STATE OF WASHINGTON
ALBERT D. ROSELLINI, Governor

Department of Conservation
EARL COE, Director

BIENNIAL REPORT NO. 7
of the

DIVISION OF MINES AND GEOLOGY

For the Period Commencing July 1, 1956
and Ending June 30, 1958

By
MARSHALL T. HUNTTING
Supervisor

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DIVISION OF MINES AND GEOLOGY

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PART I

ADMINISTRATION

The following report applies to the organization and activities of the Division of Mines and Geology, Department of Conservation, for the period July 1, 1956 to June 30, 1958.

STAFF

W. A. G. Bennett.....Geologist 4
Vaughn E. Livingston.....Geologist 2
Gerald W. Thorsen.....Geologist 1
Mark D. Haun.....Cartographer
Dorothy Rinkenberger .....Secretary-Editor
Gloria DeRossitt .....Secretary

In February 1957, Sheldon L. Glover, Supervisor, retired after 25 years in State service. He was succeeded by Marshall T. Huntting, who had been Assistant Supervisor for the preceding 1½ years and had been a geologist in the Division since May 1942.

Wayne Moen was employed as a geologist on June 16, 1957 and resigned on October 31, 1957. Mrs. Mary Walker worked as draftsman from September 17, 1956 to July 22, 1957. Mrs. Ulva M. Lehman was employed on a temporary basis as a clerk for two months in the spring of 1957. Temporary field and office assistants who worked for short periods during the biennium were William Hartwell and Jack Ellingson.

The present staff's combined experience and acquaintance with Washington geology and mineral resources and Division office procedures is an asset which is very valuable to the State and which should be retained and built up. This can only be accomplished by offering conditions of employment—salaries, equipment, and job security—which approach those in private industry and equal those in the Federal Government. The difficulties encountered in attempting to fill vacancies on the technical staff illustrate the need for improvement in all three categories.

The present technical staff of 3 geologists compares with a total of 4 geologists and 1 mining engineer comprising the Division staff 10 years ago, at a time when the demands for services were substantially less than they are now.

DUTIES OF THE DIVISION

The office of State Geologist was established in 1890 by the first State Legislature, and, except for the period 1893 to 1901, the office has been active ever since. Although the name and organization went through several changes in 1901, 1921, 1935, and 1945, the duties are basically the same as they were in 1890.

The Division of Mines and Geology is a service agency that has the responsibility to compile and distribute information on mineral resources, mineral industries, and geology of Washington. Administrative activities of the Division are limited to regulatory functions in the field of oil and gas exploration and production as required under the Oil and Gas Conservation Act of 1951 (RCW 78.52.001 to 78.52.550).

The Division has the following duties and responsibilities as set out in RCW 43.21.070 and 43.92:

(1) To examine the metallic and nonmetallic mineral deposits of the State.
(2) To prepare and distribute, at cost of printing, geologic and mineral-resource reports and maps.
(3) To collect, compile, publish, and disseminate statistics and information about mining, milling, and metallurgy.
(4) To collect and assemble an exhibit of mineral specimens.
(5) To assemble a library pertaining to mining, milling, metallurgy, and geology.
(6) To make determinative examinations of ores, minerals, and rocks for the public.
(7) To administer the Oil and Gas Conservation Act, regulating drilling and production of oil and gas.
(8) To make archaeological surveys.
(9) To cooperate with the U. S. Geological Survey in making topographic and geologic maps and to cooperate with the U. S. Bureau of Mines and with all departments of the State government.

ACTIVITIES OF THE DIVISION

The statutory duties are broadly defined, providing the flexibility necessary for the proper functioning of the Division in accordance with changing economic conditions, new trends in minerals utilization, and changing demands for mineral-resource and geologic information. The activities of the Division in fulfilling its statutory duties are described in the following paragraphs.

MINERAL DEPOSIT EXAMINATIONS

Division geologists during the biennium continued to acquire information on the metallic and nonmetallic mineral deposits in the State. Field studies were made of known mineral deposits, new deposits were sought out, and reported occurrences were investigated. Systematic geologic mapping and examination of active and abandoned mining properties in the south half of the Colville quadrangle in central Stevens County was continued. In other areas, field examinations were made of deposits of lead, zinc, copper, gold, uranium, black sand, silica, coal, and peat. Most field studies served the dual purpose of adding to our fund of information on the State's mineral resources and aiding the prospector or owner of the claim on which the mineral deposit was

located. Most of the examinations were of a preliminary nature, but some were in more detail. In examining mineral deposits at the request of their owners, Division geologists take great care not to encroach upon the field of the consulting engineer or geologist. In accordance with this policy, oral advice is given but written reports are not made for individual claim owners.

PUBLICATIONS

Geologic investigations are of little value to the public unless the results are made easily available. The demand is increasing each year for information on geology, mineral resources, and the status of the mining industry of Washington. This information is dispensed through office and field conferences, by correspondence, and, most effectively, through distribution of published reports. Most of our reports are written by staff geologists, but some manuscripts are obtained free or are purchased from specialists outside our staff. As required by law, the entire cost for printing of reports will eventually be returned to the State's General Fund through income from sale of the reports.

Reports Published

During the biennium the following reports were published and made available for distribution:

Eocene Stratigraphy of the Lower Cowlitz River—Eastern Willapa Hills Area, Southwestern Washington, by Donald A. Henriksen, Bulletin 43, 122 pages, 2 plates, 49 figures, $1.50. The Division, by providing the funds for printing, was able to obtain without other expense the manuscript of a Stanford University doctorate dissertation embodying the results of a detailed geologic investigation of a part of southwestern Washington that is of particular interest to those who are engaged in the search for oil.

