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FOSSILIZED PALM WOOD IN OREGON

By Irene Gregory*

Introduction

To geologists, petrified palm wood is a significant material. Its occurrence in the fossil record serves as an indicator of past climates and age of the rocks. To hobbyists, its attractive patterns and ease of identification make it a sought-after species. Since its anatomy is one of the least complicated of fossil plant materials, it is easily recognized; its unique appearance makes it difficult to mistake it for any other species, with the possible exception of certain fossil ferns.

This report is concerned primarily with fossil palm wood; however, since leaves and fruits are also important in the fossil record these parts of the palm are reviewed. In addition, the geologic history of palms and their occurrence as fossils in Oregon is summarized.

Identification of Palm Wood

Paleobotanists in the past have generally assigned petrified palm trunks to Palmoxylon, a genus name designed to include fossil stems with scattered bundles having fibrous caps. Fossilized palm leaves can often be referred to living genera, and there is a trend to apply these names to fossil palm wood also, where warranted. The writer is following the procedure of applying names of living genera to fossil specimens that are sufficiently well preserved to reveal identifiable anatomical structures.

A type of palm present in an assemblage of semi-tropical Eocene woods being investigated by the author is palmetto (Sabal), collected from a small outcropping of the Clarno Formation in Crook County, Oregon. Material for thin sections of the transverse (figure 1 A & B) and longitudinal (figure 2 A & B) views shown was taken from a trunk specimen that was

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* Mrs. James M. Gregory is an authority on fossil woods of Oregon. She is author of "The Fossil Woods near Holley in the Sweet Home Petrified Forest, Linn County, Oregon," which was published in the April 1968 issue of The Ore Bin and is in its second reprinting.

Figure 1-A

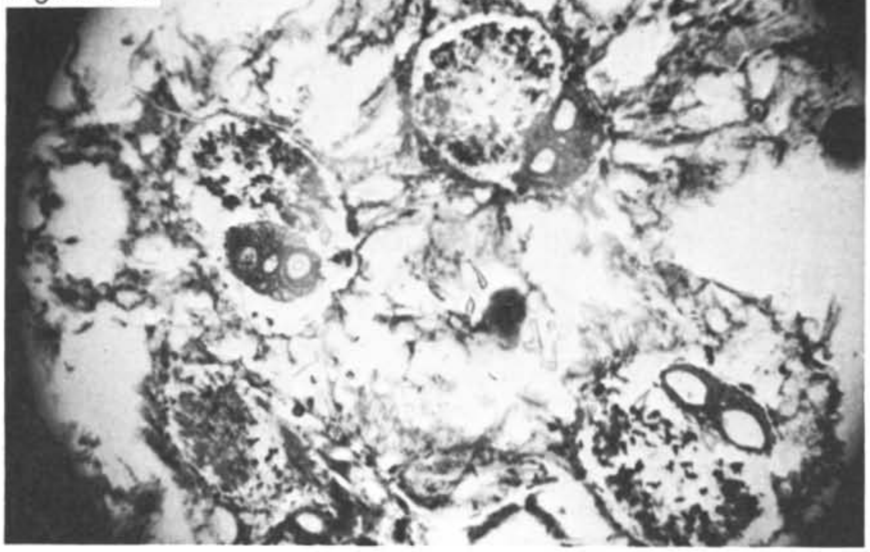
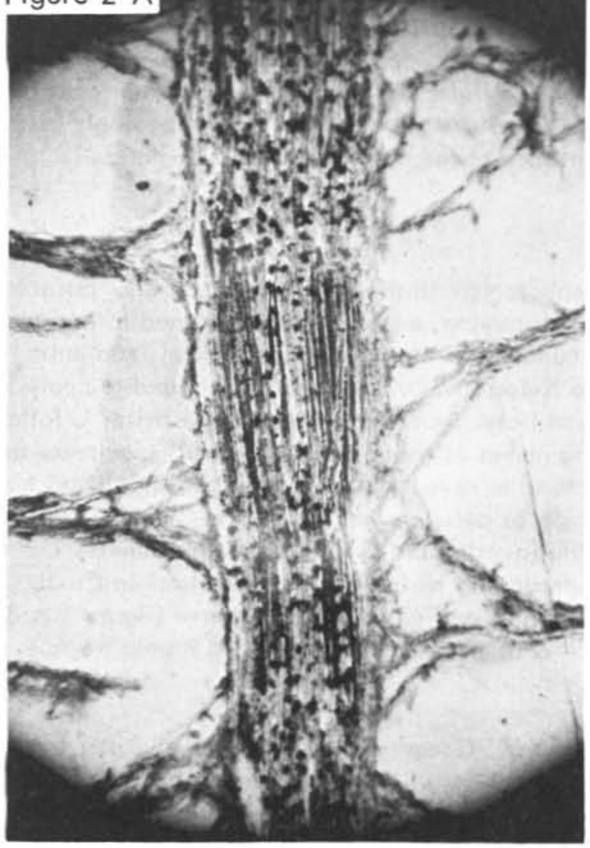


Figure 2-A



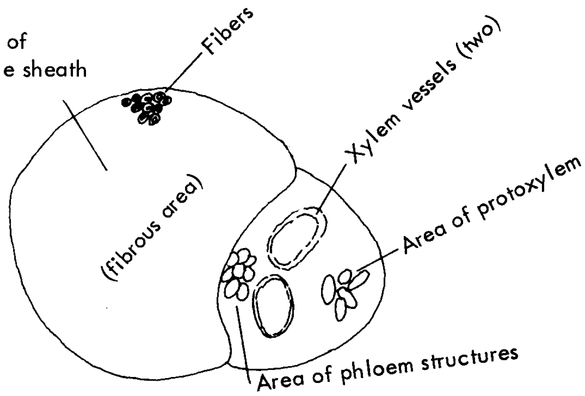


Figure 1-B

Figure 1. Transverse views of Eocene palm wood from Crook County.

A. (opposite page) Photomicrograph 45 X.

B. (above) Sketch showing detail of fibrovascular bundle in upper right portion of figure 1-A. Compression of wood before petrification produced oval shape of xylem vessels, which normally are circular.

