A PUBLICATION OF THE WASHINGTON STATE DIVISION OF MINES AND GEOLOGY

WASHINGTON GEOLOGIC NEWSLETTER

JULY 1973

BERT L. COLE
COMMISSIONER OF PUBLIC LANDS

VOLUME 1 - NUMBER 3

DON LEE FRASER, SUPERVISOR
DEPARTMENT OF NATURAL RESOURCES

VAUGHN E. LIVINGSTON, JR., STATE GEOLOGIST
DIVISION OF MINES AND GEOLOGY

DEPARTMENT OF NATURAL RESOURCES, DIVISION OF MINES AND GEOLOGY, OLYMPIA WASHINGTON, 98504

FIRST KNOWN ACTIVE FAULT IN WASHINGTON

By Robert J. Carson [1/]

A post-glacial fault has been discovered 19 miles north of Shelton in north-central Mason County; it is believed to be the first known surface expression of an active fault in the State of Washington. The fault lies halfway between Hood Canal and Lake Cushman, and 5 miles north of Hoodsport. The fault has offset the east end of Saddle Mountain, a local name given to the ridge between Price Lake and Lilliwaup swamp. Movement of the Saddle Mountain fault has taken place since deglaciation of the southern Puget Lowland, about 13,000 years ago. The fault movement was probably accompanied by major earthquakes.

The fault was discovered by the stereoscopic study of aerial photography. Simpson Timber Company kindly allowed the Division of Mines and Geology to excavate a trench across the fault scarp. Gene Visser used his front-end loader to dig through glacial drift to the volcanic bedrock. The fault crosses an old railroad grade built when the area was logged in the 1920's. Stumps on the scarp are up to at least 137 years old, so major movement on the fault probably occurred before the 19th century. The Saddle Mountain fault strikes north to northeast, dips steeply (about 75°) to the east, and is downthrown on the west. The scarp can be traced almost 1 mile from near the east end of Price Lake to just east of two ponds in the northeast corner of section 14, township 23 north, range 4 west. The scarp varies from 6 to 20 feet high, the maximum relief occurring where the fault crosses the east end of Saddle Mountain. In the trench, the contact between Vashon Till and Crescent basalt was displaced 9 feet. In

[1/] Dr. Carson, a graduate of the University of Washington, works for the Division of Mines and Geology, under a U.S. Geological Survey grant, in the summer months and teaches at North Carolina State University, in Raleigh, during the rest of the year.

addition to being a reverse fault, there was probably strike-slip movement. The possibility exists that the fault dammed surface drainage to form Price Lake, a pond in the southern part of section 14, and the two ponds in the northeast corner of section 14.

Another possible active fault is located on the northeast end of Dow Mountain. The scarp is not as long or prominent as the scarp of the Saddle Mountain fault, so the Dow Mountain fault is considered suspected rather than known. The scarp, which is 15 to 20 feet high, can be traced for only a little more than one-quarter of a mile. The fault is best exposed in an old railroad cut, about 1 mile south of Price Lake. The Dow Mountain fault strikes northwest, and is downthrown on the southwest side.

GEOLOGIC ACTIVITIES IN WASHINGTON

U.S. Geological Survey

U.S. Geological Survey activity in Washington is being maintained at about the same level as past years. Howard Gower, Chief, Western Environmental Geology Branch, of the U.S. Geological Survey at Menlo Park, California, has given us a summary of 1973 projects of the USGS in Washington State.

MINERAL RESOURCES ACTIVITIES

Mineral resources of northeastern Washington, F.C. Armstrong. Plans this year include conducting selected mine studies, compiling a map of known mineral occurences, gathering data for resource estimation, and taking samples of ores, rocks, and stream sediments within the west half of the Sandpoint 2° sheet.

Alpine-Enchantment Lakes area, J.L. Gualtieri. Geologic mapping, field checking, and sampling of streams and bedrock as well as studying the geology of the mineral deposits in the area continues; reports are in preparation.

ENERGY RESOURCES ACTIVITIES

Geology and mineral deposits of the Mt. Spokane 15' quadrangle, A.E. Weissenborn. A geologic map and an explanatory report of the Mt. Spokane quadrangle are nearing completion. A report on uranium deposits in the area is also in preparation.

ENVIRONMENTAL GEOLOGY ACTIVITIES

Spokane-Wallace 2° quadrangles, A.B. Griggs. A short descriptive report on the rocks of the Columbia River Basalt Group in the Spokane quadrangle is nearing completion. Descriptions of the Belt units and their facies changes will be prepared.

Twin Lakes 15' quadrangle, G.E. Becraft. Geologic mapping is continuing in the project area; eventually, the results of this investigation will be incorporated into a broad study of the geology of northeastern Washington.

Glacier Peak, F.W. Cater. A report on the mixed magma contact complexes is in preparation, and final reports on intrusive and metamorphic rocks of the Glacier Peak-Lake Chelan area will soon be completed and submitted for publication.

Newport 30' quadrangle, F.K. Miller. The sampling and study of plutonic rocks in northeastern Washington continues with K/Ar dating of selected samples. A geologic map of the west half of the Sandpoint 2° sheet is in preparation and will be submitted for publication.

Stevens County, R.G. Yates. A report on the geology of the Deep Creek area and its regional significance, and an analytical report on the geology of northeastern Washington is in preparation.

Northern Okanogan Highlands, C.D. Rinehart. Geologic mapping continues in the Mt. Bonaparte and Tiffany Mountain 15' quadrangles. Mapping in the northern half of the Aeneas Valley 15' quadrangle will soon be underway. The composite map of the Locmis, Oroville, Tonasket, and Conconully 15' quadrangles is nearing completion and will be published by the Washington Division of Mines and Geology. Petrographic studies of plutonic and metamorphic rocks in the project area continues, and a report on the geochronology of orogenic events is in preparation.

Olympic Peninsula, W.M. Cady. Petrographic and radiometric studies continue, and a reconnaissance geologic map of the Olympic Peninsula is in preparation. A structural analysis program of the core rocks in the project area and an account of the popular geology of the Olympic National Park are nearing completion. The preparation of a final report on the geology of the Peninsula will soon be under way.

Geology of the northwestern Olympic Peninsula, P.D. Snavely, Jr. Geologic mapping and stratigraphic, structural, and petrologic studies of the Cape Flattery area continue; reports are being prepared for publication. An interpretation of a vector aeromagnetic survey of the area will soon be completed.

Volcanic hazards in the Cascade Range, D.R. Crandell. Studies of the age, stratigraphy, mineralogy, origin, and distribution of late Quaternary volcanic rocks and surficial deposits at Mt. St. Helens and Mt. Baker continue in order to document the kinds, scale, and frequency of volcanism. A report on volcanic hazards at Mt. St. Helens, as well as other reports, will be prepared.

Canozoic floras of Pacific Northwest, J.A. Wolfe. The analysis of fossil plant assemblages of the Tertiary age from Washington continues; physiognomic analyses of leaf floras for climatic studies are under way.

Cenozoic and Mesozoic stratigraphy, Pacific Coast, W.O. Addicott. Field studies on shallow-water Oligocene and Miocene sequences in western Washington will be continued this year; reports on middle and late Tertiary biostratigraphy of the Pacific Northwest are in preparation.

GEOCHEMISTRY AND GEOPHYSICS ACTIVITIES

Genesis of basalt, T. L. Wright. Reconnaissance mapping of the Columbia River Plateau in the eastern part of the State has begun. Electron microprobe studies of residual glasses and phenocryst minerals as a basis for interpretation of petrogenesis will be conducted.

