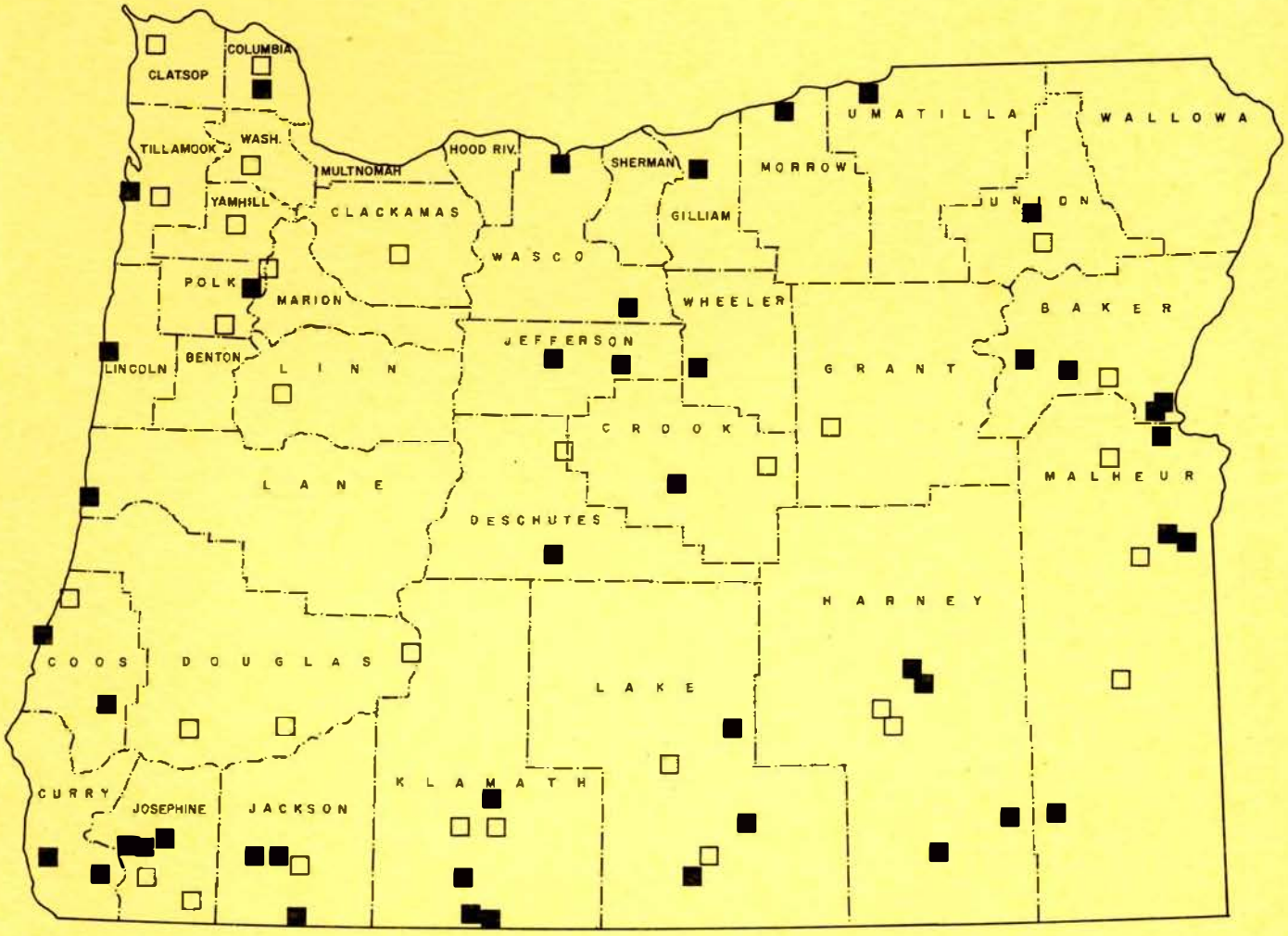
THE 17th BIENNIAL REPORT

of the

STATE OF OREGON

DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES



■ PROJECTS ACCOMPLISHED 7-1-69 to 6-30-71

□ PROJECTS PROPOSED 7-1-71 to 6-30-73

1968 - 1970

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

BULLETIN 68

SEVENTEENTH BIENNIAL REPORT OF THE STATE OF OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

1968 - 1970

1970

STATE GOVERNING BOARD

Fayette I. Bristol, Chairman	Rogue River
R. W. deWeese	Portland
Harold Banta	Baker

STATE GEOLOGIST

R. E. Corcoran

Artist's conception of Mount St. Helens' 1847 eruption.

DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

ADMINISTRATIVE OFFICE

1069 STATE OFFICE BLDG. • PORTLAND, OREGON • 97201 • Ph. (503) 229-5580

TOM McCALL
GOVERNOR

STATE GEOLOGIST
RAYMOND E. CORCORAN

GOVERNING BOARD
FAYETTE I. BRISTOL
Chairman
Rogue River

HAROLD BANTA
Baker

R. W. deWEESE
Portland

To His Excellency, The Governor
of the State of Oregon
and to
The Fifty Sixth Legislative Assembly of the State of Oregon

Sirs:

We submit herewith the Seventeenth Biennial Report of the State Geologist, covering activities of the Department of Geology and Mineral Industries for the period from July 1, 1968, to and including June 30, 1970.

Respectfully,

Fayette I. Bristol, Chairman
of the Board

R. W. deWeese, Member

Harold Banta, Member

Portland, Oregon
July 1, 1970

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BRIEF HISTORY OF THE DEPARTMENT

1872 First State Geologist, Dr. Thomas Condon, appointed by Legislature.

1911 Legislature creates Bureau of Mines of Oregon, located at Oregon Agricultural College.

1913 Legislature renames Bureau the Oregon Bureau of Mines and Geology and expands its responsibilities.

1923 Bureau incorporated into School of Mines at Corvallis.

1925 Legislature creates Oregon Mining Survey but without office or staff.

1929 Legislature creates State Mining Board with no office or staff.

1937 Legislature creates State Department of Geology and Mineral Industries, with offices in Portland, Baker, and Grants Pass.

1941 Legislature creates Spectrographic Laboratory, with installation in Portland office.

1943 Department consolidates all analytical laboratories and assay services in Portland office.

1953 Legislature adopts Oil and Gas Conservation Act and assigns regulatory responsibilities to the Department.

1965 Legislature passes an act (ORS 517.410) requiring agencies to consult with Department before issuing leases for mining or for oil and gas exploration.

FUNCTIONS OF THE DEPARTMENT

The Department conducts a continuing series of investigations into the many aspects of the state's geology. Information gathered as a result of this work is disseminated to the scientific community, federal, state, and local governments, industry, and the public generally.

Specifically, the Department:

(1) Furnishes detailed information on the engineering capabilities and limitations of selected geological formations to be used as a basic land-use planning tool.

(2) Provides data on the state's mineral resources for producers and consumers of mineral products, the financial community, planning commissions, state and local governments, and the public generally.

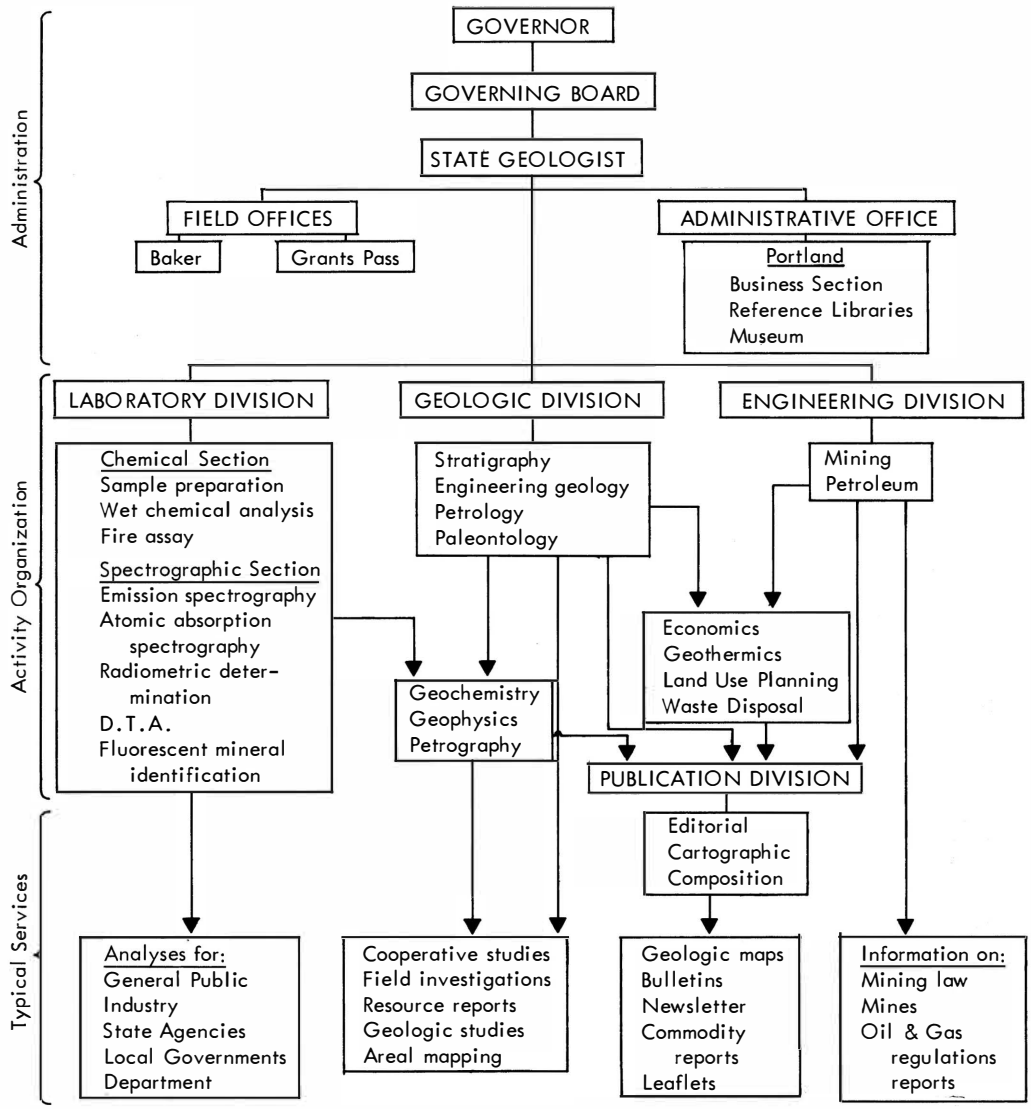
(3) Supplies a wide variety of basic geologic data to all sectors of the state's economy.

(4) Advises on the recreational and educational aspects of geology and attendant geologic hazards to residents of the state and its visitors.

(5) Administers the Oil and Gas Conservation Act, and provides assistance and information to the petroleum industry.

(6) Assists other state agencies by providing engineering geology studies, information on mining law and mining practices, and data on mineral economics.