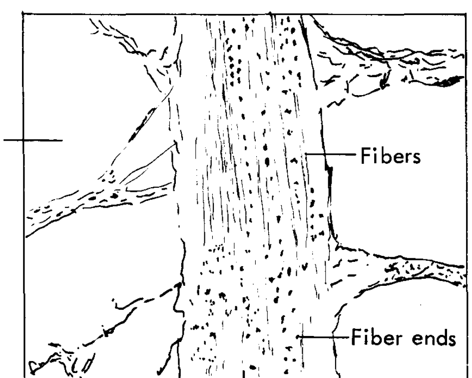


Figure 2-B

Figure 2. Longitudinal views of Eocene palm wood from Crook County.

A. (opposite page) Photomicrograph 45 X.

B. (above) Sketch showing detail of longitudinal view.

approximately 6 inches in diameter during growth, but was compressed to an oval shape by earth pressures before petrification took place. The specimen is silicified, its vascular bundles replaced with blue agate. The remainder appears black, owing to the presence of manganese, but in thin section it is a clear amber color. The unworn condition of this specimen, as well as that of other warm-climate species occurring with it, indicates the probability of its having been petrified in situ. The photomicrographs shown here are thought to be the first published record of the minute anatomy of the wood of a fossil palm from Oregon.

All of the genera, both living and fossil, making up the palm family exhibit similar anatomical structures. Their wood consists of separate fibrovascular bundles scattered in a pith-like background tissue of parenchyma cells. In cross section the parenchyma cells appear thin walled and somewhat hexagonal in shape, and fill all the spaces between the very conspicuous bundles which have prominent fibrous caps (bundle sheaths) (figure 1 A & B). The bundles run longitudinally in the stem and on out into the leaves; in cross section they show as dots or eyes and when cut lengthwise appear to be tubes (figure 2 A & B). The two (possibly three) larger pores in each bundle are xylem vessels; the area between the xylem and the fibrous cap may show phloem structures.

Although the characteristic anatomy of palm results in a distinctive appearance, on casual examination it may be confused with cross-section views of petioles of the fossil fern Acrostichum or portions of Tempskya fern masses in which cut leaf-traces resemble palm eyes.

General Botanical Background of Palms

Palms are considered to be the first angiosperms (flowering plants of today) to appear in the fossil record. Angiosperms include two groups:

1) Dicotyledons - having complicated net-like veining of leaves and producing two leaves (cotyledons) when their seed germinates; they make up most of our flowering plant species of today.

2) Monocotyledons - with but one seed-leaf (cotyledon) and parallel leaf-veining as in grasses, lilies, and palms; they provide the remaining small percentage of angiosperms.

In the fossil plant record, palms are significant as being one of the few monocotyledons to be preserved. Their durable woody nature lends itself to petrification, which is not so with the many other more herb-like plants of this group. Check lists of fossil plants invariably include but few monocotyledons.

Environment

Most palms require a minimum temperature of 42°F. and higher; only a few can adapt to a slight amount of frost. Of the several hundred recognized genera living today, nearly all are inhabitants of the tropics. The few representatives living in the United States are native only to the southern climates. Palmettos grow along the Atlantic Coast from North Carolina to Florida. Other types are limited to the Florida Keys, the area near the mouth of the Rio Grande in Texas, and to southern Arizona, California, and Hawaii. About 2000 species of palms are known today, of which 25 belong to the genus Sabal.

In the fossil record, the association of palm with other tropical species of plants shows that palms of the past had the same temperature needs as exist today, making their presence as fossils conclusive evidence of warm climate. Many of the floras containing palm leaves are associated with coal beds, signifying a swampy environment.

Stems (trunks)

Living palms can be separated into genera by cross-section views of their wood, which show different appearances based on the comparative number, size, and distribution of the fibrovascular bundles or "eyes." For example, Serenoa bundles are thin and widely but uniformly scattered through the whole wood; Thrinax has coarser, fewer and closer bundles; Cocos bundles are very numerous near the edge of a cross section and few in the center.

Palms have woody stems of varied habits, but most are well-proportioned trees remarkable for their uniformly cylindrical, typically unbranched shapes. The trunk is generally thickened near its base and is well anchored by a mass of simple, also unbranched, but contorted roots. The number of roots emerging from a coconut palm can be as many as 13,000. The fossil plant material known as "palm root" when cut shows wildly irregular oblong and circular shapes, each of which includes the typical stem structure and distribution of bundles as described above.

Since they lack a continuous cambial layer, palms are incapable of growth in thickness by adding new layers of cells as do our familiar timber trees. Thus no annual growth rings are formed. With no tree rings to count, age usually has to be based on associated historical data.

The girth of a palm is determined during its earliest years, the one main growing point being the terminal bud. Some tree types grow as much as 150 feet high. The diameter of palm stems may range from less than half an inch to two feet or more. Since palm trunks usually do not branch, the rock hunter's so-called "limb" sections of fossil palm probably represent the main stem or trunk of that individual plant. In some fossil species these may be so small as to appear reed-like, as in Reinharditia of Central

Figure 3. Fossilized trunk fragments of the rattan-type palm from the Eocene Green River Formation, Eden Valley, Wyoming. Approximately 3/4 natural size.

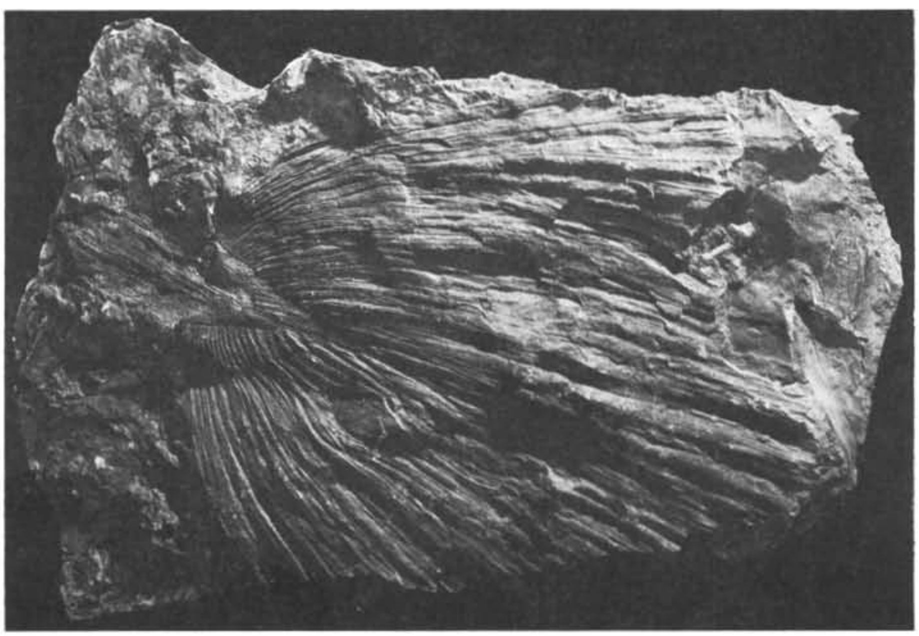


Figure 4. Portion of a fossil palm leaf (Sabalites eocenica) from Clarno-age rocks in northeastern Oregon, approximately ½ natural size. (From Hergert, 1961)

America today.

