

THE ORE.-BIN

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STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES  
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THE ASTORIA LANDSLIDES

Erosion to most of us means the slow, almost imperceptible, wearing down of the higher parts of the earth's crust by running water, wind, or ice. Seemingly mountains remain the same height and stream valleys the same depth throughout the years. The only rapid changes in the landscape which are accepted as normal are the neat excavations made when new roads, dams, or other man-made structures are constructed. It is not surprising that special attention to the choice of a foundation for an ordinary building is seldom given, for our experience tells us that the durability of the structure is infinitely less than that of the ground on which it is built. It comes as a shock to us when exceptions to our everyday observations occur. Such is the case in the land-sliding at Astoria, Oregon, at the mouth of the Columbia River.

This year, damage from landsliding in Astoria has centered in the western part of town at West Commercial and West First streets. Twenty-seven houses have been affected, five of which were already abandoned as the result of slippage last winter. The houses in this area will be destroyed unless moved and the streets, sidewalks, plumbing, landscaping, and other improvements are doomed. In 1950 twenty-three houses in the Coxcomb Hill area were removed or destroyed. A loss of fifty houses in one city due to geological processes in a matter of a few years is a serious situation, and a brief review of the geology of the area is given so that a better understanding of the underlying cause of the destruction may be had.

Structurally, the site of Astoria is on a syncline, the axis of which runs almost east-west through the center of town. The angle of dip of the limbs varies from about 10° to greater than 30°. Outcrops indicate that most of the sediment which makes up the bedrock in the city of Astoria is a clay shale containing limestone concretions. Underlying and overlying the shale is fine-grained sandstone. Petrographic examination of the shale shows that it is bentonitic and made up predominantly of the mineral beidellite (?). The sandstone contains some greensand that consists largely of a glauconitelike mineral and gypsum with minor amount of detrital grains of quartz and plagioclase feldspar. The sandstone is mainly quartz and feldspar. The fossils found in the sandstone and shale have been the subject of study by paleontologists for more than a hundred years. The shale has been designated as a part of the Astoria formation and assigned a Miocene age; however, recent re-examination of foraminifera from a roadcut along Commercial Street about 100 yards east of 37th Street by R. E. Stewart of the Department suggested an upper Oligocene age for the shale in that area. The name "Astoria formation" was first used by Thomas Condon, Oregon's pioneer geologist, sometime before 1880. Basalt is found near the center of town and most of Coxcomb Hill is thought to be a basalt plug. These rocks are assigned to the Miocene epoch also.

Landsliding in the West Commercial Street area as well as in other parts of Astoria is not new. From the top of the hill above West First Street the characteristic topography of landslides can be seen below extending on both sides and above the present zone of slippage. Evidence that the movement of some of this area is not recent is found in the fir and alder trees 8 to 10 inches in diameter growing in slump blocks. These trees show no tilting. Geologists have noted before that landsliding in the Astoria shale is to be expected when the shale occurs on slopes. Etherington, in his paper on the Astoria Miocene of southwest Washington which was published in 1931, states:

" . . . They (the Astoria shales) are very soft and subject to slumping in steeply exposed slopes causing landslides where they form part of a hillside. This tendency seems to be characteristic of the Astoria. . . ."

An explanation of the inherent property of the shale to slide is found in its high content of the bentonitic clay minerals that can take water into their crystal lattice. This causes swelling of the mineral and reduces the friction between the grains. The result is internal stress which is reflected in heaving, and the load-bearing characteristic is greatly reduced. Once landsliding has started, fractures are formed and water can penetrate deep into the shale mass thus affecting a greater volume.

Equilibrium of slope of bentonitic material in areas of heavy rainfall is established only when the angle of slope is essentially flat. If the rainfall is not great this same material may be able to stand on quite steep slopes without danger of failure. It is well known that landslides may be started and speeded up by natural causes such as earthquakes, and unnatural causes such as undercutting lower slopes of a hill in construction work.

Landsliding, a type of mass wastage, is a form of erosion every bit as potent as running water or ice. It is not as well known because the conditions necessary for it to occur are not as widespread and the results are more localized. Like flooding, the damage from landsliding may be disastrous to limited areas and at times difficult to predict; nevertheless its damage is real. If you don't believe it, ask the people of Astoria.

H.M.D.

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#### OREGON OIL AND GAS RULES

The 1953 Legislature passed a new oil and gas conservation law and it became Chapter 520, Oregon Revised Statutes. This law directs the Governing Board of the State Department of Geology and Mineral Industries to compile reasonable rules for the guidance of operators both in the prospecting for and production of oil and natural gas in order to prevent waste. Therefore the Board has just issued Miscellaneous Paper No. 4 titled "Rules and Regulations for the Conservation of Oil and Natural Gas." The paper includes an appendix containing Chapter 520, Oregon Revised Statutes, for reference purposes.

Miscellaneous Paper No. 4 may be obtained at the Portland office of the Department, 1069 State Office Building, or the field offices in Baker and Grants Pass. Price is 50 cents postpaid.

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#### WASHINGTON MINING LAW BULLETIN

The State of Washington Division of Mines and Geology, Sheldon L. Glover, Supervisor, has just issued Bulletin 41, "An Outline of the Mining Laws of the State of Washington." The author is Mr. Morton H. Van Nuys, mining lawyer, Seattle. Bulletin 41 is a revised and expanded edition of the original mining law bulletin by Mr. Van Nuys issued by the Division of Mines and Geology in 1940.

This bulletin is a valuable reference to anyone who needs to look up mining law, not only of the State of Washington but also the federal law which is basic to all public land states. It may be obtained from the Division of Mines and Geology, Olympia, Washington for 50 cents.

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## OREGON'S MINERAL INDUSTRY IN 1953

By  
The Staff

## Introduction

Total value of 1953 mineral production for Oregon has not yet been released by the U.S. Bureau of Mines. The last official figures were for 1951 when total production was valued at a little less than  $28\frac{1}{2}$  million dollars. It seems likely that value in both 1952 and 1953 did not vary greatly from this figure.

Nonferrous metal production in the State in 1953 was very small, even though gold production increased to \$288,750 as compared with \$192,815 for 1952. Only insignificant amounts of copper and lead were produced as by-products of precious metals from ore shipped to the Tacoma Smelter. However, metal mining assumed a more hopeful status because of the start of construction of the Hanna nickel smelter at Riddle and also because of increased chromite production in southwest Oregon. Interest in deposits of some nonmetallies was shown by large out-of-state mining companies and several examinations were made. On the whole, construction continued at a consistent level compared to 1952 which meant a good demand for sand, gravel, stone, and portland cement.

## Metallies

Gold, silver, copper, lead, and zinc

A major proportion of the gold produced in Oregon in 1953 came from the dredge of the Powder River Dredging Company which is working the gravel close to the town of Sumpter, Baker County. Small quantities of placer gold came also from some small hydraulic operations including about ten in Josephine and Jackson counties which were active when water was available. The principal lode gold producer was the Buffalo mine in eastern Grant County which, following its usual procedure, shipped some sorted high grade and ran the flotation mill when sufficient milling grade was accumulated in the stockpile.

Copper and lead output was very small and came principally from the smelting ore shipped from the Buffalo mine. In the late part of the year a new discovery of copper ore was made at the old Standard mine on Dixie Creek in Grant County, and a shipment of high-grade copper ore was sent from the discovery to the Tacoma Smelter. Some exploration was started at the Queen of Bronze copper mine, Josephine County, including diamond drilling by the U.S. Bureau of Mines, and it was reported that the Queen of Bronze Mining and Smelting Company, Grants Pass, had signed a contract with a Japanese company for shipment of copper concentrates from the Queen of Bronze to Japan. A diamond drilling campaign was conducted during the year at the Alameda gold-copper mine on the Rogue River near Galice. A small amount of development work was done at the Neonday (Thompson) mine on the West Fork of Cow Creek in eastern Coos County, and also at the Hamlin copper prospect on Onion Mountain in Josephine County.

Chromite

Chromite mining and prospecting activity continued active throughout the year, when weather conditions permitted, owing to the government's incentive price program. In southwestern Oregon ten chromite concentrating mills shipped concentrates to the purchasing depot. These mills are listed on the following page:

Ashland Mining Company, Ashland, Jackson County  
Bristol-Baker mill, Curry County  
Bowers mill, Josephine County  
Waldo Milling Company (was Chrome Milling Company), French Flat, Josephine County  
Foster mill, Josephine County  
Freeman and Twombly mill, Curry County  
Grants Pass chrome mill, Grants Pass, Josephine County  
Six-mile chrome mill, Josephine County  
Thompson Milling and Manufacturing Company, Ashland, Jackson County  
Radcliffe mill, Galice, Josephine County

Several new chrome deposits were discovered, the most important of which appear to be the Lucky L & R mine, the Sad Sack mine, and some deposits at "Chrome Flats," all on Chrome Ridge, Josephine County. Some new prospects were opened in the Illinois River area but very little is known about their possibilities at present.

According to the U.S. Bureau of Mines chromite reports, production of domestic chrome during the first ten months of 1953 totalled 35,028 short tons, which included production from California and Montana as well as Oregon. Mining activity was curtailed in Oregon and northern California beginning late in October because of snow in the mountains.

Chromite concentrates were shipped to Grants Pass from the town of John Day in central Oregon by Zanetti Brothers of Wallace, Idaho, who had leased the Dry Camp mine, and the mill of the Tri-County Mining Company. Other shipments of concentrates were made by Burt Hayes from the Haggard and New property near Canyon City. U.S. Bureau of Mines metallurgists from Albany, Oregon, took a 30-ton sample of chromite ore from the Chambers and Iron King mines. Metallurgical testing work designed to study possibilities of producing commercial ferrochrome from this ore was started.

#### Mercury

The Bonanza quicksilver mine near Sutherlin, Douglas County, owned by the Bonanza Oil and Mine Corporation produced continuously throughout the year. A Defense Minerals Exploration Administration loan of \$50,056 became available in the middle of the year to be used in exploratory drifting on the 830 and 1050 levels. Some new ore was developed.

Small-scale quicksilver prospecting with some production was conducted at the Maury Mountain mine in Crook County, at the Roba and Westfall property in Grant County, and at the War Eagle mine and Ruby claim group in Jackson County.

#### Nickel

Construction of the nickel smelting plant under contract by the Bechtel Corporation for the Hanna Nickel Smelting Company started early in 1953 and progressed satisfactorily throughout the year. It is now estimated that furnaces may be started in June 1954. Logging and clearing over the ore body on Nickel Mountain were nearly completed as the year ended. Construction of the aerial tramway has progressed rapidly and is nearing completion. About 400 men are employed.

The U.S. Bureau of Mines has been making smelting tests on low-grade nickel laterite from the Red Flat deposit in Curry County. This experimental work has been done along the lines of the process expected to be used by the Hanna Company at Kiddle.

### Manganese

Seven car lots of manganese oxide ore were shipped to the Geneva Steel Company, Utah, from prospects in Pleasant Valley south of Baker. Mining and shipping were done by the Ketell Investment Corporation, Portland.

The U.S. Bureau of Mines conducted a study of manganese deposits in southern Oregon and did some bulldozer trenching on the Neathamer deposit in the Lake Creek district east of Medford, Jackson County. The Bureau also did some exploratory diamond drilling on a rhodonite prospect on Upper Evans Creek in Jackson County. Some exploration work is reported to have been done at the Long Ridge manganese deposit in southern Curry County by Oliver and Earl Boyd and M. E. Porter. Reportedly about 30 tons of manganese oxide was mined but not shipped.

### Iron

A small amount of limonite from the Scappoose district, Columbia County, was mined by the Orr Engineering and Chemical Company and processed in a plant at Scappoose for use in desulphurizing manufactured gas at the Portland Gas and Coke Company plant in Portland.

### Nonmetallies

#### Sand, gravel, and stone

Construction remained at a fairly high level throughout 1952 and 1953, although probably there was a leveling off from the high rate in 1951 when value of sand, gravel, and stone was \$19,948,000. By far the largest proportion of cement aggregate was produced in the Willamette Valley where about forty sand and gravel companies continued to dig river gravels.

#### Limestone

Because of the high level of construction activity, portland cement and hence limestone were produced up to capacity of the plants. In southern Oregon the Ideal Portland Cement Company was active throughout the year. This company quarries limestone at the Marble Mountain quarry and produces cement from this stone at the plant at Gold Hill. A newspaper article reported a statement by a company official that "Although the smallest of Ideal's cement operations, the Gold Hill plant has had \$200,000 worth of modernization and its Marble Mountain quarry is one of the best sources of lime rock in the United States. . . .The Gold Hill plant has an annual payroll of more than half a million dollars . . . and another half million goes for plant materials."

In Baker County the Oregon Portland Cement Company initiated a modernization and expansion program at its quarry and plant at Lime, and the Morrison-Knudsen Company started large-scale exploration of limestone near Durkee. The objective of Morrison-Knudsen is to prove sufficient reserves so that a large-scale program for supplying stone to sugar mills, paper mills, and for agricultural purposes may be set up. Mr. Anthony Brandenthaler announced plans for a new burned lime plant at Baker to be supplied from the property of the Chemical Lime Company owned by Messrs. Brandenthaler and Lilley on Marble Creek west of Baker.

Pacific Carbide and Alloys Company continued quarrying high-grade limestone at their deposit near Enterprise in Wallowa County. A change in furnace design at the Portland plant was made late in the year which will result in increased production of calcium carbide. Undersize material was sold for agricultural use.

Agricultural limestone spread on Oregon farms in 1953 under the Production and Marketing Administration program was somewhat less than the 46,744 tons spread in 1952. More than half of the lime originated in the State of Washington. Bad weather, which prevented spreading during the liming season, was largely responsible for the decline. Oregon agstone quarries are located near Lime, Grants Pass, Roseburg, and Dallas.

### Perlite

The perlite quarry and plant of Dant and Russell, Dantere Division, at Dant on the Deschutes River in Wasco County, optioned by Kaiser Gypsum in 1952, was closed down in 1953. Late reports were that the equipment would be liquidated.

### Diatomite

The operation at Lower Bridge near Terrebonne on the Deschutes River by Great Lakes Carbon Corporation was continued at capacity throughout the year. Reportedly the company is seeking new reserves in central Oregon. Strong interest in Oregon diatomite deposits has been shown by other large mining companies who have been investigating occurrences in central and eastern Oregon.

### Silica

The only producer of silica in Oregon, the Bristol Silica Company, Regue River, continued to ship crushed quartz for metallurgical use, chicken grit, etc. A specialty, catalytic silica for the petrochemical industry, was marketed during the year. An overall increased demand was reported by Mr. F. I. Bristol, owner of the company. It is also reported that when operations of the nickel smelter at Riddle begin, demand for high-grade quartz will be greatly stepped up.

### Lightweight aggregates

Two producers at Bend, L. A. Williamson, Cascade Pumice Company, and William Miller, Central Oregon Pumice Company, were active throughout the year. Harney Concrete Tile Company, operated by Don Robbins near Burns, produced cinders and pumice. A considerable quantity of pumice was sold for road metal to logging companies.

Volcanic cinders found increased use in 1953, particularly for aggregate used with asphaltic paving. Leroy Grote produced cinders from Tetherow Butte near Redmond and L. A. Williamson operated a quarry near Tumalo.

Expanded shale continued to be produced by Northwest Aggregates and Smithwick Concrete Products Company in the Portland area.

### Clay

Brick plants were busy throughout the year as demand for building brick continued good. Most of the brick clay was produced in northern Willamette Valley, although the plant at Klamath Falls continued active as in previous years.

### Asbestos

The Canadian Johns-Manville Company finished prospecting for chrysotile asbestos in Grant County and shifted activities to Josephine County where several prospects were examined. Three diamond drill holes were put down on a prospect on Josephine Creek owned by George C. Foster. Representatives of other asbestos companies made examinations in southern Oregon.

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### UMATILLA COUNTY MAP TO BE PUBLISHED

N. S. Wagner, field geologist of the Department, has completed a preliminary geologic map of the southern half of Umatilla County. Field work on this project by Mr. Wagner was done during 1952 and 1953. For two weeks during 1953 he was assisted by R. E. Cereoran from the Portland office. A reproduction of the map together with an abstract of the report on the geology will be included in the March issue of the Ore.-Bin.

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CHRONOLOGY OF EVENTS LEADING TO  
REVALUATION OF GOLD IN 1934

It was just twenty years ago on January 31, 1934, that gold was officially revalued from \$20.67 to \$35.00 an ounce. Time passes quickly, memories are short, and many people were too young in 1934 to recall now the absorbing interest in monetary policies that people had in the early 1930's. Although the cost of producing gold has doubled and the price of commercial gold to consumers has gone up substantially, the price received by the gold miner remains at the 1934 price of \$35.00 an ounce. As gold is likely to assume increasing importance in the national economy, it may be profitable to review the sequence of events which led to the change in the gold price.

Ed.

Average Monthly Value in Dollars Per Fine Ounce 1933 London Quotation  
(U. S. Bureau of Mines Minerals Yearbook)

	<u>Dollars per fine ounce</u>
January . . . . .	\$20.5872
February . . . . .	20.6551
March . . . . .	20.6492
April . . . . .	21.5907
May . . . . .	24.2586
June . . . . .	25.2871
July . . . . .	28.8271
August . . . . .	28.3067
September . . . . .	30.6368
October . . . . .	30.7053
November . . . . .	33.1486
December . . . . .	32.2859

March 6-13, 1933

The President declared a bank holiday to prevent excessive withdrawal of bank depositors' funds.

April 5, 1933

By executive order the President forbade the hoarding of gold coin, gold bullion, and gold certificates.

April 19, 1933

The United States went off the gold standard for the second time in its history. (Shortly after the outbreak of the Civil War specie payment was suspended and gold was at a premium until January 1, 1879, when full convertibility was restored.)

April 20, 1933

By executive order the President forbade the export of gold bullion.



July 27, 1933

According to a decision of the Attorney General effective August 9, 1933, permission to export gold in ore and in concentrates, and in unretorted amalgam, bullion, and in unrefined cyanide precipitates was allowed up to 75 percent of gold-mine production. This order made it impracticable for smelters to dispose of the remaining 25 percent. There was confusion because of inability to do business with reliable purchasers abroad and very little of this class of material was shipped.

August 29, 1933

By executive order the President stated that the United States government would act as agent for producers of newly mined gold to obtain the world price through the United States Mint and Federal Reserve Banks. All sales were handled by the Federal Reserve Bank of New York. Sales abroad were made from September 13 to November 1.

October 22, 1933

The President announced by radio that he planned to control the dollar by establishing a government market for gold and to have the Reconstruction Finance Corporation buy newly mined gold in the United States. Also the government would buy and sell in the world market if necessary.

October 24, 1933

The Treasury ceased buying domestic gold (at \$29.80 an ounce).

October 25, 1933

By executive order the Reconstruction Finance Corporation began to buy newly mined gold at prices arbitrarily fixed and periodically advanced, with the price generally above the world price (\$31.36 this date - 27¢ an ounce above London quotation). Payment by the RFC was in notes payable in principal and interest on February 1, 1935.

October 27, 1933

The President authorized the Reconstruction Finance Corporation to extend government purchase of gold into foreign markets and the RFC paid \$32.36 an ounce in Paris and London markets.

November 2, 1933

The Federal Reserve Bank of New York began buying foreign gold in Paris and London.

December 28, 1933

The Secretary of the Treasury called in hoarded gold. Deadline was set for January 17, 1934, (later extended).

December 31, 1933

Monetary gold stocks in the United States totaled \$4,323,000,000, with \$310,970,000 in circulation (at \$20.67 an ounce). At this time world monetary gold stock approximated \$11,964,000,000 (at \$20.67 an ounce).

January 15, 1934

The President delivered a message to Congress in which he requested authority to vest title in the United States Government to all supplies of American-owned monetary gold and to fix the upper limit of permissible revaluation at 60 percent. Gold Reserve Act of 1934 introduced in Congress. (RFC bought 4,030,260 ounces of gold worth \$131,671,604 before ceasing its buying operations January 15, 1934.)

January 16, 1934

The Federal Reserve Bank of New York began paying depositors by check the United States price of \$34.45 per ounce less a small commission, according to the President's message to Congress on January 15 recommending that the upper limit of revaluation of the gold be set at 60 percent.

January 20, 1934

The House passed Gold Reserve Act by a vote of 360 to 40.

January 27, 1934

The Senate passed Gold Reserve Act by a vote of 66 to 23.

January 30, 1934

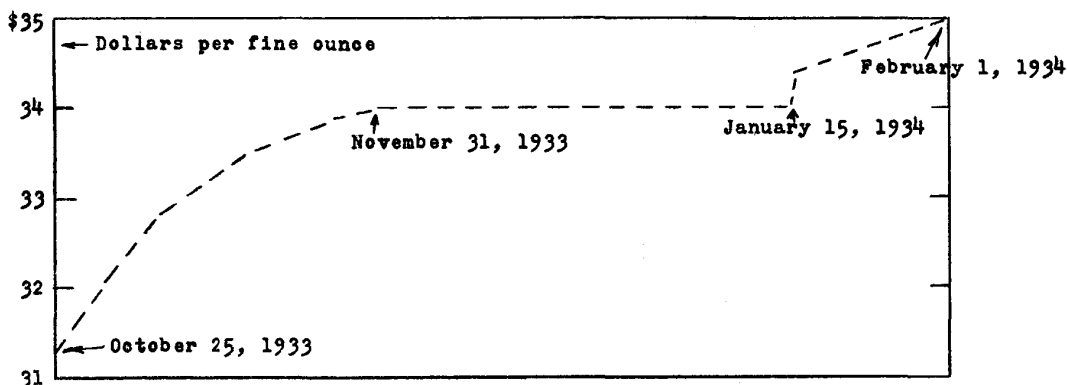
The President signed Gold Reserve Act into law.

January 31, 1934

The President issued a proclamation acting under the powers granted by Title 3 of the act approved May 12, 1933, (Thomas amendment to the Farm Relief Act) fixing the weight of the gold dollar at 15 5/21 grains, nine-tenths fine, which was 59.06 percent of the former weight of 25 8/10 grains, nine-tenths fine. The value of gold immediately became \$35 per fine ounce.

Under the Gold Reserve Act of 1934, the entire stock of monetary gold in the United States including gold coin and gold bullion heretofore held by the Federal Reserve Bank, and the claim upon gold in the Treasury represented by gold certificates was vested in the United States government and the "profit" (\$2,883,800,000) shown by the reduction of the gold content of the dollar accrued to the United States Treasury. This "profit" according to the President's proclamation constituted a stabilization fund under the direction of the Secretary of the Treasury.

The Secretary of the Treasury, with the approval of the President, announced that beginning February 1, 1934, he would buy, through the Federal Reserve Bank of New York as fiscal agent, all gold delivered to any United States Mints or assay offices in New York and Seattle at the rate of \$35 per fine troy ounce less the usual mint charges. Purchases were subject to compliance with regulations issued under the Gold Reserve Act of 1934. The Secretary of the Treasury also promulgated new regulations governing purchase and sale of gold by the United States Mints. The mints were authorized to purchase gold recovered from natural deposits in the United States or any place subject to its jurisdiction, unmelted scrap gold, gold imported into the United States after January 30, 1934, and such other gold as might be authorized from time to time by rulings of the Secretary of the Treasury. No gold could be purchased which had been held in noncompliance with previous acts or orders or noncompliance with the Gold Reserve Act of 1934. Affidavits as to the source from which the gold was obtained were required. As for imported gold, the mints could purchase only that which had been in customs custody after its arrival in continental United States.



Graph Showing Weekly Government Buying Price of Gold  
From October 25, 1933, to February 1, 1934

#### References

U.S. Bureau of Mines Minerals Yearbook  
Commercial and Financial Chronicle, New York.

F.W.L. and R.S.M.

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## VOLIN PROMOTED

M. E. Volin, formerly chief of the mining division of the U.S. Bureau of Mines, Region II with headquarters at Spokane, is now director of Region V with headquarters at Minneapolis. Mr. Volin's promotion came in December 1953, and his successor at Spokane is Wing A. Agnew, formerly Chief of the Bureau of Mines' Mt. Weather Experiment Station, Bluemont, Virginia.

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## NEW PLACER OPERATION

Placers, Inc., is a new corporation which has taken over the claims formerly owned and operated by the Pedro Brothers on Connor Creek in southeastern Baker County, Oregon. Officers of the new company are: Vernon McClure, Midvale, Idaho, President; Jacob Schoesler, Ontario, Oregon, Vice President; and Harry Schaffer, Ontario, Oregon, Secretary. The property includes four gulch-type placer claims laid out end to end and recorded as "The Group of Huntington Placers." The area on Connor Creek represents drainage below the famous old Connor Creek gold mine which had a substantial production from high-grade ore in the early days of eastern Oregon mining. Areas along Connor Creek have been placered periodically since operation of the old Connor Creek mine. Coarse gold is sometimes recovered. Both cinnabar and native quicksilver are also reported to be present. The company plans to dig with a power shovel and to truck the gravel to a stationary washing plant downstream from the working face. The plant will be placed sufficiently high above the creek to allow for tailings impoundment and will be skidded upstream as the new excavations make necessary.

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## ALUMINUM PRODUCTION

Estimated production of primary aluminum in the Pacific Northwest for 1953 was 943 million pounds, or 37 percent of the total United States production. Current production of aluminum in Washington and Oregon is almost three times the amount produced throughout the entire nation just 14 years ago. The three primary aluminum producers in the Pacific Northwest employ 8900 workers and had a payroll of \$39 million in 1953.

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Report of Industries Department, Portland Chamber of Commerce, January 1954.

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## DIATOMITE PROJECT

Malheur Wunder Earth, Inc., Vale, Oregon, is reported to control, both by location and by lease, approximately 3400 acres of land in the Harper-Westfall area of northern Malheur County, Oregon. Following are the officers of the company: Don Galbreath, Vale, President; Robert D. Lytle, Vale, Vice President; Jack Craig, North Powder, Second Vice President; Kenneth Johnson, Vale, Treasurer; and Dan Hartley, Portland, Secretary. Mr. Berle Woods, Yakima, is technical consultant. The diatomaceous earth deposits controlled by the company are fully described by B. N. Moore in U.S. Geological Survey Bulletin 875, "Nonmetallic Mineral Resources of Eastern Oregon." The company plans to install a Raymond mill with cyclones during the coming spring.

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## SALEM ALUMINA-FROM-CLAY PLANT STARTS

According to the Salem Statesman, the alumina-from-clay plant built by the government during World War II and purchased by the Harvey Machine Company, Los Angeles, has started experimental work under A. W. Metzger, Plant Manager. The experiments will attempt to point the way to practical methods of treating clays and other high-aluminous materials for recovery of alumina.

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## SNAVELY PROMOTED

Mr. Parke D. Snavely, Jr., who has been Supervising Geologist of the U.S. Geological Survey Fuels Branch in Oregon and Washington for the past several years, has been promoted to the position of Regional Supervisor, Pacific Region of the Fuels Branch, and has moved from Portland to his new headquarters at Menlo Park, California. Mr. Linn Hoover has succeeded Mr. Snavely and is now Acting Supervising Geologist in Portland with headquarters at the Main Post Office Building.

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## EASTERN OREGON MINING ASSOCIATION ELECTS OFFICERS

New officers of the Eastern Oregon Mining and Mineral Association, Baker, are: William J. Wendt, Jr., President; Joe G. Balthazer, First Vice President; Ivan Thompson, Vice President representing Baker County; C. C. Clement, Vice President representing Union County; I. B. Hazeltine, Vice President representing Grant County; Fred Moes, Treasurer; and Nadine Strayer, Secretary. Orville Fleetwood and Paul Van Arsdale were named trustees and James A. Peston, George Bailey, and Jesse Edwards were named directors.

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## MR. AND MRS. HENDRYX CELEBRATE GOLDEN WEDDING ANNIVERSARY

Mr. H. E. Hendryx, who retired from the Governing Board of the State Department of Geology and Mineral Industries because of ill health, and Mrs. Hendryx observed their fiftieth wedding anniversary at the home of their son and daughter-in-law, Mr. and Mrs. Truman Hendryx, in Washington, D.C., on December 17, 1953. For fifty years Mr. Hendryx was associated with eastern Oregon newspapers and eastern Oregon mining. No one was better known in Baker County than Ed Hendryx and no one was more familiar with mining developments in the county for the past several decades.

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## NEW OREGON OFFICE FOR HUMBLE OIL

R. M. Touring, geologist for Humble Oil and Refining Company, has been transferred from Salinas, California, to new company offices set up at Eugene, Oregon.

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## CHROME SAMPLE GIVES HIGH ANALYSIS

The highest grade chromite sample received by the Department during the past 5 years was recently sent in by George W. Bauguess, O'Brien. The sample originated at the Chrome Dome No. 1 claim on Whiskey Creek in Josephine County, jointly owned by Bauguess and Grover C. Royer. Analysis shows 58.71 percent  $\text{Cr}_2\text{O}_3$  and 12.78 percent Fe. The chrome-iron ratio is 3.13:1, and a shipment of similar grade ore would bring \$163.04 per ton delivered to the Grants Pass stockpile.

Close runner-up to the Chrome Dome ore is a sample sent in by Pat Arnet in 1950 from the Prospect claim on Onion Mountain, Josephine County. It analyzed 57.87 percent  $\text{Cr}_2\text{O}_3$ , 11.72 percent Fe with a chrome-iron ratio of 3.37:1. The higher chrome-iron ratio of Arnet's sample, however, gives it a higher calculated dollar value of \$169.28 per long ton despite its slightly lower chromic oxide content.

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## UMATILLA COUNTY GEOLOGIC MAP

The January Ore.-Bin announced that the Umatilla County map and text would be published in the February issue. It was not feasible to do this and it is now planned to publish the map in the March Ore.-Bin.

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## NEW EASTERN OREGON CHROME COMPANY

According to the Baker Record Courier, the John Day Mining Corporation of John Day has taken over the holdings of the Tri-County Mining and Concentrating Company on a two-year lease. The property leased includes the Dry Camp chrome mine near Canyon City and the Tri-County concentrating mill at John Day.

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## PACIFIC CARBIDE REMODELS

Increased production of calcium carbide will result from changes made at the Pacific Carbide and Alloys Company plant in north Portland. Continuous carbon electrodes of the Soderberg type have replaced pre-baked ones in the modernization program which cost about \$100,000. Pacific Carbide obtains high-calcium limestone from a company-owned quarry near Enterprise, Oregon. A total of about 35,000 tons of stone is shipped to Portland annually where it is burned prior to mixing in the electric furnace with petroleum coke briquets obtained from Portland Gas and Coke Company.

Calcium carbide is used principally as a source of acetylene gas which is used extensively in welding.

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## NEW SNOWMOBILE FOR BUFFALO MINE

The Buffalo mine, Grant County, only consistent lead ore shipper, has purchased a snowmobile in order to keep in contact with the outside world during wintertime. The mountains, particularly between Granite and Sumpter, are usually covered with several feet of snow and the mine will now be able to handle mail and light freight during the winter months when roads are closed.