Columbia River Basalt, D. A. Swanson. Mapping continues in the eastern part of the State to determine the stratigraphy, lateral extent, thickness changes, structure, and vent areas for the upper part of the Columbia River Basalt. Field and laboratory studies of two intravalley flows that occur along the Snake River between Devils Canyon and Asotin are nearing completion. Petrographic and petrochemical studies of the basalt, emphasizing methods of correlation, paragenesis, definition of chemical types, and problems of origin, are continuing. Detailed mapping within the Ice Harbor area continues to determine the relationship between the Ice Harbor dike swarm and local lava flows.

Geodimeter studies of Cascade volcanoes, D. A. Swanson. A Model 8 geodimeter has been installed and periodic remeasurement is in progress of small strain networks on several Cascade Range volcanoes. A strain network will be established on Mt. Rainier and the network on Mt. St. Helens will be remeasured if time permits.

Thermal surveillance of volcanoes, J. D. Friedman. The ERTS-1 multispectral scanner images and airborne infrared imaging systems are being used in conjunction with ground observations and ground-based transmitting and recording thermistor arrays to identify,

map, and monitor surface thermal anomalies in the volcanic areas of the Cascade Range; thermistor arrays and DCP transmitters will be emplaced at fumaroles near the summits of Mt. Baker and Mt. St. Helens.

National aeromagnetic survey, D. R. Mabey. Approximately 4,900 square miles of aeromagnetic surveying is scheduled for the northeastern part of the State. This investigation is being done in cooperation with the Washington Division of Mines and Geology. In addition, an aeromagnetic survey is scheduled in the northern part of Puget Sound.

Engineering geophysics, H. D. Ackermann. A seismic-ground water study in Colville Indian Reservation, near Grand Coulee Dam, is under way.

Satellite volcano surveillance, P.L. Ward. Earthquake counters and standard seismometers are being installed on Mt. St. Helens, Mt. Rainier, and Mt. Baker. Data transmitted twice daily to the ERTS-1 satellite will be evaluated in near real-time in an effort to develop a system for giving early warning when apparently dormant volcanoes are becoming active.

Tilt studies, R.V. Allen. Three 3-component tiltmeters designed by the Geological Survey have been installed in shallow drill holes at the Hanford Works, but elapsed time since installation is too short to have produced any significant results.

Hanford Microearthquake studies, A.M. Pitt. Forty-five months of microearthquake monitoring in the Hanford region has indicated about a dozen small zones of shallow intermittent swarm activity, but there still is no good evidence of a connection between these zones. Intermittent seismic activity in the 15 to 25 kilometer depth range suggests a north trending zone through the center of the network.

Geochemistry of food plants, H.T. Shacklette. Sampling of food plants and of the soils where the plants were grown continues in 11 major areas of commercial production including Yakima County. All samples will be analyzed to determine the differences in elemental composition of food plants grown in widely separated areas and to relate this to the element content of the respective soils.

MARINE GEOLOGY ACTIVITIES

Oregon-Washington Continental Margin, P.D. Snavely, Jr. Plans this year include conducting high resolution seismic reflection profiling in selected nearshore areas and coastal lakes in the Cape Flattery area of the Olympic Peninsula. Interpretation of marine geophysical data (gravity, magnetics, and CSP) obtained in the Strait of Juan de Fuca is underway.

Pacific Coast sedimentology, H.E. Clifton. A detailed analysis of the sedimentary facies found in Willapa Bay, which will include a study of the emergent terrace deposits that are composed of older estuarine sediments, will soon be underway.

Some reports of the U.S. Geological Survey that have become available since May 15, 1972, are as follows:

Cady, W.M.; Sorensen, M.L.; MacLeod, N.S., 1972, Geologic map of The Brothers quadrangle, Jefferson, Mason, and Kitsap Counties, Washington: U.S. Geol. Survey Map GQ-969.

Cady, W.M.; Tabor, R.W.; MacLeod, N.S.; Sorensen, M.L., 1972, Geologic map of the Tyler Peak quadrangle, Clallam and Jefferson Counties, Washington: U.S. Geol. Survey Map GQ-970.

Pitt, A.M., 1972, Seismic activity in the Hanford region, Washington, March 23, 1969 to June 30, 1971: U.S. Geol. Survey Open-file report.

Staatz, M.H.; Tabor, R.W.; Weis, P.L.; Robertson, J.F.; Van Noy, R.M.; Pattee, E.C., 1973, Geology and mineral resources of the northern part of the North Cascades National Park, Washington: U.S. Geol. Survey Bull. 1359.

Tabor, R.W.; Yeats, R.S.; Sorensen, M.L., 1972, Geologic map of the Mount Angeles quadrangle, Clallam and Jefferson Counties, Washington: U.S. Geol. Survey Map GQ-958.

U.S. Geol. Survey, 1973, Aeromagnetic map of parts of the Okanogan and Sandpoint 1° by 2° quadrangles, Washington-Idaho-Montana: U.S. Geol. Survey Open-file report. (See USGS open-file map*, page 11.)

In addition to these reports, summaries of significant results of many other current projects are contained in Chapter A of U.S. Geol. Survey Prof. Paper 800. Scientific notes and summaries of Survey investigations in geology, hydrology, and related fields are contained in Chapters B, C, and D of U.S. Geol. Survey Prof. Paper 800, Geologic Survey Research 1972. Reports of scientific results subsequent to January 1, 1973, may be found in the new bimonthly volumes: Journal of Research of the U.S. Geological Survey.

U.S. Bureau of Mines

The U.S. Bureau of Mines maintains an active field office in Spokane. William L. Rice, geologist, has provided us with this summary of their current activities.

The Western Field Operation Center (WFOC), U.S. Bureau of Mines, is located at West 222 Mission Avenue, Spokane, Washington. Its primary responsibility is carry out Bureau mineral-related field activities for a substantial part of the western United States. Specifically, the WFOC "baliwick" includes the states of Washington, Oregon, Idaho, Montana, Nevada, and California.

For 1973, mineral resource appraisals are underway in two National Forest areas proposed for addition to the National Wilderness Preservation System. Field work that was started two years ago in the 365,000-acre Alpine Lakes study area should be completed this season. The study area includes a large part of the high Alpine National Forest domain in the Cascade Mountains, between the Stevens Pass and Snoqualmie Pass highways. Lands involved are in King, Kittitas, and Chelan Counties, within the Snoqualmie and Wenatchee National Forests. A joint Bureau of Mines-U.S. Geological Survey open-file report on work done so far will soon be available for public review at the respective agency offices in Spokane. Final results of the investigations will be published as a U.S. Geological Survey Bulletin in the "Studies Related to Wilderness" series.

A one-year mineral resource investigation is being conducted on the approximately 200,000-acre Cougar Lakes study area in the Snoqualmie and Gifford Pinchot National Forests, in Kittitas and Yakima Counties. The study area adjoins the southeastern part of Mount Rainier National Park, and lies on the eastern flank of the central Cascade Range. An open-file report should be available for public inspection in 1974, and a formal publication may be issued at a later date.

The Minerals Availability System (MAS) is a component of the Bureau of Mines minerals-intelligence function, designed to conduct and maintain an inventory of mineral resources vital to national needs. MAS involves the collection, coding, and automated storage-retrieval of information concerning the availability of minerals from specific deposits. Current and projected MAS studies involving Washington mineral resources include investigations of tungsten, gold, silver, and nickel deposits.

WFOC is taking part in the Western Water Study Plan. Present activities involve gathering and analyzing resource and production data to determine land and water requirements for Washington's mineral industry. When completed, the study information will be made available to the state for inclusion in the state's comprehensive water plan.

