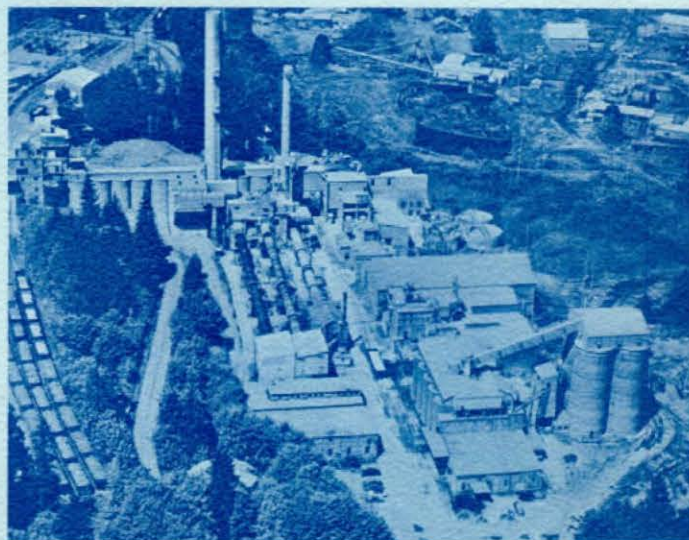


**FOURTEENTH BIENNIAL REPORT  
of the  
STATE GEOLOGIST**

**1962-1964**



**Source**



**Processing**



**Construction**

**BULLETIN 56**

**State of Oregon Department of Geology and  
Mineral Industries**



**Use**

FOURTEENTH BIENNIAL REPORT OF THE STATE GEOLOGIST

1962 - 1964



STATE OF OREGON

DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

STATE GOVERNING BOARD

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

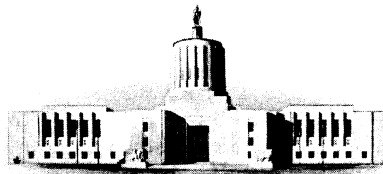
Hollis M. Dole  
State Geologist





Governor Mark O. Hatfield visited site of Oregon lunar tests when Astronaut Wolter Cunningham and NASA officials gave moon gear and vehicles tryouts. With the Governor and Cunningham is Dr. John Zeiglschmid of the NASA testing staff. NASA's interest in Oregon is the result of studies by the Department. (Photograph by David Falconer, staff photographer, the Oregonian.)

GOVERNING BOARD  
FRANK C. MCCOLLOCH, CHAIRMAN, PORTLAND  
HAROLD BANTA, BAKER  
FAYETTE I. BRISTOL, ROGUE RIVER



FIELD OFFICES:  
2033 FIRST STREET  
BAKER  
239 SOUTHEAST "H" STREET  
GRANTS PASS

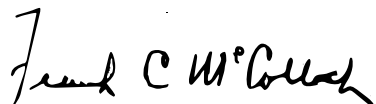
STATE OF OREGON  
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES  
1069 STATE OFFICE BUILDING  
PORTLAND, OREGON 97201

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

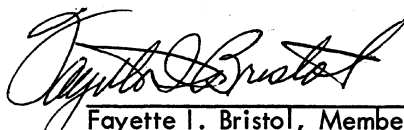
Sirs:

We submit herewith the Fourteenth Biennial Report of  
The Department of Geology and Mineral Industries, covering  
activities of the Department for the period from July 1, 1962,  
to and including June 30, 1964.

Respectfully,

  
Frank C. McColloch, Chairman

  
Harold Banta, Member

  
Fayette I. Bristol, Member

Portland, Oregon  
January 1965

## FOREWORD

During the past biennium the Department has had a most fruitful period.

More than 400,000 acres of offshore land was leased for oil and gas explorations, and by the end of 1964 the companies were announcing drilling plans for 1965. The geology of this area looks most promising for hydrocarbon accumulation, and it could well be that within the next five years a new and important basic industry will have been established in Oregon.

During the summer of 1964 considerable national attention was focused on central Oregon as the region in the United States most likely to resemble the surface of the moon. This attention was the outcome of more than four years of geologic studies by members of this Department and cooperative efforts by the Division of Planning and Development and the Bend Chamber of Commerce. If the barren areas of Recent volcanics near Bend could be utilized as a lunar research facility, a worthless piece of Oregon real estate could be turned into a valuable industrial development.

Bulletin 55, "Quicksilver in Oregon," was published just before an unprecedented rise in the price of quicksilver and will prove to be of great value to the firms now actively engaged in quicksilver exploration. This up-to-date detailed description of Oregon's mercury prospects and areas should return many thousands of dollars to the State of Oregon through the reopening of old mines and prospects and the discovery of new deposits.

The ORE BIN successfully weathered its new format change and has been well received by the mineral industry and the scientific community. Several important and timely articles, authored by Department and other scientists, were published and given widespread distribution which otherwise probably would never have reached the people of Oregon. This monthly publication is now the accepted media by Oregon geo-science researchers for early publication of their findings and for scientific discoveries of widespread interest.

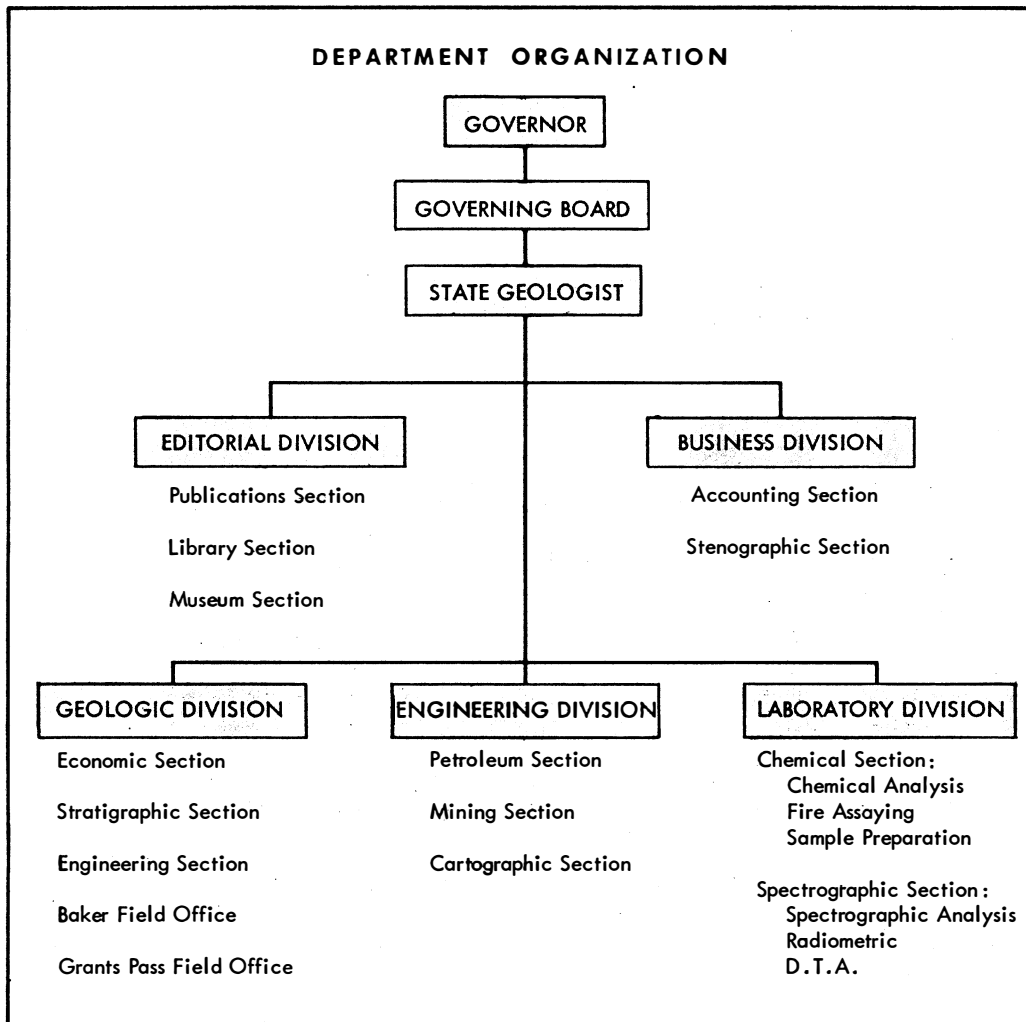
Satisfactory progress has been made in such projects as the engineering geology of the Willamette Basin and the State Geologic Map, even though activity had to be drastically curtailed as the result of budget cutbacks.

Never has the Department been called upon by so many other state departments, federal agencies, and communities for advice and counsel peculiar to our sphere of knowledge. Beside the usual work for the State Crime Laboratory and other police agencies, this Department aided several county commissions, chambers of commerce, and state departments ranging from the Corporation Department to the Veterans Department.

Our work is far from being done. A great deal of geologic mapping, the research which forms the basis of a large part of our work, mineral resource studies, and terrain analysis still remain. Projects which are just beginning that appear to have great potential for industrial development include sources of geothermal energy, geochemical delineation of mineralized areas, and geophysical prospecting methods.

The Department cooperates with many other agencies in promoting industrial development and it is with pleasure and pride that we acknowledge their assistance and look forward to even closer cooperation in the coming biennium.

Hollis M. Dole  
State Geologist



**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).

## ADMINISTRATIVE DIVISION

The law establishing the Department (Chapter 516, Oregon Revised Statutes) describes in a broad way its organization. General charge and control of the Department is made the responsibility of a three-member Governing Board, with direct supervision and superintendence of the Department by the State Geologist.

### Governing Board

Governing Board members must be Oregon citizens. They receive appointments for 4-year terms from the Governor, subject to approval by the State Senate or the Senate Committee on Executive Appointments. Members serve without compensation but are reimbursed for actual expenses incurred in the performance of official duties. Board meetings must be held at least four times a year. Meetings during the biennium were held as follows:

July 17, 1962 - Grants Pass	July 9, 1963 - Portland
October 5, 1962 - Baker	October 1, 1963 - Bend
December 11, 1962 - Portland	October 29, 1963 - Portland
May 24, 1963 - Portland	February 17, 1964 - Portland

The chairman of the board is selected by the members, and the State Geologist who meets with the Board generally serves as secretary ex-officio. Members of the board and their terms of office are as follows:

Frank C. McColloch (Chairman) - Portland	(1961 - 1965)
Harold Banta - Baker	(1963 - 1967)
Fayette I. Bristol - Grants Pass	(1964 - 1968)

### State Geologist

The State Geologist is appointed by the Governing Board. The appointment may be for a stated period of time or subject to termination. His salary is set by the board within a range determined by the Legislature. Qualifications for State Geologist have been established by law as "... 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 ten years in these fields."

The State Geologist is responsible for the work of the Department in the field and in the office. Progress reports, plans, and budgets are presented by him to the Governing Board at each meeting and it is his responsibility to see that results of investigations are promptly published. The State Geologist is authorized to employ the staff necessary for the execution of his plans and the operations of the Department.

The law establishing the Department prohibits the State Geologist or any member of the staff from holding or having an interest or dealing in any producing or prospective mineral property of any kind in this state, including oil and gas. It also prohibits the State Geologist or staff from doing private consulting work if the service is concerned with mining, geology, or any mineral industry in the state.

## EDITORIAL DIVISION

### PUBLICATIONS SECTION

The publications 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 publications section receives and edits the manuscripts, types and proofs them, and makes the lay-out of the pages for photographic reproduction. The work is done in close cooperation with the authors and with the cartography section. The actual processes of printing and binding the publications are done by the State Printer.

#### The ORE BIN

The ORE BIN has been published regularly each month for 26 years. This means that it is a well-established and well-known magazine in the mining and geologic realms. Its steadily growing circulation is now approximately 2,000, of which 1,700 are paid subscriptions at the rate of \$1 per year; the remainder go on an exchange basis to federal and state agencies and to universities and libraries all over the nation and also to several foreign countries.

The ORE BIN expresses the Department's opinions in mineral matters; it keeps the readers up to date on what is happening in the metals, non-metals, and petroleum fields, and it publishes papers on current geologic research and mapping. In recent years The ORE BIN has become more sophisticated in both its format and its treatment of content. Photographs and three-color geologic maps are now an accepted part of its style, and many of its articles are contributed by specialists from other agencies doing research in Oregon. The professional trend in the content of The ORE BIN is in keeping with the public's increasing understanding of the sciences and its awareness of the importance of basic geologic research to the healthy development of Oregon's mineral resources.

Some of the articles contributed by other agencies for publication in The ORE BIN during the biennium were: A series of reports on offshore geology by J. V. Byrne and other members of the Department of Oceanography at Oregon State University; a basic geologic study of the Cape Blanco area in southwestern Oregon by Dr. R. H. Dott, University of Wisconsin; a ground-water investigation of an area near Mosier in Wasco County, by R. C. Newcomb of the U.S. Geological Survey; a report on the use of the mineral clinoptilolite in disposing of nuclear waste, by R. E. Brown, senior geologist with Hanford Laboratories; several papers on distribution of clinoptilolite deposits in central Oregon by R. V. Fisher, University of California; and a gravity study of major structural features in the Galice quadrangle of Josephine County, by M. A. Kays and J. L. Brummer, University of Oregon.

