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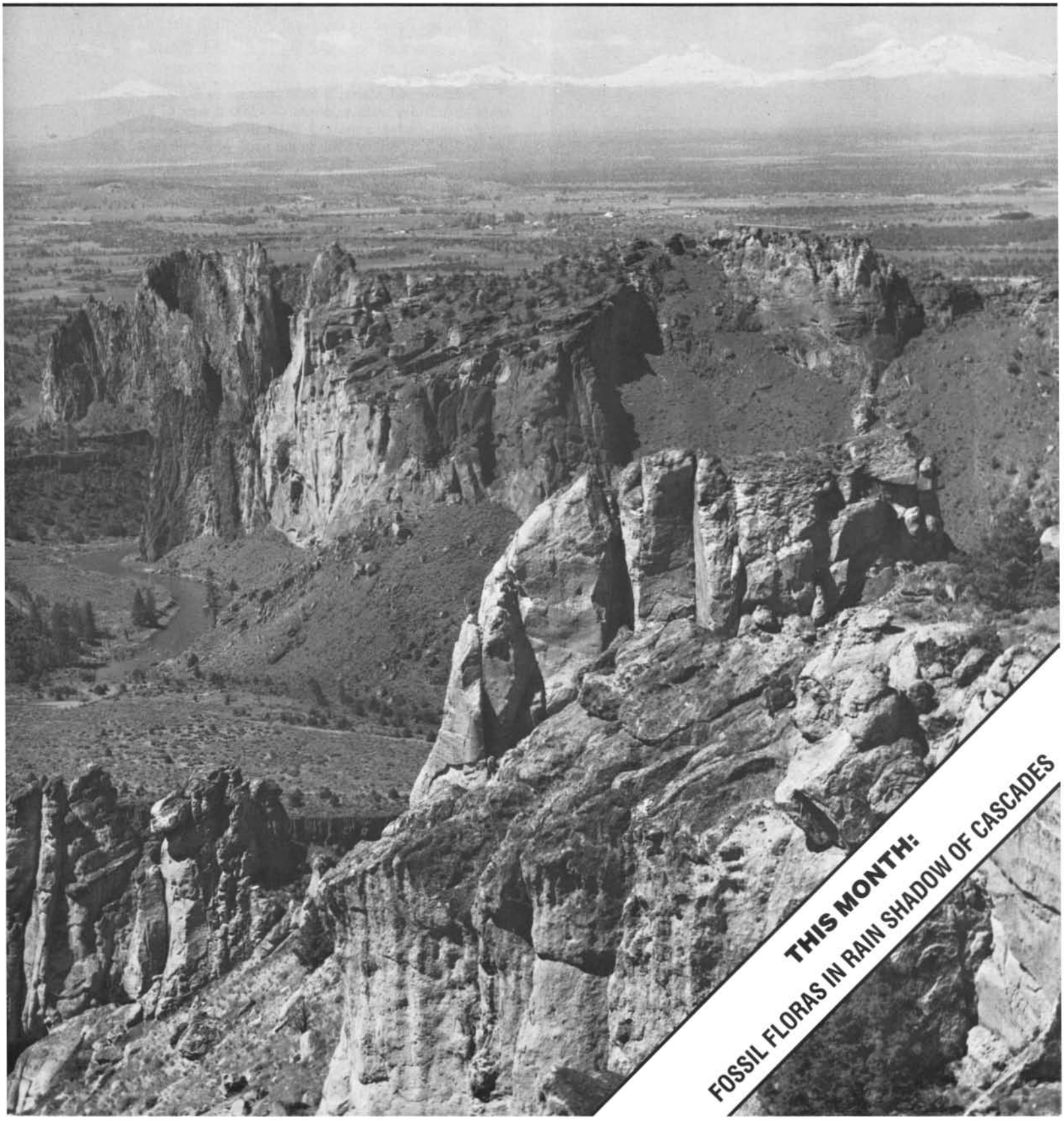

THIS MONTH:
FOSSIL FLORAS IN RAIN SHADOW OF CASCADES

OREGON GEOLOGY

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COVER PHOTO

Smith Rock, central Oregon. Fossils found near this point document developing rain shadow effect as Cascade Mountain Range in background was forming. Photo courtesy Oregon State Highway Division.

OIL AND GAS NEWS

Clackamas County exploration

After nearly 75 years, Clackamas County will see oil and gas exploration again. A 1,200-ft well drilled in 1910 north of Oregon City was the last well drilled for hydrocarbons in the county. Now, RH Exploration of Portland has applied for permits to drill three locations near Molalla (table below). The wells are planned for 3,500 to 4,000 ft. The nearest existing wells are Humble, Wicks 1 (7,797 ft) and Reichhold Bagdanoff (6,005 ft) in Marion County. Both are about 12 mi from the proposed RH locations.

Douglas County

Hutchins and Marrs, a local operator in Douglas County, plans to drill five wells to depths of 4,000 ft west of Roseburg. Nearby wells include a well to 3,693 ft, drilled 5 mi to the east, and one to 7,002 ft, drilled 9 mi to the north of the proposed sites. Drilling may commence this fall as soon as a contractor is obtained.

Columbia County

Reichhold Energy Corporation plans to resume drilling this fall in the Mist Gas Field area. The company has submitted applications to drill for five new locations (table below). These wells will seek new pools in the Clark and Wilson sand of the Cowlitz Formation.

Recent permits

Permit no.	Operator, well, API number	Location	Status, proposed total depth (ft)
240	RH Exploration Rose 1 005-00002	NE¼ sec. 20 T. 5 S., R. 1 E. Clackamas Co.	Application; 3,500
241	RH Exploration Anderson 1 005-00003	SW¼ sec. 29 T. 5 S., R. 1 E. Clackamas Co.	Application; 3,500
242	RH Exploration Rose 2 005-00004	SW¼ sec. 20 T. 5 S., R. 1 E. Clackamas Co.	Application; 4,000
243	Reichhold Energy Corp. Investment Management 21-20 009-00117	NW¼ sec. 20 T. 6 N., R. 4 W. Columbia County	Location; 2,500
244	Hutchins & Marrs Lord's Will 1 019-00018	SW¼ sec. 3 T. 27 S., R. 7 W. Douglas County	Application; 4,000
245	Hutchins & Marrs Lord's Will 2 019-00019	SE¼ sec. 34 T. 26 S., R. 7 W. Douglas County	Application; 4,000
246	Hutchins & Marrs Lord's Will 3 019-00020	NE¼ sec. 3 T. 27 S., R. 7 W. Douglas County	Application; 4,000

(Continued on page 114, **Recent permits***)*

CONTENTS

Seven fossil floras in the rain shadow of the Cascade Mountains, Oregon

by Melvin Ashwill, 940 SW Dover Lane, Madras, Oregon 97741

This paper represents a progress report of work on fossil flora found just east of the Cascade Range in Oregon. The plants of seven fossil floras (Table 1), selected from a number in the Madras, Oregon, area (Figure 1), give some indication of changes in climate from late Eocene time to early Pliocene time. Since all of the floras are found immediately east of the Cascade Range, it is thought they may help to document the "rain shadow" effect of the growing mountain range.

