

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
1069 State Office Building
Portland, Oregon 97201

BULLETIN 63

SIXTEENTH BIENNIAL REPORT OF THE STATE GEOLOGIST

1966 - 1968

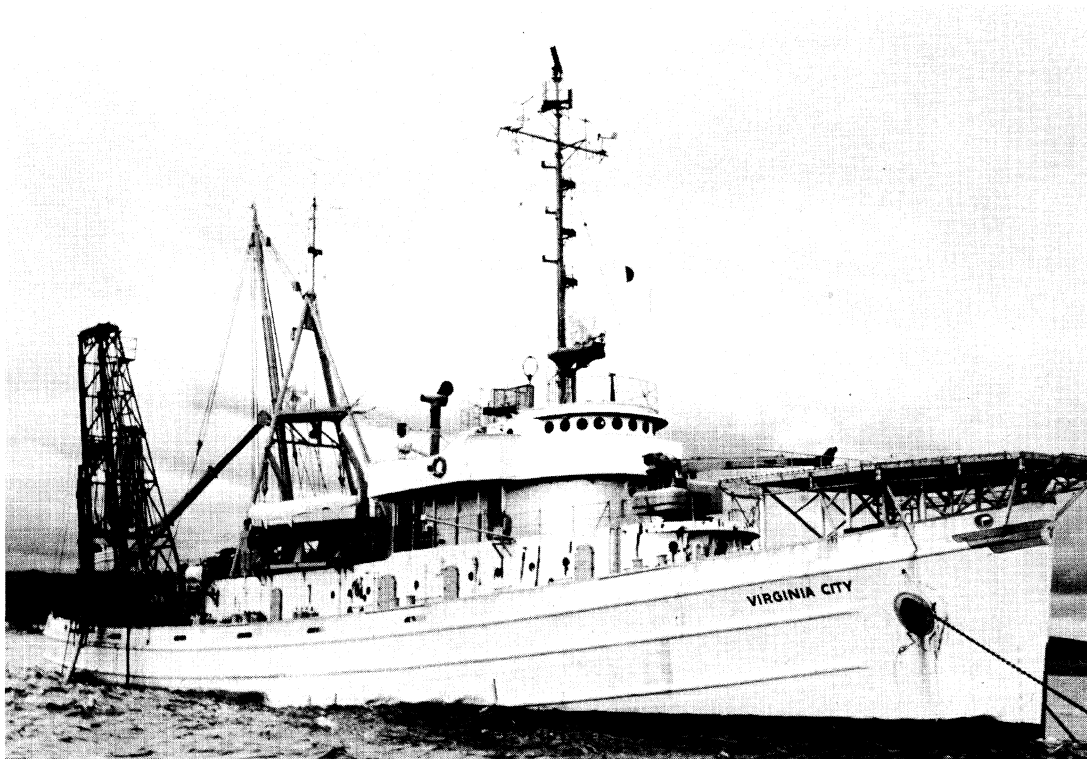


1968

STATE GOVERNING BOARD

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

Hollis M. Dole
State Geologist



USBM MARINE DRILLING VESSEL - THE R/V VIRGINIA CITY

The R/V Virginia City, shown in the above photograph, left the U.S. Bureau of Mines Marine Mineral Technology Center at Tiburon, Cal., in August 1968 to work off the southern Oregon coast. Drillings were to be made in four areas having concentrations of heavy minerals, mainly gold, platinum, chromite, magnetite, and zircon. The four areas are situated in the ocean, mostly in lands under State control, 6 miles north of Coquille, at Cape Blanco, north of the mouth of the Rogue River, and at the mouth and south of the mouth of the Rogue. The ship has a capability of core drilling to a depth of 240 feet from the ocean surface. Several years of work by the Department of Oceanography at Oregon State University and by the Office of Marine Geology and Hydrology of the U.S. Geological Survey identified the deposit areas. This cooperative work is part of the Department of Interior's Heavy Metals Program.



DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

ADMINISTRATIVE OFFICE

1069 STATE OFFICE BLDG. • PORTLAND, OREGON • 97201 • Ph. (503) 226-2161 Ex. 488

TOM McCALL
GOVERNOR

STATE GEOLOGIST
HOLLIS M. DOLE

GOVERNING BOARD

FRANK C. McCOLLOCH, Chairman
Portland

HAROLD BANTA, Baker

FAYETTE I. BRISTOL, Rogue River

To His Excellency, The Governor
of the State of Oregon

and to

The Fifty-fifth Legislative Assembly of the State of Oregon

Sirs:

We submit herewith the Sixteenth Biennial Report of
the State Geologist, covering activities of the Department of
Geology and Mineral Industries for the period from July 1,
1966, to and including June 30, 1968.

Respectfully,

Frank C. McCulloch, Chairman
of the Board

Harold Banta, Member

Fayette I. Bristol, Member

Portland, Oregon
July 1, 1968

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HISTORY OF THE DEPARTMENT

1872 - 1937

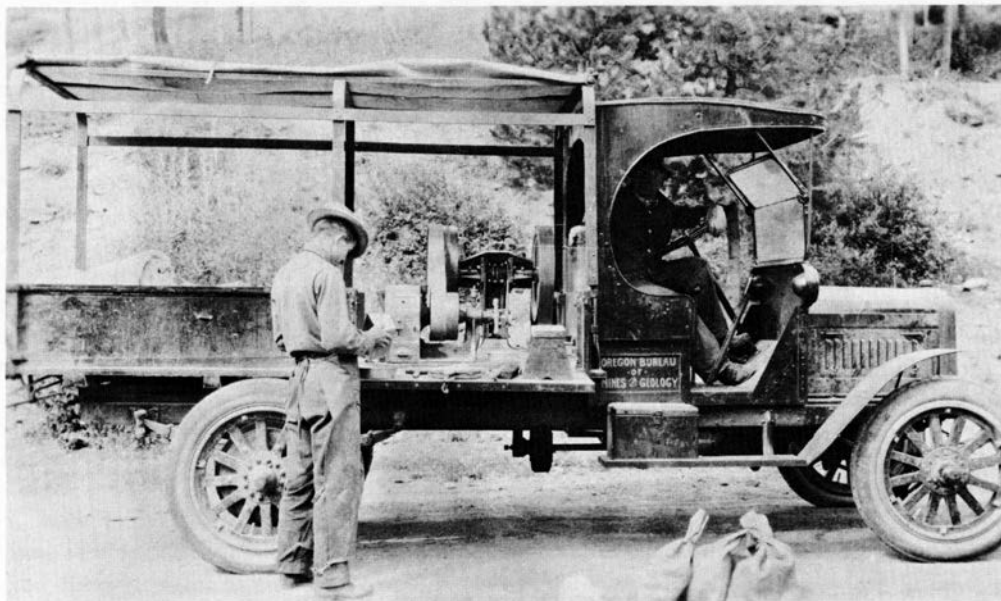
Oregon recognized the need for the office of State Geologist very early in its history. It was in 1872, only 13 years after Statehood was achieved, that the Legislature appropriated \$1000 a year to Dr. Thomas Condon and bestowed on him the title of State Geologist. Actually, this was an interim appointment and appropriation, awaiting the foundation of the University of Oregon. In 1876 the Board of Regents elected Condon to the chair of geology and natural science of the State University, and the expenses of the State Geologist became a part of the University appropriation.

Dr. Condon died in 1907. His passing left a gap in the study of Oregon geology until 1911, when the Legislature again stepped in. This time a mineral resource department was founded and was named the Bureau of Mines of Oregon. The headquarters were located at Oregon State University, with Mr. Henry M. Parks, professor of mining engineering, as director. In 1913 the Bureau's responsibilities were expanded and the Legislature changed the name to the Oregon Bureau of Mines and Geology. In 1923 the Bureau was incorporated with the School of Mines at Oregon State. This arrangement did not fit the State's needs in the fields of mining and geology, so in 1925 the Legislature created the Oregon Mining Survey and in 1929 the State Mining Board. Neither the Survey nor the Board had offices or staff, with a result that Oregon was essentially without guidance and encouragement in the development of its mineral industry.

1937 - 1968

The Legislature of 1937, in seeking ways to increase the State's industrial base and in response to the many prospectors and mining people, established the present Department. The administrative office was placed in Portland, and field offices and assay laboratories were located in Grants Pass and Baker. This office arrangement still exists, but the assay laboratories were consolidated into one laboratory in Portland during World War II.

In 1941 the Legislature added a spectrographic laboratory to the Department, not only as an aid to the work of the staff but also to help Oregon's burgeoning metal industry and to afford the law-enforcement agencies of the State a tool for crime detection and prosecution. The Legislature required that the



Mobile crushing unit accompanied field parties of Oregon Bureau of Mines and Geology (circa 1918).

spectrographic laboratory make a charge for its services.

The only regulatory responsibilities of the Department were assigned to it in 1953, when the Legislature adopted the Oil and Gas Act. This necessitated the hiring of a petroleum engineer. In 1965 the Legislature passed an act (ORS 517.410) requiring State agencies to consult with the Department before issuing leases for mining or for oil and gas exploration.

Staff

The first Director of the Department was Mr. Earl K. Nixon. He was followed by Mr. Fay W. Libbey in 1944. Upon Libbey's retirement in 1954, the present Director, Hollis M. Dole, was appointed Acting Director and, in 1955, Director. The Legislature changed the title of the administrator from Director to State Geologist in 1965, thus returning to the title given Dr. Condon nearly a century before, when Oregon first funded the study of geology at the State level.

The size of the technical staff has remained much the same over the years. By July 1937 the first Director, Mr. Nixon, had a staff of two mining engineers, five geologists, and two assayers, a total of nine. In 1943 the staff consisted of one spectroscopist, one ceramist, one editor-librarian, two assayer-chemists, two mining engineers, and six geologists, a total of 13. In 1968 the permanent staff of the Department was one assayer-chemist, one spectroscopist, one editor-librarian, one petroleum engineer, one mining engineer, one cartographer, and eight geologists, a present total of 14.

Recruiting standards of the Department are high. All engineers must be registered and have a minimum of 5 years experience; geologists must have a minimum of a master's degree and 5 years experience; and all other professional staff members must have college degrees in their specialties and several years experience. Various specialists in the mineral and geologic fields have been represented on the Department staff since 1937. In 1939, 1940, and 1941 we had a metallurgist; in 1943, 1948, 1949, and 1950 a ceramist, and from 1944 through 1958 a micropaleontologist. Stability of the technical staff, however, has been a mark of the Department. At the present time (July 1968) the years in service of the technical staff are: two in excess of 25 years with the Department; two more than 20 years; two more than 15 years; four more than 10 years; three more than 5 years; and one less than 5 years. The latter position is a replacement for our assayer-chemist, who retired in 1967 after 24 years with the Department. The business and secretarial staff has also given long and loyal service to the Department, with one secretary serving for more than 25 years, two more than 20 years, and one nearly 5 years. The accountant has been with the Department for 15 years. Since its founding, the Department has retired five of its employees. We believe this to be a singular employment record.



Field transportation equipment with geophysical instruments (1968).

Although the functions and program areas are clearly set out in the Act establishing the Department, assignment of personnel and the specialties of the scientists and engineers have lent different emphasis to the activities over the years, in order to respond to the State's needs.

In 1937, when the Department was organized, the first need was for an inventory of the metals and minerals present in the State. This led to the publishing of the Metal Mines Handbooks. In the 1930's there were many hundreds of people in the hills prospecting, with a result that a large part of the time of the engineers and geologists was spent serving this segment of Oregon's citizens. During World War II the staff turned to the study of the strategic minerals -- mercury, nickel, chrome, iron, copper, manganese, lead, zinc, and cobalt -- and government programs. It was during this period that the high-iron bauxites of northwestern Oregon were first called to the attention of industry and were extensively explored. Industry is still continuing this work and is still "picking up land." Following World War II, attention was given to building materials. During this period the Department demonstrated the expansibility of the marine shales of northwestern Oregon and the usefulness of the pumice, volcanic cinders, ash, and perlite for use in light-weight blocks, plaster, and other building applications. The many decorative stones in Oregon useful for facing were also emphasized. During the Korean crisis and the stockpiling program, Department geologists and engineers again concentrated on the strategic minerals, with uranium being added to the list. Considerable attention was given to the various Federal Acts setting up the stockpiles. The nickel smelter and mine near Riddle in southwestern Oregon, Oregon's largest mine and the nation's major source of strategic nickel, were put into operation, and the uranium plant at Lakeview was started up in this period.