\*\*\*\*\*

## QUICKSILVER MINE SUCCUMBS

The Bobnanza mine, owned by the Bonanza Oil and Mine Corporation, has closed down because of inability to make a profit under present operating conditions. The grade of ore, coupled with high costs, did not allow a profit during the past year and the outlook for the coming year is such that the company was forced to suspend. The mine contains low-grade ore but will fill up with water and it is unlikely that this ore will be readily available in future years in time of an emergency.

\*\*\*\*\*

## MOLYBDENUM IN SOILS

According to the E&M Metal and Mineral Markets, molybdenum added to soils as a trace element is making some farm land as much as 50 percent more productive. Arthur H. Bunker, President of Climax Molybdenum Company, has stated that molybdenum is being used on huge tracts of farm land in Australia, New Zealand, Hawaii, California, and New Jersey.

\*\*\*\*\*

## DIATOMITE IN 1952

According to the U.S. Bureau of Mines, annual production of diatomite for the three years 1948-1950 averaged 241,000 tons valued at \$6,154,000. It is stated that the average value per ton of diatomite at the mine has advanced from \$14.81 in 1933-1935 to \$25.55 in 1948-1950. Of the 1952 production, 48 percent was used in filtration, 29 percent as fillers, 11 percent as insulation material, and 12 percent in miscellaneous uses. Trade journal quotations on diatomite ranged from \$42 to \$100 per ton, depending upon quality, quantity, and point of sale.

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March 1954

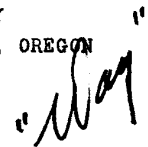
Portland, Oregon

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES  
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PRELIMINARY REPORT ON THE GEOLOGY  
OF THE SOUTHERN HALF OF UMATILLA COUNTY, OREGON

By  
N. S. Wagner\*



Introduction

Past geologic studies have served to provide a fairly well-integrated picture of the broader aspects of the geology of Umatilla County, Oregon. These studies may be summarized by stating that a thick blanket of basaltic lavas of the Columbia River series (Miocene) constitutes the most widespread formation present. Rocks of this series are well exposed from the banks of the Columbia River to the summits of most of the higher peaks in the Blue Mountains, portions of which traverse the southern and eastern sections of the county. Later formations are represented by a veneer of sediments which include Pliocene lake beds and various other Pleistocene sediments. Occurrences of this veneer are, with one exception, localized in the lowlands of the Columbia basin portion of the county. The occurrence of pre-Miocene formations in turn is limited almost exclusively to the mountains in the southern part of the county.

It has been known for a long time that pre-Miocene rocks existed in Umatilla County, but formations of these rocks were never before mapped. The primary objective of this survey was to broaden the geologic picture by mapping and correlating the pre-Miocene formations which were found to occur to a far greater extent than was previously suspected.

Location and Description of Area

The area mapped embraces nearly 1200 square miles. This includes all of Umatilla County south of an east-west line which runs through a point about 2 miles south of the town of Pilot Rock. Also included is a margin of overlap into adjoining counties. A large part of the terrain thus covered consists of the northern portion of the Blue Mountains.

Elevations in the area mapped range from about 1700 feet near Pilot Rock to 6600 feet on the peak of Tower Mountain. In general, the mountains are an elevated plateau which still contains many fairly flat areas despite severe erosion. No topographic maps are available so only estimates can be made, but the elevation for most of these surfaces would fall between 4500 and 5000 feet, although some exceed 5000 feet by a substantial margin. Relief is great, especially in the canyon of the North Fork of the John Day River and along the northern flank of the mountains which are deeply dissected by the many tributaries flowing north to the Columbia River.

Forest land is abundant and a large proportion of the area is within State and National forests. Although the population is sparse, the grazing and lumbering potentialities of the region are of major importance. U.S. Highway 395 is the only paved road. Secondary roads range from forest roads of the most primitive sort to graveled logging arterials, and there are large tracts in which roads of any kind are nonexistent. Ukiah is the only sizable settlement. Major creeks and other pertinent landmarks are indicated on the map (see opposite page 15) and need no additional description. A State park memorializing the site of one of the last Indian engagements fought in the State is situated at Battle Mountain near where the highway crosses the main body of granite in the northern belt of pre-basalt exposures.

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\* Department Field Geologist, Baker, Oregon.



### Field Work and Base Maps

Survey work was begun in the summer of 1951 and continued through the 1952 and 1953 field seasons. The only topographic map available covered a very narrow strip on the southern border of the county that is part of the Dale quadrangle. Most of the mapping was done on a United States Forest Service planimetric base and on aerial photographs. Thanks are due to various members of both the State and Federal Forest Service for a wealth of supplementary data on the location of new logging roads and for many other favors, and to the Harris Pine Mills and Pilot Rock Lumber Company for comparatively unrestricted permission to travel over their holdings. Special thanks are also due to Mr. Beamer of the Production and Marketing Administration office in Pendleton for his cooperation in arranging a gift of aerial photographs covering most of the northern half of the area. These were of invaluable assistance in mapping the exposures of the northern pre-basalt formations.

### Geology

#### General

The pre-Miocene rocks include a series of terrestrial fossiliferous sediments and acidic volcanics of early Tertiary age plus granitic intrusives and a metamorphic complex of pre-Tertiary age. Most of the exposures of these rocks are erosional windows. Great differences in elevations of exposures exist, however, often within very short horizontal distances, and it is clear that some of the higher exposures were originally not covered by more than a very thin skin of basalt, if indeed they were covered by any at all in some places. Since post-basalt faulting is comparatively negligible, it is apparent that the pre-basalt topography was highly dissected and precipitous in nature before the area was covered by the lava flood. The early Tertiary area surrounding Tower Mountain is an example of one of the topographic highs which was apparently never completely covered by the later basalts. The lack of topography on the map makes it impossible to appreciate this third dimensional factor; moreover it is not possible to describe fully the implications imposed thereby in the limited amount of space available. It can be stated, however, that the random and completely unpredictable manner of exposure with respect to elevation made it impossible to project contacts or to anticipate a pattern of emplacement which could be relied upon for any appreciable distance in tracing the pre-Miocene occurrences.

#### Pre-Tertiary metamorphics

The rocks of this series compare so closely with those mapped by Pardee in the Sumpter quadrangle, by Gilluly in the Baker quadrangle, by Allen in the Morning mine area, and by the writer in the Telocaset quadrangle, that it seems reasonable to correlate them. Individual rock types include argillites, cherts, quartzites, greenstones, gneisses, and schists, together with minor amounts of basic crystallines and occasional pods of limestone. All types have undergone considerable metamorphism.

In some places, especially in the southern portions of the area, individual phases of the metamorphic complex occur in sufficiently distinct and large-sized exposures as to justify subdivisional mapping, but in other places these various rock types are so intimately associated and often so poorly exposed that it is doubtful if they could be mapped satisfactorily even if a good topographic base map were available. Therefore all related rock types were mapped as a unit. The resulting unit compares favorably with the "argillite" series as mapped by Pardee in the Sumpter quadrangle except the small patches of gabbro and metagabbro which are included here but which Pardee was able to map separately. Pardee reports limestones with crinoids suggestive of the Carboniferous period but points out that the series as a whole probably ranges from somewhere in the Paleozoic to well within the Mesozoic. Gilluly has shown some of the greenstones to be Permian.



### Pre-Tertiary "granites"

Granite Meadows is the name by which the meadows at the head of Owing Creek have long been known. Actually, however, the "granites" of the area are more nearly a blend of diorite and quartz diorite in which biotite and hornblende are locally very abundant. Like the metamorphic rocks, these intrusives appear to correspond with those which occur in the Elkhorn range of the Blue Mountains. They are considered to belong to the middle or upper Mesozoic.

### Early Tertiary volcanics

The rocks of this group consist primarily of rhyolites and related volcanics of acidic composition. Flows probably come first in order of abundance, followed by clastic tuffs and breccias. Some stratified sands and silts occur in association with the volcanics, but these represent an exceedingly small proportion of the group as a whole and they were observed only in the northern portion of the area. The sediments contain leaf fossils and therefore they have had a great deal of attention while the larger volcanic phase of the formation has had virtually none. The fossil leaves are characterized by palms and broad-leaved evergreens which are considered indicative of a Clarno (Eocene) age. A common relationship of unconformity with respect to the underlying pre-Tertiary and the overlying basalts is exhibited in both the northern and southern groups of exposures. This stratigraphic position constitutes supporting evidence of a Clarno age designation as does also a similarity between the volcanic members and other established Clarno volcanics elsewhere in central Oregon. Some of the tuffs in the North Fork of the John Day canyon may possibly be minor phases of the John Day formation. Whether they are or not is something that will require more investigation, but in view of the possibility that they might correlate with the John Day, the formation as mapped here is tentatively classed as of Eo-Oligocene age rather than as Eocene alone.

Reference to the map will show that only two large occurrences of this rock unit are mapped in connection with the northern belt of pre-Miocene exposures. It should be mentioned accordingly that a narrow fringe of exposures actually exists at many places along both flanks of the northern pre-Tertiary belt, especially from the highway westward, but these exposures are for the most part too restricted in their extent to show without distortion on a map of the present scale.

### Later Tertiary formations

The Columbia River basalt in the area consists of a thick succession of basic to intermediate lavas. No mappable interbeds were observed and the only overlying material other than soil consists of poorly consolidated lake-bed sediments and bench gravels in the vicinity of Ukiah. The Columbia River basalts have been assigned a mid-Miocene age in the Picture Gorge area of central Oregon. Little question exists that the lava of southern Umatilla County is largely equivalent to that of the Picture Gorge area, but no conclusive evidence was observed to prove the local flows are exclusively Miocene in age. The question of age is therefore left open insofar as the upper limit is concerned.

### Structure

All attitudes noted on the pre-Tertiary rocks were recorded on schistosity and foliation. The dips are invariably steep, often vertical, and very likely reflect tight, isoclinal folding. A common trend is roughly east-west. Pre-basalt faulting was undoubtedly great as is indicated by local shearing and a generally high intensity of foliation but no regional pattern was recognized other than that to be inferred from the trend of the northern belt of pre-basalt exposures and its parallelism with the flank of the present mountains. From this there can be little doubt but what this belt of exposures coincides closely with the trend of a major pre-Tertiary fault which may even have had scarp expression in early Tertiary times.

The structure exhibited by the late Tertiary basalts is characterized by a state of light deformation in which gentle folding appears to be more prevalent, or at least more pertinent, than faulting. This is particularly conspicuous along the northern flank of the mountains where the dominant structure is a monoclinical downwarp of the blanketing basalts rather than a fault scarp like these which are so prominent a part of the mountain-valley relationship in so many other places in the Blue Mountains. This monocline starts with dips that are essentially horizontal on the summit and ends with a moderate regional dip to the northwest in the foothill area. Because the axis is breached by erosion the continuity of this structure can be traced without interruption in only a few places where the highest and youngest flows extend from the summit in an unbroken manner. The picture is further complicated by local minor faulting and by local steep dips which are present in the basalts in places where the older flows contact the sloping surfaces of the underlying pre-basalt topography. The lack of widespread faulting together with observations which indicate a state of high relief prior to the period of the basalt flooding tends to suggest that this monoclinical condition may owe its origin more to depositional molding of the basalts over the pre-basalt topography than to later structural uplift.

#### Summary

At the time field work was started the area was known to contain pre-Tertiary schists and "granite" and fossiliferous sandstones. Beyond this, knowledge concerning the pre-Miocene formations was small and it was as logical to believe as not to believe, that equivalents of the sedimentary Cretaceous of central Oregon, or the serpentine and ultrabasics of the John Day region, might well be represented in the area; likewise for the John Day and Mascall formations which occur even closer to the area. No trace of these formations was recognized, however, except for the possibility that some comparatively minor phases of the John Day formation might be represented. Instead, the pre-Tertiary rocks of this area appear to correlate with the Paleozoic and Mesozoic rocks found farther to the east in the Blue Mountains as described in Pardee's report on the Sumpter quadrangle. Most of the early Tertiary rocks were found to be of volcanic derivation rather than sedimentary as originally supposed and the bulk undoubtedly correlates with the Clarine formation. In any event, the areal extent of both the pre-Tertiary and the early Tertiary formations proved considerably greater than was generally suspected at the outset of the investigation, especially the early Tertiary volcanics of the Tower Mountain region which undoubtedly represent a major center of early Tertiary volcanism.

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#### COMMERCIAL OIL IN NEVADA

Shell Oil Company, which has been drilling in the Eagle Springs area, Nye County, Nevada, about 60 miles southwest of Ely, has found an oil horizon which may make Nevada the twenty-ninth oil-producing state in the nation. The News Letter of the Nevada Mining Association, Louis D. Gordon, Secretary, has the following comment in the March 15 issue:

"The important oil news of the last month is the announcement by the Shell Oil Company that their Eagle Springs No. 1 Well in section 36, T. 9 N., R. 57 E., had encountered oil in commercial quantities. The announcement was made at the close of business February 17, 1954, when the hole was approximately 6588 feet deep. The top of the oil bearing horizon was given as 6453 feet and a drill stem test of the 80-foot interval below this horizon indicated the well had a potential of about 180 BOPD. The high formation pressures were a very encouraging sign. Immediately upon recovery, the oil is quite gassy and has a gravity of 25.9° API, which is a good grade of crude, although nothing exceptional. The pourpoint is 80° F, which means that below that temperature the oil is solid and closely resembles black shoe polish. There was considerable surprise at the age and type of the reservoir rock,

for it is of Tertiary Age, probably the Miocene Epoch, the rock being a pyroclastic, or volcanic debris ranging in particle size from dust and ash to bombs and other ejectamenta. This type of lithology is most unusual for a petroleum reservoir rock.

"Since the initial announcement, the well has continued to drill and is currently below 7200 feet. The petroleum saturation continued as deep as 6913 feet. The Shell is currently seeking the top of the Paleozoic System. The 'pay-zone' of 460 feet already discovered will boost the daily capacity of the well far above the 180 BOPD figure which was based on 80 feet of pay."

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#### RADIOASSAYER

A "radioassayer," a new instrument for making routine tests for radioactivity has been installed at the laboratory of the Department of Geology and Mineral Industries, State Office Building, Portland, on loan from the Atomic Energy Commission. Radioassayers have been placed in a number of mills and laboratories on a temporary basis by the Commission to test all samples as they pass through. The first report of this program is given in U.S. Atomic Energy Commission RME-4025, "Routine testing of samples for radioactivity in mills and assay offices in the United States," a Progress Report by Muriel Mathez, 1953.

The radioassayer is designed to check radioactivity present in the ranges 0.05 percent to 0.1 percent and 0.1 percent to 0.15 percent  $U_3O_8$  equivalent, the 0.05-percent range especially being lower than can be determined on most Geiger-Müller counters. The purpose of this program is to provide a means for routine monitoring for radioactivity diverse types of ore samples that might not otherwise be tested for radioactivity.

Three types of particles are given out by radioactive materials as they decompose. The first, or alpha particle, is the same as a helium nucleus, being composed of two protons plus two neutrons. The alpha rays are moving at 2,000 to 20,000 miles per second and are able to penetrate several centimeters of air or a very thin foil of metal. Because of their size they are able to knock the ions out of many other atoms before they lose their energy.

The second type of emanation is known as beta rays or particles. The beta rays are nothing more than streams of fast moving electrons, which have been thrown out of the radioactive material. They travel several hundred times farther than the alpha rays since, with energies of about the same range, it would take 7500 of them to equal the mass of one alpha particle. However, a thin sheet of metal such as aluminum will stop most of the beta rays.

The third type of emanation, known as gamma rays, does not consist of particles at all, but of waves, very much like light waves, except that they are at a much higher frequency. The gamma rays travel at the speed of light, and from a few inches up to several feet of lead or concrete are required to stop them. It is for this reason that Geiger counters for use in the field usually use a tube that is most sensitive to gamma rays.

The radioassayer is designed as a beta ray counter, because beta rays are the most intense at short distances, and the sample can be placed quite close to the GM tube. Most of the tube is covered with a heavy lead shield, which also tends to cut down the background count from stray gamma rays and cosmic rays from the outer space.

The Department has previously checked with a Geiger-Müller counter all samples submitted for identification or assay, but the radioassayer will allow a more positive quantitative estimate especially for low radioactivity than has previously been possible.

There is no charge for checking any sample on this instrument and members of the Department will be glad to make radioactivity tests during regular office hours.

T.C.M.

## ROBA AND WESTFALL QUICKSILVER

The DMEA office in Spokane has reported that the only current active work in Oregon under a DMEA contract is at the Roba and Westfall quicksilver prospect on Murderers Creek, Grant County. A loan of \$20,140 was obtained. The shaft has been sunk to a depth of 80 feet from the collar, an advance of 52 feet, under the DMEA contract. The shaft has penetrated the footwall of the mineralized zone and it is stated that water is a problem. The other Oregon DMEA contracts have either been completed or rescinded.

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## OREGON LIGHTWEIGHT AGGREGATE INDUSTRY

Producers of pumice and pumicite

Cascade Pumice  
Lloyd A. Williamson  
114 Oregon Avenue  
Bend, Oregon

Deschutes Concrete Products Company  
Chester T. Lackey, Owner-Manager  
Redmond, Oregon

Central Oregon Pumice Company  
644 Franklin Street  
Bend, Oregon

Harney Concrete Tile Company  
Don Robbins  
Burns, Oregon

During 1952 pumice produced in Oregon amounted to 59,578 short tons valued at \$201,809.

Producers of volcanic cinders

Cinder Hill Quarry  
Leroy E. Grote  
Redmond, Oregon

Red Rock Cinders  
Don E. Hurrle  
Redmond, Oregon

Large quantities of volcanic cinders for road surfacing are produced by the State Highway Department. Value of production is not available.

Producers of expanded shale

Smithwick Concrete Products Company  
1750 N.E. Lombard Place  
Portland, Oregon

Northwest Aggregates, Inc.  
9255 N.E. Halsey Street  
Portland, Oregon

Total production about 93,000 yards valued at approximately \$418,500.

Producer of diatomaceous earth

Dicalite Company, Division  
Great Lakes Carbon Company  
Terrebonne, Oregon

No production statistics are available.

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## MINERAL IDENTIFICATION BULLETIN REVISED

One of the most popular State Department of Geology and Mineral Industries publications, Bulletin 16, "Field Identification of Minerals for Oregon Prospectors and Collectors," has just been issued in its fifth edition. The bulletin contains descriptions of nearly 200 minerals together with tables which aid in the determination of unknown specimens. A section of the 133-page bulletin is devoted to descriptions of mineral-testing equipment and basic prospecting tools. Several radioactive minerals have been included for the first time as well as other minerals which have become important in recent years. The bulletin is an elementary reference book and the more easily understood physical tests are stressed rather than chemical tests. Copies may be obtained at the Portland office of the Department in the State Office Building or at Department field offices in Grants Pass and Baker. The price is \$1.00.

## PACIFIC NORTHWEST METALS AND MINERALS CONFERENCE

The Oregon Section of the American Institute of Mining and Metallurgical Engineers will be host to the AIME Pacific Northwest Metals and Minerals Conference to be held in Portland, Oregon, April 29 through May 1, 1954, at the Multnomah Hotel.

F. X. Cappa, Conference Chairman, reports that the three-day technical program, which will be open to the public, includes four sessions on metals technology and will feature iron and steel and both extractive and physical metallurgy. The Industrial Minerals Division is featuring a symposium on ground water and how it may influence industrial mineral production and processing. Serving on the panel will be H. A. Swenson, District Chemist, Quality of Water Branch, U.S. Geological Survey, who will speak on the quality and character of Northwest waters; R. C. Newcomb, District Geologist, Ground-Water Branch, U.S. Geological Survey, who will give a summary of the ground-water provinces in the Northwest and their water-yielding potentialities; and John W. Robinsen, consulting ground-water geologist, Tacoma, Washington, who will discuss special or peculiar problems encountered in developing ground water for industrial mineral uses. A. M. Piper, Staff Scientist, U.S. Geological Survey, will be the moderator for the symposium and will summarize the presentations of the speakers. There will be a question and answer period.

In addition to the ground-water symposium, two sessions on industrial minerals, one on engineering geology, and one on mineral industries education, are on the program.

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## CHROMITE IN 1953

According to the U.S. Bureau of Mines, production of domestic chromite during 1953 totaled 57,000 short tons including 22,000 short tons of chromite concentrates from the Mouat mine, Stillwater County, Montana, which began milling ore in August under a government contract. Purchases by the government at the Grants Pass ore purchase depot during the year increased 57 percent and totaled 35,000 short tons. Alaska entered the field of producers as a result of the development of the Red Mountain chromite deposit by the Kenai Chrome Company with a government loan and contract granted in March. (No Alaska production is reported. Ed.)

Consumption of all grades of chromite in 1953 exceeded that of 1952 by 13 percent and was 10 percent above the previous high of 1951. It is reported that there was a noticeable trend toward the use of low-grade chrome ores in the manufacture of a low-grade ferrochromium. A sharp drop in the price of low-grade South African chrome ore provided the incentive for making a lower grade ferrealloy. South African 44-percent ore (chiefly chemical grade) experienced a \$4 per ton decline, and Turkish and Pakistan ore (high-grade metallurgical) sold for \$2 per ton less.

Of the 13 countries shipping chromite to the United States in 1953, the Philippines supplied the largest quantity, most of which was refractory grade. The next largest supplier was Turkey which received the greatest dollar value. The Union of South Africa and Southern Rhodesia provided the major portion of the balance of the imports. The last three countries supplied metallurgical grade. All chemical ore came from Union of South Africa.

Stainless steels consumed 63.4 percent of the chromium used in chromium alloys and chromium metal during 1953.

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## STUDY PREHISTORIC MINERS

There is evidence that miners worked in the Keweenaw Peninsula and on Isle Royale of northern Michigan as long as 4000 years ago and left with apparent haste. Where they came from and why they left has never been determined. A research project to study the subject has been set up by the Michigan College of Mining and Technology to attempt to solve what has been called one of the most important unsolved mysteries in North American archeology.

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Extracted from American Mining Congress Journal, March 1954

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FOSSIL LOCALITIES OF LINCOLN COUNTY BEACHES, OREGON

By  
Margaret L. Steere\*

Geologic Picture

There are many fossils to be found in the old marine sediments which form cliffs behind the beaches of Lincoln County, Oregon. Particularly fossiliferous is the Astoria formation which crops out almost continuously along the coast from the town of Lincoln Beach south to Yaquina Bay. Its areal distribution is shown as the shaded portion on the accompanying map, and in this long narrow strip, fossils may be found in unweathered road cuts as well as along the beach cliffs.

The Astoria formation is composed chiefly of blue-gray sandstones and shales that were deposited during Miocene time, about 20 million years ago, when the shore line of the sea was somewhat east of its present position. The name "Astoria formation" is tentatively applied to these Miocene sediments in Lincoln County because of their similarity to the type Astoria formation at Astoria in Clatsop County, Oregon.

Shells of mollusks (see accompanying sketches) are concentrated in great numbers in certain layers of the Astoria sediments. Scattered through the formation are many large ball-like concretions which, when split open, expose masses of fossil shells. Occasionally concretions are found that contain the fossil bones of whales and sea lions.

Overlying the Astoria formation in many places along the coast are thick deposits of brown and yellow dune sands of Pleistocene or Recent origin. These non-fossiliferous sands are readily distinguished from the older sandstone by their distinctive color and general lack of consolidation.

Another fossil-bearing marine formation, older than the Astoria, crops out at Otter Rock State Park and along the east shore of Yaquina Bay. This is the buff-colored, iron-stained, Yaquina sandstone of Oligocene age. Fossils in the Yaquina sandstone are fairly abundant, but are not so well preserved as those in the Astoria formation.

Fossil Localities

Five of the best places to find fossils along the Lincoln County beaches are described below and their locations shown on the map (see next page).

1. Fogarty Creek

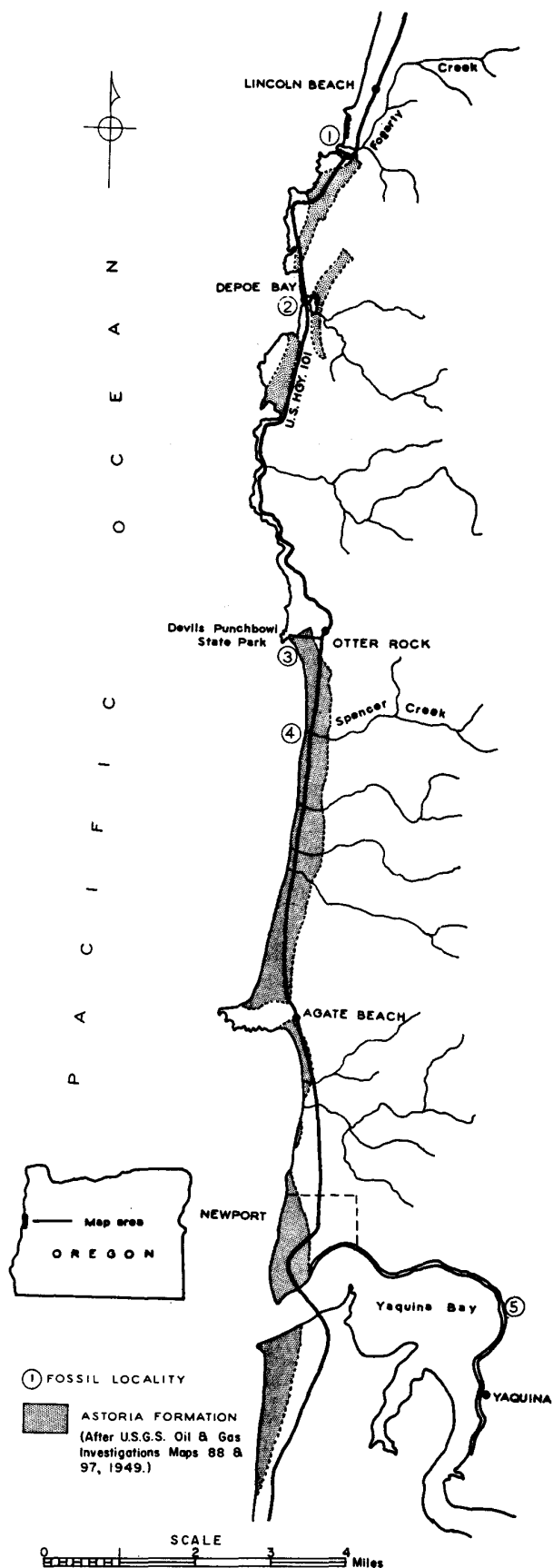
U.S. Highway 101 crosses Fogarty Creek 1.0 mile south of the Lincoln Beach post office. There is a parking space on the west side of the highway, immediately south of Fogarty Creek bridge, and a trail leads directly out to the beach. Fossils and concretions containing fossils can be found in the Astoria formation which forms the cliffs along the beach both north and south of the creek.

2. Depoe Bay

The fossiliferous Astoria formation crops out in the high cliff at the north end of the small inner bay, east of the highway bridge. The locality is easily reached by way of a road which follows around the north end of this bay to the Coast Guard Station at water level. The base of the cliff can be reached at low tide.

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\*Geologist, State Department of Geology and Mineral Industries.

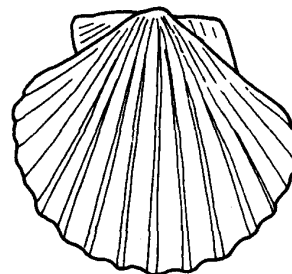
# FOSSIL LOCALITIES AND TYPICAL FOSSILS OF LINCOLN COUNTY BEACHES, OREGON



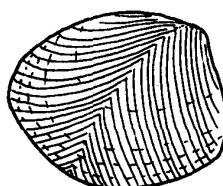
## PELECYPODS



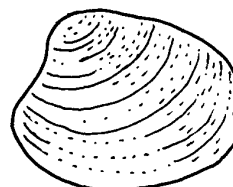
**MACROCALLISTA**



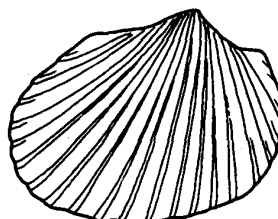
**PECTEN**



**ACILA**



**MARCIA**

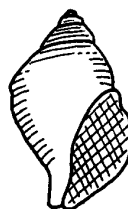


**ANADARA**



**ANADARA (side view)**

## GASTROPODS



**BRUCLARKIA**



**NATICA**



**TURRITELLA**

### 3. Otter Rock.

Fossils can be found in the sea cliffs below Devils Punch Bowl State Park, which is 0.4 mile west of the highway at Otter Rock. A good foot trail leads down to the beach from the southeast corner of the park. Buff-colored Yaquina sandstone, which forms the high cliffs of the point, yields a few fossils. The blue-gray Astoria formation, containing only a few fossils at this particular locality, crops out at the foot of the trail and is continuous, and locally very fossiliferous, as far as Yaquina Head, 5 miles to the south.

### 4. Spencer Creek.

Many well-preserved fossils and concretions containing fossils can be found where the Astoria formation crops out in the cliffs behind the beach near the mouth of Spencer Creek. Highway 101 crosses Spencer Creek 1.2 miles south of Otter Rock. There is a parking area at the north end of the bridge, and a trail leads down to the beach. The Astoria sandstone forms the sea cliffs, and in places the floor of the beach, as far as Yaquina Head, 4 miles to the south. Throughout this distance the formation is very fossiliferous.

### 5. Yaquina Bay.

Cliffs at the east end of Yaquina Bay expose Yaquina sandstone in which fossils are abundant though fragile. The locality is reached by starting from the corner of Front and Bay streets in the old part of Newport on Yaquina Bay and following a narrow, surfaced road, which runs along the north and east shore of the bay, for a distance of 3.0 miles. Fossils are numerous in chunks of weathered rock beside the road at the base of the sandstone cliff.

#### Names of the Fossils

When a paleontologist discovers a new fossil, he gives it three names, two of which are Greek or Latin, and the third is his own name. For instance, a certain mollusk, which is very abundant along the Lincoln County beaches, has been named "Anadara devincta Conrad." The first name, Anadara, is the genus, denoting a group of fossils all members of which look something alike. Next comes the species name, devincta, which differentiates the fossil from all others of that genus. And last is the name of the paleontologist himself -- in this case, Conrad. After a description of the species has been published, the name is adopted internationally.

The amateur fossil hunter will find that it is very difficult to tell one species from another, but that it is fairly easy to identify the genus of a well-preserved specimen by carefully comparing it to pictures and descriptions in the literature.

Fossils which are found in greatest abundance along the Lincoln County beaches are the mollusks. Mollusks are a large family of animals having protective shells, the most common types being pelecypods and gastropods. These two important groups are easily differentiated: pelecypods have two shells and resemble clams; gastropods have one coiled shell and resemble snails. At least 60 species of fossil mollusks (pelecypods and gastropods in approximately equal numbers) have been found in the Astoria formation in Lincoln County and more than half that number in the Yaquina formation. All of these species have been described and most of them illustrated in the literature (see bibliography).