Other types of palm stems that might be found as fossils include the rattans, climbers of today in India and the East Indies living in semi-tropical environments similar to that of the Eocene in Oregon. The two main living genera of this type are Calamus and Daemonorops, which have slender, bamboo-like stems of uniform diameter with very long internodes. Their leaf rachis (leaf stalk) is prolonged into a spiny, hook-like tendril that enables them to climb over the tallest surrounding vegetation; their stems may grow as long as 500 to 600 feet, making them the lengthiest stem on earth, with the possible exception of seaweed. They produce the commercial rattan used for cane-chair matting, bentwood furniture, and the like. The familiar rockhunter's material, "cane," from the Eocene Green River Formation in Eden Valley, Wyoming, is a fossil representative of this type of palm stem (figure 3). Specimens are found with internodes as much as 10 or 12 inches in length and showing trunk rings (leaf-base scars).

Additional stem variations that could occur as fossils include the prostrate or creeping stems of certain palmettos (Sabal) which are surrounded by a dense mass of contorted roots. Other examples are the horizontal stem of Nipa, a genus confined to southeastern Asia today, and the short vegetative shoots of Bactris and Raphis which form bushy or shrub-like clumps.

A characteristic feature of most living palm stems is the leaf bases. If the leaf bases fall off, distinctive scars remain on the trunk, but if they remain attached to the trunk, the strong lower part of the leaf stalk often forms a clasping fibrous webbing that hangs in a ragged mass around the trunk. This mass can make a thick, dense mat several feet long. Some fragments of fossil palm show only this fibrous trunk cover.

Leaves

At an early stage, the single-leaf seedlings of most palm genera look much alike; as fossils, all can be easily confused with grasses. The mature leaf forms are distinctive, although those of cycads and some tree-ferns have a superficial resemblance. The leaves, in general, are borne as a crown at the tip of the trunk. Types of palm leaves include the fan-shaped leaves of palmetto; a simple pinnate or feathery form as in the coco palm; or a bi-pinnate as in fish-tail palms whose leaflets are attached to lateral branches of the main leaf rachis.

Most fossil-palm records refer to fan-shaped leaves; reports of pinnate-type leaves are rare in the literature. Fan-shaped palm leaves have been found at several localities in the Eocene of Oregon (figure 4), and silicified petioles or leaf stalks have also been collected.

Fruit and seeds

The fruit of palms, borne in clusters, is a drupe or berry and usually one seeded; seldom do 2 or 3 seeds occur. Sizes range from that of a currant to the double coconut weighing 40 or more pounds - the largest seed known. A great number of variations in the basic form occur. The fleshy part may be almost lacking or may be pulpy or oily; the pit layer may be hard and dense as in coconut or thin as in palmetto. Many palms continue flowering and fruiting throughout the year. The coconut is thought of as the typical palm seed or nut, but more typical are small seeds - some less than half an inch in diameter - that are produced in huge clusters by many species.

Figure 5. Two views of a small fossil seed of the coconut-type palm. Seed is 1 inch in diameter (photograph courtesy of T. J. Bones).

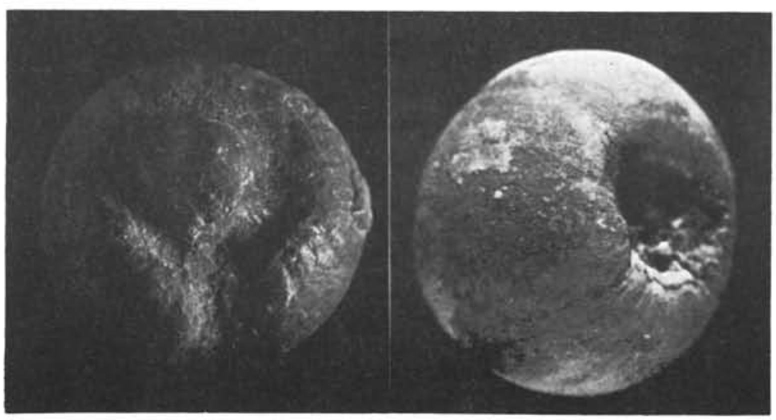


Figure 6. Two views of a tiny fossil palm seed 8 mm in diameter. Seeds were probably borne in clusters (photograph courtesy of T. J. Bones).

Fossil palm seeds are in general referred to the genus Palmocarpon. The durability of some palm seeds makes possible their remaining in excellent condition while traveling vast distances by ocean current, resulting in some confusion as to the validity of certain fossil-palm records at ancient coastal locations. Reports of Oregon palm-seed occurrences have been confined mainly to the Clarno area of central Oregon (figure 5, coconut type; figure 6, small seed).

Geologic History of Palms

The geologic history of palms goes far back into the fossil record, where they are considered to be the first of the angiosperms (flowering plants) to develop. Records of occurrences are numerous, with the earliest now tentatively considered to be the almost completely preserved palm-like leaves reported from the Middle to Upper Triassic of Colorado by Roland W. Brown (1956), who suggested they should be regarded "tentatively but credibly" as a primitive palm. The simple elliptic leaves of Sanmiguelia lewisi were borne alternately on a rapidly tapering stem. They were collected from red calcareous sandstone of the Dolores Formation near Placerville, Colo., in the vicinity of the San Miguel River, and constitute one of the more important paleobotanical discoveries of our time.