Reorganization and its results

In 1959 the Department began a reorganization of its staff and publications that is continuing today. Bulletins were issued on a commodity basis instead of on an areal coverage. Since 1959 these have covered chrome, mercury (three years in preparation and issued two years before the large price rise), and gold and silver (five years in preparation and published six months after the dual price for gold was announced). Other publications were on properties thought to offer exceptional promise (the Oregon King and Almeda mines and the lode mines in the central part of the Granite Mining district).

Oil and gas exploration reached a high in the mid-1960's with more than 500,000 acres under lease in the Willamette Valley and nearly 2 million acres in southeastern Oregon. It was the offshore "play," however, that attracted the most attention and resulted in the largest expenditure of money, more than \$60 million.

Description and delineation of terrain unique to Oregon that might have special use resulted in a number of federally sponsored programs. One was the establishment of the Blue Mountain Seismic Station near Sparta in Baker County, as part of the Vela Uniform program for the detection of underground nuclear explosions. Another was the utilization of the raw volcanic landscape of central Oregon as an astronaut-training area and also as a source of lunar reference rocks and other volcanic materials for a variety of NASA and other government agency and university research work related to the space program. The name "Moon Country" was applied to central Oregon. It is considered significant that, since the Department started its investigations of Oregon's recent volcanic landscape in 1959, Oregon State University has added two volcanologists to its teaching staff and the University of Oregon established the Center for Volcanology, a group that already has become world renowned.

One of the major contributions the Department has made to the State in the past few years has been through its geological engineering studies for urban planning. This work is used by the individual home owners, the county road departments, planning agencies at all levels, industrial and real estate developers, utilities, and anyone else interested in ground stability, ground-water possibilities, effluent disposal, source of aggregate, and geologic hazards. The first of these reports was "The Engineering Geology of the Tualatin Valley Region."

Sophisticated studies that have indirect use in the search for mineral deposits and the understanding of the earth were published and programs initiated. The published report was a series of gravity maps of Oregon, both onshore and offshore, at a scale of 1:500,000 and a contour of 10 milligals. The project under way is a systematic sediment sampling of stream drainages throughout the State. The sediments are analyzed by geochemical and spectrographic methods that will detect elements in parts per million and should indicate the more mineralized regions of the State and point to areas that ought to receive closer scrutiny by industry.

The demand by the public, resulting from greater mobility, more leisure time, and more extensive recreational facilities, to know more about scenic and interesting Oregon has not gone unnoticed. The format of the Department's monthly publication, the ORE BIN, was completely revamped in 1962 and articles on State Parks, recreation areas, unusual formations, and "rock-hound" items were featured. To call attention to an even wider range of natural phenomena the Department, in cooperation with Portland State College and the Northwest Meteoritical Society, proclaimed 1968 as The Year of the Meteorite, and urged the public to join in a concerted search to discover or rediscover these important and interesting specimens, our only material from "outer space." The interest shown by science departments of grade and high schools throughout the State and by the public in general resulted in the publication of Miscellaneous Paper No. 11, a collection of eight articles reprinted from The ORE BIN.

Cooperation with the geology departments of the universities was expressed in the publication of three guide books. The first was "Field Guidebook - Geologic Trips along Oregon Highways," that was used by a college teachers' conference in geology put on by the Geology Department at Oregon State University; the second was the "Lunar Geological Field Conference Guide Book," which was the "bible" of the International Lunar Field Conference sponsored by the University of Oregon Department of Geology and the New York Academy of Science, and the third was the "Andesite Conference Guidebook," which was used by the International Conference on Andesites sponsored by the Center for Volcanology in the Department of Geology at the University of Oregon, the International Upper Mantle Committee, and the Department. The public demand for this type of publication is demonstrated by the fact that the first guide book was out of print within two years, the second before the announcement of its publishing was made (it was subsequently republished by a private firm with the State's permission), and the third (published in June 1968) is receiving heavy sales. The ORE BIN is also used by universities, both in State and out, to publish Oregon geologic news notes, preliminary reports on researches in Oregon, and short articles which probably would take some time to get into print without the availability of this medium.



Participants of International Conference on Andesites held at Bend, 1968. Fifty-two scientists from 11 countries attended this second international conference on Oregon's volcanics. The Department published the guide book which was included in the International Upper Mantle Project's scientific reports. The book contains road logs on Oregon's Cascades which will be enjoyed by the tourist. (Photograph by Earl C. Roarig, Bend, Oregon.)

FUNCTIONS OF THE DEPARTMENT

The principal functions of the State of Oregon Department of Geology and Mineral Industries are to conduct studies and publish reports on the geology and mineral resources of the State in order to:

- (1) Aid in the State's economic development;
- (2) Give industry, the people of the State and government agencies reliable data, information, and advice on this segment of Oregon's natural resources;
- (3) Inform people and industry of geologic hazards; and
- (4) Provide greater enjoyment of our scenic resources through a better understanding of them.

Other functions are to provide analytical services, regulate oil and gas drillings, establish and maintain a geological museum and library, answer inquiries from the general public and the school children of the Nation, and to encourage a better understanding of the world around and below us by interested laymen and students through public appearances and publications.

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).

ORGANIZATION OF THE DEPARTMENT

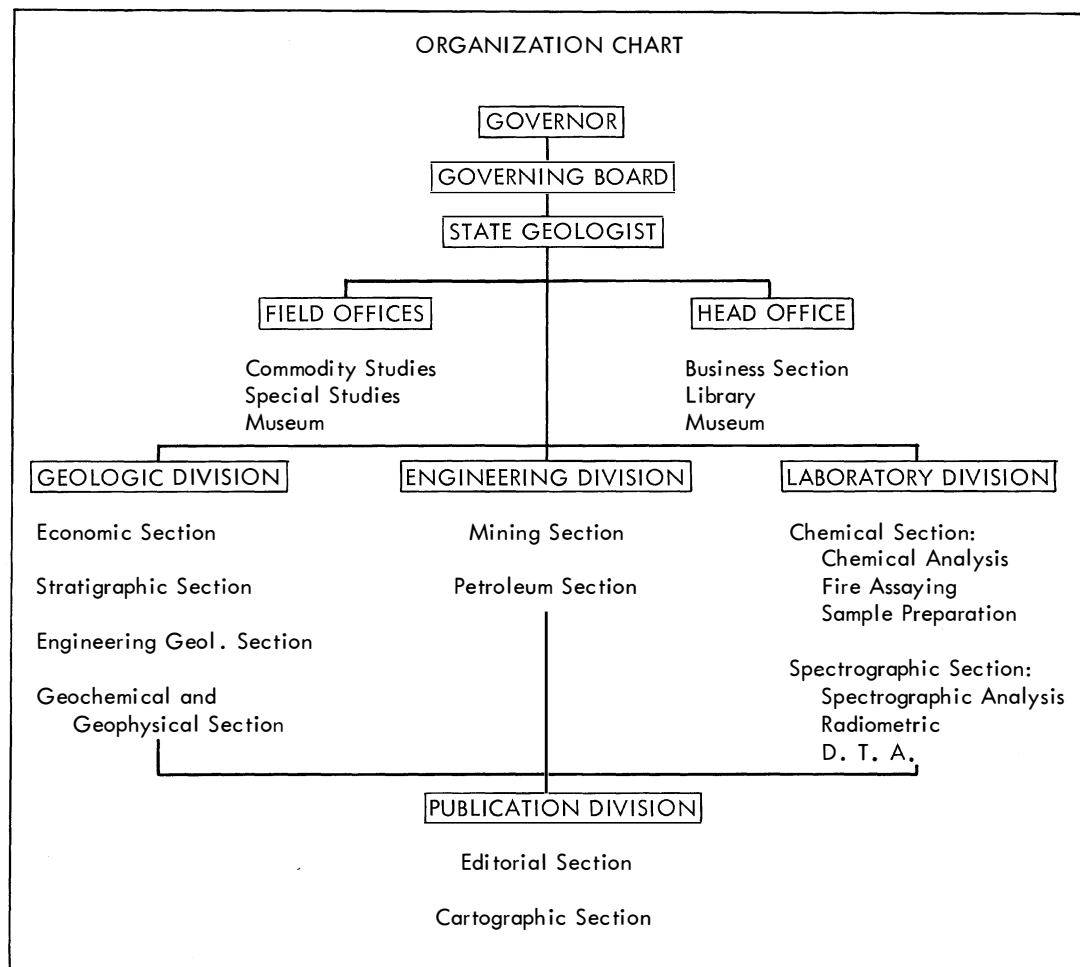
Administration

The Department is "administered by a governing board of three citizens of Oregon appointed by the Governor" (ORS 516.80). By law, the board is required to meet four times a year. The present members are:

Frank C. McColloch, chairman, of McColloch, Dezendorf, and Spears, Portland attorneys;
Fayette I. Bristol of Grants Pass, owner of Bristol Silica Co.; and
Harold Banta of Banta, Silven, and Young, Baker attorneys.

Meetings were held during the past biennium at the following times, in Portland: August 19 and October 28, 1966; March 31, June 23, September 15, and November 17, 1967; and March 15 and May 31, 1968.

The governing board appoints the State Geologist, who serves at the pleasure of the board. ORS 516.120 sets out the minimum qualifications for selecting the State Geologist as: "He shall be qualified



to perform as well as to direct the technical and executive work of the Department, and shall be either a geologist with a broad background of mining and engineering experience or a mining engineer with a broad background of geological experience, whose additional qualifications shall be an experience record which includes five years in charge of important work in either mining engineering, geology, or both, and a minimum total experience of 10 years in these fields."

Offices

The administrative offices and laboratories of the Department are located in the State Office Building in Portland. It has a full-time staff composed of the State Geologist, three geologists, one mining engineer, one petroleum engineer, one spectroscopist, one assayer-chemist, one cartographer, one editor-librarian, two secretaries, and one accountant. Permanent field offices are located in Baker and Grants Pass and are staffed by two geologists and one secretary at each location. A temporary field office is established to accommodate the work of the urban geology program; in 1967 this was located in Beaverton and in 1968 in Salem. As work progresses up the Willamette Valley, the office will be moved to keep pace with the work. A warehouse is located in Portland to house cuttings and cores from oil explorations, publication reserves, field equipment, and permanent records.

Staff assignments

To carry out the duties and objectives of the Department, four main divisions have been established: 1) GEOLOGIC; 2) ENGINEERING; 3) LABORATORY; and 4) PUBLICATION.

1) THE GEOLOGIC DIVISION has four major sections, each headed by a geologist who has specialized in his assigned field. The section head has the responsibility of planning programs and projects and seeing that they are carried to completion. These four sections and their responsibilities are:

Economic Section -- Makes studies of deposits of all the metallic minerals to determine their geologic setting in order to encourage further exploration and delineate areas having the greatest possibility for the discovery of new deposits;

Stratigraphic Section -- Assigns areas for the State Geologic Map work and performs geologic mapping; compiles measured sections and fossil lists; and assembles other data needed for the unraveling and ready understanding of Oregon's geology;

Engineering Geology Section -- Performs geologic work which pertains to urban planning, building sites, geologic hazards, and sources of building materials; and

Geochemical and Geophysical Section -- Samples and analyzes large areas in order to delineate mineral targets for further exploitation and designs, builds, and uses field instruments for detection of mineralization.

2) THE ENGINEERING DIVISION is divided into a Mining Section and a Petroleum Section. The Mining Section is responsible for developing the industrial minerals, collecting mineral production data, and disseminating mineral information. The Petroleum Section enforces the Oil and Gas Act; maintains and studies the cuttings from drillings; and prepares reports on areas deemed to have potential for oil and gas deposits from drill-hole information and surface geology.

3) THE LABORATORY DIVISION provides support to the Geologic and Engineering Divisions and carries out the provisions of the Department's Act requiring free assays on ores and spectrographic analyses for industry and others.

