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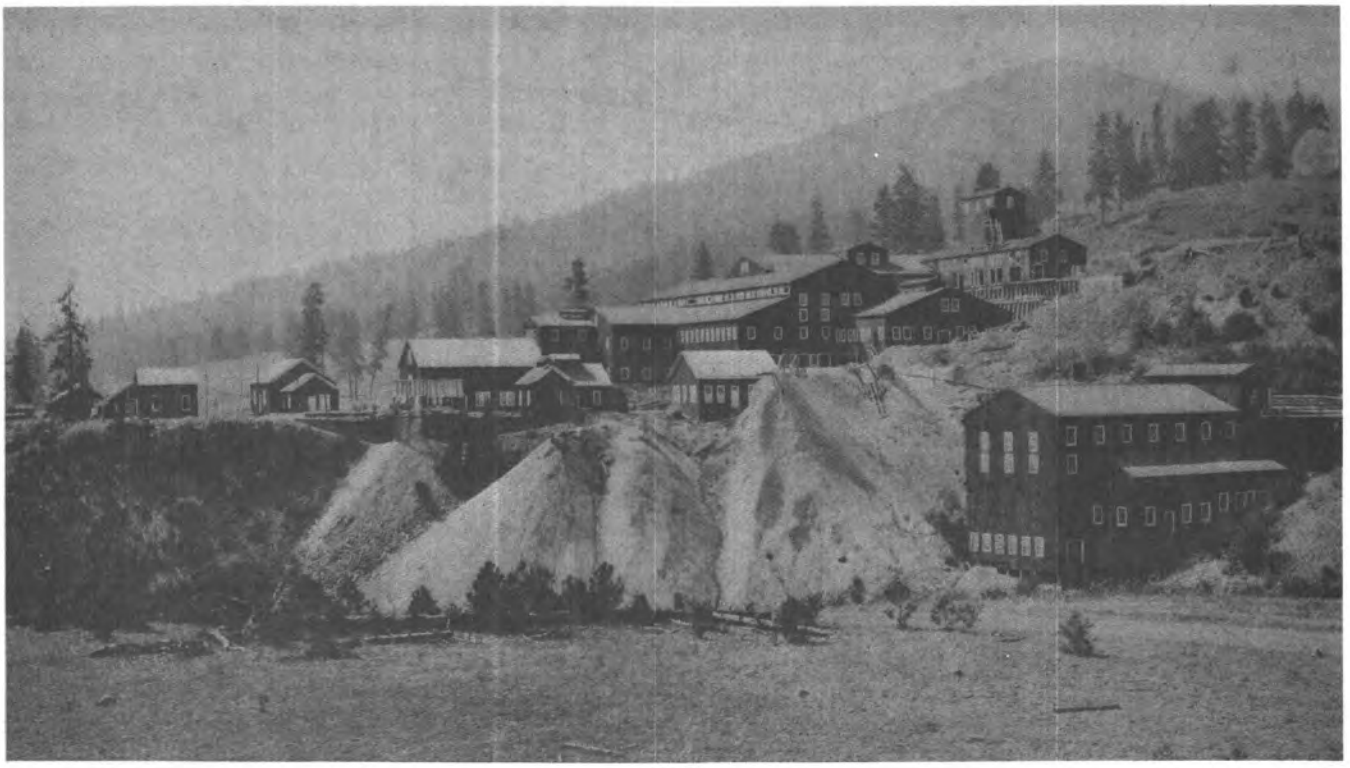
WASHINGTON GEOLOGIC NEWSLETTER



PAST

A gold-concentrating mill at the turn of the century. Today, nothing remains of the buildings, which stood a few miles south of Republic

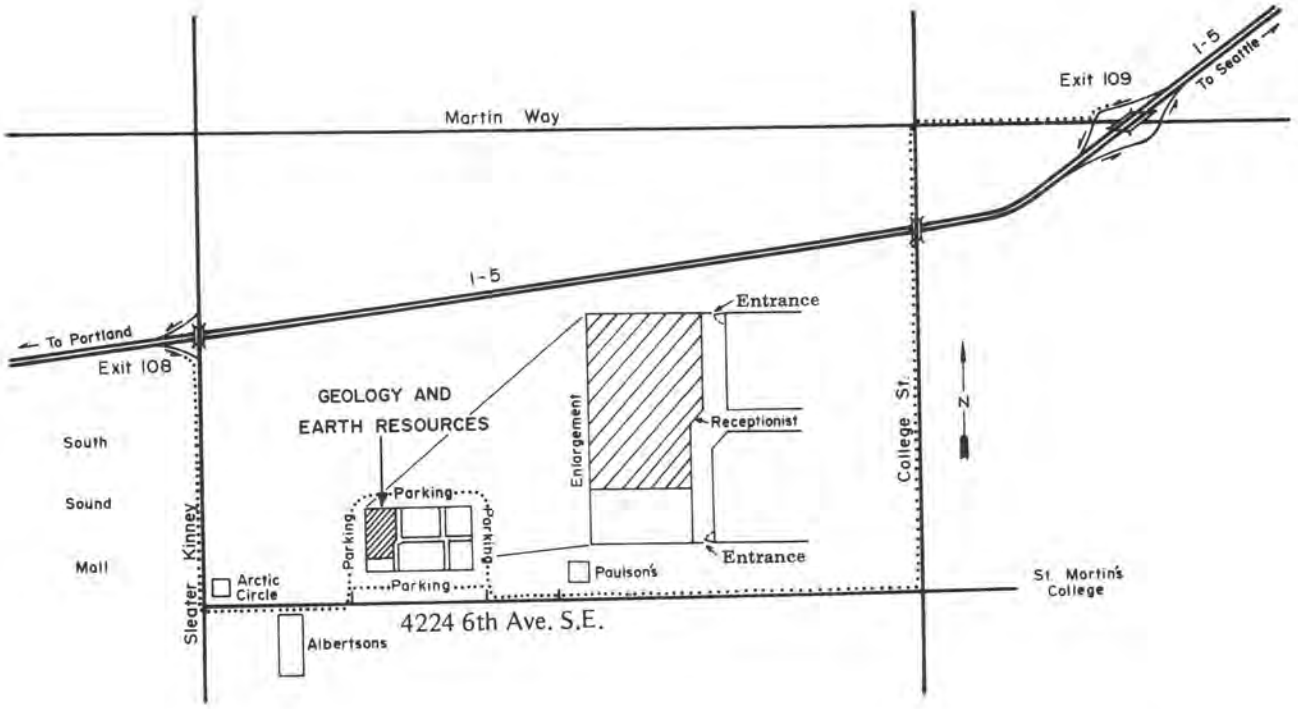
PRESENT

Northwest Alloys Magnesium plant at Addy, Washington — A major producer of magnesium metal in the United States

BRIAN J. BOYLE
COMMISSIONER OF PUBLIC LANDS

RUSSELL W. CAHILL, Supervisor
DEPARTMENT OF NATURAL RESOURCES

RAYMOND LASMANIS, State Geologist
DIVISION OF GEOLOGY AND EARTH RESOURCES



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The Washington Geologic Newsletter, a quarterly report of geologic articles, is published by the Division of Geology and Earth Resources, Department of Natural Resources. The newsletter is free upon request.

The division also publishes bulletins, information circulars, and geologic maps. A list of these publications will be sent upon request.

