's overland expedition of 1843-44, led by topographer John Charles Fremont and antedates Fremont's ascent of the Sacramento River valley in early 1846. Menzies, Douglas, and Tolmie had explored the lower Puget Sound area before Pickering and Brackenridge, but they did so as foreign observers. The trail east along the Columbia had been tramped by botanists many times before Pickering and Brackenridge, but they were the first to botanize the mountains north and east of Mount Rainier, the upper reaches of the Columbia basin, the Wallowas of eastern Oregon, and the Yakima Valley. Brackenridge had been preceded by Douglas along the Chehalis River, but not on its headwaters nor on the sandspit west of Willapa Bay. Douglas, Brackenridge and Burke botanized the Willamette Valley in that order, with Brackenridge the first botanist to continue south through the Siskiyous into northern California. Hinds had preceded him in the Sacramento area, but Brackenridge was again the first field botanist in the upper San Joaquin-Santa Clara Valley area.

As "Horticulturalist and Assistant-Botanist", Brackenridge served the Expedition both as its fern specialist and as its North American field botanist. His journals were the principal sources used by Wilkes in those parts of his Narrative dealing with the land explorations.

Brackenridge also persuaded the National Institution for The Promotion of Science in Washington to establish an experimental garden for the growth, propagation, and display of the many seeds, bulbs and living specimens he and Pickering had gathered. Beginning as a greenhouse thirty feet long behind the U.S. Patent Office, under Brackenridge's superintendance, the collection thrived. A fenced half acre was added; later, the hothouse greatly enlarged. Thus began the U. S. Botanical Garden. Brackenridge's success led also to the founding of the U.S.D.A. and its Plant Introduction Office, as well as to the Congressional Free Seed Distribution Program.

In the end, though complete official scientific reports of the Expedition were scheduled to be published in twenty four volumes at government expense with wide distribution, these goals were not realized. Although Wilkes' own five volume account appeared promptly in 1844, together with an atlas, only twenty of the scientific volumes were published, the last in 1874, thirty two years after the Expedition.

Brackenridge's own Journal manuscripts rest today in the archives of the Maryland Historical Society. Two transcript portions have been published:

Sperlin, O.B. Editor. Our First Official Horticulturist The Brackenridge Journal. Washington Historical Quarterly 1930-31 (Five installments)

Covers the period from April 28, 1841 when the expedition hove to off Cape Disappointment to October 2, 1841, when the third land party crossed into what is now California.

Maloney, Alice Bay. Journal of William Dunlop Brackenridge. California Historical Society Quarterly, 1945.

Begins October 1, 1841 when the party reached California and ends October 28, 1841, when the party arrived at the Bay of San Francisco. Also includes "An Account and List of the Plants in the Brackenridge Journal" by Alice Eastwood, with her determination of the plants mentioned by Brackenridge.

As for Brackenridge himself, little is recorded by his contemporaries. He obviously was of great energy and stamina, rather quiet and without personal idiosyncracies. He was held in high esteem by Asa Gray, longtime dean of American botanists, who named the genus Brackenridgea for him. He worked closely and amicably over the years with John Torrey, who edited the early Expedition scientific monographs. Brackenridge resisted the efforts of contemporary biographers to learn personal details about him and evidently remained a lifelong bachelor. In 1855 at the age of 45, he bought a farm near Baltimore, Maryland, where he spent the remaining years of his life. He also served for several years as the Horticultural Editor of the American Farmer.

The significance of the Wilkes expedition to American science is attested by its literature. In 1942, Haskell compiled a bibliography of 188 pages, with many twentieth century citations. There is less agreement concerning the purpose of the Expedition. Some say it was, as publicized, undertaken for purely scientific purposes. Others claim that both the Wilkes and the Fremont expeditions were war reconnaisance-intelligence forays. Still others suggest that both expeditions were to assess the routes for American settlement and the potential of land beyond the boundaries of the Louisiana purchase. And, it even has been argued that the Wilkes expedition was primarily for the benefit of the American whaling industry. In any event, the glory was for the U.S. Navy and Wilkes. Outside the tight-knit scientific community centering in Philadelphia and the nation's capital, recognition for men like Brackenridge, who might have made their professional fortune through timely publication, was denied.

DISCOVER THE TRAILS OF OREGON CAVES

If you haven't yet visited Oregon Caves National Monument near Cave Junction, you have missed a treat. Both the cave and the surrounding mountains are rewarding. A maintained and marked system of trails provides access to the park and the adjoining Siskiyou National Forest.

Although the "Marble Halls of Oregon" are the focus of attention in the park, one can also enjoy beautiful virgin forests and a variety of interesting mammals and birds.