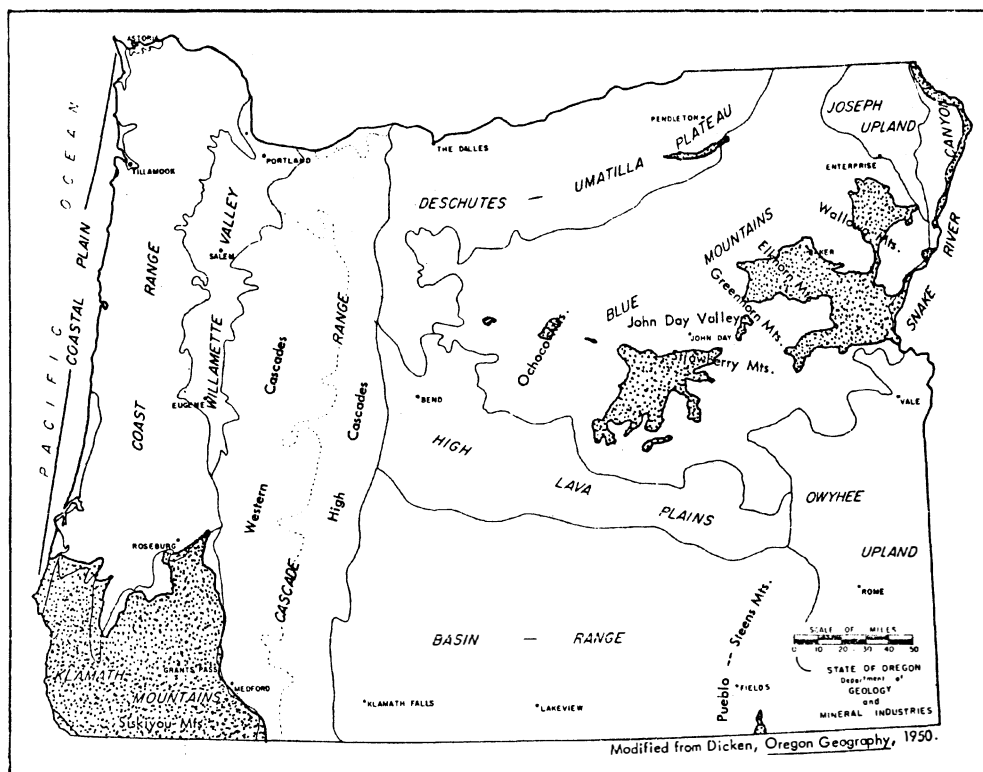
4) THE PUBLICATION DIVISION prepares the reports and maps of the scientists and engineers for public use and is responsible for the monthly publication, The ORE BIN. The Department not only publishes its own researches, but also the work of others which is considered significant to the development of Oregon's mineral industry and the understanding of its geology. Data are compiled for ready reference to the geology and mineral resources of the State. The Cartographic Section works with the other staff members from the very inception of a project, in order that the data which are obtained can be presented

in the most complete and clearest form.

The technical staff is not only responsible for specific sections of a division, but members are also assigned certain geologic areas and commodities on which they must become expert. This provides the Department a greater depth in answering inquiries on both geology and mineral deposits, and assures that the planning and execution of projects will receive careful review.

Staff size

Instead of having the full complement of geologists and engineers necessary to carry out all the duties of the Department, the technical staff serves as a nucleus to direct the work and perform only certain aspects of a project. Students are utilized to do a large portion of the preliminary work for the State Geologic Map. Professors are hired during the summer to perform work requiring skills or instrumentation not available in the Department, and consultants are used on a temporary basis for specialty work or to add manpower.



Geomorphic provinces and distribution of pre-Tertiary rocks (stippled).

PROGRAM OF THE DEPARTMENT

In the course of its duties, the Department answers thousands of letters and telephone calls each year, as well as serving hundreds of people who call at the offices. In addition, numerous other contacts are made with the public, such as field examinations, lectures, judging County and State Fair mineral exhibits, and aiding in 4-H and Boy Scout programs. The Department's major contribution to the State, however, is through its geologic mapping and mineral investigation projects. During the past biennium the following projects were under way, completed, or recessed due to lack of funds. Financial aid in the amount of \$6000 was received from the State Technical Services Act for one-half the cost of publishing reports or maps on several of the projects.

(Right) State, Federal, and university geologists meet to integrate plans for geologic work in the State. Baker, Oregon, 1968.



(Left) Members of 4-H Clubs appreciate guidance and aid in identifying their rock and mineral collections.

GEOLOGIC DIVISION

A. Economic Section

1. Geology and mineral resources of southeast Klamath and southwest Lake Counties.
2. Geology and mineral resources of Upper Chetco River area, Curry County.
3. Commodity studies:
 - a. Gold and silver in Oregon.
 - b. Geothermal resources of Oregon (recessed).
 - c. Uranium in Oregon (recessed).
4. Special studies:
 - a. The mineral and water resources of Oregon.

The geology and mineral deposits of southeastern Klamath and southwestern Lake Counties was a joint project with Pacific Power & Light Co. and Great Northern Railroad. The project was under the direction of and the work was done by Department personnel, with financial support from the companies. The contract for the work prevented either company from locating any mineral deposit found until after publication. The area covered was in excess of 6000 square miles. Field work began in August 1967 and was completed one year later. Publication will be in 1969. This area contains Oregon's only uranium mines. Other metals or mineral materials which are known to occur there include mercury, beryl, diatomite, perlite, building stone, and sand and gravel. Geothermal energy is also a possibility.

The geology and mineral deposit study of the Upper Chetco River area, Curry County, was begun in 1966. Field work is 80% completed, and publication is scheduled for 1972. The project area embraces 200 square miles in Oregon's most rugged and isolated region. There are more than 48 known prospects in the

area. Minerals found include gold, copper, cobalt, nickel, iron, and asbestos. The possibility of more extensive investigation by industry after report publication is considered good.

Work was completed on gold and silver in Oregon and on the mineral and water resources of Oregon, a joint project with the U.S. Geological Survey. The geothermal resources of Oregon and uranium in Oregon projects were temporarily recessed.



Looking westward across rugged country of the upper Chetco River, Curry County. Big Croggies on the skyline. The area has produced gold, copper, and chrome. Investigations indicate further exploration is warranted.

B. Stratigraphic Section:

1. State Geologic Map.
2. Geology of the southwestern part of the John Day uplift.
3. Geology of northeastern Oregon.
 - a. Geology of Snake River Canyon (recessed).
4. Geology of the Ironside Mountain quadrangle.
5. Special Studies:
 - a. Geology Guidebook Series.
 - b. Geologic Trips in Grant County.
 - c. Geology of State Parks (recessed).

During the past two years, field work on the State Map Project has shown excellent progress. Most of the eastern half of the State has now been completed through the efforts of geologists and graduate students from the State of Oregon Department of Geology and Mineral Industries, the U.S. Geological Survey, and the Universities. The accompanying map shows the quadrangles that have been published and the status of mapping in the uncompleted areas.

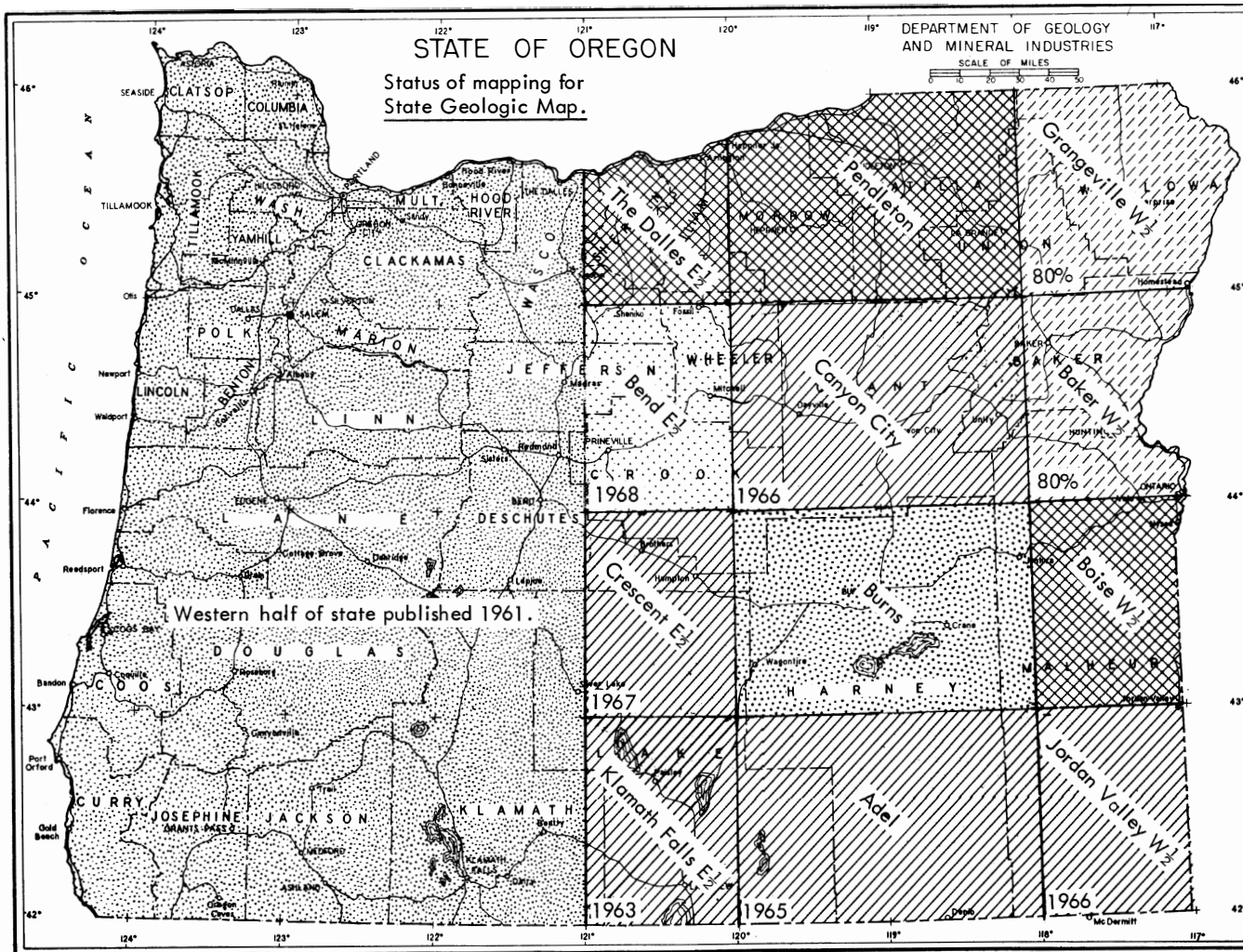
The Burns quadrangle, mapped as a cooperative project between the Federal Survey and the Department of Geology and Mineral Industries, is underlain almost entirely by sedimentary and volcanic rocks of Cenozoic age, that is, less than 60 million years old. The geologic map of the Burns area should be published by the spring of 1969. One of the most interesting and widespread rock units within this quadrangle is a volcanic ash flow that poured out on the surface of the earth about 10 million years ago. It spread out as an incandescent cloud of ash

particles over an area of several thousand square miles. Had an eruption of this type occurred in a populated area in recent times, it would have been a major catastrophe. A similar event did take place almost 70 years ago on the island of Martinique in the West Indies. In the spring of 1902 an avalanche of hot gas and volcanic ash poured down the slope of Mount Pelee toward the town of St. Pierre, the port and capital of Martinique. Within a few minutes the whole city and its 30,000 inhabitants were annihilated by the blast.

H. J. Buddenhagen, consulting geologist for the Department of Geology and Mineral Industries, has completed his field study of a major part of the pre-Tertiary geology of the Supplee-Izee area of east-central Oregon. It is in this part of the State that the oldest known fossilized rocks have been found, approximately 400,000,000 years in age. The mapping of the rocks and their structural features has revealed much important information on the early geologic history of the central Oregon region, and should encourage further search for oil and gas in central Oregon.