THE MINERAL INDUSTRY OF WASHINGTON

HIGHLIGHTS OF ITS DEVELOPMENT

1853-1980 *

by

Wayne S. Moen

Part 1 is the first installment of a three-part series that depicts the development of Washington's mineral industry. Earliest coal mining, discovery of gold, the beginning of placer mining, and early lode mining are covered here. Part 2, which will be in our October Newsletter, has the peak years of metal-mining activity (1940-1970), recent metal-mining activity (1970-1980), and industrial minerals. Part 3, in our December issue, will discuss oil and gas development, coal development, statistics of recent and current production, and the future of Washington's mineral industry.

Part 1

In 1853, a shipment to San Francisco from a mine on Bellingham Bay of 150 tons of coal valued at $4,500 gave birth to Washington's mineral industry. In the years that followed, coal as well as 30 other mineral commodities were produced, resulting in a steady growth of the state's mineral industry that, in 1980, was valued at around $300 million. In the discussion that follows, highlights of the development of Washington's mineral industry are presented from 1853, when Washington Territory was formed, through 1980, a span of 128 years.

Mining was one of the first industries to become established when permanent settlements began to appear in Washington Territory. The region was well mineralized — a fact that was soon recognized by the early settlers, though many years were to elapse before the great diversity of its mineral resources was known. Then, too, the value and importance of many mineral substances became apparent only when population increases brought about local market demands. Just how important mining was to become to the state's economy is best indicated by the dollar value of new wealth contributed by the mines of the state during the past 128 years. From no production at the beginning of the period, this value has shown a nearly continuous yearly increase, except for the occasional times of depression and market stagnation, until it reached an amount of more than $305 million in 1980. The total value of mineral production for the 128-year period has been approximately $4 billion.

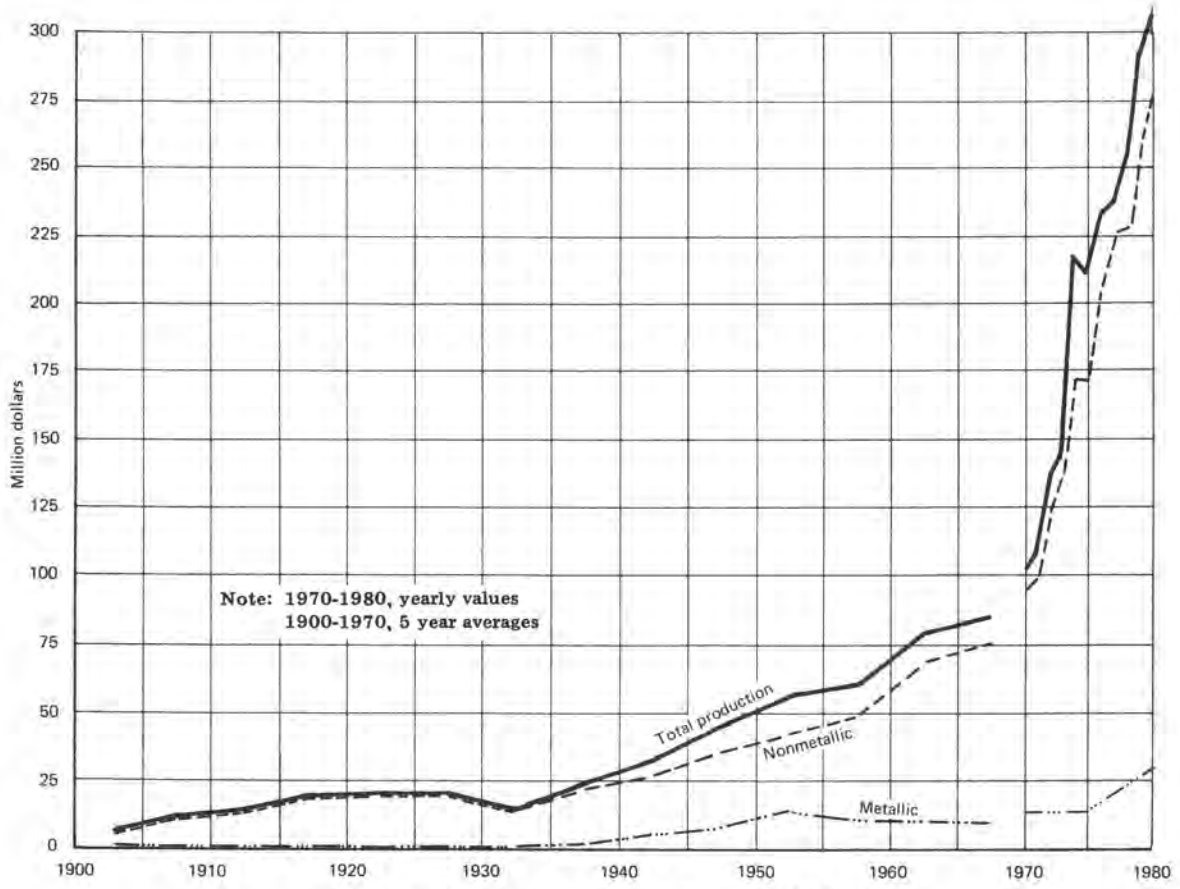
The progress of prospecting and mining here has not lacked the glamour commonly associated with the industry, but actually romance has played a relatively small part in the mineral development of the state. For some reason, when mining is mentioned one usually thinks of gold and silver and, to a lesser extent, of copper, lead, zinc, and a few other metallic ores. These have had, and do have, an important place in our mining industry, but a far more important place must be given to the nonglamorous industrial minerals — coal, sand and gravel, stone, portland cement, dolomite, and other nonmetallic substances.

In considering our first 128 years of mining, it is of interest to review the accounts of early discovery and development. Some of these records are vague and contradictory, and some have been garbled and misquoted by later commentators, but the original accounts are available in libraries and include observations and findings by competent observers who were present during or near the times and events described.

Earliest Coal Mining

The earliest recorded discovery of mineral in what was later to be Washington Territory occurred in 1833, when Dr. Tolmie, an Englishman in the employ of the Hudson's Bay Co. at Fort Vancouver and later Factor of Fort Nisqually, found and described coal outcroppings on the

* A revision and updating of the following report: Glover, Sheldon L., 1954, One hundred years of mining in Washington: Washington Division of Mines and Geology Biennial Report No. 5, part 2, p. 9-20.



Mineral production of Washington, 1900-1980

Toutle River near its junction with the Cowlitz River in what is now Cowlitz County. Other coal in this same vicinity was found in 1848, but there is no record of any mining at those times, and certainly the coal was valueless at that early period, prior to the settlement of the region.

The next record of discovery was again of coal, this time in 1852 on the shore of Bellingham Bay. A Captain William Pattle was then engaged in furnishing the Hudson's Bay Co. with timber, which he was cutting on Lopez Island. He had crossed over to the mainland and was inspecting timber on Bellingham Bay when Indians called his attention to coal outcrops along the shore. He and Messrs. Morrison and Thomas, who were working with him, immediately located adjoining claims of 160 acres under the provisions of the donation law then in force in the Territory. Captain Pattle opened a "wheelbarrow" mine on his claim and took out a small amount of coal, an operation which, although soon abandoned, apparently initiated mining in the Territory. The next year, 1853, a more ambitious undertaking was started on Morrison's claim, where the "Ma-moosie mine" was developed; about 150 tons of coal was shipped from this property to San Francisco before operations were suspended for several years. In the meantime, the blowing down of a large tree had exposed a coal bed about 2 miles north of the Pattle claim. This was located in the fall of 1853 by Messrs. Brown and Hewitt, and resulted in the organization of the Bellingham Bay Co., and the eventual development of coal reserves which, under various managements and names and despite fires and other difficulties, supported large-scale operations to 1955.