LaMotte (1952) cataloged a great many references to fossil palm throughout the world, including the earliest definite palm-wood record, Palmoxylon cliffwoodensis from the Upper Cretaceous Magothy Formation of New Jersey. Palm leaves occur in the Lower Cretaceous Dakota Group of the Rocky Mountains region, and in the Upper Cretaceous Nanaimo Group on Vancouver Island, British Columbia.

Records of palm from the Eocene are numerous. The famous Eocene London Clay flora in England contains an abundance of fossil fruits of Nipa, a tropical Asiatic palm of today (Reid and Chandler, 1933). In North America, palms are best displayed in Eocene rocks (Arnold, 1947). One particularly outstanding account is that by Knowlton (1930), who lists 14 forms from the Denver Basin, 8 based on leaves, 5 on fruits, and 1 on a silicified trunk. He reports huge leaves as large as 5 feet in diameter. Of the genera described, Sabal was the most abundant and widely distributed.

Among other notable North American Eocene floras containing palm are the Wilcox and Claiborne floras of the Gulf Coast areas (Berry, 1916 and 1924); the Raton flora of northern New Mexico and southern Colorado (Knowlton, 1918); the Jackson flora of Texas; the Eden Valley flora of Wyoming (Brown, 1934); the Puget flora of Washington and British Columbia; the LaPorte flora of California (Potbury, 1935); and the Clarno flora of Oregon.

Fossil palms, associated with other warm-climate plants, are found at the Alaskan leaf localities of Kupreanof Island and Matanuska Valley (Hollick, 1936). The flora is considered by Wolfe and others (1966) to be

Oligocene in age. Present here are two fossil-palm species, Flabellaria florissanti and Flabellaria alaskana, that are referable to the fan palms of the Arecaceae, a group that is today strictly subtropical and tropical and that bears out the suggested subtropical Oligocene climate of coastal Alaska.

Miocene palm occurrences noted by Arnold (1947) include that of the Tehachapi flora of the western Mojave Desert (Horse Canyon, Kern County, Cal.) and the Barstow beds (Mule Canyon, Yermo, Cal.). Axelrod (1950) describes Pliocene age palms from Palmdale, Cal.

The geologic history of palms in Oregon parallels that shown elsewhere in North America. Their first appearance during the Cretaceous was followed by relative abundance during the Eocene; Oligocene records are limited to palms in relict warm-climate floras of the coastal region. No fossil palms have been reported, as yet, from post-Oligocene rocks in Oregon. Miocene and Pliocene floras reflect a cooling trend in the climate. Some paleobotanists believe there was a gradual migration of palms southward during the Miocene and Pliocene toward their present association with tropical and subtropical floras of today in extreme southern United States, Mexico, and Central America.

Fossil Palm Record in Oregon

Cretaceous

The fossil record shows palms to have first occurred in Oregon during the Cretaceous. In 1958, a nut, together with an ammonite included in a concretion, was found near Mitchell, Wheeler County, and was identified as a palm seed of the genus Attalea from the Albian stage of the Cretaceous by the late Roland W. Brown, U.S. National Museum (see also Berry, 1929). This occurrence is noteworthy as being considered the earliest flowering-plant record (late Lower Cretaceous) of north-central Oregon. The specimen was kept in the U.S. National Museum (letter from E. M. Baldwin, October 24, 1958 to Lon Hancock; courtesy of Viola L. Oberson).

Eocene

Arbuckle Mountain area: The first Eocene palm record for Oregon was that of Mendenhall (1907) reporting on a coal prospect on Willow Creek, Morrow County. This location was about 22 miles southeast of Heppner in a mountainous region just west of the divide (Arbuckle Mountain) between the Willow Creek and the John Day River drainages. Monocotyledonous leaves were collected and sent to F. H. Knowlton who regarded them, on the basis of additional species collected, as being Eocene in age.

Chaney (1948) in "Ancient Forests of Oregon" pictures layers of fan-type palm-leaf fossils from the Arbuckle Mountain shales. Hogenson (1957), in an open-file report on the ground-water resources of the Umatilla River basin, recounts the collecting of fossil leaves in the Arbuckle Mountain area from shales containing carbonaceous material altered to lignite or bituminous coal. He states: "Plant fossils from several carbonaceous seams were studied by Roland W. Brown of the U.S. Geological Survey. He determined the Eocene age of the formation from these fossil plant identifications." Listed were Sabalites and other warm-climate trees including Magnolia.

Pigg (1961), in a University of Oregon master's thesis, reviewed the occurrences and used the dating of palm-leaf fossils as Eocene in determining the age of lower Tertiary sedimentary rocks in the Pilot Rock and Arbuckle Mountain areas. He mentions the occurrence of palm leaves as much as 4 feet across. Hergert (1961), in a summary of the plant fossils in the Clarno Formation, includes palm (Sabalites) leaves in a list of plants from the Pilot Rock locality.

Clarno area: Eocene palm is best known from the Clarno area, the type locality for the Clarno Formation and also the site of Camp Hancock, Oregon Museum of Science and Industry's famous outdoor laboratory for fossil plant and animal studies.

The Clarno Formation has been well described in the literature (Merriam, 1901; Hodge, 1942; Wilkinson, 1959; and Baldwin, 1964). It is composed almost entirely of andesitic volcanic material - chiefly lavas, mud flows, breccias, and tuffs, including some water-laid sediments. The formation overlies older marine rocks of Paleozoic and Mesozoic age. The Clarno sediments contain abundant silicified plant remains, mainly tropical and subtropical in nature, including palm at a number of localities (Chaney, 1948). The fossils occur in lenses of volcanic ash that accumulated in shallow lake bottoms, either by direct ash falls or by erosion and redeposition of such material. At some localities the plants are in carbonaceous shales associated with coal beds. The type exposures of the Clarno Formation can be seen about 2 miles east of Clarno Bridge in Wheeler County.

Near the type locality are the Clarno nut beds (SE$\frac{1}{4}$ sec. 27, T. 7 S., R. 9 E., Wheeler County), which are world famous among paleobotanists for their well-preserved seeds, nuts, and fruits as well as other plant parts (Scott, 1954). The nuts and other plant remains are enclosed in a bedded volcanic tuff that was laid down in very late Eocene time. A potassium-argon age of 36.4 million years was recently obtained for an overlying welded ash-flow tuff (Swanson and Robinson, 1968).