Inventory of Washington Minerals: Metallic Minerals, by Marshall T. Huntting, Bulletin No. 37, Part II, 495 pages, 27 plates, $4.50. This is one of the largest and most complex projects ever undertaken by the Division. The comprehensive data on all known and reported metallic mineral deposits of the State provide industry with information that is in constant demand.

Supplement No. 1 to An Outline of Mining Laws of the State of Washington, compiled and annotated by M. H. Van Nuys, Supplement No. 1 to Bulletin No. 41, 26 pages, free. Various changes—some major and some minor—have been made in mining laws since the publication of Bulletin No. 41 in 1953. It appeared desirable to include these changes in a short supplemental pamphlet to accompany the original bulletin (No. 41) on mining laws. It has the effect of bringing the original bulletin up to date—a less expensive procedure than making a complete revision of the earlier material.

Uranium in Washington, by Marshall T. Huntting, Information Circular No. 26, 10 pages, 1 plate, free. This is a separate printing which constitutes one section or chapter of Inventory of Washington Minerals, Part II, Metallic Minerals. Two objectives are served: The included information can readily be placed in the hands of those desiring this section only and who are not interested in purchasing the complete Inventory, and the Division is saved the necessity of writing lengthy replies to inquiries which can be handled only inadequately by the usual correspondence.

1957 Directory of Washington Mining Operations, by Vaughn E. Livingston, Information Circular No. 27, 96 pages, 2 maps, free. This directory, like those in preceding years, lists all the known producers and the active developments on deposits of metallics, nonmetallics, and sand and gravel in the State. For each operation the directory lists the name, address, location, product, and status of activity.

1958 Directory of Washington Mining Operations, by Wayne S. Moen, Vaughn E. Livingston, Jr., and Gerald W. Thorsen, Information Circular No. 28, 76 pages, 2 maps, free. The contents of this directory are similar to those of former years, differing only in details resulting from changing mineral operations. The format of this directory was altered, however, the principal change being a reduction in size from 8½ by 11 inches to 6 by 9 inches. This change in size not only reduces the cost of publication but also results in a book more convenient to use.

Oil and Gas Exploration in Washington, by Vaughn E. Livingston, Jr., Information Circular No. 29, 61 pages, 1 plate, 75 cents. This report gives data on all wells that have been drilled for oil or gas. It lists all logs, descriptions of cuttings and cores, and all test results that are on file for public inspection at the Division. A map included with the report shows the locations of the wells that have been drilled for oil or gas.

Dry-hole Map of Washington, 25 cents. Extra copies were printed of the map which accompanies Information Circular No. 29, so that this map could be distributed separately.

Ringold Formation of Pleistocene Age in Type Locality, the White Bluffs, Washington, by R. C. Newcomb, Reprint No. 1, 13 pages, 1 figure, 25 cents. This is the first of a new series of publications, the Reprint series, in which articles on geology and mining in Washington that are published by private journals will be reprinted by the Division so that these articles may be made more readily available to a wider audience and to those interested especially or only in Washington geology and mining operations.

A publications list is available from the Division. Listed are all the Bulletins, Reports of Investigations, Information Circulars, administrative reports, and Reprints that have been published by the Division of Mines and Geology and its predecessor agencies.

Three mimeographed reports which have been out of print for years were reissued during the biennium. These are: Division of Mines and Mining Report of Investigations No. 2, Washington Iron Ores, a Summary Report, by Sheldon L. Glover; Division of Mines and Mining Report of Investigations No. 3, Mineral Resources of the Wenatchee-Ellensburg-Yakima Region, by Sheldon L. Glover; and Division of Geology Report of Investigations No. 3, A Report on a Geologic Reconnaissance of the St. Helens Mining District, Washington, by Everett Hougland.

Other reports and lists which were mimeographed or offset printed during the biennium for distribution are:

Washington Gem and Ornamental Stones, Decorative Stone, and Quartz Crystal—a map and brief text showing locations and briefly describing gem stone occurrences in the State.

References to Articles on Washington Mineral Localities.

Selected Bibliography on Gem Stones.

List of Books for Amateur Geologists.

List of Selected Washington Maps and Their Sources.

Bibliography of Washington Clays.

Notes for Uranium Prospectors. This last, very popular report, which was first issued in 1949, was expanded and completely revised during the biennium.

Reports in Preparation

During the biennium the following reports were in preparation and were in various stages of completion:

Geologic Map of Washington. The entire remaining edition of the geologic map of Washington was quickly exhausted when uranium prospecting became active. This necessitated the immediate start on a complete revision of the state map—a meticulous, time-consuming, and expensive project that may require two years or more to complete. It is the most important new project scheduled by the Division. Geologic maps of all kinds have been acquired from government agencies, private companies, candidates for advanced college degrees, and other individuals. These are being reduced to the compilation scale of 1:400,000, necessary changes are being made, and the maps are being transferred to a manuscript copy of a single statewide map that will be redrafted and published at a scale of 1:500,000. The project has benefited greatly from the excellent cooperation extended by all who have made unpublished geologic maps available for use. Especially valuable has been the help of the U. S. Geological Survey, several oil companies, the University of Washington, and the State College of Washington. Although the revised State Geologic Map will be largely a compilation of maps from other sources, some mapping has been done by Division geologists specifically for this map revision project. During the summer of 1958 some additional mapping will be done in the southern Cascade Mountains by a Division geologist and a geologist of the U. S. Geological Survey under a cooperative agreement between the two agencies.

