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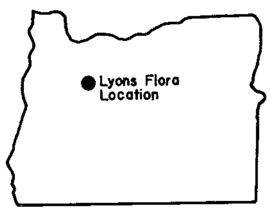
THE OLIGOCENE LYONS FLORA OF NORTHWESTERN OREGON

Herb Meyer
Student, Portland State University

The purpose of this study of the Lyons flora is to determine the age and paleoecology of the flora through the examination and identification of the fossil plant species of the flora.



The plant fossils comprising the Lyons flora were collected from a locality in the upper Thomas Creek area, 5 miles southeast of the town of Lyons, Oregon.

Geologic Occurrence

The beds from which the Lyons flora was obtained are part of the Little Butte Volcanic Series of Oligocene and early Miocene age described by Peck and others (1964). Stratigraphically below the fossil deposit, the Little Butte Volcanic Series is characterized by a pumiceous tuff-breccia which contains blocks and fragments of a volcanic flow rock. This exposure, the base of which is not exposed, underlies the fossil deposit for a thickness of more than 400 feet.

The deposit containing the fossil leaves is composed of a thinly laminated tuffaceous material which has been silicifed to varying degrees. These beds may have been deposited in a shallow, quiet body of water. Lacustrine deposition is suggested by the stratification of the beds, the abundant presence of fossil leaves, and the presence of one water plant in the fossil record.

Composition of the Lyons Flora

Twenty-four identified fossil plants represent the Lyons flora as it is known at this point in the study. Twelve have been identified to species and twelve have been identified only to genus (Table 1).

Ed. note: Herb Meyer was an OMSI student research worker and a winner in the 1972 Westinghouse Science Talent Search.

Table 1. Systematic list of species

GYMNOSPERMAE

GINKGOALES
- GINKGOACEAE
  - *Ginkgo biloba* L.

CONIFERALES
- PINACEAE
  - *Abies* sp.
- TAXODIACEAE
  - *Cunninghamia chaneyi* Lakhanpal
  - *Metasequoia occidentalis* (Newberry) Chaney
  - *Sequoia affinis* Lesquereux
- CUPRESSACEAE
  - *Chamaecyparis* sp.

ANGIOSPERMAE

GLUMIFLORAE
- CYPERACEAE
  - aff. *Cyperacites* sp.

JUGLANDALES
- JUGLANDACEAE
  - *Pterocarya mixta* (Knowlton) Brown

FAGALES
- BETULACEAE
  - *Alnus* sp. 1
  - *Alnus* sp. 2
- FAGACEAE
  - *Castanopsis longifolius* Lakhanpal

ROSALES
- SAXIFRAGACEAE
  - *Hydrangea* sp.
- HAMAMELIDACEAE
  - *Exbucklandia oregonensis* (Chaney) Brown

ANGIOSPERMAE, continued

ROSALES, continued
- PLATANACEAE
  - *Platanus condoni* (Newberry) Knowlton
- ROSACEAE
  - *Rosa hilliae* Lesquereux

SAPINDALES
- ACERACEAE
  - *Acer* sp.
- SABIACEAE
  - *Meliosma* sp.

MALVALES
- TILIACEAE
  - *Tilia* sp.

MYRTIFLORAE
- NYSSACEAE
  - *Nyssa* sp.
- ALANGIACEAE
  - *Alangium thomae* (Chaney and Sanborn) Lakhanpal

ERICALES
- CLETHRACEAE
  - Clethra sp.

CONTORTAE
- OLEACEAE
  - *Fraxinus* sp.
- GENTIANACEAE
  - *Nymphoides circularis* (Chaney) Brown

TUBIFLORAE
- VERBENACEAE
  - *Holmskioldia speirii* (Lesquereux) MacGinitie

Growth habit

The following conclusions regarding the growth habit of the Lyons species have been made through comparisons with the similar living species.