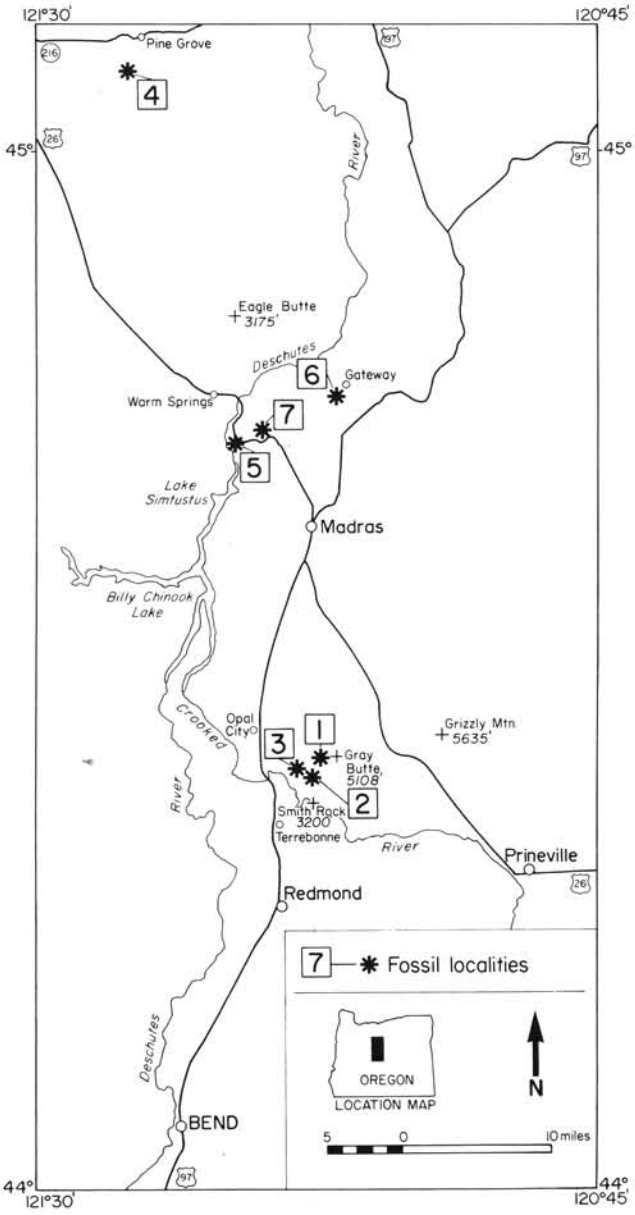


Figure 1. Map showing area of central Oregon discussed in this paper. Numbers indicate locations where the following fossil floras are found: 1. Sumner Spring flora; 2. Nichols Spring flora; 3. Canal flora; 4. Foreman Point flora; 5. Pelton flora; 6. Vibbert flora; and 7. Deschutes flora.

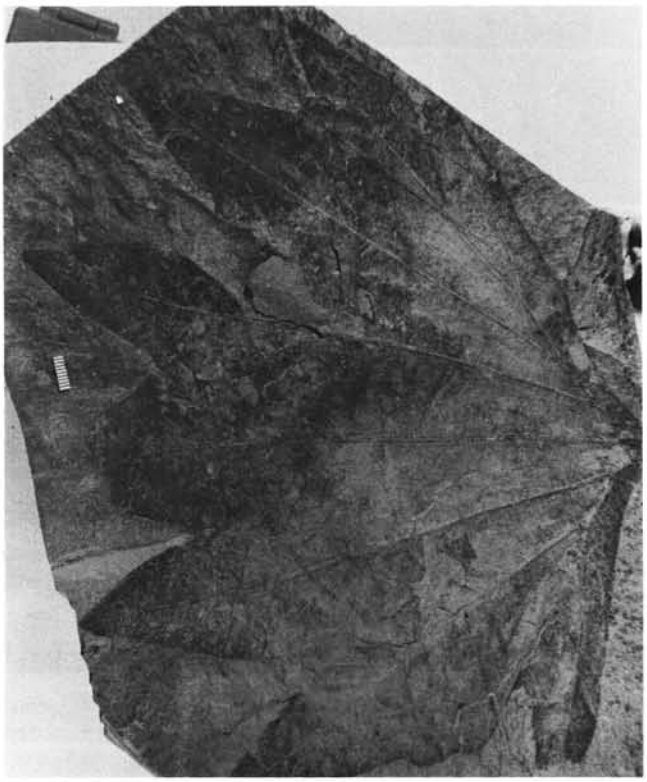
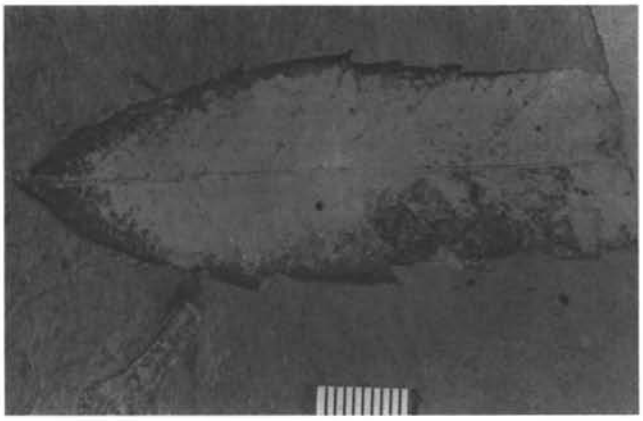


Figure 2. Platanophyllum whitneyi *(Lesquereux) MacGinitie (sycamore), Sumner Spring flora, late Eocene or early Oligocene age. Scale in millimeters.*

It is known that the change of climate in central and eastern Oregon from the Eocene moist subtropical conditions to the harsher semiarid environment found there today is partly a response to the hemispheric climatic changes. It is clear, however, that a large part of the change is also due to the developing Cascade Range that acted as a barrier to precipitation. Documentation of the rate of the change in climate remains inadequate because of gaps in the fossil record. Some recently discovered fossil floras near Madras, however, when considered in addition to the classic Deschutes flora of Chaney (1938), are helping to fill those gaps.

These seven sites, all located within a circle with a 39-km radius, range in age from late Eocene to early Pliocene (time scale of Berggren and Van Couvering, 1974). One of the floras is immediately below a basalt flow of the Columbia River Basalt Group, and three other floras lie above basalts of the same group in sediments that accumulated in the valley lying between the developing Cascade Range to the west and the older Ochoco and Blue Mountains to the east. All seven floras are less than 48 km from the summit of the Cascade Range.

The oldest flora considered here is the Sumner Spring flora (Figures 2 and 3), which is found 24 km southeast of Madras (SE¼SE¼ sec. 24, T. 13 S., R. 13 E.). The area includes a florule long known locally and was once visited briefly by Chaney (Vance, 1936). The general area was originally mapped as Clarno Formation (Eocene) by Hodge (1942) and later as John Day Formation



3a△ 3b▽

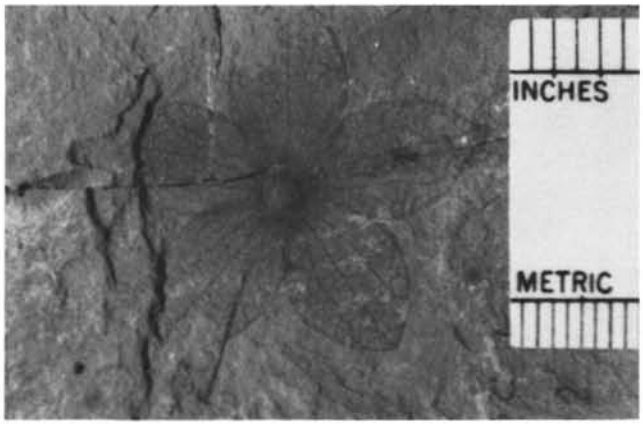


Figure 3. Sumner Spring flora, late Eocene or early Oligocene age: a. Quercus simulata *Knowlton (oak); b. five-petaled flower of* Viburnum palmatum *Chaney and Sanborn (high bush cranberry). Scale of Figure 3a in millimeters, lower edge of scale in Figure 3b in millimeters.*