Peat Resources of Washington, by George B. Rigg, Bulletin 44, 272 pages, 1 plate, 263 figures, $4.00. This report is in press and should be completed and ready for distribution soon after the close of the biennium.

Inventory of Washington Minerals: Nonmetallic Minerals, by Grant M. Valentine, Bulletin No. 37, Part I. The edition of this report, published in 1949, was entirely exhausted in April 1956. As there is a continuous demand for data on the State's industrial minerals, the bulletin is being revised, brought up to date, and considerably enlarged for reprinting. The project is in charge of Marshall T. Huntting. The completion date cannot be estimated, but it is hoped that it will be during the coming biennium.

Geology and Mineral Resources of the South Half of the Colville Quadrangle, Stevens County, Washington, by W. A. G. Bennett. Field work for this study was essentially completed during the biennium, and it is expected that the geologic map will be completed and the report will be written and published during the next 2 years.

Fossils in Washington, by Vaughn E. Livingston, Jr. Numerous requests are received for information on fossils in the State. These requests come from both professional geologists and amateurs, and a report is being written that will be suitable for both.

Bibliography and Index of Geology and Mineral Resources of Washington, 1937-1956, by William H. Reichert. This report is being compiled by Mr. Reichert as a Master of Librarianship thesis at the University of Washington. The Division has paid part of the expense incurred in its preparation and will publish the report as a bulletin. The manuscript should be completed in a few months, and it should be ready to be proofread and edited shortly thereafter.

The Channeled Scablands of Washington, by J Harlen Bretz. The Channeled Scablands of eastern Washington are unique—nothing like them exists elsewhere in the world. The Division was fortunate in obtaining the services of the foremost authority on them to write a description and explanation of their origin to be published as a bulletin. Because of the scablands' scenic attraction, the report will be of interest to tourists as well as to professional geologists.

Saline Lake Deposits in Washington, by W. A. G. Bennett. The saline lake deposits of the State were sampled and mapped in 1944 and 1945, and a report of these studies was written but never published. Continued inquiries by industrialists for information on sodium sulfate and sodium carbonate suggest the need for printing this report. Some work has been done during the present biennium to bring the report up to date so that it can be published when money for printing is made available.

Prospecting in Washington, by Donald L. Anderson. Many requests for information are received from prospectors each month. The requests cover a wide range of subjects, many of which are not adequately covered in any Division report now available. Donald L. Anderson, Professor of Mining Engineering at the University of Washington, was hired to write an information circular that would answer most of the questions commonly asked by Washington prospectors. The report should be ready for publication during the coming biennium.

Archaeology in Washington, by Bruce Stallard. As a part of one of the archaeological projects sponsored by the Division during the biennium, a report on archaeology and a history of archaeological studies in Washington is being written for publication. It is expected that this report, which should be of interest and value not only to professional archaeologists but also to everyone who is interested in early Indian history, will be ready for publication early in the next biennium.

MINING AND MILLING STATISTICS

The Division cooperates with the U. S. Bureau of Mines in collecting production data on all minerals produced in Washington. These data are published in the annual Minerals Yearbooks of the Bureau of Mines. Preprints of the Washington chapter on mineral production are available from the Bureau.

Each year Division geologists visit the active mining operations—metallic, nonmetallic, and sand and gravel—in order to compile the annual Directory of Washington Mining Operations. These directories are some of the most popular reports published by the Division.

MINERAL EXHIBITS

A rather complete labeled collection of all the metallic and nonmetallic minerals of known economic importance is maintained in the Division office for the use of prospectors, miners, and industrialists. Also included in the display are mineral substances which may have future value but which are not now being mined. This collection is housed in a large well-lighted cabinet, so that all specimens are readily accessible for handling and detailed inspection. Two other lighted display cabinets house metallic and nonmetallic mineral collections. These materials are particularly useful when callers request information on Washington minerals and localities and when users of industrial minerals wish to consider State sources of required materials.

Characteristic samples from mineral deposits and geologic formations throughout the State are collected during the course of field work. In the office they are classified and added to an extensive collection of several thousand specimens that is maintained for staff reference and for the use of visiting geologists who may be working in the State. An attractive collection of fluorescent minerals and a small collection of agates and other specimens of interest to hobbyists are on display for anyone wishing to refer to them. A special display of uranium minerals is maintained. Two sets of minerals and rocks are kept in special traveling cases for occasional display at expositions or to illustrate talks made before various groups and organizations. A supply of bulk minerals and rocks is used to fill requests for samples.

Samples of cuttings and cores from oil and gas test wells are collected, examined, labeled, and added to an extensive collection of similar materials maintained for study and reference. These samples are of particular value to the geologists of companies exploring for oil in the State.

LIBRARY

A fairly large, specialized, reference library is maintained for the use of the staff, other State agencies, and for public reference. It includes authoritative texts on mining, metallurgy, mineral resources, and geology, and nearly complete collections of the reports of the U. S. Geological Survey and U. S. Bureau of Mines. Included also are pertinent reports of the U. S. Atomic Energy Commission and other Federal agencies, as well as the publications of Canadian and other foreign geological surveys and the reports of other state geological surveys and mining bureaus. The U. S. Geological Survey and the U. S. Bureau of Mines place unpublished reports on Washington areas and mineral deposits on open file for public inspection in the Division library.