Trees

Ginkgo biloba	Exbucklandia oregonensis
Abies sp.	Platanus condoni
Cunninghamia chaneyi	Acer sp.
Metasequoia occidentalis	Tilia sp.
Sequoia affinis	Nyssa sp.
Chamaecyparis sp.	Fraxinus sp.
Castanopsis longifolius	

Low Trees and Shrubs

Pterocarya mixta	Meliosma sp.
Alnus sp. 1	Alangium thomae
Alnus sp. 2	Clethra sp.
Rosa hilliae	

Vines

Hydrangea sp.	Holmskioldia speirii

Herbs

aff. Cyperacites sp.	Nymphoides circularis (aquatic)

Although this information would seem to indicate that trees comprised most of the vegetation, it should be considered that this type of vegetation is more readily preserved in the fossil record. The larger stature of trees and the greater quantity of their leaves would, as discussed by Lakhanphal (1958), increase the probability of their preservation.

Paleoecology

The interpretations of the paleoecology of the Lyons flora are based upon comparisons with the similar living species and their climatic distribution and upon the analysis of physiognomic leaf characters.

Distribution of similar living species

Table 2 shows the similar living species of the Lyons plants identified to species and the geographical distribution of each. Those plants known only to genus have not been included since most of them have widespread geographical distribution.

The following species, as judged by their similar living species, were typically subtropical: Ginkgo biloba, Castanopsis longifolius, Exbucklandia oregonensis, Platanus condoni, Alangium thomae, and Holmskioldia speirii.

Typically temperate species include the following: Metasequoia occidentalis, Sequoia affinis, Pterocarya mixta, and Rosa hilliae. Cunninghamia chaneyi is both subtropical and temperate. Many genera not included in Table 2 (i.e., Abies, Chamaecyparis, Alnus, Acer, Tilia, and Fraxinus) are predominantly temperate plants, while Meliosma is predominantly subtropical.

Analysis of leaf characters

Certain physiognomic characters of the leaves present information which can be used as an indication of the paleoclimatic conditions under which a flora lived. The analysis of such characters for several floras are shown in Table 3, by percentage.

The length of the leaves has been measured and recorded in two categories: those 10 cm and under and those over 10 cm. Marginal characteristics have been distinguished as entire or non-entire. Entire includes those leaves with no regular indentations along the margin, whereas non-entire includes margins which are lobed, toothed, or have other regular indentations. The occurrence of an abrupt, elongate apex confirms the presence of a dripping point. The texture of the leaves of a species has been determined either as thick or thin.

Large leaves are frequently predominant in the tropical and subtropical floras; smaller leaves occur more frequently in the cooler floras. Leaves with entire margins are typical of climates that are physiologically arid for the plant during part or all of its growing season (i.e., tropical, non-humid

Table 2. Distribution of similar living species

Fossil species	Living species	East Asian	American East	American West
Ginkgo biloba	G. biloba	X		
Cunninghamia chaneyi	C. lanceolata	X		
Metasequoia occidentalis	M. Glyptostroboides	X		
Sequoia affinis	S. sempervirens			X
Pterocarya mixta	P. paliurus	X		
Castanopsis longifolius	Castanopsis spp.	X		
Exbucklandia oregonensis	E. populnea	X		
Platanus condoni	Platanus spp.		X	X
Rosa hilliae	R. palustris		X	
Alangium thomae	A. chinense	X		
Holmskioldia speirii	H. sanguinea	X		
	Total	8	2	2

Table 3. Percentage of leaf characters

Flora	Length over 10cm	Length under 10cm	Margin entire	Margin non-entire	Dripping point present	Dripping point absent	Texture thick	Texture thin
Lyons	35	65	40	60	10	90	30	70
Bridge Creek	30	70	25	75	10	90	55	45
Muir Woods modern forest	27	73	23	77	9	91	64	36
Scio	33	67	33	67	33	67	44	56
Goshen	53	47	61	39	47	53	98	2
Panama modern forest	56	44	88	12	76	24	98	2

temperate, and arctic climates). Leaves with non-entire margins are more characteristic of humid climates which are not physiologically arid for the plant. Dripping points are usually present only in the large, entire margined leaves of tropical and subtropical floras. Leaves with thick textures are also typical of tropical and subtropical species.