Coal was something familiar to those early settlers, and they needed and valued it. Also, the phenomenal growth of population in California and its lack of coal provided an immediate export market and source of much-needed cash.The extensive coal beds of Skagit, King, Pierce, and Kittitas Counties were awaiting discovery, and the

Fairfax

Wilkeson

Coal mining towns of Fairfax and Wilkeson, Pierce County, in 1927, were typical of many coal-mining towns of Washington.

Pacific Coal Co. at Carbonado, Pierce County, in 1918. Tipple and washing plant shown in photo was near portal of mine.

existence of the southwest Washington fields had been known since 1833. It is no wonder, therefore, that one occurrence after another was found and prospected in the years just subsequent to the Bellingham Bay discoveries. In 1853 coal was discovered on Black River, near the present site of Renton, and a mine was opened there in 1854. A few years later the coal fields of the Issaquah and Newcastle areas, King County, and the coking coal of Carbon River and the Wilkeson area, Pierce County, were found. In about 1871 the Kittitas field was discovered, with shipping commencing in 1886, by which time the industry was well established throughout the coal-producing areas of the state. In 1860, yearly coal production in Washington was only around 5,000 tons; by 1876, it reached 100,000 tons per year; and by 1888, it exceeded one million tons per year, with a total production from 1860 through 1899 of 18,866,000 tons.

Discovery of Gold

The discovery of gold and the beginnings of metal mining are not so well documented, but certain features are clear. In 1853 Major Isaac I. Stevens was appointed governor of the newly organized Washington Territory. He was to journey overland from St. Paul, Minnesota, to Olympia, and while so doing was charged with the duty of searching out a feasible route for a transcontinental railroad.

Governor Stevens had assigned to Captain (later, General) George B. McClellan the task of investigating passes over the Cascade Mountains; the work was underway while Stevens was journeying west. The two men met at Fort Colville in October, 1853. At that time McClellan reported that he had ascended the Yakima River on September 3, 1853, and mentioned finding the first traces of gold that he had encountered, saying "though not sufficiently abundant to pay for working, it caused considerable excitement in the camp. . . . Gold was found to exist, in the explorations of 1853, throughout the whole region between the Cascades and the main Columbia north to the boundary, and paying localities have since been found at several points, particularly on the southern tributary of the Wenatchapam [Wenatchee]. The gold quartz is also found on the Nachess [Naches] River. The gold bearing rock, crossing the Columbia and stretching eastward along Clark's Fork and the Koutenay [Kootenai] River, unquestionably extends to the Rocky Mountains." It would appear that these later mentions of gold were the result of information which came to the attention of Governor Stevens between October, 1853, and the time just prior to 1860 when he submitted his report to the War Department, and thus included a period when prospecting was becoming generally active.

Beginning of Placer Gold Mining

Certainly, it seems unquestionable that placer mining in the vicinity of Fort Colville was underway and probably began there in 1855. It must be remembered, however, that Fort Colville was an outfitting station for a very large region; and placering north of the boundary, in Canada, known to have been profitable, may have accounted for most of the activity ascribed to the Colville area. It is doubtful that the placer-gold production from the bars and tributaries of the Columbia and Pend Oreille Rivers in Washington was ever particularly important.

Whether or not gold mining actually began in the Colville area, an event of greater import was the discovery of placer gold in the Similkameen River in 1859. George A. Bethune, the first State Geologist of Washington, in his report of 1890 credits this with being the earliest find and the first to be profitably developed. The International Boundary Commission was engaged at that time in surveying the line between the United States and Canada, and in 1859 had reached the Similkameen River, having already completed the section north of Fort Colville. One of the soldiers of the party panned some of the gravel of the river bank and found it to be gold bearing. This started a "rush," resulting in hundreds of miners stampeding to the area and causing Okanogan City to mushroom to nearly 3,000 population in the first month of its existence. However, a few months later news came of the gold strikes in the Cariboo, Frazier, and other districts of Canada, and the miners, always ready

to believe that faraway fields are greener, deserted the Similkameen for the new diggings to the north.

During the next 10 years or so, prospectors were drifting north from California fields and south from Canadian fields, and were finding gold on streams here and there, both east and west of the Cascades. Some of these strikes in the early sixties were important; others were soon proved to have little value or were quickly worked out.

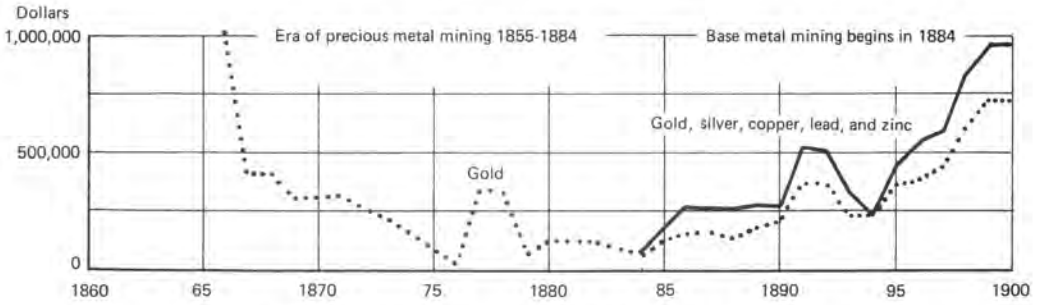
From 1855 to the early 1900's the rocker was often used in one- or two-man operations along gold-bearing bars of the Columbia River to separate placer gold from sand and gravel.

It was probably in 1860 that placer gold was discovered on Peshastin Creek in what is now Chelan County. This and Swauk Creek, where gold was first discovered in 1868 near the present town of Liberty, Kittitas County, were vigorously worked by individuals and later by mining companies for many years and are still producing some gold. The Peshastin-Swauk district has accounted for what has probably been the principal placer-gold production of the state. In this connection it is interesting to note that here, as in many other placer localities, Chinese were able to operate profitably after the earlier white miners had abandoned the diggings; eventually the Chinese moved out, and again the whites resumed work in the better localities.

The early prospectors ranged far and wide. They needed little financing, they traveled chiefly on foot, and they carried their tools and supplies on their backs when not established in temporary base camps. They missed very little in the way of promising ground, and the remains of test pits, tailing piles, old sluices, and other signs of their activities may be found today on remote and relatively inaccessible creeks throughout the mountains. This is not to say that no future discoveries of placer gold will be found, but the search will be difficult and the places will be where, for one reason or another, the "old timers" were unable to operate advantageously. Even on the better prospected streams unworked ground is occasionally found, and the bars of the larger rivers are, to some extent, replenished during each period of high water.

Placering at the present time is unimportant in Washington. The total gold recovered by this means has doubtless been considerable, although the amount is unknown. The records of recovery prior to 1900 are fragmentary at best and are not broken down to a county basis, or, for that matter, to placer as distinct from lode operations. Nevertheless, it appears reasonable to assume that the recovery made before the turn of the century greatly exceeded the later production. Since 1900, however, the records are fairly complete. The statistics of the U.S. Geological Survey and U.S. Bureau of Mines show a placer-gold production of $935,252 from 1900 to 1957, inclusive. For comparison, the lode-gold production for this same period was $52,106,982. Again, the relative insignificance of placer mining in later years is indicated by production figures for the 10-year period from 1900 to 1909, inclusive, when $350,541 was produced, as compared with figures for the similar period from 1944 to 1953, when only $12,456 was produced, or 3½ percent of the earlier amount.