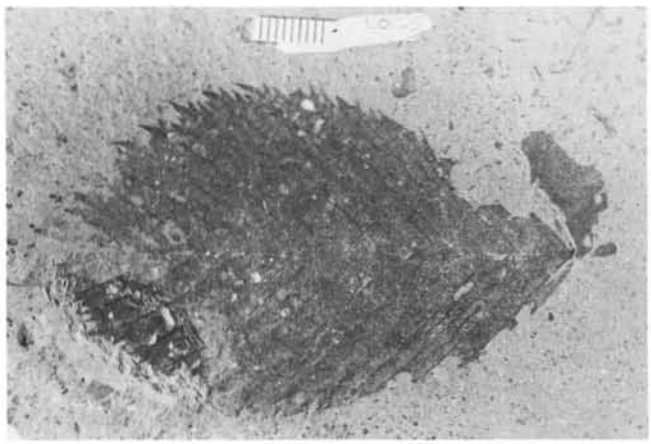
(Oligocene and early Miocene) by Waters (1968). More recent mapping by Robinson and Stensland (1979) indicates that exposures of both the Clarno and John Day Formations are found locally. The site of the Sumner Spring flora is mapped by Robinson and Stensland (1979) as Clarno Formation. Although the writer has no stratigraphic evidence as to the age of the rocks, the floral composition of the fossil assemblage suggests a late Eocene or early Oligocene time of deposition. Leaf margin analysis of a small assemblage suggests a warm, temperate paleoclimate. By far the dominant element in this flora is *Platanophyllum whitneyi* (Lesquereux) MacGinitie, an extinct type of sycamore common in some Eocene floras (Figure 2). The oaks in this flora are the evergreen type, while oaks of later floras here are the deciduous lobed varieties consistent with a change toward more temperate conditions (Figure 3). The presence of the fossil fish *Amyzon*, a member of the sucker family (Cavender, written communication, 1981), confirms that the deposit consists of pond or lake sediments. Negative evidence as to the age of the sediments includes the conspicuous absence of the moisture-loving *Metasequoia*, the so-called "dawn redwood," not common in Eocene floras but abundant in Oligocene floras of central Oregon.

A few kilometers from this flora, a second site (SW¼SW¼ sec. 26, T. 13 S., R. 13 E.) with a different floral assemblage holds the Nichols Spring flora (Figure 4). It appears to be early Oligocene or older in age and includes fruits of the tropical vine *Paleophytocrene* (Figure 4c), an extinct genus of the Icacineae family, as well as lauraceous leaves. Again, *Metasequoia* is not found here.

A third flora located in the same general area (NW¼NE¼ sec. 34, T. 13 S., R. 13 E.) is the Canal flora. The site is mapped as Clarno Formation by Robinson and Stensland (1979) and is 61 m above a brownish saprolite typical of soils near the top of the Clarno Formation. The floral elements here (*Metasequoia*, *Alnus*, *Betula*, *Ulmas*, *Crataegus*, and *Ptelea*) are typical of John Day Formation assemblages in the region. A probable middle Oligocene age is suggested. *Metasequoia* (Figure 5) is the dominant element. In south-central China, where some of these trees are found today (Chu and Cooper, 1950), annual rainfall is 115 cm, the climate is mild, and freezing temperatures are rare. Other trees growing in China today with the *Metasequoia* include the conifer *Cunninghamia*, as well as *Castanea* (chestnut), *Liquidambar* (sweet gum), *Rhus* (sumac), and *Cornus* (dogwood). It should be noted, in contrast, that the present annual rainfall at Madras is about 29 cm.

The modern Cascade Range was not in existence in its present form when the Sumner Spring, Nichols Spring, and Canal floras were flourishing. Although there is some disagreement about details of timing and events, it appears that the expanse between Madras and the ocean strand, then located along the eastern edge of the present Willamette Valley, was not high enough in elevation to greatly modify the interior climate.

Near Pine Grove, the Foreman Point flora is found immediately below a flow of the Columbia River Basalt Group (NE¼NE¼ sec. 2, T. 6 S., R. 11 E.), and the unit is interpreted as uppermost John Day Formation. This level may represent an interval in time during the development of the Cascade Range. Floral constituents include *Salix* (willow), *Alnus* (alder), three species of *Quercus* (oak) (Figure 6), *Ulmus* (elm), and *Platanus* (sycamore). Oaks are dominant in this assemblage. One indication of the trend toward less precipitation is the absence of *Taxodium* (bald cypress) and *Sequoia* (redwood). These two types of trees are abundant in a



4a△ 4b▽ 4c▽

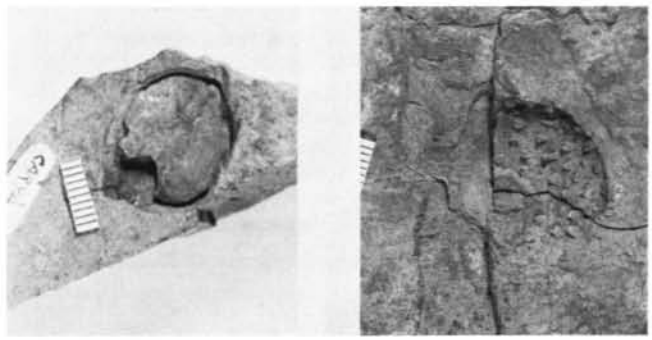


Figure 4. Nichols Spring flora, late Eocene or early Oligocene age: a. Ostrya oregoniana *Chaney (hop hornbeam); b.* Carya *sp. (hickory) fruit; c.* Paleophytocrene *sp. fruit. Scale in millimeters.*

Figure 5. Metasequoia occidentalis *Chaney ("dawn redwood"), Canal flora, Oligocene age. Left edge of scale in millimeters.*

nearby upper John Day flora lying about 152 m below the base of a flow of the Columbia River Basalt Group. In the Blue Mountains to the east, these same genera remained plentiful several millions of years later in the Mascall flora (Chaney and Axelrod, 1959).

Near Pelton Dam on the Deschutes River, 13 km northwest of Madras, the Pelton flora (Figure 7), which is roughly correlative in time with the Blue Mountains flora of eastern Oregon (Chaney and Axelrod, 1959) and the Clarkia flora near Moscow, Idaho (Smiley and Rember, 1979), rests immediately atop the Columbia River Basalt Group (SE¼SE¼ sec. 12, T. 10 S., R. 12 E.). Donald A. Swanson (written communication, 1981) considers the Grande Ronde flows of the Columbia River Basalt Group to be in the neighborhood of 15 to 16 million years old. Steven Reidel (written communication, 1981) reports that Saleem Farooqui, who had the ages determined for several basalt flows in the vicinity, considers the sediments containing the flora to be 13 ± 1 million years old. The flora is thus regarded here as mid-Miocene. Leaves are preserved here in a rolled attitude typical of mudflow entrapment. The flora, consisting, in part, of *Robinia* (locust), *Quercus* (oak) (Figure 7a), and *Crataegus* (hawthorn) (Figure 7b), and lack of the conifers typical of a moist environment suggest a climate that was drier than that of the mountains to the east, where the flora included *Taxodium* (bald cypress), *Picea* (spruce), *Fagus* (beech), and *Sequoia* (redwood). The Foreman Point flora and the Pelton flora together suggest a drier condition in the rain shadow of the Cascade Range than existed farther to the east. Thus, the barrier created by the developing Cascade Range may have already been having some

Figure 6. Quercus dayana *Knowlton (oak), Foreman Point flora, Miocene age. Scale in millimeters.*

Table 1. Plants identified in each of the seven fossil floras

CANAL FLORA
Pteris silvacola Hall (fern)
Polypodiaceae (fern)
Metasequoia occidentalis Chaney (dawn redwood)
Alnus sp. (alder)
Betula sp. (birch)
Ulmus sp. (elm)
Crataegus sp. (hawthorn)
Ptelea sp. (hop tree)
Rosa sp. (rose)

FOREMAN POINT FLORA
Cocculus sp. (moonseed)
Salix sp. (willow)
Salix hesperia Knowlton (willow)
Alnus corrallina Lesquereux (alder)
Quercus dayana Knowlton (oak)
Quercus sp. (oak)
Quercus sp. (black oak)
Ulmus sp. (elm)
Zelkova sp. (keaki tree)
Liquidambar sp. (sweet gum)
Platanus sp. (sycamore)
Acer sp. (maple)