#### Other published material

The following publications were issued during the biennium, although in some instances preparation for publishing was accomplished during the previous biennium:

- Bulletin 53. Bibliography (third supplement) of the geology and mineral resources of Oregon, 1962, by M. L. Steere and L. F. Owen.
- Bulletin 55. Quicksilver in Oregon, 1963, by Howard C. Brooks.
- Oil and Gas Investigations 1. Petroleum geology of the western Snake River Basin, 1963, by V. C. Newton and R. E. Corcoran.
- Miscellaneous Paper 8. Available well records of oil and gas exploration in Oregon, revised 1963, by V. C. Newton.



Miscellaneous Paper 9. Petroleum exploration in Oregon (reprints), 1962.  
Geologic map of the Sparta quadrangle, Oregon, 1962, by Harold J. Prostka.  
Geologic map of the Mitchell Butte quadrangle, Oregon, 1962, by R. E. Corcoran and others.

#### Publications in preparation

Prepared for publication during the biennium, and now in press, is "Geology of the Dallas and Valsetz quadrangles," by E. M. Baldwin. This bulletin should be available early in 1965. In the process of being readied for publication and expected to go to the State Printer in the spring of 1965 is "Geology of the Suplee-Izee area, Crook, Grant, and Harney Counties, Oregon," by W. R. Dickinson and L. V. Vigrass.

#### LIBRARY SECTION

The "basement rock" of the library is characterized by a wide assortment of maps and publications of the federal government agencies, principally the U. S. Geological Survey and the U. S. Bureau of Mines, which furnish a broad base of the work published on Oregon, on national and international locales, and on specific materials, formations, and mining methods. Exchanges with the geological surveys of the other states of the Union provide a continuing source of reference material as to geologic formations, mineral deposits, and fossils throughout the country, as well as to advanced technical progress. Several foreign countries, especially Canada, supply valuable reference works. Subscriptions to a number of technical journals provide current information.

Of particular pertinence to our interests is the expanding collection of unpublished graduate theses and open-file reports, more than 200 in total number, representing detailed investigations done within the state boundaries.

In addition to the primary purpose of providing a scholarly reference mine for the members of the staff, the facilities of the library are used by representatives of business, by prospectors and miners, by high school and college students, and by hobbyists and vacationers.



Staff members using the library.

## MUSEUM SECTION



A permanent display of Oregon metallic ores.

The Department's museum is a large and growing collection representative of the rocks, minerals, and fossils of Oregon. Much of it has been gathered over the years by staff members in the course of geologic mapping, mine inspection, and paleontological studies. In addition to the Oregon material, there are many unusual specimens from other parts of the world that have been either loaned or donated by visitors to the Department.

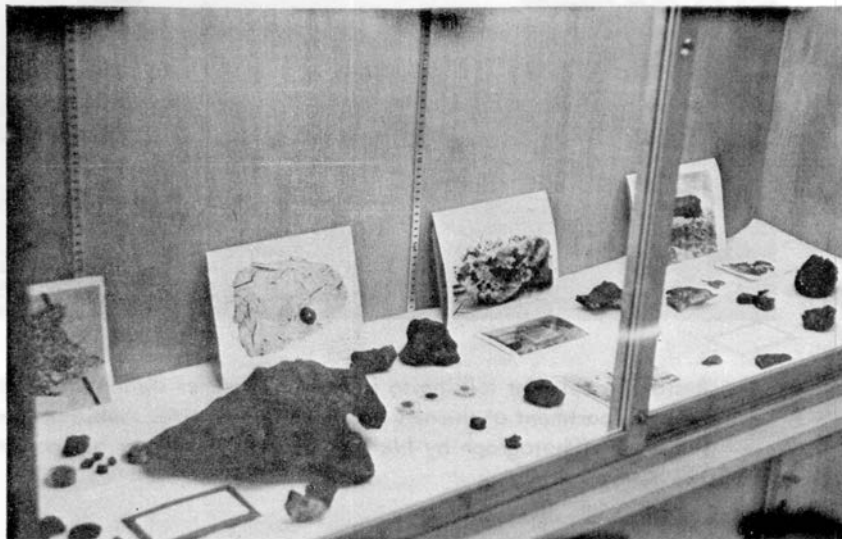
The museum collection, consisting of more than 3,000 specimens, is cataloged by a card-file system and is housed in drawers and display cases. The major portion, stored in 188 drawers, is used for reference and study purposes by staff members, research workers,

and students. Of particular interest are the ore samples from nearly every productive mine in the state.

Ten glass-front exhibit cases let the Department visitor see Oregon's economic minerals, decorative building stones, mineral crystals, plant and animal fossils, and some of the curious rocks that flowed or burst forth from volcanoes.

Several display cases are reserved for loan exhibits. One of the most outstanding of these, on indefinite loan from a Portland resident, is a colorful assemblage of copper minerals from all over the world. Some of the loan exhibits that have been on view during the past two years include a group of mineral crystals that won the national award at the American Federation of Mineralogical Societies; rare and exotic metals designed for use in the space field; and two unique collections of meteorites.

A small portion of the museum collection consists of uncataloged specimens for "give-away." These are certain rocks, minerals, and fossils that the Department receives in sufficient quantity to make available to Scout groups, school children, and others interested in geology.



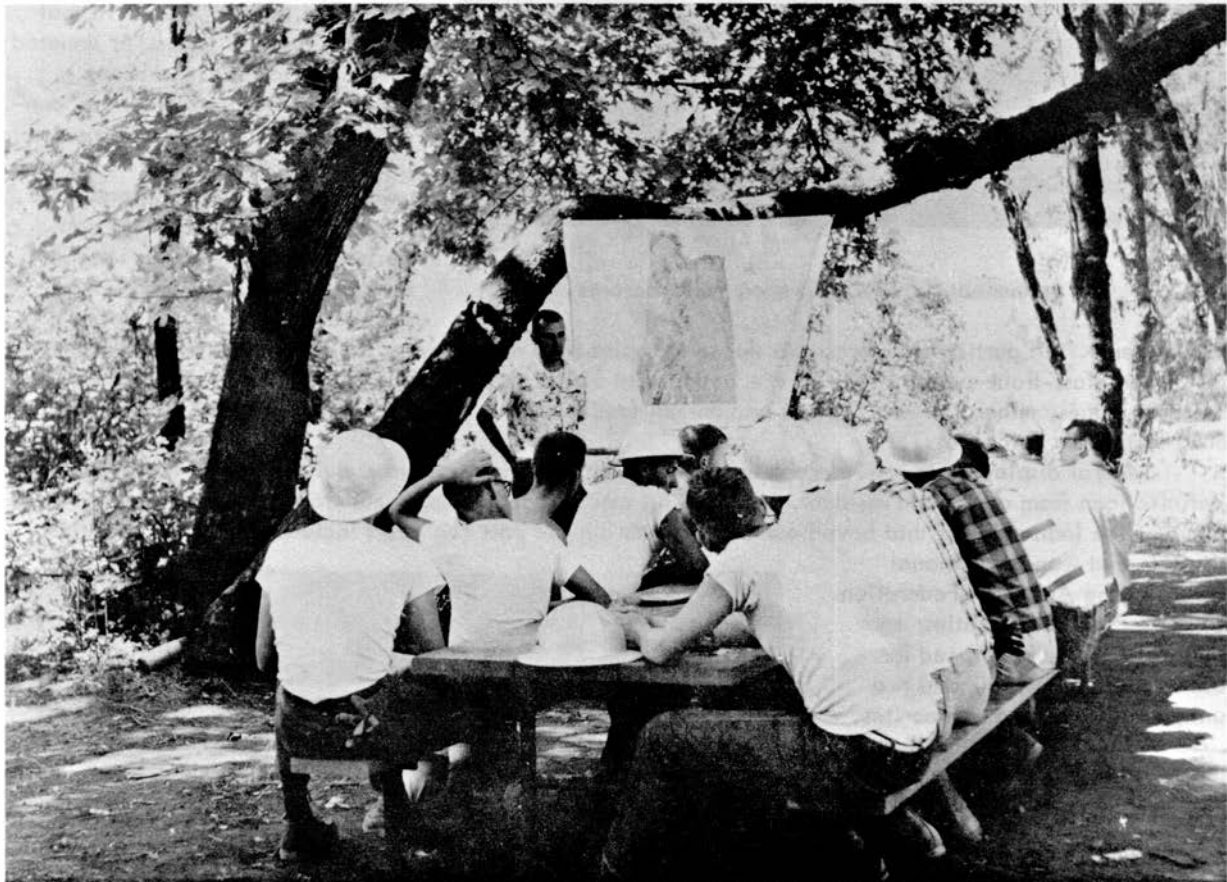
A loan collection of meteorites.

## BUSINESS DIVISION

The business division performs the accounting, stenographic, typing, and receptionist functions for the Department. This division consists of one accountant and two secretaries at the head office in Portland and one secretary at each of the field offices.

The accountant, besides fulfilling the usual duties of that classification, also advises the Governing Board and the State Geologist on budget preparation and does other tasks usually carried on by a fiscal officer.

The secretaries, in addition to their usual duties, answer routine inquiries received at the counter and through the mails, aid the librarian, and perform many office duties in order to free the geologist-engineers for more technical work.



Resident geologist talking to a group of summer student help employed by the Jackson County Parks Department at the new Rogue-Elk camp site. Subject: geology and mineral resources of the area. (Photograph by Neil J. Ledword, Director of Jackson County Parks and Recreation.)

## GEOLOGIC DIVISION

### ECONOMIC GEOLOGY SECTION

Economic geology is concerned with the finding and developing of mineral commodities within the state. The effort of this division is divided into three phases: commodity studies, basic exploration, and aid to prospectors.

#### Commodity studies

A part of the work of the economic geologist is to anticipate trends of mineral consumption and production and to make available reports on commodities of current or potential interest. During the 1962-1964 biennium the Department released a comprehensive report on mercury entitled "Quicksilver in Oregon," by H. C. Brooks. This bulletin and others of similar nature released in the past or now being compiled are of aid to the mineral investigator. A study is currently under way on gold and silver in Oregon by N. S. Wagner and Len Romp. Members of the staff write reports, mainly for internal utilization, on potential uses, occurrences, and possible economic factors of mineral or metal development.

#### Basic exploration

An important part of the promotion of mineral development is the outlining of areas of potential mineral wealth to the developer, be he a large mining company or an individual prospector. This is being done by governmental agencies in many parts of the world today as a foundation for more detailed and costly methods of ore finding. The basic tool for this is the geologic map, for any experienced prospector knows valuable mineral deposits are generally associated with certain rock types. Therefore, it is most productive to concentrate the exploratory effort in these areas of greatest potential.

Modern geochemical and geophysical exploration methods can localize still further this effort by showing relative concentration of metals or of conditions under which they would be expected. As a part of the basic exploratory work of the Department, the geochemical prospecting program has been expanded and geophysical research has been initiated. A description of a part of this work follows.



Reading gravimeter at Rome airport, Oregon.

Geochemistry: During the 1962-1964 biennium the Department initiated a geochemical stream-sediment sampling program, the object of which is to sample and test for possible unknown metallic mineral deposits in all the streams of Oregon. This program is divided between field collecting and laboratory analysis. The collecting has been done by college students working in the summer under the supervision of staff members. Analyses using wet-chemical methods are done

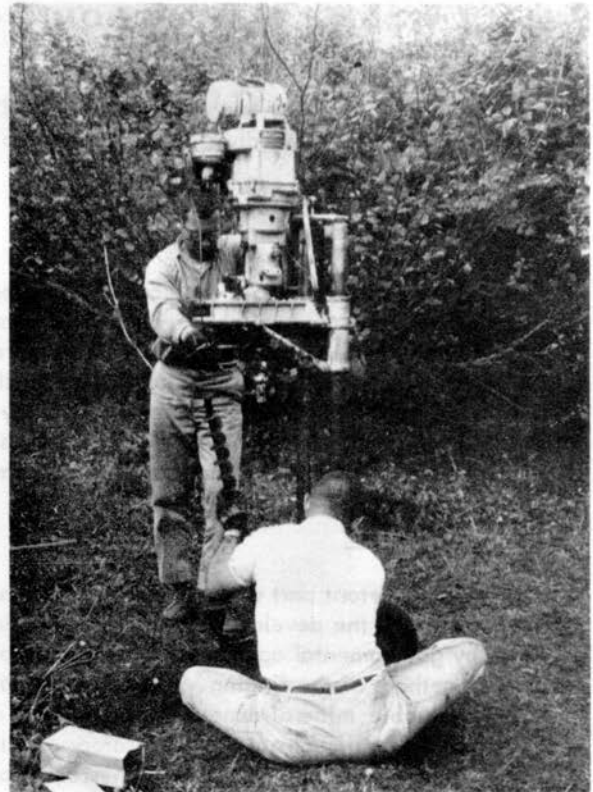
in the Department's geochemical laboratory in Portland. Although the program has been in effect for a little more than a year, several oreos showing anomalous amounts of copper, zinc, and molybdenum have been delineated. Of the approximately 1,400 samples collected so far, most have come from Josephine and Jackson Counties in southwestern Oregon. The program will continue to utilize as much student labor as possible in both field collecting and laboratory analysis.