Kittitas Gold Co. dredge on Swauk Creek, Kittitas County, in 1926, was largest gold dredge to operate in Washington. Over $35,000 in gold was recovered from 1926 to 1929.



Metal production of Washington, 1866-1900

Early Lode Mining

The real metal-mining industry of the state probably dates from the discovery in 1871 of lode gold near the base of Mount Chopaka, Okanogan County. Considerable work was done here by Hiram F. Smith, later a member of the state legislature. A short time thereafter additional lode discoveries were made in the area, but as the land was in a reservation set aside for Chief Moses and his Indian tribe, the miners were moved off by soldiers and the work was discontinued until about 1887.

Following the Mount Chopaka finds, increasing attention was centered on the occurrence of lode ores throughout the Territory, with the result that hard-rock mining, as distinct from placering, began to assume the importance it deserved. Differing from the ephemeral placer operations conducted by individuals or small groups, lode mining, to be successful, involves considerable capital, heavy equipment, permanent camps, and competent management. Obviously, it was to mean far more to the industrial development of the state than had most of the earlier placer operations.

Gold-bearing veins in the Peshastin district were first worked at Culver Gulch in 1874, but many other discoveries were soon made in that area and on the Swauk. At first the gold was separated from the quartz gangue by grinding in arrastres. These were crude mills, powered by horizontal or overshot water wheels which were geared to a revolving center post. Heavy blocks of rock, usually four in number, were attached by arms to the post and were dragged around and around in a shallow basin cut in the rock or in a stone-lined pit, the ore being fed to the mill in egg-sized pieces. Many arrastres — the remains of some of which can be seen today — were constructed in the Peshastin-Swauk district, their use being followed by stamp mills in the several instances where continued mining proved profitable.

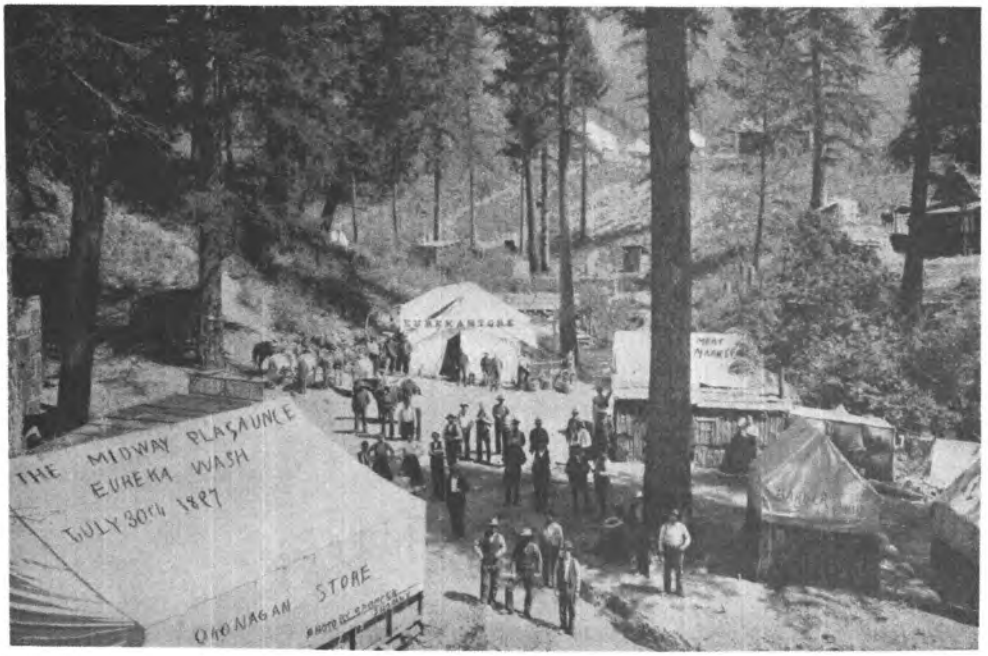
In several gold districts around 1890, arrastres were used to grind vein quartz to liberate the native gold, but because of their low capacity and poor gold recovery they were soon replaced by the more efficient stamp mill. Arrastre shown in photo was on Swauk Creek, Kittitas County, in 1924, and was powered by an overshot water wheel.

Pick and wheelbarrow miners at the turn of the century produced a portion of gold and silver from small mines in Washington.

Last Chance gold mine, Republic district, Ferry County, in 1900, was typical of the many small gold mines in gold districts of northeastern Washington.

Following this earliest lode mining, mineral discoveries were made in many northern counties, the result of the tireless efforts of countless prospectors — efforts which through 1936 had led to the locating of approximately 125,000 mining claims. The ore deposit of the Old Dominion mine, Stevens County, was discovered in 1883. This mine produced more than $600,000 in lead-zinc ore prior to 1920. The Bonanza mine, Stevens County, produced nearly 100,000 tons of lead-silver ore between its discovery in 1885 and 1957. The Germania mine, discovered in 1894 in Stevens County, produced about 1,250 tons of high-grade tungsten ore between 1904 and 1941.

In the Deer Trail and Chewelah districts of Stevens County deposits rich in silver had been discovered in 1894, and by 1940, mines of these districts produced over 2 million ounces of the metal.



Gold camp of Eureka, in 1897, was typical of the many mining camps that sprang up in areas where deposits of gold and silver were discovered. Eureka grew into the present town of Republic, county seat of Ferry County.

Blewett gold camp, Chelan County, in 1900. Gold mill on right treated most of the gold ore from mines in Culver Gulch. All that remains of the camp is the mill foundation as State Highway 97 passes directly through the old camp.

The many veins of the Ruby-Conconully district, Okanogan County, were discovered in about 1886 and produced some $200,000 in silver ore before 1907. Since that time the district has seen only intermittent activity, but at the turn of the century it was one of the most active camps in the state, with two or three thousand people in the area. Its old town of Ruby, complete with a brewery and the usual stores and saloons, is now represented only by the brush-covered foundations of former buildings.

The Sunset mine, Snohomish County, was discovered in 1897; from then to about 1932 development or production there was almost continuous. For several years, about the time of World War I, the property was one of the largest copper producers of the state, with an annual output valued between $100,000 and $200,000. The Monte Cristo mines of Snohomish County were located in 1889 and 1890, and from then until about 1903 were particularly active, producing some $7 million from gold ore which was treated at a smelter in Everett. In 1896 the Republic, Ferry County, ores were discovered. This camp has had a long, continuous history of activity and is still one of the state's most important gold producers, approximately $90 million in gold and $15 million in silver having been extracted since 1900. In 1914 the Electric Point mine of Stevens County was discovered, a property which produced more than a million dollars' worth of lead ore between 1916 and 1920. Similarly, many other ore bodies were discovered, prospected, and developed into paying properties during those earlier years of mining activity.

Sunset copper mine, Index district, Snohomish County, as it was in 1935. The mine was the state's largest copper producer in the 1920's.

In the late 1800's, smelters were erected to treat concentrates and ores from the mines, as well as from out-of-state mines. The first smelter to appear on the scene was the Colville lead-silver smelter, which was built in 1887. This was followed by smelters in Tacoma, Everett, and Spokane in 1890, in Northport in 1897, and in Keller in 1905. As ore from the mines was depleted, smelters were forced to close. Of the six original smelters built in the state, only the Tacoma smelter survived. As one of the largest copper smelters in the United States, it currently is dependent upon out-of-state and foreign ores. Many concentrating mills were also built in the main mining districts. In 1911, around 30 mills were either active or under construction, but currently only five are operational.