The names listed on page 24 represent only a few of the many species of pelecypods and gastropods characteristic of the Astoria and Yaquina formations. Some of these fossils are shown in the sketches opposite this page.



Astoria formation

## Pelecypeds:

Acila conradi MeekAnadara devineta ConradMarcia angustifrons (Conrad)Pecten propatulus Conrad

## Gastropods:

Bruclarkia oregonensis (Conrad)Ficus modestus ConradNatica oregonensis (Conrad)Turritella oregonensis ConradYaquina formation

## Pelecypeds:

Acila shumardi DallNemocardium lincolniensis WeaverMacrocallista pittsburgensis DallThracia condoni Dall

## Gastropods:

Bruclarkia columbiana (Anderson and Martin)Fusinus lincolniensis WeaverCalyptraea mamillaris Broderip

For many years fossil hunters, both amateur and professional, have been finding fossil bones of marine mammals in the outcrops of the Astoria formation along the Lincoln County beaches. Most of the bones have been identified as belonging to pinnipeds (seals and walruses), cetaceans (whales), and sirenians (sea cows). The majority of the finds have been separate parts of skeletons, such as skulls, jaw bones, and vertebrae. More rarely is an entire skeleton discovered. The best preserved specimens are generally found in the hard sandstone concretions. Among the mammals identified from the Astoria formation are the following:

## Pinnipeds (seals and walruses)

Desmatophoca oregonensis Condon

## Cetaceans (whales)

Cephalocetus oregonensis Packard and Kellogg

## Sirenians (sea cows)

Desmostylus cymatias HannibalDesmostylus hesperus Marsh (extinct species)

Remains of other vertebrate dwellers in the Miocene sea, which have been found in the Astoria formation, include a very large turtle skull, fish vertebrae, and shark teeth.

## Maps of the Area

The following topographic and geologic maps of the area may be obtained from Distribution Section, Geological Survey, Denver Federal Center, Denver, Colorado, at prices indicated.

## Topographic:

1. Cape Foulweather quadrangle, U.S. Geol. Survey, 1944. Price 20 cents.
2. Yaquina quadrangle, U.S. Geol. Survey, 1946. Price 20 cents.

## Geologic:

1. The coastal area between Cape Kiwanda and Cape Foulweather, Oregon:  
U.S. Geol. Survey Oil and Gas Invest. Prelim. Map 97, 1949. Price 50 cents.
2. Geology of the Newport-Waldport area, Lincoln County, Oregon:  
U.S. Geol. Survey Oil and Gas Invest. Prelim. Map 88, 1949. Price 75 cents.

## Bibliography

Many of the books listed below may be purchased from their publishers through local bookstores, and others may be consulted at public libraries. All may be seen at the Department's library in Portland.

General references on fossils

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Handbook of paleontology for beginners and amateurs: New York State Museum, Albany, New York, 1950.

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Illustrated key to west North American pelecypod genera: Stanford Univ. Press, 1953.

Keen, A. M., and Pearson, J. C.

Illustrated key to west North American gastropod genera: Stanford Univ. Press, 1952.

Schenck, H. G., and Keen, A. M.

California fossils for the field geologist: Stanford Univ. Press, 1950.

Shimer, Hervey W.

An introduction to the study of fossils: MacMillan Co., New York, 1933.

References describing geology and paleontology of Lincoln County

Cushman, J. A., Stewart, R. E., and Stewart, K. C.

Astoria Miocene foraminifera from Agate Beach, Lincoln County, Oregon: Oreg. Dept. Geol. and Mineral Indust. Bull. 36, part 2, 1947.

Daugherty, Lloyd F.

The mollusca and foraminifera of Depoe Bay, Oregon: Oreg. Univ. Master's Thesis, 1951.

Etherington, Thomas J.

Stratigraphy and fauna of the Astoria Miocene of southwest Washington: Calif. Univ. Dept. Geol. Sci. Bull., vol. 20, no. 5, 1931. (Contains illustrations of Miocene fossils.)

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A pinniped humerus from the Astoria Miocene of Oregon: Oreg. State Coll. Mon., Studies in Geol. No. 7, 1947.

Packard, Earl L., and Kellogg, Remington

A new Cetothere from the Miocene Astoria formation of Newport, Oregon: Carnegie Inst. Wash. Pub. 447, 1934.

Schenck, Hubert G.

Marine Oligocene of Oregon: Calif. Univ. Dept. Geol. Sci. Bull., vol. 16, no. 12, 1927.

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Nuculid bivalves of the genus *Acila*: Geol. Soc. Am. Spec. Paper 4, 1936.

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The coastal area between Cape Kiwanda and Cape Foulweather, Oregon: U.S. Geol. Survey Oil and Gas Invest. Prelim. Map 97, with text, 1949.

Vokes, H. E., Norbistrath, Hans, and Snaveley, P. D., Jr.

Geology of the Newport-Waldport area, Lincoln County, Oregon: U.S. Geol. Survey Oil and Gas Invest. Prelim. Map 88, with text, 1949.

Weaver, Charles E.

Tertiary stratigraphy of western Washington and northwestern Oregon: Wash. Univ. Pub. in Geol., vol. 4, 1937.

Paleontology of the marine Tertiary formations of Oregon and Washington, Parts 1, 2, and 3: Wash. Univ. Pub. in Geol., vol. 5, 1942.

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#### WORLD BAUXITE RESERVES

Engineering and Mining Journal, New York, November 1953, gives a resume of a talk given to the New York Section, A.I.M.E., by Irving Lipkowitz, Assistant to the President, Reynolds Metals Company, on bauxite reserves.

Mr. Lipkowitz stated that total world reserves were estimated at about 2.4 billion tons sufficient to last about 200 years at the 1952 rate of mining. Of this amount, about one-third is in Russia and satellite countries. He estimated that reserves in the United States total approximately 50 million tons. The present world figure is approximately twice the amount estimated at the beginning of World War II. The increase is the result of (1) intensive exploration for commercially high-grade ores, and (2) constant improvement of processes to make lower grades of ore commercially useable. Whereas in 1941 the industry was using bauxite with not more than 7 percent silica, at the present time improved processes have allowed commercial treatment of ores running 15 percent silica. Mr. Lipkowitz estimated that reserves of high aluminum-containing clays in the United States amounted to almost 3 billion tons. In answering questions concerning power potentials, he commented that as hydroelectric facilities require such a tremendous capital outlay which must be amortized over decades, the use of natural gas has been favored in recent years. Lipkowitz asked the hypothetical question: Why should we tie up our future? In a few years atomic energy may be used on a competitive commercial basis and smelting plants may be located close to ore supplies.

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#### A MARK TWAIN COMMENT ON GEOLOGY\*

Since my own day on the Mississippi, cut-offs have been made at Hurricane Island, at Island 100, at Napoleon, Arkansas, at Walnut Bend, and at Council Bend. These shortened the river, in the aggregate, 67 miles. In my own time a cut-off was made at American Bend, which shortened the river 10 miles or more.

Therefore the Mississippi between Cairo and New Orleans was 1215 miles long 176 years ago. It was 1180 after the cut-off of 1722. It was 1040 after the American Bend cut-off. It has lost 67 miles since. Consequently, its length is only 973 miles at present.

Now, if I wanted to be one of those ponderous scientific people, and "let on" to prove what had occurred in the remote past by what had occurred in a given time in the recent past, or what will occur in the far future by what has occurred in late years, what an opportunity is here! Geology never had such a chance, nor such exact data to argue from! Nor "development of species," either! Glacial epochs are great things, but they are vague--vague. Please observe:

In the space of 176 years the Lower Mississippi has shortened itself 242 miles. That is an average of a trifle over one mile and a third per year. Therefore, any calm person, who is not blind or idiotic, can see that in the Old Oblivion Silurian Period, just a million years ago next November, the Lower Mississippi River was upward of 1,300,000 miles long, and

\* Taken from Life on the Mississippi.

stuck out over the Gulf of Mexico like a fishing rod. And by the same token any person can see that 742 years from now the Lower Mississippi will be only a mile and three-quarters long, and Cairo and New Orleans will have joined their streets together, and be plodding comfortably along under a single mayor and a mutual board of aldermen. There is something fascinating about science. One gets such wholesale returns of conjecture out of such a trifling investment of fact.

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#### NEW SOUTHERN OREGON CHROME MILLS REPORTED

##### Fitzpatrick Mill

A small concentrating mill located at the Umpqua Cottages on U.S. Highway 99 north of Canyonville, Douglas County, has been operating for several months. The mill is owned by G. W. and J. E. Fitzpatrick. Ore from several properties in the area has been treated.

Equipment at the mill consists of a jaw crusher, a ball mill, two cone classifiers, and two small homemade concentrating tables (4 x 10 and 3 x 5 feet). A larger table is being installed. The ball mill is operated by a Briggs and Stratton gasoline engine and the tables are driven by electric motors. This mill is estimated to have a maximum capacity of about 2 tons of concentrates a day.

##### Meyer Chromite Mill

Nick Meyer, Davenport, and Lester Shippen have recently completed constructing a concentrating mill on the north bank of the Umpqua River beside Gazley Road about 2½ miles northwest of Canyonville. Some ore from the Frozen Creek chromite deposit in sec. 19, T. 28 S., R. 4 W., is stockpiled at the mill. Equipment consists of a jaw crusher, a conveyor which transports ore from the jaw crusher to a ball mill, a cone classifier, and two large concentrating tables.

##### Lucky Nine Chrome Company Mill

H. R. Winston, Wayne Young, Daryl Cohl, Raymond Carson, Sealy Carson, Bernard Carson, Dorothy Kartes, Ed Collins, and Hurley Wilson are the incorporators of the Lucky Nine Chrome Company. This company has begun the construction of a concentrating mill about 2 miles west of Canyonville north of the road to Riddle. Ore from deposits in sec. 36, T. 30 S., R. 7 W., and sec. 20, T. 30 S., R. 6 W., will be treated.

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#### DEPARTMENT STUDIES HARPER RADIOACTIVITY

N. S. Wagner, Department field geologist at Baker, made a reconnaissance of mining claims on Cottonwood Creek south of Harper in northern Malheur County to investigate reports of radioactive minerals in the area. He obtained samples from the discovery claims owned by Messrs. Louis Hall and Lormand Wise and also a neighboring claim owned by Mr. Rathman. The samples were sent to Portland for testing in the Department's "radioassayer." They were all very low-grade in radioactivity, ranging from 0.005 to 0.015 U<sub>3</sub>O<sub>8</sub> equivalent. No discrete uranium minerals were identified. Judging from the preliminary examination, radioactivity appears to be related to yellow fluorescence, and from previous experience this yellow fluorescence in eastern Oregon probably results from activation caused by some undetermined uranium salt. The uranium occurs in minute quantities in a fluorescent coating.

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## MINERALS ALLOWED IN DMEA ASSISTANCE LIST

According to revised regulations which were published March 23, 1954, in the Federal Register, the following minerals will be the subject of exploration loans under DMEA:

## (a) Government share 50 percent -

Bauxite, chromium, copper, fluorspar, graphite (crucible grade), lead, molybdenum, zinc, and cadmium.

## (b) Government share 75 percent -

Antimony, asbestos (chrysotile only), beryl, cobalt, columbium, corundum, diamonds (industrial), kyanite (strategic), manganese, mercury, mica (strategic), monazite and rare earths, nickel, platinum-group metals, quartz crystal (piezo-electric), rutile-brookite, talc (block steatite), tantalum, thorium, tin, tungsten, and uranium.

Details concerning exploration loans and application forms may be obtained from the Defense Minerals Exploration Administration, So. 157 Howard Street, Spokane, Washington, as well as other DMEA offices.

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## GOLD MARKET REOPENS IN LONDON

According to The Wall Street Journal, the London gold market reopened for trading on March 22, 1954, after a 15-year lapse. On this day, six British financiers clad in their accustomed uniform of black coats and striped trousers began buying and selling gold in the attempt by Great Britain to regain the pound sterling's prewar eminence in world finance. The London gold market has been closed since 1939 and all dealings in the metal have been handled by the Bank of England. Within a few minutes the six traders fixed a price for gold at 248 shillings and sixpence an ounce, about 20 cents under the United States official price of \$35. The discount is due to freight charges between the United States and other parts of the world. Scene of the beginning of gold trading was the famous banking house of Rothschild & Sons. Joining in the trading were five banking and brokerage firms: Johnson Matthey & Co., Ltd.; Samuel Montague & Co., Ltd.; Mocatta & Goldsmith; Pixley & Abell; and Sharps & Wilkins.

Despite the fact that so-called free trading was resumed, there are still restrictions. A special government license is required for banks or individuals inside the British sterling area to buy the metal with sterling. Other purchasers are completely confined to residents of the United States or Canada holding sterling earned in authorized trade and to residents of nations outside the sterling and dollar areas who hold sterling bought with dollars or gold. Anybody, whether in or outside the sterling area, can sell gold. Thus there is no measure of convertability of pounds into gold or dollars that has not previously existed. It was announced that a large South African gold producer would start selling more of its output through the new London market.

The E&MJ Metal and Mineral Markets comments that London's move to restore free trading in gold merely gives bullion dealers the commissions they missed for so long. United States authorities are adamant as ever against similar action here.

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## PINE CREEK PLACERS, EASTERN BAKER COUNTY

According to the Baker Record Courier, increased activity is planned for Pine Creek Placers in eastern Baker County. Pine Creek drains areas below the famous old Cornucopia gold mine. A 1200-foot cut will be run under contract to a depth of 65 feet to bedrock. Gravel from the cut will be run through sluices in order to test the gold values. If economic amounts of gold are recovered, the course of Pine Creek <sup>bed</sup> will be changed by converting the cut into a new channel so that the rest of the creek may be worked. Mr. R. M. Conley, formerly of California, is in charge of the work.

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STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES  
Head Office: 1069 State Office Bldg., Portland 1, Oregon  
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## EARTHQUAKES

By  
Ralph S. Mason\*

### Locating and fingerprinting

An earthquake is a difficult thing to get hold of. Its arrival is unexpected, its passage is swift, and its recall impossible. The great majority of earthquakes originate at depths of 10 to 20 miles but some are deeper, extending to a maximum of 450 miles. Plainly one must be ready well in advance if an earthquake is to be caught and measured. The federal agency charged with this task is the Seismological Survey of the U.S. Coast and Geodetic Survey. The program of the Coast and Geodetic Survey represents perhaps 20 percent of the seismological work done in this country and includes projects of a highly specialized nature. Besides operating seismological stations to locate earthquakes it collects statistical information on all types of earthquake phenomena including damage, prepares earthquake catalogs and epicenter maps, and conducts various types of investigations directed toward a better understanding of earthquake phenomena.

In Oregon there are two seismological devices installed to record earth motions. At Oregon State College a seismograph, which has been in operation since 1946, makes a continuous record on a photosensitive paper roll. In Portland an accelerograph was installed in the basement of the new State Office Building in 1953. This instrument, in contrast to the seismograph, does not record continuously but is actuated only when a fairly strong earth shock is felt. Accelerographs are designed to record only those shocks having an intensity of IV or over on the Modified Mercalli Intensity Scale. Shocks of this magnitude are of interest in the study of damage to structures and related subjects. An examination of the Mercalli Scale reveals that the various intensities are correlated to sensations experienced by observers and to damage suffered by structures and natural objects. Accelerographs are being used to accumulate seismic data on a scientific basis that is free from both human emotional distortion and vagaries due to type of construction and character of subsoil.

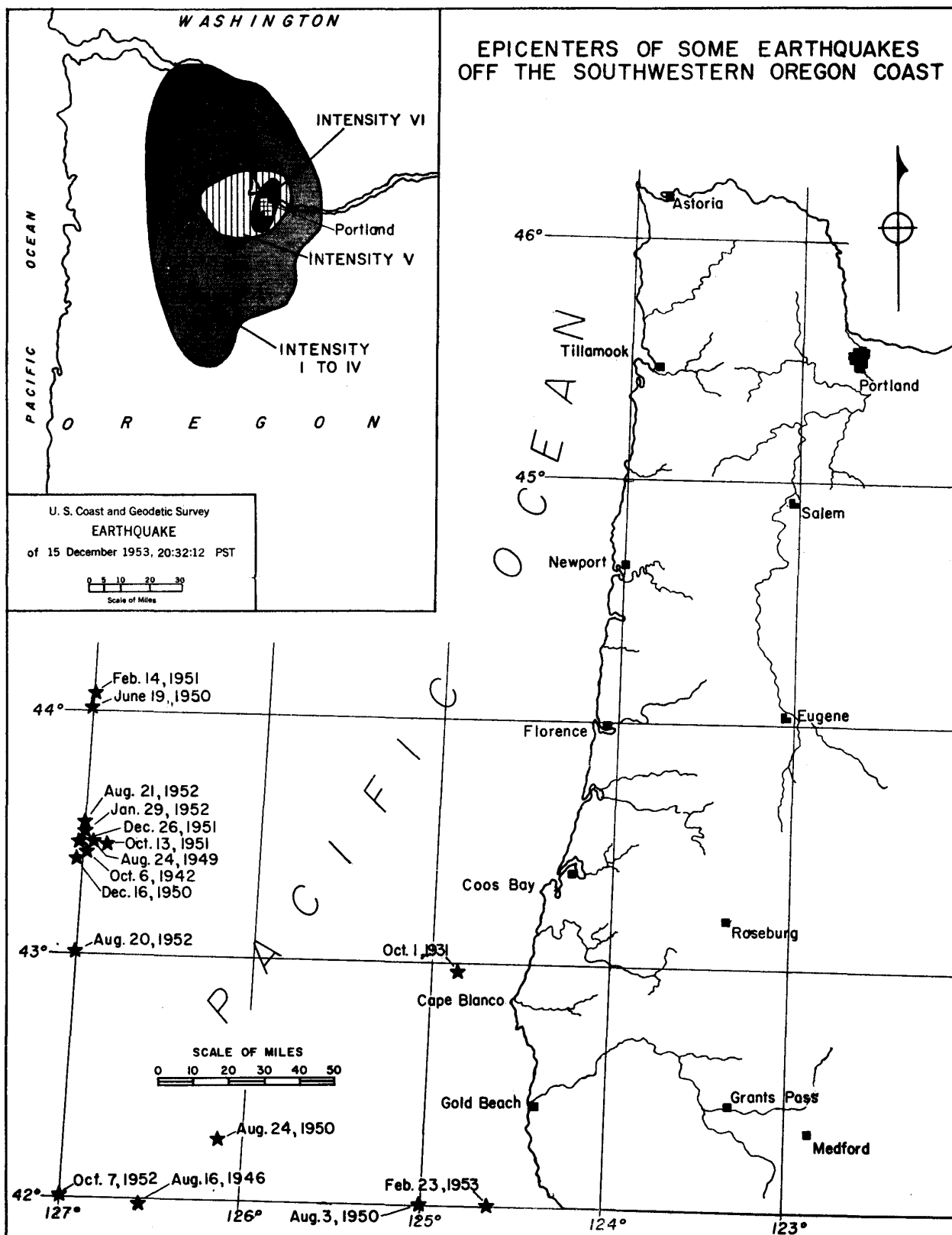
The isoseismal map set into the larger map (opposite page 31) shows the degree to which areas were affected by the December 15, 1953, shock in the Portland area. Data for this map was obtained by the Geodetic Survey largely from postal cards circulated throughout the area. The accelerograph in the State Office Building in Portland was not tripped.

The following paragraphs describing earthquake waves and the work of the Seismological Survey are taken from "Earthquake Investigation in the United States" by Frank Neumann.<sup>1/</sup>

"One of the most important phases of the Survey's seismological program is the investigation of destructive earthquake motion, a program that is of basic importance to the engineer who must design structures to successfully resist earthquake forces. The 700 persons killed in the great California earthquake of 1906 and the billion-dollar (present-day value) property loss caused from the fires that followed will always stand as a warning to those who feel that the earthquake menace can be ignored. Years of study have shown that the problem of the design engineer is technically difficult because earthquake forces are vibrational or dynamic in character and cannot be treated the same as static, or steady, forces. Much has been accomplished, however, and the Survey has played an important role in this accomplishment through furnishing authentic information on destructive ground and building motions."

\*Mining Engineer, Oregon Department of Geology and Mineral Industries.

<sup>1/</sup>U.S. Coast and Geodetic Survey Spec. Pub. 282, p. 2, rev. ed., 1953.



"An interesting phase of seismological research is its international aspect. The fact that a strong earthquake in any country is registered on seismographs all over the world has resulted in a world-wide exchange of data and cooperative effort that is matched in few other fields. This international effort has resulted in a great accumulation of technical data that has not only made possible an authentic history of world earthquakes over the past 50 years but exhaustive analyses of the data have given the scientific world the most accurate picture it has of the physical structure of the interior earth.

"In a great earthquake these seismic vibrations or waves penetrate the entire structure of the earth and travel all over its surface. While great earthquakes are seldom felt farther than a thousand miles from their source, sensitive seismographs have registered these unfelt vibrations in all parts of the world for more than 50 years. Such seismic waves are extremely complex but a few basic facts will serve to explain how they are propagated through the earth and how the distance to an earthquake can be determined from a seismograph record.

"Two types of waves travel at different speeds through the earth's interior and are known as interior waves. The faster one alternately compresses and dilates the rock as it travels forward; the slower one shakes the rock sidewise as it advances - like the vibration of a violin string. Seismological tables, based on many thousands of seismograph readings, show to the nearest second just how long it takes each of these wave groups to travel to points on the earth's surface at various great circle distances from an earthquake origin. The difference in the arrival times of two such wave groups at a seismograph station therefore corresponds to some particular epicentral distance that is shown in the seismological tables. These two waves are usually well defined on seismograph records and anyone who can recognize them can obtain the corresponding epicentral distance from the seismological tables. The largest waves recorded at distant stations, however, are usually waves that travel at nearly uniform speed through the surface rocks only and are known as surface waves. Epicenters are located on a large terrestrial globe by swinging arcs around several observatory locations, using as radii the epicentral distances determined from the station records. The common point of intersection is the location of the epicenter."

#### What causes earthquakes?

The earth's rocky crust rests upon a rubbery layer of semiplastic material which is constantly adjusting itself to the changing pressures imposed upon it. The processes of erosion cause a redistribution of the surface by gradually transporting mountains down to the sea where thick layers of sediments are slowly built up. The earth mass under the eroded mountains is in time relieved of a great weight and tends to push upwards while the off-shore zone recently loaded down with sediments tends to be depressed. The result of these two opposite tendencies is to create a zone of disturbance and instability which may produce a cracking or faulting of the crust. This explains in part why the Pacific Coast, with its high mountain ranges which are rapidly being eroded away, has so many earthquakes. Earthquakes are the vibrations created by slippage along a fault plane.

Earthquakes and volcanic activity are often closely associated. The question of whether the earthquakes set off the volcanic activity or vice versa is sometimes difficult to determine. It is known that faults may provide an escape route to the surface for pent-up molten igneous rocks called magma. In some areas of the world earthquakes presage the coming of volcanic eruptions, and native populations living near quiescent volcanic vents often leave the area after feeling a series of sharp shocks. On the other hand there is evidence that deeply buried masses of magma periodically generate terrific pressures which are relieved by forcing tongues of molten rock between the layers and joints of the overlying rock. This produces a disruption of the crust which in turn results in an earthquake. The actual surface eruption of a volcano, however, does not cause an earthquake.



Crustal movements, caused by deep-seated convectional currents which slowly move portions of the earth's surface toward each other, may be the underlying cause for yet another source of earthquakes. Some of the world's great mountain ranges are in reality large wrinkles which are thought to have been caused by this type of movement. The folding and fracturing of the opposing masses as they come together give rise to periodic adjustments along fault planes.

There are numerous kinds of faults although most of them fall into two general classes. Tensional forces produce a "normal" fault which characteristically has a fault plane steeper than 45 degrees. A compressional force may produce a "reverse" fault having a much flatter fault plane which permits one block to "ride up" over the other. Some of the complex geology of the European Alps is due to this type of faulting which is called thrust faulting if the amount of overlap of the two blocks is very large compared to the vertical movement. Movement of the two fault blocks with respect to each other may be in any direction in a plane parallel to the fault plane. If the motion is horizontal much damage will occur in populated areas to buried installations such as pipelines, and to surface structures which may be toppled over or shaken to pieces. Horizontal movement of the San Andreas rift during the 1906 earthquake amounted to 21 feet in places and caused millions of dollars worth of damage to the city of San Francisco alone. Vertical motion produces fault scarps which are the exposed fault planes. If the motion is small and the soil mantle heavy, no permanent scarp will be formed. If the displacement is large or repeated at frequent intervals for a long time, an imposing scarp will be exposed. Abert and Winter rims in Lake County were formed in this manner and are classed with some of the best examples of this type of faulting in the world.

#### What to do when an earthquake comes

Most people have an urge to rush out of doors when an earthquake comes. That this is a dangerous practice is fully supported by mortality statistics. Buildings commonly have knickknacks adorning entrances which have the unpleasant habit of toppling down onto the heads of occupants issuing forth. Walls sometimes are either poorly attached to the building proper or have a veneering which sloughs off during a severe shock. In either event the streets in front of most multiple-story buildings are poor havens of refuge during an earthquake. Standing under archways or in doorways is recommended as these are structurally strong parts. There is a certain danger of being trampled by people rushing out of a building if one stands under the entrance arch but this is preferable to cushioning the fall of a cornice weighing several hundred pounds. Chandeliers may be shaken down; bookcases may topple; and heavy mirrors, pictures, and large windows may be broken or thrown down. A safe hiding spot can often be found under a desk or heavy table. Stay there until the shaking ceases, then carefully make your way out of the building. Avoid any wires lying on the ground; they may be electrified. If possible, shut off the main gas valve in a building until a thorough check on the condition of the lines has been made. Chimneys and flues are particularly subject to damage by earthquakes and many fires have been caused by failure to examine the condition of the flues before using them.

#### Oregon, a seismologically stable state

Oregon is a relatively stable state, seismologically speaking. Compared to California, which has shocks of magnitude VI or greater on the intensity scale approximately once each year, Oregon has had only a handful since earliest records were kept. The San Andreas rift or fault and other associated earth fractures are responsible for the numerous tremors in California. Oregon, fortunately, has no such active fault system and as a consequence, has only occasional earthquakes and these have been of low intensity. The San Andreas rift extends northwestward from San Francisco and eventually passes out to sea. The path of this great fault apparently lies about 130 miles west of Coos Bay. The accompanying map shows the location of some recent epicenters located off the southwestern Oregon coast. Of particular interest is the "nest" of seven epicenters located along the 127th meridian

between latitude 43° and 44°. The zone of activity may perhaps indicate an extension of the San Andreas fault. In California, motion along the San Andreas has been largely horizontal with the western side moving northward. Horizontal motion is not likely to produce disastrous seismic sea waves. Faulting having a vertical component, however, might cause a dangerous sea wave, and if the Oregon coast should ever be visited by one of any considerable size the loss of property and life might be great. No adequate warning of such an impending wave could be given if it originated close to shore as the speed of propagation is rapid (300 to 500 miles per hour), most of the coast is entirely unprotected by off-shore shoals or islands, and the majority of coastal towns lie close to the shore and not far above sea level. A violent earthquake along the coast, coupled with an unusually great withdrawal of the sea, should be a warning that a seismic sea wave may be expected very shortly.

Neuman states:<sup>1/</sup>

"One of the important services of the Coast and Geodetic Survey is the maintenance of a seismic sea wave warning program. The principal objective is to alert public officials in such areas as the Hawaiian Islands whenever seismographic records reveal the occurrence of a submarine earthquake that might generate a destructive sea wave. Such a program would generally be impractical in areas near earthquake origins, but when 5 or 10 hours elapse between the time an earthquake occurs and the time sea waves might pile up on a distant shore there is time, by working fast, to locate the earthquake, establish the existence of a sea wave, and issue warnings to coastal populations that might be endangered.

"In Hawaii, Alaska, and Arizona, the Survey operates visible-recording seismographs that ring alarms whenever an unusually strong shock is being registered. Other participating seismograph stations are operated at Pasadena and Berkeley (Calif.), Adak (Alaska), Tokyo (Japan), Guam, and Huancaayo (Peru). Observers at 16 Survey tide stations scattered over the Pacific immediately report unusual tidal disturbances to the monitoring station near Honolulu. A high-priority communications service is maintained between reporting agencies through the combined facilities of the Army Air Force, the Navy, and the Civil Aeronautics Administration. With all of these groups functioning, the Survey's central station near Honolulu is enabled to locate a submarine shock and verify the existence of a seismic sea wave within 2 or 3 hours."

If Oregon should have a severe earthquake the pattern of damage would be irregularly centered around the epicenter. Structures built on uncompacted valley fill, water-soaked soil, or man-made earth fills would be subject to greater damage than those founded on well compacted soil or solid rock. Buildings on steep hillsides might suffer from secondary earthquake effects such as landslides and settling. Contractors, building owners, planning commissions and insurance companies should be vitally interested in the susceptibility of Oregon towns and cities to earthquake damage. The location of the epicenter cannot be predetermined but building codes, type of construction, location of structures, and insurance rates should all take subsurface conditions into consideration as such conditions are the most important factors in evaluating possible earthquake damage. This information could be obtained quite simply by collecting and evaluating data already available from well drillers, city engineers, and public utilities.

<sup>1/</sup> Op. cit., p. 19.

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#### BAKER COUNTY GOLD MINE TO GET INTO PRODUCTION

A working agreement has been made between James Muir, Don Olling, Verne Jacobson, and William Wendt for development of the Sanger gold mine, Baker County, Oregon. The group is on the property and currently engaged in readying the property for operation. Plans are to mine and mill ore from a shoot on a new vein prospected by Wendt a few years ago and to do additional prospecting work on other parts of the property. Mr. Wendt who is owner of the property erected a 5-ton test mill last summer. This includes an Ellis mill, plate amalgamation, and a Wilfley table. Tailings from the present operation will be impounded for future cyaniding.

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## ASSESSMENT WORK

The assessment year ends at noon, July 1, 1954. The right of possession to a valid mining claim is maintained by the expenditure of at least \$100 in labor or improvements of a mining nature on the claim prior to that time. However, if the work has not been completed by noon of July 1, it should have been started and must be prosecuted "with reasonable diligence" until completed.

According to Oregon law, within 30 days after the performance of labor or making of improvements to comply with the law, an affidavit setting forth the following facts must be recorded in the mine records of the county in which the mining claim is situated:

1. The name of the claim or claims, if grouped, and the book and page of the record where the location notice of said claim or claims is recorded.
2. The number of days work done and the character and value of the improvements placed thereon, together with the location of such work and improvements.
3. The date or dates of performing said labor and making said improvements.
4. At whose instance or request said work was done or improvements made.
5. The actual amount paid for said labor and improvements and by whom paid if the same was not done by the owner or owners of said claim.

