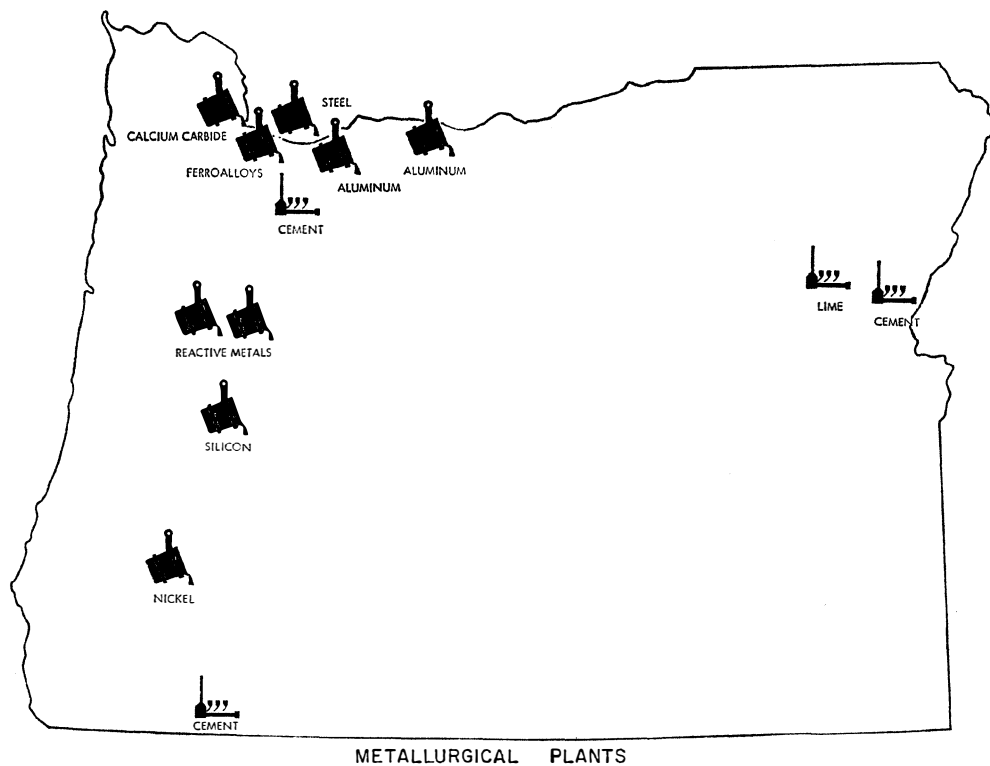


**THIRTEENTH BIENNIAL REPORT
STATE OF OREGON**

**Department of Geology and Mineral Industries
1960-1962**



THIRTEENTH BIENNIAL REPORT

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

1960 --- 1962



1963

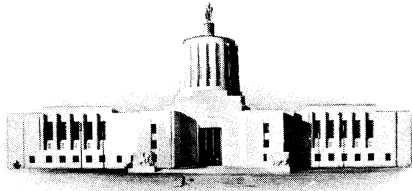
STATE GOVERNING BOARD

Frank C. McColloch, Chairman	Portland
Harold Banta	Baker
Fayette I. Bristol	Grants Pass

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Director

GOVERNING BOARD

FRANK C. MCCOLLOCH, CHAIRMAN, PORTLAND
HAROLD BANTA, BAKER
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FIELD OFFICES:

2033 FIRST STREET
BAKER
239 SOUTHEAST "H" STREET
GRANTS PASS

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
1069 STATE OFFICE BUILDING
PORTLAND 1

To His Excellency Mark O. Hatfield
Governor of the State of Oregon
and to
The Fifty-second Legislative Assembly of the State of Oregon

Sirs:

We submit herewith the Thirteenth Biennial Report of
the Department of Geology and Mineral Industries, covering
activities of the Department for the period from July 1, 1960,
to and including June 30, 1962.

Respectfully,

A handwritten signature in cursive script, reading "Frank C. McColloch".

Frank C. McColloch, Chairman

A handwritten signature in cursive script, reading "Harold Banta".

Harold Banta, Member

A handwritten signature in cursive script, reading "Fayette I. Bristol".

Fayette I. Bristol, Member

Portland, Oregon
January 1963

THIRTEENTH BIENNIAL REPORT

DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

RESPONSIBILITIES OF THE DEPARTMENT

The Department of Geology and Mineral Industries is the organization responsible for the development of the state's mineral resources and the utilization and understanding of its terrain. Unlike the federal Geological Survey, which is authorized to work in any part of the Free World, this department is confined to the 96,000 square miles of Oregon and the challenge is to determine what the minerals or geological resources may be, where they are located, and how they might be put to work for the benefit of the state.

Although its prime responsibility is one of development, the department finds that its special skills and knowledge are increasingly called upon by many different public agencies for advice and guidance where the terrain or the subsurface is involved. These responsibilities were designated by the department's enabling act and have been added to by subsequent Legislatures.

Besides encouraging development, the department has been given the responsibility of regulating drillings made in the search for oil and gas. This is important to the protection of the underground and surface water. If commercial quantities of hydrocarbons are ever found, the department must see that the fluids are extracted in the most efficient manner consistent with good conservation practice.

The wisdom of the Legislature in establishing a department to develop the state's mineral resources is attested to by the fact that industry has spent more than \$50 million in Oregon on mineral and industrial developments directly attributable to investigations and publications by the department since it was formed in 1937. The department can point to two new mineral deposits that have opened up and a third property at which mining was continued as the result of its investigations during the past biennium. In addition, considerable research is being done by several organizations for the utilization of a mineral found widespread in Oregon and first given attention by a department publication.

The location of the Blue Mountain Seismological Station near Baker came about because the department had information on the specific type of terrain peculiar to the needs of this operation. Other terrain studies have resulted in investigations by research groups interested in obtaining lunar test sites. Work is continuing on this and it is believed it will eventually culminate in the establishment of a research center. In addition, more than \$3 million has been spent in Oregon during the past two years on oil and gas investigations, some of which can be attributed to departmental encouragement.

DUTIES OF THE DEPARTMENT

Conduct geological and mineral resource studies (ORS 516.030 [1]).
Carry out economic studies pertaining to utilization of mineral raw materials (ORS 516.030 [2]).
Cooperate with Federal and quasi-public agencies in studies of value to the state (ORS 516.030 [3]).
Serve as a bureau of mineral and geological information, compile and keep up to date a mines catalog, prepare and publish reports of investigations and mineral statistics (ORS 516.030 [4]).
Collect specimens and develop a museum (ORS 516.030 [5]).
Collect a mining and geological library (ORS 516.030 [6]).
Make qualitative examinations of rocks and minerals (ORS 516.030 [7]).
Study minerals and ores and treatment processes (ORS 516.030 [8]).
Make quantitative determinations of ores and minerals (ORS 516.040).
Make spectrographic analyses (ORS 516.050).
Serve on the Dredge Mining Consulting Committee (ORS 517.700).
Serve on the Committee of Natural Resources (ORS 184.410).
Advise other agencies on mineral leases (ORS 517.410).
Administer Oil and Gas Act (ORS 520).
Participate in administration of Tide and Submerged Lands Act (ORS 274).
Establish unit operations for oil and gas development (ORS 520.260).

DEPARTMENT ORGANIZATION

Although the general organization of the department has undergone very little change since its establishment in 1937, the present biennium has seen a complete revision of duties and responsibilities within the technical staff. This became necessary in order to adjust to the ever-changing demands for materials needed by industry, the re-alignment of exploration emphasis, and the need to bring our researches into printed form more quickly for wide-spread study and review by industry and the public.