One of the most geologically complex areas in Oregon lies in the northeastern part, in the general vicinity of Baker and the Wallowa Mountains eastward to the Snake River Canyon. Understanding the structure and the areal relationships of these rock units is important for future development of economic mineral deposits and delineation of the basement geology of Oregon. The rocks are fairly old and they have been considerably folded and faulted since the time they were first deposited. Howard Brooks, district geologist in the Baker field office of the Department, has spent parts of several summers in the Snake River Canyon and adjacent areas between Richland and Huntington unraveling this structural puzzle. Farther north, Tracy Vallier mapped a stretch of the canyon between Oxbow and Hells Canyon Dam as part of a research problem for his doctoral dissertation. Vallier, who now is a professor of geology at Indiana State University, is continuing his mapping of the pre-Tertiary geology along the Snake River down stream from Hells Canyon Dam to the Washington State line, through financial support from the Idaho Bureau of Mines and Geology and the Department. When this work is completed, the information will be published by the Department as a contribution to the State Geologic Map Project. A progress report and map for the use of the canyon visitor were published in The ORE BIN in December 1967, covering the area from Huntington to Hells Canyon, a distance of 94 miles.

Personnel from the Federal Survey are beginning to compile all available geologic maps of eastern Oregon in order to assemble the final map at a scale of 1:500,000. It is planned that the map of the eastern half of the State will be available to the public some time within the next five years.



C. Engineering Geology Section:

1. Engineering Geology of the Willamette Valley for Urban Planning.

Oregon is a rapidly growing state, with industry and population build-ups centering in the more favorable areas. The Willamette Valley, within the next few decades, is destined to become a megalopolis made up of merging metropolitan areas extending from Portland to south of Eugene.

Urban planners are being called on to recommend zoning laws and direct the growth taking place in the Willamette Valley.

Planners need the data geologists and engineers can provide so that best use will be made of our ever-shrinking available land. Too frequently in the past lands have been set aside for specific purposes based upon geographical location only, while geological conditions were such that the land proved to be better suited for another purpose.

Information concerning the engineering properties of the soil and bedrock units, environmental hazards such as landslides, floods, high ground-water table, poor foundation soils, and the location and extent of engineering construction materials, is required for laying the plans for safe and effective development of land.

Sand, gravel, and other construction materials occur in limited areas. If inadequate knowledge is available of the deposits, including areal extent, quality, and quantity, the major portion of the deposit may be overrun by housing or other incompatible developments. In some cases, areas have been zoned for the production of gravels and other materials which were deficient in either quantity or quality or both.

Land requirements for various industries differ, depending upon whether large quantities of water are to be used, whether disposal of large amounts of waste is a requirement, and whether the installation can sustain minor settlement or no settlement at all. These and other numerous factors make the nature of the geology and soils equally as important as geographical location.

In order to make urban geology available, the State of Oregon Department of Geology and Mineral Industries is engaged in a detailed mapping and study of the geology and engineering characteristics of the ground in the Willamette Valley.

The result of the first of such studies, "Engineering Geology of the Tualatin Valley Region," by H. G. Schlicker and R. J. Deacon, was published in 1967 as the Department's Bulletin 60. This area was chosen first because it is one of the fastest growing communities in the Pacific Northwest. The second study, planned to be initiated as soon as funds are available, is the Salem-Dallas area immediately to the south. The Albany-Corvallis and the Eugene-Cottage Grove areas will follow (see index map).

Planners, engineers, land developers, and individual land owners will find these reports useful in the following ways:

1. Evaluation of soil and foundation characteristics for industrial, commercial, and residential properties.
2. Evaluation of soil conditions for location of roads, pipelines, and other surface and subsurface installations.
3. Evaluation of response of soils to erosion, compaction of embankments, slope stability, and internal drainage.
4. Location of hazards such as areas of flooding, slope failure, and near-surface ground-water table.
5. Determination of response of soil and rock units to earthquake forces.

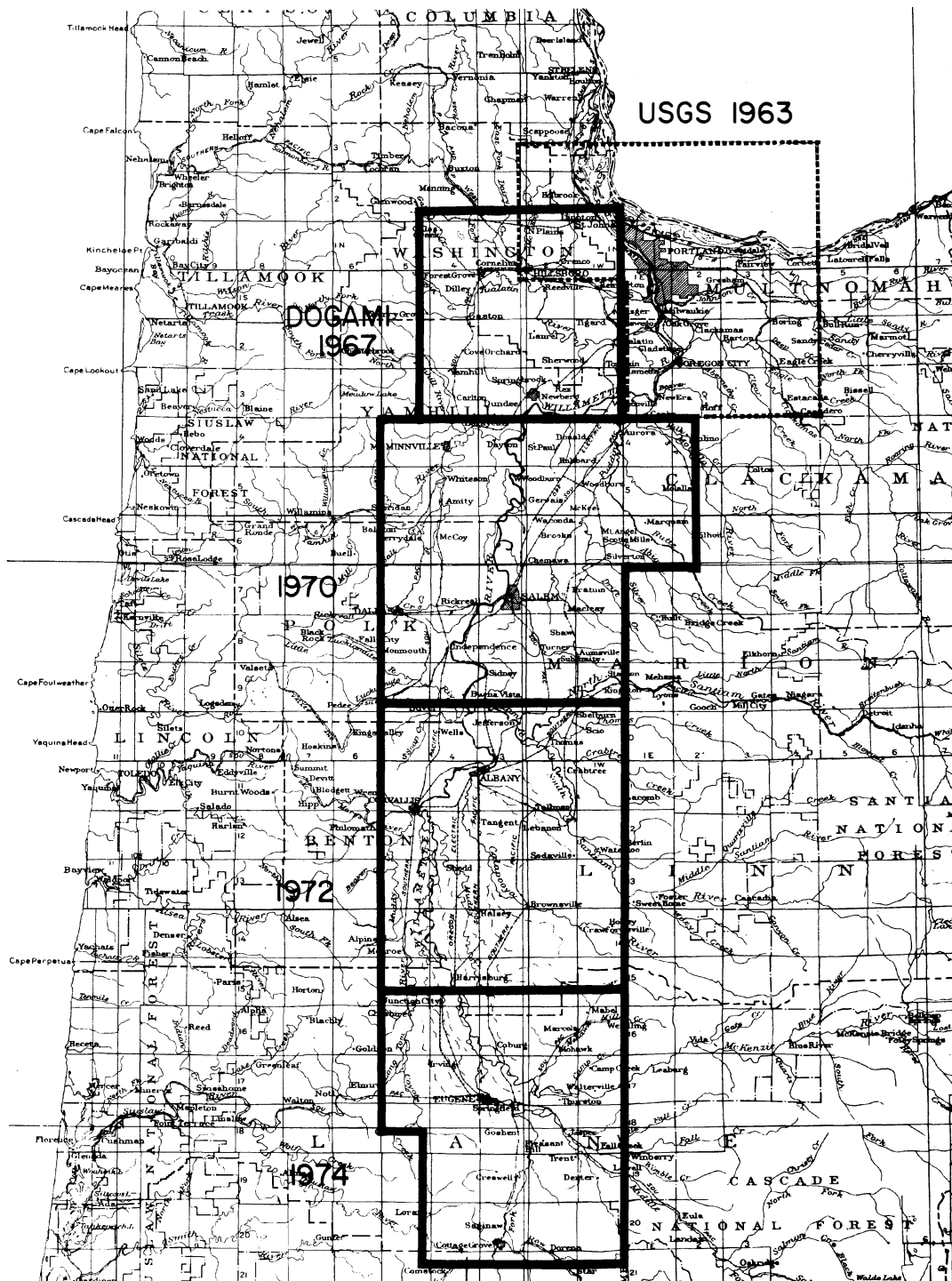
In moving into this field of geology, the Department has significantly extended its service to the people of Oregon. Geology affects everyone where he lives. If a person builds a fine house and can

find no water for domestic use, money has been wasted. A dwelling or larger structure located on unstable ground, even though the movement is a few inches a year and apparent only to the trained geologist, can be totally disastrous to that structure.

Numerous examples of costly blunders caused by the lack of use of geologic data have occurred in Oregon and elsewhere. Financially, a study will pay for itself in savings to the community, within a relatively short period of time.



Rapid changes in land use as orchards and form lands become freeways, industrial parks, shopping centers, and housing developments. View looking north towards Progress and Beaverton (photograph courtesy of Oregon State Highway Department).



Index map for the Engineering Geology of the Willamette Valley for Urban Planning.

D. Geochemical and Geophysical Section:

1. Stream-sediment sampling of southwestern Oregon.
2. Stream-sediment sampling of the Fremont Mountains, Klamath-Lake Counties.

The program of geochemical exploration by stream-sediment sampling that has been under way for several years is continuing. Although the field and laboratory work by the Department is being held at a low level, the information generated during the past is being put to increasing use.

The field and laboratory work is completed for the southwest Oregon stream-sediment program and it is anticipated that the cartography and publication will be done during 1969. Even before publication, this information is starting to be used; several mining companies have had personnel in our Portland office

copying the data and discussing it with the staff. The U.S. Geological Survey is making spectrographic determinations for 30 elements on splits of all of the samples collected in southwestern Oregon. This is yielding a great deal more information on various types of mineralization than might be expected. In addition to the four elements (copper, zinc, molybdenum, and mercury) the ones with the greatest potential that they are checking for are silver, chromium, nickel, lead, and tin. Selected samples are being checked for gold and platinum.

When this analytical work is completed, it will add a great deal of useful information for anyone making geologic studies in the region.

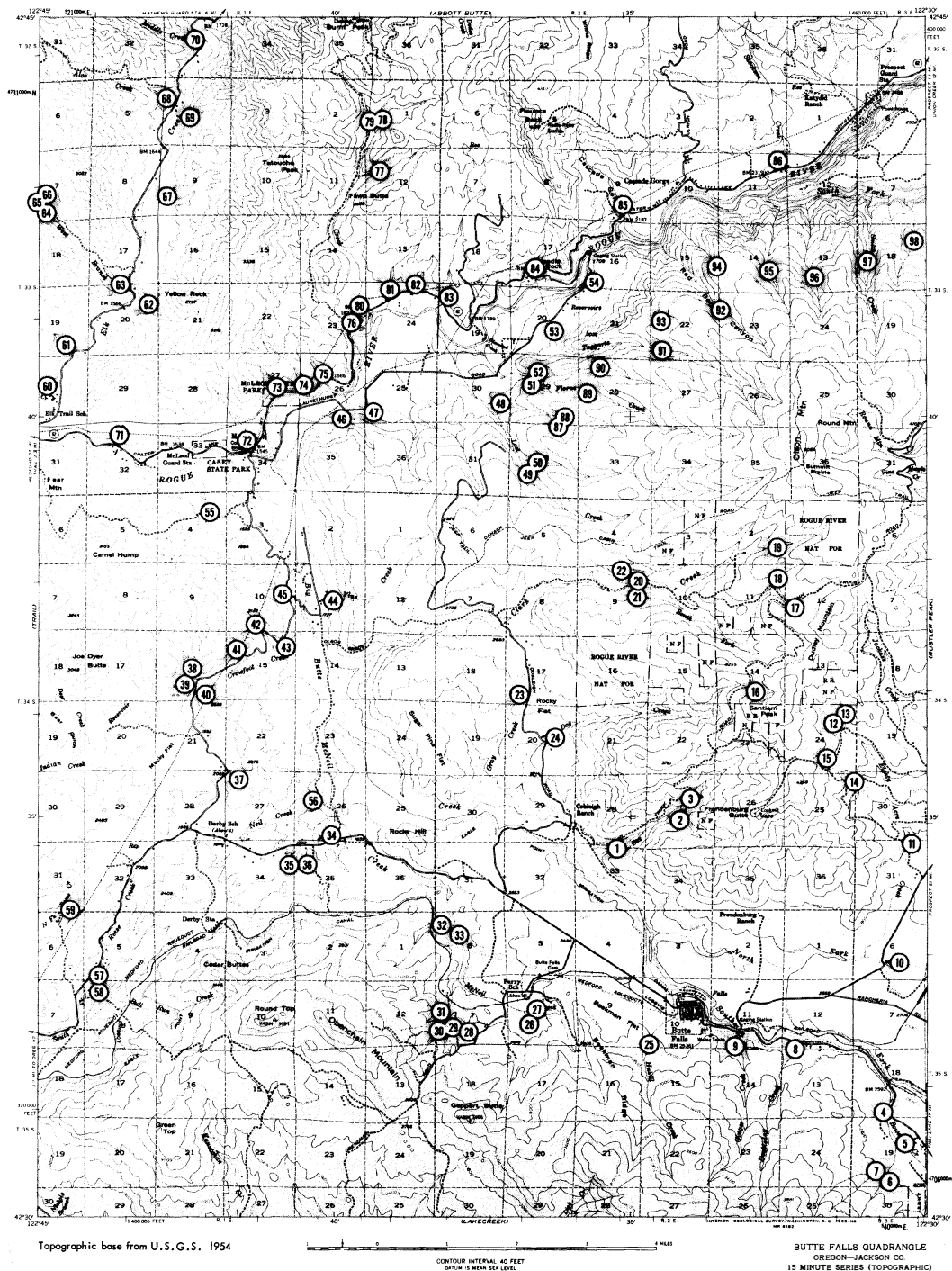
A copper anomaly found by the Department near Keating, Oregon in 1960 is (summer of 1968) being drilled by a major mining company, illustrating the time lag that often takes place in the search for metals. This anomaly was first described at a meeting of the Northwest Mining Association in Spokane in December 1960. During the next couple of years representatives of several mining companies looked at the area and took a few surface samples, but essentially nothing was done until late 1967, when a major mining company staked claims around the area, did extensive geochemical soil sampling, and has been conducting an exploratory core-drilling program since the spring of 1968. It will probably require several more months of systematic drilling to determine if enough ore is present to be developed into a mine. An even better example of this time lag is the nickel deposit at Nickel Mountain that is currently being mined by the Hanna Mining Co. Here, the original discovery was made in 1864, but it was not until nearly 90 years later that the deposit was developed.