Republic mill at Republic, Ferry County, in 1900, was one of the largest gold mills in the state at the turn of the century. The 200-ton-per-day mill used roasting and cyaniding to recover gold and silver from siliceous ores of the Republic district.

Northport smelter, Stevens County, in 1920, smelted copper, lead, and silver ores from mines in northeastern Washington, as well as copper ore from British Columbia. In 1922, after 24 years of sporadic operations, the smelter closed and was dismantled.

RAYMOND LASMANIS APPOINTED AS STATE GEOLOGIST

On June 14, Ray Lasmanis assumed his duties as manager of the Washington State Division of Geology and Earth Resources of the Department of Natural Resources. He comes to the Division directly from Canadian Superior Exploration Ltd., where he served as exploration manager. Much of his work involved the Pacific Northwest, although he also directed mineral exploration in Alaska, Spain, Portugal, and Australia.

Some of his work included participating in the decision that placed the West End epithermal gold deposit in Idaho in production in 1981. He was involved in the discovery of the Tonzona coal project, in Alaska, where he worked as manager. While serving as exploration manager in the Northwest, Ray initiated a conceptual epithermal gold-silver program which led to the acquisition and production of the DeLamar properties in Idaho in 1977. Other projects that he formulated and carried through the drilling stage were copper-nickel deposits in basic sills, stratabound copper-silver in the Belt Supergroup, and a 7,500-square-mile reconnaissance project for uranium in the Northwest Territories.

Earlier in his career, Ray worked as Southwest District exploration manager for Cominco American, Inc. While there, he planned and conducted exploration programs for massive sulfide deposits in Arizona, and discovered and outlined the Pine Flat porphyry copper deposit. He also worked in Missouri with G. F. Koehler on a program that led to the discovery and development of the Magmont lead, zinc, and copper mine.

Ray brings to the Division a career of management and experience in many fields of mineral resources. He graduated from the Missouri School of Mines and Metallurgy and is a registered professional engineer in British Columbia. He has a strong interest in mineral and fossil collecting and plans to promote more public interest in these areas in Washington. He will contact some Washington State rockhound clubs in the near future to solicit their ideas on how the Division of Geology and Earth Resources can be of service to them.

GEOLOGY FIELD OFFICE MOVES TO NEW LOCATION IN SPOKANE

The Division of Geology and Earth Resources field office, formerly located at Eastern Washington University in Cheney, has moved to new quarters in Spokane. Bonnie Bunning and Keith Stoffel, Division geologists, are now in the Spokane County Agricultural Center, which is on the grounds of the Spokane Indians Baseball Club. The building is near the Spokane County Fairgrounds. The complete address and phone number are listed on the back of this newsletter cover.

MOUNT ST. HELENS VIDEOTAPE ARCHIVE NEARS COMPLETION

by Josh Logan

Since Mount St. Helens awakened in the spring of 1980, Portland and Seattle television stations have shot hundreds of hours of videotape covering activities on and around the mountain. These tapes represent a unique historic and scientific record of one of the most exciting events ever to occur in the Pacific Northwest. The tapes contain a wide variety of subject matter, including eruptions, mudflows, and floods in progress with the destruction left in their wake. Also documented are eyewitness accounts, as well as impacts on individuals and communities.

Under a grant from the National Science Foundation, the Division of Geology and Earth Resources has been obtaining selected portions of these tapes for preservation. The tapes will be archived at our office where they may be viewed upon request. Eventually, duplicates of some of the tapes will be available for loan to researchers. However, none of the tapes are to be copied or used for commercial purposes. Rights for such activities must be negotiated with, and secured from, the respective television stations.

Presently, 80 hours of tapes have been obtained and an additional 50 hours are being acquired. An annotated videography is currently being written and will be published as soon as all tapes are received and reviewed.

Barring any new eruptions of Mount St. Helens, the project should be completed by the end of August, 1982, at which time the tapes will be available for use. Continued updating of this collection will be funded by our Division.

BOOK ON MOUNT ST. HELENS 1980 ERUPTIONS PUBLISHED BY USGS

Professional Paper 1250, *The 1980 eruptions of Mount St. Helens, Washington*, is now available for purchase from the U.S. Geological Survey. Our Division has a copy in the library for public reference work.

This 844-page volume, containing many illustrations, has 63 separate articles by authors mostly from the U.S. Geological Survey, but with some from other participating government, university, and industry scientists. These articles may be found in one of the following sections: Volcanic events, geophysical monitoring,

volcanic deposits, effects of the 1980 eruptions, and analysis of potential hazards. Also included is a geologic map of proximal deposits and features of the 1980 eruptions, at a scale of 1:50,000.

Copies can be purchased from the Branch of Distribution, U. S. Geological Survey, 604 S. Pickett St., Alexandria, VA 22304 (price $35).

MINERALOGICAL SYMPOSIUM TO BE HELD IN TACOMA

Pseudomorphs, twinning, and mineral oddities will be the theme of the 8th Annual Mineralogical Symposium, sponsored by the Friends of Mineralogy-Pacific Northwest Chapter, which will be held in Tacoma on September 24 through September 26. Some of the subjects to be discussed by the speakers will be Oddities of the Mineral Kingdom, Pseudomorphs and Paramorphs, Pseudomorphs in Smithsonite, Twinning and Pseudomorphs in Smithsonite, and What's New in Northwest Minerals. Activities include a microscope workshop, trading, dealers, and exhibits.

For more information on the symposium and registration, please contact Bob Smith, Seattle University, Box 197, Seattle, WA 98122.

OIL AND GAS ACTIVITIES IN WASHINGTON

by
Donald M. Ford
Deputy Oil and Gas Supervisor

Shell Oil Co. has completed the drilling, plugging, and abandonment of two wells in the Yakima River Canyon near the Roza Dam, in Kittitas County. The first well, Yakima Mineral Co. No. 1-33, located in section 33, township 15 north, range 19 east, was drilled to a total depth of 16,199 feet. Shell tested six or more zones in this well and encountered gas. Shell also drilled the Yakima Mineral Co. No. 2-33 approximately 350 feet northeasterly of the No. 1-33. The No. 2-33 was drilled to a total depth of 5,600 feet. This well also contained gas shows. Through testing the two wells, Shell determined that commercial production was not possible. Both wells were plugged and abandoned in June 1982.

The BISSA No. 1-29, located on Whiskey Dick Mountain, in section 29, township 18 north, range 21 east, Kittitas County, is also being drilled by Shell Oil Co. The No. 1-29 is currently drilling below 14,000 feet. The projected depth of this well is 15,000 to 17,000 feet.

Shell has two additional locations in Grant County for which drilling permits have been issued: the BN No. 1-15 located in section 15, township 17 north, range 25 east in the Frenchman Hills area, and the BN No. 1-9, located in section 9, township 15 north, range 25 east, in the Saddle Mountains' area.

Columbia Hydrocarbon is drilling Moon No. 1 in section 30, township 7 north, range 26 east, in Benton County. This well is located approximately 12 miles south of Prosser, in the Horse Heaven Hills' area.

Jack Taylor, operating under Fairview Oil and Gas, drilled the State No. 1 to a total depth of 7,158 feet, in section 16, township 30 north, range 5 west, in Clallam County. The well is located approximately 3 miles east of Port Angeles. The well was spudded April 9, 1982 and was plugged and abandoned May 25, 1982.