By law the general charge and control of the department rest in a three-member Governing Board of interested citizens who receive their appointment from the Governor, subject to approval of the State Senate. The Governing Board appoints the Director, who must have certain minimum technical skills and experience which are established by the department's enabling act. Progress reports, plans, and budgets are presented by the Director at each meeting of the Board, at least four times a year. The Director is authorized to employ the staff necessary for execution of Board-approved plans and for operation of the department. Staff is hired from Civil Service rolls, and positions must be approved by the Department of Finance and Administration and the Legislature.

The head office of the department is in the State Office Building, Portland. Field offices are located in Grants Pass and Baker. The assaying, chemical, and spectrographic laboratories, and the accounting functions are centralized in the Portland office. The library and museum are also located at Portland, but rock and mineral displays and literature of local interest are kept in each field office. These offices are maintained to enable the department to give better, faster, and more economical field inspections and to make the other services more readily available to miners, prospectors, and the general public.

The department's duties are separated into five divisions: geologic, engineering, editorial, laboratory, and business. The principal changes in responsibilities in the past biennium have been within the geologic, engineering, and editorial divisions.

The geologic division now has five sections: stratigraphic, whose responsibilities are to coordinate field mapping work for the State Geologic Map, work with the Petroleum Engineering Section in determining subsurface correlations within sedimentary basins, determine and do field mapping in critical areas, and establish measured sections and correlation charts to promote a better understanding of the geologic framework of the state; economic, whose responsibilities include geochemical studies, geophysical investigations, delineation of metallogenic provinces, and detailed field mapping in regions having a high expectancy for the occurrence of the metallic minerals; engineering, which has been assigned the duty of detailed mapping of surficial deposits in those regions expected to have the greatest industrial and population growth, delineating areas of unstable or potentially unstable ground, and determining the subsurface conditions in the Willamette Basin; and two field offices (Baker, Grants Pass), which have been assigned the roles of local administration and concentrated work on both the geology and mineral resources of the region in which the offices are located and a general knowledge of adjacent counties.

The engineering division is separated into two sections, petroleum and mining. The petroleum section is responsible for enforcing the Oil and Gas Conservation Act and operations under the Offshore Leasing Act, collecting and making available data obtained from drillings, making studies of sedimentary basins, describing cores and cuttings obtained from drillings, and preparing information to enhance the Oil and Gas Conservation Act. The responsibilities of the mining section include the gathering of statistics on Oregon's mineral industry, supervision of all drafting for publications, writing of specifications for bids on publications and major department purchases, and maintenance of the department's inventory.

The editorial division is headed by a staff geologist and is responsible for editing, establishing format, and publishing of manuscripts; the care and upkeep of the library and museum; compilation of the bibliography on Oregon's geology and mineral industries; and the preparation of material of general interest to the layman.

The laboratory division has chemical, assaying, spectrographic, radiometric, and differential thermal analysis equipment for making qualitative and quantitative determinations on Oregon rocks and minerals. The spectrographic laboratory also does work for other state agencies, private laboratories, and industrial firms on many kinds of material as provided for under ORS 516.060. Personnel in all three divisions make rock and mineral identifications, consult with callers at the office, handle correspondence, and make public appearances in behalf of the department.

The business division performs the stenographic, typing, accounting, and receptionist duties.

The department has 19 full-time employees and four part-time employees, consisting of the following: one administrator; seven geologists in the geological division; two engineers and one full-time and one part-time draftsman in the engineering division; a chemist, a spectroscopist, and a part-time sample preparator in the laboratory division; a geologist and an editor in the editorial division; and an accountant, three secretaries, and two part-time employees in the business division. See page 14 for a chart of the department's organization.

The department serves other agencies and industry through its laboratories and its technical staff. Police departments find the work done in the spectrographic and petrographic laboratories especially helpful. Industrial concerns use the spectrographic laboratory for research and control. City, county, and state agencies draw upon department experts for advice, ranging from mineral resources of their region to the prevention and control of landslides.

The general public finds the department a ready source for identification of rocks and minerals, advice concerning companies operating in the minerals field, lectures on geology and mineral resources, and aid in training of groups such as Boy Scouts, 4-H Clubs, and Campfire Girls. Field trips are conducted, as schedules permit, for science classes in grade and high schools.

OPERATION OF THE DEPARTMENT

The basic information of the department is obtained by geologic mapping and mineral resource studies. Reconnaissance mapping is still being done, principally for the state geologic map. In recent years it has become necessary to refine existing mapping to understand better the geologic setting of metallic mineral provinces, to delineate surficial deposits needed for building or construction, and to obtain a more accurate picture of the geologic framework of the state - especially in those areas blanketed by lavas or relatively recent sediments.

Detailed mapping is being augmented by geochemical studies for the purpose of reducing the target in the search for metallic mineral deposits. Increasing attention is being given to common-type rocks that may have some use as building or decorative stone. A renewed search is under way near transportation or energy arterials for deposits of industrial minerals such as pumice, diatomite, volcanic ash, and silica.

Factual data, including drill cuttings and cores, is assembled on all oil and gas drillings in response to the Oil and Gas Act, which requires that this material be furnished to the department. All information is put on reproducible sheets, so that when it is opened to the public by law, copies of the originals can be furnished at cost. Cuttings and cores on all drillings are stored in a warehouse to assure that a permanent record on drillings is kept. This material can be studied in the warehouse or "splits" are available for shipping for study in the laboratory of the interested party.

Mineral statistics are compiled, generally in cooperation with and published in detail by the U.S. Bureau of Mines. Mine and geologic maps, assay data, history and other pertinent data are collected on many properties and are kept on open file in the department's library. When warranted, this material is compiled and issued as a publication of the department.

The researches and findings of the department are placed in the hands of possible users through department publications, answering of letters, office consultations, on-the-site tours, and attendance at mining and geological conferences.

Assistance is given the prospector and small-mine operator through a free assay service (maximum of 2 samples per month), field examinations, and conferences. Not only is aid given in the technical fields of analysis, geology, and mining engineering, but suggestions are offered for marketing and developing products.



DEPARTMENT PUBLICATIONS

During the past biennium, the department issued a greater number of geological reports and maps than it had for the past decade. This includes the following: Map 1-325, Geologic Map of Oregon West of the 121st Meridian; Bulletin 52, Chromite in Southwestern Oregon; Bulletin 53, Bibliography of the Geology and Mineral Resources of Oregon; Bulletin 55, Quicksilver in Oregon (in press); Short Paper 23, Oregon King Mine, Jefferson County; G.M.S. 1, Geologic Map of the Sparta Quadrangle; G.M.S. 2, Geologic Map of the Mitchell Butte quadrangle; Miscellaneous Paper 9, Petroleum Exploration in Oregon; and 24 issues of The ORE BIN. This increase, made possible by an increased appropriation of the legislature, enabled the department to publish the backlog of manuscripts and maps that had been accumulating in the office files for some time because of a lack of funds for publication. At the beginning of the biennium, however, the department did not receive sufficient funds to pay salaries and wages for the entire two-year period. For this reason the Governing Board, with the concurrence of the Department of Finance and Administration, will request the Joint Ways and Means Committee to transfer a share of the money appropriated for publications to salaries and wages to cover this deficiency. The department hopes to receive funds in the next biennium to continue to bring accumulated maps and reports into published form in order to satisfy the increased demand by industry and the public for up-to-date geologic information.