ORGANIZATION CHART



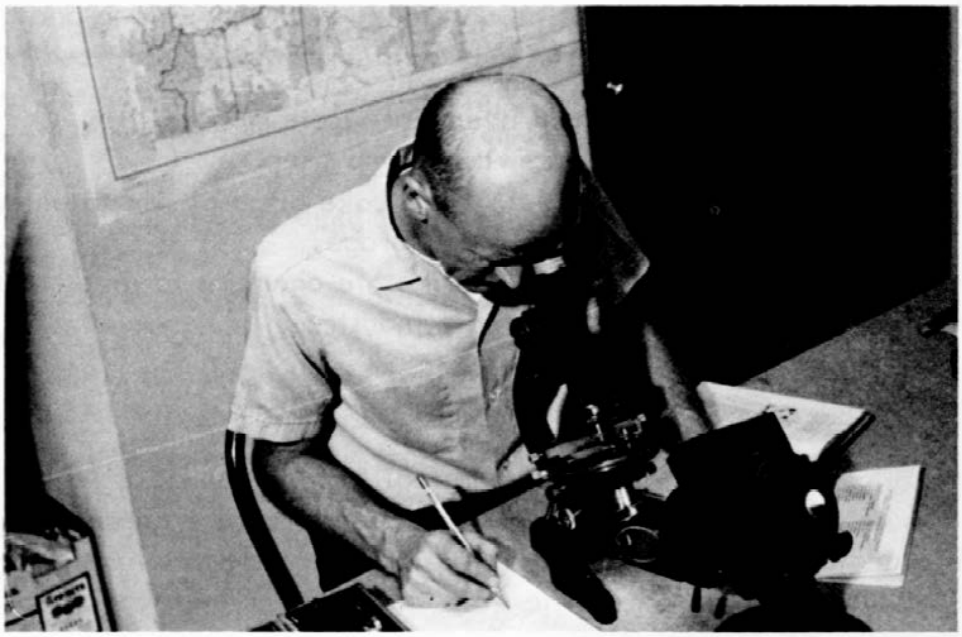
Rapid changes in land use as orchards and farm lands become freeways, industrial parks, shopping centers, and housing developments. View looking north towards Progress and Beaverton (photograph courtesy of Oregon State Highway Department).

DEPARTMENT ACTIVITIES

In preparation for the coming biennium the Department, for the first time, assigned its work load to specific activities. It was felt that this arrangement would make for an easier understanding of the current and proposed Department functions and budget requests. This reclassification has not been easy since, by its very nature, basic geological study involves several intradepartmental disciplines.

Although the programming of the Department's activities was not put into effect during the 1969-1971 biennium, the accomplishments and proposed projects are summarized below by activities. The titles of the nine activities appear below.

1. Geological Studies for Protection and Enhancement of Environment.
2. Oil and Gas
3. Economic Geology Studies
4. Inter-agency Assistance (State)
5. Special Services
6. Public Services
7. Recreational Geology
8. Information and Education
9. Preparation for Geological Catastrophies



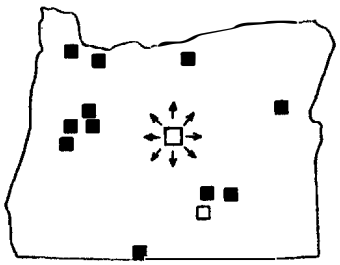
Rocks sliced thin enough to see through are studied to determine their mineral content.

ACTIVITY 1

Geologic Studies for the Protection and Enhancement of the Environment

Waste disposal

■ The Department has become increasingly involved in the rapidly growing problems of waste disposal. In Lake County the Alkali Lake storage site for chemical and metallurgical wastes was studied to determine the subsurface characteristics of the basin. Surface geologic studies were supplemented by a series of test holes to determine subsurface conditions.



■ A disposal site for pesticide containers was studied near Klamath Falls.

■ Low-level nuclear-waste storage sites in Gilliam and Harney Counties were inspected to determine subsurface structures and their relation to ground-water movement.

■ Solid-waste disposal problems in Multnomah, Marion, Washington, and Baker Counties were investigated and reports prepared for the authorities requesting the investigations.

■ Basic geologic studies were made in Marion, Benton, and Polk Counties to determine the characteristics of ground water, permeability of the near-surface horizons, and other factors necessary for making long-range plans for sewer construction.

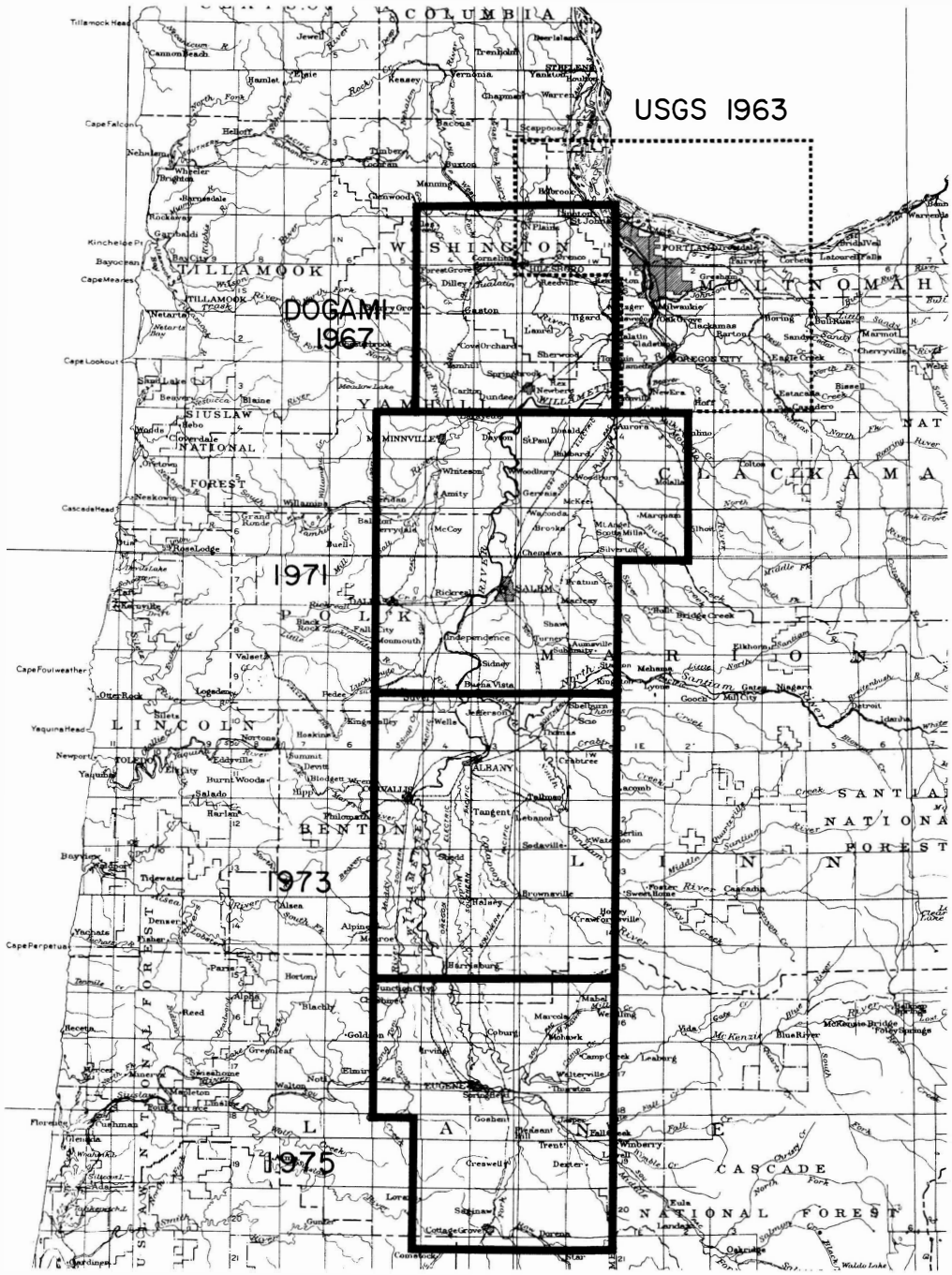
Proposed activities include:

- Geologic studies of six potential chemical-waste storage sites.
- Geologic studies of four nuclear-waste dump sites.
- Continuing geologic studies at the Alkali Lake disposal site to determine its potential for various types of chemical storage.
- Anticipated studies requested by various state agencies to investigate proposed disposal sites selected by private industry.

Land-use planning

■ Geologic maps are the basic planning tool for any land-use studies. In the northern part of the Willamette Valley area, a long-range program of preparing engineering-geology maps specifically designed for land-use planning by local governments was started. Most of the work will be done on a co-operative funding basis with the various counties.

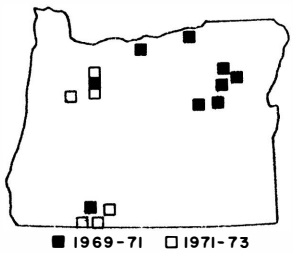
■ In response to an emergency request from the city of La Grande, a detailed engineering-geology study of a potentially dangerous landslide area was made.



Engineering geology studies of the Willamette Valley for land-use planning.

A gravel quarry - - -

- - - becomes a swimming pool.



The capabilities and liabilities of the area were assessed with respect to future development.

■ At the request of Jackson County, an inventory of the sand and gravel resources along a portion of the Rogue River, Bear Creek Valley, and the upper Applegate River was undertaken. The county was concerned with the availability of future supplies of aggregate and the proper planning for areas underlain with economic deposits.

■ Geologic examinations of sanitary landfill sites were made in three counties. Union, Jackson, and Sherman Counties requested assistance from the Department to determine the geologic factors affecting the utility of the sites.

■ Demands for building sites for subdivisions resulted in requests for basic geologic information from Polk, Jackson, Union, and Tillamook Counties.

■ The general principles of engineering geology as applied to land-use planning were discussed at a series of meetings with staff members and students at the University of Oregon School of Architecture.

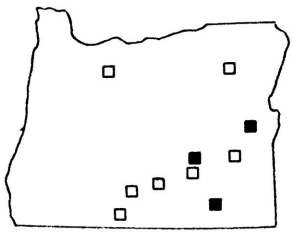
■ Two dam and reservoir sites, one in Grant and one in Morrow County, were geologically examined by the Department at the request of the State Game Commission.

■ Assistance was given to Grant County in the location of suitable rip-rap material for flood control along the John Day River.

Proposed activities include:

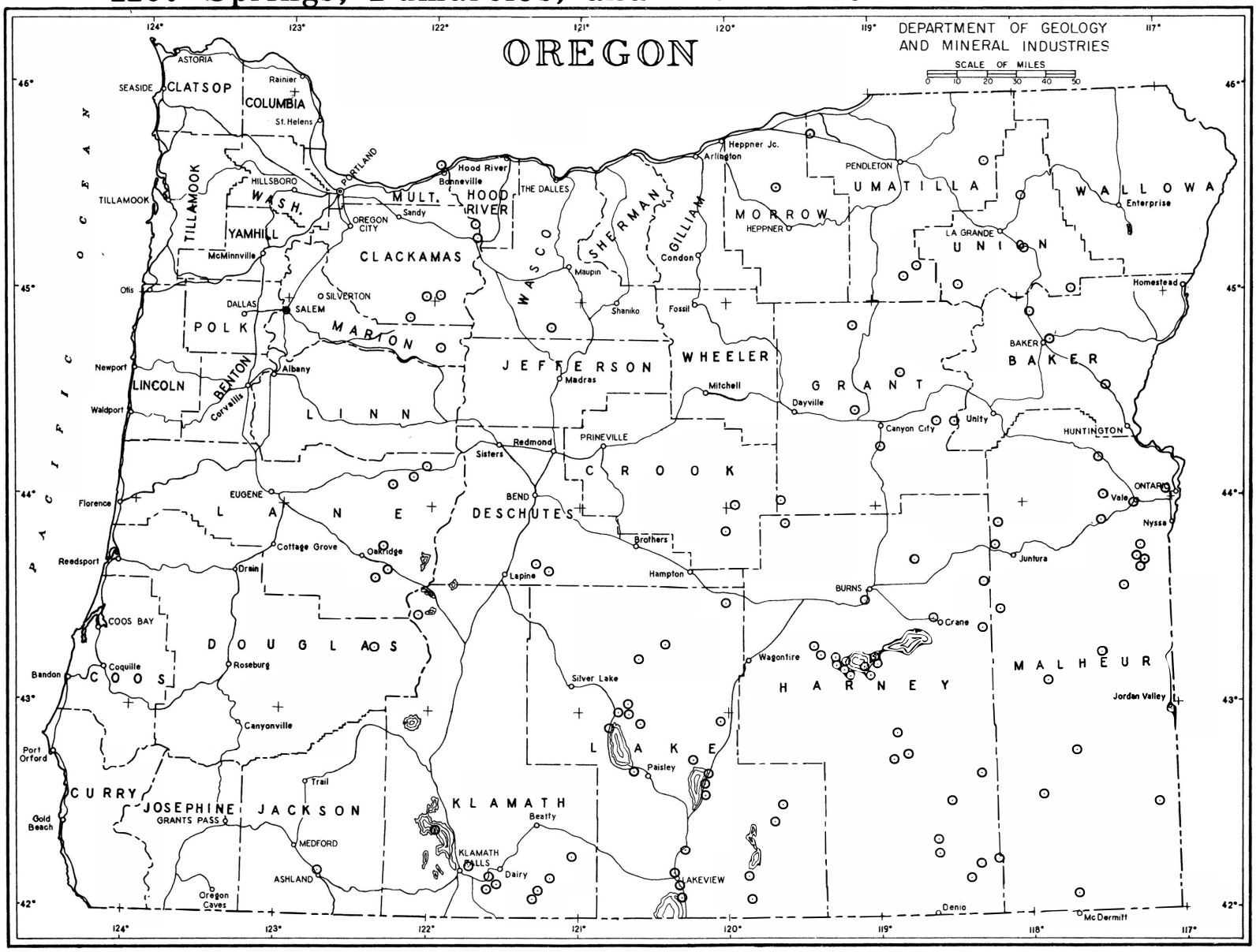
- Completion of a detailed engineering-geology study of the northern and central portions of the Willamette Valley. Results to be published in two separate reports.
- Conducting of a detailed engineering study of the southern part of the Willamette Valley.
- Publishing of a report on availability of sand and gravel and environmental geology of the Bear Creek Valley in Jackson County.