The Bureau of Mines is working cooperatively with the Bureau of Outdoor Recreation in developing a program to reclaim surface mined land sites by converting them to recreation areas. Two former gravel pits, one in King County and the other in Spokane County, are being reclaimed under this program.

The Bureau of Mines is also participating in the development of the Department of Interior Resources and Land Information Program (RALI). RALI is a digitized departmental information system designed to include data on all aspects of the use and management of the land resource. The system will aid in assuring comprehensive and timely land use planning on several governmental levels. WFOC is working on two RALI demonstration projects: (1) A sand and gravel resource study for western King County, and (2) A nonmetallic mineral resource study for a selected area south of Seattle.

The Western Field Operation Center has several public service functions in addition to its normal project work. WFOC has one of the best geological and mining libraries in the Northwest. A nearly complete collection of U.S. Geological Survey and Bureau of Mines publications is available for public reference. Most State publications covering geology and mining in the west are on file, and a comprehensive listing of current and obsolete mining periodicals is kept.

A staff mineralogist is available to identify minerals and rocks in hand specimens, and the office staff is prepared to answer public queries concerning mining and related subjects.

USGS Water Resources

Bruce Foxworthy of the U.S. Geological Survey's ground-water branch in Tacoma, Washington, reports that they will be busy in Washington this year. Below are listed ground-water branch projects for the current year.

Water Resources of the Lummi Indian Reservation, G. G. Parker and D. R. Cline

Urban Pilot Study of water-related problems in the Puget Sound area, G. G. Parker

Water Resources of the Skokomish Indian Reservation, Dee Molenaar

Lakes of Washington, data collection, G. Bortleson, J. McConnell, and R. Innes

Water Resources of the Colville Indian Reservation, ground water, D.A. Myers

Flood Hazard Information, on certain state streams, E. G. Nassar

Test Drilling and Geophysical Logging, near Walla Walla, K. L. Walters and W. V. Frederick

Evaluation of the State Observation-Well Project, K. L. Walters

Sediment Characteristics of Streams in Washington, L. M. Nelson

Ground Water in East-Central Washington, A. I. Hansen

Water Resources of the Yakima Indian Reservation, D. O. Gregg and R. J. Burt

Ground Water Models of the Columbia Basin Irrigation Project, H. Tanaka

Review of the Ground-Water Conditions in the Pullman Area, H. Tanaka and W. Lum

Evaluation of Water Resources in the Walla Walla Basin, using digital modeling, R. D. MacNish and R. Barker

Water Quality Conditions in the Duwamish Estuary, W. Haushild

Other studies being done include a stream hydraulics and anadromous fish study of several rivers and creeks, in both eastern and western Washington, and surface water studies in the Colville area.

The address of the division is:

U.S. Geological Survey
Water Resources Division
1305 Tacoma Avenue South
Tacoma, WA 98402

"In science the credit goes to the man who convinces the world, not to the man to whom the idea first occurs."

Sir William Osler

SOVIET GEOLOGISTS VISITS WASHINGTON

During late May, the Division of Mines and Geology hosted Dr. S. M. Aleksandrov, a research associate at the Institute of Geochemistry and Analytical Chemistry, Moscow, USSR. Dr. Aleksandrov is a leading authority on a group of rare borate minerals that occur in contact metamorphic zones at the margin of intrusive rock bodies. The best known member of this mineral group is ludwigite, a magnesium iron borate that sometimes contains several percent of tin.

Dr. Aleksandrov visited ludwigite deposits in Utah and California before coming to Washington, and he is now studying deposits in Alaska. The purpose of his study is to learn as much as possible about the occurrence of ludwigite and related minerals so that the knowledge gained can be applied toward finding commercial deposits of ludwigite, to be exploited for their boron and tin content, in the Soviet Union.

Two occurrences of ludwigite are known in Washington: the Read Magnetite prospect near Hunters in Stevens County, and the Jumbo Mountain near Darrington in Snohomish County. These occurrences have been studied by W.A.G. Bennett, a retired geologist, from the Division of Mines and Geology. Dr. Aleksandrov, accompanied by Eric Schuster and Dr. Bennett, visited the Read prospect and was able to study the deposit and collect rock samples to his satisfaction. However, the Jumbo Mountain occurrence proved to be inaccessible due to snow cover.

Although the schedule for Dr. Aleksandrov's visit did not allow time for extensive sightseeing, he was able to see Grand Coulee Dam, the Grand Coulee, Dry Falls, and the scenery around the North Cascade's highway. Dr. Aleksandrov was greatly impressed by

the variety of climate and scenery that we sometimes take for granted in Washington.

J. Eric Schuster

SOIL SURVEY REPORTS

The Division of Mines and Geology has discovered that it has in its possession several soil survey reports. These will be made available to the public, or anyone else interested, on a first come first served basis. The reports are on the following counties and areas: Benton County, Franklin County, Spokane County, Stevens County, Southwestern Washington, West Puget Sound, Wenatchee Area, and the Quincy Area.

There will be no charge made for their distribution.

MINES AND GEOLOGY PUBLICATIONS NOW AVAILABLE IN SPOKANE

The Division of Mines and Geology is happy to announce that we have an outlet for our publications in eastern Washington. Selected publications that are distributed free of charge by the Division will be available from the U.S. Geological Survey office, Room 678, in the U.S. Courthouse in Spokane. Selected reports, including free ones and those requiring payment, will be available from the Northwest Mining Association office, West 522 First Avenue, Spokane. Distribution at these two locations will be over the counter only. Mail requests will not be handled at either location in Spokane but will continue to be handled through the Division of Mines and Geology, Olympia, Washington 98504.

We feel this is a significant step forward in serving our information users in eastern Washington. We have long felt the need to be in closer contact with the mining people who are east of the Cascades, and perhaps this will be the first step, though small, toward establishing a permanent contact in the Spokane area.

We want to thank the U.S. Geological Survey and the Northwest Mining Association for their cooperation.

THE ROLE OF GEOLOGY IN PLANNING AND DEVELOPMENT

A major phase of planning is the evaluation of the advantages and disadvantages of one use of land as compared to another use, so as to make planning and zoning possible for the conservation and maximum beneficial use of land, our most fundamental natural resource. To a significant degree it is the characteristics of the earth materials underlying its surface that determine how land can be most effectively and safely used. Correlation of the requirements for potential use with pertinent geologic considerations will help assure that land use will not conflict with the limitations imposed by natural conditions. This is especially true when easily developed sites are depleted and suburban expansion is forced into marginal or hilly areas, where new and more imposing difficulties are encountered. Factors other than geology commonly dictate a given use for land, but this may then make knowledge and consideration of the geology even more important.

Problems of land use that are related to geology ultimately involve every aspect of civil engineering through their effect upon the design, construction, and maintenance of specific engineering works. Certain of these problems, such as earthquakes and some landslides, occur as natural geologic hazards inherent in the environment. Other problems, such as instability of cut banks and ground-water pollution, pose actual or potential threats because of unwise or poorly planned activities of man. Still others may have more to do with the economics of land use or development than with its safety, such as problems of difficult excavation or lack of nearby sources of earth material suitable for fill.

The importance of geology to planning and to civil engineering obviously is very

great; however, it is essential to point out that not all applied urban geology is engineering geology. Sand and gravel and other raw materials for construction are a concern of engineering geologists, but the economic geology of any mineral resource occurring within an area may have a critical bearing on local land-use planning and development.

The metropolitan areas of Washington desperately need new, detailed geologic maps and this can only be achieved through a greatly magnified engineering geology effort involving municipal, county, and state agencies and private firms, as well as our universities and colleges. The master key to real progress belongs to the local governments. They can provide the greatest stimulus for geologic investigations, and they are in the best position to insure that the results are applied for the maximum benefit of their citizens. Cities and counties can use geologic information not only in the formulation of long-range policies and plans, but in the day-to-day applications of local operation.