**Geophysics:** During 1963 the Department cooperated with the Geophysical Research Group, Department of Oceanography, Oregon State University, in establishing gravity base stations at 23 secondary airports in Oregon. Results of the work were published in the March, 1964, ORE BIN. Such information is vital to many types of geophysical surveys that are being conducted by both governmental and private research groups at an ever-increasing rate. A joint study with the Geophysical Research Group of O.S.U. and Stanford Research Institute on the November 5, 1962 Portland earthquake was published in the April 1963 ORE BIN.

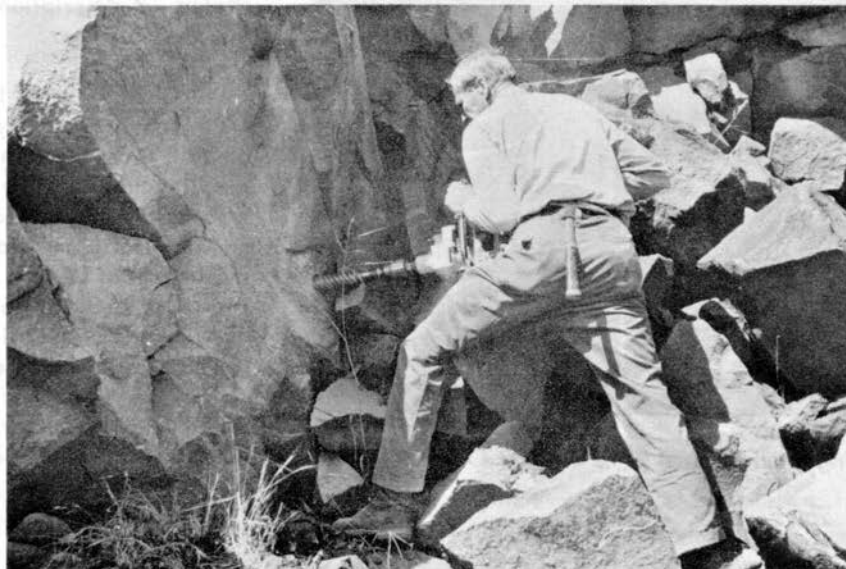
A geophysical survey utilizing electrical resistivity is being conducted in northwestern Oregon in a search for aluminum ore (bauxite). There is a good possibility that buried deposits can be found in geologically favorable oreos by utilizing this new method. Initial testing of the resistivity of known bauxite deposits has given encouraging results and further testing of this method is being tried out in new oreos.

#### Aid to prospectors

One of the main reasons for the formation of the Department was to give direct assistance to prospectors in the form of assays, of help in mapping of ore deposits, and of advice on specific mining or development problems. As a part of this program, members of the staff visit prospectors in the field, make geologic maps, and conduct sampling programs.



Portable auger used in bauxite exploration program.



Small portable core drill testing basalt in quarry in southern Benton County.



## STRATIGRAPHIC GEOLOGY SECTION

Stratigraphy is a branch of geology which includes the study of the formation, composition, sequence, and correlation of the stratified rocks as parts of the earth's crust. In Oregon the stratified rocks include the many varieties and ages of volcanic flows commonly interbedded with the marine and non-marine sedimentary deposits.

The basic work of the stratigraphic section is to accumulate and compile all available data concerning the lithology, thickness, structure, and correlation of the geologic formations within the state for publication by the Department as geologic maps or reports. This information is of special value to the mineral industry because it outlines potentially favorable areas of metallic and nonmetallic ore deposits and fossil fuels.

### State Geologic Map Project

The most important stratigraphic study in Oregon concerns the State Geologic Map Project. The geologic map of the western half of Oregon was published in 1961; since that time most of the field work has been concentrated in the eastern part. The Department, in cooperation with the U.S. Geological Survey and aided by university professors and graduate students, is continuing its mapping. Preliminary geologic maps covering 1° by 2° areas at a scale of 1:250,000 (Army Map Series sheets) are being published soon after the field work has been completed. More than 60 percent of the eastern half of the state has now been mapped on a scale of 1:250,000 or larger (see accompanying index map).

In eastern Oregon, Department geologists, professors and graduate students from Oregon State University and the University of Oregon, and graduate students from Princeton, Stanford, and Johns Hopkins Universities are conducting geologic studies in critical areas. The information developed from this research will be used in the final state map.

For the past five years H. J. Buddenhagen, consulting geologist for the Department, has been working on the pre-Tertiary geology of the Supplee-Izee area of central Oregon. The work in this area is of particular importance because these rocks are exposed as a "window" surrounded by the much younger sediments and volcanics that cover most of central and southeastern 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 geology of this region is extremely complex, because of the great degree of crustal movement that has taken place since these very old sedimentary rocks and volcanics were laid down. When this study has been completed it will contribute much valuable information on the paleogeography of central Oregon during Mesozoic and Paleozoic time and will also provide a means for correlating the older rocks in southwestern Oregon with strata of similar age in the northeastern corner of the state.

In western Oregon, Prof. E. M. Baldwin of the University of Oregon, consulting geologist for the Department during the summer field season, continued his mapping of the southern Coast Range in the Camas Valley and Tyee quadrangles southwest of Roseburg. This project is a continuation of the work he began several years ago in the Dallas and Valsetz quadrangles. When this long-range program is finished, the geology of the central and southern part of the Coast Range will be completed on a scale of 1:62,500.

The geology of the Yamhill quadrangle in northwestern Oregon with special reference to the Spencer Sands, by H. G. Schlicker, Department geologist, was published in The ORE BIN. This area lies along the eastern foothills of the northern Coast Range where potential oil-bearing sedimentary rocks are exposed at the surface.

The recent discovery of Mesozoic fossils in the Juniper Mountain area near Brogan by N. S. Wagner and H. C. Brooks from the Baker field office prompted a study of the pre-Tertiary rocks in this general vicinity to determine their ages and areal extent. A report summarizing the results of the field work was published in the Bulletin of the American Association of Petroleum Geologists for April, 1963 with the title, "Marine Jurassic exposures in the Juniper Mountain area of eastern Oregon." R. W. Imlay,

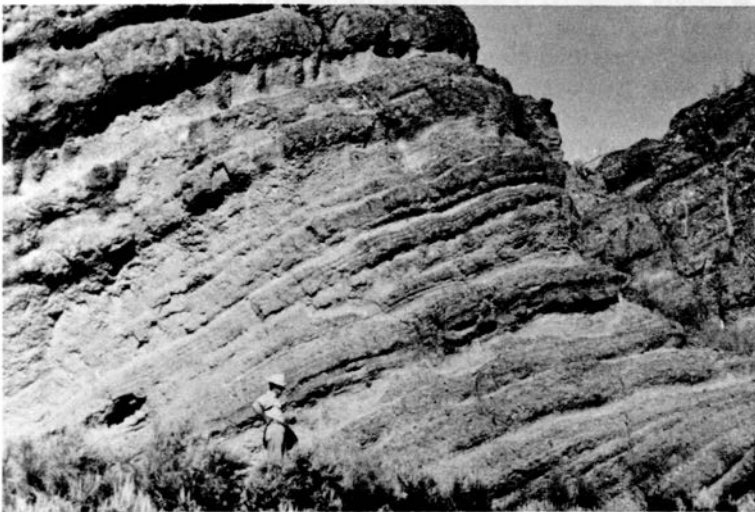
paleontologist for the U.S. Geological Survey, was co-author.

### Field work in Oregon

One of the duties of the stratigraphy section each field season is to visit other geologists working in Oregon. These include graduate students and professors and members of the Department geological staff and of the U.S. Geological Survey. The object of these visits is to learn of the progress of their work, problems concerning stratigraphy or structure in their areas of interest, regional correlations, and future plans. At the end of each year a report is prepared for Department use summarizing these activities.

### Stratigraphic notebook

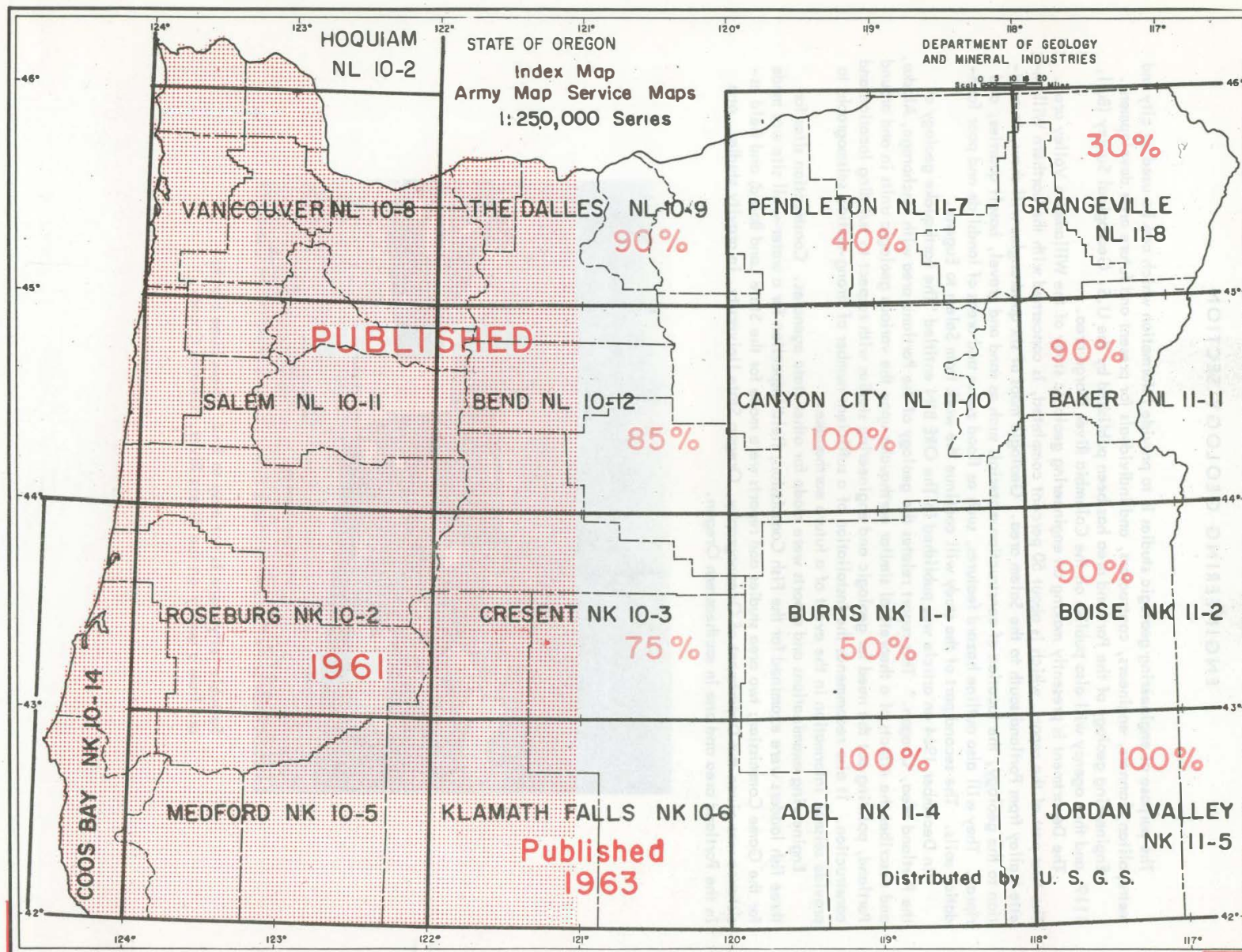
Published and unpublished reports on the geology of Oregon are abstracted for geologic information that is of value in stratigraphic studies. The stratigraphic notebook being compiled and added to each year includes brief summaries on the lithology, thickness, structure, stratigraphic position, geologic age, regional correlation and location of measured sections of each formation described. This compilation will have value in assembling the basic geology and stratigraphy of the many diverse regions of Oregon as an aid to future economic mineral development.



Close-up of inward dipping tuffs in Flat Top, Lake County.  
Note thin-bedded character of many of the separate strata.



Micro-thrust faulting in Astoria sandstone at Ecola Park,  
Clatsop County. Note convolute bedding.



Index map showing progress of field studies in eastern Oregon. Percentage figure indicates amount of work completed in each quadrangle.

## ENGINEERING GEOLOGY SECTION

The purpose of engineering geologic studies is to provide information which can be used by city and metropolitan planners, engineers, contractors, and individuals for present and future area development.

Engineering geology of the Portland area has been published by the U. S. Geological Survey (Bull. 1119) and that agency will also publish on the Columbia River Gorge area.

The Department is presently making an engineering geologic study of the Willamette Valley area. The first part of the report, which is about 50 percent completed, is concerned with the northern Willamette Valley from Portland south to the Salem area. Geologic maps of six quadrangles will show, in addition to the geology, the location of construction materials such as sand and gravel, basalt quarries, and riprap. They will also outline hazard features, such as flood zones and areas of landslide and poor foundation soils. The second part of the study will continue the work from Salem to Eugene.