If a mining claim is on O and C lands, the owner, within 60 days after the expiration of any annual assessment year, must file for record a statement under oath as to the assessment work done or improvements made during the previous assessment year at the Land Office of the Bureau of Land Management, 827 N.E. Oregon Street, Portland 14, Oregon.

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## ANNOUNCEMENT OF CHANGE OF ADDRESS

The U.S. Bureau of Land Management, Department of the Interior, Area I, which includes Oregon, California, and Washington, will have the Area office in the new Interior Building at 1001 N.E. Lloyd Blvd., Portland 14, Oregon. The state offices under the Area office will be at Sacramento for California, Spokane for Washington, and at 1001 N.E. Lloyd Blvd. for Oregon. The Interior Building telephone number will be Fillmore 3361. This number will reach both the Bureau of Land Management Area and state offices.

Oregon Land Office and Public Survey records for Oregon under the Bureau of Land Management will be located at 827 N.E. Oregon Street, the Old Bonneville Power Administration building. The telephone number will be Fillmore 3361. Proofs of labor for assessment work done on mining claims on O and C lands should be sent to the Land Office.

The mailing address of the U.S. Geological Survey effective June 1, 1954, will be: Interior Department Building, 1001 N.E. Lloyd Blvd., Portland 14, Oregon. Effective May 17, 1954, all telephones under the master number, Fillmore 3361, will have extensions as follows:

Fuels Branch	
Supervising Geologist, Linn Hoover . . . . .	Ext. 235
Ground Water Branch	
District Geologist, R. C. Newcomb . . . . .	236
Quality of Water Branch	
District Chemist, H. A. Swenson . . . . .	237
Staff Scientist, Arthur M. Piper . . . . .	241
Surface Water Branch	
District Engineer, K. N. Phillips . . . . .	239
Water and Power Branch	
Staff Engineer, L. L. Bryan . . . . .	234

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## MERCURY ON RAMPAGE

At the end of 1953 the market price of quicksilver was \$187-\$189 a flask. Early in 1954 prices began to strengthen and rose steadily month after month because of a shortage of spot metal reportedly due to U.S. Government buying abroad. On May 13 the New York price was \$240-\$245 depending on quantity and seller. Following is the comment of E&MJ Metal and Mineral Markets, May 13, under "Washington Reports."

MERCURY IS A CLOAK AND DAGGER AFFAIR. Washington will not explain its role in the recent price leap. But despite the official hush-hush, there's no doubt that the Government is quietly procuring seeds of mercury.

Here's the unofficial story: The stockpile is in excellent shape. But the view is mercury is being procured for an "immediate defense need." The material is being procured largely, but not exclusively, through barter of surplus farm goods with Spain and Italy. Some is also being bought from Mexico and elsewhere.

The Bureau of Mines recently reported that mercury has been used in one of four experiments for "appraising the prospects for private industry participation in the . . . production of electrical energy and fissionable materials from reactors." Best guesses are that mercury is or will be used as a heat transfer agent, as a coolant, or as a pressure source in vaporized form.

Gripes from mercury consumers have brought the Preparedness Subcommittee of the Senate Armed Services Committee into the picture. That's the group that created the rumpus in tin three years ago. The Subcommittee's investigators have just made a "preliminary inquiry" into why mercury prices have jumped so much in the past six months.

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## GSA PURCHASE PROGRAMS

The General Services Administration has announced the following deliveries of domestic minerals under the defense purchase programs from May 11, 1951, through March 31, 1954:

	<u>Deliveries</u>	<u>Authorized Goals</u>
Tungsten (short-ton units)	781,733	3,000,000
Manganese (long-ton units)	5,429,707	6,000,000
Chrome ore (long tons)	53,088	200,000 (46,640 on Dec. 31, 1953)
Beryl (short tons)	170	1,500
Columbium-tantalum (pounds)	3,901,051	15,000,000

These programs are separate from the exploration program of Interior Department's Defense Minerals Exploration Administration. (From The American Mining Congress Bulletin Service, May 12, 1954.)

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## ALASKAN CHROME COMING TO GRANTS PASS

As reported by Mining and Industrial News, San Francisco, the Seldovia Chrome Company, Seldovia, Alaska, has started producing high-grade chrome at its property on Red Mountain southeast of Seldovia with initial production of about 10 tons per day with a goal of 30 tons daily expected by next July. A production of 5000 tons is the goal for 1954. The ore is hauled from the mine by caterpillar and wagon, loaded on boats, and shipped to Seattle. It is then shipped to Grants Pass, Oregon, either by truck or by rail and sold under government contract.

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## MEXICAN PESO AGAIN DEVALUED

The Mexican peso has been devalued from 8.65 to 12.50 pesos to the dollar. The American Mining Congress Bulletin Service quotes Senator Bennett of Utah as saying that this devaluation gives Mexico's lead and zinc producers a further large price advantage over United States producers. Senator Bennett said that Mexico accounts for 33 percent of our total imports of lead and 36 percent of our total imports of zinc from all sources and added that "It is not likely that the safety of the world will be advanced by permitting our productive capacity to be destroyed by additional imports of zinc and lead made possible by substantial devaluation of foreign monies."

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## TOPOGRAPHIC MAPPING IN CALIFORNIA

In 1948 California started a cooperative mapping program with the U.S. Geological Survey to complete topographic mapping in the State. Over a 10-year period California contributes \$300,000 a year, which is matched by the U.S. Geological Survey.

Oregon provides no cooperative funds for mapping by the U.S. Geological Survey. Therefore topographic mapping lags in Oregon and is governed mainly by Army needs. The southeastern quarter of the State is practically a blank in availability of topographic mapping. Even aerial photographs are not available. This lack of maps is a serious handicap to the geologist in attempting to make geological studies in that part of the State which is a veritable No Man's Land as far as topographic and geologic mapping is concerned.

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## MONTANA CHROME

According to the News Letter of the Mining Association of Montana, Carl Trauerman, Secretary, the American Chrome Company, a subsidiary of the Goldfield Consolidated Mines Company, is now mining and milling 1000 tons of chrome ore per day at its Mouat mine and mill near Nye, Stillwater County, Montana, and is turning out about 380 tons of 38-percent  $\text{Cr}_2\text{O}_3$  concentrates per day. This company has a contract with the DMPA to produce 900,000 tons of concentrates over an 8-year period for delivery to the United States Government. More than 300 men are employed at the operation and the payroll averages about \$130,000 per month. The company is spending also about \$1,000,000 annually for power and supplies.

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## PRICES OF METALS AND ORES

Copper -	29.7 cents per pound at refinery	Iridium -	\$145-\$150 per troy ounce
Lead -	14 cents per pound New York	Palladium -	\$21 per troy ounce
Zinc -	10½ cents per pound East St. Louis	Platinum -	\$84 per troy ounce
Aluminum -	Ingot, 21½ cents per pound	Rhodium -	\$118-\$125 per troy ounce
Tin	93½ cents per pound New York	Ruthenium -	\$70-\$75 per troy ounce
Silver -	Foreign, 85½ cents per ounce; domestic 90½ cents per ounce	Selenium -	\$5 per pound
Antimony -	28½ cents per pound in bulk	Titanium -	99.3 percent plus, maximum 0.3 percent iron, \$4.72 per pound
Bismuth -	\$2.25 per pound in ton lots	Zirconium -	Powder, \$7 per pound
Cobalt -	\$2.60 per pound in 500-pound containers		

(From E&M Metal and Mineral Markets, May 13, 1954.)

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STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES  
Head Office: 1069 State Office Bldg., Portland 1, Oregon  
Telephone: Columbia 2161, Ext. 488

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RECONNAISSANCE GEOLOGY ALONG U.S. HIGHWAY 20  
BETWEEN VALE AND BUCHANAN  
MALHEUR AND HARNEY COUNTIES, OREGON

By  
H. M. Dole\* and R. E. Coreoran\*

During the early part of April 1954 the authors spent four days traversing US Highway 20 between Vale and Buchanan, Malheur and Harney counties, Oregon, a road distance of 83 miles. The geologic cross sections and plan which follow this text record the information obtained. It is estimated that a total of about 15,000 feet of beds is represented by the sections.

GENERAL GEOLOGY

The mapping indicated a normal sequence of beds, from younger to older, between Vale and the east slope of Stinkingwater Mountain. On Stinkingwater Mountain a blanket of fairly recent lava hides the relationship between what is thought to be older tuffaceous beds to the east and younger volcanics to the west.

In general the structure is one of low easterly dips to Drinkwater Pass; moderate westerly dips from Drinkwater Pass to the highway bridge across the Malheur River just south of Drewsey; and low easterly dips to the summit of Stinkingwater Mountain. The structure on the west slope of Stinkingwater Mountain was not clear but according to Piper's (1939)\*\* map the general trend is one of low westerly dips into the Harney Basin.

Major fault zones are inferred south and east of Harper, about midway between Juntura and Harper, and north of Juntura. Most of the evidence bearing on the fault zones is based on what appears to be an anomalous sequence of beds in the valley walls. Faulting is especially noticeable in the Owyhee basalt because of the presence of a cliff-forming welded tuff that makes a good marker bed. Many minor offsets occur in the sedimentary sections. It is not known, however, how important these are for they may reflect local slumping or perhaps folding at depth.

AGE AND THICKNESS OF THE UNITS

Younger lavas: This unit occurs as a capping of variable thickness throughout most of the western part of the traverse (see sections 12 and 16), and because it is younger than all other formations in this area a Plio-Pleistocene (?) age has been assigned to it. Thickness of the unit is probably less than 200 feet.

Idaho formation: This traverse overlaps the work of Pritchett (1953) in the Mitchell Butte quadrangle. Pritchett assigned a lower to middle Pliocene age to the Idaho formation. Because the beds he mapped were found to continue westward his age assignment has been adopted for this report.

The top of the Idaho formation lies to the east of the area traversed. The base of the formation was determined to be near mile post 220 (see section 5). The beds mapped as part of the Payette formation by Moore (1937) just south of the highway near Harper were included in the Idaho formation because Pliocene (?) vertebrate remains have been obtained from them and structural relations indicate a continuity with the beds farther east. The thickness as determined from the cross section is about 3,100 feet.

Owyhee basalt: A lower Pliocene - upper Miocene age is given to the Owyhee basalt. This follows the work of Coreoran (1953) in the Mitchell Butte quadrangle where similar stratigraphic relations were encountered.

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\*Geologists, Oregon Department of Geology and Mineral Industries.

\*\*See bibliography following sections (page 39).

The thickness of this section has been estimated to be approximately 5,000 feet, the bulk of which consists of basalt flows. Only the top of these lavas was seen; the base of the section was not determined due to faulting. It is thought, however, that the thickness given here is fairly close to the total thickness of the Owyhee basalt in this area.

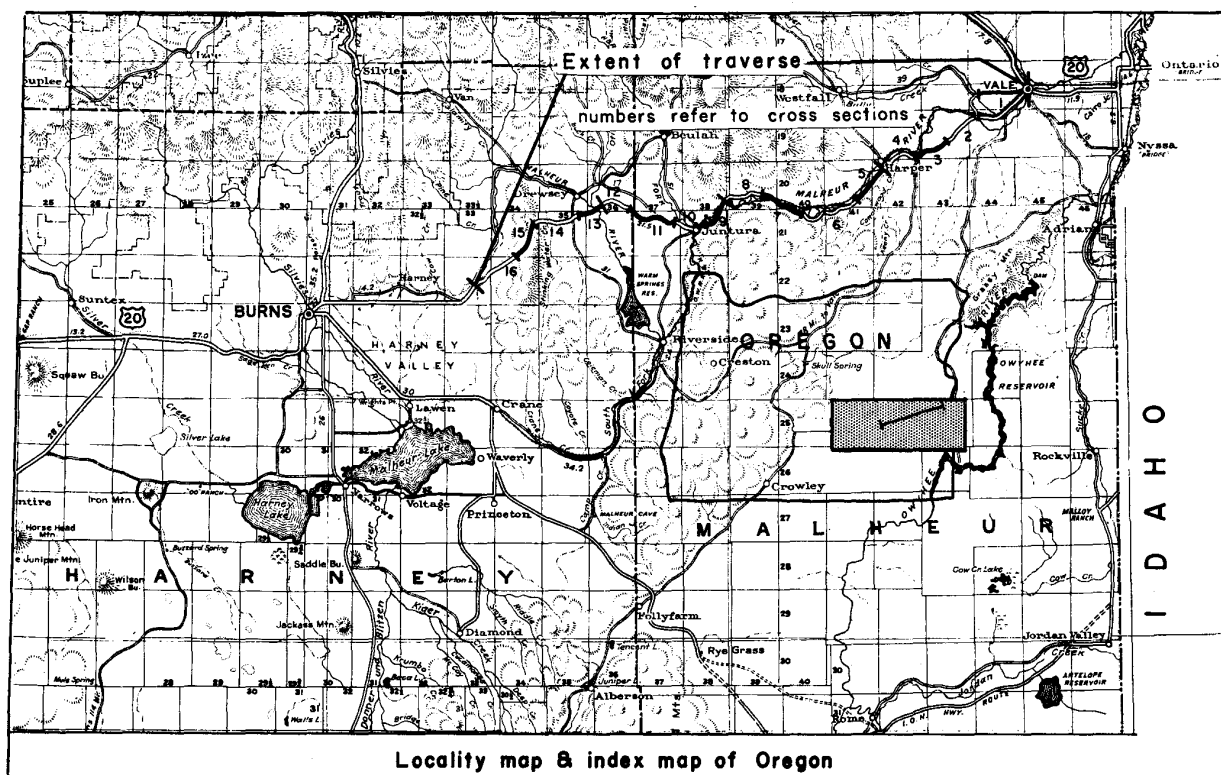
**Steens basalt:** The age of the Steens basalt has been given by Fuller (1931) as late Miocene or early Pliocene. This was based on its stratigraphic position above the Alvord Creek beds of middle Miocene age. The minimum thickness of this unit as represented on section 16 has been estimated to be about 1,200 feet.

**Siliceous extrusives:** The western margin of the traverse is in siliceous extrusives as named by Piper who assigned a Miocene(?) age to them. It is thought that these volcanics may be equivalent to Fuller's Pike Creek beds which would place them below the Steens basalt and above the Alvord Creek beds. A thickness could not be estimated for this unit.

**Payette formation:** Just a few miles north of the highway (see sections 12, 13, and 14) in the Otis Basin, Moore recognized the Payette formation and assigned it a Miocene age. The section which this traverse crossed is undoubtedly a continuation of the beds mapped by Moore. Sharf (1935), in the Rockville area of eastern Malheur County, considered the Payette formation an equivalent of the Mascall formation and assigned a middle Miocene age. Buwalda (1924) considered the Payette formation to be upper Miocene. In this report the Payette is designated as middle to upper Miocene in age.

Neither the top nor the base of the Payette formation was definitely delineated. The top may be represented on section 7, but faulting has so complicated this area that little reliance can be placed on the continuance of the section. Even so, about 5,600 feet of Payette beds are thought to be present.

**Columbia River lava(?):** The badly altered and fractured lavas and pyroclastics occurring unconformably below the Payette formation, as shown on section 11, were designated Columbia River lava(?) only because of their stratigraphic position. Any thickness given can be only an estimate. From measurements on the cross section a thickness of about 300 to 500 feet was obtained.



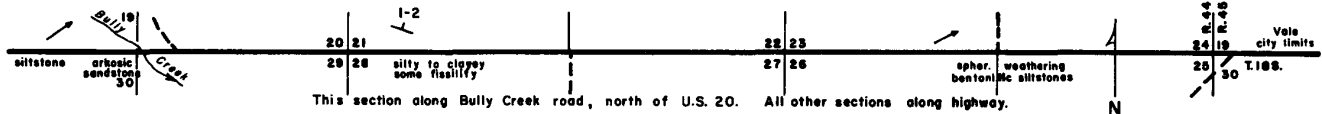
# GEOLOGIC CROSS SECTION & PLAN ALONG U.S. HIGHWAY 20

## VALE TO BUCHANAN Malheur & Harney Counties, Oregon

Section 1

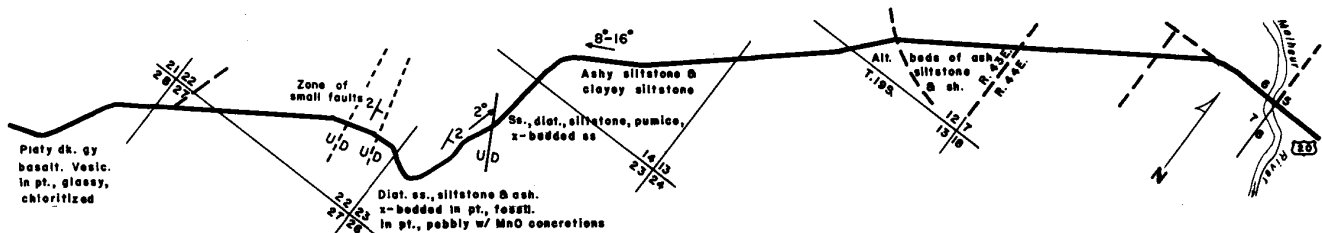


Poorly sorted sandstones and siltstones. Some cut and fill. Capping of terrace gravels; pebbles and cobbles basaltic.



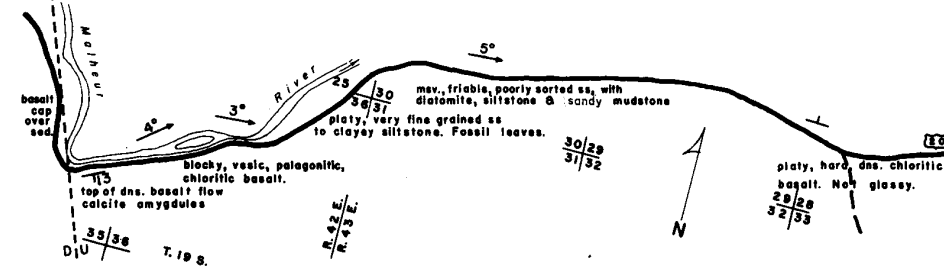
Poorly sorted diatomaceous, pumiceous sandstones & siltstones with intercalated basalt flows. Terrace gravels on east slope.

Faulting minor, may reflect folding at depth.

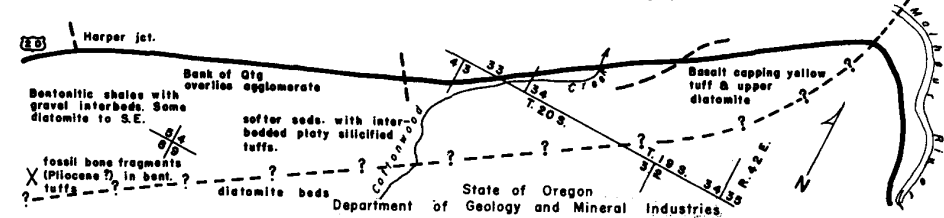


Poorly sorted, friable sandstones, siltstones & claystones with numerous thin intercalated basalt flows.

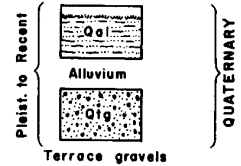
Major fault zone parallels Malheur River near western edge.



Tuffaceous & diatomaceous beds with gravel interbeds. Sequence of beds south of road not definitely determined. Complicated fault system. Slumping prominent.



### EXPLANATION



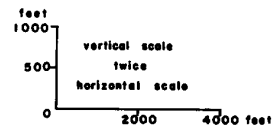
Strike & dip of beds

Direction of prevailing dip

Fault

U, upthrown side; D, downthrown side  
Dashed where approximately located

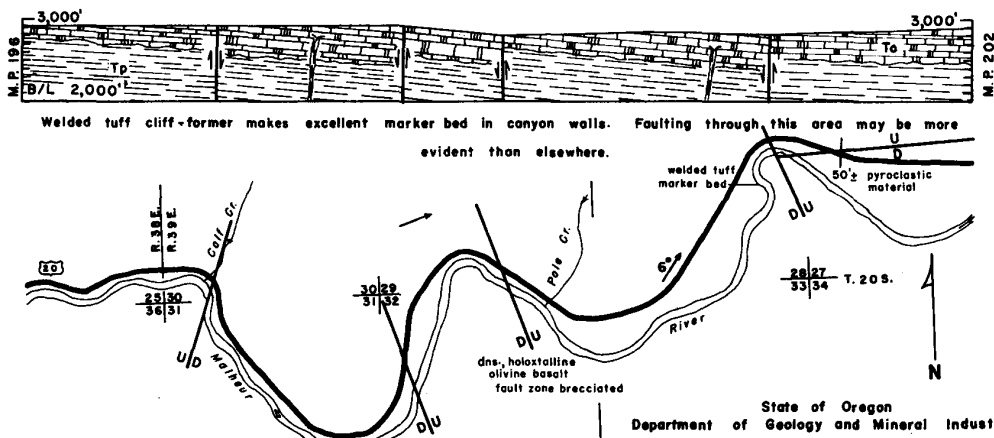
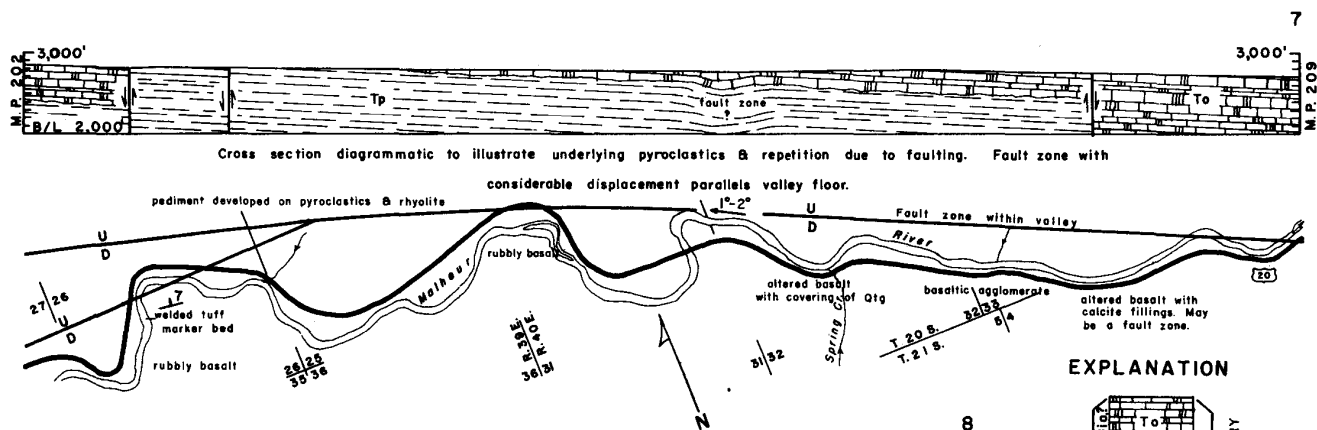
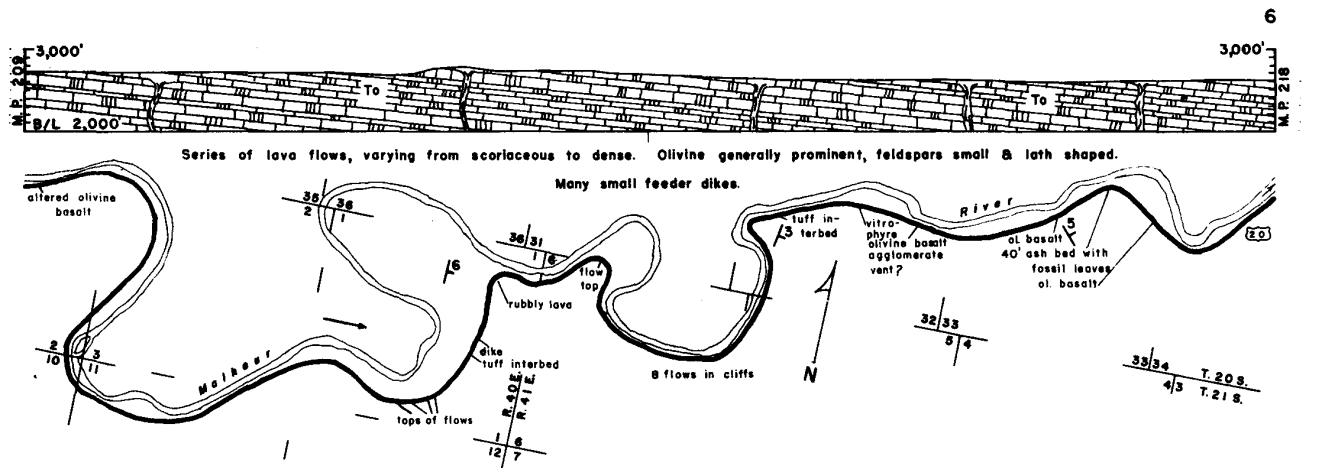
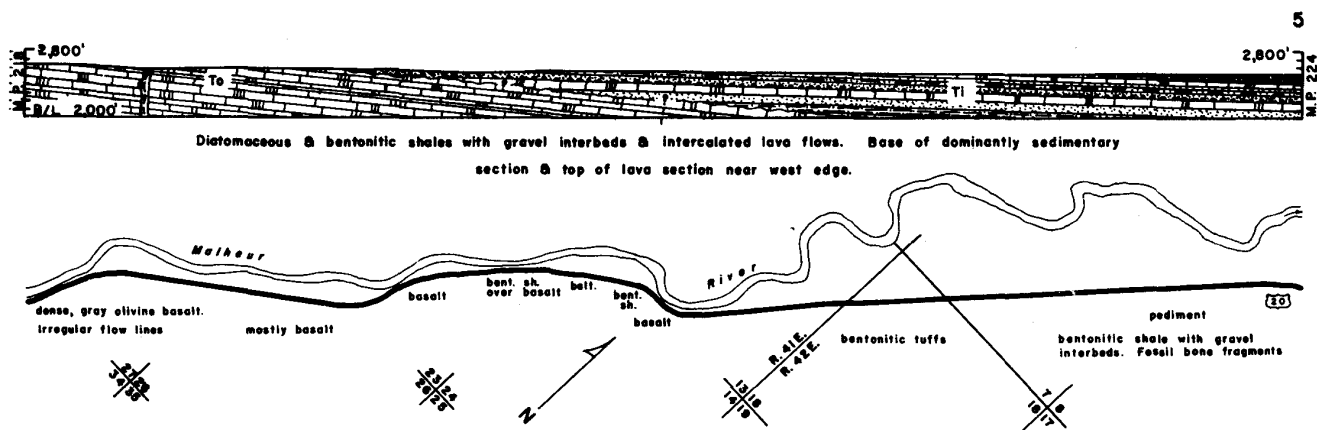
Cross section elevations from aneroid readings



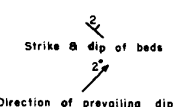
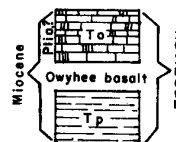
Note: Read cross sections from east to west

Base map furnished by State Highway Department.

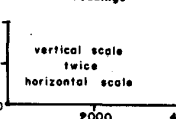




# EXPLANATION

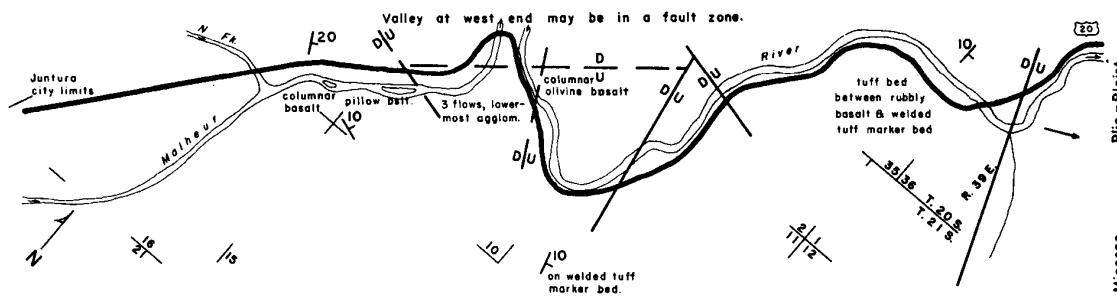


Cross section elevations from aneroid readings

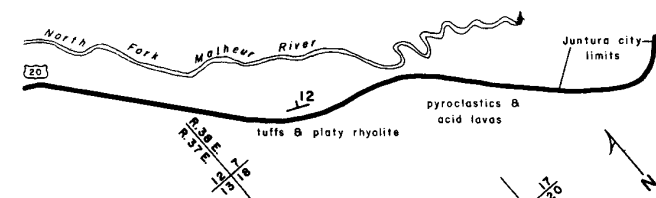




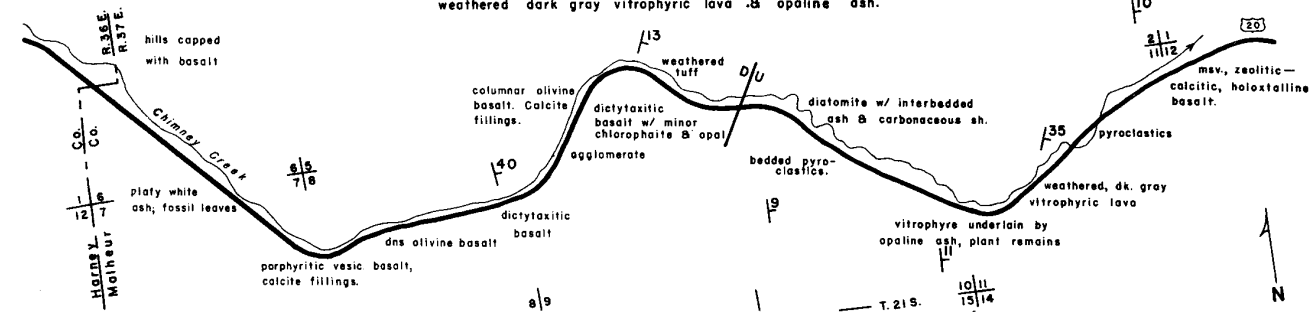
Lava flows prominent in canyon walls with few thin tuff beds. Agglomeratic near base.



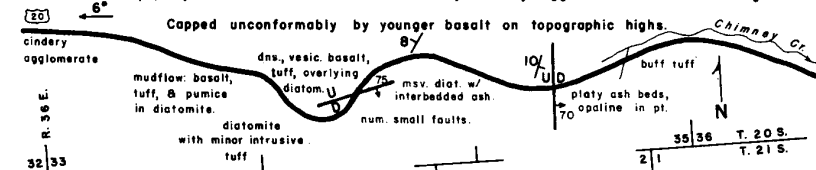
Fairly non-resistant tuffs with platy rhyolite along southwest side of valley



Alternate beds of diatomite, ash & carbonaceous shales with intercalated basalt. Unconformably underlain by weathered dark gray vitrophyric lava & opaline ash.