The long-anticipated geologic map of the western half of Oregon, published in cooperation with the United States Geological Survey, is now available for general distribution. More than 80 geologic units are shown on this multicolored map and are briefly described in the legend. Pictured for the first time are all the geologic formations of western Oregon on a single sheet, greatly facilitating interpretation of large areas which heretofore have not been shown in their entirety. Petroleum exploration companies have found this map to be particularly valuable in outlining areas of potential oil and gas deposits.

The chrome bulletin records more than 300 occurrences of chrome ore in southwestern Oregon. These deposits represent a valuable reserve of a highly strategic material and they could very well be the source for a ferrochrome industry for Oregon.

The bibliography on geologic reports is an invaluable service publication to aid those conducting research projects in the state. In the bibliography are listed and indexed approximately 700 references relating to the geology and mineral technology of Oregon that have appeared in the literature during the years 1951 through 1955.

The report on the Oregon King mine was published because it was one of the few silver producers in Oregon and because there appeared a good possibility of more ore at lower depths. Since publication of this report, the property has been leased to an exploration group which has begun shipping silver-copper ore from one of the higher levels in the old mine workings. At the same time the shaft is being cleared in order to explore the lower levels for deeper potential ore zones.

The Geologic Map Series has been started by the department in order to save on publication costs. The Sparta and Mitchell Butte quadrangles originally were planned for issuance as bulletins, but instead have been printed on one sheet of paper with a multicolored geologic map on the front and an explanatory text on the reverse. Geologic work on the Sparta quadrangle not only furnished basic data on the bedrock geology and structures in that part of the state, but also was instrumental in the establishment of a new seismograph station east of Baker as part of the Federal Government's Vela-Uniform project for detection of underground nuclear explosions.

Petroleum Exploration in Oregon (Miscellaneous Paper 9) is a compilation of articles pertaining to the geology of the Pacific Northwest reprinted from various petroleum journals and the department's monthly publication, The ORE BIN. Interest in Oregon's oil and gas potential has increased considerably during the past few years, and the department encourages petroleum exploration companies working in the state by supplying them with all pertinent geologic information available.

The ORE BIN has increased its subscription list to more than 1,700 persons, private business concerns, and governmental agencies. The size and format of the magazine have been changed to modernize its appearance. We have encouraged submission of articles dealing with research on different aspects of Oregon's geology currently under investigation by university geological departments and by other experts working in the state. Reports of general interest concerning our State Parks, the recent Portland earthquake, and commodity reports on the mineral industry in Oregon also appear from time to time. The ORE BIN carries announcements of geological reports published by Federal or State Geological Surveys and news items on new mineral uses or developments.

A comprehensive survey of quicksilver deposits in Oregon by the department has now been completed and publication of the report is anticipated this spring. Oregon is one of the five major sources of mercury in the United States and has had a record of almost continuous production dating back to 1882. This publication will provide basic information concerning the origin and deposition of mercury ore in the state and should help re-establish the mining of this metal in the near future.

EXPLORATION FOR PETROLEUM IN OREGON

Petroleum exploration has progressed at a fairly good pace in Oregon over the past few years. Almost all of the early ventures were made by small "wildcat" groups, but during World War II larger oil companies began to show interest in the state. Following passage of the State Oil and Gas Act of 1953, exploration activity increased noticeably. Enactment by the Oregon legislature of a comprehensive law was understood by industry as encouragement to establish an oil business in the state.

The 1953 act was patterned after the model law designed by the Interstate Oil Compact Commission and augmented by suggestions from North Dakota officials, who were revising their oil statutes about the same time. The Compact is composed of 30 member states and 3 associate member states. Oregon has been an associate member of this organization since 1954. A unitization law was passed by the Oregon legislature in 1961 which greatly improved regulation over oil and gas production, allowing profitable conservation methods to be put into effect. The State of Texas is currently considering adoption of a similar law, after experiencing great difficulty with its prorationing regulations.

Interest in Oregon's oil prospects has sharpened during the past decade, because of dwindling reserves in the United States coupled with a steadily increasing demand for petroleum products. California, the main supplier for the Far Western States, has had a declining production since 1953, because there have been no large, new oil fields discovered. In 1962, the Far Western States imported about 300,000 barrels of foreign oil daily. Productive regions in this country have been well combed for new petroleum deposits, so now the search for oil must be made in unexplored, nonproducing areas. Hence, "wildcat" regions such as Oregon are currently in the spotlight. The present focus on Oregon is in the Willamette Valley and offshore along the continental shelf.

Sedimentary Basin Areas

Oregon has been unattractive to oil exploration in the past because of thick volcanic sections and difficulty in obtaining geophysical data. However, large sedimentary areas in the state offer suitable environment for oil

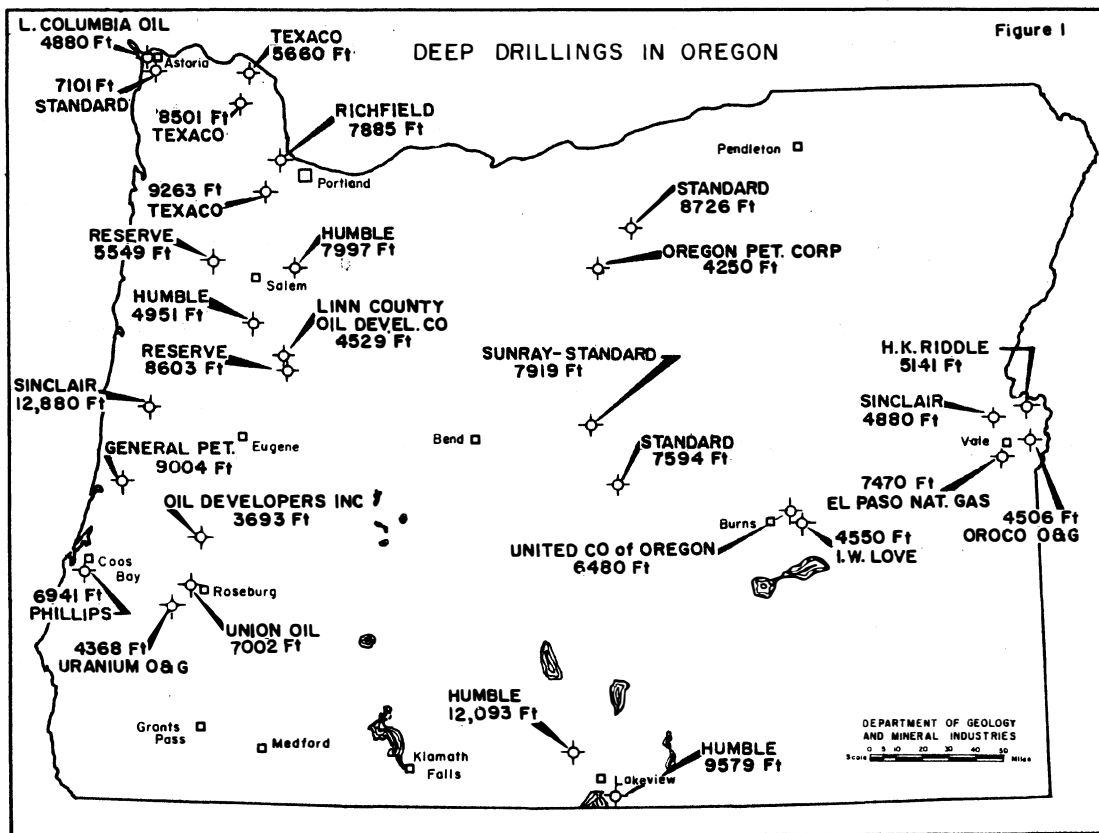


Figure 1. Map showing significant oil or gas tests.

and gas accumulation. In the coastal region west of the Cascade Mountains and including the continental shelf lands, there are approximately 11,000 square miles of Tertiary marine sediments and interbedded lavas exposed, with measured thickness of about 15,000 feet. In central Oregon, 6,000 square miles of Mesozoic-Paleozoic marine rocks are indicated by scattered outcrops. Less interesting to oil explorers than the marine basins but still holding some promise, especially for gas production, are the three deep basins in eastern Oregon which contain thick sections of Tertiary lake sediments. These intermountain sedimentary areas are named the Lakeview, Harney, and Ontario-Payette basins. Past drilling in the Ontario-Payette area has revealed petroleum-type gas in the sediments, but thus far the most promising gas horizons have contained fresh water.