Full sets of all topographic maps of Washington are maintained for the use of the staff and for public reference. Similarly available are aerial mosaics, planimetric maps, special geologic maps, mine maps, and various other maps. The map collection is constantly being enlarged.

Most of the library material is acquired without cost on an exchange basis from other State and Federal agencies and from educational institutions. A few volumes are acquired by private donations, and a few texts and reports of

especial interest are purchased through limited funds available for the purpose. Library acquisitions are increasing rapidly as a result of increased mineral-resource exploration activity nationally and publication of the results of these studies, and as a result of greatly increased numbers of publications distributed by the Federal agencies and other state geological surveys. Increasing library acquisitions emphasize the need to hire for the Division staff a person who has professional training or experience in library work as well as a thorough knowledge of geology.

MINERAL IDENTIFICATION SERVICE

The Division provides a free mineral identification service for the public. Samples of ores, rocks, minerals, and clays from Washington localities are examined and identified. The senders are advised of the possible value of submitted samples, and suggestions are given for further prospecting or analysis whenever such action appears warranted. Through this service new occurrences of potential value are occasionally found and brought to the attention of those who are seeking new sources of mineral raw materials in the State. Sample identification does not include assays or quantitative chemical analyses, as these services are available from commercial concerns.

During the biennium the Division of Mines and Geology received and reported upon 1,432 samples. This is more than 3 times as many sample examinations as were made during the 2-year period 10 years earlier, in 1946-48. This indicates a greatly increased interest in Washington's mineral resources and shows increased public dependence upon help and advice from the Division in developing these resources. It also emphasizes the need for additional staff to handle the increased work load.

The laboratory of the Division is equipped for most of the mineralogical studies required. Equipment consists of a diamond saw and laps for making thin sections and polished sections of rocks and ores; binocular, petrographic, and metallographic microscopes; a small laboratory electric furnace for high-heat tests; a spectrograph and densitometer for qualitative and quantitative examinations of rock and mineral specimens; blow-pipe equipment for qualitative tests; sieves for making screen analyses of sands; Geiger counters and a scintillation detector for radiometric tests of uranium-bearing samples; ultraviolet lamps for fluorescence tests; and a high-intensity magnetic separator.

OIL AND GAS

In July 1957 oil was discovered in quantity thought to be commercial in a well at Ocean City in Grays Harbor County. This discovery set off the biggest boom of oil and gas exploration and leasing activity ever experienced in the State. For months the Division of Mines and Geology was flooded with telephoned, written, and personal requests for information on the geology and oil and gas exploration history and potential of the State. An old report by the Division of Mines and Geology giving a history of earlier oil and gas exploration had been out of print for several years, so in order to supply answers to many of the requests for information, this report was revised, brought up to date, and printed as Information Circular 29, "Oil and Gas Exploration in Washington 1900-1957."

Since the early 1930's the Division has collected and cataloged all available information on the progress and results of oil and gas test drilling. These data are on open file for all geologists and oil men who desire to see or copy them.

In 1951 the Oil and Gas Conservation Act was passed by the legislature. The Act and the rules and regulations drawn up under its authority govern the drilling, testing, and other operations that comprise exploration and production of oil and gas in Washington. In January 1954 the Oil and Gas Conservation Committee appointed the Supervisor of the Division of Mines and Geology to be Oil and Gas Supervisor for the State and gave him the duty of administering the Act.

From January 18, 1954, through June 30, 1958, a total of 133 drilling permits were issued, of which 20 were issued during the 1956-58 biennium. No new personnel were hired when the administration of the Oil and Gas Conservation Act was turned over to the Division in 1954. In fact, the Division's professional staff now consists of only 3 geologists as compared with 4 geologists and a mining engineer 10 years ago.

In order to provide some of the greatly increased services demanded by oil and gas exploration groups, the Division needs funds to set up a micropaleontological laboratory and to hire a geologist to operate the laboratory, do field geologic mapping, and help in the issuance of drilling permits and the collection of data required by law.

ARCHAEOLOGY

In 1957 the legislature appropriated money to the Division of Mines and Geology for the purpose of making archaeological surveys. With the advice and assistance of archaeologists from the University of Washington and the State College of Washington a program to include three projects was adopted. These were site-survey or reconnaissance projects, the purpose of which was to discover and evaluate sites of archaeological significance so that the sites most likely to be productive could later be excavated and studied in detail. Archaeological surveys were made according to schedules for each of these projects, and the following reports were submitted by the men in charge of the projects: (1) Highway Salvage Archaeology in the State of Washington: An Appraisal, by Bruce Stallard, 6 pages, (2) Preliminary Surveys for Highway Salvage Archaeology in the State of Washington: Final Report, by Bruce Stallard, 23 pages, (3) An Archaeological Survey in the Wells Reservoir in the State of Washington, by Bruce Stallard, 14 pages, (4) Archaeological Resources of the Soap Lake Area, by Bruce Stallard, 6 pages, (5) Archaeological Survey of the Methow River Valley, Washington, by Earl H. Swanson, 28 pages, and (6) Archaeological Survey of the Pend Oreille River Valley from Newport to Jared, Washington, by Allan H. Smith, 237 pages.