The Great Western Oil Co., out of Dayton, Ohio, applied for a drilling permit for Savaria No. 2, in section 8, township 14 north, range 18 east, in Yakima County. The proposed well is located about 5 miles northwest of Selah, south of the Wenas Valley. Drilling on this well has not been initiated to date.

An application to drill a well in section 17, township 14 north, range 3 west, in Lewis County, has been received from Oil and Land Enterprises, Inc., of Alexandria, Louisiana. This well is proposed to be drilled to 8,000 feet.

Snowbird Resources, Ltd. suspended drilling on their Snowbird-Moses Lake No. 1A at a depth of 6,979 feet. The well is located in section 13, township 20 north, range 26 east, in Grant County, about 4 miles southeast of Ephrata.

STUDY OF PIERCE COUNTY LANDFORMS PUBLISHED

The paper, "Landforms for planning use in part of Pierce County, Washington," by Allen J. Fiksdal, has been published in *Applied Geomorphology; A proceedings volume of the 11th "Binghamton" geomorphology symposium, Kent State University, 1980,* edited by R. G. Craig and J. L. Craft, and published by George Allen & Unwin, Boston, in 1982.

Mr. Fiksdal was an environmental geologist with the Division of Geology and Earth Resources for nine years and is now an exploration geologist with Bechtel, Inc., in Ann Arbor, Michigan.

THE WASHINGTON GEOLOGY BIBLIOGRAPHY – A PROGRESS REPORT

The *Bibliography and Index of the Geology and Mineral Resources of Washington, 1963-1980* is now in progress and should be completed by fall, 1982.

Our Division librarian, Connie Manson, has been working with the American Geological Institute to prepare this bibliography on their GeoRef data base. In its final form, the bibliography will include approximately 5,300 citations and will give complete citation, joint author cross references, and detailed subject, county, and rock formation indexes.

Funding to prepare the bibliography was provided through a grant from the U.S. Bureau of Mines, but because of our own Division's funding problems we don't know yet whether we will be able to publish this as a bulletin or only make it available as an open-file report. Either way, it should be available by this fall.

MINERAL REPORT RELEASED

The results of a 2½-year survey of the mineral potential of the Colville and Okanogan National Forests are now available for purchase. Dr. A. R. Grant, a consulting geologist, conducted the geochemical and geologic study. Grant collected and analyzed about 2,739 stream sediment samples, and collected 5,091 rock chip samples of which 1,167 were analyzed. The two reports may be purchased from the Okanogan National Forest, P. O. Box 950, Okanogan, WA 98840 (509/422-2704). The Okanogan National Forest study, text and plates, sells for $33.80, and the Colville National Forest report, text and plates, sells for $40.25. These reports are also available for public examination at our Division of Geology and Earth Resources library.

OPEN-FILE REPORTS RECENTLY RELEASED BY DIVISION OF GEOLOGY AND EARTH RESOURCES

The following open-file reports are available for distribution by writing to or calling the Division library:

Korosec, M. A., 1982, Table of chemical analyses for thermal mineral spring and well waters collected in 1980 and 1981: Washington Division of Geology and Earth Resources Open-File Report 82-3, 4 p. Free.

Korosec, M. A.; Phillips, W. M., 1982, WELLTHERM — Temperature, depth, and geothermal gradient data for wells in Washington State: Washington Division of Geology and Earth Resources Open-File Report 82-2, 74 p. Free.

[WELLTHERM is a computerized data base containing temperature, depth, and geothermal gradient information for 1,035 wells in Washington State. The report consists of a computer printout of well observations arranged by county, and a brief explanatory text.]

Korosec, M. A.; Phillips, W. M.; Schuster, J. E., 1982, The low temperature geothermal resources of eastern Washington: Washington Division of Geology and Earth Resources Open-File Report 82-1, 20 p. Free.

RECORDS OF MINING CLAIMS CAN BE SEEN ON MICROFICHE AT DIVISION LIBRARY

According to Dean Crandell, geologist at the U.S. Bureau of Land Management in Spokane, 18,545 mining claims in Washington have been recorded with the Bureau as of March of this year. This includes 17,324 lode claims, 1,136 placer claims, 53 mill sites, and 32 tunnel sites. Okanogan County has the largest number of mining claims.

The Division has obtained a listing of all the mining claims that have been recorded with the Bureau. These records are now available on microfiche for reference purposes at the Division of Geology and Earth Resources library; the listing includes such information as name, location, claimant, and type of claim. Our Division field office in Spokane also has this listing.

RECENT U.S. GEOLOGICAL SURVEY OPEN-FILE REPORTS ADDED TO OUR DIVISION LIBRARY

The following U.S. Geological Survey Open-File Reports are now available for inspection in our Division library. However, if you wish to purchase any of these reports, please write or call:

Open-File Service Section
Branch of Distribution
U.S. Geological Survey
Box 25425, Federal Center
Denver, CO 80225
(303) 234-5888

Crosson, R. S., 1981, Earthquake hazard evaluation in the Pacific Northwest: U.S. Geological Survey Open-File Report 81-965, 1 volume.

Eaby, J. S.; Clague, D. A., 1982, Preliminary description of basalt from the southern Juan de Fuca Ridge: U.S. Geological Survey Open-File Report 82-200C, 17 p.

Fox, K. F., Jr., 1981, Reconnaissance geologic map of the Churchill Mountain quadrangle, Stevens County, Washington: U.S. Geological Survey Open-File Report 81-169, 3 sheets, map scale 1:24,000.

Hill, G. W.; Chin, J. L., 1981, Tidal flat sediments - texture, Willapa Bay, Washington: U.S. Geological Survey Open-File Report 81-738, 58 p.

Koski, R. A.; Goodfellow, R.; Bouse, R. M., 1982, Preliminary description of massive sulfide samples from the southern Juan de Fuca Ridge: U.S. Geological Survey Open-File Report 82-200B, 22 p.

Langston, C. A., 1981, Calculation of strong ground motion and local field-far field relationships for the April 25, 1965, Puget Sound, Washington, earthquake: U.S. Geological Survey Open-File Report 81-377, 82 p.

Minard, J. P., 1981, Distribution and description of the geologic units in the Bothell quadrangle, Washington: U.S. Geological Survey Open-File Report 81-106, 4 p., 1 sheet, map scale 1:24,000.

Normark, W. R.; Morton, J. L.; Delaney, J. R., 1982, Geologic setting of massive sulfide deposits and hydrothermal vents along the southern Juan de Fuca Ridge: U.S. Geological Survey Open-File Report 82-200A, 22 p.

Snavely, P. D., Jr., 1981, Geophysical data collected on the continental margin midway between Washington State and Vancouver Island, B.C., along line 19, USGS R/V S.P. Lee cruise 3-76: U.S. Geological Survey Open-File Report 81-895, 1 sheet, map scale 1:250,000

Snavely, P. D., Jr.; Wagner, H. C., 1982, Geologic cross section across the continental margin of southwestern Washington: U.S. Geological Survey Open-File Report 82-459, 10 p., 1 plate.

Wilson, J. R., 1981, Geologic map of the Bangs Mountain quadrangle, Ferry and Stevens Counties, Washington: U.S. Geological Survey Open-File Report 81-581, 2 sheets, map scale 1:24,000.

Zietz, Isidore, 1981, Preliminary composite magnetic anomaly map of part of the northwestern United States: U.S. Geological Survey Open-File Report 81-835, 13 p.