Of the 168 oil and gas drillings made so far in Oregon, the majority have been drilled in the western Tertiary basin, whereas most of the remaining holes have been drilled in the Harney and Ontario-Payette basins. A small amount of drilling has been done around the margin of the outcrop area of Mesozoic-Paleozoic rocks in central Oregon, but because of the masking Tertiary volcanics geologic interpretation is extremely difficult, and, thus, objectives are elusive.

Despite the many exploration tests in the state, no commercial amounts of oil or gas have been found to date. A few minor shows of oil have been obtained in drill cuttings and cores and many occurrences of gas encountered, some of which have been utilized for domestic purposes. Of the drillings made thus far, only 28 penetrated deeply enough into the sedimentary basins to give adequate geologic information on the region. More deep holes are needed before the most likely areas can be outlined. (See Figure 1.)

Onshore Exploration

In 1960, after 7 years of field exploration, Humble Oil & Refining Co. began a large land-acquisition program in south-central Oregon and north-central California. The company gathered 500,000 acres of leases,

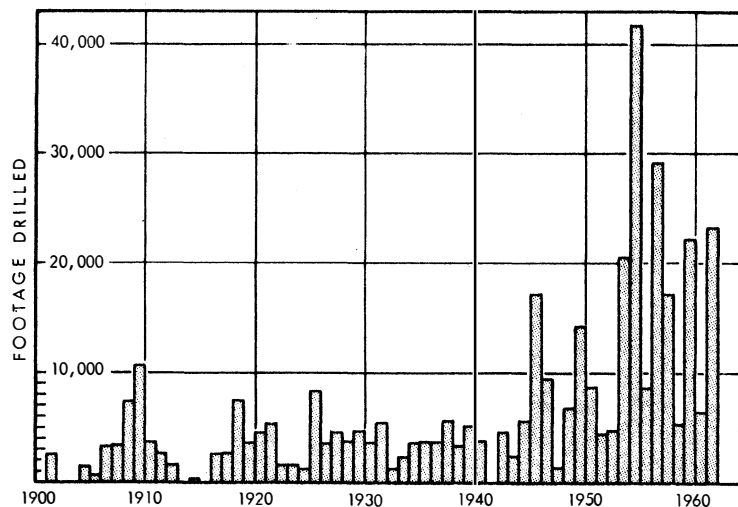


Figure 2. Total footage drilled in Oregon (1902-62). Oil and gas tests (core holes not included).

mostly Federal land, into one large block along a structural feature running north-south for more than 80 miles. Two deep holes were drilled in the Oregon half of the lease block, after which the company became discouraged and gave up the venture. No other major activity occurred until the fall of 1961, when Humble, Gulf, and Reserve Oil & Gas Co. began leasing in the Willamette Valley of western Oregon. Superior, Texaco, Standard, and several independent groups entered the activity a few months later. The leasing continued into the summer of 1962, by which time nearly a million acres had been taken. Reserve and Humble drilled three deep tests in the Willamette Valley before the close of 1962. Although no production was discovered, apparently results of the drilling were not entirely discouraging, since leasing continued after drilling was completed, but Humble did drop leases in the area of its first drilling.

Table 1 lists drilling permits issued in the

period July 1, 1960, to June 30, 1962. Figure 2 shows footage drilled in the state during the last 60 years.

Drilling in the 1960-62 biennium was comparable to that in the most active periods of the past (see right). The oil industry experienced a serious recession in 1958-59 because of oversupply and a sharp decrease in demand for petroleum products. This business setback reflects in drilling activity in Oregon for the same period.

Biennial period	No. permits issued	Deep tests drilled	Footage drilled
1954-56	14	8	59,738
1956-58	14	5	46,105
1958-60	8	2	16,275
1960-62	7	5	40,377

Offshore Exploration

Recent advances in technology of deep-water drilling have stirred tremendous interest in the oil prospects of continental shelf lands all over the world. Oil companies hope to find less volcanic rock and thicker sedimentary zones in the offshore area of Oregon than is commonly found onshore. Dr. John V. Byrne (Oregon

Table 1. PERMITS ISSUED BETWEEN JULY 1, 1960 and JULY 1, 1962

Permit No.	Company	Well Name	Location	Total Depth
41	Ross R. Mitchell & Associates	Bliven No. 3	SE $\frac{1}{4}$ sec. 10, T. 8S., R. 5W. Polk County	580'
42	Humble Oil & Refining Co.	Thomas Crk Unit No. 1	NE $\frac{1}{4}$ sec. 18, T. 36S., R. 18E., Lake County	12,093'
43	Ross R. Mitchell & Associates	Bliven-Adams No. 4	NW $\frac{1}{4}$ sec. 15, T. 8S., R. 5W., Polk County	340'
44	Humble Oil & Refining Co.	Leavitt No. 1	NE $\frac{1}{4}$ sec. 2, T. 40S., R. 20E., Lake County	9,579'
45	Two State Oil & Gas Co., Inc.	Vale City No. 1	SW $\frac{1}{4}$ sec. 21, T. 18S., R. 45E., Malheur County	1,185'
46	Reserve Oil & Gas Co.	Esmond No. 1	SW $\frac{1}{4}$ sec. 7, T. 12S., R. 1W., Linn County	8,603'
47	Humble Oil & Refining Co.	F. Wicks No. 1	NE $\frac{1}{4}$ sec. 11, T. 7S., R. 1E., Marion County	7,797'

State University Department of Oceanography) reported in the May 1962 issue of The ORE BIN that volcanic rocks are scarce, if not absent, where samples have been taken from submarine banks off the central coast of Oregon and that there is probably a thick section of sedimentary rock on the shelf in this region which includes rock as young as Pliocene. Byrne also reported that fault and fold structures favorable for the entrapment of oil exist on the continental shelf slope off the central coast.

Following enactment of an offshore lease law by the legislature in 1961, four major companies began geophysical studies in coastal waters of Oregon. In 1962 six others joined in studying the continental shelf lands (see table 2). The 1961 law requires permits for geophysical work offshore to be obtained from the State Land

Board. Oil companies spent close to \$3 million on exploration while making studies offshore in Oregon during 1961 and 1962. No submerged land leases for drilling had been applied for by the close of the biennium. Leases on offshore state land must be placed for bid.