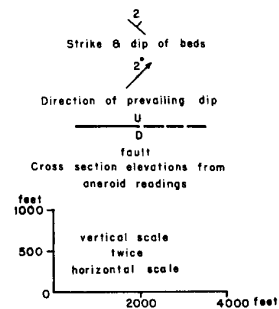
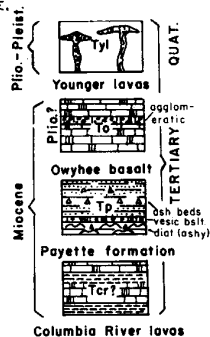


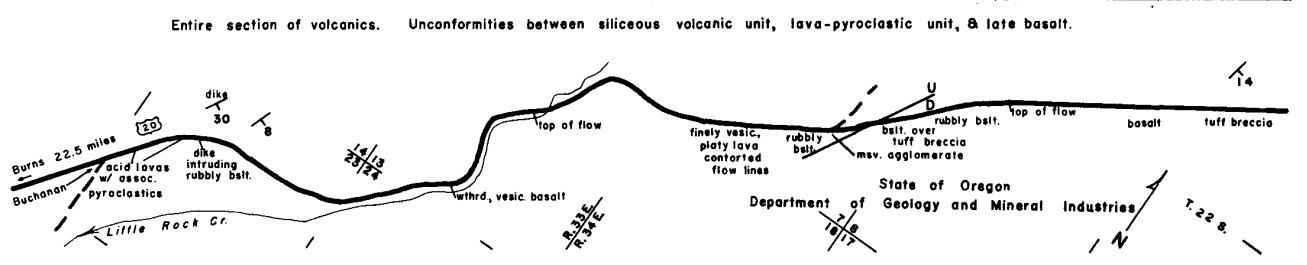
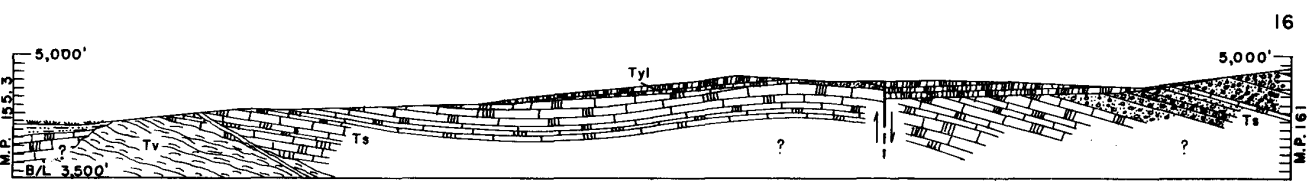
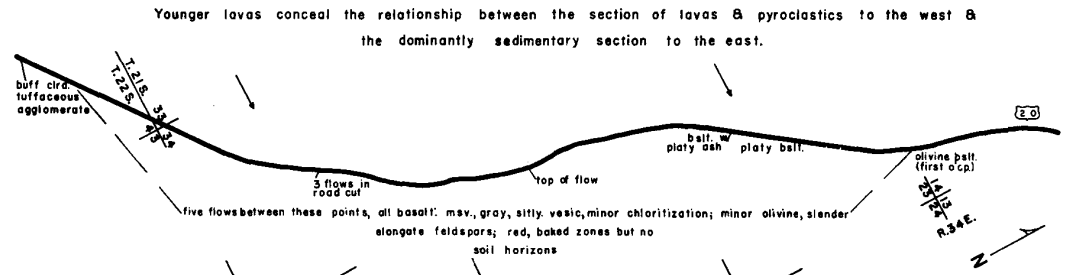
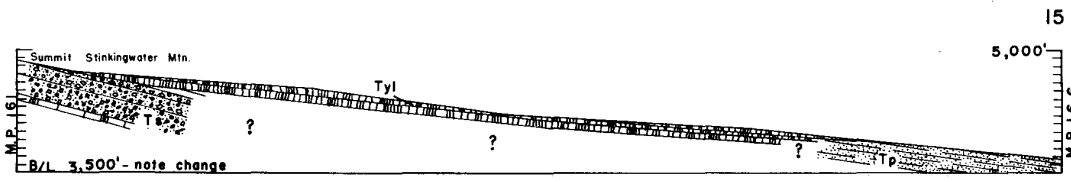
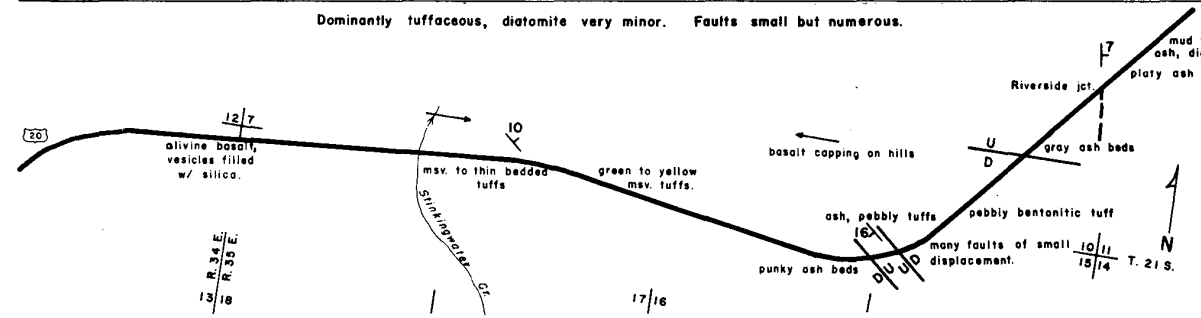
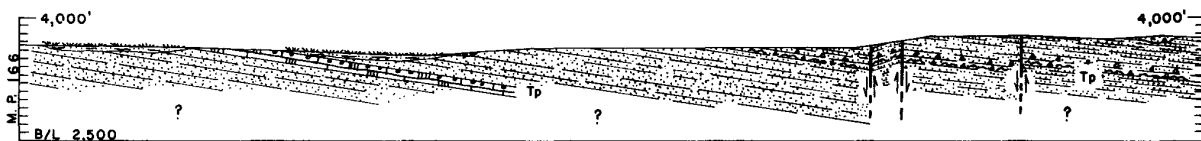
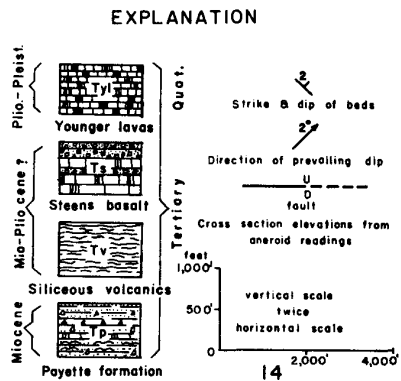
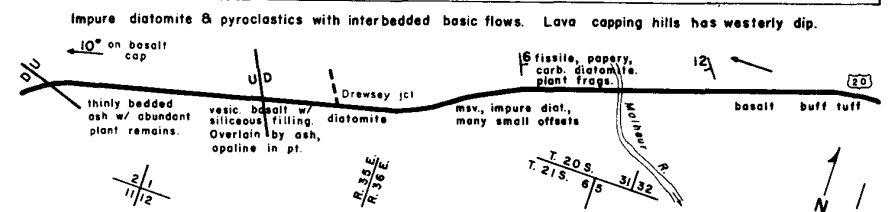
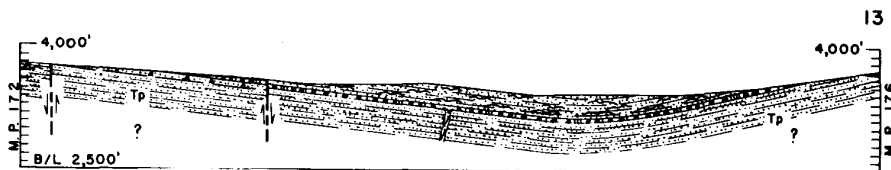
Diatomite, platy ash beds & tuff. Intruded by cindery agglomerate near west edge.



Capped unconformably by younger basalt on topographic highs.

## EXPLANATION





State of Oregon  
Department of Geology and Mineral Industries

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## PAPER ON PLACERS

The Department has just issued Miscellaneous Paper No. 5 entitled "Oregon's Gold Placers" to answer the many inquiries concerning location and characteristics of placers and equipment used in small-scale placer mining. Miscellaneous Paper No. 5 is a compilation by the Department staff and most of the material included was originally published in The Ore.-Bin. Contents of the paper are: History, Placer activities, Placer areas, Beach placers of the Oregon coast, River-terrace placers, Summary, Description of southwestern placer mining areas, Description of northeastern placer mining areas, "Is It Gold?", Prospecting with a gold pan, List of references, Graph showing 100 years of Oregon gold production, Illustration of small-scale placer mining apparatus, and Maps showing placer mining areas.

Miscellaneous Paper No. 5 may be obtained at the Portland office of the Department at 1069 State Office Building and from field offices in Baker and Grants Pass. The price is 25 cents.

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## SATURDAY ANNE CHROME

A chrome deposit which occurs in a body of serpentine about 250 feet wide was found this spring by A. O. Craig, Selma, on the ridge between Soldier Creek and O'Connor Creek near Schoolhouse Flat in the Briggs Creek area of Josephine County. Float was found on both sides of the ridge and the outcrop of the chrome in place was about 3 feet wide by 5 feet long of schlieren banded ore. Other exposures have been found in excavations. A road was recently built from Schoolhouse Flat to the deposit by Roy Jackson and the ore is being concentrated at the Six Mile chromite mill owned by Roy Jackson and Jean Pressler.

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## GEOLOGICAL SOCIETY HONORS THOMAS CONDON

TO

THOMAS CONDON  
(1822-1907)

Pioneer Oregon geologist, teacher, author, clergyman; who came to Oregon around Cape Horn as a pioneer missionary in 1852; who provided a church home at The Dalles for all Christian faiths; who was the first investigator of the fossil beds of the John Day country; who at the founding of the University of Oregon in 1876 became its first professor of geology and continued as professor and teacher until 1907; whose geological classroom was the great outdoors and whose book, "The Two Islands," was the foundation for the study of the historical geology of Oregon; this plaque is dedicated by the Geological Society of the Oregon Country.

May 29, 1954

A bronze plaque with wording as reproduced above in honor of Thomas Condon, "Father of Oregon geology," was dedicated by the Geological Society of the Oregon Country at the new Thomas Condon State Park near Picture Gorge of the John Day River on May 29, 1954. More than 100 persons, including representatives of geological societies from Bend, Eugene, and John Day; the State Department of Geology and Mineral Industries; and the State Highway Department joined the Geological Society of the Oregon Country in paying tribute to the first investigator of the John Day fossil beds of central Oregon. Dedication speakers listed Dr. Condon's achievements which included his appointment by the Oregon Legislature as first State Geologist in 1872, selection as the first professor of geology at the newly created University of Oregon in 1876, and his discovery of the upper Oligocene horse in 1866, one of the most important contributions to American paleontology. In 1946 the State System of Higher Education established the Condon lectureship in his honor.

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## WORK AT NICKEL MOUNTAIN

Mining of ore on Nickel Mountain has been started by the Hanna Coal and Ore Corporation even though the aerial tramway has not yet been put into operation. Heavy earth-moving equipment transports the ore to a coarse crusher from which it is now transported about 2 miles by road down to the smelter site. Transmission and substation facilities at the plant have been completed by Bonneville Power Administration and the California Oregon Power Company. Copco is supplying power to the Bonneville substation at the smelting plant and this Copco power is replaced by Bonneville with delivery over the new 230,000-volt Klamath Falls-Redmond line. The smelting plant will get 65,000 kilowatts of firm power under the contract with Bonneville. The drying and calcining equipment are already in use and electrodes are being baked in No. 1 furnace (June 11, 1954). It is expected that ore will be fed to this furnace and the tramway will be in operation by July 1.

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## SAND AND GRAVEL PRODUCERS

A new list of sand and gravel producers in Oregon has been prepared and is now available at Department offices in Portland, Baker, and Grants Pass. Price is 5 cents.

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STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES  
Head Office: 1069 State Office Bldg., Portland 1, Oregon  
Telephone: Columbia 2161, Ext. 488

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GEOLOGY OF THE JOHN DAY COUNTRY, OREGON\*

By  
Margaret L. Steere\*\*

Introduction

The first person to recognize the significance of the fossil mammal remains in the John Day Country was Thomas Condon, at that time pastor of the Congregational Church at Fort Dalles (The Dalles, Oregon). In 1861 a company of soldiers returning to Fort Dalles from the Crooked River Country, brought back fossilized bones and teeth, including a fine rhinoceros jaw. Thomas Condon saw the fossils and, having considerable knowledge of and interest in geology and paleontology, recognized the importance of the find and decided to take the first opportunity to visit the locality. The following year, 1862, he obtained permission to join a company of soldiers taking supplies to Harney Valley. On the way the company visited the Crooked River fossil locality, and on the return trip they came by way of Bridge Creek where Condon made his first collections in the John Day Country. The following summer he returned to collect again at Bridge Creek, and in 1864 saw for the first time the large exposures of John Day beds in the John Day River valley north of Picture Gorge.

Summer after summer he returned to this area, which he called Turtle Cove, to collect specimens and study them. Having little in the way of scientific books for identifying the material, he sent specimens of fossil horse teeth to Professor Marsh at Yale. This find made him discoverer of the Oligocene horse. Almost immediately he received a request from Marsh to guide an expedition into the field. Other groups of scientists, hearing about the find or seeing the specimens, began coming to the John Day fossil beds, conducted there at first by Condon. Much material was sent to Smithsonian Institute, American Museum of Natural History, and various universities for identification.

In 1876 Thomas Condon was made the first Professor of Geology at the University of Oregon where he taught for many years. During this time he wrote a number of reports on the geology of various parts of the State, including the John Day Country. These were later compiled into a book entitled "The Two Islands," (Condon 1902), which was the basis for all future geological study in Oregon.

On May 29, 1954, in appreciation for Professor Condon's contribution to knowledge of geology and paleontology of the John Day Country, the John Day Fossil Bed State Park was renamed "Thomas Condon State Park," and an inscribed plaque was placed by members of the Geological Society of the Oregon Country at the roadside park facing the spectacular outcrop of John Day beds in Sheep Rock.

Location

The John Day Country is generally considered to be the mountainous territory drained by the John Day River and its tributaries lying between the Cascade Range and the Blue Mountains.

The area shown on the accompanying map is the portion of the John Day Country that is most easily accessible and most frequently visited. It is bounded roughly by the towns

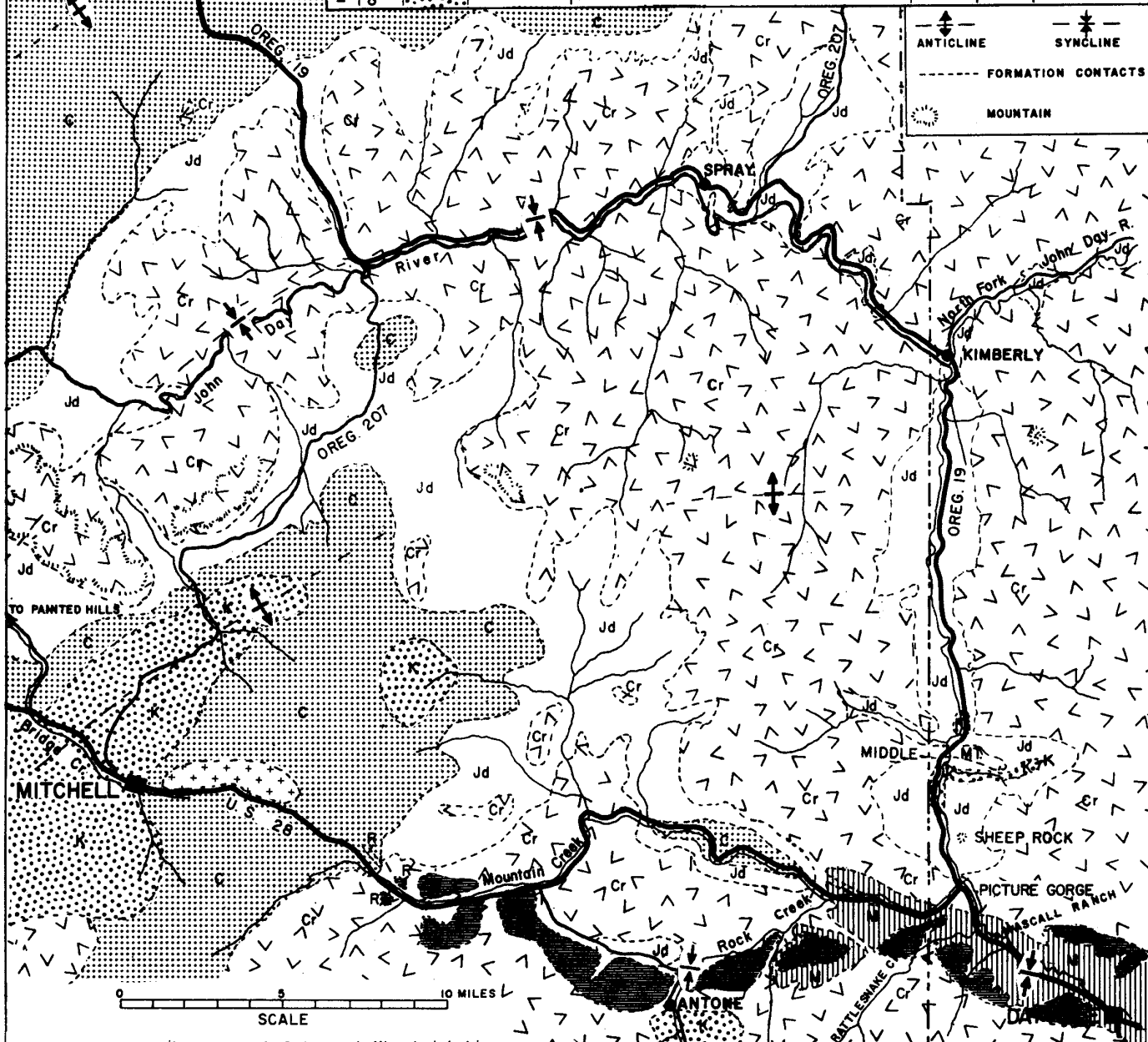
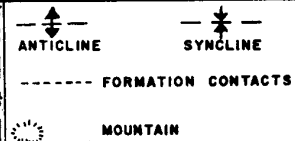
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\* This report was published in shorter form in the May 1954 News Letter of the Geological Society of the Oregon Country.

\*\* Geologist, Oregon Department Geology and Mineral Industries.

# GEOLOGIC SKETCH MAP OF THE JOHN DAY COUNTRY

## LEGEND

TIME	SYMBOL	FORMATION	DESCRIPTION	THICK- NESS	AGE (MILL. YRS)	FOSSILS
QUAT.	+	UNNAMED	LAVA FLOW FROM LOCAL VENT ALLUVIUM (NOT SHOWN ON MAP)		1	
PLEIST. RECENT	+					
PLIO.	■	RATTLESNAKE	DISCONFORMITY GRAVEL, SAND, SILT WELDED TUFF	800'	10	VERTEBRATES
	▨	WASCALL	UNCONFORMITY WHITISH VOLCANIC ASH AND TUFF GRAVEL, SAND, SILT LENSES	1,000'	15	VERTEBRATES AND PLANTS
	▨		UNCONFORMITY			
Cr	▨	COLUMBIA RIVER BASALT	BASIC LAVA FLOWS	2,000'	20	
Jd	▨	JOHN DAY	DISCONFORMITY UPPER - BUFF TUFFS MIDDLE - GREEN " LOWER - RED "	1,000'	30	VERTEBRATES AND PLANTS
	▨		UNCONFORMITY			
Cr	▨	CLARNO	VOLCANIC AGGLOMERATES, ACID LAVAS GRAVEL, SAND, CLAY	3,000'	50	VERTEBRATES AND PLANTS
	▨		GREAT UNCONFORMITY			
Cr	▨	CRETACEOUS & PRE-CRETACEOUS	MARINE CONGLOMERATES, SANDSTONE, SHALE (INCLUDES OLDER METAMORPHIC ROCKS)	?	100	MARINE INVERTEBRATES



of Mitchell, Fossil, and Dayville, and includes Picture Gorge and the John Day fossil beds. Highways crossing the map area follow the valleys of the John Day River and its tributaries. These streams in their downward carving through successively older rocks have exposed to the traveler a hundred million years of geologic history.

Because the accompanying geologic sketch map was compiled from a number of published and unpublished sources of varying accuracy, it should be regarded only as a reconnaissance map subject to changes.

### Geologic History

#### Pre-Cretaceous and Cretaceous rocks

Very ancient, metamorphosed rocks of probable Paleozoic and lower Mesozoic age underlie the John Day region and crop out in a few places; but so extreme was the squeezing and folding of these strata that in their meager outcrops the record of life and accompanying geologic events has been almost entirely destroyed.

The oldest rocks of the John Day region in which fossils are sufficiently well preserved to make possible an age determination are late Mesozoic (Cretaceous) sediments. In Cretaceous time, one or more great seaways covered most of the State of Oregon, and ammonites and other forms of shell life were abundant. Dark gray shales and slates bearing these marine fossils crop out along U.S. Highway 28 in the Ochee Mountains a few miles west of Mitchell. Conglomerates and sandstones also comprise a large part of the Cretaceous sediments and represent the old shore line of the Cretaceous sea. About 2 miles north of Picture Gorge an indurated conglomerate believed to be of Cretaceous age crops out on either side of the John Day River for a distance of about 1 mile along State Highway 19. A few poorly preserved fossil leaves have been found in this material (Coleman 1949).

At the close of the Mesozoic era, the land was uplifted and the rocks steeply folded. The sea withdrew far to the west, beyond what is now the Cascade Range, and never again invaded the John Day Country. The uplifted land underwent a long period of erosion, and the formations of the Cenozoic era which followed were laid down as terrestrial or land deposits on this old erosion surface. A marked unconformity exists where rocks of the two eras are seen in contact.

#### Clarno formation

Accumulation of terrestrial volcanic material began in late Eocene time when numerous explosive volcanoes in the John Day Country and elsewhere covered the land with volcanic debris. These volcanic rocks attained a thickness in some places of nearly 3000 feet. They crop out over wide areas in the John Day region and have been named the Clarno formation after exposures near Clarno Bridge on the John Day River west of Fossil.

The early products of the Clarno volcanoes were basalt flows, agglomerates, breccias, and tuffs; later the material changed to acid lava flows (rhyolite). During quiet intervals between volcanic eruptions, normal processes of erosion in streams and lakes worked over the volcanic rocks and redeposited them locally as gravels, sands, and muds. Where the environment was suitable, plant and animal life became established. Subsequently all was buried under volcanic extrusions. Thus we see conglomerates, sandstones, and shales interbedded in the Clarno volcanics, particularly in the lower part of the formation, and some of the finer sediments contain fossil plant material. That the climate was warm and humid in Clarno time is indicated by the presence of fossil fruits and the leaves of semi-tropical plants. Although fossil plants are fairly abundant in the sedimentary layers of the Clarno formation, fossil animal remains appear to be extremely rare.

The typical appearance of the Clarno formation where it crops out in the map area is that of rounded stony hills of a reddish hue.



The Clarno and older formations were subjected to folding and considerable erosion at the end of the Eocene so that all later formations lie unconformably on these folded and eroded rocks.

#### John Day formation

Beginning in late Oligocene and continuing until middle Miocene another period of volcanism took place during which ash was carried away from exploding volcanoes by the wind and deposited frequently over the land to form the colorful and fossiliferous John Day beds. It was originally believed by Condon and other geologists who early studied the area that these were lake beds. Today, however, it is generally accepted that the sediments are aeolian and that waterlaid tuffs occur only in small pockets near the base of the formation. Most geologists believe that the chief source of this material was from volcanoes in the young Cascade Range and that the volcanoes which deposited the Eagle Creek formation in the Columbia Gorge also contributed ash to the John Day region.

The intervals between ash falls were long enough for plant and animal life to become re-established many times over. The beautifully preserved leaf imprints near Bridge Creek in the Painted Hills State Park north of Mitchell is an example of the flora of the John Day formation. Other similar flora are found at various places in the lower part of the John Day formation, two of which occur in the area shown on the sketch map: one near the mouth of Deer Gulch just south of Middle Mountain on the east side of the John Day River; the other in the bluff behind the High School in Fossil. On the basis of leaf count, the dominant trees of the John Day Country in late Oligocene time were *Metasequoia*, birch, and alder.

More than 100 species of fossil mammals have been recognized in the John Day beds from the area along the John Day River between Picture Gorge and Spray. These include many extinct forms of cats, dogs, camels, rodents, and rhinoceroses. The primitive three-toed horse, *Miohippus*, was also present. Most common animals were the oreodonts -- cud-chewing, piglike beasts, long extinct, whose fossilized skulls were collected in large numbers as curios in the early days by settlers in the region.

Three divisions have been recognized in the John Day beds and described in detail by Coleman (1949), namely Lower, Middle, and Upper. The Lower John Day formation of upper Oligocene age is composed predominantly of red tuffs and contains much fossil plant material but only a small amount of vertebrate remains. The Middle John Day formation, which is predominantly green tuff, and the Upper John Day formation, which is chiefly buff-colored tuff, are of lower Miocene age and contain abundant vertebrate fossils. A thick flow of welded tuff from some local vent forms a distinct line of demarcation between the middle and upper members of the John Day formation. A complete section of the Upper John Day formation, together with the welded tuff beneath it, is exposed on the west face of Sheep Rock.

The bright colors of the John Day formation are caused by the chemical action on iron minerals in the tuff during periods of weathering between showers of ash. Reds and yellows are due to various degrees of oxidation of these minerals to form hematite and limonite, while the greens are due to reduction and hydration of the iron minerals under conditions of low oxygen and the presence of organic material to form ferro-ferrie iron compounds.

The fantastic castellated shapes one sees in the John Day beds are due to the differential erosion of hard and soft layers of the rock, and are particularly characteristic of the green and buff members of the formation. The lower, red member, where exposed at the surface, tends to weather down into low, rounding hills. The John Day formation is easily recognized by its bright colors, tuffaceous texture, and oddly eroded appearance.

Following the deposition of the John Day beds, the formation was warped slightly and then underwent a short period of erosion resulting in a highly dissected topography.

### Columbia River basalt

In middle Miocene time Oregon, Washington, and Idaho were the scene of the most extensive accumulation of basic lavas in the world. The whole region of the John Day Country was turned into a desolate waste by tremendous flows of lava known as the Columbia River basalt. This welled up out of many fissures in the earth and spread over all earlier formations like a black pavement. Early flows filled in topographic irregularities on the eroded John Day formation, as at Picture Gorge where the basalt apparently filled a low area in the old erosion surface.

As many as twenty-three distinct layers of basalt can be counted in Picture Gorge, and these are generally interpreted as representing twenty-three flows of lava. In the opinion of Dole,\* however, there were only fourteen flows. Pseudo-layers, he believes, were produced in certain flows by a cooling phenomenon as follows: heat escaping upward through the lava caused a critical temperature to be reached about midway in the flow. At this level, tension was such that a sharp line of demarcation occurred between top and bottom of the flow. The top, cooling rapidly, fractured in an irregular manner, while the bottom, which cooled more slowly, fractured in columns, thus producing the appearance of two flows where actually only one existed.

In Picture Gorge at least 1500 feet of basalt can be seen. In other regions outside the map area, lava sections have been measured that are more than 5000 feet thick. In some places, carbonaceous soil layers occur between flows, indicating that here was a short period of quiescence before the land was again covered by a great flood of lava.

The Columbia River basalt is a dense, fine-grained olivine rock that is nearly black on fresh exposure. It is very resistant to erosion and forms the dominant topographic features of the region. Although somewhat warped into regional folds, locally it appears nearly horizontal and is seen as prominent flat surfaces, table mountains, hog backs, rim rocks, and narrow, steep-sided canyons. The basalt acts as a protective capping layer on top of the soft John Day beds, thus retarding erosion. A small remnant of basalt on Sheep Rock prevents the soft tuffs beneath from being washed entirely away.

### Mascall formation

In upper Miocene time the flows of Columbia River lava gave way to intermittent showers of ash from volcanoes. A down warping of the Columbia River basalt south of Picture Gorge formed a syncline in which wind- and water-laid ash, together with lesser amounts of silt and gravel, accumulated to a maximum depth of at least 1000 feet. This series of nearly white ashy deposits was named the Mascall formation for the typical exposure near the Mascall Ranch on the John Day River south of Picture Gorge.

Fossil leaf imprints of the Mascall flora are well preserved in the white ashy shale in various outcrops east of Dayville. According to Chaney (1948), *Metasequoia*, characteristic of the Lower John Day formation, occurs only in small numbers in the Mascall formation, the dominant conifer being swamp cypress. Oak and beach are abundant. Fossil bones of mammals and fish have been found in the Mascall formation.

The close of the Miocene epoch was marked by considerable folding and faulting over much of Oregon. A series of large folds developed trending northeast to east across the John Day region as shown on the sketch map. It was during this period of deformation that the Cascade Mountains were greatly uplifted to form a climatic barrier between western and eastern Oregon.

### Rattlesnake formation

Erosion of the faulted and tilted strata in the vicinity of Picture Gorge resulted in the deposition of about 800 feet of gravel, sand, and silt on top of the Mascall formation. A single flow of welded tuff (ignimbrite) from some local vent is interbedded in this series

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\* Dole, H. M., Geologist, Oregon Department Geology and Mineral Industries, oral communication.

of sediments. The flow is about 50 feet thick and can be traced for many miles along the John Day valley south of Picture Gorge. It is composed of a hard glassy material showing flow structure and containing aligned and flattened pumice fragments (Taubeneck 1950). At the top and bottom of the flow the glassy texture grades into a porous tuff.

The origin of this peculiar tuff was for many years a matter of considerable speculation, but was generally regarded as a flow of rhyolite. In recent years observations of extrusions from active volcanoes have given rise to the theory that this is a form of nuée ardentes (fiery cloud). Such volcanic outbursts are erupted as a glowing gaseous cloud of incandescent particles, the whole mass moving at great speed. The entire phenomenon is one of exceedingly short duration, perhaps only a matter of a few days. After extrusion the hot plastic particles adhere to one another till they are welded together, while the larger fragments are flattened under the weight of the mass.

Thus the welded tuff of the Rattlesnake formation was extruded in a few days' time, while the sands and gravels, which comprise most of the formation, continued their slow accumulation, finally covering the tuff flow. Along the north side of the John Day valley between Picture Gorge and Dayville, recent erosion has removed the upper gravels so that the resistant welded tuff stands out conspicuously as a horizontal buff-colored rim rock above the white, tilted Mascall formation.

Fossil bones of camels, antelopes, and grazing horses discovered in the sediments near Rattlesnake Creek (type locality of the Rattlesnake formation) date the deposit as Pliocene in age.