The lack of stratification within the nut beds, plus the presence of standing Equisetum stems, seems to indicate that the material accumulated by very rapid deposition. Arnold (1952) suggests that the nut beds may have been deposited during a flood.

Many fine collections of plant material have been made from the Clarno nut beds, but the most remarkable is that of Thomas J. Bones of Vancouver, Wash. Mr. Bones describes his work:

"I first visited the Clarno nut and seed beds in 1942 and discovered that finding specimens there was a real challenge to the collector. At first I could find only some of the larger nuts, but later discovered that by careful working, seeds even the size of poppy seeds could be found. The larger seeds and nuts are worked out in the field as a hard rock mining operation, by digging and breaking. The smaller seeds are obtained from matrix material that is brought home, broken down, screened and looked over with a magnifying glass."

"Walnut, grape, magnolia, moonseed, palm, pistacia, elder and water lily are some familiar plant seeds found that continue to grow on earth. Many of the hundreds of seeds found at Clarno represent plant species now extinct. Dr. Richard A. Scott, USGS, has worked on identification of this Clarno material."

Although most of the original Thomas J. Bones collection has been permanently located in Washington, D.C. in the National Museum of the Smithsonian Institute since 1961, Mr. Bones has continued collecting and has accumulated many more equally noteworthy specimens since that time.

Among the fossil plants found by Mr. Bones in the Clarno Formation are wood, leaves, leaf fronds, and seeds representing at least eight different genera of palms. Other collectors have found palm in the Clarno area, including trunks and root masses. One of the largest of these specimens is a jasperized stump of typically rounded appearance that is 3 to 4 feet in diameter and estimated to weigh 2 tons. For many years it was on display in Antelope and was considered by its owner to be a meteorite. Later it proved to be one of the largest fossil palm stumps ever found in Oregon or, indeed, anywhere (Richard Rice, oral communication, April 1969).

Other areas: As geologic mapping in Oregon has increased, the presence of many additional areas occupied by rocks of the Clarno or equivalent age in central and eastern Oregon has become evident. The occurrence of fossil palm wood at some of these localities is proving to be a factor in age determination. Recently such a determination was made for the Dooley Rhyolite of the Ironside Mountain area of eastern Oregon by W. D. Lowry ("Geology of the Ironside Mountain quadrangle, Oregon," State of Oregon Department of Geology and Mineral Industries Bulletin, in manuscript form) (figure 7).

Other localities, as yet not noted in the literature, contain fragmented fossil palm wood of presumed Eocene age spread over areas of many square miles in eastern Oregon. In some places the palm wood has been eroded from Clarno-age rocks and transported to areas of younger formations, as in the Jamieson-Huntington region. Pieces of silicified wood, fossil "bog" containing palm wood and root chips, portions of palm leaves, and other palm debris have been collected from various places by rock hunters.

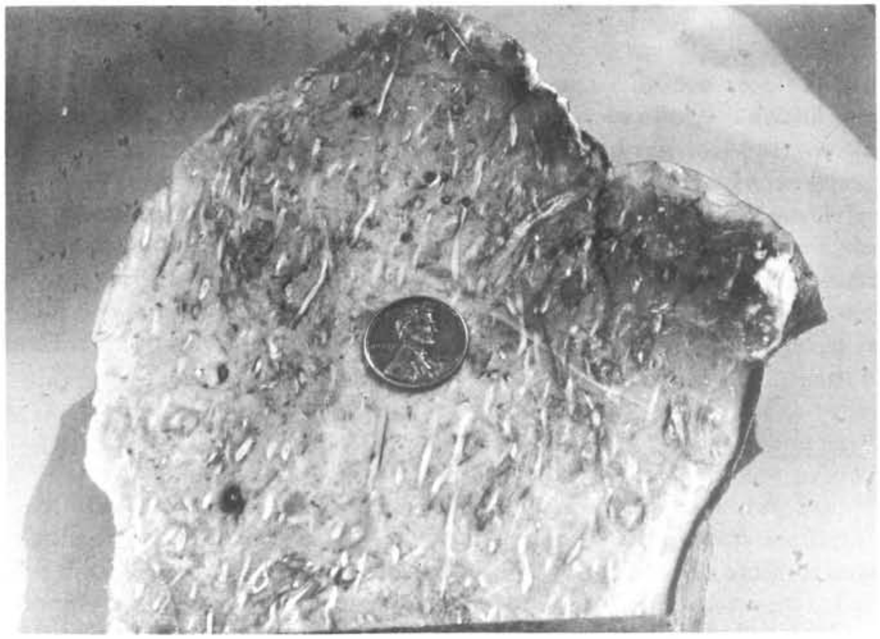


Figure 7. Longitudinal view of fossil palm wood from the Ironside Mountain quadrangle, Baker County, Oregon.

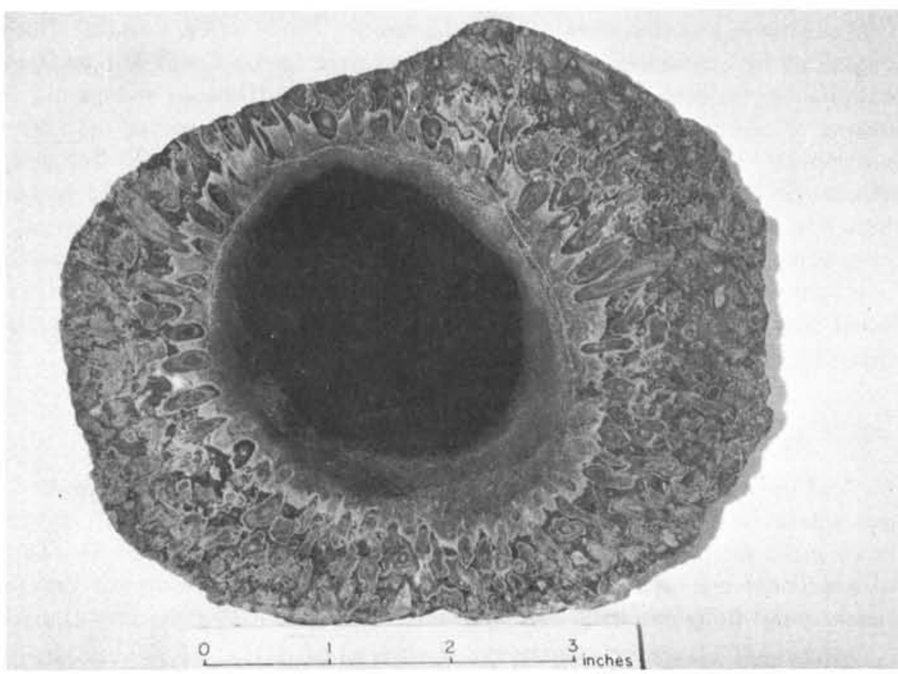


Figure 8. Cross section of an entire fossil palm trunk (about 3 inches in diameter) surrounded by a thick layer of roots. Dark mineral impurities in silica obscure typical "eye" pattern of trunk. Specimen found in Sams Valley near Medford, Oregon (Richard Rice collection).