In 1962, Standard Oil Co. became operator under its exploration permit for a six-company group composed of Humble, Pan American, Ohio, Superior, Phillips, and Texaco oil companies. Essentially the same group made aeromagnetic surveys of the coastal region in the summer of 1961. Pure, Mobil, and Richfield oil companies participated in the aeromagnetic surveys but were not with the group

operated by Standard. Besides the geophysical studies offshore, two companies engaged in bottom sampling programs. Drilling into the ocean floor is limited to 500 feet of penetration under the exploration permits. The depth limit is enforced by confining sampling to punch-type coring or to drilling with salt water in uncased hole.

Table 2. PERMITS for OFFSHORE GEOPHYSICAL STUDIES

Company	Type Survey	Federal Lands Exploration Permit	State Lands Exploration Permit
Gulf Oil Corp.	Seismic	8-16-62 to 2-15-62	6-15-61 to 10-12-61
Shell Oil Co.	Seismic	8- 8-61 to 8- 8-62	6-13-61 to 12-31-62
Union Oil Co.	Seismic	8-15-61 to 2-15-63	7-10-61 to 7- 9-63
Standard Oil Co.	Seismic	6- 6-62 to 12- 6-62	9- 1-61 to 8-31-63
Superior Oil Co.	Gravity	7-11-62 to 1-11-63	7-15-62 to 10-15-63

Exploration Costs

The acreages in table 3 are based on revenue from rental of public land, using an average rental rate of 20 cents per acre through July 1960. The Federal government raised rental in September 1960 to 50 cents per acre,

Table 3. CHART SHOWING ACREAGE UNDER LEASE IN OREGON

Biennial Period	Acreage Leased State Land	Rental Collected State Land	Acreage Leased Federal Land	Rental Collected Federal Land*	Est. Acreage Leased-Private	Est. Rental Collected-Private
1954-56	66,678	\$ 38,022	547,500	\$ 219,000	450,000	\$ 90,000
1956-58	16,800	4,000	272,500	109,000	260,000	52,000
1958-60	60,648	30,747	460,000	182,795	400,000	80,000
1960-62	15,349	8,826	231,250	30,201**	800,000	300,000

*37 $\frac{1}{2}$ percent of this money is returned to the counties in which leases are made.

**Rental is probably small because of old leases which require 50 cents per acre the first year and no rental for the second and third years.

and this effectively raised the rate on private lands. Estimated acreage of private land leased was made by using a factor obtained from figures of private land contained in Federal units and from other sources. More than half of the land in eastern Oregon is publicly owned, while west of the Cascade Mountains the government owns a much smaller percentage. This is noticeable in the table, where large acreages of state land appear in two bienniums; during both of these periods the exploration took place in eastern Oregon.

The total exploration expenditures in Oregon between 1902 and 1962 are calculated at more than \$10 million. This estimate is considerably below that of industry's, which places a total of \$12 million on oil exploration in the state between the years 1953 and 1962*. The difference in these figures is understandable, since the department made its estimate by assuming drilling costs to comprise 30 percent of the total exploration expense onshore and offshore expenses to be related to the number of ships employed. An estimate of the upland expenditures was made by a second method, using \$20 per foot for holes drilled with rotary equipment and \$6 to \$8 per foot for holes drilled with cable tools. This amount was considered an approximation of the total spent on investigations including drilling. The estimate obtained for expenditures using this method checked very closely the \$10 million figure. Exploration onshore, which has not resulted in drilling thus far, is not included in the department's estimate. Such companies as Gulf Oil Corp., Shell Oil Co., Richfield Oil Corp., Superior Oil Co., Texaco, Phillips Petroleum Co., Pan American Petroleum Corp., and others have made at least limited studies since 1950 without resultant drilling operations. Also, the department has no way of estimating management overhead charged to exploration.

Figure 3 shows estimated expenditures by oil companies while making studies and test drillings in the state between the years 1902 and 1962. As can be seen on the curve, wildcat activity prior to 1943 did not represent much financial gain for the state. However, during and after World War II, large firms became active, with the result that expenditure on studies and drilling increased considerably during the next 19 years. If exploration continues at the current pace for the next few years, a noticeable effect will be felt upon the state's economy.

Future Exploration

Offshore studies are expected to continue for at least another year before any land is nominated for bidding. It is hard to foretell how much competitive bidding will develop for Oregon's submerged land, but, using lease sales in Washington as a guide, most of the continental shelf will go for no more than rental, with a few more desirable parcels bringing bids of several dollars per acre.

More drilling is expected in the Willamette Valley within the next 2 years, and this appears to be Oregon's best hope for finding production in the near future. An independent Texas group represented by E. W. McDowell of San Antonio, Texas, leased nearly 25,000 acres of land in Coos County during the summer of 1962 for what is hoped to be a very interesting oil test. No activity is expected in central Oregon for a time, because no leasing of consequence has taken place since Humble Oil & Refining Co. drilled in Lake County in 1960. One or more tests will probably be drilled next biennium in the Ontario-Payette Basin, with hopes of discovering gas production.

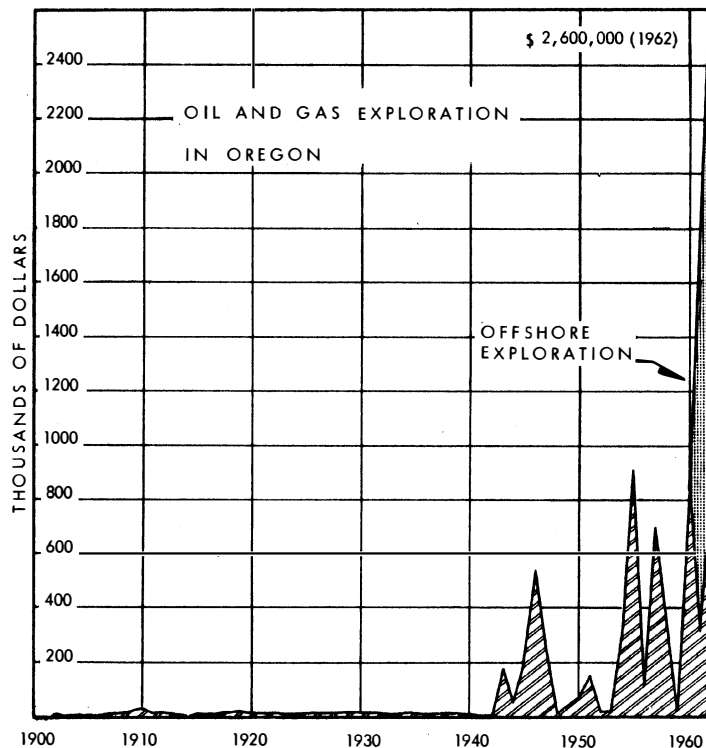
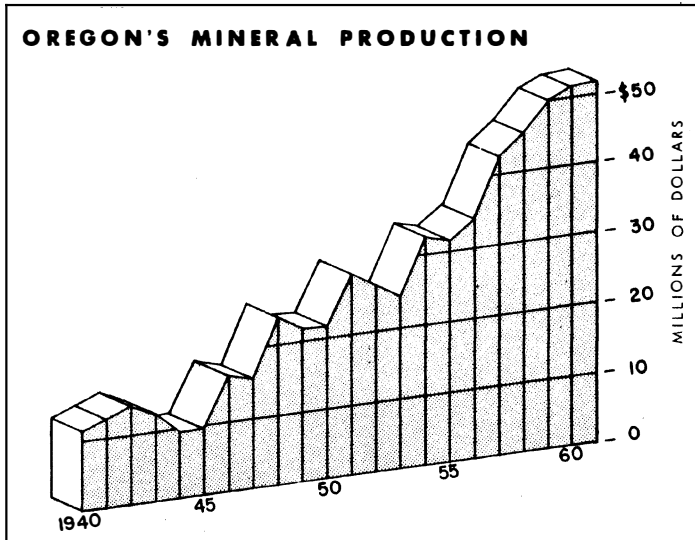


Figure 3. Curve showing exploration expenditures.