Geothermal areas



■ Large areas of Oregon lying east of the Cascades are covered with relatively young lavas. In some places, deeply buried layers of rock that are still hot heat ground water until it becomes steam. Geothermal steam has been harnessed for power in New Zealand, Iceland, Italy, Mexico, and California. The Department has been making field examinations for several years for the purpose of identifying those areas in Oregon which might have sufficient geothermal potential to be of interest to power utilities. Both Lakeview and Klamath Falls make use of high

Hot Springs, Fumaroles, and Hot Water Wells in



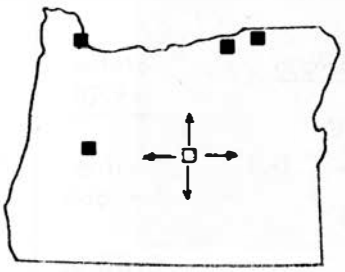
temperature ground water for space heating, and the potential for producing electrical power in these areas appears to be good.

A compilotion of all known thermal springs and wells in the state was made by the Department and published with an index map showing their location.

Proposed activities include:

- Delineation of three geothermally potential areas which might be of interest to industry.

Nuclear plant site studies



- During the biennium the Department participated in the studies and deliberations of the Nuclear Development Co-ordinating Committee and the Nuclear Plant Siting Task Force. In addition, proposed nuclear plant sites were inspected in Lane, Columbia, Umatilla, and Morrow Counties.
- It is expected that additional proposed nuclear plant sites will be examined during the next biennium.

Cost of the program is estimated at: $169,213.

Geysering steam well near Adel, Lake County.

ACTIVITY 2

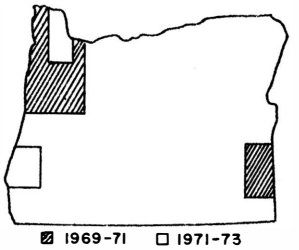
Oil and Gas

■ Under ORS 520, the Department has the responsibility of regulating the search for and the development of oil and gas minerals in the state. The authority also includes the collection of well records and maintenance of a sample library. Each drilling must be bonded to insure proper abandonment plugging. Casing, testing, and cementing programs are also reviewed by the Department. Two permits were issued during the 1968-1970 biennium for shallow test drilling. Surveillance of the two operations required several visits to the well sites.

Drilling Permits

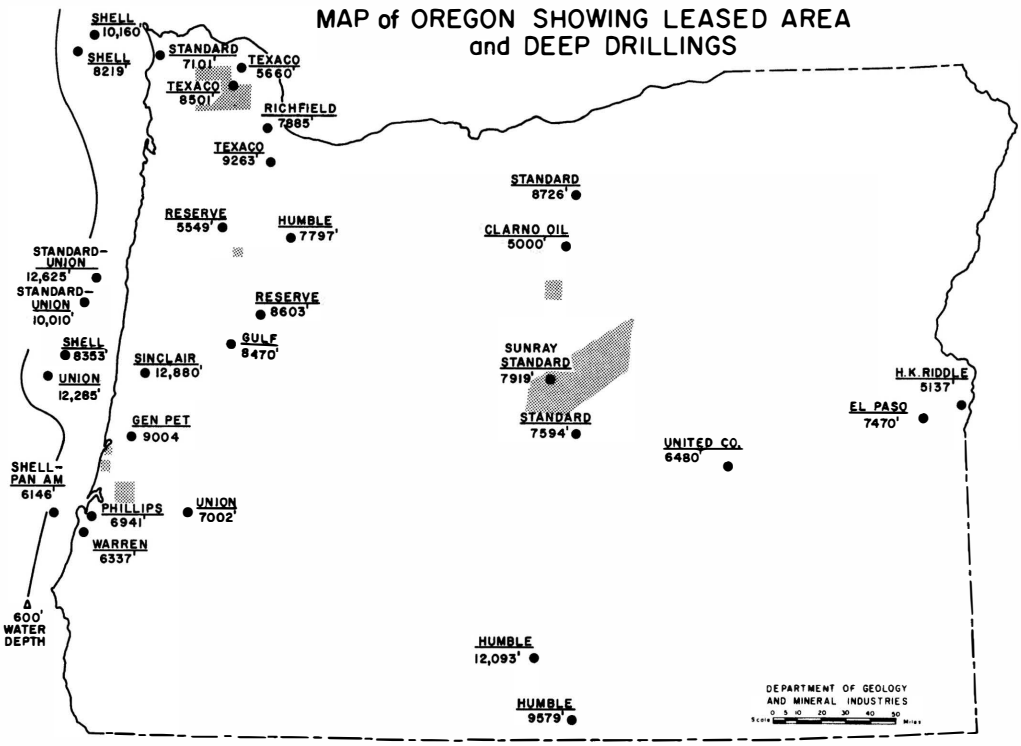
Company	Well Name	Location	Depth	Status (1970)
R.F. Harrison	Morrow No. 1	Sec. 18, T. 12 S., R. 15 E. Jefferson County	3300' (old T.D.)	Fishing for tools
W.G. Craig	Gilmour Estate No. 1	Sec. 24, T. 9 S., R. 4 W. Marion County	500'	Drilling

Information on petroleum exploration was mailed to inquiring companies at an average of 10 requests per month. The data asked for involved well surveys, descriptions of rocks penetrated, and statements on potential producing areas of Oregon. The Department also participated in studies made by the U.S. Geological Survey, Interstate Oil Compact Commission, and Potential Gas Committee of the Colorado School of Mines concerning exploration and development of hydrocarbons. Reports were requested by various state and private organizations on existing or suggested regulations for oil and gas development. The Department acts as consultant on oil and gas matters with other state agencies. Studies of gas storage sites are planned for western Oregon.



Leasing

Several major companies acquired oil and gas leases in the 1968-1970 biennial period. Mobil, Texaco, and Standard of California leased an estimated 20,000 acres in Washington, Columbia, and Clatsop Counties. Mobil also picked up several thousand acres of land in Coos and Douglas Counties. In May 1970 Texaco began active exploration near Paulina in Crook County by leasing 150,000 acres



of federal lands and more than 4,000 acres of state school lands. This new move will undoubtedly result in the drilling of at least one deep test hole.

Offshore

The Department made inspections of offshore operations during 1961-1967 and employed observers to monitor core drilling.

Proposed activities include:

- Increased interest in underground storage for natural gas prompts an investigation by the Department into prospects in Oregon. Studies for storage sites will be focused on northwestern Oregon to begin with, since the need is greatest in this area and the possibility of finding suitable geologic structures is good. The demand for natural gas has become so great that utility companies must look for new reserves to replace the dwindling domestic supply.

Gas occurrences have been known in the Coos Bay area for a long time. Investigation of attractive structures in that area appears to be worth while.

- Changing technologies and new concepts of environmental protection will be reflected in the revision of Miscellaneous Paper No. 4, "Rules and Regulations for the Conservation of Oil and Natural Gas," which is scheduled for publication during the next biennium.
- The Department's growing library of oil-well drill samples will be catalogued and published.
- Drilling data on the test wells drilled in the state will be compiled and published.
- The microfossil content of cuttings from two deep test wells will be obtained, identified, catalogued, and made available to industry for study.

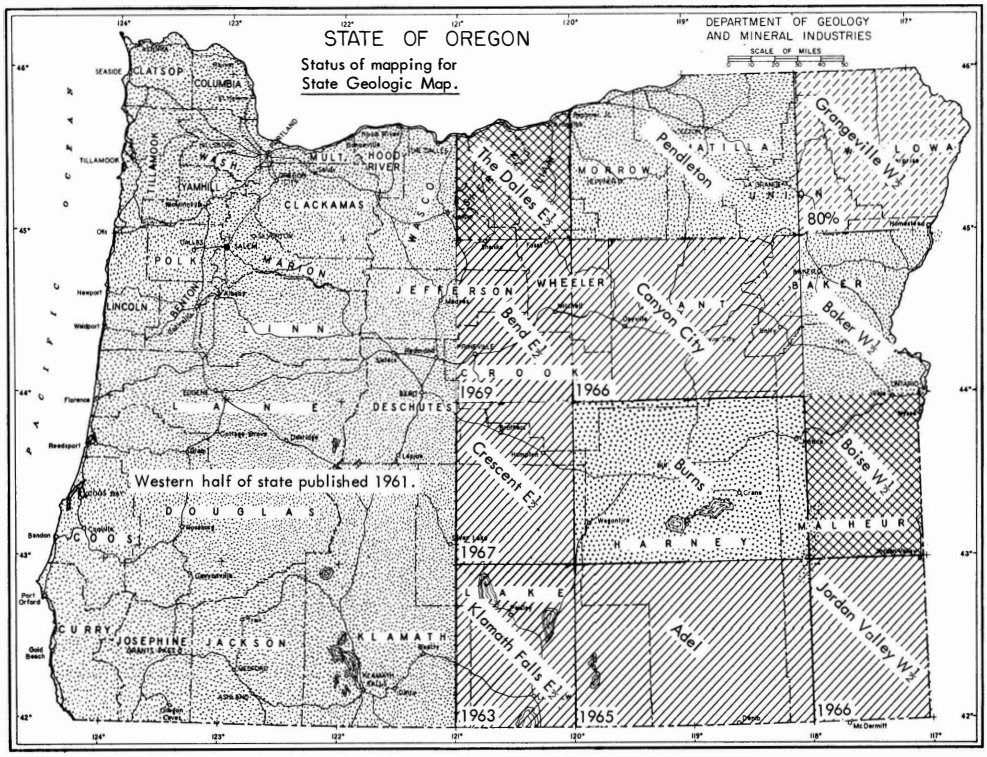
Cost of the program is estimated at: $34,494.

Seismic exploration crew drilling holes to test for oil and gas structures.

ACTIVITY 3

Economic Geology Studies

■ Less than 15 percent of the state has been geologically mapped in sufficient detail to be of use by today's planners, industry, and the public generally. Areas mapped by the Department during the past biennium and those planned for study during the coming one are shown on the index map below.