Each of the survey projects accomplished its purpose, but the highway salvage archaeology project was found to be impractical, so it was discontinued and Bruce Stallard, the principal investigator for the project, engaged in two special surveys in the Soap Lake area and in the Wells Reservoir along the Columbia River. He later wrote a general report on archaeology in Washington which will be published by the Division.

COOPERATIVE PROJECTS

Topographic Mapping

The Division continued to cooperate with the U. S. Geological Survey in topographic mapping within the State. The mapping is conducted by the Survey, the State contributing half of the funds through a cooperative, matching agreement. Additional topographic mapping is carried on and paid for solely by the Federal agency.

The first topographic quadrangle map in Washington was published in 1895 by the U. S. Geological Survey. In order to speed up the mapping program the State Legislature of 1903 authorized expenditure of State funds on a 50-50 matching basis, and the Legislature of 1909 appropriated money for this purpose. Since that time the State has provided matching funds almost every year. The total amount expended from 1909 through 1958 is $379,782, and 73 quadrangle maps have been completed or are in progress under this cooperative program. In spite of greatly increased mapping in recent years by the U. S. Geological Survey independent of the cooperative program, there still are large areas in the State for which no topographic maps are available, and there are other large areas for which the available maps are of inadequate scale or accuracy.

Through the courtesy of Mr. Robert O. Davis, Pacific Region Engineer, Topographic Division, U. S. Geological Survey, Sacramento, California, the following data on progress of mapping in Washington during the biennium have been supplied:

70 new triangulation stations were established and monumented.
7,600 square miles of photography were completed.
9,400 square miles were compiled by photogrammetry and field surveys.
98 new 15- and 7½-minute quadrangles were published.

Quadrangles worked on and financed as cooperative projects between the State of Washington and the U. S. Geological Survey are:

Names of quadrangles	*Counties in which located*	*Estimated publication date*
Cedar Lake 1	King	Early 1961
Doe Mountain	Okanogan	Early 1962
Mazama	Okanogan	Early 1962
Ptarmigan Peak	Okanogan	Early 1962
Slate Pass	Okanogan	Early 1962
Stillaguamish 2 (Oso)	Snohomish and Skagit	①
Stillaguamish 3 (Granite Falls)	Snohomish	August 1958
Stillaguamish 4	Snohomish	August 1959
Sultan 1	Snohomish and King	August 1959
Sultan 2 (Monroe)	Snohomish and King	December 1958
Sultan 4	King	Early 1961

① Published during the biennium.

Also during the biennium, the following quadrangles were completed and published by the U. S. Geological Survey using Federal funds only. (New official names appear in parentheses.)

Names of quadrangles	*Counties in which located*
*Auburn	King and Pierce
Bacon NE (Stratford)	Grant
Bacon NW (Soap Lake)	Grant
Bacon SE (Gloyd)	Grant
Bacon SW (Grant Orchards)	Grant
*Badger Gap	Kittitas
*Black Diamond	King
*Black Rock Spring	Yakima
*Black Rock Spring NE	Yakima and Kittitas
*Black Rock Spring NW	Yakima and Kittitas
*Black Rock Spring SW	Yakima
**Blaine NW (Blaine)	Whatcom
**Blaine SE (Ferndale)	Whatcom
**Blaine SW (Lummi Bay)	Whatcom
*Boylston	Kittitas
Bridal Veil	Clark and Skamania
Brookfield	Pacific and Wahkiakum
Buckley	King and Pierce
Camas	Clark
Camas 15′	Clark
Cape Elizabeth 15′	Jefferson and Grays Harbor
Cheney	Spokane and Whitman
Corbett (Washougal)	Clark
*Doris	Kittitas
Dungeness NW (Dungeness)	Clallam
Dungeness SW (Carlsborg)	Clallam
*East Kittitas	Kittitas
*Elephant Mountain 7½′	Yakima
Enumclaw	King and Pierce
Ephrata SE (Ephrata)	Grant
Ephrata SW	Grant
False Bay NE (False Bay)	San Juan
**Friday Harbor SE (Friday Harbor)	San Juan
**Friday Harbor NE (Waldron Island)	San Juan
**Friday Harbor NW (Stuart Island)	San Juan
**Friday Harbor SW (Roche Harbor)	San Juan
*Ginkgo	Grant and Kittitas
Humptulips	Grays Harbor
*Issaquah 7½′	King
Kapowsin	Pierce
*Kittitas	Kittitas
La Center 15′	Cowlitz and Clark
Lake Tapps SW (Orting)	Pierce
Maple Valley 7½′	King
Marysville NE (Arlington East)	Snohomish

* Civil editions prepared by the U. S. Geological Survey from mapping originally compiled by the Army Map Service.