Ernest R. Artim

YOUR STATE GEOLOGIST REPORTS

Energy certainly is in the headlines these days. Whether we are in a serious energy crisis seems to be subject to some interpretation. Whether we are or not, the Washington Division of Mines and Geology is pulling together all available information in our files that deals with energy and will publish it under one cover. Geology plays an important part in all forms of energy, and the division is getting prepared, as best we can, to meet the challenge of exploration for new energy sources and reserves.

New information is being developed on the state's coal reserves. Work is being done in the area of geothermal energy exploration. Areas where oil or gas might occur and the state's uranium reserves are being reviewed. The hydroelectric picture is being examined and evaluated.

We are always on the lookout for new techniques and technological procedures that might make our state's energy resources more usable, or that will enhance exploration methods for as yet undiscovered energy resources.

At this point in time, increased interest and effort are being directed toward geothermal energy and the different techniques that might be useful in identifying hot spots in the earth's surface. So far, division geologists have located several areas that look interesting, but much more work will be needed to develop definitive information, either positive or negative. It is our intent that the division continue to develop accurate, usable information on energy resources in the state, which will be made available to the public as it is developed.

Ted Livingston

GEOLOGIC ACTIVITIES OF COLLEGES IN WASHINGTON

Central Washington State College

Don Ringe, Chairman of the Department of Geology at CWSC, reports that the following projects are being conducted there:

Structural and stratigraphy of the Columbia River Basalt, south of Ellensburg, Robert D. Bentley and Steven E. Farkas

Geology of the upper White River area, and low-grade metamorphism in the central Cascades, Donald A. Hartman (dissertation in progress at University of Washington)

Ice contact depositional features in the northern Waterville Plateau, Don Ringe

Eastern Washington State College

The following research project is being conducted by EWSC:

X-ray fluorescence analysis for sulfur in Roza basalt, Dennis Simmelink and W. K. Steele.

NEW PUBLICATIONS OF MINES AND GEOLOGY

Two new Information Circulars are off the press and available to the public. They are as follows:

Information Circular 48, 1971-72 Directory of Washington mining operations, by J. Eric Schuster. 1973. 97 p. 3 maps. Free

Information Circular 49, Conconully mining district of Okanogan County, Washington, by Wayne S. Moen. 1973. 42 p. 16 figs. Free.

Reprinted From PACIFIC SEARCH

J. Eric Schuster, DMG geologist, prepared a geothermal report for the magazine PACIFIC SEARCH, which was printed in their May 1973 issue as "The Search for Hot Rocks, Geothermal Exploration, Northwest." This article is now available from us, at no charge, as Division of Mines and Geology Reprint 11.

The reprint lists the requirements that are necessary for a geothermal reservoir to exist and discusses the two general types of fields, dry steam and hot water. Diagrams include a pictorial view of a geothermal reservoir, showing the heat source, permeable rocks, fluid, and a cap rock; and an illustration of a dry steam and a hot water plant.

Open-file Report

Dr. Paul E. Hammond, of Portland State University, has prepared, for the Washington Division of Mines and Geology, an open-file report titled "Preliminary Geologic Map of the Southern Cascade Range, Washington." Dr. Hammond is well acquainted with the geology of the area, having worked in the central and southern Cascades since 1957. The mapping and compilation were conducted with special emphasis on young volcanic rocks, volcanic centers, and geologic structures, and should be of value in conducting the research for geothermal energy fields.

Copies will be available for inspection (but not reproduction) at the office of the Division of Mines and Geology, 1404 Jefferson St., in Olympia; the California Division of Oil and Gas, 1416 Ninth St., in Sacramento; and at the Oregon Department of Geology and Mineral Industries, 1069 State Office Bldg., in Portland.

Interested persons may have copies made at their own expense by writing to Ivor McCray's Copy Center, 121 W. Legion Way, Olympia, WA 98501.

Cispus Report

In our continuing program of responding to educational needs, we have prepared, in cooperation with the Superintendent of Public Instruction, a report titled "A Learning Guide on the Geology of the Cispus Environmental Center Area, Lewis County, Washington," by J. Eric Schuster. This geologic report will be used by the teachers of the public schools who conduct educational sessions at the Cispus Center.

STAFF PROFILES

DON FORD

Don is the Assistant Supervisor of the Division of Mines and Geology and the administrator of the Surface Mined Land Reclamation Act. He received his B.S. in geology from the University of Wisconsin and also did 2 years of graduate work there. He and his wife Jeannette have 3 children: Charlotte is married and lives in Detroit, Michigan; Carolyn is married and in the process of moving to Brazoria County, Texas; and Russell attends Washington State University.

Don's work specialities are economic geology, petroleum geology, and surface

mining. His professional career started with the U.S. Geological Survey in 1948, in Alaska; and, from there, he went to California and was employed as a petroleum geologist. In 1957, Don joined the Department of Natural Resources, Lands Division, where he was concerned with the leasing of minerals and oil and gas properties on state lands and the sale of mineral materials. In April 1970, he transferred to the Division of Mines and Geology.

Don was a pilot in the Army Air Force in World War II, was recalled in 1968 for a tour of duty, and is now in the retired reserve category with the rank of Lt. Colonel. He is very active with the Tumwater Area Council Boy Scouts and has served as District Chairman and on the Executive Board. His hobbies are hunting, fishing, and target shooting with muzzle loaders.

J. ERIC SCHUSTER

Eric joined the Division of Mines and Geology in 1970. He was raised on a wheat farm near St. John, in eastern Washington. He and his wife Kathleen have one little daughter, Dana. In 1966, he graduated with distinction in geology from Washington State University. Eric obtained his M.S. in geology from the University of Wyoming, and served as a teaching assistant at both schools in their geology departments. He spent one summer working as an exploration geologist in the Yukon Territory, Canada.

Eric's work specialities are economic geology, petrology, and mineralogy. He has become our expert in the geothermal energy field. Some of his reports that are available to the public are "Geothermal Exploration in Washington" and "Geothermal Energy—Questions and Answers." He is presently conducting a program of thermal gradient and heat flow measurements. This summer, Eric will continue field work and geologic mapping on the geology of the Colville area in Stevens County.

Eric's general air of decorum and his shy smile belie the fact that one might occasionally catch him tucking a pinch of snuff in his lower lip. He does this with great aplomb and a twinkle in his eyes. As we pass a little niche in the hall, we are apt to find a special treat there from the Schusters—last week, it was cherries from Yakima. His hobbies are hunting, fishing, and the building and shooting of muzzle loaders.

OLE ORR

Love of adventure and travel took Ole to Alaska when she was just out of school. There, she stayed to work for an airline, got married, raised her family, and acquired the nickname of Ole. Now, she is known as Opal on formal documents only. We enjoy

hearing about her days of camping and fishing in the "land of the midnight sun." However, because of her husband's health, the family moved "outside," and lived in Oregon and Montana for a time. After she was widowed, Ole settled her family in her former hometown of Shelton, where she now lives.

Ole works in the nucleus of our division. She is secretary to Ted Livingston, our State Geologist, and also functions as office manager. Therefore, she is aware of all the activities and serves as a source of office information to the rest of the staff.

Prior to joining the staff of DNR, Ole worked 8 years for the City of Olympia Public Works Division and the Olympia Planning Commission as a secretary. She spent two years with the Timber Sales Division and transferred to the Division of Mines and Geology in 1969.