■ Geologic mapping of the Upper Chetco area, lying principally in Curry County, was essentially completed during the biennium. Numerous mineral prospects are located within the map boundaries, as is also the Kalmiopsis Wilderness Area. The Upper Chetco area is an important key to solving geologic problems connected with the Klamath Mountains province.

Jetty rock must be hard, tough, heavy, and resistant to sea water. Only large blocks can be used.

■ Four quadrangles, the Ivers Peak, Tyee, Sitkum, and Camas Valley, are being geologically mapped on a part-time basis. A total of 240 square miles was covered during the biennium by a professional geologist employed by the Department.

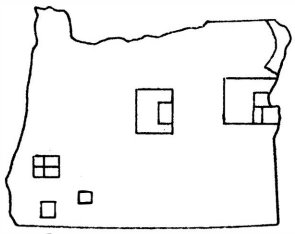
■ Mapping of the Baker AMS quadrangle at a scale of 1:250,000 was nearly completed. Detailed mapping of particularly critical segments of this large area at a scale of 1:62,500 was continued, with approximately 100 square miles completed.

■ A map of the geology of the southwestern Oregon coast was published and will accompany a bulletin to be issued early in 1971.

■ Geologic mapping of approximately 250 square miles of the inner gorge of the Snake River canyon was accomplished. This difficult area is being mapped on a part-time basis by a nondepartmental professional geologist.

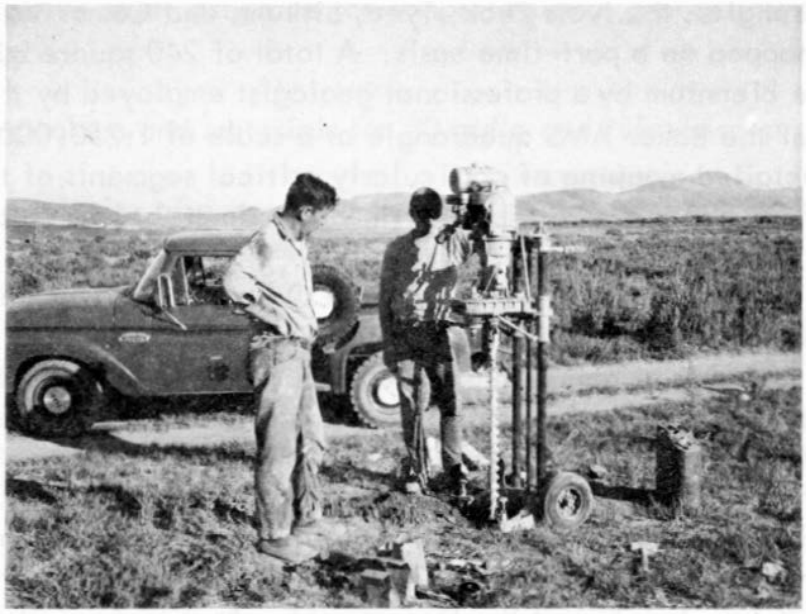
■ A total of 6,000 square miles of eastern Klamath and western Lake Counties was geologically mapped and a map and bulletin published. The project was cooperatively financed by Pacific Power & Light Co., Great Northern Railway (now Burlington Northern, Inc.), and the Department. As direct results of the study, one company is investigating the geothermal resources and a second is sampling a diatomite deposit.

Proposed activities include:



- □ Complete one geochemical survey in the Blue Mountains.
- □ Publish four economic reports on diatomite, zeolites, nickel, and copper.
- □ Publish a geologic map of the Baker AMS quadrangle.
- □ Complete the geologic mapping of 130 miles of the Snake River canyon.
- □ Complete the geologic reconnaissance of the Huntington, Mineral, and Olds Ferry quadrangles.
- □ Produce a geologic map and bulletin of the Upper Chetco area of Curry County.
- □ Publish a geologic map of the Mitchell 15-minute quadrangle.
- □ Complete the geologic studv of a metamorphic aureole in the Tiller-Drew area of Jackson County.
- □ Conduct an aggregate-resources survey in three districts and publish three reports.
- □ Complete the geological mapping of the Tyee, Sitkum, Ivers Peak, and Camas Valley quadrangles.

Cost of the program is estimated at: $141,721.

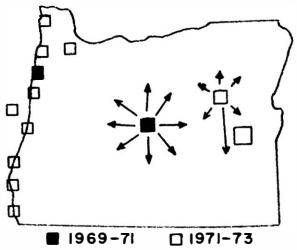


Test drilling on a diatomite prospect, Klamath County.

Suction dredging for sand and gravel, Willamette River near Ross Id.

ACTIVITY 4

Interagency Assistance



- During the past biennium the Department provided information and research to more than 30 state agencies which called upon it for assistance.
- In-depth studies of various aspects of sand and gravel resources administered by the State Division of Lands were provided.
- In cooperation with other natural-resource agencies, plans and initial studies were undertaken for a comprehensive study of the state's marine estuaries.

Proposed activities include:

- Preparation of three sand and gravel studies for the Division of Lands.
- Appraising the geologic-resource potential of 512,000 acres of state-owned lands in eastern Oregon for the Division of Lands.
- Providing assistance to the Division of Lands and other resource agencies involved in drafting legislation for the offshore mining of hard minerals.
- Geologically mapping 14 marine estuaries in a cooperative, comprehensive study.
- Completion and evaluation of a comprehensive inventory of state forest land mineral resources.

Cost of the program is estimated at: $97,023.

ACTIVITY 5

Special Services

During the previous biennium, work was started on the compilation of an open-file, unbound library of data on the principal geologic formations in the state. A total of nine additional formations was catalogued during the current biennium. When it is completed, the long-range project will provide a basic geologic tool for any future studies of the state's geology and mineral resources.

Requests for information on the geology of Oregon come from all levels. In addition to those originating with the mineral and petroleum industries, there is a steadily increasing demand from local governments, regulatory bodies, and federal agencies. An estimated 570 requests will be serviced during the current biennium.

Little long-range planning has been accomplished in the past, but pressures by state and federal governments are forcing local governments to initiate studies. Basic to any long-range planning for land use is a comprehensive understanding of the resources, capabilities, and liabilities of the land itself. The Department has already provided assistance to several urban areas by making detailed geologic studies and publishing a series of maps, as discussed under Activity 1.

Proposed activities include:

Completion, or near completion, of the library of information on Oregon geologic formations.

The servicing of approximately 750 requests from industry, local governments, and other regulatory agencies.

Assistance to an estimated seven urban areas needing basic geologic information to provide the groundwork for long-range land-use planning.

Cost of the program is estimated at: $84,693.

Ice Age floods left deposits of sand and gravel in southeastern Washington County.

ACTIVITY 6

Public Services

The Department continued to provide a wide variety of services for the public in general. Analytical services included: fire assaying, wet-chemical analysis of rocks and minerals, radiometric analysis of samples, rock and mineral identification, fossil flora and fauna identification, fluorescent examination, differential thermal analysis of clays, and examination of rock specimens under the petrographic microscope.

Other public services rendered included: preparation of rock, mineral, and fossil displays for the Department's three offices, the servicing of approximately 13,000 requests received by either mail or telephone or in person; talking to numerous school and service groups; and providing leaders for field trips.

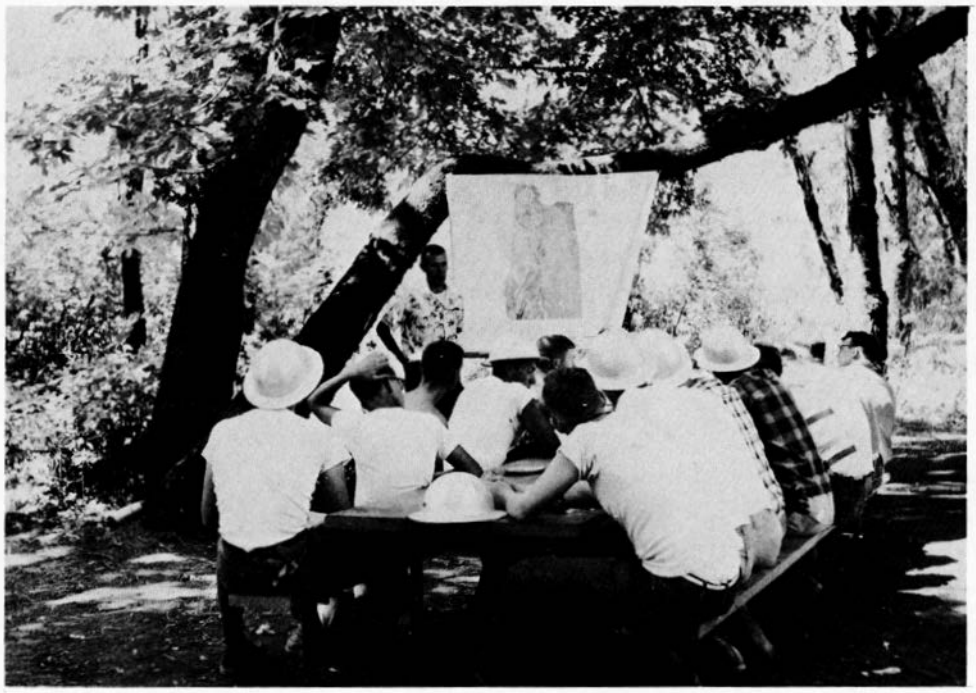
Much of the Department's information is disseminated through its various publications. These include the monthly newsletter, The ORE BIN, which is distributed on an annual subscription basis; reprints of special interest articles from The ORE BIN; miscellaneous tear sheets, small maps, charts, and diagrams; and Bulletins, Short Papers, Miscellaneous Papers, and multicolored geologic maps.

The Department maintains a comprehensive technical library on every phase of geology pertinent to the state. The library is open to the public and is much used by students, researchers, recreationists, professional geologists, and the public in general.

Proposed activities include:

Providing approximately 6,200 assays on Oregon rocks and minerals.
Providing approximately 3,400 spectrographic and radiometric analyses.
Providing approximately 2,800 rock and mineral identifications.
Providing approximately 500 identifications of fossil flora and fauna.
Enlarging present museum display area by 25 percent.
Responding to an estimated 13,500 requests for information
Responding to an estimated 200 requests for talks to groups.
Providing an estimated 30 leaders for field trips.
Publishing an estimated 76,800 copies of the monthly newsletter, The ORE BIN.
Republishing an estimated 16 selected articles from The ORE BIN.
Reprinting an estimated 18 leaflets, maps, tear sheets.
Publishing a bulletin, "Oregon Mining Laws."
Reissuing two out-of-print publications.
Maintaining and enlarging the Department's library of technical books by 3 percent.

Cost of the program is estimated at: $140,691.



A staff geologist briefs Jackson County Parks Department High School employees on the geology of their community.

Department inorganic chemical laboratory for determination of elemental contents of rocks and minerals.

ACTIVITY 7

Recreational Geology

Interest in geology, which until recently was restricted almost entirely to the professional, has spread widely. This interest, coupled with more leisure time and better transportation, has resulted in a great increase in requests for information on the geology of the state.

The Department has published several geologic reports on our State Parks. The park most recently examined was Cove Palisades in central Oregon. The study and report were undertaken cooperatively with the Madras Chamber of Commerce, Jefferson County, and interested citizens. Other parks which have been studied, with reports published, include: Collier, Arago, Cape Lookout, Cape Sebastian, Owyhee, Humbug Mountain, and Ecola.

Since recreationists are predominantly motorists, the demand for information about roadside geology has steadily increased. The Department has published several road logs which describe scenic points of interest, giving their geologic age, method of formation, rock type, and other pertinent information. In cooperation with the Grant County Planning Commission, the Grant County Chamber of Commerce, and the U.S. Geological Survey, the Department assisted in the preparation of some roadside geology plaques and an illustrated brochure. The route covered by the study leads through picturesque John Day Valley, Picture Gorge, and neighboring areas.