** Compilation by the U. S. Coast and Geodetic Survey, drafting and reproduction by the U. S. Geological Survey

Names of quadrangles	*Counties in which located*
Marysville NW (Arlington West)	Snohomish
Marysville SE (Lake Stevens)	Snohomish
Marysville SW (Marysville)	Snohomish
*McDonald Spring	Kittitas
Medical Lake 15′	Spokane
Mineral	Pierce and Lewis
Mobray (Wynoochee Valley)	Grays Harbor
Montesano	Grays Harbor and Pacific
Morse Creek	Clallam
Moses Lake NE (Moses Lake North)	Grant
Moses Lake NW	Grant
Moses Lake SE (Moses Lake South)	Grant
Mt. Rainier National Park	Pierce and Lewis
Mt. Vernon NE (Mount Vernon)	Skagit
Mt. Vernon NW (La Conner)	Skagit
Mt. Vernon SE (Conway)	Skagit and Snohomish
Mt. Vernon SW (Utsalady)	Skagit, Snohomish, and Island
Othello	Adams
*Pomona 7½′	Kittitas and Yakima
*Poverty Bay 7½′	King and Pierce
Quinault Lake	Grays Harbor
Raft River (MacAfee Hill)	Grays Harbor
*Redmond 7½′	King
Ridgefield	Cowlitz and Clark
Satsop (Grisdale)	Grays Harbor and Mason
Sauvie Island 7½′	Clark
*Selah Springs 7½′	Kittitas and Yakima
Sequim	Clallam
Stanwood NE (Stanwood)	Snohomish
Stanwood NW (Juniper Beach)	Island and Snohomish
Stanwood SE (Tulalip)	Island and Snohomish
Stanwood SW (Langley)	Island
St. Helens 15′	Cowlitz and Clark
St. Helens 7½′	Cowlitz and Clark
Sumas SW (Bellingham North)	Whatcom
Sumner	Pierce
*Tacoma North 7½′	Pierce
Vancouver 7½′	Clark
Wheeler NE	Grant
Wheeler NW (Wheeler)	Grant
Wheeler SE (Bassett Junction)	Grant
Wheeler SW (Sieler)	Grant
Willapa (Raymond)	Pacific
Wilson Creek NW	Grant
Wilson Creek SE	Grant
Wilson Creek SW	Grant
Winchester NE	Grant
Winchester SE	Grant
*Wymer	Kittitas
*Yakima East 7½′	Yakima and Kittitas

* Civil editions prepared by the U. S. Geological Survey from mapping originally compiled by the Army Map Service.

Coal Investigations

During the biennium arrangements were made for the initiation of a 2-year investigation of the coal reserves of Washington. The work is to be done by the Fuels Branch of the U. S. Geological Survey, and the cost is to be shared equally by the State and the Federal Government, with the State's share for the first year being borne by the Division of Power Resources.

At the end of the first season's work a progress report will be submitted, and upon completion of the investigations a final report will be made which will tabulate the amounts of coal present in each township in each coal field in the State. The tabulation will be subdivided to show the coal in each rank—lignite, sub-bituminous, bituminous, and anthracite. The data will also be broken down into 3 categories of thickness of coal seams (2½ to 5 feet, 5 to 10 feet, and more than 10 feet thick), 3 categories of thickness of overburden (0 to 1,000 feet, 1,000 to 2,000 feet, and 2,000 to 3,000 feet), and 3 categories of reliability and abundance of data (measured, indicated, and inferred reserves).

With these data available, anyone who may be interested in coal in the Northwest will be able to make preliminary appraisals of Washington's coal resources for any possible industrial use. Before any large-scale use of Washington coal will be possible it will be necessary to make more detailed studies of the coal reserves available in the area considered, and, in order to provide the necessary base or guide for the core drilling that would be required, it is necessary that detailed geologic maps be made of each coal field. It is recommended that money be appropriated for detailed geologic mapping of individual coal fields as well as for completion of the State-wide coal reserve studies during the coming biennium.

Other Cooperative Projects

A cooperative agreement was made with the Fuels Branch of the U. S. Geological Survey for a season of geologic mapping to be conducted during the coming biennium. The results of this mapping in the southern Cascade Mountains will be used in the revised State Geologic Map which is currently being compiled.

Cooperation is maintained with the U. S. Bureau of Mines in the collection of mineral production statistics in Washington. Information on mining operations and mineral producers, maintained separately by the Bureau and the State Division of Mines and Geology, are exchanged in the interest of complete coverage. Assistance is given the Bureau in exchange for copies of detailed production records.

The Division cooperates with the U. S. Coast and Geodetic Survey by maintaining in Olympia for the Survey a strong-motion accelerograph. Periodic checks are made to be sure that the instrument is in good operating condition and to determine whether or not the instrument has recorded any strong-motion earthquakes.

Cooperation with the U. S. Atomic Energy Commission is achieved through distribution of A.E.C. literature by the Division and through an agreement by which the Division will publish certain A.E.C. reports on uranium prospects and areas in Washington. The A.E.C. has provided the Division with a "radiometric assayer" instrument for the purpose of making quantitative analyses of uranium ores.

During the past biennium the Division has had occasions to provide information and be of assistance to the U. S. Forest Service and other Federal agencies as well as such State agencies as the Department of Commerce and Economic Development, Highway Department, Commissioner of Public Lands, Pollution Control Commission, Department of Employment Security, Tax Commission, and Department of Licenses.

PART II

MINERAL INDUSTRY OF WASHINGTON

The mineral industry of Washington comprises an important part of the over-all economy of the State—more important than is generally recognized. In comparison with the other extractive industries in the State, mining in 1957 had a raw product value of $58,680,000, which is a little less than one-tenth the value of unprocessed agricultural products for that year, about one-fourth the value of the logging industry's output, and nearly three times the value of the products of the commercial fisheries. Likewise, the value of mineral production in Washington is larger in comparison with that for the adjacent states of Idaho and Oregon and the territory of Alaska than most people realize. Washington's mineral production for 1955 exceeded that of each of these three neighbors. Figures supplied by the U. S. Bureau of Mines show Washington's production to have been $67,334,000—slightly higher than Idaho's preliminary figure of $67,041,000, more than double Oregon's $33,050,000, and well above Alaska's recent average annual production of about $25,000,000. Washington production in 1956 dropped somewhat to $61,723,000, and production dropped still further in 1957 to $58,680,000.