In December 1964 an article was published in The ORE BIN entitled "The earthquake geology of the Portland area, Oregon." This report relates the geology of the Portland area with Anchorage, Alaska, and describes the effects of a theoretical similar earthquake upon the various geologic units in and around Portland, pointing out the need for geologic and engineering studies with respect to building location and construction. It also recommends the installation of a sufficient number of strong-motion seismographs to provide seismic information in the event of a future earthquake.

Engineering examinations and reports were made for other state agencies. Construction sites for three fish ladders were examined for the Fish Commission; field inspection for a water-well site was made for the Game Commission; two area studies and reports were made for the State Land Board; and field assistance was given the Department of Oceanography, Oregon State University, in gravity studies, one in the Portland area and one in southeastern Oregon.



Suitable jetty stone is not easy to find. These huge blocks are from a quarry on the Siletz River, Lincoln County.

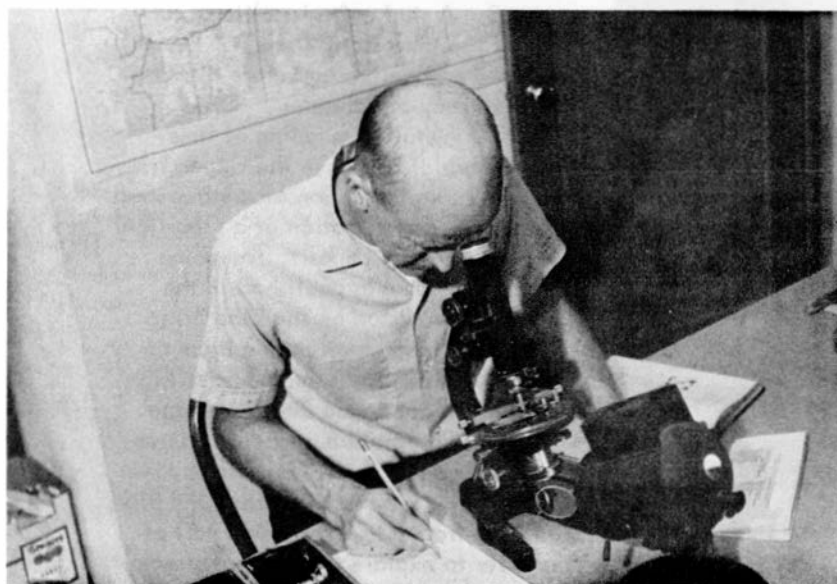


## FIELD OFFICES

The Department's field offices were located in Baker (northeastern Oregon) and Grants Pass (southwestern Oregon) at the time the Department was established in 1937, since these were the areas of greatest mining activity. Interest in the metallic minerals still remains high in these two areas. For instance, the Grants Pass office had 2,328 visitors in 1963, which compares with 3,047 visitors at the main office in Portland during the same period.

Each office has a Resident Geologist and a District Geologist. The Resident Geologist is responsible for the administration of the office and the supervision of geological and mineral resource work in the area. The District Geologist makes investigations and answers requests for inspections in the counties adjacent to the field offices. The work of these offices is integrated with that of the Portland office.

Geologists in the field offices identify rocks and minerals for visitors, accept ore samples for assay, and make limited qualitative tests, both chemical and petrographic. In addition to carrying on research and field projects, the geologists make examinations of mineral prospects; assist other State or Federal agencies with geologic problems; accumulate and dispense information on mineral deposits and geology; aid graduate students doing research and mapping; and give talks to schools and organizations.



District geologist examining specimen under petrographic microscope. Mineral samples taken in for identification are often given such close scrutiny.

Projects in which both field offices participated during the biennium include:

A summary report on the history, distribution, and geology of Oregon's gold and silver deposits. Information for this report is being compiled for future publication.

Investigation of vermiculite in weathered granitic rocks in various parts of the state. Dr. Lloyd W. Staples of the University of Oregon collaborated with the Baker office in the investigation, and a report on an occurrence in Baker County was published in the October 1964 ORE BIN. Further work is in progress, with the Grants Pass office cooperating in collecting samples.

Some of the investigations carried out by the Baker office during the biennium were:

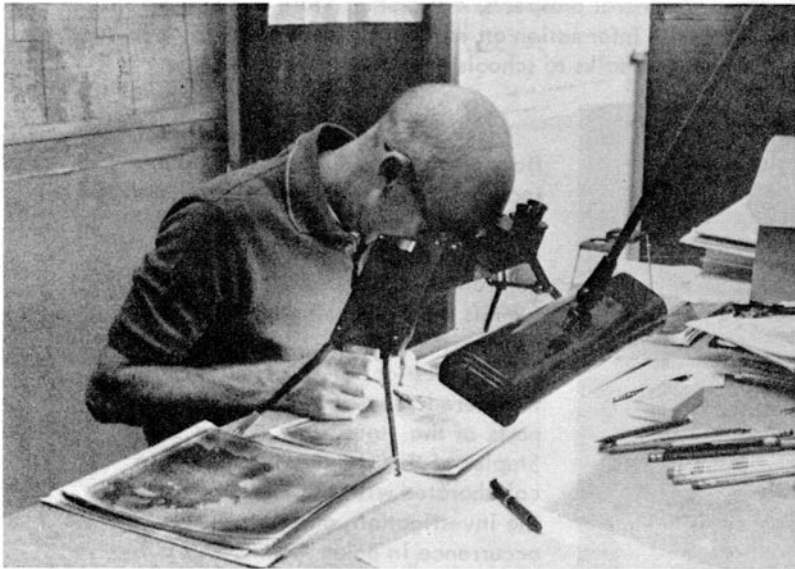
1. A study of the availability of natural gas to the mineral industry. The work entailed preparation of a map of secondary gas distribution areas, a list of all primary and secondary users in the mineral field, and a map of the distribution of mineral occurrences that could benefit by gas processing. A paper on this subject was delivered before the Oregon Academy of Science.
2. A mine safety study in cooperation with the State Industrial Accident Commission and other agencies, and also a U.S. Bureau of Mines first-aid training course, sponsored in part by the Buffalomine, in which 36 students participated.
3. A review of the placer potential of the lower Sumpter Valley in connection with the Mason Dam flooding.



4. A study to recommend sites for a magnetic station in Baker County for the U.S. Coast and Geodetic Survey.
5. Resources studies for the Tri-County Survey and for Grant County.
6. A pumice-expansion study in cooperation with the Portland office, results of which were published in the April 1965 issue of The ORE BIN.
7. A summary of the Coast Asbestos deposit and operation in Grant County, published in the October 1963 issue of The ORE BIN.

Projects in which the geologists at the Grants Pass office were involved during the biennium include the following:

1. Preparation of a proposal for an aeromagnetic and geochemical survey for the Minerals Committee of the Josephine County Area Development Committee, a cooperative program with the Division of Planning and Development.



Department geologist utilizing stereoscope for studying aerial photographs.

2. A preliminary investigation of the geothermal ground-water potential in the Klamath Falls and Diamond Craters areas.

3. A study of a lazulite occurrence in southwestern Oregon. Report prepared and delivered before the Oregon Academy of Science.

4. Detailed mapping of limestone (marble) bodies in the Upper Triassic Applegate Formation of southwestern Oregon, and preparation of a report on the Jones marble deposit, Josephine County, which was published in the October 1962 issue of The ORE BIN.

5. Research on the problem of turbidity fluctuations and cause of high turbidity in the Rogue River drainage.

6. Preparation of a geologic report and map of the lower Illinois River for the June 1964 issue of The ORE BIN, resulting from a trip down this part of the river to explore and collect stream-sediment samples.

Two of the most important projects of the Department are under the direction of the District Geologists. The District Geologist from Grants Pass is continuing investigations of the Recent volcanic rocks in central Oregon as an aid in attracting lunar research to Oregon. A series of reports in The ORE BIN describes the areas studied. This work also includes a cooperative project with the U.S. Geological Survey for the geological mapping of the east half of the Crescent AMS sheet. The Baker District Geologist, upon completion of his study on the quicksilver deposits in Oregon, began mapping of the Oregon portion of the Mineral quadrangle, an area of complex geology which contains considerable limestone.

## ENGINEERING DIVISION

### PETROLEUM SECTION

Petroleum engineering, like many other positions, encompasses varying responsibilities depending on the needs of the employer. Governmental requirements for this position are likely to call for more administrative duties than a similar position in the industry. Since Oregon has no oil or gas production as yet, the responsibilities of the petroleum engineer are concerned with the exploration phase of operations. Related to the initial regulation duties is the obligation to make drilling data easily available to the public so that more prospecting will be done. Administrative procedures encompass the drafting of new regulations to keep pace with technological advances. Enforcement of regulations entails administrative correspondence with oil companies as well as the actual on-site inspection of drilling facilities. With adequate controls the state can foster proper development of its petroleum deposits without waste and without damage to other resources.

Exploration for oil in the upland and offshore regions of the state involves several governmental agencies. The Department served as liaison on oil and gas matters with the Land Board, Fish and Game Commissions, Highway and Forestry Departments, Division of Planning and Development, the State Engineer, Water Resources Board, Natural Resources Committees, Corporation and Real Estate Departments, U.S. Bureau of Land Management, and the U.S. Geological Survey. Besides the cooperative ventures with state and federal agencies, the Department met several times with representatives of the Western Oil & Gas Association to obtain industry views on regulations.

Oregon has been an associate member of the Interstate Oil Compact Commission since 1954, which membership has been extremely beneficial to the state. The present oil and gas laws of Oregon were patterned after a model law suggested by the I.O.C.C. The state is represented on the Research and the Regulatory Practices Committees of the I.O.C.C. by H.M. Dole and V.C. Newton.

Drilling programs are reviewed by the Department before drilling or repair permits are issued and surety bonds must be posted before work can begin. Oil companies are asked to file notices covering various operations during drilling and are required to file with the Department upon abandonment or completion. Inspections are made periodically during the drilling of oil and gas tests to insure that adequate blow-out prevention equipment is being used and to witness certain operations.

Offshore core drilling has also been closely regulated for the past two years. The Department felt it necessary to limit depth of drilling to 1,000 feet below the ocean bottom for two reasons: 1) Because core holes are drilled without casing or blow-out prevention equipment, and 2) because deep drilling would have allowed evaluation of tracts before bidding took place.

Files of well records are maintained by the petroleum engineer for use by the public. Copies of any of the records may be obtained at cost upon request. Operators are required to submit drill-cutting samples and cores to the Department. The sample library of the Department presently contains samples representing 182,000 feet of drilling.

Dissemination of geologic data produced in exploration work is a major function of the oil and gas section. Some 400 requests for data were processed in the biennial period. Two studies utilizing drilling data have been undertaken. One is still in progress and the other was published as a bulletin, "Petroleum Geology of the Western Snake River Basin, 1963," by V.C. Newton and R.E. Corcoran. Three or four articles were prepared for national trade magazines in the past two years. Oil and gas publications by the Department now total one bulletin and five miscellaneous papers.

Field projects other than regulatory inspections consist of investigations of reported oil and gas seeps. No valid oil seeps were found during the biennial period, but several small gas occurrences were located. Gas and associated salt water from the seeps were analyzed. Traces of petroleum were recorded from one sample.

## MINING SECTION

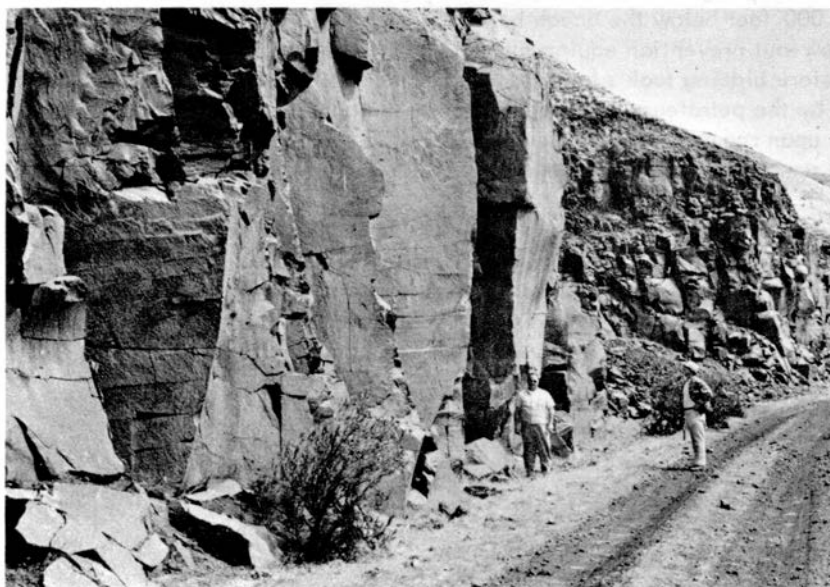
The mining section, headed by a mining engineer, is concerned with a wide variety of activities, responsibilities, and services. Mainly, it serves as a clearing house for information on the mining and metallurgical industries of the state. Although no production canvass is conducted by the Department, it does cooperate with the U.S. Bureau of Mines' canvass by supplying lists of mine operators in the state. Information on state and federal mining laws is provided. Commodity studies of certain of the state's mineral resources are made to provide information on the location, quality, size, and other pertinent factors necessary for eventual utilization by industry. Knowledge is constantly being compiled from all available sources on the mineral commodities known to occur in the state, and the economic and metallurgical factors affecting them. Information on mining engineering, metallurgical treatment of ores, mineral economics, markets, and new developments is provided by published material, personal conferences, and correspondence.