Popular articles on the geology of specific points of interest are prepared from time to time. Oregon's rich geologic history has provided the state with a wide variety of geologic phenomena -- hundreds of cinder cones and lava flows just barely cool; an abundance of fossils from ancient seas, prairies, and forests; and scores of lakes, waterfalls, glaciers, landslides, and huge fault-block mountains.

Oregon is a treasure house of semiprecious gemstones. Both residents and visitors spend much time in searching for, cutting, shaping, and polishing opal, agate, quartz, carnelian, jasper, and the famous "thunderegg," the State Rock. Annual production of this one mineral resource is conservatively estimated at one million dollars. The Department is exploring the feasibility of establishing a series of "mineral parks" where several levels of "rockhound" activity might be accommodated.

<u>Proposed activities include:</u>

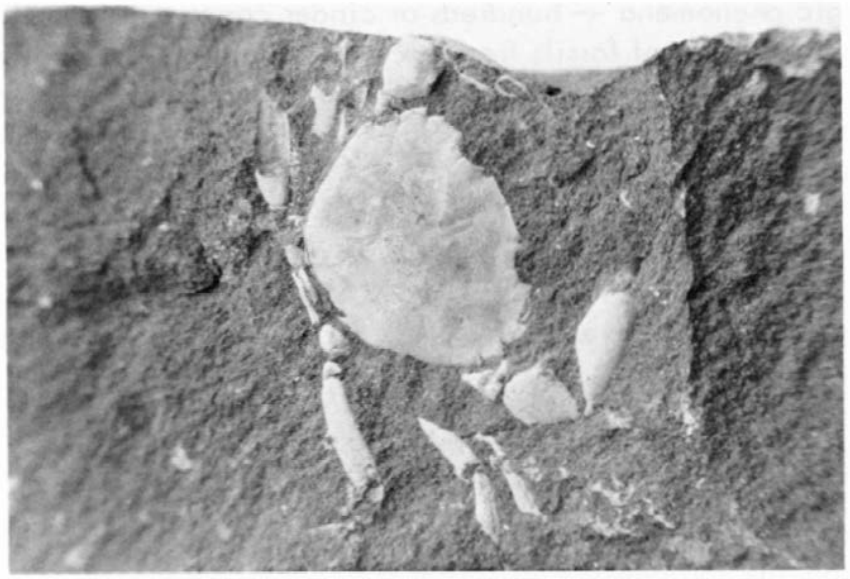
Publishing a report calling attention to geologic features which should be preserved from the inroads of civiliation.

Publishing brochures on the geology of five State Parks.

Publishing roadside geology trip logs of 500 miles of highway.

Publishing a brochure describing 40 of Oregon's outstanding scenic features.

Young people from 4-H Club look for fossils in sandstone quarry.



The search was worth it! A 35-million-year-old crab.

The Mormon Basin, an important gold-producing area in northern Malheur County in the early 1900's.

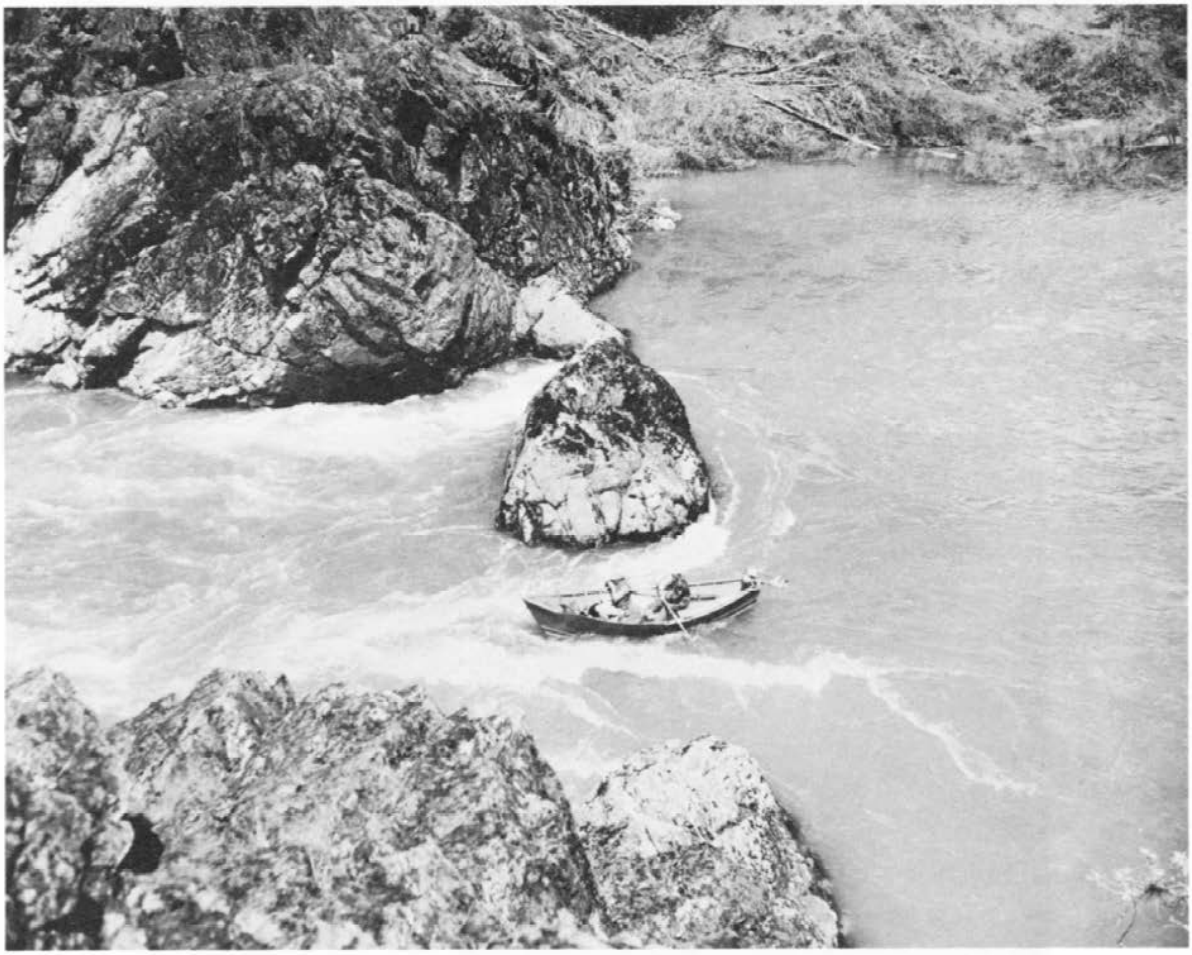
The Greenback gold mine in Josephine County produced $3\frac{1}{2}$ million dollars of gold between 1898 and 1912.

Publishing a series of articles on Oregon's geologic phenomena.

Publishing three articles on the history of Oregon mining.

Promoting the establishment of two commercial and two noncommercial "mineral parks."

Cost of the program is estimated at: $27,878.



Hells Gate, the place where the Rogue River encounters hard, resistant rock and races through a narrow canyon, is a tourist attraction near Grants Pass.

ACTIVITY 8

Information and Education

The Department accumulates a widely varied mass of information as a result of its many activities and research programs. Much of this information is disseminated promptly to special interest bodies such as local governments and industry. A great deal of additional information is also available but must be painstakingly sorted out from numerous reports, publications, and field notes. As time permits, the Department prepares bibliographies of published material on Oregon geology. Specialized bibliographies are also prepared to accompany technical reports and articles issued by the Department.

As the work of mapping the geology of the state progresses, certain information of particular interest to various groups is developed. When feasible, these scattered bits of information are culled from the main reports and combined into a publication. A series of articles on fossil localities in various parts of the state was produced by this method.

Geology, once taught exclusively at the college level, now is being offered in both high schools and grade schools. Geology-based activities are also part of the various youth programs such as the Scouts, Campfire Girls, 4-H Clubs, and others. The Department has cooperated in this effort by supplying geologic information in the form of leaflets and small maps, by advising youth group leaders, assisting at workshops, and helping in other ways.

The growing numbers of retired people living in the state have also spurred a demand for information about the geology and mineral resources of the state, particularly the semiprecious gemstones which are found so abundantly here. In addition to providing general information, the Department has cooperated with the State Parks Division in producing a pamphlet showing locations of rocks, minerals, and fossils of interest to the tourist.

During the biennium the Department also participated in several television programs and assisted in an adult-education lecture series on geology.

Proposed activities include:

Compiling a library of reference materials on Oregon geologic phenomena.

Publishing an article on the geologic factors to be considered in the selection of a site for building a house.

Publishing a bibliography of articles on physical, economic, and historical geology of interest to the layman.

Publishing a series of articles on the geologic history of the state.

Assisting school districts throughout the state in the development of programs designed to acquaint the students better with the geology of the state.

Developing five study programs for nonprofessional groups interested in Oregon geology.

Providing speakers and materials for 20 radio and television programs.

Developing a series of programs on environmental geology for KOAP-KOAC TV

Studying, on a cooperative basis with the Oregon Archaeological Society, two archaeological sites.

Collecting, annotating, and compiling 200 additional reports on mineral deposits.

Providing access and assistance for an estimated 2,500 persons to library materials.

Cost of the program is estimated at: $87,860.

Geological library

The Department maintains a growing geological library which numbers in the thousands of volumes. The library is a repository for maps and publications of the U.S. Geological Survey, the U.S. Bureau of Mines, and other State Geological Surveys throughout this nation and Canada. In addition, it receives professional bulletins from many museums and universities. It subscribes to a number of professional journals, and it acquires pertinent doctoral and master's theses from Oregon and other universities. The library thus serves as a convenient, comprehensive, and up-to-date source of geological information for the staff members, for the researchers in industry, and for students.

Geological museum

The museum contains a representative collection of the state's rocks, minerals, ores, and fossils. Hundreds of specimens are on display in 14 cases. The remainder are catalogued and stored in drawers for handy reference. Outstanding specimens are constantly being added to the museum, many of them donated by persons interested in helping to augment the Department's collection.

Department facilities include libraries of technical publications, rocks, minerals, fossils, semiprecious gem stones, building stones, and oil and gas well cores.

ACTIVITY 9

Preparation for Geological Catastrophies

Geologic catastrophies such as landslides, earthquakes, seismic sea waves, and volcanic eruptions pose a continuing threat to areas such as Oregon which are largely covered with recent lavas and which front on long reaches of exposed coastline. At the present time it is impossible to predict accurately the next occurrence of volanic eruptions, earthquakes, or seismic sea waves. The close relationship between seismic activity and volcanic activity is well known and has been carefully monitored on the Island of Hawaii for many years, with highly successful results. The installation of micro-seismic sensing instruments at selected points in the state might very possibly yield, over a period of time, sufficient data to predict where and when renewed volcanic and earthquake activity could be expected.

A cooperative international seismic sea-wave early warning system has been established for many years. The system, however, is designed solely to provide as much advance warning as possible of the arrival of destructive earthquake-generated waves along the shores of the Pacific Ocean. The program does not include any provisions for identifying those areas where damage to property might be severe, or even total, should seismic sea waves hit the coast.

Although not as spectacular and destructive as siesmic sea waves, the normal waves and breakers along the Oregon coast annually claim the lives of about a dozen persons. The Department has attempted, as the opportunity afforded, to disseminate basic information on the behavior of wave patterns and the hazards existing at various types of shorelines.

In addition to the direct threat to human life, the waves along the Oregon coast present a constant hazard to beach-front lands and property. Recent acceleration of land development along the coast, much of it without due regard to the geologic hazards involved, can only lead to severe problems in the future. The Department has published several articles which have explored this problem, but no in-depth studies have been made.

Landslides are a normal, widespread, and often predictable geologic phenomenon. When they involve areas which have been developed by man, they are often regarded as disasters. Landslide-free ground suitable for various kinds of development is largely used up in Oregon, and many developments lie on landslide-prone slopes.