* R. M. Touring, Area Geologist, Humble Oil & Refining Co., Los Angeles; talk before the Oregon Press Meeting October 5, 1962, Benson Hotel, Portland, Oregon.

OREGON'S MINERAL INDUSTRY

The mineral industry in the state continued on an "increased yield" basis during the biennium, just as it has for nearly a quarter of a century. Value of raw minerals produced in the state in 1961 was \$51,467,000. This figure does not accurately reflect the total impact of the mineral and metallurgical industry in the state, which accounted for payrolls amounting to nearly \$65,000,000 (see table below). Mining and metallurgy supply a much-needed balance wheel to the state's economy, which has a characteristically seasonal fluctuation, by providing steady employment throughout the year.



Sand and gravel and crushed stone continued to be the most important mineral commodities produced in the state, both in respect to dollar value (\$34.5 million) and to the communities dependent upon them. A growing awareness by various county planning commissions of the vital need for these building and construction materials has resulted in the taking of preliminary steps to identify potential sources, which may then be protected from encroaching urbanization until they can be exploited and eventually rehabilitated for public-use sites or other beneficial community uses.

Production of lightweight aggregates, both natural and expanded, increased during the biennium. The state has large reserves of pumice, cinders, and expansible shale and should continue to supply not only local needs but those of neighboring states as well. Quarrying of ornamental and architectural building stone increased

over previous years. Large quantities of volcanic tuffs of many textures and colors occur in the state and form the basis for the industry.

The first asbestos produced in the state in many years is being mined and processed in Grant County, and bentonite mined in Crook County helped quench northwest forest fires. The state's oldest manufacturing activity, the brick and tile industry, continued to produce brick and tile as it has for nearly a century. In addition to these prosaic products, one plant began creating a variety of art forms including planters, vases, figurines, wind chimes, and patio pieces. Limestone was produced at four quarries scattered about the state, principally for the production of portland cement and burnt lime.

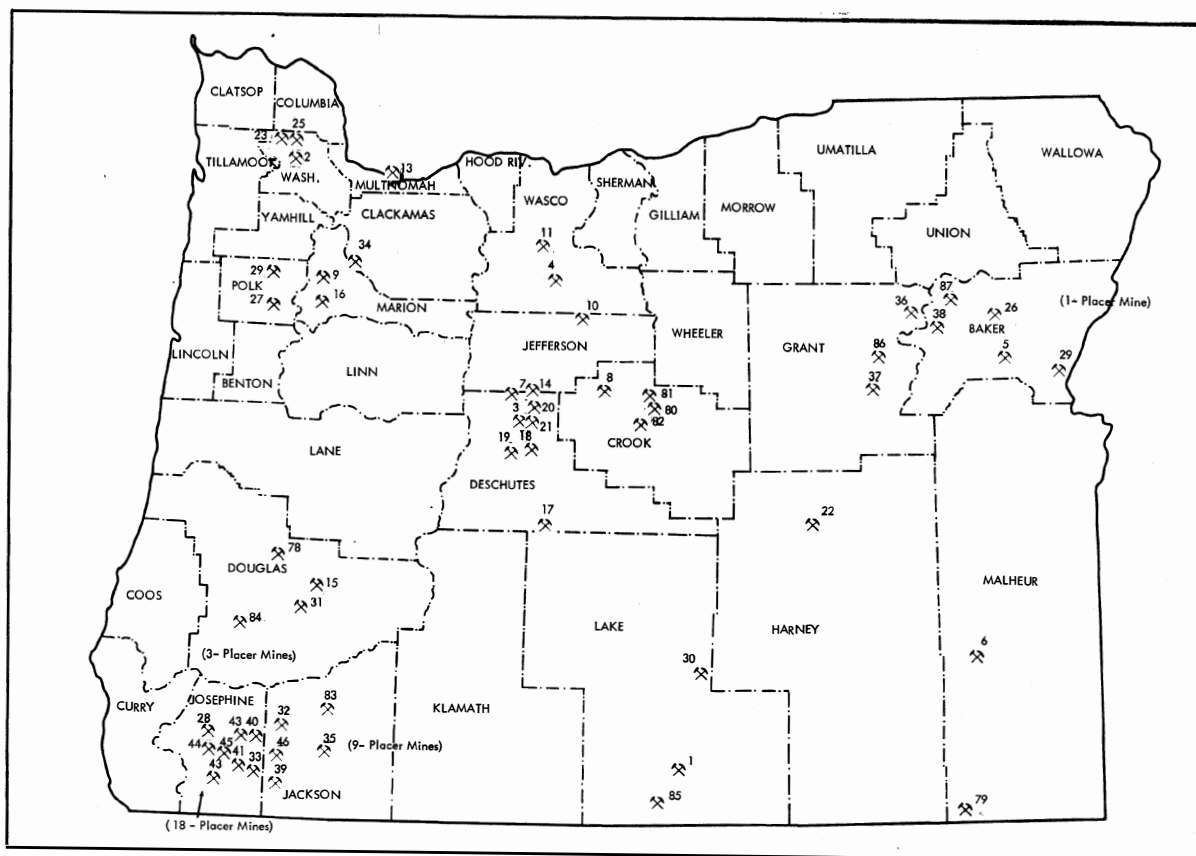
The only nickel mine and smelter in the United States continued its around-the-clock operation at Riddle, pumping \$3,000,000 in annual payrolls into Douglas County. Resumption of activity at the Oregon King mine in Jefferson County added silver to the state's list of metals. Exploration work at the Buffalo mine in Grant County, and in the Bohemia District of Lane County, revealed lower extensions of ore beneath previously worked-out areas. Interest in iron-ore deposits prompted several large companies to examine high-grade deposits, but the only ore mined was from the Scappoose district and that was used for paint pigment. Mercury mining declined notably during the biennium, with only one or two small operations working on a part-time basis. Uranium ore from the Lucky Lass and White King mines in Lake County was shipped to Salt Lake City for treatment. The aluminum ores of northwestern Oregon, discovered by the department in 1944, were explored by a major producer during the biennium.

Oregon Mineral Industry Employment and Payrolls*

	1960 Employment	Payrolls	1961 Employment	Payrolls
Mining	1,181	\$6,662,000	1,112	\$6,558,000
Mineral manufacturing	2,860	16,740,000	2,674	16,216,000
Primary metals	5,751	37,128,000	5,532	36,662,000
Miscellaneous	796	4,786,000	821	5,274,000
Totals	10,588	\$65,316,000	10,139	\$64,710,000

*Oregon State Employment Compensation figures.

ACTIVE MINES



Building Stone Quarries

1. Banasco
2. Carver
3. Cinder Hill
4. Hawaiian Travertine
5. Moon Mesa
6. Natural Stone
7. Ochoco Stone
8. Oregon Emerald
9. Oregon Tuff Stone
10. Oregon Rose
11. Oregon Rainbow
12. Red Rock
13. Rocky Butte
14. Sahara Tan
15. Snow Bird
16. Stayton Flatrock
17. Williamson

Lightweight Aggregates

18. Cascade Pumice Corp.
19. Central Oregon Pumice Co.
20. Cinder Hill Quarry
21. Deschutes Concrete Products Co.
22. Harney Concrete Tile Co.
23. Northwest Aggregates, Inc.
24. Red Rock Mine
25. Smithwick Concrete Products Co.