The mining section assists community planning organizations in their long-range plans for establishing tourist attractions based on local mineral deposits, mines, or other geologic phenomena. An active file is maintained of operating mines to provide necessary information to state and federal agencies, the mining press, equipment manufacturers, industrial mineral users, and the general public.

The mining section maintains a complete file of topographic maps covering the state and a current record file on the status of new mapping prior to its publication. Also included in the files are over 2,500 mine maps and other related charts of Oregon mines. The mining engineer is a member of the State Mapping Advisory Board, which prepares an annual request for new topographic mapping and supplies information on all mapping in the state. The mining section, working with the cartographic section, also prepares specifications, cost estimates, and bids for all of the Department's publications.

During the past biennium the mining section reviewed several hard-mineral lease forms in cooperation with the State Land Board. A long-range study of off-shore mineral resources, mining methods, and legislation of other states has also been started. Growing notional concern over water supplies resulted in a decision to study the water requirements for the mining and metallurgical industry for the state, and a compilation of present use and projected need was prepared.

Miscellaneous duties performed by the mining engineer include servicing a strong-motion accelerometer under a cooperative agreement with the U.S. Coast and Geodetic Survey; maintaining the Department's vehicles; and maintaining control over the physical inventory of the Department.



Volcanic outcrops such as this supply vital aggregate for highway and dam construction and for concrete. In 1964 Oregon quarries produced \$24,000,000 worth of crushed rock.

## CARTOGRAPHIC SECTION

The cartographic section has the responsibility of maintaining a close working relationship with the geologists and engineers in solving the many problems involved in the preparation of the Department's maps. Preparation of all maps, charts, and graphs in the composition of the Department's publications, and the construction of models and other graphic materials for demonstration purposes are some of the duties of the cartographer. Due to the complex and unique character of the multi-colored geologic maps issued by the Department, the cartographic section is currently preparing all of the color separation plates and delivering them camera-ready to the printer.

Unlike the everyday contact which private industry maintains with the lithographer, where items to be printed have a standard format, the geologic map as prepared by the Department's cartographic section is of such a complex nature that many of the phases involved, such as compilation of data and color separation, can be carried out only by the cartographer. Therefore, the preparation of a geologic map of scientific value involves more than the drawing of lines. The cartographer must have not only artistic ability and knowledge of photo-lithology methods but also a background in geology. In addition to map making, the cartographic section assists the editorial division with the selection of photographs used in publications and the design of publication covers.

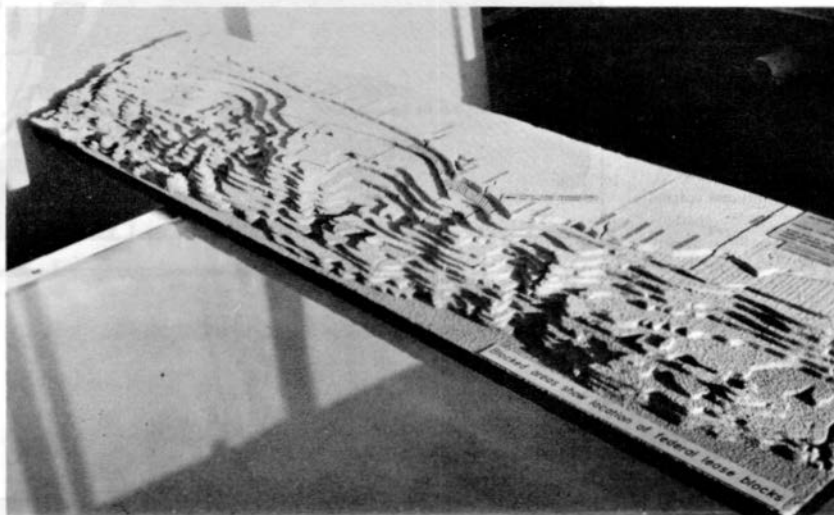
During the biennium final drafting work was done on geologic maps for the Suplee-Izee area, the Ironside Mountain quadrangle, and the Dallos-Valsetz quadrangle.

The past biennium has seen an increase in the amount of color used in The ORE BIN. This was made possible primarily by the use of photo-reproduction methods and has resulted in more attractive and readable printing at little added cost. Color maps for some of the representative articles which were published in The ORE BIN during 1964 are reproduced herein as examples of work of the Cartographic Section. Chronologically they are listed as follows: Index map and aerial photograph of Diamond Craters, Oregon; geologic map of lower Illinois River area; geologic map of the Yoquina Bay area, Newport; and geologic map of the Portland, Oregon area.

Accelerated interest in oil and gas exploration off the Oregon coast during the past biennium necessitated the construction of an official lease map to show the position of the three-mile line that separates state and federal land and the location of the lease blocks on the state's submerged lands. The project, which was carried out in cooperation with the State Land Board, required the highest degree of accuracy possible. The final map had a scale of one inch to one mile and was 36 feet long.

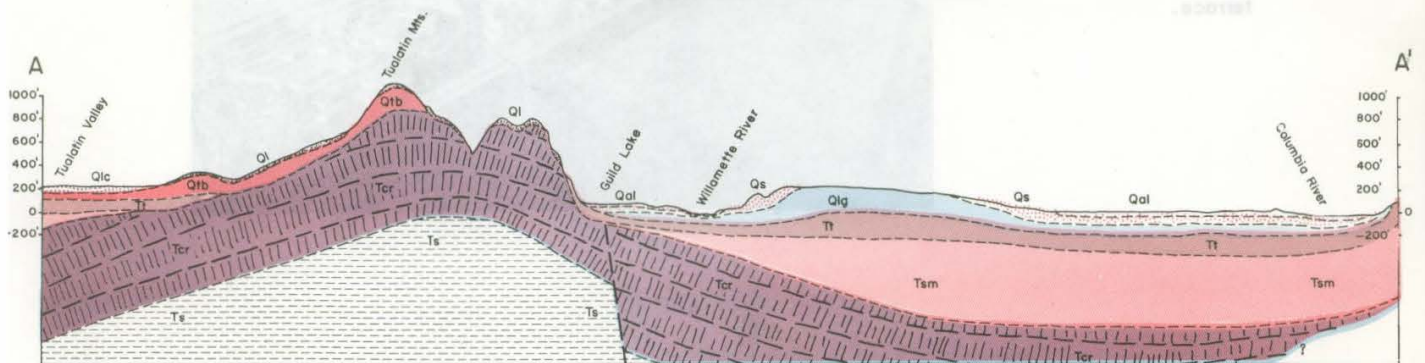
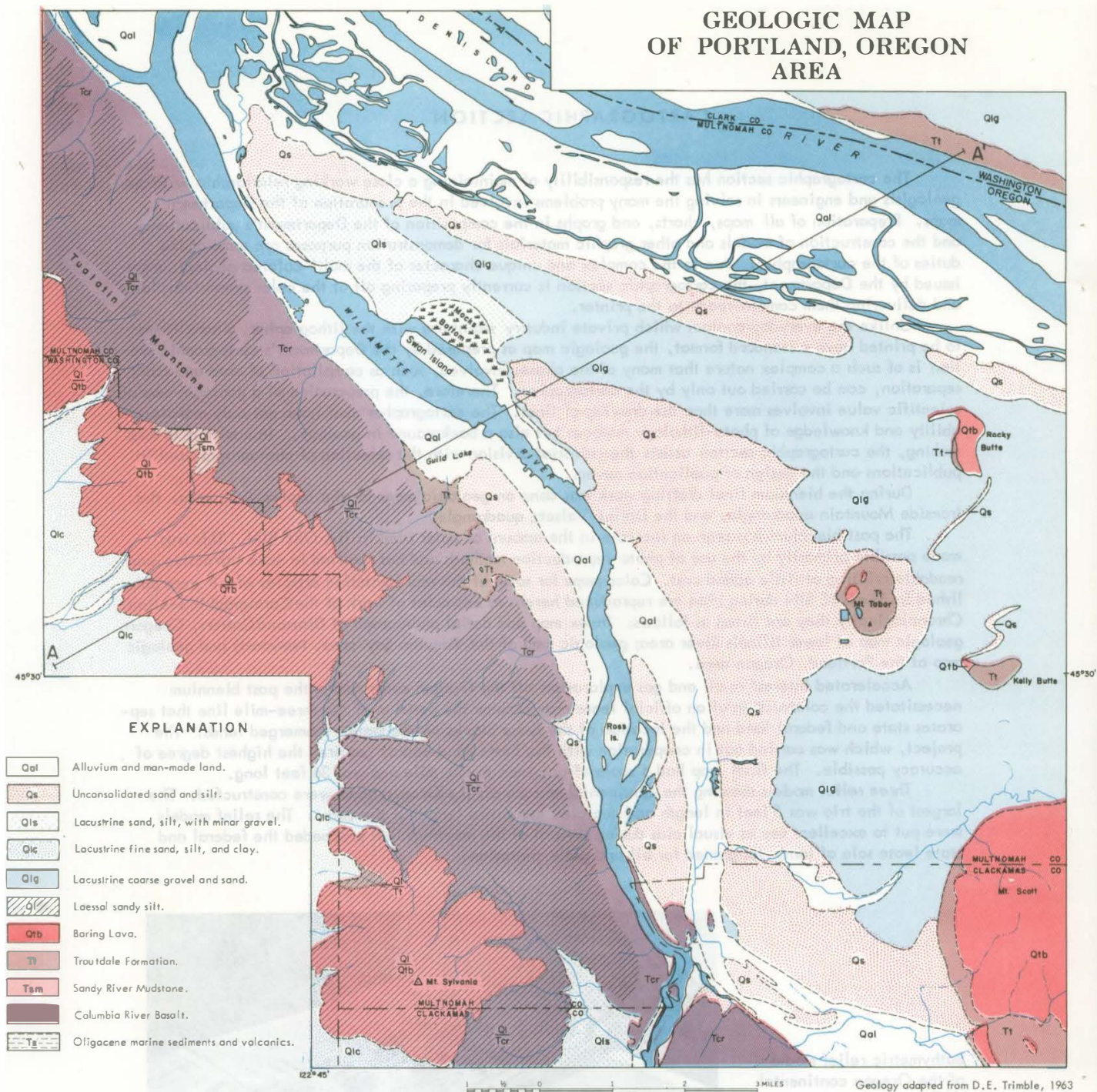
Three relief models showing the continental terrace off the Oregon coast were constructed. The largest of the trio was 5 feet in length and depicted the entire length of the coast. The relief models were put to excellent use as visual aids during several of the meetings that preceded the federal and state lease sale of lands designated for oil and gas exploration.

Bathymetric relief model of the Oregon continental terrace.