Comparisons with the other floras in Table 3 indicate that the Lyons flora is unlike the subtropical Goshen flora and the more tropical Panama modern forest. A closer similarity to the temperate Bridge Creek and Muir Woods floras is apparent. The Lyons species are quite similar to the Scio species in size, textural, and marginal characteristics. The Scio flora is apparently a semi-subtropical coastal flora, although it has few species in common with the Lyons flora.

Paleoecological conditions of the Lyons flora

The comparison with modern species and the analysis of leaf characters indicate that the Lyons flora contained plants which were both subtropical and temperate, although the temperate species were predominant. Since the Lyons flora grew near the margin of the Oligocene sea, the occurrence of both subtropical and temperate species in the flora can be attributed to the moderate climatic conditions which resulted from the influence of a marine climate. Under such moderate conditions, subtropical species which were typical in the Eocene and early Oligocene floras had survived into the middle Oligocene.

The Lyons flora probably represents a forest which grew near a coastal environment which had a warm temperate climate with mild, moderate temperatures.

Age and Correlation of the Flora

The Tertiary of western North America experienced a climatic cooling trend as this period progressed. Eocene and early Oligocene floras contain typically tropical or subtropical plants. Beginning in the middle Oligocene and continuing through the middle Miocene, climatic changes gave rise to temperate hardwood-conifer forests. Cool temperate floras became

Table 4. Distribution of Lyons species in other Tertiary floras

	Oligocene							Miocene				Pliocene
	Early		Middle				Late	Early	Middle		Late	Early
Fossil species	Comstock	Florissant	Goshen	Scio	Rujada	Bridge Creek	Weaverville	Eagle Creek	Latah	Mascall	Stinking Water	Troutdale
Ginkgo biloba								X	X	X		
Cunninghamia chaneyi					X							
Metasequoia occidentalis				X	X	X	X					
Sequoia affinis		X			X							
Pterocarya mixta					X				X	X	X	
Castanopsis longifolius					X							
Exbucklandia oregonensis					X	X		X	X			
Platanus condoni					X	X						
Rosa hilliae		X				X						
Alangium thomae			X	X	X	X						
Nymphoides circularis						X						
Holmskioldia speirii		X	X			X						
Species in flora	0	3	2	2	8	7	1	2	3	2	1	0
Species in sub-epoch	3		11				1	2	3		1	0

Table 5. Distribution of Lyons genera in other Tertiary floras

	Oligocene							Miocene				Pliocene
	Early		Middle				Late	Early	Middle		Late	Early
Fossil genera	Comstock	Florissant	Goshen	Scio	Rujada	Bridge Creek	Weaverville	Eagle Creek	Latah	Mascall	Stinking Water	Troutdale
Abies		X			X	X				X	X	
Chamaecyparis		X										X
Alnus					X	X		X	X	X	X	X
Hydrangea		X	X			X	X		X	X	X	
Acer		X				X		X	X	X	X	X
Meliosma			X									
Tilia		X				X	X	X	X			
Nyssa						X	X	X	X	X		
Clethra												
Fraxinus				X	X	X				X		X
Genera in flora	0	5	2	1	3	7	3	4	5	6	4	4
Genera in sub-epoch	5		8				3	4	7		4	4

predominant by the Pliocene. As these climatic changes occurred, the plant species, and often genera, would change accordingly. Therefore, the plant species from any one sub-epoch are somewhat distinctive from those of any other.

The age of the Lyons flora is based upon comparisons made with the distribution of the same plant species in other Tertiary floras, as shown in the correlation charts (Tables 4 and 5). It is most probable that the age of the Lyons flora is equivalent to the age of those floras which contain the largest number of species in common with it.

Table 4 shows the distribution of the Lyons plants identified to species; Table 5 shows the distribution of the plants identified only to genus. Those plants known to species are most useful for age determination, whereas those known to genus actually reveal little infomation about age. This is due to the fact that many of the genera are widely distributed throughout the Tertiary epochs, while species are more limited to a single epoch or sub-epoch.

The table showing the distribution of plants identified to genus is included primarily to show their distribution in other floras.