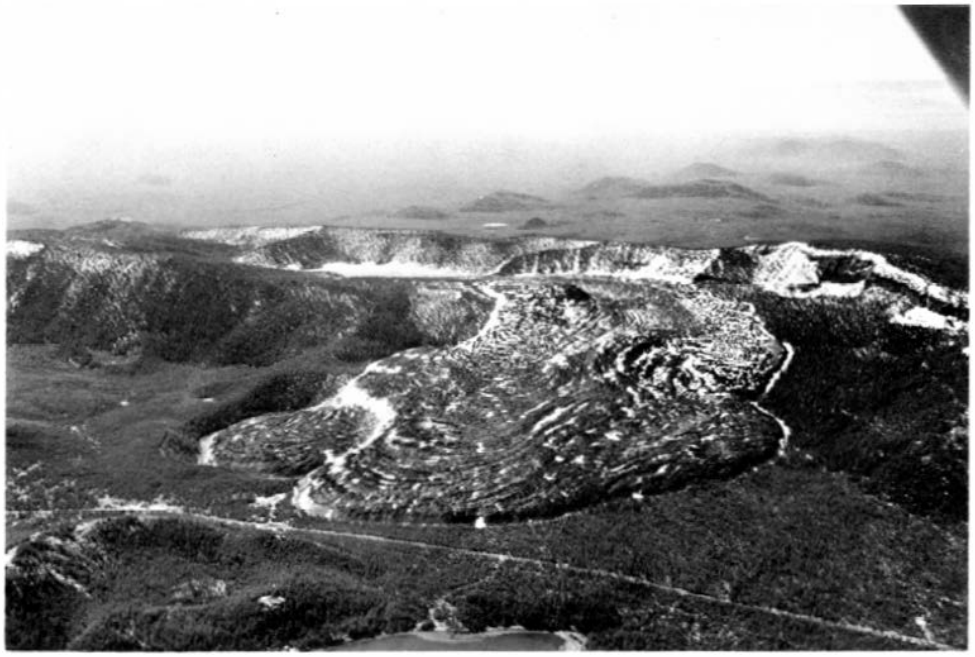
The Department has made several detailed engineering-geology studies of areas where landslides might be a problem. Other areas have also been studied and as a result several localities susceptible to landslides have been discovered. Contrary to popular opinion, landslides are not restricted to the regions of heavy rainfall in western Oregon. Late in the biennium the Department undertook a detailed study of a landslide area near La Grande in Union County (see Activity 1).

Landslides are a commonplace geologic phenomenon, but a real disaster when roads and homes are involved.

The river occupies its natural floodplain during high water, regardless of where man chooses to build his house.

Some rivers become torrential streams that alternately bury and exhume anything in their paths.

Central Oregon is a volcanic wonderland of cones and lava flows. Latest volcanic activity in the state occurred in the early 1800's.



Proposed activities include:

Identifying four areas having a landslide potential and preparing recommendations designed to reduce the hazard to life and property.

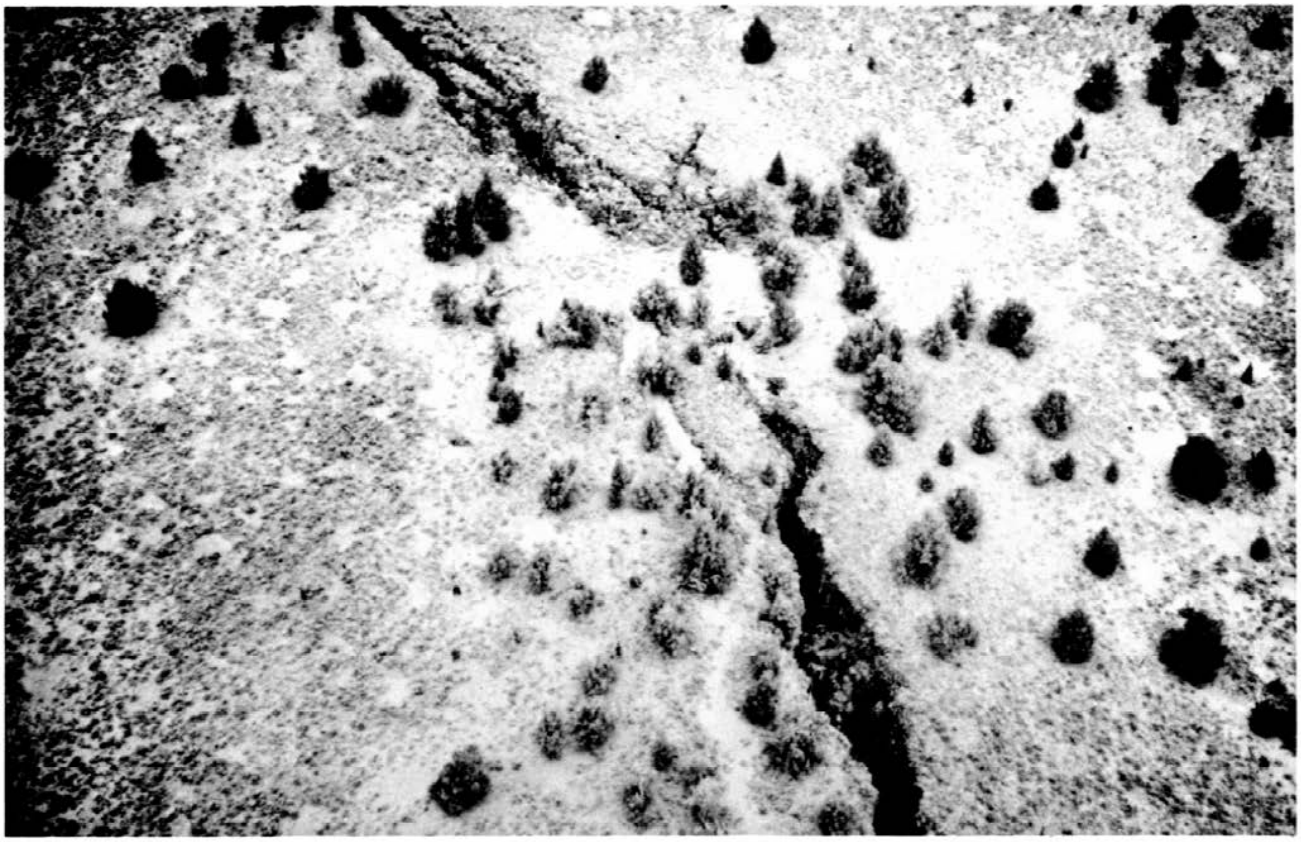
Establishing, in cooperation with other agencies, a seismic network to monitor selected volcanic areas.

Identifying six areas where there is a potential hazard from renewed volcanic activity and preparing, in cooperation with other agencies, a comprehensive plan designed to provide maximum emergency measures.

Preparing, in cooperation with other state agencies, a comprehensive plan for reducing the threat to human life and property from seismic sea waves.

Preparing, as part of a multi-agency study of the coast, a report on six areas having unusually severe exposure hazards peculiar to the coastal environment, and recommending measures designed to reduce property damage.

Cost of the program is estimated at: $11,751.



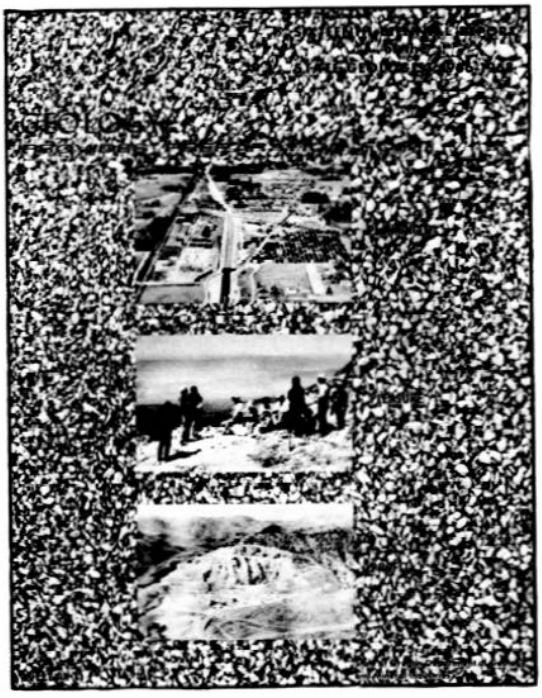
Crack-in-the-Ground southeast of Bend, taken from the air. The gaping fracture has been compared by lunar scientists with rilles on the surface of the moon.

PUBLICATIONS

The ultimate purpose in making a geologic study is to publish maps and reports for use by industry and the general public. The work that a geologist does has no real value until the published results can be made widely available.

The publication section of the Department is responsible for issuing The ORE BIN each month and for preparing for publication other printed matter, including bulletins, miscellaneous papers, short papers, and texts for the geologic map series. In so preparing this material, the publication section receives and edits the manuscripts, types and proofs them, and makes the layout of the pages for photographic reproduction. The work is done in close cooperation with the authors and with the cartographers who prepare the accompanying maps.

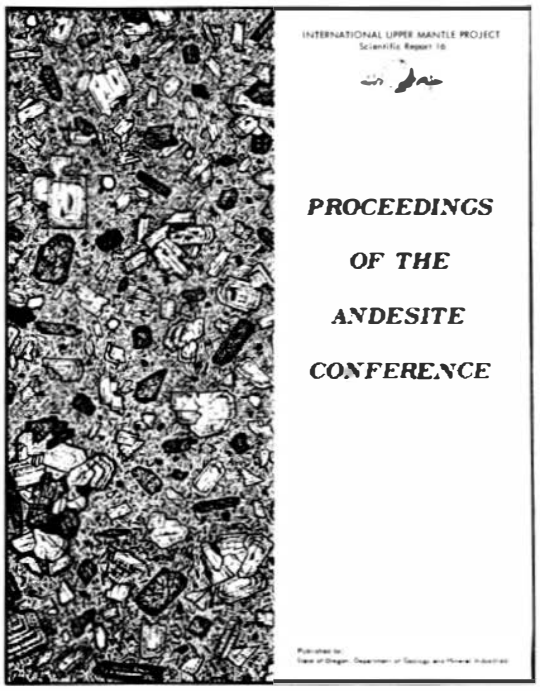
During the past biennium, the Department issued a greater number of geologic reports and maps than it had during any biennium over the past 20 years. This includes the following: Bulletin 63, The Sixteenth Biennial Report of the State Geologist; Bulletin 64, Mineral and Water Resources of Oregon; Bulletin 65, Proceedings of the Andesite Conference; Bulletin 66, Reconnaissance Geology and Mineral Resources of Eastern Klamath and Western Lake Counties, Oregon; Bulletin 67, Bibliography of the Geology and Mineral Resources of Oregon; Bulletin 69, Geology of the Southwestern Oregon Coast West of the 124th Meridian (in press); Bulletin 70, Geology and Morphology of Selected Lava Tubes in the Vicinity of Bend, Oregon (in press); G.M.S. 4, Geology of the Powers Quadrangle (in press); Oil and Gas Investigation 2, Subsurface Geology of the Lower Columbia and Willamette River Basins; Miscellaneous Paper 12, Index to Published Geologic Mapping in Oregon; Miscellaneous Paper 13, Index to The ORE BIN, 1950-1969; Miscellaneous Paper 14, Thermal Springs and Wells in Oregon; and 24 issues of The ORE BIN. An interim report on waste disposal of chemical and radioactive wastes and two engineering geology studies on sand and gravel resources for Jackson County were prepared by the Department staff but were published elsewhere, as was a study for Marion County.