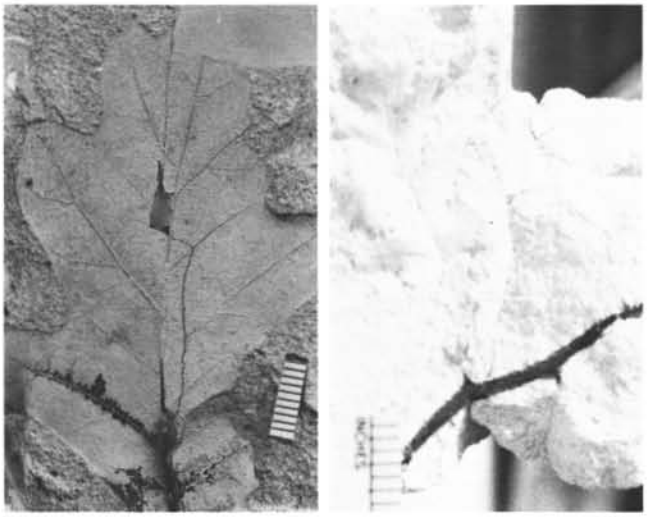
PELTON FLORA
Quercus sp. (oak)
Quercus sp. (black oak)
Ulmus sp. (elm)
Liquidambar sp. (sweet gum)
Platanus sp. (sycamore)
Crataegus sp. (hawthorn)
Acer sp. (maple)
Robinia sp. (locust)

VIBBERT FLORA
Populus sp. (poplar)
Quercus sp. (black oak)
Platanus sp. (sycamore)
Acer sp. (maple)

DESCHUTES FLORA
Populus pliotremuloides Axelrod (quaking aspen)
Populus alexanderi Dorf (cottonwood)
Salix florissanti Knowlton and Cockerell (willow)
Quercus sp. (oak)
Prunus irvingi Chaney (cherry)
Acer negundoides MacGinitie (box elder)

SUMNER SPRING FLORA
Equisetum sp. (horsetail)
Keteleeria sp.
Picea sp. (spruce)
Pinus sp. (pine)
Typha sp. (cattail)
Englehardtia sp. (walnut family)
Quercus simulata Knowlton (oak)
Liquidambar sp. (sweet gum)
Platanus sp. (sycamore)
Platanophyllum whitneyi (Lesquereux) MacGinitie (sycamore)
Ailanthus sp. (tree of heaven)
Acer sp. (maple)
Tetrapteris-like fruits

NICHOLS SPRING FLORA
Cinnamomum sp. (cinnamon)
Salix sp. (willow)
Carya sp. (hickory)
Alnus sp. (alder)
Ostrya oregoniana Chaney (hop hornbeam)
Castanea sp. (chestnut)
Sapindus sp. (soapberry)
Platanus nobilis Newberry (sycamore)
Paleophytocrene sp.



7a△ 7b△

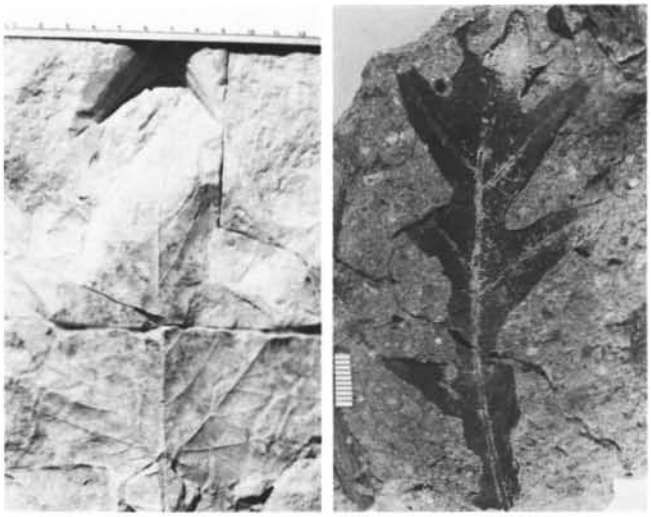
Figure 7. Pelton flora, mid-Miocene age: a. Quercus *sp. (oak), scale in millimeters; b. leaves of* Crataegus *sp. (hawthorn) still attached to silicified stem. Scale in sixteenths of inches.*

effect on the weather by mid-Miocene time.

Somewhat higher in the stratigraphic sequence, a flora (Figure 8) at the Vibbert gravel pit (SE¼SE¼ sec. 19, T. 9 S., R. 14 E.) near Gateway adds a significant chapter to the record. In a study of vertebrate fauna at this site, Cavender and Miller (1972) assign a tentative "mid-Pliocene" age (late Miocene, according to the time scale of Berggren and Van Couvering, 1974). Leaves of *Platanus* (sycamore) (Figure 8a) and two species of *Quercus* (oak) (Figure 8b) extend the known range of these genera considerably later in time than previously documented in the area. These plants, along with large leaves of *Populus* (poplar) and *Acer* (maple), indicate that late Miocene conditions obviously did not approach the present state of aridity in central Oregon.

The final flora to be noted in this paper is the Deschutes flora of Chaney (1938). Fossil localities are about 18 m below the basalt rimrock 10 km northwest of Madras (NW¼NE¼ sec. 8, T. 10 S., R. 13 E.). The age of this flora has been determined to be 4.3 million years (Evernden and James, 1964). As noted in Chaney's study, the assemblage of *Salix* (willow), *Populus* (cottonwood and quaking aspen) (Figure 9), *Prunus* (chokecherry), and *Acer* (box elder) clearly indicates a condition nearing modern semiaridity. To Chaney's floral list for this locality may now be added a lobed form of *Quercus* (oak) recently collected from the bottom layers of the deposit. A newly discovered assemblage called the Rehermann flora lies less than 1 km from the Deschutes flora site and stratigraphically 5.5 m above it. Lithologic and floral similarities in the material from the Rehermann and Deschutes sites suggest that they are correlative. *Alnus* (alder) has been identified in the Rehermann flora and may be added to the list of plants growing there in early Pliocene time. Alder and willow are found today on the banks of the Deschutes River 3 km away.

The snow-capped peaks of the youthful High Cascades rise to heights of 2,379 to 4,395 m above sea level (Harris, 1976). Between the peaks, there are scores of kilometers where the elevation of the skyline is in the range of 1,220 to 1,830 m (Highsmith and Leverenz, 1962). Since the stratovolcanoes of the High Cascades were not present until after the deposition of the seven floras discussed here (Baldwin, 1964; Taylor, 1981), the peaks were not a factor in the paleoclimate affecting the floras. The older portions of the Cascade Range, however, may have begun to affect the Madras area as early as late Miocene time, as shown by the Foreman Point flora.



8a△ 8b△

Figure 8. Vibbert flora, late Miocene age: a. Platanus *sp. (sycamore), scale in both English and SI units; b.* Quercus *sp. (oak), scale in millimeters.*

Many oak trees (*Quercus garryana* Douglas) presently grow at the Foreman Point site, making this genus one of the few represented in every age in central Oregon from the Eocene down to the present, excepting the Pleistocene which awaits documentation. Other persistent genera found in some central Oregon floras through the ages and still growing there today include *Celtis* (hackberry), *Crataegus* (hawthorn), *Alnus* (alder), and *Salix* (willow). *Platanus* (sycamore), although extinct in Oregon now, grew profusely from Eocene time until the time of the late Miocene Vibbert flora. *Acer* (maple) is documented in all ages from Eocene to early Pliocene time (Deschutes flora) but is found locally now only in isolated patches of escaped *Acer negundo* (box elder) or in small islands of *Acer macrophyllum* (big-leaf maple) in canyons that are tributary to the Deschutes River near the base of the Cascade Range. The Pelton flora, several millions of years younger than the Foreman Point flora, reflects a still drier trend. These two floras indicate that the Cascade Range, even in its juvenile stages, was affecting the climate of central Oregon to an unexpected degree. On the other hand, the Vibbert flora shows that enough precipitation still fell in the area in early Miocene time to sustain a healthy growth of *Populus* (poplar), *Platanus* (sycamore), *Quercus* (oak), and *Acer* (maple). The change from a warm, moist, temperate climate to one that is semiarid has been, not surprisingly, a gradual process.