The correlation of those twelve plants identified to species (Table 4) indicates a close resemblance to middle Oligocene floras. Representation of Lyons species in the subtropical early Oligocene floras is less prominent. Cool temperate floras that are younger than late Oligocene age also show little similarity to the Lyons flora. Resemblance to the middle Oligocene Bridge Creek and Rujada floras of Oregon on the basis of species is noteworthy. The Lyons plants bear eleven species in common to the floras of this sub-epoch; seven species are common to the Bridge Creek flora and eight are common to the Rujada flora. This evidence would indicate that the Lyons flora is of middle Oligocene age.

As pointed out, generic comparisons have a limited value when used in age determination. However, the information from Table 5 confirms the placement of the Lyons flora in the middle Oligocene to Miocene group. The abundance of genera in common with the early and middle Miocene floras does not contradict the middle Oligocene placement of the Lyons flora; many of the Oligocene genera survived into the early and middle Miocene.

Holmskioldia speirii, a species abundant in the Lyons flora, is not known regionally in floras younger than middle Oligocene age. It can, therefore, be used as an indication of pre-late Oligocene age in a flora. Accordingly, its presence in the Lyons flora confirms the pre-late Oligocene age of the flora.

The close resemblance of the Lyons flora to the Bridge Creek and Rujada floras and the pre-late Oligocene age indicated by *Holmskioldia speirii* indicate that the age of the Lyons flora is middle Oligocene.

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Explanation of plates

PLATE I.

Figure 1. *Ginkgo biloba* L.
Figure 2. *Cunninghamia chaneyi* Lakhanpal
Figure 3. *Metasequoia occidentalis* (Newberry) Chaney
Figure 4. *Sequoia affinis* Lesquereux
Figures 5, 6. *Pterocarya mixta* (Knowlton) Brown
Figure 7. *Hydrangea* sp.

PLATE II.

Figure 1. *Castanopsis longifolius* Lakhanpal
Figure 2. *Alnus* sp. 2
Figure 3. *Alnus* sp. 1
Figure 4. *Alnus* "cones"
Figure 5. *Chamaecyparis* sp.
Figures 6, 7. *Exbucklandia oregonensis* (Chaney) Brown

PLATE III.

Figure 1. *Platanus condoni* (Newberry) Knowlton (Reduced X 2/3)
Figure 2. *Rosa hilliae* Lesquereux
Figures 3, 4. *Holmskioldia speirii* (Lesquereux) MacGinitie

PLATE IV.

Figure 1. *Meliosma* sp.
Figure 2. *Tilia* sp.
Figure 3. *Nyssa* sp.
Figure 4. *Fraxinus* sp.
Figure 5. *Acer* sp.

PLATE V.

Figures 1, 3. *Alangium thomae* (Chaney and Sanborn) Lakhanpal
Figure 2. *Clethra* sp.
Figure 4. *Nymphoides circularis* (Chaney) Brown

All figures are natural size unless otherwise noted.