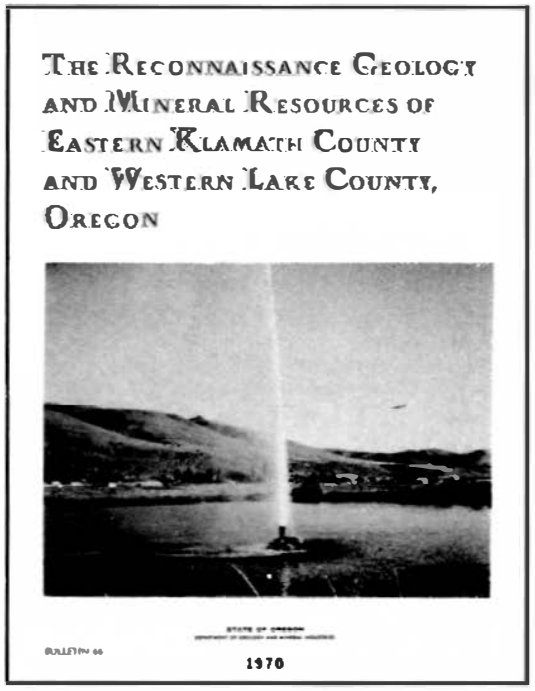


Bulletin 63, the Sixteenth Biennial Report of the State Geologist, covered the years 1966 to 1968. The theme of the report is, "Geology provides preparation for planning, pleasure, and profit." This report elaborated on the history, functions, organization, program, and services of the Department to show (1) the vastly enlarged area now occupied by minerals, metals, and geology in the personal and economic lives of Oregonians, and (2) the fact that in recent years numerous new duties and obligations have been imposed upon this Department in order to provide the citizens of the state with vitally needed geologic information.

Bulletin 64, "Mineral and Water Resources of Oregon," was prepared by the U.S. Geological Survey in cooperation with the State of Oregon Department of Geology and with other agencies. The report was commissioned by Senator Mark O. Hatfield. Section 1 describes the geology of Oregon and presents information on the known and potential mineral resources. Section 2, on water resources and development, deals with quantity, quality, and distribution of surface and ground water and with its utilization.

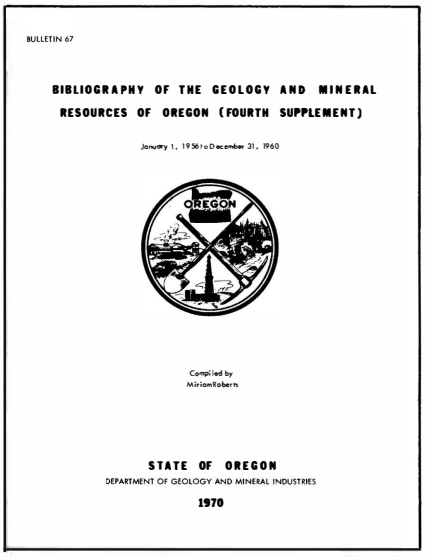
Bulletin 65, "Proceedings of the Andesite Conference," is edited by Dr. A. R. McBirney, Head of the Department of Geology at the University of Oregon. The Andesite Conference was organized through the joint efforts of the Upper Mantle Committee, the Center for Volcanology, and the State of Oregon Department of Geology and Mineral Industries. The report contains a group of papers representative of the topics and views discussed at the conference held July 1968 in Bend, Oregon. This volume is a companion to the Andesite Conference Guidebook (Bulletin 62), which provided information on areas in the Oregon Cascades visited on field trips during the conference.





Bulletin 66, "The Reconnaissance Geology and Mineral Resources of Eastern Klamath County and Western Lake County, Oregon" by N. V. Peterson and J. R. McIntyre, describes a large region of continental Cenozoic volcanic rocks and sediments whose mineral resources are mainly uranium, mercury, copper, lead, zinc,

silver, diatomite, pumice, perlite, and peat. The area is believed to have a good potential for geothermal electric power development, because hot-water zones beneath Klamath Falls are now being tapped for space heating in houses, schools, and office buildings.


BULLETIN 67

BIBLIOGRAPHY OF THE GEOLOGY AND MINERAL RESOURCES OF OREGON (FOURTH SUPPLEMENT)

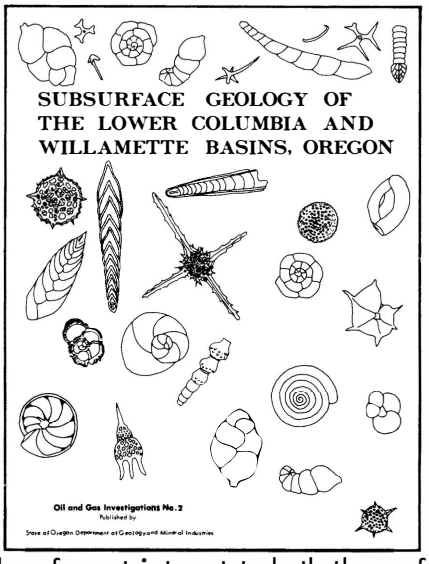
January 1, 1956 to December 31, 1960

Compiled by
Miriam Roberts

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
1970

Bulletin 67, "Bibliography of the Geology and Mineral Resources of Oregon (Fourth Supplement)" covers all published and unpublished reports on Oregon geology and minerals issued during the five-year period from January 1, 1956 through December 31, 1960. A 10-year supplement covering the period from 1961 through 1970 is in the process of compilation.

Bulletin 69, "Geology of the Southwestern Oregon Coast West of the 124th Meridian" by Professor R. H. Dott, Jr., will be published during the spring of 1971. This report presents a compilation of both detailed and reconnaissance mapping of a large part of Oregon in Curry and Coos Counties by professors and graduate students from the University of Wisconsin. The region includes deposits of chromium, platinum, gold, silver, and copper. The map shows the bedrock geology and outlines areas of unstable slopes and fault zones.


SUBSURFACE GEOLOGY OF THE LOWER COLUMBIA AND WILLAMETTE BASINS, OREGON

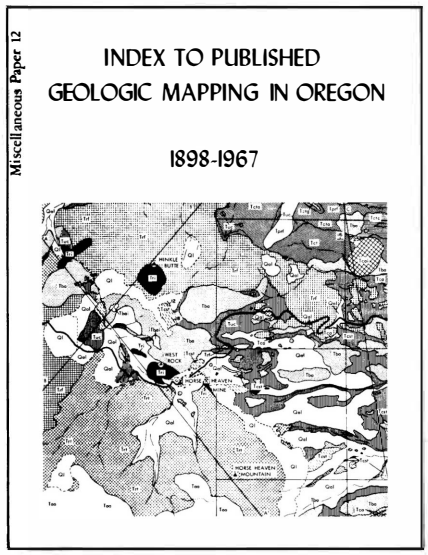
Oil and Gas Investigations No. 2
Published by
State of Oregon Department of Geology and Mineral Industries

Bulletin 70, "Geology and Morphology of Selected Lava Tubes in the Vicinity of Bend, Oregon" by Ronald Greeley, will also be published during the spring of 1971. The geology and mode of formation of eight distinctive lava tubes in the volcanic region south and east of Bend are described in considerable detail. This report, the first definitive study of lava tubes in Oregon, will be of great interest to both the professional and recreational geologists who come to Oregon each year to study our volcanic rocks and landforms.

Bulletin 39, "Geology and Mineralization of the Morning Mine Region, Grant County, Oregon" by R. M. Allen, which was withdrawn from sale a number of years ago, will be reissued by the Department in 1971. Dr. T. P. Thayer, U.S. Geological Survey, has prepared a new geologic map to accompany the report showing details of the rock formations surrounding the Morning mine. The mine had a long history of production before it was closed down during World War

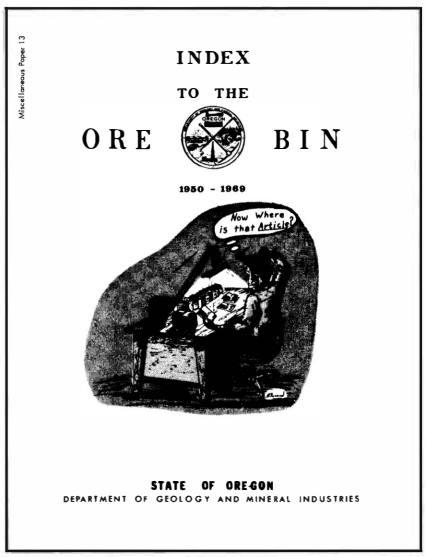
II. It is hoped that this report will encourage further exploration and development of the mining area.

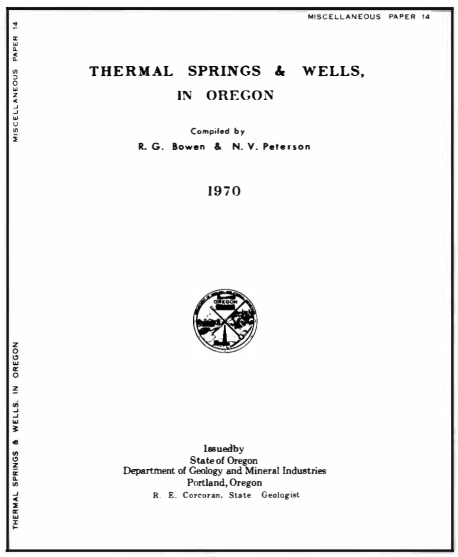
Oil and Gas Investigation No. 2, "Subsurface Geology of the Lower Columbia and Willamette River Basins, Oregon" by V. C. Newton, Jr., presents all available data on 25 deep exploratory wells in northwestern Oregon and correlates this information with surface mapping. The Oregon Coast Range is underlain by a thick section of marine sedimentary rocks of the type usually associated with deposits of oil and gas. It has been reported that exploration of this region by private oil companies is presently under way.

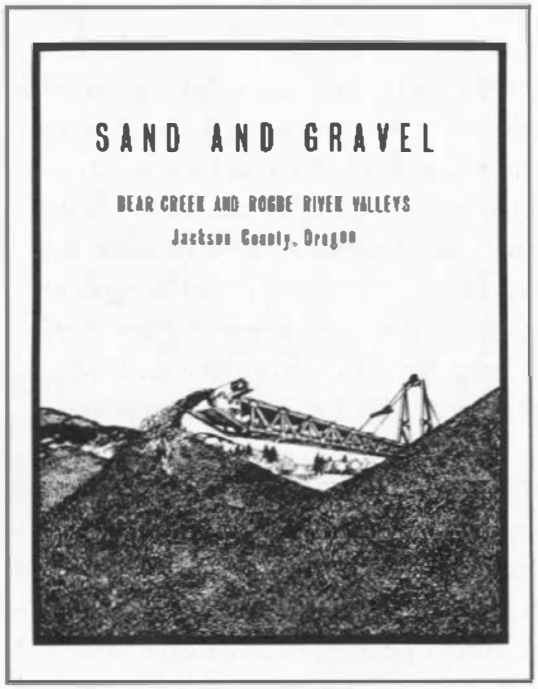


Miscellaneous Paper 12, "Index to Published Geologic Mapping in Oregon" compiled by R. E. Corcoran, provides up-to-date information on all available geologic maps that deal with Oregon since the first one was published in 1898. In the past 70 years at least 225 geological and geophysical maps have been completed. More than 100 of these maps were printed in the past eight years, reflecting the growing demand for this type of information in economic resource studies and land use planning.

Miscellaneous Paper 13, "Index to The ORE BIN, 1950-1969" compiled by Margaret Lewis, includes all signed articles that have appeared in the Department's monthly newsletter over the past 20 years. This report is a handy reference guide for individuals, schools, universities, and libraries. A small charge is made for back issues of The ORE BIN to help defray publishing costs.