Figure 9. Populus pliotremuloides *Axelrod (quaking aspen), Deschutes flora, early Pliocene age. Scale in millimeters.*

This article on some Tertiary fossil floras in central Oregon is a preliminary report. Future discussions, based on ongoing studies, will include leaf-margin and size analyses and comparisons of floral diversity between localities.

The writer maintains a substantial educational display of central Oregon fossils at his home near Madras. Numerous individuals and several school and summer science camp groups make use of the collection each year. Those readers interested in the display or in precise information on the locations of the fossils discussed in this paper are invited to contact the writer.

ACKNOWLEDGMENTS

Thanks are due to Ted M. Cavender, Ohio State University; Steven Manchester, Indiana University; C.J. Smiley, University of Idaho; William Rember, University of Idaho doctoral candidate; and Howard Schorn, University of California, for their kind help with identifications, and to Harry Phillips, Warm Springs, Oregon, and Daniel and David Rehermann, Madras, discoverers of two of the seven floras. John Gerretson, Roseburg, Oregon, and Michele Vowell, Portland, were of great help with photography. Manuscript review by William Orr, University of Oregon, is appreciated.

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BLM calls for public input on areas of mineral potential

The U.S. Bureau of Land Management (BLM) is inviting recommendations from both the public and industry nominating "Areas of Critical Mineral Potential" (ACMP).

The move stems from President Reagan's April 5, 1982, report to the Congress on his National Materials and Minerals Management Program Plan calling for an invitation to the public to nominate areas of high mineral interest. Nominations will be used to identify areas of critical mineral potential for priority withdrawal review.

Robert F. Burford, director of the BLM, said that information gathered in the process will help to stimulate review of areas presently withdrawn or "off-limits" to energy and mineral entry or development. The nominations will also provide a basis for negotiating access to minerals on public lands withdrawn by other agencies.

Withdrawn areas in Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming can be nominated, except for Indian reservations and other Indian holdings; lands in the National Wildlife Refuge System; and other lands administered by the U.S. Fish and Wildlife Service, National Park System, Wild and Scenic Rivers System, National System of Trails, and designated wilderness areas. Areas within BLM or Forest Service Wilderness Study Areas may be nominated and will be treated as part of the wilderness study program.

Nominations should be in the form of a letter written as specifically as possible and including the following information:

1. Minerals of interest.
2. A map or land description showing the area nominated.
3. A brief statement of the rationale for the nomination, i.e., mineral occurrence or exploration potential.
4. A brief description of the nature and the effect of the withdrawal or segregation, if known.
5. The name, address, and telephone number of a person who may be contacted by BLM to review the nomination.

Geologic maps, cross-sections, and sample analyses may be included. Published literature and reports may be cited in support of the nominations. Any data considered confidential should be appropriately marked. Nominations should be limited to no more than three typewritten pages excluding any maps or bibliographic materials. Send nominations to: Director (690), Bureau of Land Management, 1800 C Street N.W., Washington, D.C. 20240.

After Washington Office review, nominations will be sent to BLM State and District offices for processing. Each party making a nomination will be notified of the action BLM plans to take regarding the nominated area.

If you have any questions or desire further information about the review process or status of your nomination, please call the Division of Mineral Resources, Oregon State Office, (503) 231-6812. □

USGS High-Altitude Photography Program nearly complete for Oregon

The U.S. Geological Survey's high-altitude photography of Oregon is nearing completion. As of July 1, 1983, only the extreme southeastern corner of the state has not been completed. That area includes the Adel and parts of the Burns (east half), Boise, and Jordan Valley (Oregon parts of both) $1° \times 2°$ quadrangles.

For more information, see the announcement on p. 62 in the June issue of *Oregon Geology*. □

DOGAMI sells geologic publications over-the-counter or by mail

Some of our readers may not be aware that as part of its mission to provide geologic and related information to the public, the Oregon Department of Geology and Mineral Industries (DOGAMI) sells a wide variety of geologic publications in the main office in Portland and in the Baker and Grants Pass field offices. Many of the publications summarize our own studies and were published by DOGAMI; others are from other sources but are made available to the public by DOGAMI because the material is related to the geology of Oregon, is timely, and fills a general public demand.

DOGAMI PUBLICATIONS

Available DOGAMI serial publications are listed on the back cover of the magazine as long as a sufficient supply remains available. Because they are printed in rather limited numbers, some go out of print all too quickly. Since Department resources are allocated for the publication of results of current investigations, out-of-print items are usually not reprinted.

The following publications are close to going out of print and should be ordered by interested buyers as soon as possible. The supply of some, in fact, is so low that their names have already been taken off the publication list:

BULLETINS

26. Soil: Its origin, destruction, and preservation (Twenhofel, 1944)	$1.00
60. Engineering geology of the Tualatin Valley region (four maps only, text is out of print) (Schlicker and Deacon, 1967)	4.00
77. Geologic field trips in northern Oregon and southern Washington (GSA field trip guides, 1973)	5.00
79. Environmental geology of inland Tillamook and Clatsop Counties (Beaulieu, 1973)	7.00
83. Eocene stratigraphy of southwestern Oregon (Baldwin, 1974)	4.00
84. Environmental geology of western Linn County (Beaulieu and others, 1974)	9.00
85. Environmental geology of coastal Lane County (Schlicker and others, 1974)	9.00

MAPS

Geologic map of the Albany quadrangle (Allison, 1953)	1.00

MISCELLANEOUS PAPERS

6. Oil and gas exploration in Oregon (Stewart and Newton, 1965)	3.00
16. Mosaic of Oregon from ERTS-1 imagery (1973)	2.50
17. Geologic hazards inventory of the Oregon coastal zone (Beaulieu and others, 1974)	5.00

SHORT PAPERS

2. Industrial aluminum—a brief survey (Motz, 1940)	1.00
18. Radioactive minerals the prospector should know (White and others, 1976)	.75
23. Oregon King mine, Jefferson County (Libbey and Corcoran, 1962)	3.00
26. Rock material resources of Umatilla County (Schlicker and others, 1976)	4.00

DOGAMI periodically releases open-file reports containing such material as geothermal-gradient data, geophysical data, geologic maps, micropaleontological data, bibliographic information, geochemical data, and mineral resource assessments. These reports have not been edited to usual DOGAMI standards but because they are of immediate interest they are released in a preliminary form, often with such signal words as "preliminary" or "reconnaissance" in their titles. A list of the currently available 66 open-file reports is available *free upon request* from the Portland office.

Back copies of the Department's magazine, both the current *Oregon Geology* and its predecessor, the *Ore Bin*, are also for sale.

Clerical assistant Pat Maloney (left) assists a customer in finding the right topographic quadrangle maps.

Single issues of *Oregon Geology* cost $.75 over the counter and $1 mailed; single issues of the *Ore Bin* cost $.50 over-the-counter and $1 mailed. Complete *Ore Bin* volumes (12 issues) are still available for the years 1963, 1966, 1972, 1973, 1974, 1975, 1977, and 1978 and when ordered as a complete set may be purchased at the reduced rate of $3 for each year.

The publication sales staff has assembled a number of packets of still-available back issues of the *Ore Bin* and *Oregon Geology* so that readers interested in specific subjects may, without the need to study indexes or reference lists, buy all still in-print pertinent materials published in the magazine since it was started in 1939. The number of magazines in each packet varies, of course, depending on how many articles were published on a specific subject, but the cost of each packet is roughly half the cost of the magazines if they were purchased individually.

There are three groups of such packets. The first consists of special interest subjects: Mount St. Helens ($3), geothermal exploration and development ($6), fossils ($6.50), oil and gas exploration and development ($3), state parks ($3), coastal geology ($7), meteorites ($3), earthquakes ($3), field trip guides ($5), landslides ($2), caves/lava tubes ($2), and offshore geology (continental shelf, etc.) ($3).