Limestone

26. Chemical Lime Co.
27. Dewitt's Polk County Lime Co.
28. Ideal Cement Co.
29. Oregon Portland Cement Co.

Miscellaneous Nonmetals

30. Alkali Lake Sodium
31. Big Quartz Mine
32. Bristol Silica Co.
33. Leverett Marble
34. Wilhoit Coal Mine

Gold Lode Mines

35. Ashland
36. Buffalo
37. Cobalt-Gold
38. Columbia-North Pole
39. Ducharme No. 6
40. Greenback
41. Humdinger
42. M. C. Claim
43. Oro Grande
44. Reno
45. Snow Bird
46. Warner

Gold Placers (47-77)

- Anderson
Baker Flat
Buddy
Bear
Brown
California Bar
Can Can
Coarse Gold Creek
Crump
De Janvier
Edmonds
Esterly
Forest Queen
Goff
Golden Bar
Golden Lyon
Gold Nugget
Hogum Creek
Johnson
King
Last Chance
Lucky Strike
Maloney
Oregon Bar
Rocky Gulch
Ruble
Schaffer
Schoemaker
Sterling
Sutter
Upper Hogum

Mercury Mines

78. Bonanza
79. Bretz
80. Maury Mt.
81. Mother Lode
82. Towner
83. War Eagle

Miscellaneous Metals

84. Hanna Nickel Smelting Co. (nickel)
85. Lucky Lass Mine (uranium)
86. Standard Mine (copper, gold)
87. Twin Mt. Mining Co. (molybdenum)

(Exact locations of gold placers not shown)

OREGON'S GROWING METALLURGICAL INDUSTRY

Modern metallurgy is concerned not only with the physical and chemical properties of metals but with the nuclear electron shell characteristics as well. Today's metallurgy is far divergent from the pure gold and solid copper objects shaped between two smooth stones by the first metallurgists. In Oregon a growing space-age and reactive metals industry now numbers more than half a dozen firms which collectively can smelt, refine, mold, cast, roll, draw, mill, fabricate, and test exotic metals such as tungsten, titanium, zirconium, hafnium, tantalum, and columbium. These metals are also available as oxides, carbides, chlorides, and hydrides, and, in ingot, powder, and mill forms. The industry stems from basic research by the U.S. Bureau of Mines during World War II at its Albany laboratories. Plants and laboratories are now located at Albany, Beaverton, and Portland. All of the raw materials are imported into the state, some of them from half way around the world.

The presence of the exotic metals plants and laboratories in the state provides an excellent example of the possibilities for further growth in this field. The plants and laboratories are here almost solely because of the nearly ideal living and working conditions for the highly trained personnel which operate them and do basic research. As pointed out above, none of the raw materials originate in the state and, furthermore, almost none of the finished products are consumed here.

The abundance of low-cost electrical power has attracted various electro-process industries which produce aluminum, nickel, elemental silicon, ferrosilicon, calcium carbide, ferrochrome, steel, and the various exotic metals. Oregon continues to be the only state in the Union which produces and smelts nickel. The Hanna Nickel Smelting Co. mine and plant at Riddle in Douglas County employs 450 men on a three-shift, year-around operation and consumes \$1.3 million worth of electrical energy annually. The plant has the world's largest ferrosilicon furnace which is used to supply an intermediate smelting product. High-purity silica is smelted by National Metallurgical at its Springfield plant to produce elemental silicon used by the electronic industry and as an alloy in aluminum and steel. The operation uses silica from a quarry in Jackson County and some imported from Nevada.

Two aluminum reduction plants, operated by Reynolds Aluminum Co. at Troutdale and Harvey Aluminum Co. at The Dalles, use imported alumina in their electrically energized potlines. In the Portland area, two plants, operated by Pacific Carbide & Alloys and the Electrometallurgical Corp., use electric furnaces to manufacture calcium carbide from limestone and coke. The carbide is used to generate acetylene gas and forms the basis for many chemicals and plastics.

Considerable interest in the establishment of a ferrochrome plant in the state has been shown during the past two years. Feasibility studies by private groups and public agencies have shown that chromite ores in Oregon and northern California are amenable to the production of high-carbon ferrochrome and that there are adequate reserves of ore for a moderate sized plant. Remoteness from potential markets for the finished product, financing for the construction of the plant, and competition from existing producers pose serious problems which would have to be overcome before a plant could become a reality. Establishment of a ferrochrome plant would stabilize the chromite mining industry, which has been active during national emergencies and idle at other times. A survey completed by the department shows that in southwestern Oregon alone there are 280 chromite mines and prospects. The creation of a dependable, long-range market would undoubtedly greatly increase this number.

Oregon has portland cement plants located in Baker, Clackamas, and Jackson Counties. The three plants have been in continuous operation for many years and have repeatedly increased their capacity to keep pace with the perpetually growing demand. High-grade limestone is burned in a modern plant near Baker to produce burnt lime for northwest process industries.

At Lakeview a solvent extraction uranium yellow-cake plant capable of handling over 200 tons of ore per day is currently idle. Originally, the plant processed ore from the White King Mine, which is located a short distance north of the plant. At the present time uranium ore from two properties in the area is shipped to Salt Lake City for processing. The plant contains basic equipment which could be used for a variety of chemical extraction processes.

During the biennium, Coast Asbestos Co. completed and placed in operation a beneficiation plant near Mt. Vernon which treats crude asbestos ore mined from an adjacent pit. The ore is crushed, screened, and air-separated into various grades before being shipped to California markets. The property was operated during World War I but the present plant is the first of its kind in the state.

The following pyroprocess plants treating Oregon minerals should be mentioned, although they are not shown on the map on the cover. In Washington County two plants expand shale to make lightweight aggregate largely used in concrete block and prestressed girders and panels. Twenty brick and tile plants which use local clays and supply in most instances red firing ware for local consumption are scattered across the state.

FINANCIAL STATEMENT

The department's activities are financed by money appropriated by the Legislature out of the State's General Fund. Appropriations received by the department are divided into accounts classified as follows: Personal Services; General Operating & Maintenance; Capital Outlays; and State Geological Map. Funds appropriated for use under one classification may not be used for expenditures in a different classification. All departmental expenditures are evidenced by warrants drawn on the State Treasurer and are audited by the office of the Secretary of State.