Much is float, and in most occurrences the original source of the material is not known. Whole sections of palm wood have been seldom reported from rock-hunter localities of eastern Oregon.

West of the Cascades in the Medford area, palm wood occurs in areas mapped by Wells and Peck (1961) as late Eocene nonmarine sedimentary rocks, equivalent in age to the Clarno Formation east of the Cascades. Complete sections of petrified palm wood have been found (figure 8). The presence of palm is to be expected in other western Oregon Eocene localities as an associated species with other warm-climate and subtropical fossil plants.

Oligocene

As yet, fossil palm wood and leaves have not been noted with certainty from the John Day Formation of central Oregon, which contains an abundant flora of temperate-climate species. The palm-wood specimens thus far reported from the John Day have occurred as float and are considered to represent reworked material of Eocene age.

West of the Cascades, palm-leaf fragments are reported from two localities in Oligocene rocks. One is in the Eagle Creek flora of the Columbia Gorge area, described by Chaney (1920). The other is in the Rujada flora (Chaney, oral communication, February 1969). The Rujada* flora, described by Lakhanpal (1958), is situated near Layng Creek Ranger Station about 23 miles east of Cottage Grove. Here, in tuffaceous sediments, are leaves of temperate species as well as palm, catalpa, avocado, and other subtropical and warm-temperate trees. The presence of these relict species of warmer Eocene times is thought to be due to the relatively mild and uniform coastal climate of Oligocene time which enabled them to carry on long after their extinction elsewhere under less favorable climatic conditions.

In spite of the wealth of tropical and subtropical woods in the Sweet Home petrified forest near Holley, no palm has as yet been encountered there by the writer (Gregory, 1968).

General distribution

The accompanying map (figure 9) shows some of the localities in Oregon where fossil palm has been found as leaves, fruits, or wood. Probably many more such localities can be added to the map in the future as additional specimens are reported. Most of the occurrences shown on the map represent fossil palm material that was found in place. That is, it was enclosed

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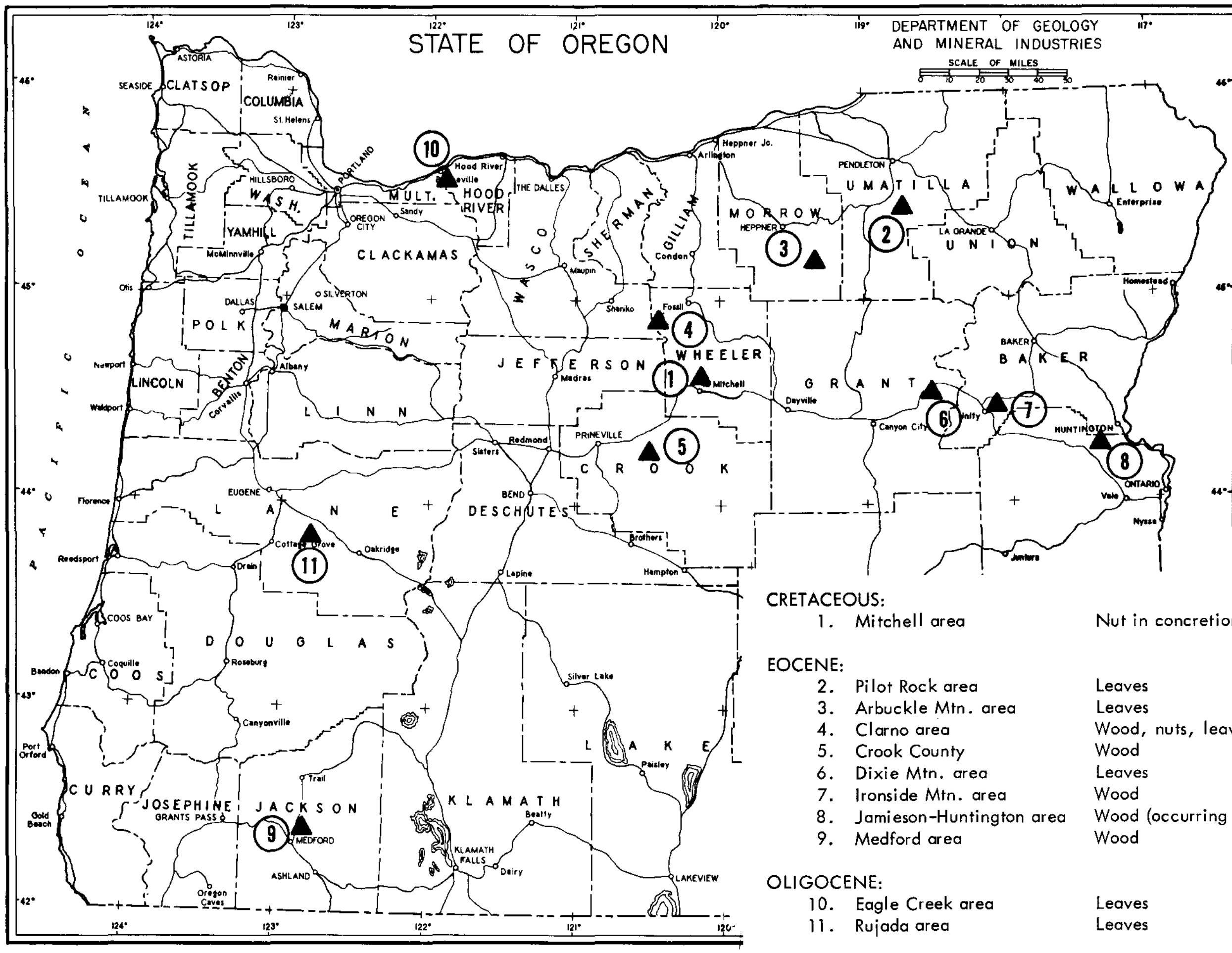
* The name "Rujada," which is so often mispronounced, is made up from the initials of two loggers, R. Upton and J. Anderson, together with the initials of the Department of Agriculture. It is correctly pronounced Rue-jade-ah.