Ole has one daughter and one son in Shelton, Mrs. John (Sara) Watkins and Collin; one son (Foster) in California; and 2 grandchildren. When she has time, she likes to garden, fish, and travel.

"UNITED STATES MINERAL RESOURCES"

U.S. Geological Survey Professional Paper 820, "United States Mineral Resources," by D. A. Brobst and W. P. Pratt, editors, is a 1973 resource-appraisal report. The foreward, by Rogers C. B. Morton, Secretary of the Interior, is listed below:

> Minerals and mineral fuels are literally the corner stones of modern life. They constitute the source materials for most of the things we use, and they supply the energy that powers our machines and heats and cools the air where we live and work. In short, they are the physical source of most of the necessities, conveniences, and comforts of life in the United States today.
>
> Most mineral resources are nonrenewable, for the deposits from which they are extracted are not being naturally reformed at anywhere near the rate we are using them. They are extendable, however, in the sense that new deposits are discovered by exploration, and deposits once too poor in quality to recover economically are made available by advancing technology. And, of course, many mineral products can be recycled.
>
> Because of our dependence on minerals and mineral fuels, the question of the magnitude of usable resources is of mounting concern. Generally the problem has been assessed in terms of proved reserves—workable deposits that have already been discovered and inventoried. To plan our future, however, we need some idea of the magnitude of resources that are geologically available if we are able to find and use them economically.
>
> As a part of our response to the Mining and Mineral Policy Act of 1970, the Geological Survey provides in this volume the first overall assessment of mineral resources since that of the President's Materials Policy Commission in 1952. It goes beyond traditional resource appraisals, which have considered mainly inventoried reserves, to examine the geologic availability of resources that will be needed in future generations. For many minerals, these appraisals are preliminary at best, for not enough is known about their origin, distribution, or the geologic environments favorable for their occurrence to assess their potential now. But at the least they represent a beginning, a take-off from which we can expect to enlarge our knowledge of our mineral-resource endowment with advancing science and exploration.

Professional Paper 820 may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402 for $9.15, postpaid.

U.S. GEOLOGICAL SURVEY 7½-MINUTE TOPOGRAPHIC QUADRANGLES
(New maps received in the Division of Mines and Geology Library since April 1, 1973)

Name	Latitude	Longitude	County
Almira SE	47°30'00"	118°45'00"	Lincoln
Almira SW	47°30'00"	118°52'30"	Lincoln, Grant
Arlington	45°37'30"	120°07'30"	Klickitat
Ashnola Mountain	48°52'30"	120°22'30"	Okanogan
Ashnola Pass	48°52'30"	120°15'00"	Okanogan
Bauerman Ridge	48°52'30"	120°00'00"	Okanogan
Billy Goat Mountain	48°45'00"	120°15'00"	Okanogan
Brief	47°52'30"	120°22'30"	Chelan
Burr Canyon	46°30'00"	118°37'30'	Franklin
Castle Peak	48°52'30"	120°45'00"	Whatcom, Okanogan
Chikamin Creek	47°52'30"	120°37'30"	Chelan
Connell	46°37'30"	118°45'00"	Franklin, Adams
Connell SE	46°30'00"	118°45'00"	Franklin
Cormana Lake	47°22'30"	118°22'30"	Lincoln
Davenport	47°37'30"	118°07'30"	Lincoln
Frosty Creek	48°52'30"	120°37'30"	Okanogan
Harrington	47°22'30"	118°15'00"	Lincoln
Harrington SE	47°15'00"	118°15'00"	Lincoln, Adams
Hoodoo Peak	48°15'00"	120°15'00"	Okanogan
Kahlotus	46°37'30"	118°30'00"	Franklin, Adams
Lind SW	46°45'00"	118°37'30"	Adams
Lower Monumental Dam	46°30'00"	118°30'00"	Franklin, Walla Walla
McAlester Mountain	48°22'30"	120°37'30"	Chelan, Okanogan
Mesa East	46°30'00"	118°52'30"	Franklin
Mount Lago	48°45'00"	120°30'00"	Okanogan
Mount Prophet	48°45'00"	121°07'30"	Whatcom
Oval Peak	48°15'00"	120°22'30"	Okanogan, Chelan
Pasayten Peak	48°45'00"	120°37'30"	Okanogan, Whatcom
Quinton	45°37'30"	120°30'00"	Klickitat
Remmel Mountain	48°52'30"	120°07'30"	Okanogan
Shano	46°45'00"	118°52'30"	Adams
Shull Mountain	48°45'00"	120°45'00"	Whatcom, Okanogan
Sprague Lake	47°15'00"	118°00'00"	Lincoln, Adams
Sprague Lake NE	47°22'30"	118°00'00"	Lincoln
Sprague Lake SW	47°15'00"	118°07'30"	Lincoln, Adams
Stehekin	48°15'00"	120°37'30"	Chelan
Sulphur Lake	46°37'30"	118°37'30"	Franklin, Adams
Sun Mountain	48°15'00"	120°30'00"	Chelan, Okanogan
Tatoosh Buttes	48°52'30"	120°30'00"	Okanogan
Waterville	47°37'30"	120°00'00"	Douglas

U.S. GEOLOGICAL SURVEY 15-MINUTE TOPOGRAPHIC QUADRANGLES
(New maps received in the Division of Mines and Geology Library since April 1, 1973)

Buttermilk Butte	48°15'00"	120°15'00"	Okanogan, Chelan
Twisp	48°15'00"	120°00'00"	Okanogan

USGS OPEN-FILE MAP*

An open-file aeromagnetic map of parts of the Okanogan and Sandpoint 1° by 2° quadrangles, Washington-Idaho-Montana (1 sheet, scale 1:250,000) by the U.S. Geological Survey, is available for inspection at the Washington State Division of Mines and Geology office in Olympia.

SEISMIC RISK

A term that is beginning to be used frequently in discussions of earthquake hazards is seismic risk. Seismic risk carries with it the everyday meaning of seismic hazard; however, risk has the connotation of probability or chance of loss. Quantitative studies of seismic risk are few and, like the two measures of earthquake size (magnitude and intensity), the word "risk" is often used loosely in this context.

Seismic risk may be defined as the likelihood of damage or injury from an earthquake within a given time interval (design period). Seismic risk is normally given as a statement of probability; such as, in any 10-year period, the probability that the design acceleration of 10 percent of gravity will be reached or exceeded is about 50 percent.

Some terminology used in ascertaining seismic risk and their definitions are:

Maximum credible earthquake.—This is the maximum earthquake that appears capable of occurring. It is the maximum rational and believable event consistent with the known facts. While it is highly unlikely, it is still a believable event that could occur within the present geologic framework and present geologic epoch. No statement can be made with regard to its probability of occurrence, other than that it is finite.

Maximum probable earthquake.—This is the maximum earthquake that might occur with a fairly high probability. The tectonic forces which cause it are reasonably well understood. Statistical data allow the prediction of a recurrence interval for this earthquake. For all but the most critical considerations, it is the maximum "design" earthquake; that is, the one used in the design criteria of large structures.

Active fault.—An active fault is one that has moved in historic time, or along which offset of Holocene materials can be demonstrated. If Holocene materials are not offset or are absent, but numerous epicenters have been recorded on or in close proximity to the fault, a classification of active may be used.

Potentially active fault.—A potentially active fault is one that offsets Pleistocene materials, but for which offset of Holocene materials is lacking, and for which seismic activity is nominal or absent.

Inactive fault.—An inactive fault is one for which there is evidence that offset of Holocene or Pleistocene deposits has not occurred, and along which strain release has been nominal, or for which there is other geologic evidence that movement has not occurred within the present geologic framework.