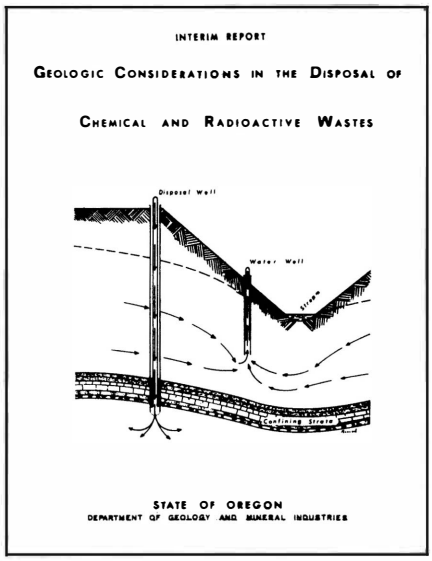


Miscellaneous Paper 14, "Thermal Springs and Wells in Oregon" compiled by R. G. Bowen, shows all thermal areas in the state and includes a list giving the exact location of each hot spot. There are almost 200 geothermal zones, mostly in south-central and southeastern Oregon, and these are a good indication of the great potential for this relatively new energy resource. Electricity produced by natural steam is essentially pollution free and, if properly developed, could provide the Pacific Northwest with a large additional block of power to meet the demand during the coming years.

G.M.S. 4, "Geology of the Powers quadrangle" by E. M. Baldwin and Paul D. Hess, describes the geology of a quadrangle surrounding the Powers area in southwest Oregon. This region is of economic interest, in that there are known deposits of nickeliferous laterite near the southern border of the quadrangle, and the northern area has been explored for coal, oil, and gas.

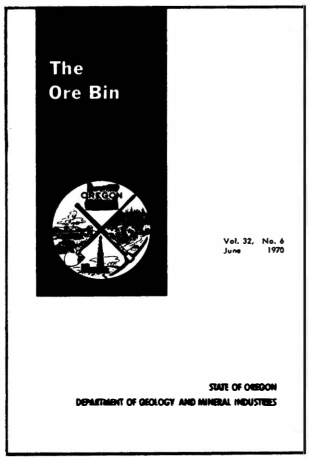
At the request of the Jackson County Planning Commission, the Department made a study of the sand and gravel resources in the Bear Creek, Rogue River, and Applegate valleys. It is imperative that the counties in Oregon, particularly those having large metropolitan areas, establish long-range plans for conservation of construction materials for future use. If these deposits are not set aside, the cost of building private houses and commercial structures will rise sharply, because sand and gravel will have to be hauled from distant sources. Copies of the report have been sent to all planning commissions in Oregon, because, to our knowledge, no other county in the state has embarked on such a comprehensive economic survey. Marion County was among the first to appreciate this need.

An interim report has been prepared by V. C. Newton, Jr. on "Geologic Considerations in the Disposal of Chemical and Radioactive Wastes." There is increasing concern about the problems of adequately treating and storing toxic liquids of various types on or beneath the ground. This report was written to describe the relation of geologic conditions to disposal operations and to derive from previous studies criteria for selecting disposal sites. Information was obtained from state agencies in Kansas, Illinois, New York,



Washington, South Carolina, and Colorado as to how these materials were being handled in other parts of the country. A final report, in which chemical and radioactive waste-management procedures will be treated in greater detail, will be prepared during the coming biennium. Comments and suggestions received by the Department from the other states as a result of the distribution of the interim report will be incorporated in the final publication.

The ORE BIN, publication of the Department mailed to more than 2,500 individuals, government agencies, and institutions each month, has reached an all-time high in distribution, with paid subscriptions of 1,921 individuals. A broad variety of subjects has been presented during the past two years, ranging from annual accounts of the previous year's mineral industry to a report on the geology of Cove Palisades State Park; from a description of some fossil fruits and seeds found in Wheeler County to a history of sand and gravel operations in the Portland area. The ORE BIN also serves as a "bulletin board" by including announcements of new geological publications available, summaries of federal and state legislation affecting the minerals industry, and recent industrial developments in mining and processing.



OREGON'S MINERAL INDUSTRY

Oregon's mineral industry has been serving the state for the past 118 years. At first, its major contributions were the development of "instant wealth," the rudiments of law and order, and the influx of sufficient population to spur the development of the state. Gold in the streams, on the beaches, and in deeply buried veins accomplished this.

Today, Oregon's mineral industry produces almost no gold, but the list of commodities mined, processed, or fabricated in the state is long. The mineral industry is a privately owned, tax-paying, viable, and rapidly responsive business. It enjoys no subsidies and its products are sold in direct competition with other producers, often on a world-wide basis.

In 1969 the value of Oregon-produced minerals amounted to $31.50 for each man, woman, and child living in the state. The most important were sand and gravel and crushed stone, for these are the "growth minerals" essential to the development of the state. Every community in the state feels the impact of this segment of the mineral industry. Although mineral production varies from county to county, the average value of minerals produced in 1969 amounted to $1,671,222 for each county. This value, incidentally, is based largely on the pit price of the raw material and not that at the point of sale, a figure that would be considerably greater.

Metallurgical products from Oregon plants

Aluminum
Brick and tile
Calcium carbide
Cement
Expanded shale
Ferromanganese
Ferronickel
Ferrosilicon
Lime
Mercury
Minor exotic metals
Perlite
Silicon
Steel
Titanium
Vermiculite
Zirconium

Oregon has been a center for the refining, smelting, and fabrication of exotic or reactive metals for many years. Each year sees an expansion of activity as more and more ancillary services are provided and plant capacity and integration increase. Oregon now boasts one of the most modern steel mills in the country, with a high-purity iron ore imported in the form of a slurry, which after pelletizing is fed directly to the furnaces.

Mining can be fun and each year more and more "rockhounds" take to the hills and the plains in search of Oregon's seemingly inexhaustible supply of semiprecious gem stones. "Rockhounds" are recruited from all age groups, and the activity rates as a top family recreational activity in the state. Although mining semiprecious gem stones occupies a great deal of time, an even greater amount of time and effort is expended in the cutting, polishing, and fabrication of the raw material. Based upon an admittedly incomplete canvass, it has been estimated that the value generated by this activity amounts to more than $1,000,000 annually in sales.

Summary of Oregon's Mineral and Metallurgical Industry

Commodity	Mined in Oregon	Imported to Oregon for processing	Processed in Oregon	Fabricated in Oregon	Used in Oregon
		The Metals			
Mercury	yes	yes	yes	--	yes
Gold	yes	no	yes	no	minor
Iron	no	yes	yes	yes	yes
Aluminum	no	yes	yes	yes	yes
Nickel	yes	no	yes	no	yes
Titanium	no	yes	yes	yes	no
Zirconium	no	yes	yes	yes	no
Antimony	yes	no	yes	no	no
Minor exotic metals	no	yes	yes	yes	no
		Industrial Minerals			
Sand and gravel	yes	no	yes	--	yes
Stone	yes	no	yes	--	yes
Limestone	yes	yes	yes	--	yes
Shale	yes	no	yes	--	yes
Silica	yes	yes	yes	--	yes
Bentonite	yes	yes	yes	--	yes
Semiprecious gem stones	yes	no	yes	yes	yes
Clays	yes	yes	yes	yes	yes
Pumice and cinders	yes	no	yes	--	yes
Soapstone	yes	yes	yes	--	yes
Peat	yes	yes	yes	--	yes
Geothermal water	yes	no	no	--	yes
Diatomite	yes	yes	yes	--	yes
Oranamental stone	yes	yes	yes	--	yes

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

	1968	1969
Clays	$ 284	$ 321
Diatomite	W	W
Gem stones	750	750
Gold (recoverable content of ores, etc.)	1	36
Lime	2,407	2,337
Mercury	502	22
Nickel (content of ore and concentrate)	W	W
Peat	11	---
Pumice and volcanic cinders	977	1,139
Sand and gravel and stone	42,625	39,388
Silver (recoverable content of ores, etc.)	1	9
Talc and soapstone	1	---
Value of items that cannot be disclosed: Cement, copper (1968), lead (1968), and values indicated by symbol "W"	16,890	16,162
Total	$64,449	$60,164

Mineral deposits are not renewable and the industry is constantly faced with the necessity for discovering new sources for its raw materials. During the biennium, several major exploration programs were undertaken by large mining companies looking for uranium, copper, gold, silver, lead, zinc, and aluminum. A federal program to delineate possible offshore areas which might contain economic concentrations of precious metals was recessed before sufficient data could be accumulated.

Sand and gravel operators typically are located on the fringes of urban areas since their product, which is low in unit value, cannot be transported economically for great distances. Until fairly recently, there were no severe problems with respect to a continued supply of sand and gravel. Rapidly expanding centers of population, a steadily increasing rate of use on a per-capita basis, and the equally steady removal of potential supply areas by zoning and urbanization have combined to create a very real problem in many areas of the state. The Department has conducted several detailed studies into this problem and is planning to make a long-range study of the sand and gravel resources of the entire state as funds permit.

Demand for electrical energy, coupled with concern for the environment, has incited a search for areas in the state which could yield sufficient quantities of superheated geothermal steam. Geothermal steam has been harnessed in other volcanic areas of the world, and the Department has been attempting to identify areas in Oregon where industry might find it attractive to explore and later develop the natural thermal energy. This type of power generation has considerable appeal both to the power industry and to the public, since it has no objectionable waste discharge and táps a natural resource having great potential and a very long productive period.

COMPARATIVE STATEMENT OF EXPENDITURES

	1967-1969 Total Expenditures 7/1/67-6/30/69	1969-1971 Estimated Expenditures 7/1/69-6/30/71	1971-1973 Funds Requested 1971-1973
Personal Services:	$454,986.41	$550,891.00	$615,073.00
General Operating Maintenance:	$ 88,780.80	$ 94,998.00	$158,909.00
Office Supplies	3,225.39	3,000.00	3,500.00
Telephone & Telegraph	5,384.05	4,500.00	7,500.00
Postage, Freight, and Express	4,411.06	3,000.00	6,000.00
Printing	17,998.93	14,000.00	53,000.00
Rents	22,015.84	28,218.00	29,130.00
Premiums & Assessments	715.58	720.00	1,200.00
Professional Services	5,769.85	8,000.00	17,479.00
Industrial & Laboratory	3,714.66	4,500.00	5,500.00
Heat, Light, Power	1,216.12	1,300.00	1,500.00
Library	947.78	900.00	1,200.00
Laundry	127.50	130.00	150.00
Photos & Blueprints	2,622.05	3,000.00	4,000.00
Gas & Oil Well Administration	255.75	1,000.00	1,000.00
All Other	2.35	90.00	100.00
Building & Ground	256.37	250.00	500.00
Travel Expenses: In State	17,683.62	20,390.00	24,150.00
Travel Expenses: Out of State	2,433.90	2,000.00	3,000.00
Capital Outlays:	$ 4,597.11	$ 17,694.00	$ 21,342.00
Office Furniture & Equipment	2,130.13	5,499.00	1,330.00
Motor Vehicles		2,600.00	2,887.00
Laboratory & Field	2,466.98	9,598.00	17,125.00
Special Requests:	$ 14,956.72	$ 15,000.00	$ --
State Geological Survey	14,956.72	15,000.00	--
Total Expenditures	$563,321.04	$678,586.00	$795,324.00

THE APPROPRIATION ---

(1969 - 1971 FISCAL BIENNIUM)

Salaries and Wages	$ 550,891.00	81.30%
General Operating & Maintenance	94,993.00	13.90
Capital Outlays	17,694.00	2.60
State Geologic Map	15,000.00	2.20
TOTAL	$ 678,586.00	100.00%

--- AND WHAT IT PAID FOR

(1968 - 1970 REPORTING PERIOD)

2,484	Square miles geologically mapped
133	Field investigations
25	Oil & Gas Act inspections
84	Cooperative projects with other agencies
14	Major publications issued
65,429	Copies of The ORE BIN
265	Mineral sets
2,041	Mineral identifications
4,824	Chemical analyses
1,871	Radiometric determinations
2,900	Geochemical analyses
32	Differential thermal analyses
1,447	Spectrographic analyses
823	Petrographic examinations
179	Talks
28	Field trips for groups
9	Office tours
17	Television and radio appearances
21	Exhibits judged
7	Court appearances as expert witnesses