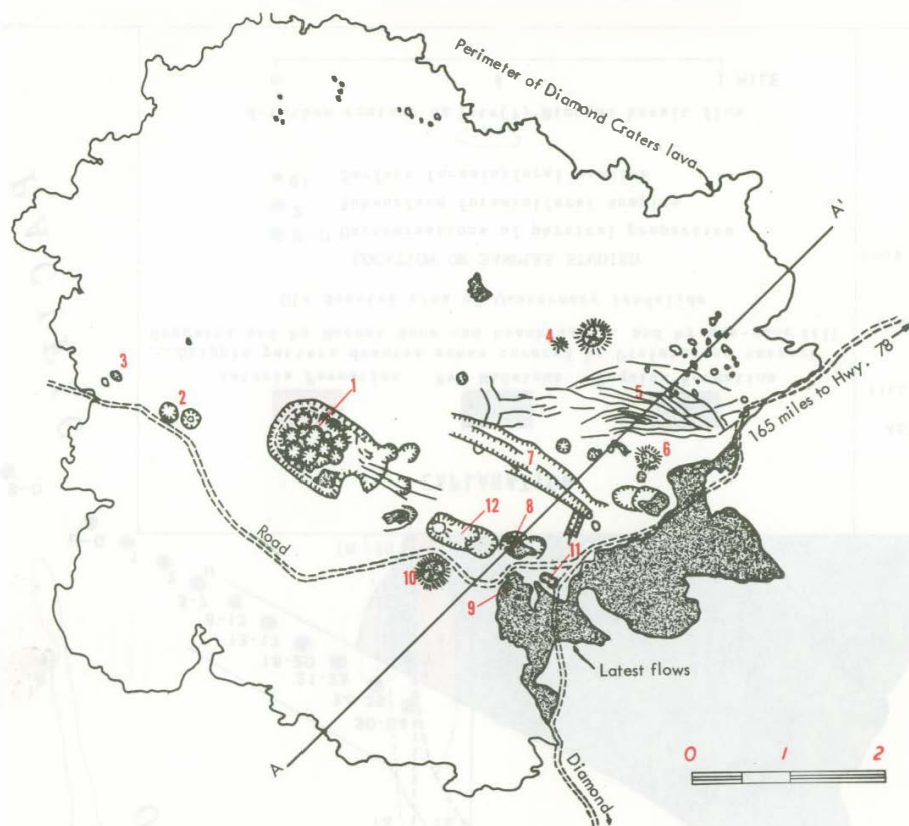




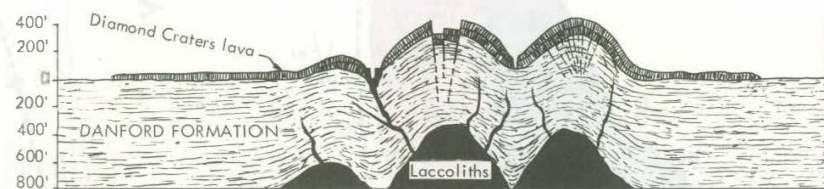
# GEOLOGIC MAP OF PORTLAND, OREGON AREA







GEOLOGIC CROSS SECTION

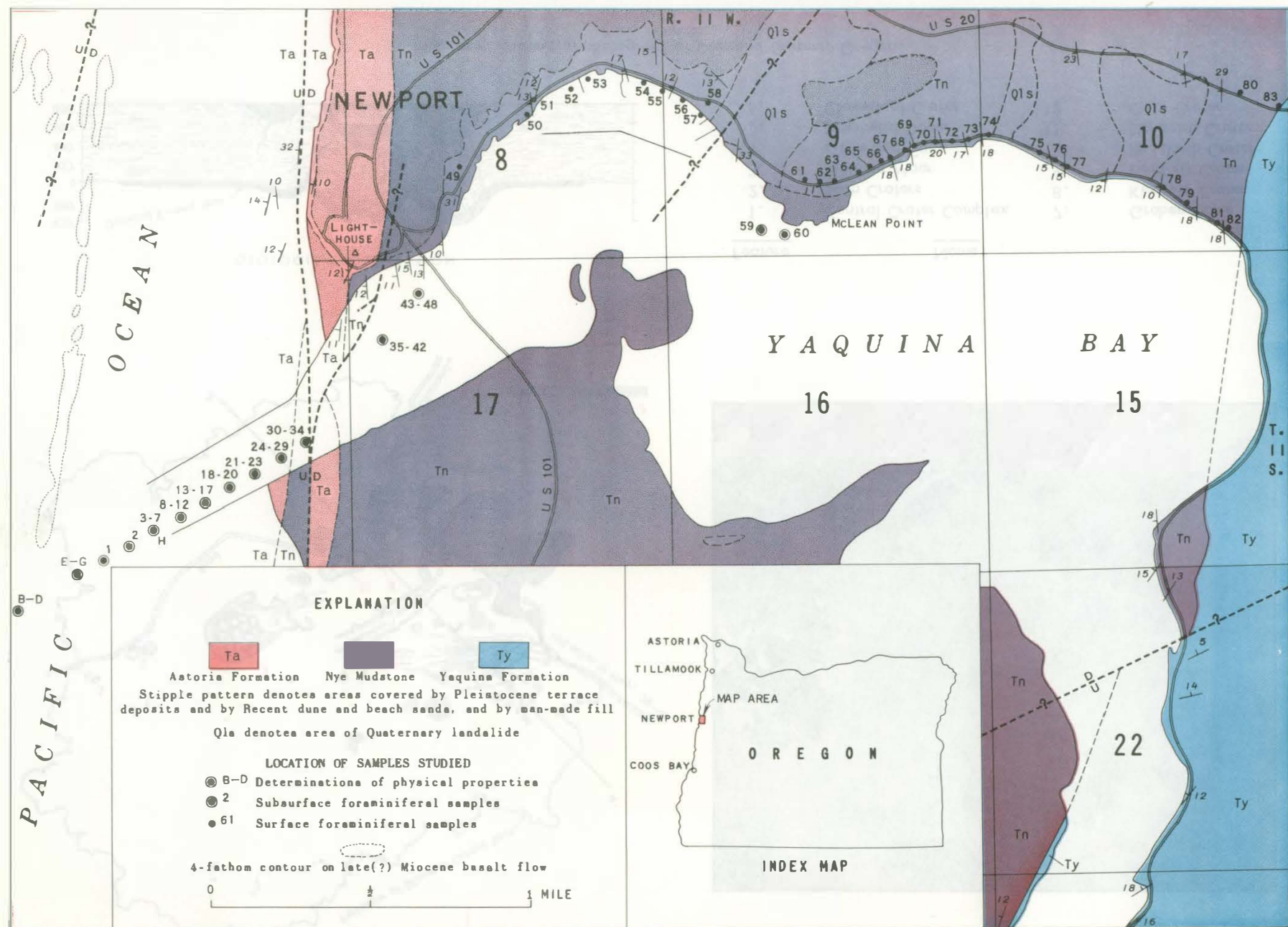


Feature

Name

- |    |                        |     |                 |
|----|------------------------|-----|-----------------|
| 1. | Central Crater Complex | 7.  | Graben Dome     |
| 2. | Twin Craters           | 8.  | Keyhole Crater  |
| 3. | Malheur Maar           | 9.  | Lava Pit Crater |
| 4. | Little Red Cone        | 10. | Red Bomb Crater |
| 5. | Northeast Dome         | 11. | Big Bomb Crater |
| 6. | Cloverleaf Crater      | 12. | Oval Crater     |

Index map and aerial photograph of Diamond Craters, Oregon.

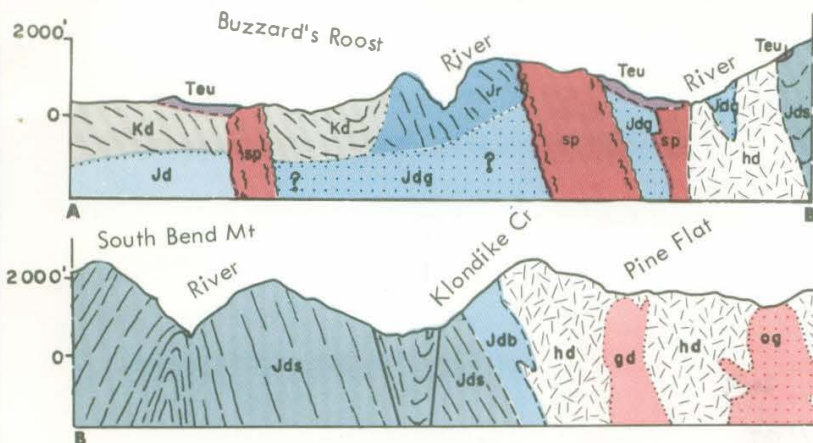
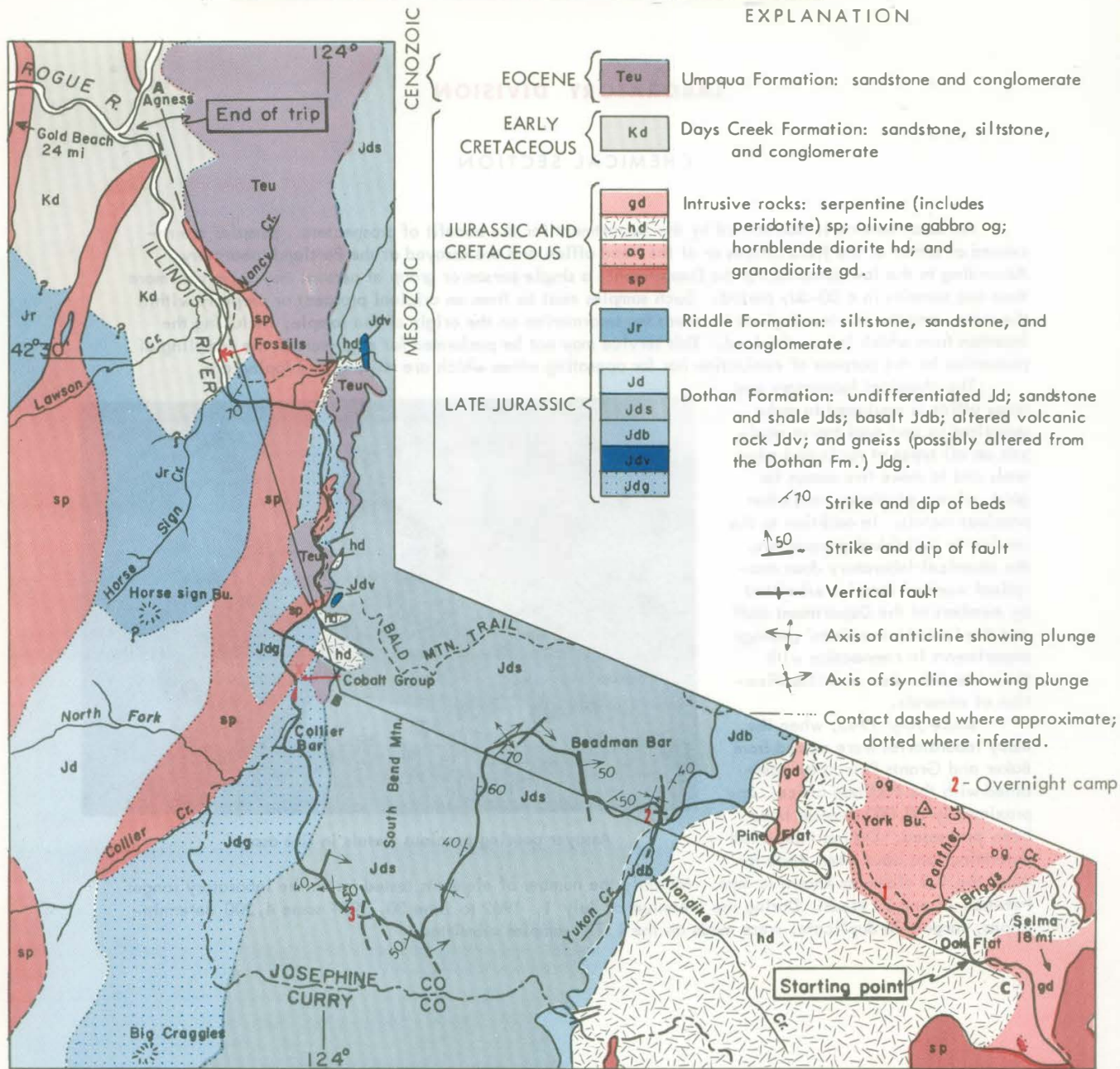


Geologic map of the Yaquina Bay area, Newport, Oregon, showing sample locations.



# GEOLOGIC MAP — LOWER ILLINOIS RIVER AREA

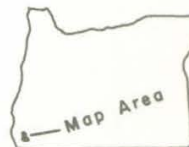
## EXPLANATION



Diller, 1903  
Adapted from: Wells, Hotz, and Cater, 1949  
Wells and Peck, 1961

1 2 3 4 5 miles

Vertical scale exaggerated 2 1/2 times



## LABORATORY DIVISION

### CHEMICAL SECTION

An assay service is maintained by the Department for the benefit of prospectors. Samples are received at either of the field offices or at the head office and ore assayed at the Portland laboratory. According to the law establishing the Department, a single person or group of persons may submit no more than two samples in a 30-day period. 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.

The chemical laboratory and assay office is equipped to make quantitative and qualitative analysis on all types of rocks and minerals and to make fire assays for gold, silver, platinum, and other precious metals. In addition to the service to individual prospectors, the chemical laboratory does analytical work on samples submitted by members of the Department staff and the State Universities' geology departments in connection with their identification and classification of minerals.

Since July 1943, when the assay laboratories were moved from Baker and Grants Pass to be combined with the Portland office, approximately 30,000 samples have been processed. During this period determinations have been made for 45 of the 103 elements known to man. Monthly the number of elements tested for in the laboratory ranges between 14 and 22 kinds. During the biennium of July 1, 1962 to June 30, 1964 some 4,200 determinations, largely in duplicate, were made on the 1,777 samples submitted.

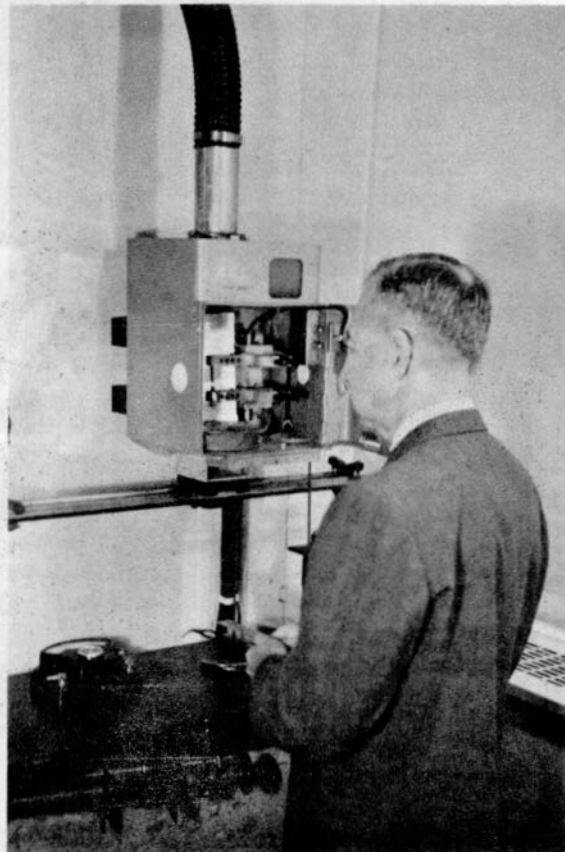


Assayer pouring precious metals in fire assay.