PLATE I

fig. 1

fig. 3

fig. 4

fig. 2

fig. 5

fig. 6

fig. 7

PLATE II

fig. 1

fig. 2

fig. 3

fig. 4

fig. 5

fig. 6

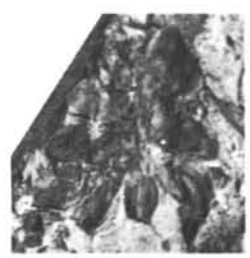

fig. 7

PLATE III

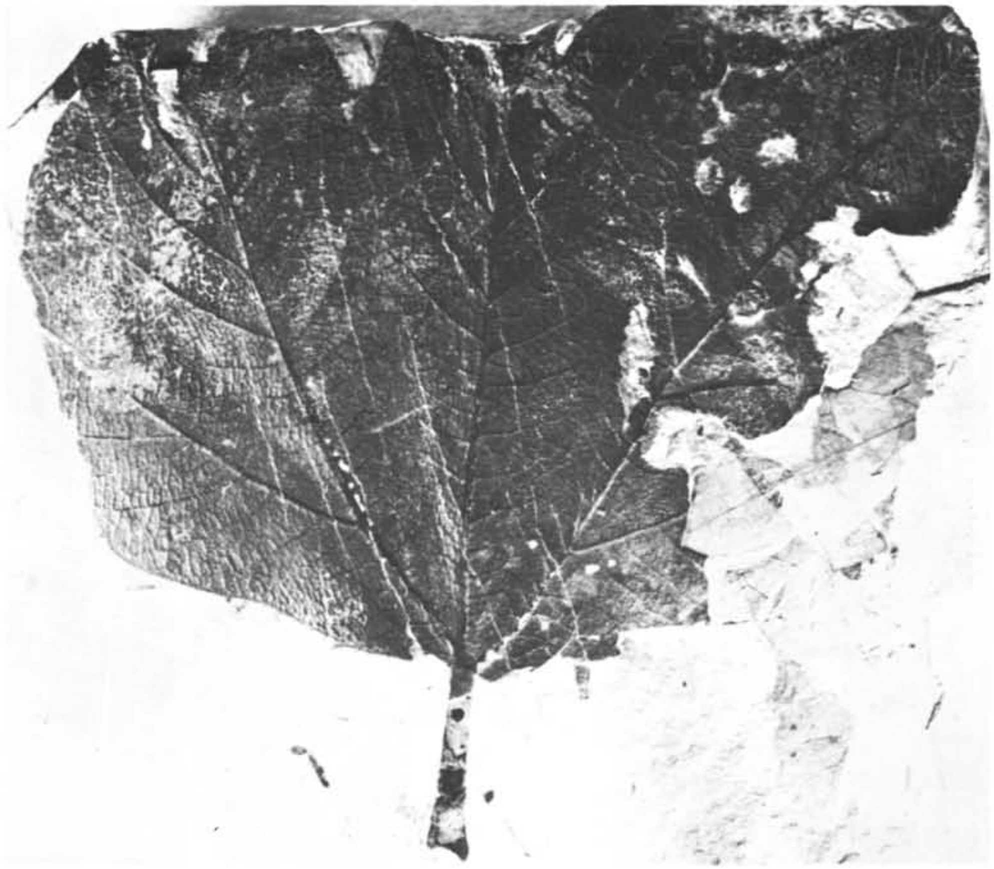

fig. 1

fig. 2

fig. 3

fig. 4

PLATE IV

fig. 1

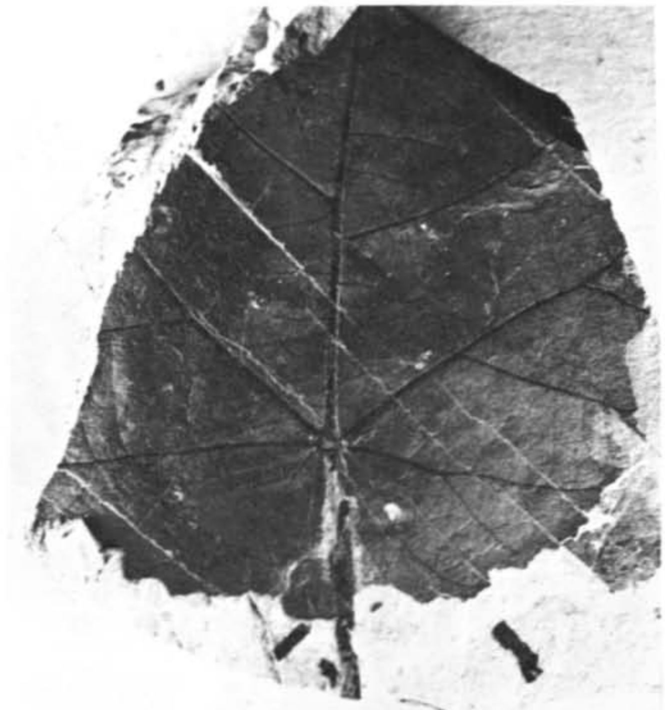

fig. 2

fig. 3

fig. 4

fig. 5

PLATE V

fig. 1

fig. 2

fig. 3

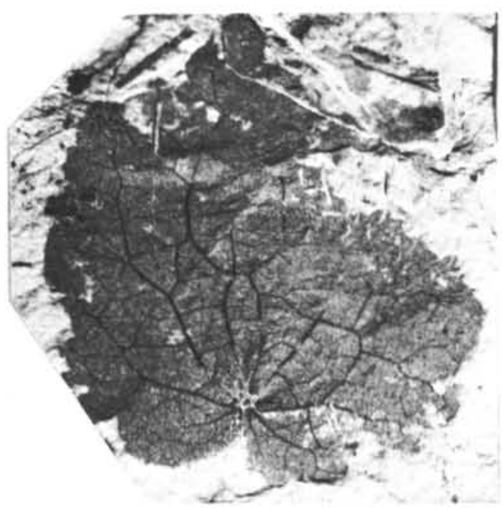

fig. 4

THESES ON OREGON GEOLOGY ADDED TO LIBRARY

The following unpublished master's theses and doctoral dissertations on the geology of Oregon have been added to the Department's library:

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* * * * *

COPPER FROM CANS

The copper mining industry is a big consumer of old steel cans. U.S. mining companies buy millions of them from municipal waste-separating facilities for use in a process that accounts for nearly 15 percent of the nation's copper production. When shredded and mixed with certain chemicals, the reclaimed steel helps to leach copper from low-grade ore. A large part of the cans is recovered from city garbage by magnetic separation. An American Iron and Steel Institute estimate for 22 cities shows 2.25 billion steel cans extracted from waste using magnetic separation in 1972.

(Compressed Air, v. 78, no. 2, Feb. 1973)

* * * * *

AN ACRE IS MORE THAN JUST 43,560 SQUARE FEET

Land-use planning is here to stay; it is here now and it looks as though it will be with us for the long pull. However, one gets the distinct impression that to many people, including planners, land is only a surface, sometimes flat, sometimes hilly. It may be low and swampy or dry and high. Land-use planners talk about these surfaces in terms of so many people per square mile, so much runoff per drainage basin, so many tons of fallout per acre, and so on. But they talk only about the surface. The unit of surface is the acre, roughly equal to an average city block or, more precisely, 43,560 square feet.

Geologists take a different view of "land." First, they view it as a three dimensional block of the earth's crust. Each block is unique in many ways though its surface may appear to be identical to adjoining parcels. What lies immediately below the surface is much like the mythical Pandora's Box, which loosed many ills and blessings when opened. Lurking beneath an innocent