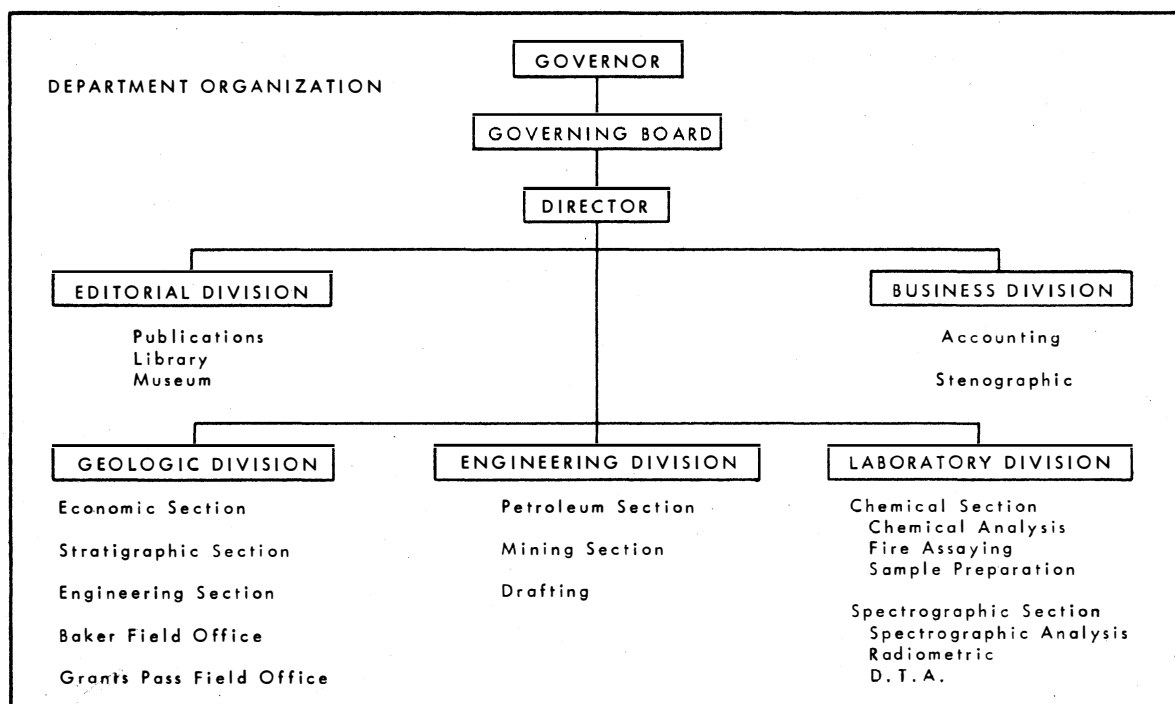
Funds received by the department through the sale of publications, spectrographic fees, oil and gas test permits, and miscellaneous receipts amounted to \$8,438.64 in the period covered by this report. All receipts of the department are returned intact to the General Fund.

Department expenditures in the 1959-61 biennial period, the amount appropriated for the 1961-63 biennium, and the request for appropriations for the 1963-65 biennium are shown on the facing page.

The 1963-65 budget request more accurately reflects the basic monetary requirements of the department than did the 1961-63 allocation. It was recognized prior to the beginning of the 1961-63 budget period that insufficient funds had been appropriated to pay all the salaries of the employees for the whole biennium and to meet the other personal service expenses required by law. This deficiency came about when, in the budget review, it was anticipated that some positions would be left vacant due to retirement or resignation. As this department's employment is very stable (average tenure of the 12 technical positions is 11 years) no vacancies occurred. To obtain the necessary funds for salaries, it was decided by the Governing Board, with the concurrence of the Department of Finance and Administration, to request the Emergency Board to transfer to Salaries and Wages funds that would accrue by postponement of printing of researches. Salary and other Personal Services requests for the 1963-65 biennium do not take into account the salary increases which should have resulted from the new classifications and position adjustments made in the department during the present biennium. It is hoped that funds to meet the reclassification will be made available from anticipated funds granted for state-wide salary adjustments.

The 5½ percent increase in General Operating and Maintenance over the 1961-63 allocation is largely a reflection of the increased cost of doing business and meeting the expenses of field men.

The increase in Capital Outlay marks a return to the department's policy of obtaining one piece of scientific equipment each biennium in the attempt to keep our laboratories from getting too far out of date on analytical and research instruments. Effort will also be made to replace out-moded or worn-out furniture and to better equip our offices.



COMPARATIVE STATEMENTS OF EXPENDITURES

	1959-1961 Total Expenditures 7/1/59-6/30/61	1961-1963 Estimated Expenditures 7/1/61-6/30/63	1963-1965 Funds Requested 1963-1965
<u>Personal Services:</u>	<u>\$273,650.45</u>	<u>\$301,391.00</u>	<u>\$314,460.00</u>
<u>General Operating & Maintenance:</u>	<u>\$ 65,887.60</u>	<u>\$ 75,598.00</u>	<u>\$ 80,205.00</u>
Office Supplies	1,832.30	1,800.00	2,400.00
Telephone & Telegraph	2,791.42	3,608.00	3,700.00
Postage, Freight, Express	2,942.29	3,000.00	3,000.00
Printing	4,797.35	15,000.00	15,000.00
Rents	24,722.10	25,155.00	25,500.00
Premiums & Assessments	473.97	700.00	700.00
Auditing	488.54	950.00	1,100.00
Industrial & Laboratory	3,689.72	3,000.00	3,500.00
Heat, Light, Power	705.37	600.00	1,000.00
Library	743.13	600.00	750.00
Laundry	83.95	85.00	85.00
Photos & Blueprints	823.14	600.00	1,200.00
Gas & Oil Well Law Administration	310.66	400.00	600.00
All Other	490.25	600.00	600.00
Building & Ground	1,756.71	700.00	700.00
Travel Expenses: In State	17,557.98	17,000.00	18,570.00
" " : Out of State	<u>1,678.72</u>	<u>1,800.00</u>	<u>1,800.00</u>
<u>Capital Outlays:</u>	<u>\$ 9,178.22</u>	<u>\$ 4,200.00</u>	<u>\$ 8,347.00</u>
Office Furniture, Equipment	1,851.39	600.00	2,816.00
Motor Vehicles	1,650.00	3,600.00	3,450.00
Laboratory & Field	2,484.06		2,026.00
Library & Others	<u>3,192.77</u>		<u>55.00</u>
<u>Special Requests:</u>	<u>\$ 14,761.93</u>	<u>\$ 15,000.00</u>	<u>\$ 15,000.00</u>
State Geological Survey	<u>14,761.93</u>	<u>15,000.00</u>	<u>15,000.00</u>
 Total Expenditures	 <u>\$363,478.20</u>	 <u>\$396,189.00</u>	 <u>\$418,012.00</u>

SUMMARY

	<u>Expended 1959-1961</u>	<u>Appropriated 1961-1963</u>	<u>Requested 1963-1965</u>
Personal Services	\$273,650.45	\$301,391.00	\$314,460.00
General Operating & Maintenance	65,887.60	75,598.00	80,205.00
Capital Outlays	9,178.22	4,200.00	8,347.00
State Geologic Map	<u>14,761.93</u>	<u>15,000.00</u>	<u>15,000.00</u>
TOTAL	\$363,478.20	\$396,189.00	\$418,012.00

THE APPROPRIATION

(1961 - 1963 FISCAL BIENNIUM)

Salaries and Wages	\$ 301,391	76.00 percent
General Operating & Maintenance	75,598	19.15
Capital Outlays	4,200	1.06
State Geologic Map	15,000	3.79
	<hr/>	<hr/>
TOTAL	\$ 396,189	100 percent

AND WHAT IT PAID FOR

(1960 - 1962 REPORTING PERIOD)

2,572 Square miles geologically mapped	3,158 Mineral identifications
State Geologic Mapping 600	
Quadrangle Mapping 405	5,307 Chemical analyses
Special Studies 1,567	2,287 Radiometric determinations
182 Field investigations	1,268 Spectrographic analyses
6 Commodity studies	721 Petrographic examinations
12 Engineering-geology studies	119 Talks
35 Cooperative projects with other agencies	27 Field trips for groups
10 Publications issued	6 Office tours
51,850 Copies of The ORE BIN	22,841 Pieces of mail sent (excludes bulk mail)
345 Mineral sets	26,459 Pieces of mail received
14,596 Visitors	7 Television and radio appearances
	14 Exhibits judged