The second group of packets is by location. Areas covered by individual packets include the John Day area ($3.50), Baker County ($3), Wasco and Jefferson Counties ($3), Tillamook and Lincoln Counties ($4), Grant County ($3), Gilliam and Wheeler Counties ($3.50), Clatsop and Columbia Counties ($4), Coos and Douglas Counties ($4), Harney and Malheur Counties ($2.50), Deschutes and Crook Counties ($3), Umatilla/Union/Wallowa Counties ($4), Yamhill/Washington/Multnomah/Clackamas Counties ($4), Jackson and Klamath Counties ($3), Lake County ($3), Lane County ($2), Benton/Marion/Linn Counties ($3), Curry County ($3.50), and Josephine County ($3).

The third group of packets is devoted to minerals. Subjects of packets on metallic minerals and their costs are as follows: gold ($4), chromite/black sands ($2), sulfide ores ($2), copper/silver/nickel ($2), aluminum (bauxite) ($2), platinum/iron/manganese/uranium ($2), and mercury ($1.50). A "superpacket" containing articles on all the metallic minerals costs $15. A superpacket for nonmetallic minerals costs $9, while individual nonmetallic mineral packets cost as follows: marble/limestone/sodium chloride/soapstone/silver/perlite/diatomite/coal ($3), rock materials ($2.50), lightweight aggregate/pumice ($2), and clinoptilolite/cement/carbon dioxide/boron/asbestos ($2). There are also packets for miscellaneous minerals and strategic minerals that sell for $2 each.

Pat fills mail orders every day.

The packets are available by mail or over-the-counter *from the Portland office only*. Readers are reminded that the packets contain only those issues that are still in print. Some of the most popular issues have been out of print for years.

USGS PUBLICATIONS

Most of the non-Department publications available from DOGAMI are those published by the U.S. Geological Survey (USGS). The Portland, Grants Pass, and Baker offices all sell USGS topographic maps over-the-counter and through the mail (folded). The 7½-minute quadrangles (scale 1:24,000) and 15-minute quadrangles (scale 1:62,500) cost $2; the 1° by 2° quadrangles (scale 1:250,000) cost $3.25. Topographic quadrangle indexes of Oregon are available free from DOGAMI or from the USGS, Box 25286, Denver Federal Center, Denver, CO 80225. A topographic map of the entire state (scale 1:500,000) and a planimetric map of the same scale with more cultural features but no topography sell for $3.25 each. Topographic maps of national parks in the Pacific Northwest (Crater Lake, Mount Rainier, North Cascades, and Olympic National Parks) are also available for $3.25 each.

The USGS has also produced many geologic studies based on work done in Oregon. Those sold by DOGAMI are listed below.

A limited number of copies of Bulletin 1119, *The Geology of Portland and Adjacent Areas*, by Trimble (1963), is still available for $5 (number limited to two per order). Geologic quadrangle maps (GQ series) sell for $3 each and are available for the Galice, Portland, Medford, Aldrich Mountain, Monument, and Mt. Vernon quadrangles.

Geologic investigation maps (I series) are available at a variety of prices. Maps I-325 (Oregon west of the 121st meridian) and I-902 (Oregon east of the 121st meridian) each sell for $5. Map I-1091-D (distribution, composition, and age of late Cenozoic volcanism in Oregon and Washington) sells for $3. The rest of the Oregon maps in the I series sell for $2.50 each and cover geology of the following quadrangles: I-457 (west half of Jordan Valley), I-493 (east half of Crescent), I-540 (Eagle Rock), I-541 (Ochoco Reservoir), I-542 (Post), I-543 (Lookout Mountain), I-555 (Madras), I-556 (Dufur), I-568 (east half of Bend), I-727 (Pendleton), I-866 (Waldport and Tidewater), I-867 (Yaquina and Toledo), I-868 (Cape Foulweather and Euchre Mountain), and I-1116 (Oregon part of Grangeville). Other I-series geologic maps selling for $2.50 cover the following areas or subjects: I-587 (tectonic structure of the main part of basalt of the Columbia River Group, Oregon and Washington), I-595 (geologic map of Oregon), I-872 (John Day Formation in the southwest part of the Blue Mountains and adjacent areas), I-1021 (pre-Tertiary rocks in the eastern Aldrich Mountains and adjacent areas to the south), and I-1142 (Smith Rock area).

In addition, the Department sells a rapidly growing number (currently 35) of Miscellaneous Field Studies Maps (MF series). A list of these maps, which cover a variety of subjects including geology, potassium-argon dates, mineral resource assessments, geophysical data, geochemical analyses, and biostratigraphy, is available *free upon request* from DOGAMI.

All of the USGS publications mentioned above are available by mail or over-the-counter from the Portland office of DOGAMI. Field offices carry USGS publications pertaining to their geographical areas only. □

World oil reserves higher than previously estimated

World oil reserves are about 12 percent more than previously reported in petroleum trade journals, a U.S. Geological Survey (USGS) energy expert told the World Petroleum Congress in London recently.

Charles D. Masters estimated world reserves of economically recoverable petroleum at approximately 723 billion barrels of conventional crude oil. He also estimated that there is a 90-percent probability that the amount of oil available for future discovery is between 321 and 1,417 billion barrels, with 550 billion barrels being the most likely amount for future discovery.

The U.S. share of world reserves exceeds 29 billion barrels plus about 80 billion barrels available for future discovery, the USGS scientist said. As an agency of the Department of the Interior, the USGS prepares estimates of mineral and energy resources to aid planning by all levels of government.

In remarks prepared for the London meeting, Masters said the present world production of oil is about 20 billion barrels per year, about twice the discovery rate of 10 to 12 billion barrels of new reserves per year. Thus, at the current rate of production and discovery, the estimate by Masters of 723 billion barrels of reserves plus 550 billion barrels of future potential would be enough to last for about another half-century.

Masters, a geologist at the Survey's National Center in Reston, Virginia, said his estimates were based on a variety of data from national governments, scientific and trade publications, and field files of Petroconsultants, Ltd., a world-wide petroleum data organization. The new estimates were compiled in a study by Masters; David Root, a mathematician with the USGS in Reston; and W.D. Dietzman, a petroleum engineer with the U.S. Energy Information Administration (EIA) in Dallas, Texas.

Data from fields comprising 80 percent of the world's oil reserves were examined, Masters said. Authoritative and comprehensive data on oil are lacking for a few nations, but he and his coauthors are confident their estimates are proportionally and geographically reasonable.

—USGS News release

New mineral display in State Capitol

The mineral display case in the State Capitol in Salem which was donated last year by the Oregon Council of Rock and Mineral Clubs is showing a new collection during September, October, and November. The exhibit was furnished and arranged by members of the Oregon Agate and Mineral Society (see list of the Council's member societies on p. 101 in the last issue of *Oregon Geology*) and consists of specimens of petrified wood from Oregon.

The collection of about two dozen items displays 13 different kinds of petrified wood from eight Oregon counties. Most of the pieces are polished slabs, rounds, and limb ends; one represents a large butterfly with wings made of oak from Crook County and a body of sycamore from Linn County.

The member societies of the Oregon Council of Rock and Mineral Clubs take turns supplying exhibits for the State Capitol display case. Each collection is shown for a period of about three months. □

Gem and mineral show to be held in Portland in October

The 1983 Cascade of Gems, a regional gem and mineral show, will be held October 21-23 at the Multnomah County Exposition Center, 2060 N. Marine Drive, Portland, Oregon. The show will include numerous displays, competitions, dealers, demonstrations, programs, camping, and special opal exhibits.

The doors will be open from 10 a.m. to 9 p.m. on October 21 and 22 and from 10 a.m. to 5 p.m. on October 23. Cost of admittance is $1.50 for adults, $.50 for children from 6 to 12 years of age when accompanied by an adult, and on Friday, October 21, $1 for seniors. □

Address changes

The **American Geological Institute** (AGI) is moving its headquarters, and access to its Datapoint computers, including the GeoRef information system, will be limited until about September 20. Beginning September 16, the new AGI address will be **4220 King Street, Alexandria, VA 22302**. The phone number, which will probably remain unchanged, is (703) 379-2480.