#### Pleistocene and Recent rocks

The course of the John Day River was established near the end of Pliocene time and was controlled by structural features. The synclinal basin south of Picture Gorge had filled with sediments of the Rattlesnake formation to an elevation that covered the Columbia River lavas at Picture Gorge. Continued aggrading of the floor of the basin raised the stream level to a point where drainage found an outlet through the anticline to the north by way of a local north-trending syncline (not shown on the map) near Middle Mountain (Coleman 1949). Thus the John Day River, as it cut down through the Mascall and Rattlesnake formations, became superimposed on the Columbia River basalt at Picture Gorge. Farther to the north, the course of the stream swung westward in the east-west syncline near Kimberly.

In more recent times, the John Day River and its tributaries have enlarged and deepened their valleys by erosion and removal of the rocks encountered. Where the formations are soft the valleys widen out, and where the rocks are hard the streams are confined to narrow canyons. East of Mitchell a local lava flow, probably related in age to the intracanyon flows of the Deschutes and Crooked rivers area (Hodge 1942), filled part of one of the valleys tributary to the John Day River.

#### Ancient Man in the John Day Country

On the west wall of Picture Gorge, a type of fossil art in the form of crude drawings, from which the Gorge derived its name, have intrigued the imagination of many a passer-by. These markings, called pictographs (Cressman 1937), were painted on the basalt walls with a pigment made from red iron oxide mixed with a resinous substance. Now weathered and dull almost beyond recognition, they are believed to be at least 5000 years old. Similar paintings and carvings on rock walls have been found in many places in Oregon and all are located near lakes or rivers where the aboriginal Indians came to fish and hunt. Living Indians disclaim any knowledge of the origin of the drawings. Whether they had some important symbolic meaning or whether they were done for the artist's own amusement will probably never be known.

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## BAKER COUNTY LATEST LIMESTONE PRODUCER

National Industrial Products Corporation, Durkee, Oregon, is the name of the wholly-owned subsidiary of the Morrison-Knudsen Company which has brought into production the newest limestone operation in the State. The quarry is located about 4 miles southeast of Durkee in Baker County, and 28 miles southeast of Baker on the main line of the Union Pacific Railroad. Extensive exploration was carried on by Morrison-Knudsen interests before the plant was installed. Diamond drilling was employed as was also sampling by bulk carload shipments to several different potential markets. This exploration work showed that high-calcium limestone satisfactory for the various market demands could be produced in large quantity. The company installed large-capacity crushing, conveying, and storage facilities, and built a railroad spur and siding which has a sufficient capacity for more than twenty railroad cars per day. Present production averages about 500 tons a day. The deposit occupies the greater part of 820 acres. Depth of stone available as shown by drilling is at least 160 feet. Exploration

so far has proved 15 million tons. The company plans to serve heavy chemical and metallurgical industries with sized material as required. Contracts have already been entered into with several sugar mills in southwestern Idaho and southeastern Oregon. Operations are directed by Mr. J. V. Otter, Box 450, Boise, Idaho.

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#### NEW PURCHASE PROGRAM FOR QUICKSILVER

The government has set up a purchase program for quicksilver in which it will buy 200,000 flasks at a guaranteed price of \$225 per flask, it was announced on July 6. Under the program General Services Administration will buy 125,000 flasks of domestic quicksilver and 75,000 flasks of Mexican metal. The guaranteed price will be in effect until December 31, 1957. GSA may enter into private contracts with foreign producers, especially in Canada, over and above the 200,000 flask total. It was reported that reaction to the news was mixed but the price for quicksilver was unchanged during the week of July 8, remaining at \$280-285 per flask. Demand was quiet. It was the feeling of users of the metal that the program will bring out more quicksilver, especially if the government pulls out of the European market, as seems probable.

The E&MJ Metal and Mineral Markets, New York, issue of July 15, reports that feeling in the industry is that the price will eventually decline to approximately \$225 per flask. However, spot metal during the preceding week developed further market strength. Prices from \$285 to \$290 per flask, a new high, were paid.

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#### STATE GEOLOGIC MAP WORK SPEEDED UP

Work on the State Geologic Map is being pushed by both cooperating agencies, the State Department of Geology and Mineral Industries and the U.S. Geological Survey. Hollis Dole, geologist of the Department, is mapping in the western Cascades east of Eugene. N. S. Wagner and Max Schafer, geologists with the Department, have been finishing up in the Umatilla County mapping project. Dr. Francis Wells with an assistant is now in southwestern Oregon where he is conferring with Dr. Ralph Imlay and Dr. Roland Brown, paleontologists of the Survey. They together with Hollis Dole have planned an investigation of problems in the Upper Elk River area of Curry County and in central Douglas County for the immediate future. Dr. Ewart M. Baldwin of the University of Oregon, working for the U.S. Geological Survey during the current field season, is mapping in the lower Siuslaw area of Lane County. Mr. Linn Hoover of the U.S. Geological Survey is mapping in the Drain and Anlauf quadrangles of Douglas County. Dr. Aaron Waters, professor of geology at Johns Hopkins University who is doing State Geologic Map work for the U.S. Geological Survey, is mapping in central Oregon, at present in Deschutes and Crook counties.

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#### SUCCESSFUL EXPERIMENTS REPORTED BY HARVEY

According to the Salem Statesman, the Harvey Aluminum Company at its Salem experimental plant has been successful in developing processes for the treatment of Salem bauxite. The company reported on June 30 that the plant on Cherry Avenue has been doing research on Salem laterite for several months and believes that alumina can be successfully produced from the Salem material. It was also stated that aluminum sulphate might be a by-product. The company announced that a pilot plant to go into active production will be built, and predicted that later a larger plant along the same lines would be built in the same general area.

The Salem plant, now operated by Harvey, was built during the war in order to develop a process invented by the Chemical Construction Company of New York to produce alumina from high-alumina clays. The process was not fully tried out because the government shut off funds for such work after the submarine menace was overcome and there was then no shortage of bauxite. The Harvey Company purchased the plant from the government for \$325,000. A. W. Metzger is in charge of the Salem work.

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OREGON CHROMITE PRODUCERS

Fifty Oregon chromite producers shipped a total of 5,550 long tons, gross weight, of ore and concentrates to the General Services Administration chromite-buying depot at Grants Pass during 1953 according to U.S. Bureau of Mines Mineral Industry Statistical Division. Value of the Oregon chromite came to \$484,453. Of the six counties in the State which produced chromite during 1953, Josephine County had the greatest production with a total of 3,422 tons. Curry County produced 649 tons, Coos 16, Douglas 172, Grant 1,076, and Jackson 21 tons. Chromite received from unknown sources amounted to 194 tons. Of the total Oregon production only 936 tons of ore assayed less than 45 percent  $\text{Cr}_2\text{O}_3$  and was valued at \$76,599. The 4,614 tons of ore assaying more than 45 percent brought \$407,854 to the 44 operators supplying this grade. Lowest grade ore shipped to the stockpile assayed 42 percent  $\text{Cr}_2\text{O}_3$  while the highest was 54 percent. The weighted average of Oregon ore delivered during the year was 47.35 percent  $\text{Cr}_2\text{O}_3$  with a 2.48 to 1 chrome-iron ratio.

Fifteen Oregon producers have given permission to publish the results of their 1953 chromite production as listed below:

<u>Name</u>	<u>County</u>	<u>Long Tons</u>	<u>Percent <math>\text{Cr}_2\text{O}_3</math></u>
O. K. Coster	Coos	10 6	44 46
Ernest A. Foster	Curry	59	49
Fred Gardner & Sons	Curry	17 91	44 48
O. W. Stuenkel	Douglas	13	45
Arthur F. Neuman	Grant	242	48
Zanetti Bros.	Grant	490	49
Ashland Mining Co.	Josephine	10 469	44 49
Austin B. Brownell	Josephine	6	47
Fred Langley	Josephine	20 227	43 48
A. W. Johns	Josephine	10	51
E. K. McTimmonds	Josephine	25 167	44 46
Jean Pressler & Roy Jackson	Josephine	46 105	43 47
R. W. Radoliff	Josephine	49	51
Wm. S. Robertson	Josephine	74 188	44 47
Arthur Strickland	Josephine	14	46

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## MINING CONGRESS STRATEGIC MINERALS SESSIONS

Among the important sessions of the American Mining Congress meeting in San Francisco September 20-24 will be round-table meetings of strategic mineral producers, especially those operating under government purchase programs. Monday afternoon, September 20, has been set aside for these sessions, with a separate group for each metal. Fay Bristol has been chosen Chairman of the chrome group, and all people in attendance at the convention who are interested in chrome production are invited to be present and take part in the discussions. It is expected that federal government officials who have jurisdiction over the chrome program will attend and participate in the discussions. These group meetings will be held on the fourth floor of the Civic Auditorium.

On Wednesday noon September 22 the Strategic minerals luncheon will be held in the Crystal Room of the Whitecomb Hotel. S. H. Williston, Vice President of Cordere Mining Company and Chairman of the Strategic Minerals Committee of the American Mining Congress, will be Chairman of this luncheon meeting. Hon. J. Bracken Lee, Governor of Utah, will give the main address. This luncheon will be a sell-out judging by the advance sale of tickets.

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## GOVERNMENT QUICKSILVER PURCHASE PROGRAM

The General Services Administration has announced that producers of mercury who will wish to supply the metal to the government under the recently announced program should notify the GSA no later than June 30, 1955, of their desire to participate in the program. The announced government price is \$225 per 76-pound flask f.o.b. delivery point with duty (\$19) paid by the seller of Mexican mercury. The metal will be examined by government inspectors at the purchase points to decide whether or not the metal meets specifications. Rejected shipments must be removed at the seller's expense. The announcement of the government program, according to the American Mining Congress News Letter, states that "Small producers are particularly invited to participate in the program."

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## OREGON MINE REJUVENATED

The Pyx Mine, a gold prospect in the Greenhorn District of Grant County, Oregon, has been taken over by the Greenhorn Mountain Development Company, Box 908, Baker, Oregon. Underground development work has been under way since early in the year and a 25-ton test mill is under construction. The mill flow sheet was worked out by the Denver Equipment Company and consists primarily of jigging and flotation with tabling to be added as development progresses. Power for the mill and for underground lighting will be generated by a diesel-electric unit. Present plans call for a payroll of ten men at the outset on a one-shift, 40-hour-week basis. Ward L. Hill is general manager; Glen Ingles, mine superintendent; and Frank Kolkow, mill superintendent.

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## BONANZA QUICKSILVER MINE REOPENS

As reported previously in The Ore-Bin, the Bonanza quicksilver mine suspended operations on February 15, 1954. Because of the rapid increase in price during succeeding months, the mine reopened on June 1. Mining was started on the 370 and higher levels and work on the 5th, 6th, 7th, 8th, and 1050 levels will be undertaken when removal of water allows access, which is expected to be within 30 days. The Gould furnace has been put back in use. Plans are being formulated by the management to increase production. Fifteen men are now employed.

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## NEW LAWS AFFECTING THE MINING INDUSTRY

Senator George W. Malone's amendment to the Mutual Security Act recently passed by Congress deletes a section of the act which would have allowed expenditures by the United States to stimulate production of critical minerals in foreign nations. Senator Malone stated in presenting his arguments that transportation of strategic minerals from foreign lands to the United States in a war emergency would certainly be interrupted and the interruption might last long enough to paralyze our war efforts. He stated his belief that more of the government's attention should be given to encouraging domestic production of minerals and less to production in foreign lands.

Another amendment by Senator Malone, approved by the Senate, had to do with raising the depletion rate for 32 critical metals from 15 to 23 percent. It had previously been approved by the House. This amendment was included in the new tax law recently passed and applies to the following domestic deposits: antimony, bismuth, cadmium, cobalt, columbium, lead, lithium, manganese, mercury, nickel, platinum and platinum group metals, tantalum, thorium, tin, titanium, tungsten, vanadium, zinc, and uranium, as well as asbestos, bauxite, beryl, celestite, chromite, corundum, fluorspar, graphite, ilmenite, kyanite, mica, olivine, quartz crystals (radio grade), rutile, black steatite talc, and zircon.

The new tax law also raises the amount of mine exploration expenditures which a taxpayer may choose to deduct in a year or on a deferred basis from \$75,000 to \$100,000 allowable in only four taxable years.

The mining industry through the American Mining Congress has been urging changes in the tax laws for a number of years in order to give a transfusion to a sick industry. The present Congress has recognized more than any other in recent history the need for a healthy mining industry for national defense as well as to combat the "have not" theory so prevalent in Washington since World War II.

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## DEPARTMENT STAFF CHANGES

David White, who has been field geologist for the Department at Grants Pass, Oregon, since 1952, resigned on July 1 to accept a position with Alcoa at Bauxite, Arkansas. Mr. White was previously on the staff of Alcoa Mining Company when the company was mapping the geology of the bauxite areas of northwestern Oregon. He started work for the Department in 1948.

Mr. White's successor at Grants Pass is Max Schafer, a graduate of the University of Oregon, who worked for the U.S. Geological Survey in the Colorado Plateau area after his hitch in the Army.

Bob Bentley, a graduate student in geology at Oregon State College, has joined the staff on a temporary basis as a Geologist I to assist Department geologist Len Ramp in field mapping of chromite areas in southwestern Oregon.

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## DR. HOWEL WILLIAMS MAPS PART OF THE CASCADES

Dr. Howel Williams, well known geologist and volcanologist of the University of California, has been mapping in the Cascade Range for the U.S. Geological Survey during the current field season. His work is connected with the cooperative project between the Survey and the State Department of Geology and Mineral Industries which will result in the construction of a State Geologic Map.

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## U.S. GEOLOGICAL SURVEY GEOLOGIST MAPS PORTLAND AREA

Mr. Don Trimble of the Engineering Geology Section of the U.S. Geological Survey, Denver, Colorado, is mapping the geology of the Portland area during the current field season.

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## ZIRCONIUM AND HAFNIUM PRODUCTION

As reported by the Bureau of Mines, production of raw zirconium sponge at the Bureau's plant at Albany, Oregon, during May was 29,599 pounds. During the same period, raw hafnium sponge production was 734 pounds. The stated amounts of both metals produced were shipped to the Atomic Energy Commission.

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## QUICKSILVER IN OREGON - 1953

Oregon's five quicksilver mines produced a total of 648 flasks of mercury during 1953. An estimated 13,061 tons of ore was mined which ranged from .125 percent up to 16.7 percent of contained mercury as reported by the Bureau of Mines. One percent contains 20 pounds of quicksilver per net ton. Ore was treated in four retorts and one furnace. Richest ore in the State was mined by Eickemeyer Brothers at the Maury Mountain mine in Crook County. The ore averaged over four 76-pound flasks per ton. Eickemeyer Brothers retorted an estimated 10 tons of ore which produced \$8,410 worth of metal. Roba and Westfall on Murderers Creek in Grant County retorted 30 tons of ore which produced one flask. The Bonanza mine in Douglas County was the largest producer. During 1953 the annual average world price of a flask of quicksilver, as reported by E&MJ Metal and Mineral Markets, was \$193.03. Prices during the year fluctuated between a high of \$217 at the first of the year and a low of \$183 in November. The price has skyrocketed during the first seven months of 1954. At present, August 12, 1954, the quotation is \$290-\$293 per flask.

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## EASTERN OREGON MINING NEWS

Eastern Oregon chrome production has continued throughout the year with steady shipments of concentrates originating from the Dry Camp property which is operated by the John Day Mining Company and from the Haggard and New claims which are operated by Burt Hayes and associates. Both of these properties are in Grant County and both were active producers last year. Two new concentrating mills are under construction in Grant County. One is being built near the forks of Dixie Creek by Mr. Paul Remaley and the other is near the Burt Hayes mill on Dog Creek. The latter is being built by Earl Lyman and Glenn Findlay and associates who have leases on the Kingsley and several other neighboring chromite prospects.

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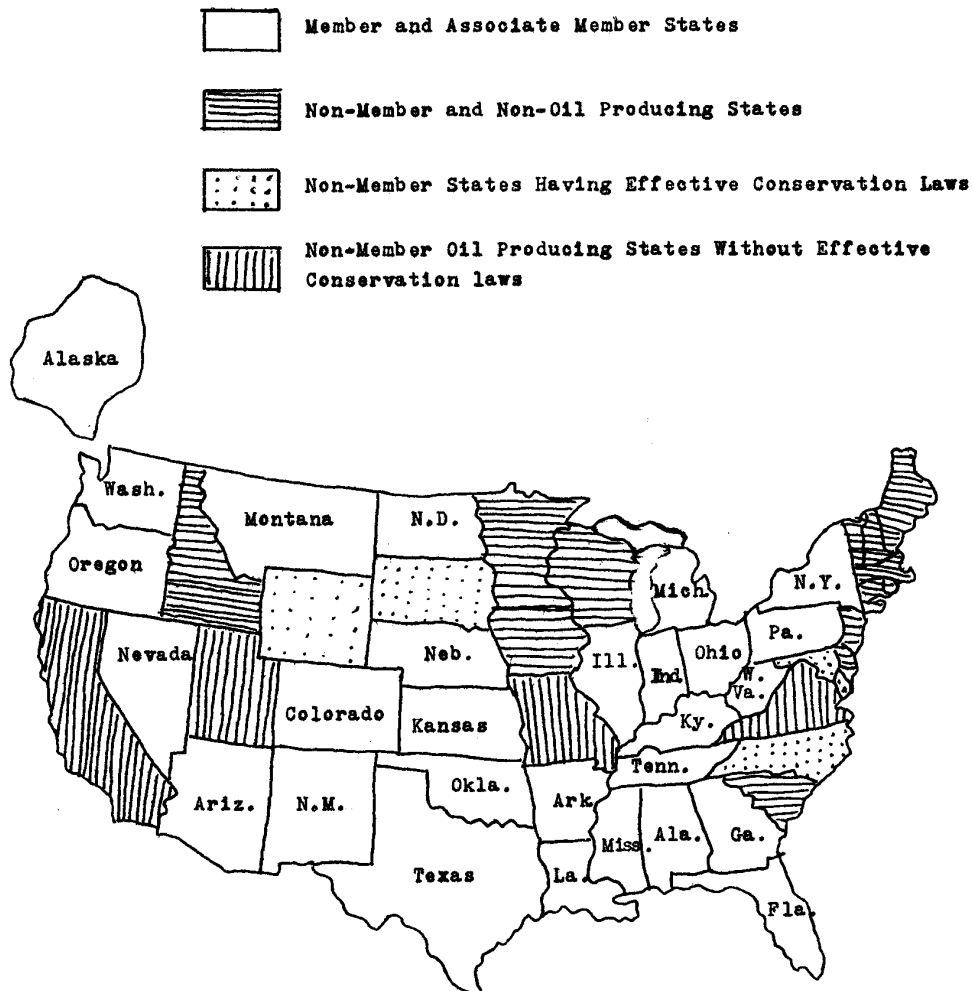
Ray Summers has resumed mining of shipping-grade copper ore from development tunnels at the Standard mine in Grant County. Surface exploration was carried on here during the early part of 1954. In addition to the copper the work has exposed a new lens of massive, high-grade cobalt ore, a lens of which was mined at the Standard in the early days. At present mining will be limited to copper ore; several shipments were made from this new showing last fall.

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## OIL COMPACT COMMISSION APPROVES OREGON'S MEMBERSHIP

Governor Paul Patterson on July 7, 1954, acknowledged receipt of the official approval by the Interstate Oil Compact Commission of Oregon's application for Associate Membership in the Commission. Vote by the Members of the Commission was unanimous in approving Oregon's membership.

The Commission is a voluntary association of twenty-two oil-producing states as Members and five (now six with Oregon) states having prospects for oil and gas production as Associate Members. To qualify both as Members and Associate Members, the states must have an acceptable oil and gas conservation law. Oregon's oil and gas conservation law passed by the last Legislature is administered by the Governing Board of the State Department of Geology and Mineral Industries, who made application for Associate Membership in the Commission with the approval of the Governor. The sole purpose of the Interstate Oil Compact Commission is to promote conservation of oil and gas and to prevent physical waste.



Adapted from Interstate Oil Compact Commission Map

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## NEW CHROMITE PROSPECT

A new Oregon chrome prospect called the Dark Star is being developed by L. L. Hassler, Kerby, and Donald M. Hassler, Cave Junction. Float boulders of massive chromite as much as 2 feet in diameter have been found in a landslide area near the section line between secs. 25 and 36, T. 37 S., R. 10 W., in western Josephine County nearly half a mile north of the Chrome King mine. About 8 tons of massive chromite assaying about 50 percent  $\text{Cr}_2\text{O}_3$  and 11 percent Fe has been mined. A road is being built to the deposit from the Chrome King mine road.

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## GRANBY CONSOLIDATED EXPLORES SOUTHERN OREGON MINE

Granby Consolidated Company of Canada has leased the Turner-Albright mine in the Waldo mining district of Josephine County, Oregon, and is repairing the adits and opening new trenches on the surface in preparation for diamond drilling. Harvey Parliament, geologist and engineer in charge of the work, has been doing geologic mapping prior to the core drilling which was begun on August 20.

The property has changed hands several times since its discovery before 1900. Early efforts were made to produce gold from surface ore and 3000 feet of adits and crosscuts were driven showing copper sulphides in places. Several mineralized gossan zones show on the surface.

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## TWO NEW OREGON BAUXITE OCCURRENCES

A new occurrence of ferruginous bauxite has recently been discovered at Park Place near the south bank of the Clackamas River by Mr. Murray Miller of Oregon City who found it in an old building excavation on Harley Street. The bauxite closely resembles that found along the north bank of the Clackamas at the Oregon City Sand and Gravel plant approximately one mile west of the Park Place locality. Legal description of the new location is SE $\frac{1}{4}$  sec. 20, T. 2 S., R. 2 E. Thickness and extent of the ore are unknown and the occurrence is of questionable commercial value because the deposit is in a residential district.

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A section of pisolitic laterite eight feet thick has been found by Don Trimble of the U.S. Geological Survey near Estacada. The layer which is similar to that found previously in the Estacada area is exposed on the right bank of the Clackamas River about a quarter of a mile downstream from the River Mill Dam and about halfway up the 100-foot bank. The exposure is partly concealed by brush and talus. Legal description of the locality is NE $\frac{1}{4}$  sec. 19, T. 3 S., R. 4 E., Clackamas County. Areal extent of the bauxite is unknown and drilling would be necessary to delimit and sample the layer. A rather extensive terrace extending northeastward along the Clackamas River could possibly be underlain by the deposit.

A specimen sample obtained by Mr. Trimble returned 40.3 percent  $\text{Al}_2\text{O}_3 + \text{TiO}_2$ , 11.5 percent Fe, and 17.8 percent  $\text{SiO}_2$ . The occurrence was visited by a member of the Department staff and a sample obtained but assay results are not yet available.

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## EXPLORATION OF OREGON PERLITE BY DIAMOND DRILL

The deposit of perlite owned by Northwest Perlite Company of Portland, located east of Sheaville in Malheur County, was explored by diamond drilling during June and July. Drilling was done by Nichols-Thompson Drilling Company of Boise. A total of 361 feet was drilled in twelve holes, the deepest of which was 48 feet. As far as is known this is the first time that a perlite deposit has been explored with a diamond drill. Despite the characteristic shell-like fracture of this volcanic glass, the owners report excellent core recovery.

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INVESTIGATION OF SALEM HILLS, OREGON. BAUXITE DEPOSITS

A Progress Report

By

R. E. Corcoran\*

Introduction

Ferruginous bauxite and bauxite nodules in the Salem Hills were found by the Department in 1945 while investigating laterized basalt areas in the Willamette Valley. A brief description of these deposits was included in Department Bulletin No. 29, Ferruginous Bauxite Deposits in Northwestern Oregon. Assays of some of this material exposed in road cuts indicated that the bauxitic material in these hills might be of sufficient grade to warrant a more detailed investigation.

In the summer of 1953, work in this area was recommenced by the Department. A drilling program was begun in the fall of 1953 in the areas that appeared to have the best possibilities on the basis of areal extent and grade of bauxite. Twenty-one holes were put down by hand auger for a total of 379 feet. Most of the holes were drilled to a depth of 20 feet unless the material appeared to be too clayey before that depth was reached. One hole was drilled to a depth of 40 feet and two others to 24 feet because of the greater possible thickness of bauxitic section apparent in these areas. Two or three deep holes may be drilled later in 1954 to determine whether there are any lower bauxitic zones within the section above the weathered basalt. Work so far completed is not sufficient to warrant an estimate of tonnage available.

Location

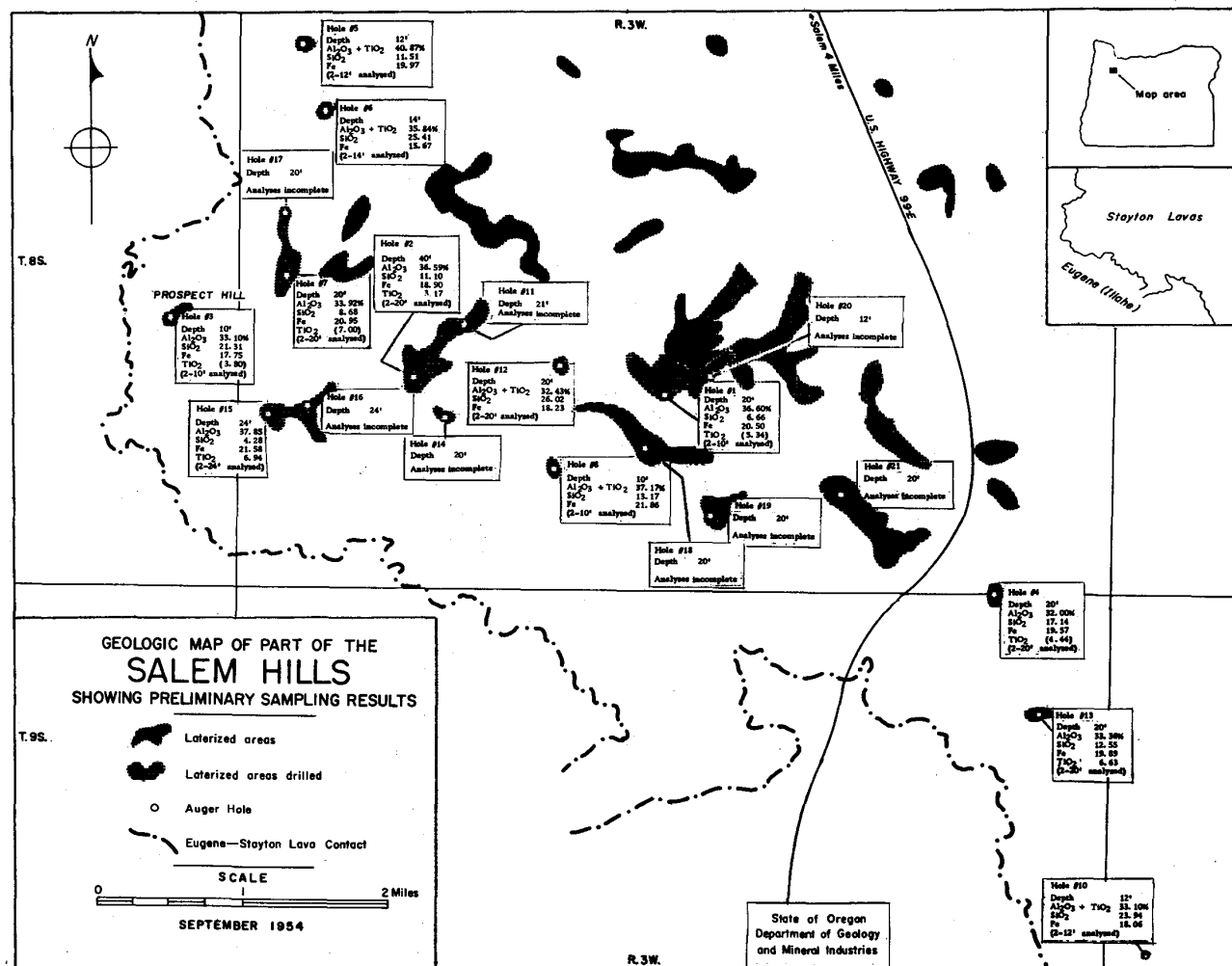
The area under discussion comprises a fairly narrow strip of land approximately 2 miles wide having a general northwest-southeast trend in T. 8 S., Rs. 2 and 3 W. This area lies approximately 7 miles south of Salem in Marion County and is easily accessible from U.S. Highway 99E via a network of graded secondary county roads. Topographic maps of the Salem and Stayton quadrangles cover the area. The highest elevation in this vicinity (1,121 feet) is at Prospect Hill (NE $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 25, T. 8 S., R. 3 W.), but the general surface elevations of the drill holes range from 850 to 1,000 feet.

General geology

The ferruginous bauxite in the Salem Hills (as well as that in Washington and Columbia counties to the north) is associated with lavas of probable Miocene age. The basalts here are called Stayton lavas after Thayer (1939) and Munderff (1939). Schlieker (1954) correlates these flows with the Columbia River lavas on the basis of similar stratigraphic ages, mineralogy, and lithology. The Stayton lavas lie unconformably on Oligocene marine tuffaceous sandstones and pebble conglomerates, which in this area have been called the Illahe formation (Thayer, 1939, and Munderff, 1939). This formation can be traced southeastward into the Lebanon quadrangle where the Eugene formation with a comparable Oligocene marine fauna has been mapped (Allison and Felts, 1954). The name "Eugene formation" has been adopted for this report.

The Stayton lavas where unweathered are typically fine grained and dense, rarely porphyritic. The average composition of the basalt according to Munderff is as follows: 54 percent plagioclase, 19 percent augite, 21 percent glass, 5 percent magnetite, and 1 percent miscellaneous minerals.

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\* Geologist, Oregon Department Geology and Mineral Industries.



The flows in the Salem Hills area dip gently to the east and northeast with the strike changing from about N. 45° W. in the south to N. 15° W. toward the north. The easily eroded underlying Oligocene sediments have produced a fairly steep cuestaslike escarpment on the western margin. The Salem Hills, sloping north and east approximately 150 to 200 feet per mile, reflect the dip slope of the underlying lavas.

The process of laterization and consequent bauxitization of the basalt in both the Salem Hills and Washington-Columbia county areas has been described by Libbey, Lowry, and Mason (1945) and Allen (1948). The presence of the bauxitic section capping the higher topographic areas indicates that the laterization was restricted to the uppermost flows. Certain relatively high areas, however, consist of weathered basalt or lithomargic clay that is found beneath the laterized section elsewhere. The reason for this somewhat spotty distribution of the laterite in the upland is difficult to explain. One possibility is that after the bauxite horizon was developed, uplift of the area initiated a general rejuvenation of the drainage system. The streams were then able to carry away most of the bauxite with the exception of some partially protected interstream areas. Another possibility is that the uplift of the present Salem Hills area was accompanied by considerable faulting more or less normal to the present strike of the flows. Although displacement may have been comparatively small, the bauxite would be stripped more rapidly from the higher blocks. The Salem Hills are at present apparently in a transitional stage in which a few remnants of bauxitic material still exist. These remnants may occupy areas of down-dropped blocks where erosion, because of somewhat lower topographic position, was at a minimum. The present high position of some of these bauxitic areas is due, perhaps, to the differential erosion effect between the harder, more resistant layers of ferruginous bauxite and the softer clays beneath.