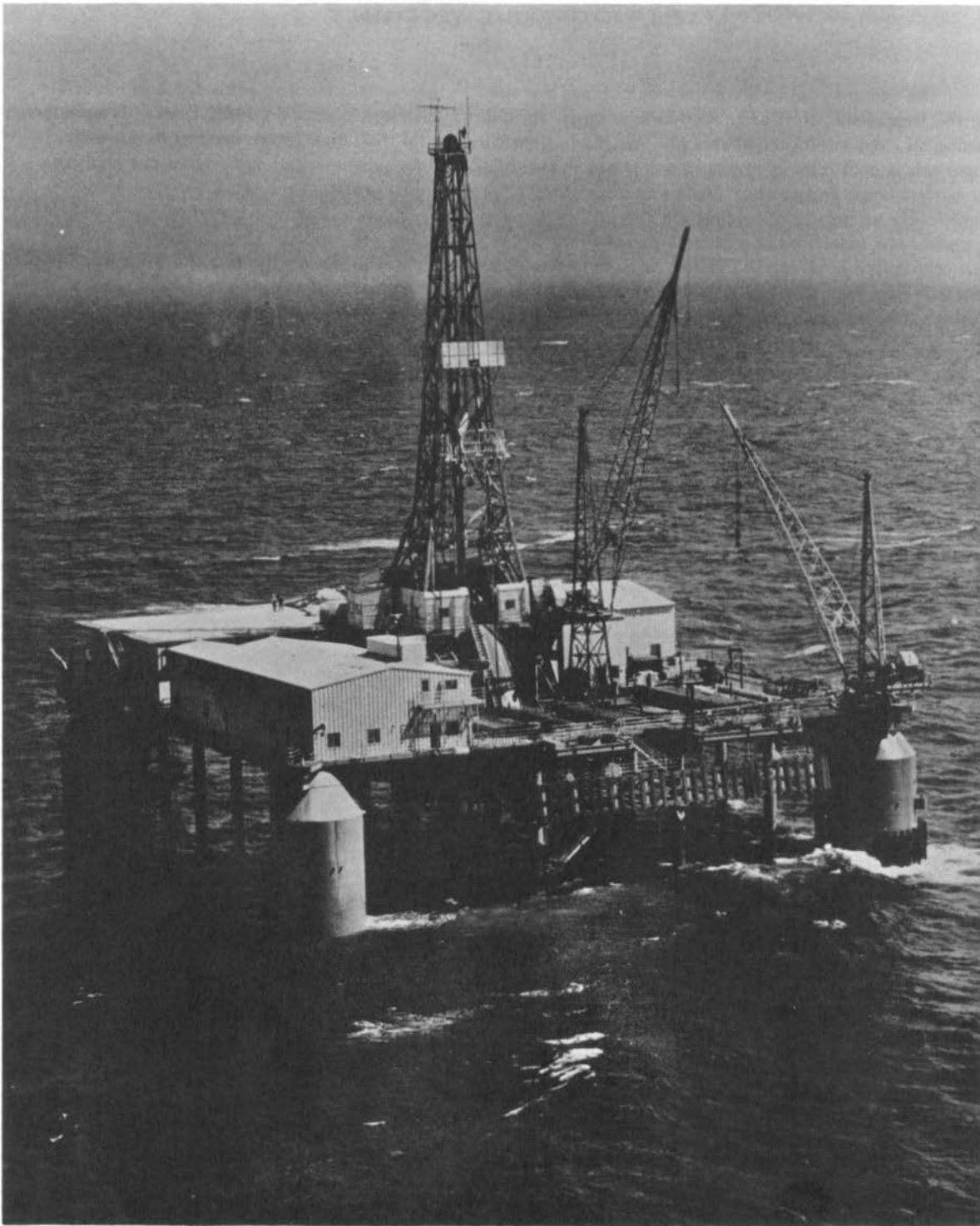
## SPECTROGRAPHIC SECTION

The spectrographic laboratory determines the metallic elements present in many types of materials for the Department staff and, on a charge basis, for other public agencies and private firms. Prospectors, geologists, and mining engineers are assisted in determination of the value of ore samples or minerals. Paper ash is analyzed for the pulp and paper industry. Chemical substances of many types are analyzed for both content and purity. Metals or alloys used or produced by various firms are identified spectrographically to make certain that the right alloy is being used. Items of criminal evidence, such as glass or paint, are identified or matched for the State Crime Laboratory, Multnomah County Sheriff, and the Portland Police Laboratory. Foods, toys, and air samples are checked for purity and safety for the State Board of Health. When time is available, spectrographic assistance in identifying minute mineral samples is given to the universities and colleges in the state.

A pulverized ore sample is being placed in the Arc/Spark stand ready to be vaporized in the electric arc. The light beam from the arc will enter the spectrograph and a photograph made of its spectrum. When the photograph is analyzed in a microphotometer, the amount of each element present can be estimated and recorded.







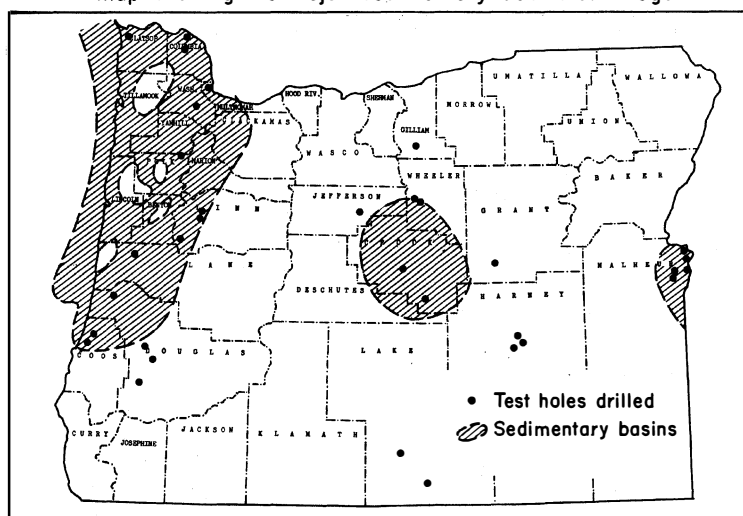
Blue Water II (Blue Water Drilling Corp.) 205 x 205-foot floating platform. The equipment has been contracted for Shell Oil Co. for deep-water work along the Pacific Coast. While drilling, the hull members of the Blue Water II are 40 feet below the water surface, the working deck is 40 feet above ocean level.

## PETROLEUM IN OREGON

Oil companies and wildcatters began prospecting in Oregon 62 years ago. After drilling 170 test holes without a single commercial discovery, the oil prospectors became more studious in planning drilling ventures. Because considerable volcanic rock was encountered in certain upland areas, recent studies have turned to the continental shelf bordering the state.

Drilling onshore may have condemned large volcanic areas from further exploration, but it has delineated several sedimentary basins that merit further investigation (see sketch map below). In western Oregon 10,000 feet of Eocene-Oligocene marine sediments are known to have been deposited. Mesozoic marine rocks which crop out over a large portion of central Oregon offer hope for commercial accumulations of petroleum. Numerous gas shows encourage additional test drilling in the Pliocene-Miocene lake sediments of the Western Snake River Basin.

Map showing the major sedimentary basins of Oregon

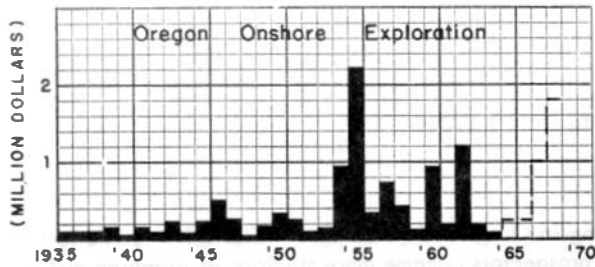


Prospects for a discovery on the continental shelf adjacent to the Oregon coast are good. An estimated 15,000 feet of Tertiary sediments, Pliocene through Eocene, have been deposited in the shelf region. The offshore sedimentary basin extends 50 miles seaward from the coast at Florence.

Early in 1964 several oil companies asked the federal government to offer for lease certain portions of outer continental shelf lands along the Oregon and Washington coasts. These offshore areas were opened to bidding in Los Angeles on October 1, 1964. The Oregon Land Board held a lease-sale in December, 1964, for state-owned submerged lands bordering the coast between Reedsport and Bandon. Results of the state and federal leasing along the Oregon coast are shown on Table 1.

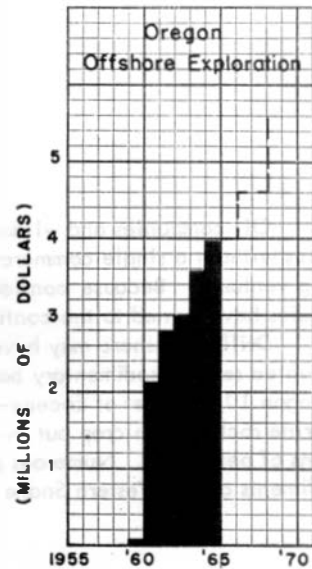
TABLE 1. OREGON OFFSHORE LEASING

Agency	Acreage	Bonus	Per Acre	Rental	Total Amount
State	13,600	\$ 28,996	\$ 2.13	\$ 13,600	\$ 42,596
Federal	425,550	\$27,760,240	\$65.23	\$1,276,650	\$29,036,890

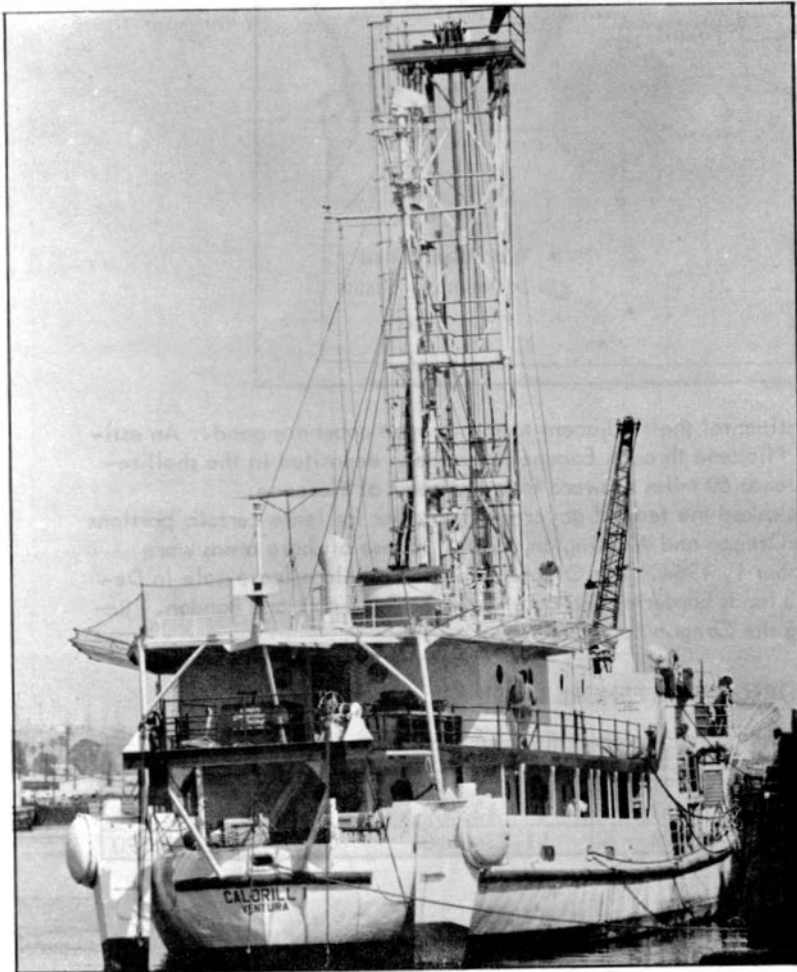


Projections of future oil exploration in Oregon are depicted on the accompanying graphs. The prediction for onshore activity is taken optimistically, since interest in the shelf region should attract attention to potential upland locations. Offshore work is shown as a conservative estimate through 1968. Drilling to evaluate lease holdings, rather than a major discovery, is forecast for the next three years.

Total exploration expenses onshore 1935 to 1964 were approximately \$10 million, including land costs. Offshore expenditures 1960 to 1964 totalled approximately \$11.3 million, excluding cash bonus and rental. If the assumption is made that drilling and land acquisition amount to 40 percent of development cost, the industry will expend another \$120 million before lands leased in Oregon and Washington at the 1964 sole are in full production. Even if results of drilling are discouraging, oil companies may still find it necessary to spend \$20 million by 1968 to evaluate their holdings.



Bonuses and rentals paid in 1964 are not included.



Coldrill I (Coldrill Offshore, Inc.) Center-well core-drilling ship, used by Standard Oil Co. and Union Oil Co. to drill shallow core holes off the Oregon coast in 1964. Large outboard motors position the vessel, so that no anchors are needed during drilling operations.