THESES ADDED TO OUR DIVISION LIBRARY

We have recently acquired these theses in our Division library where they are now available for reference work.

Anderson, R. A., Jr., 1971, Stability of slopes in clay shales interbedded with Columbia River basalt: University of Idaho M.S. thesis, 297 p.

Cohen, P. L., 1979, Reconnaissance study of the "Russell" basalt aquifer in the Lewiston Basin of Idaho and Washington: University of Idaho M.S. thesis, 163 p.

Conklin, B. J., 1981, The structural geology of Cambrian rocks in the Flat Creek area, Stevens County, Washington: Washington State University M.S. thesis, 94 p., 1 plate.

Egemeier, R. J., 1981, Upper Cretaceous stratigraphy of Matia, Clark, and Barnes Islands, San Juan County, Washington: Washington State University M.S. thesis, 149 p.

Hadley, D. G., 1981, Coal petrology of the Big Seam, Centralia coal mine, Centralia, Washington: Western Washington University M.S. thesis, 61 p.

Janzen, J. H., 1981, Geology of the Heidegger Hill and Monumental Mountain area, northeastern Washington: Eastern Washington University M.S. thesis, 35 p., 1 plate.

Kuhns, M. J. P., 1980, Late Cenozoic deposits of the Lower Clearwater Valley, Idaho and Washington: Washington State University M.S. thesis, 71 p., 1 plate.

Lance, D. M., 1981, Sulfide mineralization of the Midnite uranium mine, Stevens County, Washington: Washington State University M.S. thesis, 167 p., 3 plates.

Marcus, K. L., 1981, The rocks of Bulson Creek—Eocene-Oligocene sedimentation and tectonics in the Lake McMurray area, Washington: Western Washington University M.S. thesis, 84 p.

Price, E. H., 1982, Structural geometry, strain distribution, and mechanical evolution of eastern Umtanum Ridge and a comparison with other selected localities within Yakima fold structures, south-central Washington: Washington State University Ph. D. thesis, Rockwell Hanford Operations RHO-BWI-SA-138, 199 p., 6 plates.

Salami, S. O.,1978,A reconnaissance study of the groundwater flow systems in the central part of the Lewiston-Clarkston area, Idaho-Washington: University of Idaho M.S. thesis, 105 p.

Schriber, C. N., 1981, Structural geology in the Northport area, Stevens County, Washington: Washington State University M.S. thesis, 99 p.

Schwimmer, P. M., 1981, Paleomagnetism of the Eocene volcanics in northeastern Washington, and implications for the tectonic evolution of the Pacific Northwest: Western Washington University M.S. thesis, 166 p.

Shah, S. A., 1969, Comparative ore reserve estimates of the Van Stone mine: University of Idaho M.S. thesis, 56 p.

Waggoner, G. L., 1981, Sedimentary analysis of gravel deposits in the vicinity of Clarkston, Washington: Washington State University M.S. thesis, 107 p., 1 plate.

PROGRESS REPORT ON GEOTHERMAL ENERGY PROGRAMS IN WASHINGTON

by Michael A. Korosec

During the past year substantial progress has been made on many of the ongoing geothermal programs within Washington. While exploration in the Cascades and Columbia Basin continues, commercial use of the resource is nearing fruition. Most notable of the programs is the City of Ephrata district heating project, which is partially funded by a grant from the Federal Department of Housing and Urban Development (HUD). Thermal water from the municipal well will be used to heat the Grant County Courthouse and two HUD subsidized housing units four blocks from the courthouse. The retrofitting of the courthouse will be financed by the county. A centralized heat pump, actually two separate units connected in series, will boost the 80°F well water to 120°F to meet normal requirements and, if needed, to 140°F plus for peak demand. Water will be returned to the municipal water system at 70°F.

Ground-breaking ceremonies were held April 12th, and the first part of this project is scheduled for completion in September 1982. The geothermal heating system is expected to cut yearly fuel bills at the courthouse by 85 percent. After a one year evaluation, the system may be expanded to include the Grant County Justice Center and, if all goes well, the central business section of the city will be part of a district heating unit.

The town of North Bonneville drilled a 2,220-foot well during the fall of 1981. This exploration/production well, the deepest geothermal well drilled in the state to date, represents the second phase of a project designed to eventually provide geothermal heat to the entire town. The first phase involved geologic mapping, geochemical sampling, and the drilling of three 500- to 600-foot temperature gradient holes. The deep well produces a high volume artesian flow with a temperature of 34°C (93°F). A maximum temperature of 43°C (109°F) was measured downhole. These temperatures are less than the originally targeted temperatures of 50° to 55°C and studies are currently underway to determine how to use the available resource.

At Mount Baker, Seattle City Light's geothermal project has reached the second phase of exploration. After preliminary reconnaissance work during the summer of 1981 by the consulting firm Nevin, Sadlier-Brown, Goodbrand Ltd., more detailed surface exploration on and around the stratovolcano is scheduled to include geologic mapping, geochemical sampling, and geophysical investigations. Seattle City Light hopes to eventually identify a geothermal resource of sufficient size and temperature to generate electricity.

The Division of Geology and Earth Resources is continuing its multiproject geothermal exploration program. Projects completed over the past year include temperature gradient/heat flow drilling in the Cascades, temperature gradient measurements of wells in eastern Washington, geohydrologic studies for the Yakima area, geologic mapping of the White Pass-Tumac Mountain area, regional gravity determinations for the south and central Cascades, and sampling and water analysis of thermal and mineral springs. Preliminary reports from many of these projects are listed in table 1. Additional results will be discussed in a report scheduled for release during the summer of 1982.

Ongoing or soon-to-be-initiated geothermal projects by the Division include time-space-composition modeling of south Cascades Quaternary volcanics, geohydrologic studies of the Moses Lake-Connell-Ritzville area, regional and site specific gravity surveys and interpretation of gravity for the Washington Cascades, soil mercury surveys in the south Cascades, and the collection and interpretation of existing temperature and geophysical logs from water wells of the Columbia Basin.

Table 1. – *Recent Division of Geology and Earth Resources geothermal publications*

Biggane, J. H., 1981, The low temperature geothermal resources of the Yakima region – A preliminary report: Washington Division of Geology and Earth Resources Open-File Report 81-7, 70 p., 3 plates.

Clayton, G. A., 1980, Geology of White Pass-Tumac Mountain area, Washington: Washington Division of Geology and Earth Resources Open-File Report 80-8, 1 map, scale 1:24,000.

Danes, Z. F., 1981, Preliminary Bouger gravity map, southern Cascade Mountains area, Washington: Washington Division of Geology and Earth Resources Open-File Report 81-4, 1 sheet, scale 1:250,000.

Korosec, M. A., 1982, Table of chemical analyses for thermal mineral spring and well waters collected in 1980 and 1981: Washington Division of Geology and Earth Resources Open-File Report 82-3, 4 p.

Korosec, M. A.; Phillips, W. M., 1982, WELLTHERM — Temperature, depth, and geothermal gradient data for wells in Washington State: Washington Division of Geology and Earth Resources Open-File Report 82-2, 74 p.

Korosec, M. A.; Phillips, W. M.; Schuster, J. E., 1982, The low temperature geothermal resources of eastern Washington: Washington Division of Geology and Earth Resources Open-File Report 82-1, 20 p.