The address of the **Association of Engineering Geologists** (AEG) has been changed to **Box 506, Short Hills, NJ 07078**. And the address for **AEG newsletter editor** and former Portland resident **Richard C. Kent** is now **Box 9291, College Station, TX 77840**, phone (409) 845-3224. □

GSOC luncheon meetings announced

The **Geological Society of the Oregon Country** (GSOC) holds noon meetings in the Standard Plaza Building, 1100 SW Sixth Ave., Portland, OR, in Room A adjacent to the third-floor cafeteria. Upcoming meetings, topics, and speakers:

October 21—*Bicycling through Germany, France, Austria, and Ireland*, by Gerhardt Meng.

November 4—*Wild Flowers of Oregon*, by Vance L. Terrall, M.D., retired.

November 18—*Spring in the Mojave Desert*, by Donald Barr, naturalist.

December 2—GSOC *Grand Tour No. 1: Parks and Monuments of the Southwest*, slide presentations by Al and Ruth Keene, leaders, and Robert Richmond, Donald Parks, Claire Stahl, and Frances Rusche.

For additional information, contact Viola L. Oberson, Luncheon Program Chairwoman, phone (503) 282-3685. □

NWMA course to study precious-metal mines

The Northwest Mining Association (NWMA) has announced a course on the exploration, discovery, and development of five important Western precious-metal mines.

Titled "An In-depth Study of Five New Silver and Gold Mines," the NWMA's Short Course will be held November 28–30 at the Davenport Hotel in Spokane, Washington, preceding the NWMA 89th annual convention, "Domestic Mining—An Era of Change."

The course is designed to provide practical information to those who are interested in any phase of precious-metal development, according to William B. Booth, manager of environmental and public affairs for Sunshine Mining Co. Booth is co-director of the course with George J. Beattie, a consultant and international lecturer on mine management.

The program provides an in-depth look, from concept to closure plan, of Equity Silver Mines, British Columbia; Hecla's Silver Shaft Development, Idaho; Placer Amex's Golden Sunlight Mines, Montana; Ranchers' Escalante Silver Mine, Utah; and Sunshine's 16-to-1 Mine, Nevada.

The total review of these five properties will cover exploration, development, operating, and plans for further development and/or completion of mining.

Booth said the course will provide valuable insight to the prospector; explorationist; mine planner and operator; and mill operator, refiner, engineer, and manager.

Registration is limited. For additional information or registration materials, contact Northwest Mining Association, 633 Peyton Building, Spokane, WA 99201, 509/624-1158. □

USGS provides northern California earthquake information

The U.S. Geological Survey (USGS) Office of Earthquakes, Volcanoes, and Engineering is offering a new service called "Information Update," a recording that gives current information 24 hours a day about earthquakes occurring in northern California. The phone number for Information Update is (415) 327-9164. The information is updated each day, except during periods of high or unusual activity, when it is updated more frequently. □

(**Recent permits**, *continued from page 106*)

Permit no.	Operator, well, API number	Location	Status, proposed total depth (ft)
247	Hutchins & Marrs Glory Hole 1 019-00021	NW¼ sec. 10 T. 27 S., R. 7 W. Douglas County	Application; 4,000
248	Reichhold Energy Corp. Crown Zellerbach 33-26 009-00118	SE¼ sec. 26 T. 6 N., R. 4 W. Columbia County	Application; 4,000
249	Reichhold Energy Corp. Busch 14-15 009-00119	SW¼ sec. 15 T. 6 N., R. 5 W. Columbia County	Application: 2,800
250	Reichhold Energy Corp. Longview Fibre 33-36 009-00120	SE¼ sec. 36 T. 6 N., R. 5 W. Columbia County	Application; 4,000
251	Reichhold Energy Corp. Grimsbo 11-16 009-00121	NW¼ sec. 16 T. 6 N., R. 5 W. Columbia County	Application; 2,600
252	Hutchins & Marrs Great Discovery 1 019-00022	SE¼ sec. 3 T. 27 S., R. 7 W. Douglas County	Application; 4,500 □

Available publications

ORDER FORM – CUT ON DASHED LINE

		Price	No. Copies	Amount
BULLETINS				
33.	Bibliography (1st supplement) geology and mineral resources of Oregon, 1947: Allen	$ 3.00		
35.	Geology of the Dallas and Valsetz quadrangles, rev. 1964: Baldwin (map only)	3.00		
36.	Papers on Tertiary foraminifera: Cushman, Stewart, and Stewart, 1949: v. 2	3.00		
44.	Bibliography (2nd supplement) geology and mineral resources of Oregon, 1953: Steere	3.00		
46.	Ferruginous bauxite deposits, Salem Hills, 1956: Corcoran and Libbey	3.00		
49.	Lode mines, Granite mining district, Grant County, Oregon, 1959: Koch	3.00		
53.	Bibliography (3rd supplement) geology and mineral resources of Oregon, 1962: Steere and Owen	3.00		
61.	Gold and silver in Oregon, 1968: Brooks and Ramp	17.50		
62.	Andesite Conference guidebook, 1968: Dole	3.50		
65.	Proceedings of the Andesite Conference, 1969: (copies)	10.00		
67.	Bibliography (4th supplement) geology and mineral resources of Oregon, 1970: Roberts	3.00		
71.	Geology of selected lava tubes in Bend area, Oregon, 1971: Greeley (copies)	5.00		
77.	Geologic field trips in northern Oregon and southern Washington, 1973	5.00		
78.	Bibliography (5th supplement) geology and mineral resources of Oregon, 1973: Roberts	3.00		
81.	Environmental geology of Lincoln County, 1973: Schlicker and others	9.00		
82.	Geologic hazards of Bull Run Watershed, Multnomah, Clackamas Counties, 1974: Beaulieu	6.50		
83.	Eocene stratigraphy of southwestern Oregon, 1974: Baldwin	4.00		
84.	Environmental geology of western Linn County, 1974: Beaulieu and others	9.00		
85.	Environmental geology of coastal Lane County, 1974: Schlicker and others	9.00		
87.	Environmental geology of western Coos and Douglas Counties, 1975	9.00		
88.	Geology and mineral resources of upper Chetco River drainage, 1975: Ramp	4.00		
89.	Geology and mineral resources of Deschutes County, 1976: Peterson and others	6.50		
90.	Land use geology of western Curry County, 1976: Beaulieu	9.00		
91.	Geologic hazards of parts of northern Hood River, Wasco, and Sherman Counties, Oregon, 1977: Beaulieu	8.00		
92.	Fossils in Oregon (reprinted from *The Ore Bin*), 1977	4.00		
93.	Geology, mineral resources, and rock material of Curry County, Oregon, 1977	7.00		
94.	Land use geology of central Jackson County, Oregon, 1977: Beaulieu	9.00		
95.	North American ophiolites, 1977	7.00		
96.	Magma genesis: AGU Chapman Conference on Partial Melting, 1977	12.50		
97.	Bibliography (6th supplement) geology and mineral resources of Oregon, 1971-75, 1978	3.00		
98.	Geologic hazards of eastern Benton County, Oregon, 1979: Bela	9.00		
99.	Geologic hazards of northwestern Clackamas County, Oregon, 1979: Schlicker and Finlayson	10.00		
100.	Geology and mineral resources of Josephine County, Oregon, 1979: Ramp and Peterson	9.00		
101.	Geologic field trips in western Oregon and southwestern Washington, 1980	9.00		
102.	Bibliography (7th supplement) geology and mineral resources of Oregon, 1976-1979, 1981	4.00		
GEOLOGIC MAPS				
	Reconnaissance geologic map of Lebanon quadrangle, 1956	3.00		
	Geologic map of Bend quadrangle and portion of High Cascade Mountains, 1957	3.00		
	Geologic map of Oregon west of 121st meridian (USGS I-325), 1961	5.00		
	Geologic map of Oregon east of 121st meridian (USGS I-902), 1977	5.00		
GMS-4:	Oregon gravity maps, onshore and offshore, 1967 (folded)	3.00		
GMS-5:	Geologic map of Powers quadrangle, Oregon, 1971	3.00		
GMS-6:	Preliminary report on geology of part of Snake River Canyon, 1974	6.50		
GMS-8:	Complete Bouguer gravity anomaly map, Cascade Mountain Range, central Oregon, 1978	3.00		
GMS-9:	Total field aeromagnetic anomaly map, Cascade Mountain Range, central Oregon, 1978	3.00		
GMS-10:	Low- to intermediate-temperature thermal springs and wells in Oregon, 1978	3.00		
GMS-12:	Geologic map of the Oregon part of the Mineral quadrangle, 1978	3.00		
GMS-13:	Geologic map of the Huntington and part of the Olds Ferry quadrangles, Oregon, 1979	3.00		
GMS-14:	Index to published geologic mapping in Oregon, 1898-1979, 1981	7.00		
GMS-15:	Free-air gravity anomaly map and complete Bouguer gravity anomaly map, Cascade Mountain Range, northern Oregon, 1981	3.00		
GMS-16:	Free-air gravity anomaly map and complete Bouguer gravity anomaly map, Cascade Mountain Range, southern Oregon, 1981	3.00		
GMS-17:	Total-field aeromagnetic anomaly map, Cascade Mountain Range, southern Oregon, 1981	3.00		
GMS-18:	Geology of the Rickreall, Salem West, Monmouth, and Sidney 7½-minute quadrangles, Marion, Polk, and Linn Counties, Oregon, 1981	5.00		
GMS-19:	Geology and gold deposits map of the Bourne quadrangle, Baker and Grant Counties, Oregon, 1982	5.00		
GMS-20:	Map showing geology and geothermal resources of the southern half of the Burns 15-minute quadrangle, Oregon, 1982	5.00		
GMS-21:	Geology and geothermal resources map of the Vale East 7½-minute quadrangle, Oregon, 1982	5.00		
GMS-22:	Geology and mineral resources map of the Mt. Ireland quadrangle, Baker and Grant Counties, Oregon, 1982	5.00		
GMS-23:	Geologic map of the Sheridan quadrangle, Polk and Yamhill Counties, Oregon, 1982	5.00		
GMS-24:	Geologic map of the Grand Ronde quadrangle, Polk and Yamhill Counties, Oregon, 1982	5.00		
NEW! GMS-25:	Geology and gold deposits map of the Granite quadrangle, Baker and Grant Counties, Oregon, 1982	5.00		
GMS-26:	Residual gravity maps of the northern, central, and southern Cascade Range, Oregon, 1982	5.00		
GMS-27:	Geologic and neotectonic evaluation of north-central Oregon: The Dalles 1° by 2° quadrangle, 1982	6.00		
NEW! GMS-28:	Geology and gold deposits map of the Greenhorn quadrangle, Baker and Grant Counties, Oregon, 1983	5.00		
NEW! GMS-29:	Geology and gold deposits map, NE¼ Bates quadrangle, Baker and Grant Counties, Oregon, 1983	5.00		
OIL AND GAS INVESTIGATIONS				
3.	Preliminary identifications of foraminifera, General Petroleum Long Bell #1 well	3.00		
4.	Preliminary identifications of foraminifera, E.M. Warren Coos County 1-7 well, 1973	3.00		
5.	Prospects for natural gas production or underground storage of pipeline gas, upper Nehalem River Basin, Columbia-Clatsop Counties, Oregon, 1976	5.00		
6.	Prospects for oil and gas in the Coos Basin, western Coos, Douglas, and Lane Counties, Oregon, 1980: Newton and others	9.00		
NEW! 7.	Correlation of Cenozoic stratigraphic units of western Oregon and Washington, 1983	8.00		