The cave is located within a natural transition between two mountainside forest types. At elevations below about 1,200 meters (4,000 feet) grows a mixed forest of broadleaf and conifer trees. Here tall Douglas-firs and a few pines tower above low broadleaf trees and shrubs. The latter include tanoak, prickly-leaved canyon live oak, orange-barked Pacific madrone, golden chinkapin (named for the mustard-colored under-surfaces of its narrow leaves), and purplish-stemmed shrubs of manzanita. Higher than about 1,200 meters, an all-conifer forest grows. Here one may stand among huge Douglas-firs -- many with trunks 1-2 meters (3-6 feet) thick -- as well as graceful, silent stands of white fir, Port Orford-cedar, and incense-cedar. The large old Douglas-firs all bear fire-blackened trunks, a reminder that wildfire has been a natural part of the forest for thousands of years.

Largest known three in the park is Big Tree, a grand old Douglas-fir measuring 12.5 feet in diameter and perhaps 1,200 - 1,500 years old. See it along the 3-mile Big Tree Trail.

Common wildflowers include trillium, vanilla-leaf, starflower, redwood violet, modest whipplea, and twinflower. The holly-like leaves of dwarf Oregon grape are also common. Ferns include swordfern and bracken fern. Mosses and alumroot grow profusely around the cave opening and on damp cliffs and rocks along the trails. Lichens, clinging to branches and trunks, give many trees a hairy appearance.

September and October are especially nice months to hike the trails of Oregon Caves National Monument.

(Adapted from Oregon Caves, the official National Park Service visitor leaflet.)

CHAPTER CALENDARS

PORTLAND CHAPTER

Meetings

Sat., Nov. 12, J. E. Edstrom, Speaker. Mr. Edstrom, an experienced and competent botany instructor at local community colleges, will tell us about flowering plants on Mt. Rainier and show us many of his excellent slides taken on two field trips this past summer, one a featured field trip of our chapter.

Mon., Dec. 10. Glenn Walthall, Speaker. Glenn is a biology teacher at Sunset High School, a frequent speaker on natural history subjects, and a competent authority on local fungi and bryophytes. Subject of his presentation will be "Fungi and Friends of Tryon Creek."

Field Trips

Sat., Nov. 3. Mushrooms on the Salmon River Trail. Keith Warren, leader. Meet 8:30 a.m. State Motor Vehicle Dept. parking lot, N.E. 60th and Glisan; or Zig Zag Ranger Station, 9:30 a.m.

Sat., Nov. 10. Audubon Sanctuary. Glenn Walthall, leader. Meet 9:30 a.m. at Audubon House, N.W. Cornell Road. We'll be looking at the likes of Myxomycetes so you'll want a hand lens. No dogs please.

Other Saturdays open. Call Shep Wilson 228-7823 or Joyce Beeman 639-3353 to see if an impromptu trip may be arranged.

WILLAMETTE VALLEY CHAPTER

Meetings

Mon., Nov. 19, 7:30 p.m. in the Carrier Room of the First United Methodist Church, State and Church Street, Salem. Program: "Taxonomy, an Art or Science?" presented by Dr. Kenton Chambers, Department of Botany, Oregon State University.

Field Trip

Sat., Nov. 10. Bagby Hot Springs, lichens, Corinne Sherton, leader. It's a short, easy walk of 1 1/2 miles into the cabin and from there another 1/2 mile to see all of the lichens. If you want to dip your feet into Bagby's hot water, bring your towel along. Also, bring your lunch. Round trip driving distance about 175 miles.

SISKIYOU CHAPTER

Meetings

Thurs. Nov. 1. Forest Diseases and their Wildflower Hosts, Andy Kier, speaker. Andy has been doing research on this topic for the U. S. Forest Service.

Thurs., Dec. 6. How Plants Work Inside, Dr. Ron Nitsos of the SOSC Biology Dept., speaker. Physiology, anatomy of plants.

Both meetings are in Rm. 171, Science Building, SOSC Campus, 7:30 p.m.

Field Trips

Sat. Nov. 3. Fall Colors, Upper Rogue River, Gil Plunkett, leader. Meet Ashland Bi-Mart, 8:00 a.m.; or Medford K-Mart 8:30 a.m. Bring lunch and water for all day.

FIELD TRIP REPORTS

PORTLAND CHAPTER

Sat. Sept. 22 -- John Hoffnagle, The Nature Conservancy land steward, led a small but cosmopolitan group of Native Planters and Nature Conservancy members around Cox Island Preserve in the mouth of the Siuslaw River. He supplied a comprehensive plant list and explanation of salt marsh habitat and survival mechanisms.