In addition to the southwestern Oregon stream-sampling program, the geochemical service is used by the Department as a rapid method for determining the presence of metallic mineralization in areas being evaluated on other projects. For example, when the Department makes a study for the State Division of Lands in connection with a request to relinquish mineral rights on its land holdings, the geologist making the field check takes soil, rock, or sediment samples to be checked, either in the geochemical or assay laboratory.

A new project undertaken in 1968, with anticipated publication in 1969, consists of sediment sampling and analysis of streams draining areas of potential mineralization in Lake and Klamath Counties as a part of a cooperative survey made with Great Northern Railroad and Pacific Power & Light Co. In addition to copper, zinc, molybdenum, and mercury, these samples will be analyzed for uranium because of its known occurrence and potential for further deposits in the region.



Sampling dry wash near Summer Lake,
Lake County, Oregon.



One of 36 fifteen-minute quadrangles covering southwestern Oregon, showing stream-sediment sample sites. Each sample is analyzed for 4 elements by geochemical methods and for 30 elements by spectrographic methods. Composite samples are run for gold and platinum by atomic absorption.

E. Interagency Assistance:

1. Mineral right evaluation:
 - a. State Division of Lands.
 - b. Counties.
2. Mineral lease consultations:
 - a. State Division of Lands.
 - b. State Forestry Department.
3. Geologic engineering:
 - a. Game Commission.
 - b. Fish Commission.
 - c. Economic development.
4. Review of incorporation applications:
 - a. Mineral companies.
 - b. Treasure trove.

Each year the State Division of Lands and the counties are approached to release mineral rights of land on which the surface rights have been sold. The Department inspects the land and advises whether or not minerals of value exist.

By law, a State agency must consult with the Department before it leases land for mineral, including oil and gas, exploitation by private companies. The Department works with the agency in setting up the terms of the lease and in advising what precautions should be taken to protect the State's interest. Usually it is the work of the Department that brought the investigating companies to apply for the lease in the first place.

As the State agency informed on geology, other agencies are more frequently calling on staff members for advice on foundations for buildings, dams, fish ladders, and other capital construction projects. An example of the value of this work concerns the building

of a reservoir in north-central Oregon. Inspection by the Department indicated that one footing for the dam, as proposed, might not be on bedrock and that there was a probability that a portion of the reservoir would require grouting, for one of the lava flows had a rubbly base which could allow excessive drainage of the pool. This alerted the agency to the necessity for drilling, and gave them a better idea on project costs.

The Corporation Commissioner asks the Department to comment on proposals submitted to his office for clearance for public sale of stock.

An unusual case in 1968 concerned a treasure-trove excavation on the coast. Examination by Department personnel indicated that the excavation had reached bedrock and deeper exploration was not warranted.



State, Federal, and University geologists meet in field to confer on geology of northeastern Oregon. Note lime plant and quarry of Oregon Portland Cement Co. in background. Lime, Oregon, June 1968.

ENGINEERING DIVISION

A. Mining Section:

Mineral Production

One look at the table showing Oregon's annual mineral production for 1966 shows the great importance of two commodities to the state's welfare. Sand and gravel and crushed stone, in addition to creating \$68,000,000 in primary wealth, provided the "growth minerals" which fueled the economy of every sector of the state (see table 1).

Table 1. Some of Oregon's Minerals at a Glance
(in thousands of dollars)

	<u>1966</u>
Clays	\$ 362
Gold	10
Lime	2,283
Mercury	309
Sand and gravel; stone	68,615
Pumice; volcanic cinders	1,256
Miscellaneous*	<u>19,926</u>
Total	\$107,484

* Cement, copper, diatomite, iron ore, lead, perlite, nickel, peat.

Last year 19 counties were members of the "Million-Dollar-a-Year Club," membership in which is restricted to counties producing a minimum of one million dollars worth of minerals annually. Since sand and gravel and crushed stone account for 78 percent of the state's total mineral production, the importance of these commodities to communities throughout the state becomes apparent. Ordinary sand and gravel, dredged up from state-controlled stream beds, annually pumps about \$200,000 into state coffers in the form of royalties alone. Growth minerals are valued in the pit for canvassing purposes. These same materials are worth approximately 10 times as much when processed, delivered, and sold (see table 2).

Far more important than this, however, is the impact that these products have on community development. There is no substitute for them in most domestic, industrial, and commercial construc-

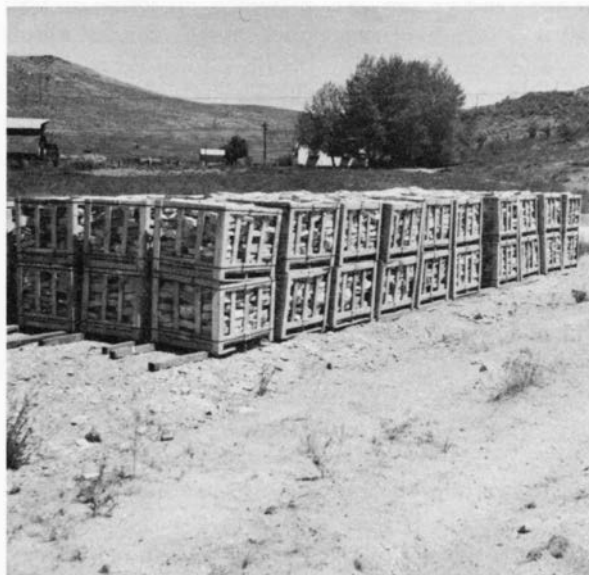
tion, and in all likelihood there never will be. The supply of growth minerals is limited, and unless prompt steps are taken even these resources will be removed from utilization by urbanization. The State of Oregon Department of Geology and Mineral Industries has long urged communities, planning groups, and other agencies charged with resource management to insure that existing deposits of sand and gravel and stone are protected until they can be used.

Mining characteristically requires a very small amount of land, and produces more dollars of primary wealth per acre than any other natural resource. One acre of sand and gravel 27 feet deep will yield 43,560 cubic yards. If this is state-owned land, the state will receive more than \$5000 in royalties from that one acre. The value of the sand and gravel sold will amount to more than \$400,000, and if all of the sand and gravel from that one acre is used for concrete aggregate for building construction, the resulting structures will be worth more than \$4,000,000. After the sand and gravel have been removed, the excavation can be used for a sanitary fill, a public park with a ready-made amphitheatre or lake basin, or as a site for commercial or industrial buildings with the basements already dug.

Table 2. The Million Dollar a Year Club*

<u>County</u>	<u>Value</u>	<u>County</u>	<u>Value</u>
Baker	\$ 6,499,000	Lake	\$ 1,020,000
Clackamas	7,474,000	Lane	8,500,000
Coos	1,112,000	Linn	3,429,000
Deschutes	1,003,000	Malheur	1,091,000
Douglas	9,929,000	Marion	1,145,000
Gilliam	31,950,000	Multnomah	6,200,000
Hood River	1,465,000	Sherman	1,424,000
Jackson	3,402,000	Umatilla	1,820,000
Josephine	1,146,000	Washington	2,466,000
Klamath	2,124,000		

* In addition to the values shown, there was a total of \$7,913,000 which could not be assigned to specific counties, plus the production from Lincoln and Morrow Counties, which was concealed to avoid disclosing individual company confidential data.



Known by the trade name of "Moon Mesa Rock," decorative-type building stone from Dooley Mountain, Baker County has been used in many notable edifices constructed throughout the Northwest during recent years. Shown here awaiting shipment is rock in palletized form at the yards of the Blue Mountain Stone & Lime Co., Baker, Oregon.

Oregon's mineral and metallurgical industry is many things to many people. It supplies the aggregate and concrete for building miles of roads and dozens of bridges. It refines exotic metals for applications in outer, inner, and under space. It provides building stone for beautifying houses and other buildings, bedding material for plants, and pigment for paints. It provides more hours of recreation than any other natural resource in the State. It adds a much-needed stability to an economy plagued by seasonal employment fluctuations. It serves and benefits every community in the State. It provides jobs directly for 12,000 wage earners. Oregon's industrial-mineral producers pay taxes, cater to the varied and ever-increasing demands of growing communities, operate without benefit of federal or state subsidies, locate their own resource materials, develop, mine, and beneficiate them with their own money, and sell a product that has advanced less in price than has the general economy.

In 1967 each person living in Oregon used an average of 7.5 tons of sand and gravel, compared to the national average of 6.5 tons. Oregon is a relatively undeveloped state which is shifting the emphasis in its construction to the more durable building materials. The demand for "growth minerals" such as crushed stone and sand and gravel has been increasing rapidly over the years and the curve will be steeply upward in the future.

Although the \$107 million value reported (see table 1) set an all-time record, it did not include such Oregon-produced metallurgical products as ferro-nickel, pig aluminum, ferrosilicon, elemental silicon, the various exotic metals, regular and alloy steels, calcium carbide, and other furnace products. The value of these metallurgical products is considerable, but no figures are published to show the dollar total. Quite likely, the total value of these products amounts to more than \$300 million annually.

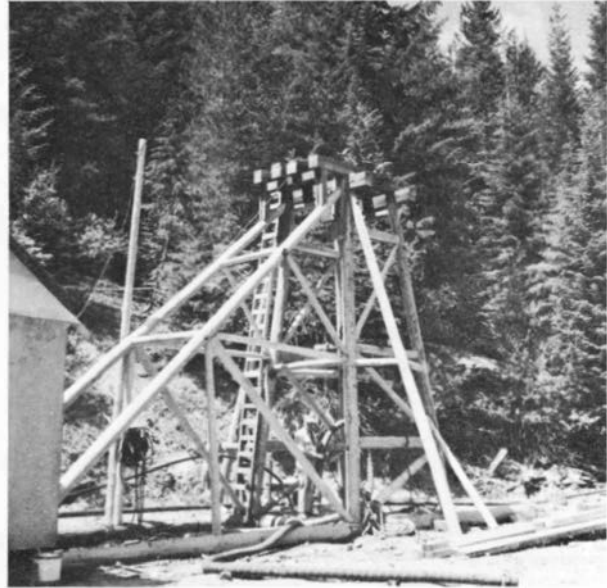
The rapid increase in the value of the state's mineral and metallurgical production is perhaps best illustrated by the fact that the value is doubling ever more frequently. Starting in 1942, it required 10 years to double the value, followed by an 8-year period in which it doubled again. The last doubling required only 6 years. During the 25-year period from 1942 to 1966, the total value of production soared 664 percent.