Available publications (continued)

SPECIAL PAPERS	Price	No. Copies	Amount
1. Mission, goals, and programs of Oregon Department of Geology and Mineral Industries, 1978	3.00	_____	_____
2. Field geology of SW Broken Top quadrangle, Oregon, 1978: Taylor	3.50	_____	_____
3. Rock material resources of Clackamas, Columbia, Multnomah, and Washington Counties, Oregon, 1978: Gray and others	7.00	_____	_____
4. Heat flow of Oregon, 1978: Blackwell, Hull, Bowen, and Steele	3.00	_____	_____
5. Analysis and forecasts of the demand for rock materials in Oregon, 1979: Friedman and others	3.00	_____	_____
6. Geology of the La Grande area, Oregon, 1980: Barrash and others	5.00	_____	_____
7. Pluvial Fort Rock Lake, Lake County, Oregon, 1979: Allison	4.00	_____	_____
8. Geology and geochemistry of the Mt. Hood volcano, 1980: White	3.00	_____	_____
9. Geology of the Breitenbush Hot Springs quadrangle, Oregon, 1980: White	4.00	_____	_____
10. Tectonic rotation of the Oregon Western Cascades, 1980: Magill and Cox	3.00	_____	_____
11. Theses and dissertations on the geology of Oregon: Bibliography and index, 1899-1982, 1982: Neuendorf and others	6.00	_____	_____
12. Geologic linears of the northern part of the Cascade Range, Oregon, 1980: Venkatakrishnan, Bond, and Kauffman	3.00	_____	_____
13. Faults and lineaments of the southern Cascades, Oregon, 1981: Kienle, Nelson, and Lawrence	4.00	_____	_____
14. Geology and geothermal resources of the Mount Hood area, Oregon, 1982: Priest and Vogt	7.00	_____	_____
NEW! 16. Index to the *Ore Bin* (1939-1978) and *Oregon Geology* (1979-1982), 1983: Mahoney and Steere	4.00	_____	_____
SHORT PAPERS			
21. Lightweight aggregate industry in Oregon, 1951: Mason	1.00	_____	_____
24. The Almeda Mine, Josephine County, Oregon, 1967: Libbey	3.00	_____	_____
25. Petrography, type Rattlesnake Formation, central Oregon, 1976: Enlows	3.00	_____	_____
27. Rock material resources of Benton County, 1978: Schlicker and others	4.00	_____	_____
MISCELLANEOUS PAPERS			
1. A description of some Oregon rocks and minerals, 1950: Dole	1.00	_____	_____
5. Oregon's gold placers (reprints), 1954	1.00	_____	_____
8. Available well records of oil and gas exploration in Oregon, rev. 1982: King, Olmstead, and Newton	4.00	_____	_____
11. Collection of articles on meteorites, 1968 (reprints from *The Ore Bin*)	3.00	_____	_____
15. Quicksilver deposits in Oregon, 1971: Brooks	3.00	_____	_____
17. Geologic hazards inventory of the Oregon coastal zone, 1974: Beaulieu, Hughes, and Mathiot	5.00	_____	_____
18. Proceedings of Citizens' Forum on potential future sources of energy, 1975	3.00	_____	_____
19. Geothermal exploration studies in Oregon—1976, 1977	3.00	_____	_____
20. Investigations of nickel in Oregon, 1978: Ramp	5.00	_____	_____
MISCELLANEOUS PUBLICATIONS			
Landforms of Oregon (17 × 12 inches)	1.00	_____	_____
Mining claims (State laws governing quartz and placer claims)	1.00	_____	_____
Geological highway map, Pacific NW region, Oregon-Washington (published by AAPG)	5.00	_____	_____
Geothermal resources of Oregon map, 1982 (published by NOAA)	3.00	_____	_____
Fifth Gold and Money Session and Gold Technical Session Proceedings, 1975	5.00	_____	_____
Sixth Gold and Money Session and Gold Technical Session Proceedings, 1978	6.50	_____	_____
Back issues of *The Ore Bin*	50¢ over the counter; $1.00 mailed	_____	_____
Back issues of *Oregon Geology*	75¢ over the counter; $1.00 mailed	_____	_____
Colored postcard, *Geology of Oregon*	10¢ each; 3 for 25¢; 7 for 50¢; 15 for $1.00	_____	_____
Oregon Landsat mosaic map, 1983 (published by ERSAL, OSU)	$8.00 over the counter; $11.00 mailed	_____	_____

OREGON GEOLOGY

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