Ernest R. Artim

A PUBLICATION OF THE WASHINGTON STATE DIVISION OF MINES AND GEOLOGY

WASHINGTON GEOLOGIC NEWSLETTER

JANUARY 1973

BERT L. COLE
COMMISSIONER OF PUBLIC LANDS

VOLUME 1 - NUMBER 1

DON LEE FRASER, SUPERVISOR
DEPARTMENT OF NATURAL RESOURCES

VAUGHN E. LIVINGSTON, JR., STATE GEOLOGIST
DIVISION OF MINES AND GEOLOGY

DEPARTMENT OF NATURAL RESOURCES, DIVISION OF MINES AND GEOLOGY, OLYMPIA WASHINGTON, 98504

QUARTERLY PUBLICATION

For years the Division of Mines and Geology has considered the possibility of publishing a quarterly news report on geologic happenings in the state. Now, after much thought, the quarterly newsletter has become a reality. Through it, we hope to keep the people of Washington abreast of events that are of geologic significance in our state. We would like to hear from you about what you think of our efforts as we go along.

THE DIVISION OF MINES AND GEOLOGY

A New Function Under an Old Name

Since its inception in 1945, the State Division of Mines and Geology and its predecessor agencies, dating back to 1890, have been almost totally concerned with the development of the state's mineral resources. During the 1960's, however, the division began to recognize the wide application that geology has on the welfare of mankind. As a result of this recognition, the division began to diversify its activities.

One of the first fields of new activity was that of environmental geology. Because of the growing concern for the environment by the public, we felt it necessary to establish an environmental geology section within the division to handle environmental problems that were geologically oriented.

The first step in this program was to start developing data on landslides in the state with the hope that in time a landslide map would be produced showing those areas that would be hazardous to build on because of potential slide conditions. As the program began to develop, we recognized that the problems were of a far broader scope than we anticipated, and that they would require more time to solve than we had supposed. Typical of the problems we have run into, and where we hope to be of special assistance, is that of the local land use planner who is trying to develop a comprehensive plan with which to intelligently guide the development of the land. We very soon discovered that none of the plans that we reviewed had received any geologic input so that such things as seismic stability, landslide potential, etc. had not been considered. As a result of this, the division is beginning to gather basic geologic data and reduce it to a form usable by the land use planner or the land developer. Traditionally, geologists have produced maps and geologic reports primarily for the benefit

of other geologists. It is the hope of the division that we can circumvent that problem, and that we will be able to produce geologic information that will be usable by those with only a small amount of geologic knowledge.

Another area that was found wanting was in the amount of geologic information that was available to our state education system at the junior and senior high school levels. As a result of this, the division from time to time has published nontechnical popular geological reports that could be used by students or by anyone else who was interested. We have made an attempt to reprint articles that would be of interest to the student and these are made available free of charge on request. We are currently participating in the development of a geologic education program for the Cispus Environmental Education Center.

The main goal of the division is to be of service to the taxpayers of the State of Washington in whatever way we can. We feel an obligation to the people of our state. We recognize it is their dollars that support our activities, and we propose that they get full value for the moneys they expend.

Except for Alaska, Washington has more glaciers than any other state. In the Skagit Basin, 396 glaciers cover 64½ square miles of the northern Cascades.

ENVIRONMENTAL GEOLOGY NEWS

We are preparing a bibliography of Washington landslides that will consist of, in its final form, published as well as unpublished data such as engineering reports and theses dealing with or showing the locations of landslides in the state. An annotated bibliography of published literature of Washington landslides has been completed in card form. The bibliography is a byproduct of a Keysort card file—more than 350 landslides have been inventoried and classified. Both the card file and the bibliography will be expanded to include additional unpublished material as it becomes available. The card file should serve as a useful data bank for slope stability information and may be the basis for future publications in this field.

Don Tubbs, a University of Washington graduate student, recently completed a DNR-USGS sponsored study of landslides that occurred in Seattle during the winter of 1971-1972. Don was able to establish close correlations with landslides to both geology and rainfall. The results of his study will be made available this winter.

A geologic recon of the southern Cascades was conducted last summer by Dr. Paul Hammond of Portland State. Dr. Hammond had a "running start" on this project as a result of his graduate studies (University of Washington) and previous work for industry in the area. Paul's work was supported by the Department of Natural Resources, through the Division of Mines and Geology. The study is being conducted with special emphasis on factors of possible geothermal significance. An open-file preliminary map will be available this winter, with a final sheet planned for the following winter.

Mapping of the lowlands along the west side of Hood Canal began this last summer in another project jointly sponsored by the USGS and DNR. This project stresses Pleistocene and Recent geology with special emphasis on environmental factors. Dr. Robert Carson of Raleigh, North Carolina, is conducting this work. Bob is well versed in the Pleistocene history of the area, having done his Ph. D. studies (at the University of Washington) in the area between the Olympic Mountains and the Chehalis River. The first summer's work was concentrated on the area between the Skokomish and Hamma Hamma Rivers.

SURFACE MINED LAND RECLAMATION

While it is true that hindsight is often clearer than foresight, a look back over the past two years that Washington's Surface Mining Land Reclamation Act has been in effect indicates some clear foresight in the past has contributed to the goals being met today.

Since January 1, 1971, when the law became effective, approximately 900 applications for surface mining permits were received, and more than 800 permits, many with special conditions,

were issued. Data compiled between January 1, 1971 and September 1972 show that approximately 1,820 acres of land were newly disturbed during this period, primarily by sand and gravel operations. Of this total, some 475 acres or approximately 26 percent have been partly or totally reclaimed. The remainder of these acres will be reclaimed as the material is depleted and mining activity at the site ceases. It is significant that some of the reclaimed acres were disturbed prior to 1971 and not subject to the law. Often, mining and reclamation plans received from surface mining operators include reclamation plans for acreage disturbed prior to 1971, which reflects a changing attitude on the part of many companies to comply with the intent of the law rather than just the letter of the law, with regard to such items as revegetation, erosion control, water impoundment, screening, etc.

As far as the future of surface mining regulation is concerned, there are indications of possible further regulation in a number of bills to come before the federal legislature. The majority of these bills are directed toward setting federal minimums for reclamation, which generally are more restrictive than present state regulations. Some of these bills, if passed, could require revision of state regulations or even be federally administered. Of particular note in this regard were House Bill 6482 and Senate Bill 630, which were considered during the 1972 Federal Congress.

"Nay if I understand anything, greater wealth now lies hidden beneath the ground in the mountainous parts of your territory than is visible and apparent above ground."

Agricola De Re Metallica, 1556

WASHINGTON METAL MINES

Whereas nonmetallic mineral deposits of some type or other may be found in each of the state's 39 counties, metal deposits occur mainly in the northern half of the state where Tertiary and Mesozoic intrusive granitic rocks predominate. Since the beginning of mining in Washington in 1855, the bulk of the state's metal production has come from only 10 counties. Incomplete records indicate that from 1855, when gold was first mined in Washington, through 1971, $418 million in metals was produced. The principal metals, in decreasing order of production value, are zinc, gold, lead, copper, silver, and uranium. Smaller amounts of tungsten, mercury, iron, antimony, manganese, molybdenum, tin, and chromite have also been mined.

Currently the production of metals in Washington is limited to gold, silver, lead, zinc, and uranium. From the Knob Hill mine, at Republic in Ferry County, come gold and silver. From the Pend Oreille mine, at Metaline Falls in Pend Oreille County, come lead and zinc. From the Midnite mine, on the Spokane Indian Reservation in Stevens County, comes uranium. The combined 1971 production of these mines was in the neighborhood of $8.5 million.