looking land surface may be a plague of geologic hazards or a wealth of mineral resources which may be set free if the surface land cover is removed and the "box" opened. Geologic hazards lying beneath the surface may go unnoticed for centuries. Landslides, subsidence, changes in water table, contamination of potable water, and destruction of natural springs are some of the geologic hazards which may become all too apparent when the land is disturbed.

Mineral resources that may be underlying the land surface include such things as sand and gravel, crushable rock, dimension stone, jetty rock, fill material, ground water, oil and gas, coal, metallic ores, and industrial minerals.

To a geologist, "land" is the basis for economic opportunity. For example, communities rely on abundant and nearby sources of aggregate in the form of sand and gravel or crushable rock. A century ago these materials were readily available on or near the surface in certain areas. Today these easily mined deposits are largely gone and only the buried reserves are left. Unfortunately, land-use planning often fails to recognize that mineral wealth may lie hidden beneath the surface and much zoning has effectively prohibited the development of these resources.

Here is an example of how good land-use planning can provide for utilization of the entire block of land. A deposit of sand and gravel 27 feet deep underlying one acre of land will produce 43,560 cubic yards of highly useful material, which if sized and screened will "swell" in volume when sand is separated from gravel and then gravel is screened from boulders. All of these products are normally salable and under present market conditions should realize about $2.00 per cubic yard as they leave the plant. This is roughly $87,000 per acre. In the construction industry, its worth increases with use; if the aggregate is in a concrete structure the value is approximately 100 times greater than the original pit price.

After the sand and gravel, or other mineral, has been extracted, the mined area may serve a variety of useful purposes if properly handled. Such pits may become solid waste landfill sites, "instant basements," or recreational sites with ready-made lakes. If used for solid waste landfill, the acreage of surface is again available to the planner for a variety of other commercial uses.