The gibbsite nodules noted and described by Lowry, Libbey, and Mason (1945) are widely scattered throughout the soil zone and, because of their high  $\text{Al}_2\text{O}_3$  content ( $\pm 60$  percent), may constitute an important source of "sweetening material" for upgrading the bauxite underneath.

The accompanying map shows the location of all the holes drilled through August 1954. The percentages of  $\text{Al}_2\text{O}_3$ ,  $\text{SiO}_2$ ,  $\text{TiO}_2$ , and Fe are averages obtained for the entire hole or for the intervals noted. Assays for hole no. 14 and holes no. 16 through 21 have not been completed and no averages can therefore be given. The zones of laterization shown on the map are only approximate since insufficient drilling has been done up to the present time to outline such areas more accurately.

None of the holes drilled so far has penetrated the entire weathered basalt section. Hole no. 2 was drilled to a depth of 40 feet in March 1954 when there was extreme ground-water saturation. Much of the sample in the auger pod was lost each time it was brought to the surface because of the constant seepage of water into the hole. Samples obtained from this hole below 25 feet are therefore not considered to be completely valid.

#### Analyses of samples

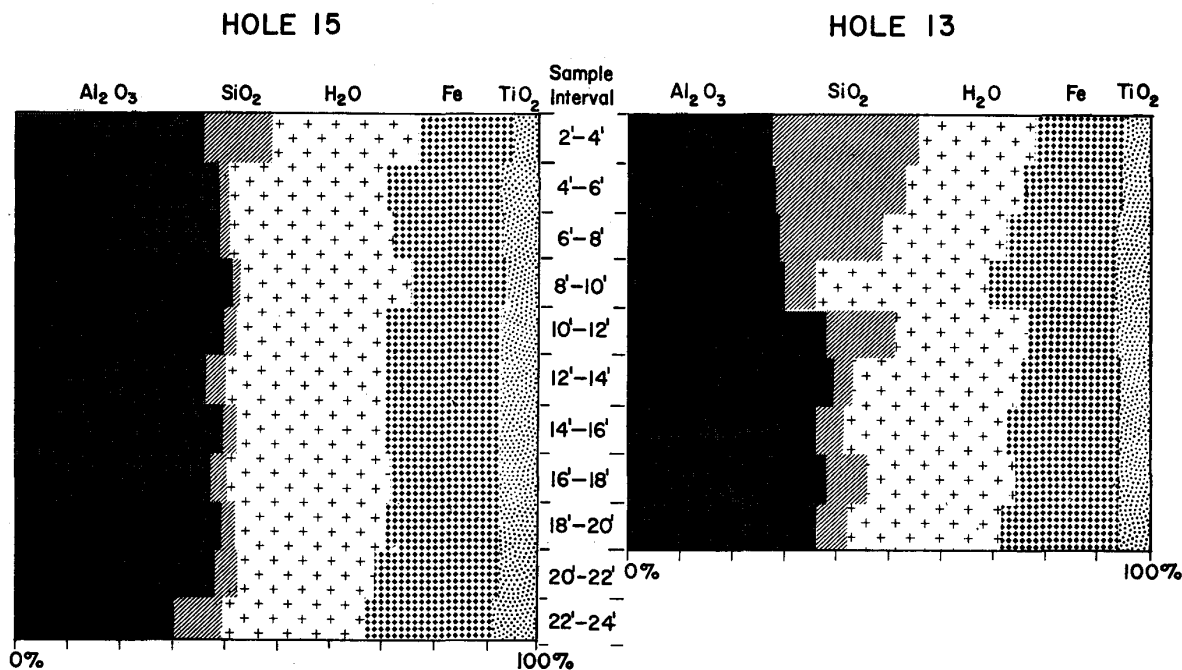
Results of the analyses of the first 13 holes show a general decrease downward in the amount of  $\text{Al}_2\text{O}_3$  with a consequent increase in  $\text{SiO}_2$ . The Fe usually attains a maximum percentage at depths from 8 to 14 feet although it does not show the variability that is characteristic of the  $\text{SiO}_2$  and  $\text{Al}_2\text{O}_3$ . In the Salem Hills bauxite there appears to be a definite relation between the quantity of Fe and  $\text{TiO}_2$ . The  $\text{TiO}_2$  content increases proportionately to the Fe with an approximate Fe: $\text{TiO}_2$  ratio of 3:1. There is also a similar relation between the quantity of  $\text{Al}_2\text{O}_3$  and  $\text{TiO}_2$ , but the correlation is not as definite. This relationship is of interest since Bardossy and Bardossy (1954) found the opposite to be true with respect to Hungarian bauxites.

The highest percentage of  $\text{Al}_2\text{O}_3$  in any of the holes so far assayed (41.95 percent) is from the 8 to 10-foot interval in hole no. 15; the highest Fe (25.16 percent) is from the 16 to 18-foot interval in hole no. 7. The  $\text{TiO}_2$  content ranges from 2.17 percent to 9.32 percent with the average being approximately 5 to 6 percent. The lowest percentage of  $\text{SiO}_2$  so far analyzed (1.34 percent) is from the 8 to 10-foot interval in hole no. 15. There is usually a pronounced increase in silica content in the zone between the base of the bauxitic horizon and the varicolored nongibbsitic clays beneath.

Thermal analyses of the bauxitic material show that the principal aluminous minerals are gibbsite and kaolin. The iron minerals have not as yet been positively identified. Eyles (1952) has found that hematite is the predominant iron oxide in Antrim laterite developed on basaltic flows similar to those present in the Salem Hills. Thermal analyses of some of the high-Fe samples indicate that small amounts of goethite are also present. X-ray patterns of Columbia County laterite showed the presence of maghemite, goethite, and hematite (Allen, 1948). Panned concentrates show a very small percentage of titaniferous magnetite and ilmenite. The principal titanium minerals have not as yet been definitely determined, but from the studies of Fredrickson (1948), Eyles (1952), and Allen (1948) they would most likely be anatase with perhaps some brookite and rutile.

Chemical analyses of holes no. 13 and 15 have been plotted (see graph below) to show the variation in chemical composition with depth at each 2-foot interval. Hole no. 13 was unique because it showed a general increase in  $\text{Al}_2\text{O}_3$  with depth at the expense of the  $\text{SiO}_2$ . Although the overall average of the hole is 33.36 percent  $\text{Al}_2\text{O}_3$  and 12.55 percent  $\text{SiO}_2$ , the lower 12 feet averages 35.87 percent  $\text{Al}_2\text{O}_3$  and 6.99 percent  $\text{SiO}_2$ . Analyses of hole no. 15 were included because the hole penetrated the greatest thickness of higher-grade bauxitic material so far encountered.

Graphs Showing Variation in Chemical Composition of Auger Samples With Depth



## Chemical Analyses of Drill Samples

Sample Interval  (Feet)	Hole 15				Hole 13			
	Percent Al <sub>2</sub> O <sub>3</sub>	Percent SiO <sub>2</sub>	Percent Fe	Percent TiO <sub>2</sub>	Percent Al <sub>2</sub> O <sub>3</sub>	Percent SiO <sub>2</sub>	Percent Fe	Percent TiO <sub>2</sub>
2-4	36.17	13.24	18.55	5.00	27.72	27.96	16.85	5.25
4-6	38.56	2.22	21.69	7.48	28.44	24.88	18.51	5.84
6-8	38.94	2.08	21.12	7.04	28.85	18.12	20.73	6.63
8-10	41.95	1.34	18.80	5.65	33.11	5.80	23.94	7.04
10-12	40.09	2.36	22.15	6.90	35.54	12.94	17.22	6.14**
12-14	37.45	3.76	21.90	7.24	39.55	3.90	19.23	
14-16	39.81	2.52	21.94	(6.65)*	36.35	5.20	21.02	
16-18	37.49	3.52	20.90	7.44	38.03	8.18	19.56	
18-20	39.81	2.76	21.55	(6.52)*	35.10	5.96	21.92	
20-22	35.46	4.26	24.11	7.44				
22-24	30.68	9.02	24.66	7.34				

\* Figures in brackets are calculated.  
Bracketed TiO<sub>2</sub> percentages appearing  
on map are composite analyses rather  
than weighted averages.

\*\* Average TiO<sub>2</sub> content for  
bottom 10 feet.

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#### STATE MAPPING COMMITTEE ORGANIZED

Governor Paul Patterson announced September 15, 1954, the appointment of a State Mapping Committee which has been set up under the auspices of the State Committee on Natural Resources. At the Governor's suggestion the Committee held an organizational meeting to plan for increased topographic mapping in the state and to coordinate mapping activities of various state agencies as well as to cooperate with the U.S. Geological Survey in extending and increasing topographic mapping throughout the state. The following members were present:

Stuart Moir, Forest Counsel, Western Forestry and Conservation Association  
Glen L. Corey, Oregon Geographic Board  
Charles E. Stricklin, State Engineer - represented by D. J. McLellan  
John H. Hann, State Board of Forestry  
Jay W. Blair, State Highway Department  
N. V. Hurst, State Tax Commission  
Robert C. Baum, State Soil Conservation Committee  
Ralph S. Mason, State Department of Geology and Mineral Industries  
F. W. Libbey, State Department of Geology and Mineral Industries

In addition to these representatives of state and private groups, the Governor invited G. A. Eklund and T. F. Murphy of the Topographic Branch of the U.S. Geological Survey in Sacramento, California, and Ector B. Latham, U.S. Coast and Geodetic Survey of Portland, to attend in an advisory capacity. The organizational meeting was held in the State Office Building September 14 and the following officers were elected: F. W. Libbey, Chairman; J. W. Blair, Vice Chairman; and Ralph S. Mason, Secretary.

Subcommittees were appointed to draw up Articles of Organization and to plan for a coordinated effort to increase the amount of topographic mapping so badly needed in the state. Plans were discussed for providing a map information clearing house.

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#### GOLD DREDGE STOPS WORK

It is reported that the gold dredge of the Powder River Dredging Company which has been operating for a number of years in Sumpter Valley has suspended operations because of inability to secure some additional ground. This was the only active gold dredge in the State and the State's major gold producer; suspension will mean that Oregon's gold production will dwindle to only a few thousand dollars a year.

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#### SOURCE OF STOCKPILE MATERIALS

According to Senator George W. Malone, 80 percent of the strategic and critical materials now being stockpiled are being obtained from Asia, Africa, and other areas abroad. Senator Malone also asserted that "In time of war, materials from these distant foreign lands would be denied to us. Governments which control them will actually be neutral or subject to neutralization through enemy attack, embargoes, or interdiction."

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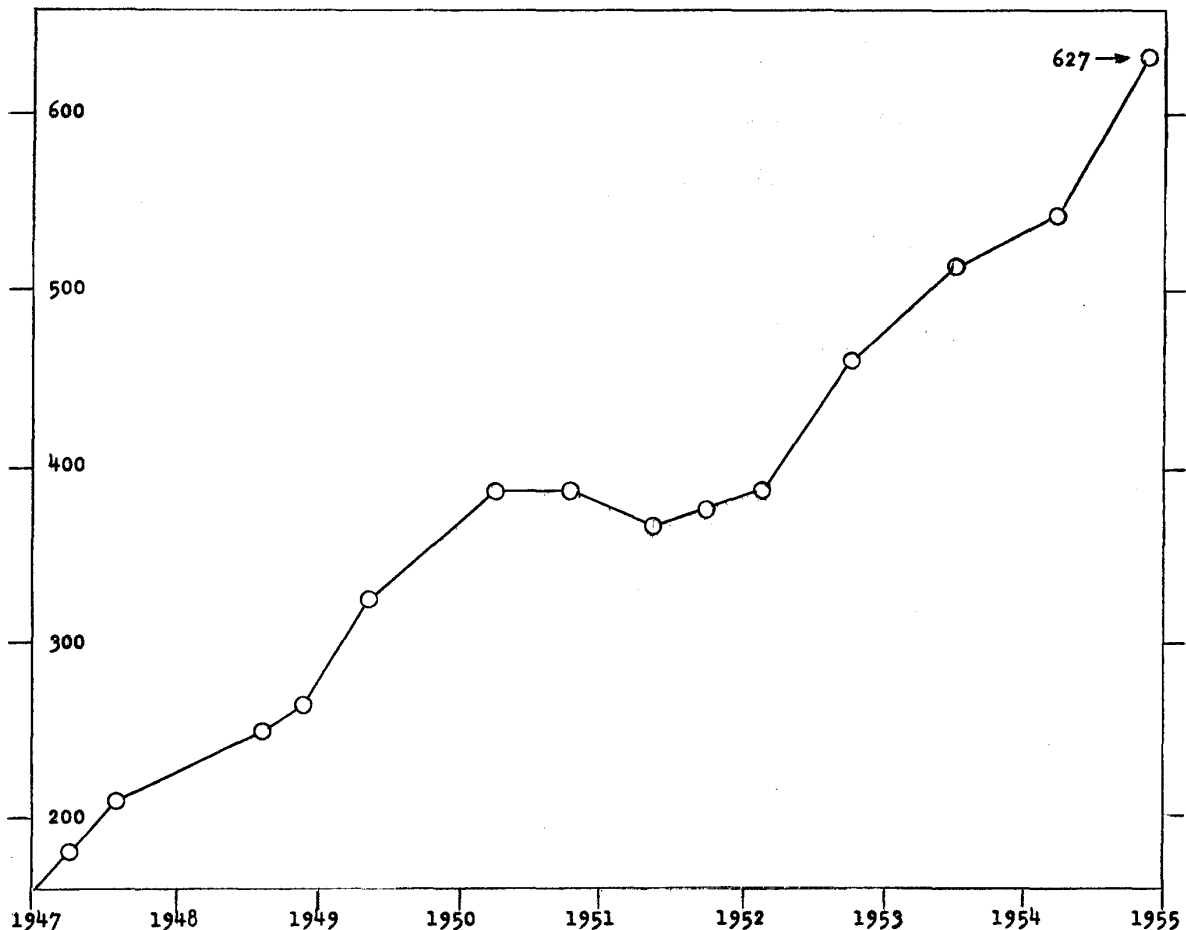
## ORE.-BIN MAILING LIST REACHES 1,000 MARK

On September 15, the Ore.-Bin mailing list hit the 1,000 mark. Paid subscriptions on this date totaled 627, while the balance of 373 was distributed to libraries, State legislators, colleges and universities, and over-the-counter sales. Most copies go to subscribers in Oregon, but forty-three other states and four foreign countries are also on the mailing list. Most distant subscriber is the Geological Survey of South Africa at Pretoria.

The accompanying graph shows the growth in paid subscriptions over the past seven years.

Originally issued as a Press Bulletin in November 1937, the first Ore.-Bin was published January 10, 1939. The aim of the Ore.-Bin is to publish pertinent articles concerning the geology and mineral industry of the State. Articles include reports on new uses of rocks, minerals, and metals; mine reports of new mineral deposits; geological notes and maps of areas studied; and mineral and metal commodity statistics. Several Ore.-Bin articles have proved so popular that they have been reprinted several times to satisfy the demand. "Facts about Fossils" and "Oregon's Gold Placers," now issued as Miscellaneous Papers 3 and 5 respectively, were originally printed in the Ore.-Bin.

Graph Showing Increase in Paid Subscriptions to The Ore.-Bin  
1947 - 1954



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## NEW ACCESS ROAD IN JOSEPHINE COUNTY

According to the Grants Pass Bulletin, the Bureau of Land Management will ask for bids on the first 12 to 15 miles of a new main-line road west of Galice in Josephine County, and it has been recommended by Mr. Charles Fogelquist, Road Engineer for the Bureau of Land Management, and Mr. Elmer Metsker, Chairman of the Road Committee of the Association of O and C Counties, that \$500,000 be allocated to this project. The first section of the road will extend from Galice to Soldier Camp but part of this section will be improvement of the existing Chrome Road. Two new switchbacks will probably be necessary in the present road. Plans call for extension of the road 15 miles beyond Soldier Camp in order to tap timber between Bear Camp lookout and the Rogue River. Timber will not be cut within half a mile of the river.

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## CHROMITE PRODUCTION

According to figures in the Federal Register, total tonnage of chromite purchased by the government at Grants Pass up to June 30, 1954, amounted to 60,479 gross dry tons. The Bureau of Mines reports that in June domestic production of chromite totaled 13,356 short tons, of which California shipped 2,196 tons, Oregon 1,107 tons, and Montana 10,053 tons. Therefore during June the Grants Pass depot received 3,303 short tons or 2,946 long tons. (See footnote.)

Imports of chromite during 1953 totaled 2,226,610 short tons. During the first six months of 1954 imports amounted to 926,324 short tons. Consumption for 1953 was 1,335,755 short tons and 423,582 short tons for the first six months of 1954.

It is reported by the E&MJ Metal and Mineral Markets that a delegation from Turkey has been in Washington attempting to negotiate a deal for the sale of 100,000 tons of Turkish chromite and that the delegation has left for home without securing the contract because the price offered by the United States was not satisfactory.

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Footnote: Tonnage figures alone do not present a true picture of the variation in chromite production among the three states. Montana chrome consists of concentrates low both in  $\text{Cr}_2\text{O}_3$  and chrome-to-iron ratio. California and Oregon chromite production represents both lump ore and concentrates of metallurgical grade equivalent to that brought in from Turkey and Rhodesia.

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## NEW CHROMITE SAND PROJECT

The Daily Journal of Commerce, Portland, reports that a new industrial plant is planned for the Coquille, Oregon, area. Pacific Northwest Alloys, Inc., Meade, Washington, a subsidiary of Chromium Mining and Smelting Corporation of Canada, has contracted with General Services Administration to upgrade chrome concentrates stockpiled at the site of the old Metals Reserve treatment plant on the Southern Pacific west of Coquille. The upgraded concentrates running to about 40 percent  $\text{Cr}_2\text{O}_3$  will be shipped to Meade where low-carbon ferrochrome will be made in electric furnaces. This ferro-alloy will run about 48 percent chromium and 0.06 percent maximum carbon.

In addition to the low-grade chromite concentrates at the Coquille plant which were mined by two companies, Humphreys Gold Dredging Corporation and Krome Corporation during World War II, there are large areas of chromite-bearing sands which might be made available. These areas are in ancient elevated terraces between Bandon and South Slough, Coos County, Oregon.

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## CHANGE IN MINING LAW

The President has approved S3344 which amends the mining laws to permit mineral location and development on mining claims which may also contain Leasing Act minerals. The new law allows minerals to be located on the same ground that Leasing Act minerals, such as oil, gas, coal, phosphate, sodium, or oil shale, may also be leased. This law clarifies the status of a great many claims located on the Colorado Plateau. It also makes valid mining locations on fissionable source materials.

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## SELENIUM

By

Margaret L. Steere\*

### Introduction

Selenium is one of the paradoxical elements in nature that can be both useful and harmful. The element was discovered in 1817 by Berzelius, a Swedish chemist, who found it in the flue dust of the sulfuric acid works at Grupsholm, Sweden. For many years selenium was an obnoxious by-product of copper refineries and was discarded. After World War I, commercial uses for selenium began to develop, particularly in glass factories, but it wasn't until after World War II that the element came into its own through the great demand for selenium rectifiers in the electrical industry. Today selenium is considered to be one of the most critical metals for industry and the national stockpile.

In spite of selenium's important contributions to industry, its detrimental qualities cannot be overlooked. The highly toxic and corrosive effects of certain selenium compounds are well-known industrial hazards. Poisoning of livestock by selenium-absorbing plants growing on seleniferous soils has long been a problem in certain range lands of western United States. Recent studies by public health agencies of population groups have shown that daily ingestion of small amounts of selenium may render teeth more susceptible to decay.

### Properties of Selenium

Selenium is a grayish solid occurring usually in needlelike crystals and sometimes in glassy droplets (Palache and others, 1944). It has a metallic luster, red streak, and a specific gravity of 4.47. One of the most remarkable properties of this element is the difference shown in its ability to conduct electricity in darkness and in light. When illumination is increased its conductivity is increased.

Selenium is closely related to sulfur and tellurium with which it is commonly associated in nature. It occurs in native form, like sulfur, and also in selenides of copper, silver, lead, mercury, bismuth, and thallium. About twenty-five minerals contain selenium in varying amounts, but none of these is considered a commercial source at the present time.

### Economic Importance of Selenium

#### Uses

The principal consumer of selenium is the electrical industry which makes extensive use of selenium rectifiers, particularly the miniature type suitable for radio and television sets. Military uses of the selenium rectifier are numerous and include aircraft controls, guided missiles, radar equipment, and others.

Selenium has been employed in the glass industry for many years. It alters the normal greenish tinge to a neutral gray, and when added in relatively large quantities it produces ruby-red glass which has a wide variety of uses from tableware to tail lights.

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\* Geologist, Oregon Department Geology and Mineral Industries.

Selenium improves the quality of rubber and increases the machinability of stainless steel and the tensile strength of copper alloy. It is used extensively as a pigment to produce various shades of red in paint, paper, printing inks, dyes, and many other products. It is widely employed in industrial chemistry in the manufacture of products such as soaps, waxes, plastics, pharmaceuticals, and insecticides. Selenium is the catalyst in the synthesis of cortisone, used to treat arthritis, and isonicotinic acid, used to treat tuberculosis.

Statistics show (Sargent 1954) that the electrical and the chemical industries each consume about 40 percent of the nation's production of selenium. The glass industry uses about 13 percent, and the steel industry consumes most of the remainder.

#### Production of selenium

According to the U.S. Bureau of Mines (Sargent, 1954), the only commercial source at present is the anode mud or slime produced in the electrolytic refining of blister copper. The slimes generally contain from 4 to 25 percent selenium.

Production of primary selenium in the United States was 687,384 pounds in 1952 and 923,887 pounds in 1953. Demand exists at the present time for larger quantities of selenium than are available. The American Mining Congress Bulletin Service for September 1954 reports that negotiations are underway by General Services Administration for the purchase of 40,000 pounds of commercial selenium produced from accumulations of flue dust at lead smelters.

#### Selenium as a Hazard to Man and Animals

Selenium and most of its compounds are very toxic and certain compounds, particularly selenium oxychloride, are exceedingly corrosive. Considerable experimental data are available on selenium poisoning in animals, but the physiological effects of the element and its compounds on human beings are not entirely understood.

#### Industrial hazards

Poisoning by selenium is an industrial hazard but adequate safeguards to prevent exposure minimize the dangers. Exposures to selenium may result during smelting and refining of sulfide ores containing selenium and from the use of selenium compounds in the manufacturing of the numerous items mentioned above. Selenium poisoning may result from the inhalation of dust and volatile compounds, by ingestion, and to some extent by absorption through the skin (Patty, 1949).

Standards for maximum allowable concentrations of selenium have been established as 0.1 ppm\* selenium in air, 4 ppm in feedstuffs, and .05 ppm in drinking water.

#### Toxic vegetation

Naturally occurring selenium compounds in soils of semiarid lands of western United States are capable of producing toxic vegetation.

Two types of livestock poisoning are caused by the seleniferous vegetation (Williams and others, 1941). One type is chronic and results from daily ingestion of small amounts of selenium which may be present in cereals, grasses, and other forage plants. It manifests itself in horses and cattle by deformity of hoofs, loss of hair, and emaciation. In severe cases, the animal either is permanently impaired or dies. In poultry, eggs either do not hatch or weak chicks result. The other type of poisoning is acute and results from the ingestion of larger amounts of selenium which are present in the indigenous range plants particularly certain species of Astragalus. These plants sometimes accumulate as much as 10,000 ppm of selenium. Only 10 ounces of green Astragalus bisulcatus rich in selenium will cause death of sheep in 30 minutes (Trelease, 1942).

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\*Ppm: parts per million.

Publications concerning health hazards caused by seleniferous foodstuffs coming into markets outside seleniferous areas prompted a comprehensive survey of grain from widely different sources by the U.S. Department of Agriculture (Williams and others, 1941). Nearly 1,000 samples of wheat and wheat products were examined. Results showed that 75 to 80 percent contained 1 ppm or less of selenium while 90 percent contained less than 4 ppm and thus the great majority could not be considered toxic.

Public-health surveys have been made to determine the effects of selenium on persons living in known seleniferous areas. These investigations revealed that a great majority of the urine specimens of these people contained selenium in various amounts, indicating absorption of selenium. The results did not evidence any definite symptoms of selenium poisoning according to Patty (1949). However, it was observed that among families examined there existed a prevalence of bad teeth, varying from marked discoloration through all stages of decay.

A recent study (Hadjimarkos and others, 1952) of Oregon school children showed that there may be a relationship between dental caries and presence of selenium in the body. A group of high school children born and reared in Clatsop County where the rate of dental caries is said to be the highest in the State, was compared to a group of high school children from Klamath County where the caries rate is the lowest. It was found that a direct relationship was indicated between the prevalence of dental caries and urinary selenium concentrations of the subjects.

#### Investigations of Seleniferous Soils

##### History

Poisoning of livestock in the semiarid range lands of western United States was for many years unexplained. At first the disease was attributed to alkali waters and was known as alkali disease. Losses were great. For example, a herder in Huerfano County, Colorado, drove 200 sheep into a gulch in the evening and in the morning 197 sheep were dead (Beath and others, 1946). The origin of the disease remained a mystery until 1933 when O. A. Beath and associates at the University of Wyoming discovered that certain wild plants growing on some of the range soils were able to absorb and accumulate sufficient quantities of selenium to be highly toxic to animals.

As a result of these findings, a Presidential order on September 5, 1933, authorized the Secretary of Agriculture to set aside a sum of money for conducting surveys and other investigations in an effort to "definitely determine the areas injuriously affected by the presence of selenium in soils" (Byers 1935). Out of this survey came a series of seven reports published between 1935 and 1948 under the title "Selenium occurrence in certain soils in the United States with a discussion of related topics."

##### Distribution of seleniferous soils

It was early recognized that concentration of selenium in soils was directly related to certain geologic formations which served as the parent material from which the soil was derived. At first, selenium soils were thought to be limited to marine shales of Cretaceous age, but with broadening of field studies, it was found that seleniferous soils were derived from a variety of formations ranging in age from Late Paleozoic to Recent. Highly seleniferous soils were found in Eocene tuffs in Wyoming (Beath and others, 1946). They were found in glacial, lacustrine (lake bed), and recent alluvial materials which had been transported from seleniferous regions and deposited in marginal basins. Up to the present time, seleniferous soils capable of producing toxic vegetation have been found in the semiarid portions of the fifteen states which make up the Great Plains and Rocky Mountain region, and in Canada.

##### Indicator plants

One of the valuable aids in locating seleniferous soils is the presence of certain native plants which seem to require selenium for normal growth. These include 28 species of Astragalus (legumes with pealike flowers, such as vetches), and probably all species of

Xylorrhiza (woody aster), Oenopsis (a composite related to goldenrod) and Stanleya (prince's plume) (Trelease 1942). All of these are handsome and conspicuous western wild flowers. They not only absorb selenium but concentrate it in large amounts. They give off volatile selenium compounds and hence have a very offensive garlicky odor.

A number of domestic plants such as wheat, barley, corn, oats, and rye although capable of absorbing large quantities of selenium are not restricted to seleniferous soils and are therefore not selenium indicators.

#### Properties of seleniferous soils

Irrigation of seleniferous soils in semiarid regions has resulted in a very marked decrease of selenium in plants (Byers and others, 1938). The soluble compounds formerly available to the plants were removed and the residual selenium was essentially unavailable as plant food. Selenium, Byers explains, may be present in soils in three forms which become available to plants only by slow processes of hydrolytic action. These forms are free selenium, pyritic selenium, and basic ferric selenites, the last being the most common, particularly in soils containing iron oxide. Selenium may also be present in forms immediately available to plants as selenates and as more or less evanescent organic compounds resulting from decay of seleniferous plants. These two soluble forms are subject to eluviation and removal by percolating water, which accounts for the low content of selenium in plants grown on irrigated and humid soils even when selenium is fairly abundant in the soils.

Thus it is that soils which produce toxic vegetation are limited to arid or semiarid regions where rainfall is too low for percolating waters to carry away the soluble selenium compounds. In humid regions, on the other hand, soluble selenium compounds are removed by leaching and probably also by erosion.

#### Geology of Selenium

The reason for the variable concentrations of selenium in the rocks of the earth's crust is not fully understood. It is known that selenium accompanies sulfur both in the sulfides that separate from magma and in emanations from volcanoes. Igneous rocks contain about 0.09 ppm selenium, while certain volcanic tuffs have been shown to contain as much as 187 ppm.

Selenium brought into solution through weathering is carried to the sea, but little of it remains in the sea water. Part is removed during the precipitation of hydroxides of iron and manganese which are able to adsorb selenium nearly quantitatively, and part during the precipitation of carbonate sediments (Rankama and Sahama, 1949). Selenium in sea water averages only 0.004 ppm, while that contained in sea-bottom sediments averages 1 to 2 ppm.

Byers and others (1938) propose that formations which are notably seleniferous were deposited contemporaneously with periods of great volcanic activity and that selenium came wholly from volcanic dust and gases. Trelease and Beath (1949) suggest that, although some of the selenium may have been thus contributed, most of it was a primary constituent of magmas and molten materials intruded into or poured out upon the land mass from which the seleniferous sediments were derived.

Selenium is associated with uranium and vanadium in carbonaceous deposits of the Jurassic Morrison formation in New Mexico (Cannon, 1953). A selenium area known as the Poison Basin in Wyoming coincides with the outcrop of the uranium-bearing sandstone of the Miocene Browns Park formation in Wyoming (Vine and Prichard, 1954). Soils formed on the outcrops of both formations support selenium indicator plants, and hence these plants can be useful guides to uranium prospecting.

#### Selenium in Oregon

The first indication that there were seleniferous soils in Oregon came in 1940 when the U.S. Department of Agriculture made a reconnaissance investigation of lacustrine and alluvial materials along the Snake River basin (Lakin and Byers, 1948). Because seleniferous soils had

(Continued on page 68.)