Oregon streams supply much of the sand and gravel produced in the state. River barges commonly transport the freshly dredged aggregate to screening and crushing plants.



(Left) Shown here is a shredder in service on the pilot operation at the peat pit developed by Jewell's Mother Earth, Inc., Enterprise, during the summer of 1966. Today peat is being produced and marketed under the company's own trade name and also packaged under contract for other suppliers. Two new 50x100-foot buildings are being constructed to house increased capacity processing and bogging facilities and for warehouse purposes. The enlarged facilities are scheduled for completion by August 1, 1968.



(Above) For nearly 3 years the Omega Mines Co., Vancouver, B.C., has been conducting an appraisal of certain of the better known eastern Oregon gold lode mines located in the vicinity of Bourne, Baker County. This has included extensive rehabilitation of old workings, new subsurface exploration, and diamond drilling, principally on the old E & E and North Pole properties. Pictured here is the newly erected headframe on the shaft at the Golconda mine - the next target scheduled for dewatering and examination by the company.



(Above) Mining claims embracing most of the better known copper prospects in the Lower Powder River valley district in Baker County have been under investigation during the past 2 years by teams of specialists representing two major mining companies -- Cyprus Mining Co. and Kennecott Copper's Bear Creek Exploration subsidiary. Both companies are currently following up their previous investigations with core-drilling projects designed to explore subsurface conditions of mineralization at critical places in their respective holding areas. Pictured here is a Boyles Brothers drilling crew spudding in their 13th test for Cyprus at a location near the old Mother Lode mine on Balm Creek. Between them, these exploration projects constitute the most comprehensive appraisal ever conducted in terms of the open-pit potential of the prospects in this area.



(Left) Discovered only four years ago and still very much in an exploratory stage of development, the Canyon Creek Cinnabar prospect has already yielded 105 flasks of retorted quicksilver. The 7-flask shipment pictured here constitutes the most recent (May 1968) shipment. It originated from 8 tons of sorted ore from a newly opened test ore.

Although it is too early at this state of development to evaluate the prospect's potential, it can certainly be described as one of the most interesting new discoveries made in recent years. The cinnabar occurs in bedding planes, joints, and shears of a steeply dipping pre-Tertiary (probably Triassic) sediment over an ore as yet not fully delineated.

Other mercury operations in the State include the Gloss Buttes mine in Lake County, the Bretz mine in Molheur County, the Block Butte mine, Lone County, and the Elkhead mine in Douglas County.

(Right) The Bretz mine in southern Molheur County has a history of mercury production extending back to 1931.



(Left) High-purity quartz has been mined at the Bristol Silica mine for the past 30 years. The mine is located in Jackson County.



Large aggregate plants supply a variety of products for their customers. Premixed concrete, bituminous mix, and loose aggregate, all tailored for a particular application are shown here in a Portland area sand and gravel plant.

The Metals

The mining and metallurgical industry as a tax-paying, profit-seeking industry must necessarily produce materials that are in demand. There is no government subsidy for not mining and refining ore, nor does the industry get paid for minerals and metals which it has produced but cannot sell. As a result, the industry is both viable and pliable. Over the years Oregon mines and mills have produced minerals and metals as they were required and in the quantities needed, in both peace and war. Years ago the West needed, above all else, two vital ingredients -- manpower and wealth. The mines attracted the men and the men produced gold and silver (wealth) in prodigious quantities. During two world wars Oregon was a major producer of strategic chrome and mercury. Today the federal government has decided that gold and silver ore unimportant in our notional economy and the emphasis has turned to the modern metals.

Oregon is one of the principal centers for the production of the various exotic metals used in atomic applications and space-age hardware. The state's exotic-metals industry was fully discussed in the October 1967 ORE BIN. In addition to the unique aspects of this branch of metallurgy, some of the new

(Right) Aircraft-mounted differential spectrometer used to determine gamma radiation from surface or near-surface rocks. Sophisticated equipment of this type is being used by second-generation uranium prospectors in southern Oregon. (Photograph courtesy of Nuclear Fuels Division, Gulf Oil Corp.)



metals are replacing old-line metals where severe corrosion or heat problems exist. Skins of aircraft have changed from canvas to aluminum to titanium, and exteriors of railroad passenger cars have evolved from wood through steel to titanium.

Two major international mining companies are currently exploring for copper in northeastern Boker County. The Department had earlier conducted a geochemical investigation of a portion of the area and published a brief report summarizing the findings. Geochemical prospecting is employed to identify areas having a higher than average level of mineralization. The Department believes that it can be most effective if it selects likely districts for study, conducts surveys to pinpoint areas for more intensive study, and then attempts to attract industry to mount intensive exploration which might lead to a mining operation.

Large areas of eastern Oregon are being examined by three mining companies which are looking for uranium. Uranium mining is experiencing renewed activity as the demand for industrial applications of radioactive materials grows. The companies are using sophisticated detection devices which, in the initial stages of the program, are airborne. Numerous occurrences of uranium-bearing minerals are known in the central and south-central portions of the State. Two deposits in the Lakeview area have a history of production, though both are currently idle. Exploration for additional ore is being conducted at one of the properties.



Aerial view of Oregon Metallurgical Corp. plant at Albany, Oregon. This plant is one of a group that has benefited from the pioneer work done by the U.S. Bureau of Mines research center located at Albany. The Bureau perfected processes which made it possible to produce "space age" metals such as titanium, zirconium, hafnium, columbium, and tantalum in commercial quantities. Oregon is one of the leading states in the Union in the production of these metals.

B. Petroleum Section:

History of Drilling in Oregon

The first oil test holes were drilled in Oregon around 1902. The interest at that time centered in Malheur County on the eastern border of the state and in the Willamette Valley near the town of Newberg. Since these early ventures, 175 oil and gas holes have been drilled in Oregon without a single commercial discovery. Beginning in 1961, major companies explored the offshore region bordering the state until last year. A succession of eight dry holes left them too discouraged to continue the search. Onshore activity was continued by two wildcatters and three large firms.

Oregon has regulated petroleum exploration since 1923. Inspections and filing of records were first done under the supervision of county courts, but passage of new laws in 1949 and 1954 gave the responsibility to the Department of Geology and Mineral Industries. The state now regulates drilling and development operations under the amended oil and gas conservation statute. Since passage of the latest oil and gas law in 1954, 59 drilling permits have been issued and more than 200 well-site inspections have been made. The Department maintains open files of well data and has available for study several thousand well samples.

Although most of the offshore exploration conducted from 1961 to 1966 was on federal OCS (outer continental shelf) lands, the Department supervised inspections of coring operations under a cooperative arrangement with the U.S. Department of the Interior. Besides the mentioned duties, the Department has consulted with other state and federal agencies on matters concerning oil exploration, and it had an active role in the drafting of state lease forms and continental shelf regulations.

Status of Projects

Five publications dealing with regulations and well records have been issued since 1954. A second subsurface geologic study based on deep well records is to be published within the year. This bulletin gives an interpretation of regional geologic conditions and relates them to oil and gas accumulations.

Sampling of carbonaceous shales in Oregon was continued this biennium in the search for commercial grade oil shale. Oregon has one high-grade deposit near Ashland, but tonnage is too small to be of commercial use. Arrangement was made with one major oil company to have the shale samples checked for residual hydrocarbons in addition to the tests made by the U.S. Bureau of Mines for pyrobitumens. Residual hydrocarbons indicate whether or not environmental conditions are favorable for the generation of hydrocarbons. Several more sites along the southwestern coast should be sampled to complete the project.

A paleontological study of deep-hole samples was initiated in 1967 in conjunction with subsurface correlation of drillings in northwestern Oregon. The paleontological work is being done by Dr. R. E. Thoms of Portland State College. It is hoped that eventually all deep-well samples from western Oregon can be studied and age dating established.

Cooperative studies during this biennium include preparation of chapters on petroleum exploration, oil shale, and saline waters for the U.S. Geological Survey's bulletin on The Mineral and Water Resources of Oregon. Data covering underground disposal of wastes in Oregon were collected for a national study being conducted by the Interstate Oil Compact Commission. The Department is represented on the Research, Regulatory Practices, and Public Lands Committees of the Compact. Some data were also supplied to the Water Resources Board on use of water in oil refining.

Future Projects

The work of maintaining and upgrading the sample library will be continued. Wear on containers and addition of new material require many hours of sorting and packing. Scores of microslides will be added to the foraminifera library as a result of studies of library samples by oil companies and research groups. More micropaleontological work will be done on deep holes so that the samples can be utilized to the greatest extent and results of these studies will be made available through Departmental publications.

Analyses of formation (connate marine) waters and natural gas will continue to be made where the occurrences appear to be significant. Formation waters aid in environmental studies and may also contain valuable minerals. The composition of a natural gas indicates its quality as a fuel and its proximity to oil.

The two subsurface studies undertaken by the Department cover the most densely drilled areas. Until more deep holes are drilled in other parts of the State, no other such projects can be undertaken. Results of offshore exploration on OCS lands are not available to the State. Perhaps the information may be released by the U.S. Geological Survey at some later time when competition for leases is not a factor.

Offshore Activity, 1966-1967

Company	Tract No.	Well Name	Location	Water Depth	Total Depth	Remarks
Shell	22	Expl. Test 1	26 mi. offshore from Seaside	408'	10,160'	Shows reported, but noncommercial
Union	136	Fulmar 1	25 mi. offshore from Heceta Hd.	404'	12,221'	No shows
Union-Standard-Pan Am Group	57	Grebe (deepening)	16 mi. offshore from Waldport	195'	10,010'	No shows
Pan Am Group	102	Coos Bay 1	12 mi. Sw. of Bandon	352'	6,146'	Shows tested, but noncommercial

Eight offshore holes have been drilled along the Oregon coast since shelf exploration began in 1961. Some oil and gas was encountered in two of the holes but in quantities too small to produce. In 1966, oil companies dropped 65,000 acres of leases off the Oregon coast and in 1967 another 315,000 acres. Currently, only eight tracts are still being held. The main activity involved preliminary geological and geophysical studies from 1961 to 1964 and deep test drilling from 1965-1967. There is little interest at present in the offshore prospects.

Onshore Activity, 1966-1967

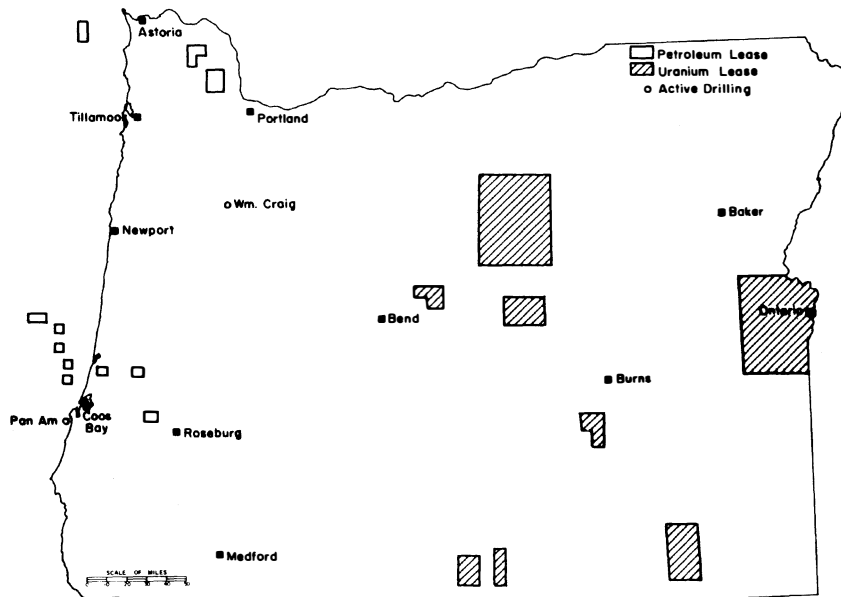
Company	Permit No.	Well Name	Location	Total Depth	Year Drilled	Remarks
Butte Oil of Oregon	55	Cowan 1	NW $\frac{1}{4}$ sec. 8, T. 1 S., R. 3 W. Washington County	959'	1966-67	Abandoned
Marvin Lewis	56	Crossley-Jennings 2	NE $\frac{1}{4}$ sec. 31, T. 6 S., R. 4 W. Polk County	2100'	1966-67	Abandoned
Central Oils, Inc.	57 D	Morrow 1- (deepening)	SW $\frac{1}{4}$ sec. 18, T. 12 S., R. 15 E. Jefferson County	3300'	1966	Drilled out abandonment plug, then work stopped. Replugged and abandoned.
Ivan Vojvoda	58 RD	Barr 1- (redrill)	NW $\frac{1}{4}$ sec. 32, T. 11 S., R. 1 W. Linn County	4529' 3937' RD	1966	Set whipstock and attempted to redrill zone with hydrocarbon shows. Twisted off, abandoned.
Wm. G. Craig	59	Gilmour 1	SW $\frac{1}{4}$ sec. 24, T. 9 S., R. 4 W. Marion County	1560'	1967-68	Operations suspended. Plan to deepen in 1968.