About half of the state's gold production has come as a coproduct or byproduct of base metal mining. Early production included large amounts of placer gold from deposits along the Columbia River as well as from deposits along the banks of the Similkameen River, Ruby Creek, Sultan River, Swauk Creek, and Peshastin Creek.

An estimate of gold produced in Washington from 1855 through 1971 would be around $90 million. Currently, Washington produces in excess of $1 million yearly in gold, almost all of which comes from the Knob Hill mine.

Silver

Silver has been the principal metal from 40 mines, but most of the production has been a byproduct from gold and base metal mines. The total silver production of Washington from 1866 through 1971 has been roughly 22 million ounces, worth about $17.5 million. Although the dollar value of silver does not exceed that of gold, the total ounces of silver produced exceeds gold.

Gold

Approximately 100 mines have at one time or other produced gold in Washington. Major producing mines have been the Knob Hill, Gold King, and Holden mines in the Republic, Wenatchee, and Railroad Creek mining districts of Ferry and Chelan Counties. Significant amounts of gold have also been produced from the Blewitt, Monte Cristo, Mount Baker, and Slate Creek mining districts of the northern Cascades, from the Oroville-Nighthawk district of north-central Washington, and from the Orient district of northeastern Washington.

The leading silver-producing counties are Ferry, Stevens, Chelan, and Pend Oreille. At the turn of the century, about half of the silver produced in Washington came from gold and silver lode mines, whereas the other half came from lead, zinc, and copper mines. Since 1957, nearly three-fourths of the silver has been a byproduct of gold mining operations. Currently silver is produced as a coproduct at the Knob Hill gold mine and as a byproduct at the Pend Oreille lead-zinc mine. Knob Hill mine produces over $150,000 in silver annually, while Pend Oreille mine produces about $30,000.

Lead and Zinc

Although the Pend Oreille mine is presently the only lead and zinc producer in the state, at one time or other 20 mines produced zinc and 35 produced lead. Because of its silver content, lead was mined as early as 1885 in Stevens County, but it was not until 1939 that major amounts of zinc were produced. Since 1939, the Metaline mining district of Pend Oreille County has been the state's leading lead-zinc producer. Significant amounts of lead and zinc have also been produced at the Van Stone mine in Stevens County, and large amounts of zinc ore were mined at the Holden mine in Chelan County.

Total cumulative production of zinc in Washington through 1971 is about $65 million, and lead $155 million. Currently, the Pend Oreille mine produces around $3.3 million of combined lead and zinc.

Copper

Although copper is not presently mined in Washington, 25 mines have produced copper as their principal product. From 1860 through 1961 a total 122,000 tons of copper valued at around $4.5 million came from Washington mines. The bulk of the production came from the Holden mine in Chelan County, which over a 20-year period produced 107,911 tons of copper. Since the closure of the mine in 1957, the production of copper in Washington has been insignificant; however, copper remains the most sought-after metal in the state by major mining companies engaged in exploration work.

Uranium

Although minable deposits of uranium were not discovered in Washington until 1954, the production of uranium has exceeded several other metals that were discovered 50 years earlier. In the ten-year period between 1955 and 1965, 4.7 million pounds of U_3O_8 valued at around $30 million was extracted from 1.2 million tons of ore. The bulk of the production came from the Midnite mine on the Spokane Indian Reservation in southern Stevens County. Mining at the Midnite mine resumed in 1969, and in 1971 the mine produced around 47,000 tons of ore that contained 300,000 pounds of uranium oxide valued at $3.25 million.

Exploration for metallic minerals by major mining companies continued throughout 1972 but declined somewhat from that of previous years. For the most part, exploration activities were directed toward large low-grade deposits of copper. Bear Creek Mining Company continued to explore their copper prospect on Tolman Mountain in southern Ferry County while Cyprus Mines Corporation, Humble Oil Company, and Inspiration Development Company diamond drilled low-grade copper deposits in northern Okanogan County. In northwestern Washington, Natural Resources Development Corporation continued development work at the Clipper copper property on the South Fork of the Snoqualmie River in King County. In Snohomish County, rehabilitation of Sunset mine was undertaken by Joe Cashman of Skykomish; and, at the Wayside mine near Granite Falls, parts of the mine have been rehabilitated by Ram Mines, Inc. and diamond drilling for new veins was carried out. In the 1930's, the Sunset mine was a major producer of copper.

Rising silver prices encouraged several mining companies to investigate several silver mines that have produced in the past. In the Conconully mining district of Okanogan County, work was underway at the Fourth of July, Peacock, and Mohawk mines. In the Loomis district, sampling of the silver-bearing veins at the Ivanhoe mine was undertaken by Old Channel Placers, Inc.

At least three lead-zinc properties were under investigation during 1972. On the Colville Indian Reservation, Cordero Mining Corporation diamond drilled for zinc at the Iron Dike prospect. At the Schumaker mine in Stevens County, Coronado Development Corporation made preparations to mine lead-zinc that will be milled at Goldfield Consolidated mill near Aladdin. At the Pend Oreille mine at Metaline Falls, exploration and devel-

opment work was undertaken on a new lead-zinc ore body that lies 125 feet below the presently producing ore zone.

Exploration for uranium was confined to the Spokane Indian Reservation in southern Stevens County. Exploratory drilling at the Midnite mine exceeded 3,000 feet. Three miles northeast of the Midnite mine, Midnite Mining Company carried out radiometric surveys and exploratory drilling on mineral leases held by Evergreen Minerals, Inc.

Wayne S. Moen

Some people think of aluminum as being a light metal. However, a cubic foot of aluminum weighs about the same as a cubic foot of marble (166 pounds per cubic foot).

THE OLYMPIC PENINSULA REPORT

Geologists have always been intrigued with the Olympic Peninsula and, over the years, various individuals and teams have contributed large amounts of data on the geology of this area. Presently, a concerted effort is being made to bring together all available geologic mapping and information on the rocks of this structurally complex area. This work is being coordinated and assembled for publication by Roland Tabor and Wallace Cady of the U.S. Geological Survey. In addition, they have completed much new mapping, particularly in the Olympic Mountains. In this connection, two detailed geologic maps were recently published by the U.S. Geological Survey: Geologic Map of The Brothers Quadrangle, by W. M. Cady, M. L. Sorensen, and N. S. MacLeod; and Geologic Map of the Tyler Peak Quadrangle, by W. M. Cady, R. W. Tabor, N. S. MacLeod, and M. L. Sorensen. As an outgrowth of his work in this area, Roland Tabor is currently assembling a popular report on the geology of the Olympic National Park.

Parke D. Snavely and Norman S. MacLeod, also of the USGS, have been conducting geologic studies for the past several years along the north flank of the Peninsula to Cape Flattery. Their work will result in a detailed geologic map of that area, as well as add substantially to overall geologic knowledge of the Olympic Peninsula.

Last summer an extensive geophysical survey was made in the Straits of Juan de Fuca and off the northwest tip of Washington. This research was carried out jointly aboard a Canadian research vessel by the U.S. Geological Survey and the Canadian Geological Survey. The project was co-headed by Parke D. Snavely of the Office of Marine Geology and Don L. Tiffin of the Canadian Survey.

For the past several years Richard J. Stewart of the University of Washington has been engaged in geologic studies, largely in the west-central part of the Olympic Mountains. His particular contributions have dealt with metamorphism as related to the geologic history of these rocks.