CRETACEOUS:

1.	Mitchell area	Nut in concretion

EOCENE:

2.	Pilot Rock area	Leaves
3.	Arbuckle Mtn. area	Leaves
4.	Clarno area	Wood, nuts, leaves and leaf stems
5.	Crook County	Wood
6.	Dixie Mtn. area	Leaves
7.	Ironside Mtn. area	Wood
8.	Jamieson-Huntington area	Wood (occurring as float)
9.	Medford area	Wood

OLIGOCENE:

10.	Eagle Creek area	Leaves
11.	Rujada area	Leaves

Figure 9. Some fossil palm localities in Oregon.

in or intimately associated with the geologic formation in which it was originally buried before petrification. Fossil palm fragments occurring as float have less geologic significance.

Suggestions for the Rock Hunter

Reports of palm-wood occurrences from both east and west of the Cascades are frequent. However, many specimens, when examined under magnification, show no cellular structure and are actually various forms of orbicular agate and jasper or oolitic material. Others do prove to be palm, but the locations for all are a closely held secret of the finders, palm wood being one of the rock hunter's materials that has developed a certain desirability and "mystique" of its own. Prized varieties of palm wood for jewelry making include an ivory-colored jasp-agate with snow-white "eyes," as well as jet-black palm wood also with white "eyes." More commonly it is found in soft, blue-gray shades. Occasionally, a specimen of a deep, rich maroon color is found.

Hobbyists who wish to determine whether or not a specimen is palm wood can generally do so with a 10 X lens. After orienting the specimen to get a possible transverse or cross-section view, they should look for scattered "eyes" all with a similar pattern and each having two (rarely three) tiny, solid-looking dots (vessels) on one side. A longitudinal cut through an eye will show it as a lengthwise line or tube. If, instead, it appears as a short line or is ball shaped, the specimen is more probably one of Oregon's ubiquitous oolites rather than the sought-after palm.

Acknowledgments

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The U.S. Geological Survey has recently issued Bulletin 1235, "Bibliography of North American Geology, 1965." The 1144-page publication is sold for $4.75 by the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402.

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DeWEESE APPOINTED TO GOVERNING BOARD

Governor Tom McCall appointed R. W. deWeese, vice president of ESCO Corporation, to the Governing Board of the Department of Geology and Mineral Industries April 17, 1969. DeWeese replaces former chairman of the Board, Frank C. McColloch, whose term expired in March. Mr. deWeese has been associated with both the metals and mining industries for a number of years. He has worked with the American Mining Congress in developing a planned usage for our mineral deposits so that the exploitation of these resources will be balanced with preservation of the natural environment. During his 28-year tenure with ESCO, he has been directly involved with phosphate mining in Florida, copper mining in the southwest, taconite development in the Mesabi iron range in Michigan, and surface mining for coal in the central states.

Mr. deWeese has also contributed much of his time to civic activities, locally and state-wide; he is a director of Portland Public Schools, District No. 1, President of Portland Chamber of Commerce, and technical counselor for Oregon State University. He also serves as a director on the boards of several Oregon companies in addition to his regular duties with ESCO. His wide background of experience in both industry and public affairs will provide the Department with much valuable counsel in establishing its future policies and actions.

Members of the Governing Board are: Fayette I. Bristol, chairman, Rogue River; Harold C. Banta, Baker; and R. W. deWeese, Portland.

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NININGER METEORITE AWARD OPEN TO QUALIFIED STUDENT

An award of $1000 is given annually by Dr. and Mrs. H. H. Nininger (1) to generate interest in meteorites among the greatest number of student scientists and (2) to generate within the student scientist the ability to interpret logically and objectively his and other's experimental methods, data, and hypotheses, and to learn by writing. Paper must be written specifically for the Nininger prize and must be received not later than September 1, 1969. Undergraduate and graduate students are eligible. For information regarding the requirements for the paper, write to Dr. Carleton B. Moore, Director, Center for Meteorite Studies, Arizona State University, Tempe, Arizona 85281.

The $1000 may be awarded as a single or divided prize. The papers will be judged by a national panel of scientists engaged in meteorite investigations. Nininger awards have been given annually since 1962 to recipients at colleges and universities all over the United States.

* * * * *

GEOCHEMICAL ANALYSES TO BE RELEASED

On June 20, 1969 the results of all analyses of stream sediments on more than 3000 streams in southwestern Oregon will be released for public inspection at the State of Oregon Department of Geology and Mineral Industry's offices in Portland, Baker, and Grants Pass. These samples were collected during the summer months from 1963 to 1967 as a part of a state-wide mineral-evaluation program. Semiquantitative chemical analyses were made for copper, zinc, molybdenum, and mercury in the Department's laboratory in Portland by R.G. Bowen. This information has been available on open file since the inception of the program.

New information to be released at the same time consists of semiquantitative spectrographic analyses for 30 elements by the U.S. Geological Survey. The Survey's analyses were made at the Denver laboratories under the supervision of Jerry Motooka. The samples were scanned for the following elements: iron, magnesium, calcium, titanium, manganese, silver, arsenic, gold, boron, barium, beryllium, bismuth, cadmium, cobalt, chromium, copper, lanthanum, molybdenum, niobium, nickel, lead, antimony, scandium, tin, strontium, vanadium, tungsten, yttrium, zinc, and zirconium

In addition to being available for inspection at the Department's offices, these data, tabulated on approximately 400 pages, will be duplicated and mailed to any interested person for $25.00. All orders with payments received by June 6 will be mailed on June 20.

A bulletin containing all of the above information, together with maps, discussion of geology, geochemistry, analytical techniques, anomalies, and mineral deposits in the region where the samples were collected is now being prepared for publication. The analytical data are being released early, because it is the Department's policy to make such information available as soon as possible after it has been compiled.