Dying plant material in the salt marsh is washed over by the tides and enriches the water, which is then fed upon by marine life. This vital link in the food shain is being preserved while dredging and building goes on within sight. The old house is a remnant of an earlier logging industry when a caretaker corralled logs into booms as they floated downriver from the mountains. The house has historic landmark status and funds are being raised for restoration. Some remains of farming is still evident in plants gone wild. The Island is now haven for waterfowl and other birds, but few mammals.

We looked at fleshy Jaumea carnosa and Salicornia virginica, more reminiscent of desert than of marsh plants. Potentilla pacifica was common. The little Glaux maritima puzzled us inlanders for awhile. Lovely Aster chilensis mingled with golden Grindelia intergrifolia. The grasses included Saltgrass, Distichlis spicata and Triglochin maritimum. Also present on the Island are Casmerodius albus (American egret) and Anas acuta (pintail).

Kitsy Snouffer
Sara Barnum

WILLAMETTE VALLEY CHAPTER

Sat. August 11--Canyon Creek Meadows at the foot of 3 Fingered Jack was explored by five eager members and two guests of the Willamette Valley Chapter. The day began with a pink flowered Penstemon procerus to greet us. Also in that area was a Haplopappus species and Ceanothus velutinus. Along the way we saw Erigeron aliceae, Senecio triangularis, Potentilla flabellifolia and P. breweri, Saxifraga tolmiei and S. ferruginea, Cassiope mertensiana, Phyllodoce empetriformis, Silene douglasii, Oxyria digynia, Phacelia hastata var. leucophylla, Luetkea pectinata.

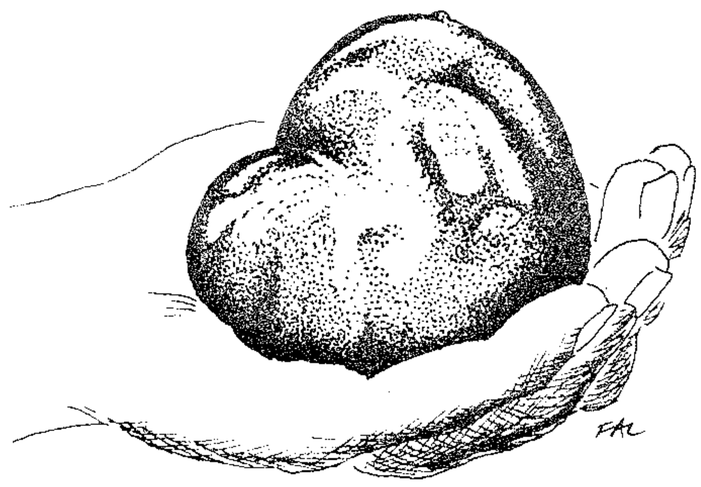
SISKIYOU CHAPTER

Sat. October 6--About a dozen members of the Siskiyou Chapter enjoyed a pleasant Fall day in quest of the unusal algae Nostoc amplissimum, the amazing "Mare's eggs" at Mares Egg Spring on the West side of the Klamath Basin. The spring is not far from Fort Klamath and a few miles south of Crater Lake.

Mares eggs are a colonial blue green algae that covers the bottom of the cold spring like cobbles in a cobble stone street. They range in size from microscopic to more than a foot across with a thin papery covering and a gelatinous center. The most complete account of Mares eggs is in the 22 October 1967 issue of the Portland Oregonian's Northwest Magazine by the late Art Chipman of Medford.

The trip started at Ashland, headed up the Dead Indian Road with a brief stop at the Hollenbeck Environmental Study area, then on the Mares Egg Springs with several quick stops along the very dry Klamath Marsh. We lunched at Mares Egg Springs and then drove on to Collier State Park on the Williamson River north of Chiloquin. There we enjoyed a look at their extensive collection of old logging paraphenalia. Fall was evident in the yellows and oranges of the quaking aspens.

FAL



A handful of Mares Egg

WELCOME TO NEW MEMBERS

Emerald Chapter
- Mary B. Warner, Eugene
- Alan Dickman, Eugene
- Michael Kaminski, Eugene

Portland Chapter
- Lawrence K. Purchase, Portland

Siskiyou Chapter
- Kathy A. Adams, Medford

BEGINNER'S BOTANY

The Miracle of a Tree.

The parts of a tree and how they work, silently and usually invisibly, are almost miraculuous. We need now and then to remember and consider these processes to keep alive our own sense of wonder. It is also worth our while to share this wonder with children and adults; perhaps in this way we can help others understand why we care so much about the welfare of Oregon's flora.

A tree is anchored in the ground permanently. Its roots hold it firmly to the earth. Unlike animals, trees are committed to the site they have "chosen," and cannot take shelter in a storm or seek waterholes during drought. But roots do much more than provide a firm grip. They also transport water and mineral nutrients from the soil upward to the rest of the tree. Tiny root hairs, tubular in form, interface between soil and root. The roots are also often assisted in absorbing nutrients by root fungi, called mycorrhizae.