A canvass of the mining industry conducted late in 1957 by the State Division of Mines and Geology in preparation for the publication of its annual "Directory of Washington Mining Operations" shows small gains in some fields and substantial losses in others. The losses may be attributed to the steadily declining market for base metals during the year and to increased competition from out of the State for some industrial minerals and mineral fuels produced here. The decline in metals prices and the attendant decline in production is not just local but is nationwide and is a matter of increasing concern nationally.

METALLIC MINING

In 1957 there were 68 metallic mining properties in production or under active development with the expectation of production in the near future. This represents a net loss of 7 operations from the previous year. The metal output for 1957 was valued at about $14.4 million, a decline of nearly $2 million from the previous year. The closure of 2 of the State's 4 large zinc-lead mines and the only large copper mine was reflected in the decreased production of metals in 1957.

Zinc and lead.—Zinc, with a value of $5.6 million for 1957 production, led all other metals by a large margin. However, this was a decrease of about $1.4 million from the previous year. Lead production decreased very slightly to $3.6 million in 1957. As a consequence of the continued low prices paid for zinc and lead, only 2 of the 4 large zinc-lead mines that operated in 1955

were still in operation by the end of 1957. The Deep Creek mine of the Goldfield Consolidated Mines Co. was closed down in the late fall of 1956, and the Van Stone mine of the American Smelting & Refining Co. was closed during the summer of 1957. Most of the current production of lead and zinc comes from the Pend Oreille Mines & Metals Company's Pend Oreille mine and from the American Zinc, Lead & Smelting Company's Grandview mine, both at Metaline Falls, Pend Oreille County. A small amount of lead ore was mined at the Gladstone and Electric Point mines in northern Stevens County.

Copper.—For the past 20 years, more than 90 percent of the copper produced each year has come from the Howe Sound Company's Holden mine in Chelan County. In midsummer of 1957 this operation, caught in the cost-price squeeze, was forced to close down permanently. In 1957, copper production dropped in value about $1.5 million from the preceding year to about $1 million, and the production for 1958 will be negligible. A small amount of copper production was reported in 1957 from Ferry, Okanogan, Pend Oreille, and Stevens Counties. Exploration programs at several copper properties were carried on during 1957, including diamond drilling by the Howe Sound Co. at the Calumet property, and drilling at the Glacier Peak property by the Bear Creek Mining Co., the exploration subsidiary of Kennecott Copper Corp. Both of these properties are in Snohomish County. A little farther to the south, in King County, The Anaconda Co. drilled a copper deposit at the Rainey mine.

Gold and silver.—Gold production in 1956 was $2.5 million, down about 5 percent from the year before. Silver production, at $406,000, was up about 3 percent. As in previous years, three mines continued to produce most of both of these metals—the Knob Hill mine in Ferry County, and the Gold King mine and the Holden mine in Chelan County. The Knob Hill and Gold King mines produce gold ore with silver as an important byproduct, and the Holden mine produced copper-gold ore with some silver. Gold and silver production in 1957 was somewhat greater than during the previous year, but production figures were not released by the U. S. Bureau of Mines, in order to avoid disclosing individual company confidential data.

Uranium.—Completion in midsummer 1957 of the Dawn Mining Company's 440-ton-per-day uranium processing mill at Ford, in southern Stevens County, allowed production to be resumed at the company's Midnite mine. In 1957 a few thousand tons of uranium ore was reported shipped from the Dahl lease of Daybreak Uranium, Inc., and a few carloads of ore was shipped from the Lehmbecker lease of North Star Uranium, Inc. Total production during the year was 178,464 pounds of uranium oxide concentrate, having a value of about half a million dollars.

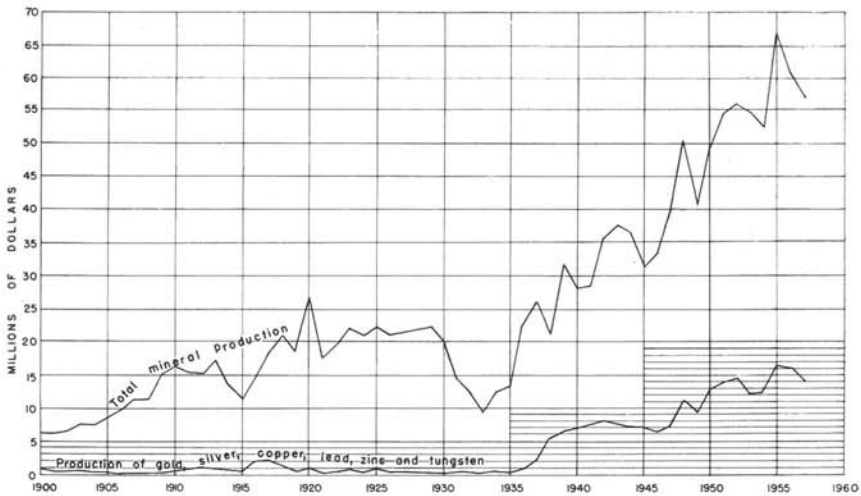
Other metals.—The value of tungsten, mercury, and iron ore produced in 1957 amounted to less than ten thousand dollars, but production of mercury was increasing.