Korosec, M. A.; Schuster, J. E.; Blackwell, D. D.; Danes, Z. F.; Clayton, G. A.; Rigby, J. A.; McEuen, R. B., 1981, The 1979-1980 geothermal resource assessment program in Washington: Washington Division of Geology and Earth Resources Open-File Report 81-3, 270 p., 1 map, scale 1:24,000.

Schuster, J. E.; Korosec, M. A., 1981, Preliminary report on heat-flow drilling in Washington during 1981: Washington Division of Geology and Earth Resources Open-File Report 81-8, 36 p.

GEOLOGISTS TED LIVINGSTON, WAYNE MOEN, AND WELDON RAU RETIRE FROM OUR DIVISION

Three long-time Division of Geology and Earth Resources geologists have recently retired.

Vaughn E. (Ted) Livingston, Jr. — Ted came to work with the Division of Mines and Geology in June 1956, after having received a bachelor's degree, in 1954, and a master's degree, in 1955, in geology from Brigham Young University. He was promoted to Geologist III in 1959 and to Geologist IV, assistant supervisor of the Division, in 1963. Among his duties as assistant supervisor were the management of field mapping programs and regulatory activities under the Oil and Gas Conservation Act. Upon Marshall Huntting's retirement as State Geologist in October 1971, Ted was promoted to that position. Under Ted's leadership during the 1970's, new programs began, which included environmental geology, statewide geothermal resource assessment, and coal resource evaluation. During this period, the name of the division was changed to the Division of Geology and Earth Resources, and the staff doubled in size. Ted authored several division bulletins and information circulars and was a co-author of the 1961 state geologic map. Ted's retirement became effective on May 31.

Wayne S. Moen—Wayne received a bachelor's degree in geology from the University of Washington in 1952. He went to work for Shell Oil Co. as a geologist for a year and then worked for the U.S. Atomic Energy Commission as a uranium geologist from 1953 to 1956. In 1957, he served with our Division. Wayne then became a consulting geologist and engineer with Weldit Tank and Steel Co., in Bellingham, until 1959 when he returned to the Division where he remained until his retirement on June 30, 1982.

Wayne produced an extensive series of mineral commodity reports, publications on mining districts, bulletins, and geologic maps. Among the several publication awards he received from the Society for Technical Communication, Puget Sound Chapter, was an award for excellence (first place). During his tenure with the Division, Wayne probably visited and evaluated more mines and prospects in Washington than any individual ever has, and his extensive knowledge of Washington mineral deposits was always freely available for the benefit of explorationists and prospectors. Wayne's expertise has been a mainstay in the Division for the more than 23 years that he was employed here.

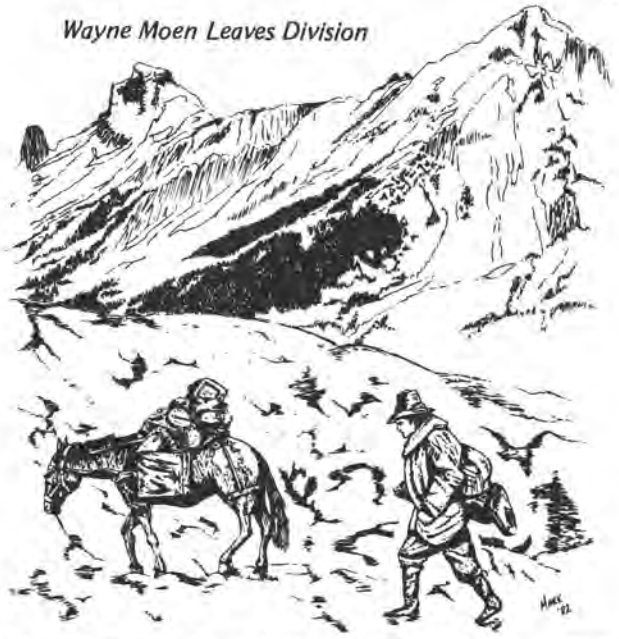
Weldon W. Rau—Weldon received a bachelor's degree in geology from the University of Puget Sound in 1943, and a master's degree (1946) and a Ph.D. (1950) from the University of Iowa. He held associate and assistant professorships in geology at the University of Puget Sound from 1948 to 1950. During the following 10 years he was employed by the U.S. Geological Survey conducting research in Tertiary biostratigraphy of western Washington, Oregon, and northern California. He was based in Portland until 1954 and then Menlo Park, California, until 1960. Since 1960, Weldon has been the biostratigrapher for our Division. He is a member of several professional societies, has published numerous journal articles, U.S. Geological Survey professional papers, maps, and bulletins, and he has authored geologic maps, bulletins, and reports for both the Washington Division of Geology and Earth Resources and the Oregon

Department of Geology and Mineral Industries. Weldon is the recipient of a national award for excellence (first place) for technical report writing from the Society for Technical Communication.

During his tenure with the U.S. Geological Survey and our Division, Weldon has become an authority on stratigraphic and structural geology of western Washington and is a broadly recognized expert in the interpretation of microfossil assemblages from the Tertiary of northwestern North America. Weldon intends to continue to be professionally active and will remain in the Olympia area. He will be serving the Division on a part-time basis for at least the next year.

Ted, Wayne, and Weldon have a combined length of service of more than 71 years. During those years, they have helped to bring many beneficial changes to the Division and have served as models of the highest standards of professionalism for the rest of their colleagues. Their services and friendship will be missed by all. We wish them the best for many happy, busy, and productive years in the future.

Wayne Moen Leaves Division



After 23 years as Minerals Geologist for Washington Division of Geology and Earth Resources, Wayne retired on June 30th. [Wayne expressed the wish that this drawing appear in the newsletter, vividly depicting one of his hobbies he intends to pursue.]

U.S. GEOLOGICAL SURVEY 7½-MINUTE TOPOGRAPHIC QUADRANGLES
(Maps received in the Division library, May 5, 1982)

Name	New edition	Photo revised	Latitude (indicates southeast corner)	Longitude	County
Bothell	1953	1981	47°45'00"	122°07'30"	Snohomish; King
Conconully East	1981		48°30'00"	119°37'30"	Okanogan
Coyote Butte	1981		46°52'30"	118°07'30"	Adams
Friday Harbor	1954	1981	48°30'00"	123°00'00"	San Juan
Gould City	1981		46°30'00"	117°30'00"	Garfield
Hay	1981		46°37'30"	117°52'30"	Whitman
Holly	1953	1981	47°30'00"	122°52'30"	Kitsap; Mason; Jefferson
Joe Lake	1980		48°07'30"	119°22'30"	Okanogan
Lance Hills	1980		47°22'30"	117°37'30"	Spokane
Latah	1980		47°15'00"	117°07'30"	Spokane; Whitman
Malott	1981		48°15'00"	119°37'30"	Okanogan
Maltby	1953	1981	47°45'00"	122°00'00"	Snohomish; King
McNeil Island	1955	1981	47°07'30"	122°37'30"	Pierce; Thurston
Newport, Wash.-Idaho	1968	1981	48°07'30"	117°00'00"	Pend Oreille
Point Roberts	1952	1981	48°52'30"	123°00'00"	Whatcom
Puyallup	1961	1981	47°07'30"	122°15'00"	Pierce
Sassin	1980		47°22'30"	117°52'30"	Lincoln
Skookum Creek	1968	1981	48°15'00"	117°07'30"	Pend Oreille
Sperry	1981		46°37'30"	118°22'30"	Franklin; Adams
Stormy Mtn.	1968	1981	47°52'30"	120°15'00"	Chelan
Tonasket	1981		48°37'30"	119°22'30"	Okanogan

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