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MYRTLE POINT AREA IN COOS COUNTY MAPPED

"Geologic map of the Myrtle Point area, Coos County, Oregon," by Ewart M. Baldwin has been published by the U.S. Geological Survey under the Mineral Investigations Field Studies Map series. The map, designated as MF-302, is in color at a scale of 1:48,000 on a 22- by 27-inch sheet. It is available for 50 cents from the U.S. Geological Survey, Federal Center, Denver, Colo. 80225.

The map area lies at the southern end of the Coos Bay coal field and is a southward extension of the Coos Bay structural basin. Lower to middle Eocene Umpqua Formation, middle Eocene Tyee Formation, and upper Eocene Coaledo Formation overlie pre-Tertiary rocks of the Klamath Mountains. A total of about 20,000 feet of Tertiary sediments is represented.

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AVAILABLE PUBLICATIONS

(Please include remittance with order. Postage free. All sales are final and no material is returnable. Upon request, a complete list of the Department's publications, including those no longer in print, will be mailed.)

BULLETINS

2.	Progress report on Coos Bay coal field, 1938: Libbey	$ 0.15
8.	Feasibility of steel plant in lower Columbia River area, rev. 1940: Miller	0.40
26.	Soil: Its origin, destruction, preservation, 1944: Twenhofel	0.45
33.	Bibliography (1st supplement) of geology and mineral resources of Oregon, 1947: Allen	1.00
35.	Geology of Dallas and Valsetz quadrangles, Oregon, rev. 1963: Baldwin	3.00
36.	(1st vol.) Five papers on Western Oregon Tertiary foraminifera, 1947: Cushman, Stewart, and Stewart	1.00
	(2nd vol.) Two papers on Western Oregon and Washington Tertiary foraminifera, 1949: Cushman, Stewart, and Stewart; and one paper on mollusca and microfauna, Wildcat coast section, Humboldt County, Calif., 1949: Stewart and Stewart	1.25
37.	Geology of the Albany quadrangle, Oregon, 1953: Allison	0.75
46.	Ferruginous bauxite deposits, Salem Hills, Marion County, Oregon, 1956: Corcoran and Libbey	1.25
49.	Lode mines, Granite mining dist., Grant County, Ore., 1959: Koch . .	1.00
52.	Chromite in southwestern Oregon, 1961: Ramp	3.50
53.	Bibliography (3rd supplement) of the geology and mineral resources of Oregon, 1962: Steere and Owen	1.50
56.	Fourteenth biennial report of the State Geologist, 1963-64	Free
57.	Lunar Geological Field Conference guide book, 1965: Peterson and Groh, editors	3.50
58.	Geology of the Suplee-Izee area, Oregon, 1965: Dickinson and Vigrass	5.00
60.	Engineering geology of the Tualatin Valley region, Oregon, 1967: Schlicker and Deacon	5.00
61.	Gold and silver in Oregon, 1968: Brooks and Ramp	5.00
62.	Andesite Conference Guidebook, 1968: Dole, editor	3.50
63.	Sixteenth Biennial Report of the State Geologist, 1966-1968	Free

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Geologic map of Albany quadrangle, Oregon, 1953: Allison (also in Bull. 37) .	0.50
Geologic map of Galice quadrangle, Oregon, 1953: Wells and Walker	1.00
Geologic map of Lebanon quadrangle, Oregon, 1956: Allison and Felts	0.75
Geologic map of Bend quadrangle, and reconnaissance geologic map of central portion, High Cascade Mountains, Oregon, 1957: Williams. . . .	1.00
GMS-1 - Geologic map of the Sparta quadrangle, Oregon, 1962: Prostka . . .	1.50
GMS-2 - Geologic map, Mitchell Butte quad., Oregon, 1962: Corcoran et al. .	1.50
GMS-3 - Preliminary geologic map, Durkee quad., Oregon, 1967: Prostka . .	1.50
Geologic map of Oregon west of 121st meridian: (over the counter) . . . . . folded in envelope, $2.15; rolled in map tube, $2.50	2.00
Gravity maps of Oregon, onshore and offshore, 1967: [Sold only in set]: flat . . folded in envelope, $2.25; rolled in map tube, $2.50	2.00

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18.	Radioactive minerals the prospectors should know (2nd rev.), 1955: White and Schafer	0.30
19.	Brick and tile industry in Oregon, 1949: Allen and Mason	0.20
20.	Glazes from Oregon volcanic glass, 1950: Charles W.F. Jacobs	0.20
21.	Lightweight aggregate industry in Oregon, 1951: R. S. Mason	0.25
23.	Oregon King Mine, Jefferson County, 1962: F.W. Libbey and R.E. Corcoran	1.00
24.	The Almeda Mine, Josephine County, Oregon, 1967: F.W. Libbey	2.00

MISCELLANEOUS PAPERS

2.	Key to Oregon mineral deposits map, 1951: R. S. Mason	0.15
3.	Facts about fossils (reprints), 1953	0.35
4.	Rules and regulations for conservation of oil and natural gas (rev. 1962)	1.00
5.	Oregon's gold placers (reprints), 1954	0.25
6.	Oil and gas exploration in Oregon, rev. 1965; Stewart and Newton	1.50
7.	Bibliography of theses on Oregon geology, 1959: H.G. Schlicker	0.50
7.	(Supplement) Bibliography of theses, 1959 to Dec. 31, 1965: M. Roberts	0.50
8.	Available well records of oil & gas exploration in Oregon, rev. '63: Newton	0.50
10.	Articles on Recent volcanism in Oregon, 1965: (reprints, The ORE BIN)	1.00
11.	A collection of articles on meteorites, 1968: (reprints, The ORE BIN)	1.00
12.	Index to published geologic mapping in Oregon, 1968: R. E. Corcoran	Free

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Oregon mineral deposits map (22 x 34 inches), rev. 1958	0.30
Oregon quicksilver localities map (22 x 34 inches), 1946	0.30
Landforms of Oregon: a physiographic sketch (17 x 22 inches), 1941	0.25
Index to topographic mapping in Oregon, 1961	Free
Geologic time chart for Oregon, 1961	Free

OIL and GAS INVESTIGATIONS SERIES

1.	Petroleum geology of the western Snake River basin, Oregon-Idaho, 1963: V. C. Newton, Jr., and R. E. Corcoran	2.50