Activity onshore in Oregon was revived in 1967, when Mobil Oil Co. began leasing in western Oregon. The company acquired a total of approximately 70,000 acres in Columbia, Clatsop, Douglas, and Coos Counties. Mobil was active in the state in 1954 to 1957 and drilled a 9000-foot hole near the town of Reedsport before terminating exploration in 1957. Besides Mobil's holdings, leases were also being maintained onshore in Oregon by Texaco, Inc., Standard of California, Superior Oil Co., and Atlantic-Richfield Oil Corp. in the 1966-68 period.

Wildcatters have accounted for all of the onshore footage drilled in the past two years. These holes were shallow and none found significant shows of hydrocarbons. William Craig of Tacoma, Wash., began drilling near Buena Vista in the Willamette Valley in July 1967. He located his test near two old holes which were drilled by the Portland Gas & Coke Co. (now Northwest Natural Gas Co.). Gas was found in salt-water sands in the P.G. & C. holes. Ivan Vojvoda, Los Altos, Cal., attempted to redrill the Linn County Development Co. "Barr 1" near Lebanon in October 1966. Good oil and gas shows were reported in the original hole, but nothing could be produced after production casing was set and cemented in the hole. Vojvoda lost tools in the hole shortly after whipstocking, and was forced to abandon the project.

Marvin Lewis of Salem, Ore., drilled near the Reserve Oil & Gas Co.'s abandoned "Brue 1" in 1966-67 to retest shallow sands at 1500 to 2000 feet. Tools were lost in the hole and tests were not completed. Butte Oil Co. of Oregon drilled a few miles southeast of Forest Grove in 1966 to test Oligocene marine sands beneath the Columbia River Basalt. The drill-string twisted off at a depth of 959 feet and the tools were never recovered.

Thus mechanical problems have forced abandonment in three of the five projects that were started in the biennial period. It appears very likely that one or two holes a year will be drilled for at least the next few years. Mobil very likely will drill a deep test in northwestern Oregon after another season of field studies. The offshore search is not expected to gain momentum again until the 1970's.



Map showing 1967 oil drillings, lands under lease to oil companies, and area of State lands leased for uranium prospecting as of January 1968.

LABORATORY DIVISION

A. Chemical Section:

In July of 1943 the assay laboratories in Grants Pass and Baker were moved to and combined with the Portland installation. This laboratory is maintained by the Department for the benefit of prospectors. Samples are received either at the field offices or the office in Portland. During any 30-day period, any person or group of persons may submit two samples. Such samples must be from an original prospect or property within the state, and the service is given in return for information on the origin of the sample, including the location from which it was obtained. This service may not be performed for engineers in the sampling of properties for the purpose of evaluation, nor for operating mines which are milling or shipping ore. Samples are also submitted by staff geologists in the field for analysis and assay.

For the past six years the pace of the assay and chemical laboratory has been quite constant. Approximately 2300 determinations are made each year with gold, silver, and copper accounting for the major portion, although many other metals or elements are requested and determined.

When, in March 1968, the U.S. Government amended the gold regulation and the price of gold on the free market began to rise, an immediate impact was felt by the assay and chemical laboratory. Inflow of samples for assay and analysis has nearly tripled over the normal rate at the time of this writing (May 15, 1968). Projection for summer and fall of 1968 indicates a very heavy demand on the assay service of the Department. There appears to be a definite resurgence in interest, not only in gold but in all the minerals in the State.



The first stage in the analysis of the many samples received by the Department is breaking them down to small-sized pieces in this jaw crusher. Grinding further reduces the samples to a fine powder, which is then carefully weighed and analyzed. Gold and silver samples are melted in a gas-fired assay furnace. Nearly 2300 determinations are made by the laboratory each year.

B. Spectrographic Section:

A spectrographic laboratory is maintained by the Department for the benefit of prospectors, industry, and the general public. The spectrograph identifies the various metallic elements in many types of materials by burning a sample of the material in a carbon arc and photographing the spectrum of the light emitted by the arc. The photograph is analyzed in a microphotometer to determine the approximate amount of each element in the sample. Sample sizes may vary from 10 pounds for an ore sample to a few milligrams of microscopic inclusion in a precision casting. A reasonable charge is made for all analyses, except those done to assist the geological or mineralogical investigations of the Department.

The SPECTROGRAPHIC LABORATORY serves the prospector by:

- Naming all metals present in an ore sample.
- Checking the efficiency of separation of panned concentrates.
- Identifying rare earths and rare metals.
- Rechecking process samples from milling operations.

The SPECTROGRAPHIC LABORATORY serves the general public by:

- Locating sources of air and water pollution.
- Finding uses for slags and waste products.
- Determining advantageous trace elements in oyster shells or other fertilizers.
- Checking used motor oil for bearing wear or dirt.
- Identifying scale buildup in pipes or tanks.
- Verifying composition of precious metals or jewelry.

The SPECTROGRAPHIC LABORATORY serves other public agencies by:

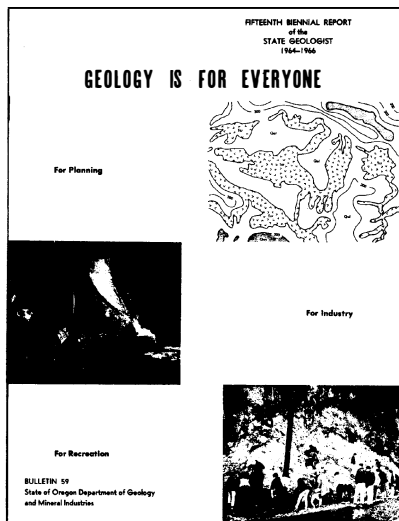
- Comparing glass, paint, or metal samples for criminal investigations.
- Identifying poisonous metals in food or on toys.
- Checking metal alloys for compliance with specifications.
- Analyzing water samples for fish-hatchery use.
- Comparing paint markings on logs which may be stolen.
- Determining causes of corrosion on metal towers or buildings.

The SPECTROGRAPHIC LABORATORY serves industry by:

- Analyzing paper ash for paper manufacturers.
- Identifying composition of thin metallic coatings.
- Locating source of defective inclusions for manufacturers of precision castings.
- Analyzing metals in boiler water before treatment.
- Determining impurities in waste water.
- Verifying purity of metals and ceramics purchased for manufacture.
- Checking purity of reclaimed aluminum and zinc alloys.
- Determining composition of welding rod and flux.
- Locating leaks or corrosion on liquid systems by analyzing the liquid.
- Checking cleanliness of salts for heat treating.
- Checking use of the proper oil or grease by analyzing engine deposits.

PUBLICATION DIVISION

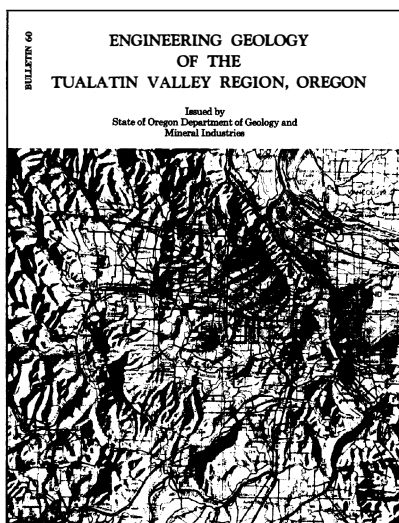
During the biennium the Publication Division issued the following reports:



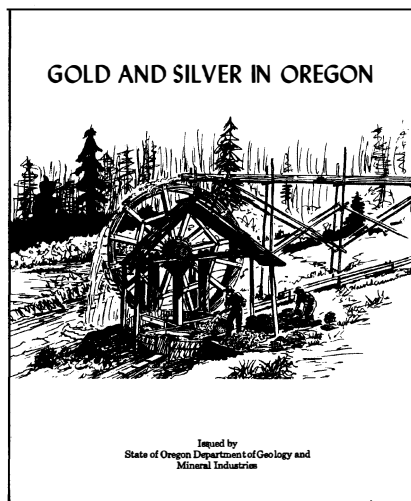
Bulletin 59, "Geology is for Everyone," was the Fifteenth Biennial Report of the State Geologist, covering the years 1964 to 1966, and was designed to lay at rest the archaic view that geology is useful only to the mining and oil industries and to demonstrate that geology is for land development; for the recreationist hunting for that rockhound's prize the thunder egg, or enjoying our State Parks; for the student using the Department's museum as a study reference collection or doing research in its library; or perhaps availing himself of the speaker and letter services; for children in classes or hobby groups; for the mineral investigator through the geologic map project or the geophysical and geochemical program; for industrial development through geothermal energy studies, the search for new mineral wealth, and petroleum exploration.

Geologic Map Series 3, "Preliminary geologic map of the Durkee quadrangle, Baker County, Oregon" by Harold J. Prostka was issued in 1967. The multi-colored map and text are printed on a single sheet, 22 by 26 inches in size. The Durkee quadrangle lies in northeastern Oregon immediately south of the Sparta quadrangle, which was also mapped by Prostka and published as GMS-1. The region is underlain by a complex series of Permian and Triassic rocks and two ages of intrusives. Miocene lavas, Pliocene lake beds, and Pleistocene alluvium occupy fairly large areas.

A series of three maps prepared in the Department of Oceanography at Oregon State University and entitled "Gravity Maps of Oregon (Onshore and Offshore)" was issued as GMS-4. The series is composed of "Free-Air Gravity Anomaly Map of Oregon," "Complete Bouguer Gravity Anomaly Map of Oregon," and "Free-Air Gravity Anomaly Map West of Oregon." The three maps are printed on 43- by 54-inch transparent sheets at a scale of 1:500,000 to fit over the state geologic map (western half).

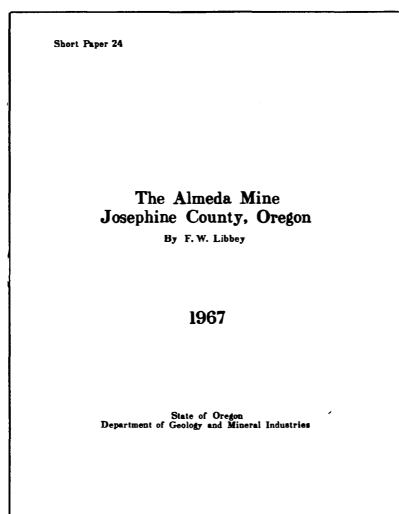
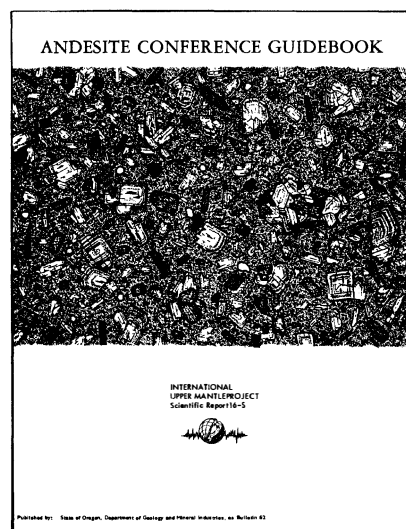


Bulletin 60 presented the "Engineering Geology of the Tualatin Valley Region, Oregon" by Herbert G. Schlicker and Robert J. Deacon, for which preparation was financially aided through a federal grant from the Urban Renewal Administration of the Housing and Home Finance Agency, under the Urban Planning Assistance Program authorized by Section 701 of the Housing Act of 1954, as amended. The bulletin describes the geology of the Tualatin Valley region and discusses the application of it to urban problems, such as the engineering characteristics of the geologic units; geologic hazards such as landslides, flooding, and earthquake probability; the availability of construction materials; ground-water resources; and water-pollution problems. The 103-page bulletin is copiously illustrated.