Between the roots and the tree's crown runs a connecting conduit, the trunk. The trunk holds the leaves aloft in the sun, helps store water and waste products and to some degree holds the leaves out of reach of hungry animals.

In the core of the trunk is the heartwood, often dark in color. Former sapwood, the heartwood serves mostly as a rigid support for the tree. Surrounding it is the sapwood (xylem) that carries water and nutrients up from the roots to the leaves. The sapwood is often light in color.

A layer of cells, called the cambium, separates the sapwood from the bark. Here in the cambium, active cell growth builds up new sapwood, in one direction, and inner bark, in the other direction. This is the only area where growth of the trunk takes place. Growth is outward, not upward. The bark must crack and split to accomodate this growth, hence the heavy furrows in the bark of older trees.

Down through the inner bark (phloem) flows sugar from the leaves to feed the trunk and roots. (Thus, stripping the bark from a tree kills it by starving the roots and trunk.) And wrapped around the outside of the tree is its coat of outer bark, the coarse covering which we can see. This barrier, sometimes several inches thick, protects the tree from invasions of insects and disease, from excessive heat, cold, and desiccation, and from injuries such as falling trees, sliding snow crusts, and wildfire.

The trunk supports the crown, which consists of branches, twigs, leaves, flowers, and fruits. The tree increases its height and spread by adding growth to the ends of twigs in the crown. This growth comes from young cells produced in buds.

The crown manufactures the food needed by the tree for growth and maintenance. This food-making process, called photosynthesis, takes place primarily in the leaves (broadleaves or needleleaves), but also in green twigs, green bracts, and other green tissues. Wholly unlike animals, trees need not capture other organisms to assuage their hunger. Indeed, the tree supplies food for other organisms, making them, and all other green plants, the most important chemical factories in the world. Without their basic product, sugar, there would be no food for humans or animals, no humus for the soil, no coal for fuel, no oxygen for air-breathers, and of course, no wood and wood-derived chemicals.

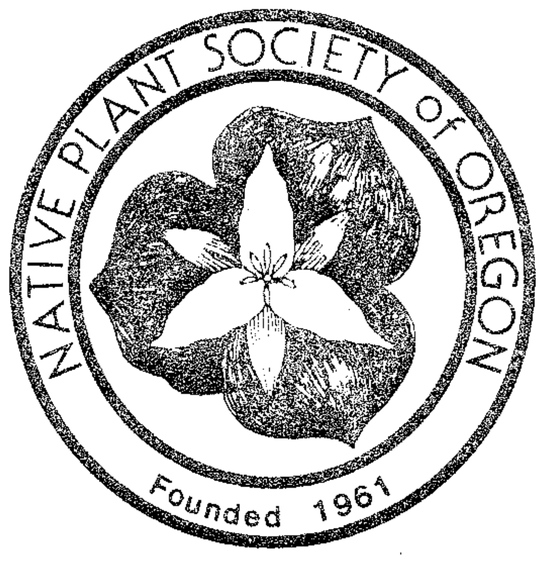
Inside each leaf, millions of green-colored microscopic particles, called chloroplasts, manufacture sugar. They trap radiant energy from sunlight to power this amazing process. Their raw materials are nonliving substances: carbon dioxide gas from the air; water and minerals from the soil. Oxygen, a by-product, is released to the environment where it is needed by air-breathing organisms.

And what happens to the sugar that trees manufacture? With the aid of chemical activators, called enzymes, every living cell in the tree -- from root tips to crown top -- goes to work on the sugar. New products result. Each enzyme does a certain job, working with split-second timing and in harmony with the others. In general, enzymes break down the sugar and recombine it with nitrogen and minerals from the soil to form other substances such as starches, fats, oils, and proteins, all of which are needed for the growth of flowers, fruits, cones, seeds, defensive chemicals (such as poisons and waxes), wood and bark. Some of these products are consumed by animals, thereby serving as a base for the whole ecosystem, including humans.

In smaller green plants -- the shrubs, herbaceous plants, algae, etc. -- much the same processes are silently and invisibly at work, although wood may not be formed and the plants' internal organization may be different. Perhaps the most amazing feature of all is that plants do these things without benefit of a centralized nervous system -- brain and spinal cord -- so important to chordate animals. They perform their miracles of chemistry without even "thinking" about it. But then, so do our own bodies. The difference is that trees and other plants provide the initial step: the production of sugar through photosynthesis.

by Vern Crawford

(freely adapted from a publication by the U.S. Forest Service)



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