NONMETALLIC MINING

The production of nonmetallic minerals—those that are used for industrial purposes and not as ores of the metals—had a value of $44.3 million in 1957, a decline of $1.2 million from the previous year. Leading in value was sand and gravel. Following in decreasing order were: portland cement, stone, coal, magnesite, clay, diatomite, pumice, peat, gem stones, carbon dioxide, olivine,

epsomite, talc and soapstone, gypsum, strontium, and grinding pebbles. Every county in the State had a record of production of at least one of the mineral products in the above list. Of the five leading products, only sand and gravel had an increase in value of output during 1957. Coal production continued its downward trend, and the 1957 production of 360,336 tons was the lowest recorded since 1886. However, the coal industry saw reason for hope when in 1957 several major companies showed new interest in some of the coal fields in Washington. Geologic studies were made of the coking coals in Pierce County, and power companies started a core-drilling program to evaluate the Tono coal field in Thurston and Lewis Counties. Coal in Kittitas County and other areas in the State was investigated as a possible source of fuel for steam-electric power plants.

A bright spot in the mineral fuels picture was the discovery of what promised to be the first commercial oil well in Washington. The encouraging results of early production tests at the Tanner Sunshine Mining Co.-Medina No. 1 well at Ocean City in Grays Harbor County triggered the biggest oil land leasing boom in the history of the State. Six wells drilled during 1957 had a total footage of over 30,000 feet, and drilling activities can be expected to increase during 1958.



Value of Washington's mineral production, 1900-1957

SELECTED MINERAL PRODUCTION①—1950 THROUGH 1957

PRODUCT	1950		1951		1952		1953	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Clay (except for cement).....short tons	217,000	$251,850	205,000	$285,631	225,000	$352,576	198,233	$312,141
Coal .....short tons	874,000	5,828,555	867,000	6,031,400	844,000	5,986,129	689,831	5,047,928
Copper .....short tons	5,057	2,103,712	4,089	1,979,076	4,357	2,108,788	3,740	2,146,760
Gold .....troy ounces	92,117	3,224,095	67,405	2,359,175	54,776	1,917,160	62,560	2,189,600
Lead .....short tons	10,334	2,790,180	8,602	2,768,692	11,744	3,781,568	11,064	2,898,768
Peat .....short tons	.....	.....	45,304	98,955	42,580	111,386	32,107	104,274
Pumice .....short tons	11,013	22,672	5,105	10,832	3,604	8,089	②	②
Sand and gravel.....short tons	10,606,000	7,435,340	10,547,000	7,595,837	13,322,000	9,422,117	11,182,835	9,317,793
Silver .....troy ounces	364,000	329,127	335,000	303,145	316,000	285,675	321,202	290,704
Stone .....short tons	4,931,000	5,734,563	5,030,000	5,664,433	4,591,000	5,491,525	4,438,259	5,890,849
Tungsten ore (60% conc.).....short tons	.....	.....	9	33,417	4	14,008	5	19,710
Zinc .....short tons	14,807	4,205,188	18,189	6,620,796	20,102	6,673,864	32,786	7,540,780
Miscellaneous③	.....	17,129,354	.....	20,802,940	.....	19,985,862	.....	18,817,913
Total.....	.....	$49,055,000	.....	$54,554,000	.....	$56,139,000	.....	$54,577,000

PRODUCT	1954		1955		1956		1957④	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Clay (except for cement).....short tons	261,328	$318,500	365,331	$411,807	319,988	$439,461	297,669	$488,071
Coal .....short tons	619,209	4,478,127	609,790	4,263,030	472,620	3,432,127	360,336	2,760,505
Copper .....short tons	3,636	2,145,240	3,958	2,925,668	2,926	2,487,100	1,760	1,023,400
Gold .....troy ounces	66,740	2,335,900	74,360	2,602,600	70,669	2,473,415	②	②
Lead .....short tons	9,938	2,723,012	10,340	3,081,320	11,657	3,660,298	12,734	3,641,924
Peat .....short tons	43,134	153,058	②	②	37,043	128,964	39,364	153,274
Pumice .....short tons	②	②	②	②	5,291	14,757	②	②
Sand and gravel.....short tons	16,044,687	13,595,014	21,645,161	19,350,682	16,841,792	15,037,128	19,923,621	16,774,521
Silver .....troy ounces	313,735	283,946	436,348	394,917	448,442	405,863	②	②
Stone .....short tons	5,366,890	9,526,534	6,593,212	10,579,631	8,057,338	11,659,598	8,453,540	10,600,497
Tungsten ore (60% conc.).....short tons	18	65,812	12	45,949	②	②	②	②
Zinc .....short tons	22,304	4,817,664	29,536	7,265,856	25,609	7,016,866	24,000	5,568,000
Miscellaneous③	.....	16,903,830	.....	19,765,194	.....	17,811,399	.....	19,015,178
Total.....	.....	$53,300,000	.....	$67,334,000	.....	$61,723,000	.....	$58,680,000

① Compiled by State Division of Mines and Geology from statistics obtained in cooperation with U. S. Bureau of Mines and, in part, published in Minerals Yearbook.

② Included in "Miscellaneous."

③ Includes items indicated by ② above; also in various years the following: carbon dioxide (natural), chromite, diatomite, epsomite, gem stones, gypsite, iron ore, lime, magnesite, manganese, olivine, portland cement, quartz, strontium, talc and soapstone, uranium, and other mineral commodities.

④ Preliminary statistics, subject to revision.