## OREGON'S MINERAL INDUSTRY

In the past 10 years the dollar value of mineral wealth produced in Oregon has increased an enormous 157 percent, with a 19.4 percent rise in the last year alone. In 1963 the production of stone and of sand and gravel accounted for approximately two-thirds of the state's total mineral production. The rapid and continuing growth rate of the state's mineral industry is all the more remarkable in that the effects of inflation are a minor factor in the swelling dollar value of the commodities produced. The unit value of stone and sand and gravel has increased only 8.18 percent in the past decade. These are low-value commodities which are vital to all heavy construction, highways, and industrial and domestic buildings. Higher unit costs for basic building materials inevitably increase finished costs out of all proportion to the original increase. No other segment of the construction materials industry has been able to hold down the delivered costs of its products as well as have the producers of industrial minerals.

Oregon's mineral industry permeates every segment of the state, and contributes importantly to the local economies of many counties. The distribution of the mineral industry by counties is shown on the accompanying map. The rapid growth of the industry in Oregon is clearly shown in the table below, which depicts the relative rank of the 19 counties which have produced more than \$1 million during one or more years in the period from 1954 to 1963. During this time the yearly number of counties has doubled, from 6 in 1954 to 12 in 1963. Douglas County, largely through the efforts of Hanna Nickel Smelting at Riddle, pushed into first place for the first time in 1963. The county had been in second place for the preceding seven years, with either Lane or Clackamas Counties first. This year for the initial time Gilliam and Klamath Counties became members of the million-dollar club. Wasco and Sherman Counties, included this year, have each been members once before in the decade. The six counties of Baker, Clackamas, Douglas, Jackson, Lane, and Multnomah have been million-dollar mineral counties for each of the past past 10 years. Twenty-five of the state's 36 counties reported increased mineral production over that of 1962.

Relative rank of counties producing at least \$1,000,000 of mineral wealth for the years shown between 1954 and 1963.										
	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Baker	4	3	4	4	4	4	3	4	5	4
Clackamas	1	1	1	1	1	1	4	3	3	2
Clatsop							8			
Coos			7							
Deschutes			8	9	7	8	7			
Douglas	6	5	2	2	2	2	2	2	2	1
Gilliam										11
Jackson	2	2	3	5	5	5	6	5	4	6
Klamath										9
Lane	5	6	6	6	3	3	1	1	1	3
Linn						7			8	8
Malheur		9				10				
Marion				8	8					
Multnomah	3	4	5	3	6	6	5	6	6	5
Sherman		8								7
Tillamook									9	
Umatilla					9	9	9		7	10
Wasco				7						12
Washington		7					10	7		
No. of Counties	6	9	8	9	9	10	10	7	9	12

The importance of the state's stone and sand and gravel industry can hardly be over-emphasized. All 36 of the counties reported production of either sand and gravel or of stone or both. In 16, these two mineral commodities were the only sources of primary mineral wealth reported. The production of stone and sand and gravel is important to the economy of the communities throughout the state, not only because it employs workers and uses large quantities of fuel and other supplies, but most importantly it provides the wherewithal for a community to grow.



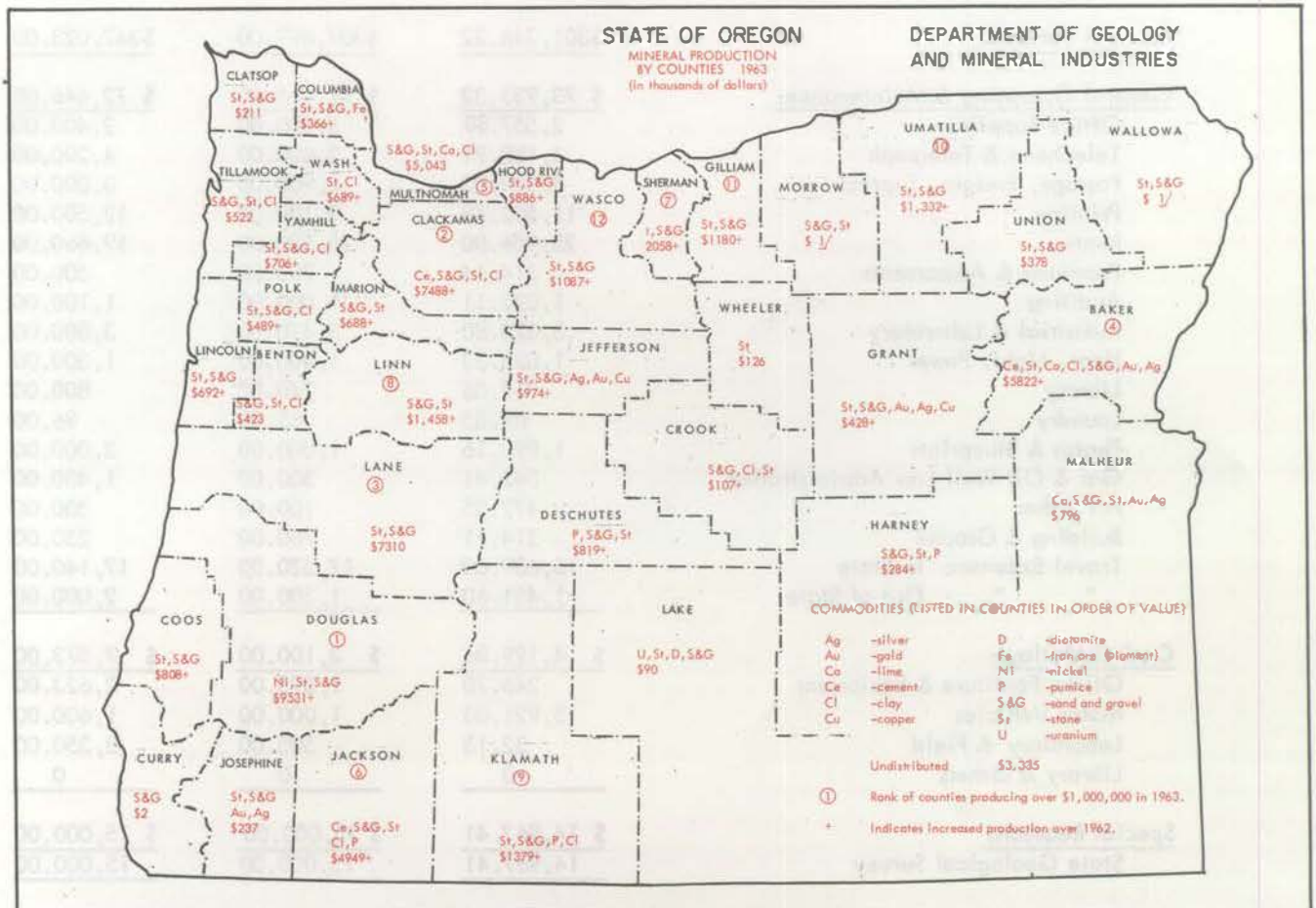
Commercial and industrial construction depends heavily on concrete, and concrete is largely composed of aggregate - sand and gravel and stone. Long-range planning for the most efficient use of these vital commodities should be a matter of concern to many areas in the state, but only a few county planning commissions have taken action so far.

Oregon's metallurgical industry embraces a wide variety of activities. The production of electro-process calcium carbide and various ferro-alloys and aluminum has contributed substantially to the economy for many years. Newcomers to the metallurgical scene include production of the growing list of exotic, space-age metals such as zirconium, tungsten, columbium, and titanium. Characteristically, these new metals are extremely costly, are produced in relatively small quantities in "clean" plants which do not contribute seriously to air or water pollution, and employ highly skilled personnel. Equally characteristic of these new operations is the importing of nearly all raw materials from great distances and the eventual shipment of the finished product to markets also at considerable distances. The Department is continually striving to find sources of raw materials which might be used in the exotic metals smelters. The search involves basic geologic studies to identify likely areas for more detailed investigation, analyses of numerous samples, and economic studies comparing existing sources of supply with those for local, undeveloped deposits.

Oregon's pyro-process industries include those producing cement, brick and tile, lime, expanded shale, vermiculite, and perlite. These industries are noted for their stability, are little affected by seasonal variations, and contribute importantly to the economy of the communities in which they are located. Since they are intimately related to the construction industry, and since the state is developing steadily, a comparable growth in the production of pyro-process commodities can be expected. The Department makes numerous investigations of deposits which may have potential value as sources of new or additional raw materials for industry.

	1962		1963		Percent Change	
	Employment	Payrolls	Employment	Payrolls	Employment	Payrolls
1. Mining . . . . .	1,263	\$ 7,272,000	1,335	\$ 8,667,000	+ 5.7	+19.2
2. Mineral Manufacturing . . . . .	2,820	17,589,000	3,080	20,268,000	+ 9.2	+15.2
3. Primary metals . . . . .	5,405	36,521,000	5,348	36,979,000	- 1.07	+ 1.25
4. Miscellaneous . . . . .	352	2,190,000	407	2,316,000	+15.6	+ 5.75
	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
	10,267	\$66,535,000	10,592	\$71,354,000	+ 3.17	+ 7.25

\* Oregon State Employment Department figures. Percentages added.



## COMPARATIVE STATEMENT OF EXPENDITURES

	1961-1963 Total Expenditures 7/1/61-6/30/63	1963-1965 Estimated Expenditures 7/1/63-6/30/65	1965-1967 Funds Requested 1965-1967
<u>Personal Services:</u>	<u>\$301,348.22</u>	<u>\$307,899.00</u>	<u>\$347,023.00</u>
<u>General Operating &amp; Maintenance:</u>	<u>\$ 73,933.32</u>	<u>\$ 71,415.00</u>	<u>\$ 72,646.00</u>
Office Supplies	2,557.88	2,200.00	2,400.00
Telephone & Telegraph	4,188.91	3,600.00	4,200.00
Postage, Freight, Express	3,028.03	2,900.00	3,000.00
Printing	11,502.48	9,100.00	12,500.00
Rents	25,056.00	25,500.00	19,660.00
Premiums & Assessments	314.14	700.00	500.00
Auditing	1,022.11	1,000.00	1,100.00
Industrial & Laboratory	3,323.80	3,470.00	3,800.00
Heat, Light, Power	1,023.33	1,000.00	1,300.00
Library	717.06	740.00	800.00
Laundry	89.35	85.00	96.00
Photos & Blueprints	1,990.16	1,000.00	2,000.00
Gas & Oil Well Law Administration	342.41	500.00	1,400.00
All Other	472.35	100.00	500.00
Building & Ground	214.11	700.00	250.00
Travel Expenses: In State	16,639.60	17,520.00	17,140.00
" " : Out of State	<u>1,451.60</u>	<u>1,300.00</u>	<u>2,000.00</u>
<u>Capital Outlays:</u>	<u>\$ 4,199.86</u>	<u>\$ 3,100.00</u>	<u>\$ 7,573.00</u>
Office Furniture & Equipment	246.70	1,595.00	2,623.00
Motor Vehicles	3,921.03	1,000.00	1,600.00
Laboratory & Field	32.13	505.00	3,350.00
Library & Others	<u>0</u>	<u>0</u>	<u>0</u>
<u>Special Requests:</u>	<u>\$ 14,967.41</u>	<u>\$ 15,000.00</u>	<u>\$ 15,000.00</u>
State Geological Survey	<u>14,967.41</u>	<u>15,000.00</u>	<u>15,000.00</u>
 Total Expenditures	 \$394,448.81	 \$397,414.00	 \$442,242.00

## SUMMARY

	Expended 1961-1963	Appropriated 1963-1965	Requested 1965-1967
Personal Services	\$301,348.22	\$307,899.00	\$347,023.00
General Operating & Maintenance	73,933.32	71,415.00	72,646.00
Capital Outlays	4,199.86	3,100.00	7,573.00
State Geologic Map	<u>14,967.41</u>	<u>15,000.00</u>	<u>15,000.00</u>
 TOTAL	 \$394,448.81	 \$397,414.00	 \$442,242.00

## THE APPROPRIATION

(1963 - 1965 FISCAL BIENNium)

Salaries and Wages	\$ 307,899	77.42 percent
General Operating & Maintenance	71,415	18.01
Capital Outlays	3,100	0.79
State Geologic Map	15,000	3.78
	<hr/>	<hr/>
TOTAL	\$ 397,414	100.00 percent

## AND WHAT IT PAID FOR

(1962 - 1964 REPORTING PERIOD)

1,079 Square miles geologically mapped	4,271 Chemical analyses
State Geologic Mapping 900	1,946 Radiometric determinations
Quadrangle Mapping 124	1,263 Spectrographic analyses
Special Studies 55	177 Petrographic examinations
322 Field investigations	93 Talks
45 Oil and Gas Act inspections	42 Field trips for groups
16 Commodity studies	22 Office tours
4 Engineering-geology studies	24,689 Pieces of mail sent (excludes bulk mail)
29 Cooperative projects with other agencies	28,084 Pieces of mail received
7 Publications issued	5 Television and radio appearances
60,850 Copies of The ORE BIN	20 Exhibits judged
379 Mineral sets	6 Expert witness in court
13,354 Visitors	
2,077 Mineral identifications	