Small wonder then that geologists are concerned when poor land-use planning ignores the mineral wealth hidden beneath the land surface. We are running out of natural resources, and future needs must be considered in current land-use planning. We must start thinking of an acre as being more than just 43,560 square feet of surface.

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DOLE TO HEAD OIL SHALE PROJECT IN COLORADO

Former Oregon state geologist Hollis M. Dole, Assistant Secretary of Interior during Nixon's first term, has been named to head an oil shale development program in western Colorado. The Interior Department announced that he will become senior executive in charge of the jointly sponsored oil shale development program of the Atlantic Richfield Co. and the Oil Shale Corp., with headquarters in Denver.

Dole, assistant secretary for mineral resources since March 1969, had major responsibility for federal policies and programs related to energy and mineral resource development and was among the first of the Administration officials to alert the country to the energy crisis. Dole was instrumental in securing passage of the Mining and Minerals Policy Act and the Geothermal Steam Act, and was interested in upgrading the capabilities of mineral science colleges and increasing the number of their graduates. He was head of the Oregon Department of Geology and Mineral Industries from November 1954 until March 1969.

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DONALD McGREGOR

Donald G. McGregor, resident of Grants Pass, Oregon, and the most recently appointed member of the Department's Governing Board, died February 15 at the age of 70. Mr. McGregor was appointed to the Board by Governor Tom McCall in August 1972 and would have served in this capacity until March 1976 (see August 1972 ORE BIN). During his short term of office he became particularly interested in the development of Oregon's potential for geothermal power.

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CHINA DEVELOPING GEOTHERMAL RESOURCES

Before 1949, the geothermal resources of China were used only in treatment of certain skin diseases, for pleasure bathing, and as oral medication in curing certain illnesses. The potential for agricultural and industrial use went unrecognized.

With the increased geological surveying of the country, additional sources of geothermal energy have been discovered, and the exploitation of these resources for industrial, agricultural and household uses is increasing. In 1958 generation of electric power with geothermal energy was started, and since that time investigations into development of this resource have expanded. Such energy is now recognized by China as being relatively abundant in reserve, low cost in exploitation, and unpolluting to the human environment.

At present, geothermal energy in the form of natural steam, warm and hot water springs is being used for generation of electricity in a number of locations. In some urban areas natural hot water has been piped for heating purposes and for industrial production, especially in industries which require large supplies of hot water, such as dyeing, paper manufacturing, chemical production. In rural areas, warm and hot springs have been channeled for irrigation of nursery crops and of paddy fields to shorten the growing period. Also, water from hot springs is used in greenhouses, poultry and fish hatcheries, fermentation processes, and for steaming and drying foodstuffs.

(from Geothermics, v. 1, no. 3, Sept. 1972)

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BIBLIOGRAPHY OF ALASKAN GEOLOGY

The Alaska Geological Survey has published two new bibliographies on Alaskan geology, each with subject index. The volumes cover the years 1965-1968 and 1969-1971, and are fifth and sixth respectively in a series on Alaskan geology covering literature published since 1831. The bibliographies are designed for geologists and others who seek information on the geology of Alaska. As stated in the introduction, the data for Alaska were compiled from Abstracts of North American Geology, published by the U.S. Geological Survey, and from Bibliography and Index of Geology, published by the Geological Society of America. The volumes are available by writing to Alaskan Department of Natural Resources Division of Geological Survey, College, Alaska. Each publication is $1.00.

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AVAILABLE PUBLICATIONS

(Please include remittance with order; postage free. All sales are final - no returns. Upon request, a complete list of Department publications, including out-of-print, will be mailed)

BULLETINS

8.	Feasibility of steel plant in lower Columbia River area, rev. 1940: Miller . . .	$0.40
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39.	Geology and mineralization of Morning mine region, 1948: Allen and Thayer . .	1.00
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52.	Chromite in southwestern Oregon, 1961: Ramp	3.50
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GMS-1: Geologic map of the Sparta quadrangle, Oregon, 1962: Prostka	1.50
GMS-2: Geologic map, Mitchell Butte quad., Oregon: 1962, Corcoran and others . .	1.50
GMS-3: Preliminary geologic map, Durkee quadrangle, Oregon, 1967: Prostka . . .	1.50
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