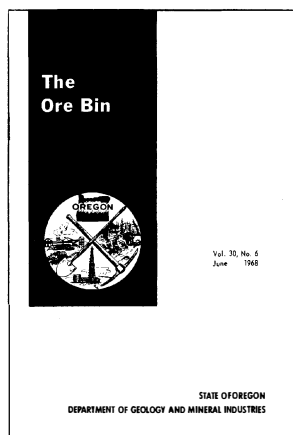
Bulletin 61, "Gold and Silver in Oregon," by Howard C. Brooks and Len Ramp, 337 pages, discusses some 500 lode and placer mines and prospects. These two staff geologists have concluded a 5-year project of assembling information that was previously scattered through a great number of published and unpublished records. This bulletin, the largest ever issued by the Department, contains mine maps, index maps of mining areas, tables and graphs of production statistics, and historical photographs. Between 1850 and 1965 Oregon produced about 5.8 million fine ounces of gold and 5.4 million ounces of silver worth a total of about \$210,000,000 at today's prices, more than half of the gold having been mined before 1900. It is hoped that study of this publication will suggest properties or areas that should be investigated more thoroughly, with attention paid especially to those districts where there have been considerable prospecting and tunneling, in the light of large-scale methods of mining available today.

Bulletin 62 is the "Andesite Conference Guidebook," edited by Hollis M. Dole, and containing 107 pages. The guidebook was designed primarily for the Andesite Conference held in the Eugene-Bend area June 30 to July 5, 1968 under sponsorship of the International Upper Mantle Committee, the University of Oregon Center for Volcanology, and this Department. The volume is composed of a series of papers by specialists in various aspects of andesitic rocks in the High Cascades and the Paulina Mountains. It includes field-trip logs to the Santiam-McKenzie area and to Newberry Caldera, a description of the geology of Mount Hood, three reports on the Crater Lake area, and a summary of the petrochemistry of Cascade andesite volcanoes in general. Colored geologic maps and many photographs make this publication one of interest to the public, especially those vacationing in the mountains.



Short Paper 24, "The Almeda Mine, Josephine County, Oregon," was written by F. W. Libbey, former Director of the Department, in line with the Department's duty to make available information on the economic geology of the state. This 53-page report describes the geology of the deposit, gives a history of the development and sporadic operations of the past, and suggests the possibility of new discoveries under modern methods of exploration and production.

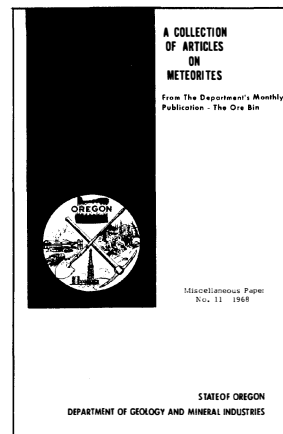
The mine is situated in a mineral area known as the Big Yank Lode, which crosses the Rogue River north of Galice, and has been the subject of several geologic studies. Files of mine records and reports of examinations have been made available for this study, and such modern methods as a gravity survey and the Department's stream-sampling program have been utilized in compiling the report. Mr. Libbey presents evidence to show that the property still has commercial value in gold, silver, copper, and barite under up-to-date methods of mining.



The ORE BIN, publication of the Department mailed to more than 2000 individuals, government agencies, and institutions each month, has reached an all-time high in distribution, with paid subscriptions of 1542 in June 1968, which figure does not include copies mailed out on an exchange basis. A broad variety of subjects has been reviewed during the past two years, ranging from annual accounts of the previous year's mineral industry to studies of Oregon's potential for geothermal energy production, and from the exotic-metals industry developed from experiments of the U.S. Bureau of Mines' Albany establishment to offshore placer accumulations in the economic field; from identification of the remains of a fossil sand shark to methods of determining the genera of fossil woods in the Sweet Home Petrified Forest, in the area of paleontology; from an explanation of the finding of fulgurites on Mount Thielsen to the history of the Sams Valley meteoritic shower; and the geologic background of such scenic spots as Stein's Pillar near Prineville and Cape Arago and Cape Lookout State Parks on the coast, as well as the accessible part of the Snake River canyon between Farewell Bend and Hells Canyon.

Miscellaneous Paper No. 11 is a gathering of reprints from The ORE BIN entitled "A Collection of Articles on Meteorites," many of them written by Dr. Erwin F. Lange of Portland State College, local authority on meteorites. The Department, in cooperation with Portland State College, established 1968 as "The Year of the Meteorite" in an endeavor to interest Oregonians in reporting known meteorites in private ownership and locating possible others in the field, with the purpose of extending our knowledge of outer space.

Staff geologists prepared a large part of the information for "The Mineral and Water Resources of Oregon," to be published by the U.S. Geological Survey as a U.S. Senate Committee report at the request of Senator Mark O. Hatfield. This will be available in September 1968 as one of the Department's bulletin series.



"Geology of the Ironside Mountain Quadrangle, Oregon" by W. D. Lowry, is ready for publication, also as a bulletin. The quadrangle is located in the southern portion of the Blue Mountains in Malheur, Grant, Baker, and Harney Counties, in a region underlain by Tertiary and pre-Tertiary rocks, the oldest of which the author believes may be of Precambrian age. Dr. Lowry, at present in the Department of Geological Science, Virginia Polytechnic Institute, prepared part of the text and map as a doctoral dissertation in 1943, and completed mapping of the 30-minute quadrangle in 1956.

Editing is under way on the first draft of the manuscript for Oil and Gas Investigation No. 2, "Willamette Valley-Lower Columbia Subsurface Study," by V. C. Newton, Jr. This report describes results of deep drilling in northwestern Oregon and regional geologic relationships are interpreted on six subsurface sections. Possibilities for finding commercial petroleum deposits in the area are discussed, using the information collected in the study.

Another in the Department's bulletin series will be "Geology of the Southwestern Part of the John Day Uplift," by H. J. Buddenhagen, consulting geologist of Grants Pass. He has completed the mapping program which he started 11 years ago in the pre-Tertiary inlier of central Oregon. According to Mr. Buddenhagen, "As in all areas of complex and obscure geology, map compilation and analysis have revealed areas of apparent anomalies where additional investigation is needed...Inadequately mapped, anomalous and poorly understood areas and problems will be pointed out and discussed; and hopefully enough interest will be generated to attract more detailed studies of this complex and interesting region."

HEAD OFFICE

MUSEUM

New specimens are constantly being added to the museum, many of them donated by individuals interested in helping augment the Department's collection. A recent gift from Leonard J. Wilkinson of Prineville, Oregon, consists of more than 100 kinds of minerals, rocks, and fossils. The specimens are all of prime quality and originate from many different regions, including Oregon. Among the group are fossil plants, trilobites, and fish, polished agates, large crystals of barite, selenite, and sphalerite, a rare specimen of native copper with silver, and many exceptionally fine examples of unusual and colorful minerals. The collection is on display in the Department's Portland office. The accompanying photograph shows a part of the collection.



LIBRARY

The catalog of library material in the Department was increased by a welcome assortment of U. S. Bureau of Mines and U. S. Geological Survey publications, material received in exchange from the Geological Surveys of other states and Canada, and also by professional journals and trade magazines. During the biennium we added 12 theses written by graduate students pertaining to the geology of Oregon to our valued collection of such unpublished material.



In connection with his mineral collection, Mr. Wilkinson donated to the Department his extensive library of reference books on rocks, minerals, gems, fossils, and general geology. This large group of books and pamphlets will be arranged according to subject matter, and parts of it will be available in the fall for loan to rock clubs and other interested groups. The photograph at left depicts a small representative sample of the material given by Mr. Wilkinson.

COMPARATIVE STATEMENT OF EXPENDITURES

	1965-1967 Total Expenditures 7/1/65-6/30/67	1967-1969 Estimated Expenditures 7/1/67-6/30/69	1969-1971 Funds Requested 1969-1971
<u>Personal Services:</u>	<u>\$381,237.04</u>	<u>\$453,167.00</u>	<u>\$517,422.00</u>
<u>General Operating & Maintenance:</u>	<u>\$ 81,889.58</u>	<u>\$ 77,900.00</u>	<u>\$115,274.00</u>
Office Supplies	2,603.15	2,200.00	3,000.00
Telephone & Telegraph	4,825.33	4,200.00	4,500.00
Postage, Freight, Express	3,270.68	3,000.00	3,500.00
Printing	16,406.66	14,000.00	20,000.00
Rents	20,379.84	21,820.00	22,620.00
Premiums & Assessments	487.73	500.00	720.00
Auditing	1,901.30	1,200.00	23,250.00
Industrial and Laboratory	3,896.88	3,800.00	4,500.00
Heat, Light, Power	1,022.26	1,300.00	1,300.00
Library	882.14	400.00	1,200.00
Laundry	117.17	100.00	144.00
Photos and Blueprints	3,538.27	2,100.00	3,400.00
Gas & Oil Well Law Administration	82.93	1,500.00	2,500.00
All Other	44.75	500.00	500.00
Building and Ground	348.89	250.00	750.00
Travel Expenses: In State	19,225.77	18,230.00	20,390.00
Travel Expenses: Out of State	2,855.83	2,300.00	3,000.00
<u>Capital Outlays:</u>	<u>\$ 7,555.10</u>	<u>\$ 4,734.00</u>	<u>\$ 18,894.00</u>
Office Furniture & Equipment	2,425.10	381.12	6,696.00
Motor Vehicles	1,800.00	1,382.88	2,600.00
Laboratory & Field	3,330.00	2,970.00	9,598.00
<u>Special Requests:</u>	<u>\$ 14,612.17</u>	<u>\$ 15,000.00</u>	<u>\$ 15,000.00</u>
State Geological Survey	14,612.17	15,000.00	15,000.00
Total Expenditures	\$485,293.89	\$550,801.00	\$666,590.00

SUMMARY

	Expended 1965-1967	Appropriated 1967-1969	Requested 1969-1971
Personal Services	\$381,237.04	\$463,848.00	\$517,422.00
General Operating & Maintenance	81,889.58	78,100.00	115,274.00
Capital Outlays	7,551.10	4,734.00	18,894.00
State Geologic Map	14,612.17	15,000.00	15,000.00
TOTAL	\$485,293.89	\$561,682.00	\$666,590.00

THE APPROPRIATION

(1967 - 1969 FISCAL BIENNIUM)

Salaries and Wages	\$ 453,167.00	82.25 percent
General Operating & Maintenance	77,900.00	14.16
Capital Outlays	4,734.00	0.86
State Geologic Map	15,000.00	2.73
	<hr/>	<hr/>
TOTAL	\$ 550,801.00	100.00

AND WHAT IT PAID FOR

(1966 - 1968 REPORTING PERIOD)

6,556	Square miles geologically mapped	2,224	Geochemical analyses
148	Field investigations	51	Differential thermal analyses
32	Oil and Gas Act inspections	1,360	Spectrographic analyses
72	Cooperative projects with other agencies	743	Petrographic examinations
9	Major publications issued	165	Talks
		21	Field trips for groups
63,275	Copies of The ORE BIN	5	Office tours
358	Mineral sets	28,674	Pieces of mail sent (excludes bulk mail)
19,421	Visitors	33,035	Pieces of mail received (Portland)
1,848	Mineral identifications	13	Television and radio appearances
4,356	Chemical analyses	17	Exhibits judged
1,858	Radiometric determinations	7	Court appearances as expert witnesses