For the past 5 years my geologic studies have been directed largely toward the coastal area of the Olympic Peninsula. A report on the biostratigraphy of the Quinault Formation, published by the Division of Mines and Geology in 1970 as Bulletin 62, was the first research to be made available from the project. I am now engaged in overall geologic investigations, primarily of the Taholah and Destruction Island quadrangles. This study will culminate in a geologic report and map of the area. The report will serve as a base for solutions to geologic problems such as landslides and those dealing with road construction as well as for evaluating the mineral potential of this and surrounding areas. In addition, a report on the geology of the immediate coastal area is nearly ready for publication. It is designed to appeal to the beginning geology student as well as those generally interested in the natural sciences. The report is also intended as a guide for geologic field trips.

Weldon W. Rau

"Civilization exists by geological consent—subject to change without notice." Will Durant

---

ENGINEERING AND URBAN GEOLOGY

The division is in the process of completing a report and table for use by city and county planners, land developers, and hopefully for use also by the average single home developer. The report and table have been prepared for the Puget Lowland area.

A report "Urban Geology, Western Washington; A State-of-the-Art Review" is tentatively to be presented at the annual meeting of the Cordilleran Section of The Geological Society of America, March 22, 23, and 24, at Portland State University in Portland.

An environmental geologic mapping program of the Puget Lowland was initiated with a trial project in the Olympia-Lacey area. The mapping will be done on the 7½-minute USGS topographic quadrangle sheets. The division is also cooperating with the USGS on a trial mapping program in conjunction with the Resource and Land Inventory (RALI) Project.

DIRECTORY OF WASHINGTON MINING OPERATIONS 1971-1972

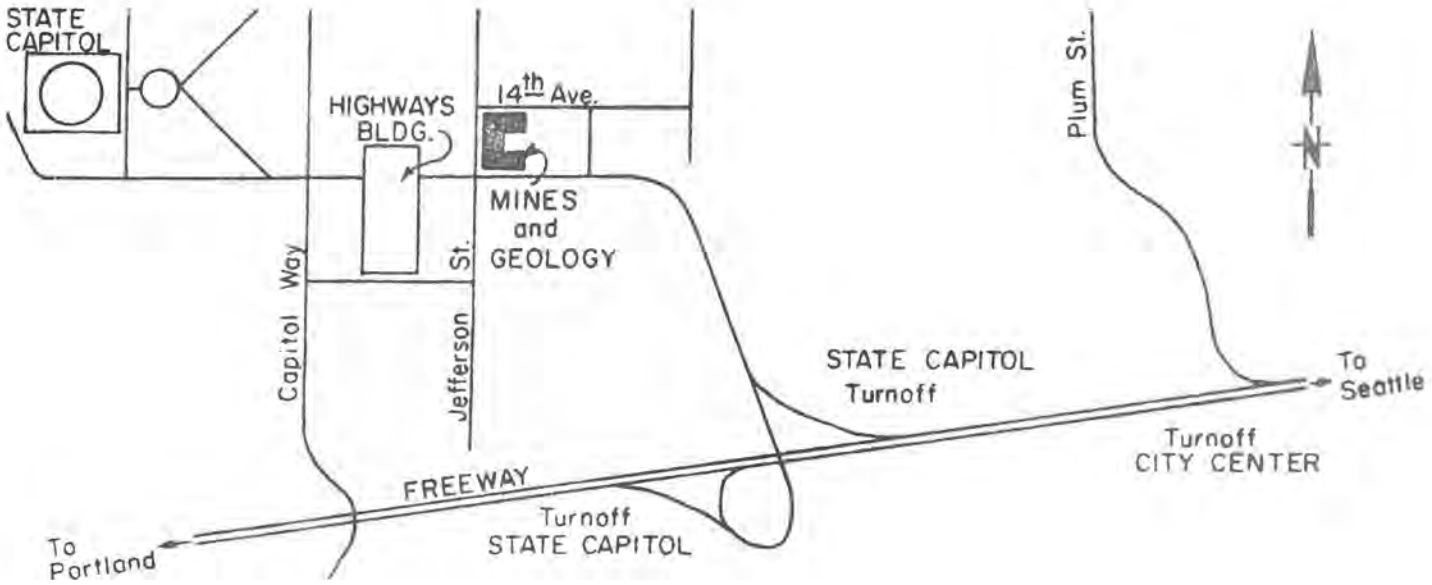
This free publication will be available in the spring of 1973 to anyone who requests it. The Directory is a biennial listing of all known metallic, nonmetallic, and sand and gravel operations in Washington. Company name, address, product, and location of mine(s) are included for each operation. The 1971-1972 Directory will contain in excess of 300 listings. If you would like a copy, write to the Division of Mines and Geology, Department of Natural Resources, Olympia, WA, 98504, and request Information Circular No. 47.

DIVISION MOVES TO NEW BUILDING

On November 8, Mines and Geology moved into new offices at 14th and Jefferson on the east campus of the Capitol grounds. Although the offices are temporary, they offer an improvement over the space occupied by the staff for the past 17 years. Ample parking is provided for visitors who should experience no trouble in finding our building as it is the first state office building after taking the State Capitol exit from Interstate 5.

Library as well as laboratory space has been expanded, and the mailing room has been designed for greater efficiency. Considering everything, Mines and Geology should be able to serve the public and perform duties more efficiently in the new offices. Stop by and visit us.

See diagram below.



GEOLOGY—AN EXPANDING ROLE

Geologists do more than search for oil, gas, and minerals from the ground. Creeping urbanization has placed the geologist in a position of major responsibility for environmental study and evaluation. The natural environment exists on a geologic foundation and is modified and controlled by active geologic processes. Thus, the geologist, in dealing with his environment, automatically finds himself "the expert" in untraditional ways. The "environmental geologist" must work with other natural scientists, evaluating geologic factors, inventorying resources, and assessing other environmental variables. These data must be weighed to decide realistic priorities in long-range land use planning and resource development. Ultimately, these priorities must be communicated to law makers and administrators in order to be effective.

YOUR STATE GEOLOGIST REPORTS

One of the unfortunate situations of our times is the apparent communication gap that has developed between the mineral producer and the environmentalist. At a time when the expertise of all segments of our population should be brought to bear on the problems of pollution abatement and control, we have a situation that to someone sitting in the middle like myself looks like a bull fight. Instead of attacking issues and problems, the environmentalists are by and large attacking industries. Industry on the other hand, still has the lingering attitude in many instances that the environmentalists are bent on destroying the vitality of the nation. It becomes very obvious with a minimum amount of observation and thought that both attitudes are wrong and need to be revised.

It has been surprising to me how much industry and the environmentalist have in common if they would just sit down together and talk. As I read the various reports that come across my desk, I am impressed at the amount of money and effort that industry is pouring into lowering the amount of harmful emissions being released into the environment. Occasionally, I see articles that describe the findings of committees that were formed when industry people and environmentalists sat down and talked rationally and calmly together, and I find these to be very rewarding. When this happens, it seems that environmentalists are finding that industry is made up of people who are responsible and concerned about what is happening, and industry people are finding that environmentalists are responsible, intelligent people who are also concerned about what is happening. Unfortunately, there was too much antagonism and mistrust generated when environment-awareness first crashed onto the scene. How much better it would have been if the environmentalist had been wise enough to say, "Hey, what you are doing isn't right, let us help you straighten out the mess," and if industry had been wise enough to say, "You are right, we do have problems and we will be glad to accept your help in getting them straightened out."

I'm convinced that if the environmentalist and industrialist will work together in harmony toward a common goal there is no problem they cannot solve. If, however, they stubbornly refuse to see or even consider the other fellow's side, the solutions to our problems will be slow in coming and the emnity that already exists will be increased to the point that it could jeopardize our national well-being.

Ted Livingston

If you would like to subscribe to the Geologic Newsletter, please write to the Department of Natural Resources, Division of Mines and Geology, Olympia, Washington, 98504.