Selenium Content of Soils, Minerals, and Vegetation  
From Malheur County, Oregon\*

Sample No.	Place of collection	Material	Selenium in -	
			Soil or mineral	Vege- tation
			P.p.m.	P.p.m.
1.	Oregon State Exper. Sta. at Vale.	Grayish-brown silt loam, 0-8 in.	0.1	---
2.	1 mi. E of Vale, on Oreg. 28.	Light-brown silt loam, 0-10 in.	0.1	---
3.	same	<u>A. nudisiliquus</u>	---	0.5
4.	22 mi. S of Ontario, on Oreg. 201.	Rotten ferruginous sandstone	0.8	---
5.	same	<u>A. nudisiliquus</u>	---	1
6.	In Sueker Creek Canyon, approaching Rockville.	<u>Astragalus</u> sp.	---	1
7.	1½ mi. SE of Jordan Valley.	<u>Astragalus</u> sp.	---	0.5
8.	30 mi. W of Jordan Valley	Light-brown loam, 0-10 in.	0.2	---
9.	same	<u>Astragalus</u> sp.	---	0.5
10.	In cut along Owyhee River at Rome.	Yellowish-brown silt loam	0.2	---
11.	4 mi. W of Rome,	Light-gray silt loam, in creek cut	2.0	---
12.	same	<u>Stanleya</u> sp.	---	360
13.	6 mi. W of Rome.	Yellowish-brown calcareous gravelly loam, 0-10 inches	0.8	---
14.	same	<u>Stanleya</u> sp.	---	220
15.	½ mi. N of No. 13.	Gravelly grayish-brown loam, 0-10 in.	2.0	---
16.	same	<u>Stanleya</u> sp.	---	60
17.	6½ mi. W of Rome.	Gray sandy loam, 0-10 in.	0.8	---
18.	same	Sandstone	0.05	---
19.	same	<u>Stanleya</u> sp.	---	650
20.	4 mi. N. of Rome, on road to Follyfarm	Yellowish-brown sandy loam, 0-10 in.	0.8	---
21.	same	<u>Stanleya</u> sp.	---	180
22.	6 mi. NW of Rome, on road to Follyfarm	Light gravelly sandy loam, 0-10 in.	0.8	---
23.	same	<u>Stanleya</u> sp.	---	10
24.	same	<u>A. beekwithii</u>	---	1
25.	8 mi. NW of Rome, on road to Follyfarm	Light-gray sandy loam, 0-10 in.	0.2	---
26.	same	<u>Stanleya</u> sp.	---	7
27.	same	Indian paintbrush	---	4
28.	5 mi. S of U.S. 20, on road to Riverside	Light-brown silt loam, 0-10 in.	0.2	---
29.	same	<u>Astragalus</u> sp.	---	1
30.	5 mi. E. of crossroad to River- side, on U.S. 20	Diatomaceous earth	0.1	---
31.	5 mi. E of Juntura, on U.S. 20	Gray sandy loam	0.05	---
32.	same	<u>A. stenophyllus</u>	---	2
33.	7 mi. E of Juntura, on U.S. 20	Gravelly gray silt loam, 0-10 in.	0.05	---
34.	same	<u>A. stenophyllus</u>	---	1
35.	20 mi. W of Vale, on U.S. 20	Diatomaceous earth	0.2	---
36.	10 mi. W of Vale, on U.S. 20	Brown silt loam, 0-10 in.	0.1	---
37.	same	Alfalfa	---	1

\* Adapted from Lakin and Byers, 1941.



been found on the Payette formation in Idaho, a search was made for selenium in similar deposits in Malheur County in eastern Oregon. A total of 37 samples of soil, rock, and vegetation was collected in Malheur County in a circuit from Vale to Jordan Valley, to Rome, to Riverside, and back to Vale. As a result, a seleniferous area was located in the vicinity of Rome, about 60 miles west of Jordan Valley. Eighteen samples were collected at eight localities in this area (Nos. 10 to 27 in table on p. 67). The eight soil samples ranged in selenium content from 0.2 ppm to 2.0 ppm. Samples of an indicator plant Stanleya growing on this soil ranged from 7 ppm to 650 ppm. The sediments in the vicinity of Rome are believed to be in the Idaho formation of Pliocene age.\* This is the only known study of selenium in Oregon soils.

The Quality of Water Branch of the U.S. Geological Survey reports that there are no analyses for selenium in the ground and surface waters of Oregon.

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#### HORSE HEAVEN WILL PRODUCE AGAIN

It is reported that Cordero Mining Company will install a small furnace at the Horse Heaven mine in Jefferson County, Oregon, to treat ore already broken in the mine left when the property shut down in December 1944. At that time a fire burned the furnace plant and caused closure of the property.

The Horse Heaven was one of the best known quicksilver producers before and during World War II. Cinnabar, the ore of quicksilver, was discovered in the area by A.J. Champion in 1933. Claims covering the property were acquired by Ray Whiting and cinnabar was discovered in place at the base of Horse Heaven Mountain by Ray Whiting, Jr., and Harry Hoy. The mine began production in 1934. Horse Heaven Mines, Inc., acquired the property in 1936 and produced continuously until the fire in 1944.

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#### DEPARTMENT DIRECTOR RETIRES

The Governing Board of the State Department of Geology and Mineral Industries has announced that F. W. Libbey, Director of the Department, will retire on November 1 under the State Retirement Act. At the same time the Board announced that Hollis M. Dole, Department geologist, has been appointed to succeed Mr. Libbey as Acting Director.

Mr. Dole is a graduate of Oregon State College and did graduate work in geology at U.C.L.A. and the University of Utah. During World War II he served in the Navy for three years and after the war was employed by the U.S. Geological Survey Ground-Water Division in Arizona. He joined the Department as geologist in charge of the Grants Pass office in 1946 and in 1947 was transferred to the head office. Mr. Dole was appointed Assistant to the Director in September 1954.

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#### CONVERTING SALT WATER TO FRESH WATER

According to Reclamation News published by the National Reclamation Association, Washington, D.C., the U.S. Department of the Interior will start field tests next spring on converting saline to fresh water at Miller, South Dakota. A contract on this research program has been let to Ionics, Inc., Cambridge, Massachusetts, to develop and operate field equipment. It is stated that the Ionics equipment makes use of plastic membranes and electric current to remove salt from salt water. It is stated that the equipment will be tested on irrigation water in Arizona this winter.

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#### OREGON STATE PROFESSORS TO GO TO THAILAND

Oregon State College has entered into a 2½-year contract with Kasetsart University, Bangkok, Bangkok, Thailand, to supply technical assistance for the purpose of strengthening the educational and research programs of the University. The program is financed by the Thai government.

Oregon State College has agreed to send to Thailand as soon as practicable an initial group of six staff members to assist the University in improving teaching methods and curricula, research projects and methods, laboratory and classroom facilities, libraries, etc., and in advising the University on the selection and use of the necessary books, equipment, apparatus, supplies, and teaching aids.

Dr. Ira S. Allison, Head of the Department of Geology at Oregon State College has been appointed Chief Adviser of the group of visiting professors. Other fields to be represented include agricultural engineering, chemistry, physics, agricultural economics, plant pathology, and entomology.

Kasetsart University was founded in 1943 and is growing rapidly in enrollment and facilities. It includes colleges of agriculture, forestry, cooperative science, irrigation, and fisheries. In its expansion program several new buildings have been erected and others are contemplated.

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#### NEW OIL PERMITS

Recent permits to drill new oil tests have been secured by the following groups:

- (1) Oil Developers, Inc., Roseburg, Oregon.

Scott No. 1 located in SW $\frac{1}{4}$  of SW $\frac{1}{4}$  of sec. 5, T. 27 S., R. 6 W., Douglas County. Elevation of the ground is 482 feet. Permit approved October 4, 1954.

- (2) H. K. Riddle, Moore Hotel Building, Ontario, Oregon.

Kiesel Estate No. 1, located in SW $\frac{1}{4}$  of sec. 8, T. 19 S., R. 47 E., Malheur County. Elevation of the ground is 2176 feet. Permit approved September 2, 1954.

Earlier permits were issued to Roderick Stamey, Ontario, Oregon, on March 26, 1954, to drill at a location in sec. 14, T. 19 S., R. 44 E., Malheur County, and to Walter Kernin, Roseburg, Oregon, on March 22, 1954, to drill in the NE $\frac{1}{4}$  SE $\frac{1}{4}$  sec. 30, T. 28 S., R. 6 E., Douglas County.

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#### QUICKSILVER

The price of quicksilver continues to soar because, according to E&MJ Metal and Mineral Markets, the supply situation is very tight. The quotation reported in the October 14 issue is \$325 to \$330 per flask for spot metal. Interest in re-opening old quicksilver mines has been stepped up both in California and Oregon since potential producers feel that the government's new program, under which a ceiling of \$225 per flask is guaranteed over a 3-year period, will be some assurance that a new operation could pay off before the bottom drops out of the market.

The General Services Administration has issued a statement that the government has not contracted with foreign producers to deliver quicksilver to the account of the United States Government and that present and future procurement efforts of GSA are being directed toward obtaining the metal in this hemisphere.

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#### GEOLOGIC MAP OF CORVALLIS, OREGON, AREA

A new geologic map of a section of western Oregon near Corvallis prepared by the U.S. Geological Survey with the cooperation of the Oregon State Department of Geology and Mineral Industries has just been issued. It is designated QM-150 of the Oil and Gas Investigations series. Authors are H. E. Vokes, D. A. Myers, and Linn Hoover. Price of the map is 50 cents and it may be procured from the Distribution Section, U.S. Geological Survey, Denver, Colorado, or from the Chief of Distribution, U.S. Geological Survey, Washington, D.C.

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STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES  
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URANIUM PROSPECTING  
By The Staff

The following material has been prepared to answer some of the questions most frequently asked the Department about radioactive minerals, radiation detection equipment, and laws governing locations of claims for fissionable materials. Included also are references to published information on uranium minerals and how to prospect for them.

Ed.

Radiation Detection Equipment

General

The two main types of radiation detection instruments are the Geiger and scintillation counters. Both work on the same principle in that they detect and count the frequency of particles resulting from radioactive disintegration. An electric charge is set up on a Geiger counter when a particle enters the gas-filled Geiger-Mueller tube, and an electric charge is set up on a scintillation counter when a particle strikes a crystal which the instrument contains.

The cost of an instrument may be the primary consideration if purchase is contemplated. The scintillometer costs several times as much as the Geiger counter but it is much more sensitive. Ease of carrying, reading, and the use to be made of the instrument will also influence the choice.

The scintillometer is used for detecting small variations in radiation over wide areas. This instrument can be used from a plane or car with some success. The Geiger counter is best adapted to prospecting in mines and in widespread zones of known radioactivity.

A dial which records in mR/hr\* is a desirable feature on the instrument. Readings recorded in mR/hr have more meaning than "counts per minute" as the counts will vary with the instrument. Scintillation counters always record in this manner but some Geiger counters do not. A Geiger counter without a recording dial generally has a headphone attachment. A probe attachment for the Geiger tube is handy in exploring small crevices or drill holes.

Use

Several factors enter into the proper use of the instruments and interpretation of their results. Following are those that are considered most important:

(1) Background count - A background count of radiation results from cosmic rays and small noncommercial amounts of radioactive material which nearly always are present in all rocks. The background count may vary over distances of a few feet; therefore when determining the radioactivity of a specimen the background reading should always be found and subtracted from the total. Since the scintillometer gives much higher counts than the Geiger counter, it is less affected by the background, especially on low-grade samples.

(2) Mass effect - A large mass of weakly radioactive rock may give a fairly high reading on a counter, although the amount of radioactive material in a small sample of the rock is minute. A scintillometer is especially sensitive to this phenomenon. The Geiger

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\* mR/hr = milliroentgens per hour. One milliroentgen is 1/1000 of a roentgen. A roentgen is a definite unit of radiation and is used to measure the quantity or amount of radiation.

counter has a smaller area of detection and is not as strongly affected. Light-colored acid lavas such as rhyolite and dacite often give a higher count than the darker basic rocks but do not necessarily contain commercial quantities of uranium.

(3) Depth of detection - Depth of detection of uranium ores depends upon size and grade of the deposit, thickness and type of cover, and type of instrument used. Generally speaking, small quantities of radioactive material cannot be detected through more than several feet of water or loose soil and rock. Solid rock gives an even greater shielding effect.

(4) Precautions - It is well to realize that these machines are delicate electronic instruments and cannot take excessive abuse. If the instrument does not perform properly a check of the batteries frequently discloses the source of most trouble. Radio repair shops are usually equipped to make this check. If other repair becomes necessary it is much safer to ship the instrument to the manufacturer.

A Geiger counter can become contaminated by radioactive dust or radon gas, one of the disintegration products of uranium. If so, it will not give accurate results.

Cold weather may affect the Geiger counter tube, causing improper functioning of the instrument. Care should be used in wet weather. Water may "short out" the machine if it penetrates to the inner workings.

Contrary to popular notion, a counter will not "burn out" in the presence of high-grade radioactive samples. Also, the needle on the recording dial will fluctuate within narrow limits while being held on a single sample.

Excessive static in earphones, the "frying" sound, may be due to a "short" somewhere in the machine.

#### Radioactive Minerals

The uranium and thorium minerals are the only radioactive substances that are at present of commercial or potential commercial value. There are a few other elements that are radioactive but the radioactivity is so slight that it is recognized on radiation counters only when large masses of rock containing these elements are present - i.e., mass effect. An example would be the rocks containing potassium minerals. Gold and other more common metals cannot be detected by radiation counters.

Some uranium salts and radioactive minerals, such as autunite, show distinctive fluorescence when examined under the short or long wave fluorescent lamp. Carnotite, pitchblende, and many other radioactive minerals do not fluoresce. Therefore fluorescence is only an aid in the determination of radioactive materials but it is not a sure test.

There is no known danger from radioactivity in handling samples of uranium minerals. Since 1950, doctors and technicians of the U.S. Public Health Service in cooperation with other agencies have been checking the health hazards to mine and mill workers in the uranium industry on the Colorado Plateau. The September 1954 issue of Mining Engineering reported Duncan Heladay, coordinator of the program, as stating, "...it takes many years of exposure to radioactive materials to cause damage to human organisms."

#### Analysis

##### Chemical analysis for uranium

With time, uranium partially "breaks down" into "daughter products" or disintegration products. All of these products are radioactive and contribute to the radiation detected by a Geiger counter. Therefore, since part of the total "count" may be due to elements other than uranium, the most common method for determining the actual amount of uranium in the ore is by a chemical analysis. This analysis is designated on the assay report as percent uranium.

##### Equivalent U<sub>3</sub>O<sub>8</sub>

Because Geiger and scintillation counters are sensitive to all types of radioactive decay, they only tell that radioactivity is present. They do not differentiate between the various radioactive elements. Therefore, the mR/hr of the counters is generally converted

to "equivalent  $U_3O_8$ " when reporting results from the assay-type instruments. This is sometimes termed a radiometric analysis. Equivalent  $U_3O_8$ , then, means the amount of radioactivity rather than the amount of uranium.

#### Assay services of the Department

The offices of the Department of Geology and Mineral Industries in Portland, Baker, and Grants Pass are equipped to examine any specimens originating in Oregon by testing on a Geiger counter. The Department is not equipped at present for the chemical determination of uranium or thorium in amounts below 0.1 percent.

The Atomic Energy Commission has placed in the Portland office of the Department a Radioassayer. The Radioassayer is an assay-type Geiger counter that automatically counts for one minute and then records the total as  $U_3O_8$  equivalent.

#### Laws Governing Fissionable Materials

Staking a claim for uranium is no different than for any other mineral. Public Law 585, 83rd Congress, provides that a claim may be staked for uranium. No license is needed for prospecting, and existing State and Federal mining laws apply. However, radiation counters may not be taken out of the country without an Atomic Energy Commission license.

Prospectors are not required to report any discovery of fissionable material, although State and Federal agencies are glad to assist the prospector who submits interesting samples from a bona fide discovery.

The Atomic Energy Commission will provide information on the location of the nearest purchasing point of uranium ores. Ore does not have to be sold to the Government, but it is required that a license be obtained in order to sell, transfer, or receive more than minute quantities of uranium or thorium ores that have been removed from the ground.

#### Radioactive Minerals in Oregon

In Oregon no definite uranium mineral or deposit has yet been authenticated by the Department. However, there are several places where minor amounts of radioactivity have been found. In some of these places the radioactivity has been attributed to some indefinite uranium salt. The thorium minerals, allanite and monazite, have been found in the Wallowa Mountains and very minor amounts of monazite sand have been found in some stream beds and along the coast.

It is interesting to note that the Atomic Energy Commission, in its nation-wide investigations, has recorded discoveries of radioactive materials in almost every possible rock type and in most classes of ore deposits.

There is still a lot to learn about the genesis and occurrence of uranium. The agencies and men working in this branch of earth science are the first to admit this.

#### References and How to Obtain the Publications

##### Oregon Department of Geology and Mineral Industries

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"Bibliography and index of literature on uranium and thorium and radioactive occurrences in the United States," by Margaret Geoper: Geological Soc. Am. Bull., vol. 64, 1953. Part I, Arizona, Nevada, and New Mexico (50 cents); Part II, California, Idaho, Montana, Oregon, Washington, and Wyoming (25 cents); and Part III, Colorado (25 cents). May be obtained from the Geological Society of America, 419 West 117th Street, New York, N.Y.

U.S. Atomic Energy Commission

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"Selected bibliography on uranium exploration and the geology of uranium deposits," by Margaret Cooper: RME 4007, 1953. Available from the Office of Technical Services, Department of Commerce, Washington 25, D.C. (35 cents).

U.S. Geological Survey

"Identification and occurrence of uranium and vanadium minerals from the Colorado plateaus," by A. D. Weeks and M. E. Thompson; Bulletin 1009-B, 1954. For sale by U.S. Government Printing Office, Washington 25, D.C.

McGraw Hill

"U<sub>3</sub>O<sub>8</sub>, a formula for profits" (a collection of articles on the uranium situation): Engineering and Mining Journal, Sept. 1954. May be obtained from the McGraw-Hill Publishing Company, 330 West 42nd Street, New York 36, N.Y. (50 cents).

## Addresses of Atomic Energy Commission

U.S. Atomic Energy Commission  
Division of Raw Materials  
Washington 25, D.C.

U.S. Atomic Energy Commission  
Colorado Raw Materials Operations  
P.O. Box 270  
Grand Junction, Colorado

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## EASTERN OREGON MINING NEWS

The Department's branch office in Baker reports that Mr. Frank Reid and associates have leased the Herschhoff furnace on the Ochoco Mining Company's property (Crook County) in order to test ore from the Mother Lode quicksilver mine located in the Ochoco Mountains about 30 miles from Prineville. Reid and associates have been developing the mine during the past season and operate as a partnership under the name of Canyon Creek Mining Company, General Delivery, Prineville, Oregon.

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Production of limestone at the quarry of National Industrial Products Corporation at Durkee, Baker County, Oregon, is now about 15 railroad cars a working day (approximately 825 tons per day). Most of the output is going to sugar and paper mills.

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## FOURTH EDITION OF MINING LAW BULLETIN ISSUED

"Mining Laws of the State of Oregon," designated as Bulletin No. 1, has just been issued in its fourth revised edition by the State Department of Geology and Mineral Industries. This new revision contains numbering and wording according to Oregon Revised Statutes. As the oil and gas conservation law was issued previously as a separate Department publication (Miscellaneous Paper No. 4), it is not included in this new edition. Mr. Sam R. Haley of the State Statute Revision Council provided the applicable ORS pages for reproduction, and Mr. Ralph S. Mason of the Department staff assembled the bulletin material.

Since publication of the first edition of Bulletin No. 1 in 1937 the Department has sold nearly 5,000 copies. The fourth revised edition may be obtained for 50 cents from the Portland office of the Department at 1069 State Office Building, or from the field offices at Baker and Grants Pass.

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SCHEDULE OF PRICES FOR URANIUM ORE\*  
(As Specified in Atomic Energy Commission Price Circ. 5 Revised, and Circ. 6)

Grade of ore, percent U <sub>3</sub> O <sub>8</sub>	Pounds of U <sub>3</sub> O <sub>8</sub> per ton of ore	Price per ton of ore							
		Base Price		Grade premium		Mine develop. allowance .50/lb.	Price before initial prod. bonus & haulage allowance	Initial prod. bonus on 10,000 lbs.	Price before haulage allowance
		Pound U <sub>3</sub> O <sub>8</sub>	Ton of ore	75¢ a lb. over 4-lb.	25¢ a lb. over 10-lb.				
0.10	2.00	\$1.50	\$ 3.00	\$ -	\$ -	\$ 1.00	\$ 4.00	\$ 3.00	\$ 7.00
0.11	2.20	1.70	3.74	-	-	1.10	4.84	3.74	8.58
0.12	2.40	1.90	4.56	-	-	1.20	5.76	4.56	10.32
0.13	2.60	2.10	5.46	-	-	1.30	6.76	5.46	12.22
0.14	2.80	2.30	6.44	-	-	1.40	7.84	6.44	14.28
0.15	3.00	2.50	7.50	-	-	1.50	9.00	7.50	16.50
0.16	3.20	2.70	8.64	-	-	1.60	10.24	8.64	18.88
0.17	3.40	2.90	9.86	-	-	1.70	11.56	9.86	21.42
0.18	3.60	3.10	11.16	-	-	1.80	12.96	11.16	24.12
0.19	3.80	3.30	12.54	-	-	1.90	14.44	12.54	26.98
0.20	4.00	3.50	14.00	-	-	2.00	16.00	14.00	30.00
0.21	4.20	do	14.70	0.15	-	2.10	16.95	14.70	31.65
0.22	4.40	do	15.40	0.30	-	2.20	17.90	15.40	33.30
0.23	4.60	do	16.10	0.45	-	2.30	18.85	16.10	34.95
0.24	4.80	do	16.80	0.60	-	2.40	19.80	16.80	36.60
0.25	5.00	3.50	17.50	0.75	-	2.50	20.75	17.50	38.25
0.26	5.20	do	18.20	0.90	-	2.60	21.70	18.20	39.90
0.27	5.40	do	18.90	1.05	-	2.70	22.65	18.90	41.55
0.28	5.60	do	19.60	1.20	-	2.80	23.60	19.60	43.20
0.29	5.80	do	20.30	1.35	-	2.90	24.55	20.30	44.85
0.30	6.00	3.50	21.00	1.50	-	3.00	25.50	21.00	46.50
0.31	6.20	do	21.70	1.65	-	3.10	26.45	21.70	48.15
0.32	6.40	do	22.40	1.80	-	3.20	27.40	22.40	49.80
0.33	6.60	do	23.10	1.95	-	3.30	28.35	23.10	51.45
0.34	6.80	do	23.80	2.10	-	3.40	29.30	23.80	53.10
0.35	7.00	3.50	24.50	2.25	-	3.50	30.25	24.50	54.75
0.36	7.20	do	25.20	2.40	-	3.60	31.20	25.20	56.40
0.37	7.40	do	25.90	2.55	-	3.70	32.15	25.90	58.05
0.38	7.60	do	26.60	2.70	-	3.80	33.10	26.60	59.70
0.39	7.80	do	27.30	2.85	-	3.90	34.05	27.30	61.35
0.40	8.00	3.50	28.00	3.00	-	4.00	35.00	28.00	63.00
0.41	8.20	do	28.70	3.15	-	4.10	35.95	28.70	64.65
0.42	8.40	do	29.40	3.30	-	4.20	36.90	29.40	66.30
0.43	8.60	do	30.10	3.45	-	4.30	37.85	30.10	67.95
0.44	8.80	do	30.80	3.60	-	4.40	38.80	30.80	69.60
0.45	9.00	3.50	31.50	3.75	-	4.50	39.75	31.50	71.25
0.46	9.20	do	32.20	3.90	-	4.60	40.70	32.20	72.90
0.47	9.40	do	32.90	4.05	-	4.70	41.65	32.90	74.55
0.48	9.60	do	33.60	4.20	-	4.80	42.60	33.60	76.20
0.49	9.80	do	34.30	4.35	-	4.90	43.55	34.30	77.85
0.50	10.00	3.50	35.00	4.50	-	5.00	44.50	35.00	79.50
0.60	12.00	do	42.00	6.00	0.50	6.00	54.50	42.00	96.50
0.70	14.00	do	49.00	7.50	1.00	7.00	64.50	49.00	113.50
0.80	16.00	do	56.00	9.00	1.50	8.00	74.50	56.00	130.50
0.90	18.00	do	63.00	10.50	2.00	9.00	84.50	63.00	147.50
1.00	20.00	3.50	70.00	12.00	2.50	10.00	94.50	70.00	164.50
2.00	40.00	do	140.00	27.00	7.50	20.00	194.50	140.00	334.50
3.00	60.00	do	210.00	42.00	12.50	30.00	294.50	210.00	504.50
4.00	80.00	do	280.00	57.00	17.50	40.00	394.50	280.00	674.50
5.00	100.00	do	350.00	72.00	22.50	50.00	494.50	350.00	844.50
6.00	120.00	3.50	420.00	87.00	27.50	60.00	594.50	420.00	1,014.50
7.00	140.00	do	490.00	102.00	32.50	70.00	694.50	490.00	1,184.50
8.00	160.00	do	560.00	117.00	37.50	80.00	794.50	560.00	1,354.50
9.00	180.00	do	630.00	132.00	42.50	90.00	894.50	630.00	1,524.50
10.00	200.00	do	700.00	147.00	47.50	100.00	994.50	700.00	1,694.50

\*From California Division of Mines Mineral Information Service, vol. 7, no. 11, Nov. 1, 1954.



## NEW DRILLING PERMIT ISSUED

Drilling permit no. 5 was issued November 15, 1954, to El Paso Natural Gas Company, 303 Tribune Building, Salt Lake City, Utah. The application to drill stated that the well will be known as Federal No. 1. The drilling site was given as the NE $\frac{1}{4}$  sec. 5, T. 20 S., R. 44 E., Malheur County.

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## MINERAL NOTES

Chrome

Chromite shipments received at the Grants Pass depot on November 8 surpassed all previous daily totals, except for the opening day on November 23, 1951, when there was a rush of shipments due to accumulation in anticipation of the depot's opening. Shipments originate in six counties in Oregon, with California and Alaska also contributing.

General Services Administration has recently announced that 70,070 tons of chromite ore and concentrates have been delivered to the Grants Pass stockpile. This is approximately 35 percent of the total amount deliverable under the contract which expires June 30, 1955.

The Government's "Defense Production Act Inventory" now contains nearly \$447 million worth of metals and minerals. Included with the 19 stockpiled commodities are 157,223 tons of chromite. The mineral and metal reserve was created under the Government's Korean expansion program when purchases were made at guaranteed floor prices. Most of these stocks will be transferred to the regular federal stockpile shortly.

Chromite will be one of the items in the proposed U.S. Agriculture Department barter transactions with foreign countries according to E&MJ Metal and Mineral Markets. These will be direct commodity-for-commodity transactions involving the exchange of United States surplus farm goods for metals and minerals. They do not include the use of foreign currencies acquired through sale of farm surplus.

Mercury

The New York price of quicksilver in mid-November was quoted as \$323-330 per 76-pound flask, according to E&MJ Metal and Mineral Markets. Buying was slow, the consumer coming into the market only when he had to. Some foreign metal was available, mainly from Yugoslavia and Mexico, but Spanish quicksilver, usually the controlling factor in the price, was missing. The lack of Spanish metal has been the source of many unconfirmed rumors. Metal and Mineral Markets report that there is some skepticism of Spanish metal reaching the United States and that there are widespread reports of technological problems in the new Spanish furnaces.

GSA has not been able to purchase a single flask of mercury under its announced stockpile purchase price of \$225 a flask. This is the only government stockpiled material that does not show substantial progress. The failure to date bears out the feeling of the quicksilver industry that the announced price was way too low.

Manganese in 1953

The final annual figures for manganese in 1953 have recently been released by the U.S. Bureau of Mines. The statistics showed domestic production in 1953 to be 157,536 short tons of manganese ore running 35 percent or more manganese. This is somewhat higher than the 1952 production of 115,379 tons but still not up to the 1944-48 average of 167,263 tons. Domestic production, however, was still a small fraction of the imports which amounted to 3,500,986 tons, the highest on record. India continued to be the main source of the imports by providing 37 percent of the total. Other important contributors were Gold Coast, Union of

South Africa, and Cuba. Of the domestic production Montana supplied 72 percent and Nevada around 10 percent. Oregon produced 46 tons of ore running approximately 39 percent manganese and 271 tons running approximately 25 percent manganese.

Of possible interest to owners of low-grade manganese properties is an article in the November 1, 1954, issue of Chemical and Engineering News. This article is on a pilot plant at Paterson, New Jersey, that converts raw material containing 10 to 12 percent manganese to a concentrate running about 60 percent manganese. The recovery from the low-grade raw material is stated to be 80 percent and the concentrate is suitable for the chemical and dry-cell battery industries. The process which was developed by Ernest S. Nossen and put through the pilot plant stage by E. S. Nossen Laboratories uses a nitric acid leach and is applicable to carbonate, oxide, and some types of silicate ores. The pilot plant is using at present ore from Aroostook County, Maine, that contains large amounts of calcium oxide, iron oxide, and silica, all so intimately mixed that heretofore the material has been considered useless. Pilot plant capacity is around 12 tons of ore a day and the "break even" point was estimated to be 600-700 tons.

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#### REVISION OF MINING LAWS TO BE CONSIDERED BY NEXT CONGRESS

According to the November 1 Bulletin Service of the American Mining Congress, a bill is expected to be introduced early in the next session of Congress to codify and revise the laws dealing with the conservation and reclamation activities of the federal government. Two sections of the 674-page proposed measure are of particular interest to the mining industry as they would confine the use of the surface on mining claims located or patented within all national forests pretty much to rules and regulations set up by the United States Forest Service. Similar changes in the mining laws were contained in measures introduced in the past session of Congress by Representative Hope (Kansas) and Senator Anderson (New Mexico). The 83rd and previous sessions of Congress have not seen fit to pass such legislation. The proposed measure is now before the House Judiciary Committee. The American Mining Congress states that its Public Lands Committee has the measure under study and expects to submit its comments to the House Committee in the near future.

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#### BUREAU OF MINES REPORTS ON OREGON ORES

Results of sampling and testing a nickel deposit in Curry County, Oregon, by the U.S. Bureau of Mines, have been published (Sept. 1954) in Report of Investigations 5072, Preliminary investigation of the Red Flats nickel deposit, Curry County, Oregon, by R. J. Hundhausen, J. R. McWilliams, and L. H. Banning.

In 1946 and 1947, the Oregon Department of Geology and Mineral Industries examined and sampled the Red Flat area, as well as the Nickel Mountain and Woodcock Mountain areas, and published reports in the Ore.-Bin. Because of the continuing world shortage of nickel and the need for the development of new sources of this strategic metal, the Bureau of Mines in 1952 and 1953 further drilled and sampled the Red Flat area. A fairly large deposit of nickeliferous laterite and nickeliferous serpentine was indicated. A 15-ton ore sample was subjected to smelting tests in the Bureau's Northwest Electredevelopment Laboratory in Albany, Oregon. These tests, which are described in the above pamphlet, showed that it is technically feasible to recover a low-carbon ferronickel product from the Red Flat ore.

The Hanna Nickel Smelting Company at Riddle, Oregon, is now producing ferronickel from similar ore on Nickel Mountain in Douglas County.

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Metallurgical testing by the Albany Laboratory of the Bureau of Mines has demonstrated that the Seappoose iron ore in Columbia County, Oregon, may be smelted to make pig iron suited to the foundry trade. Results of the tests are published in the U.S. Bureau of Mines Report of Investigations 5079, Metallurgical tests on Seappoose (Oregon) iron ore, by J. P. Walsted, October 1954.

Only two iron smelters have ever operated commercially in the Pacific Northwest, and these have been dormant for many years. The blast furnace built at Oswego, Oregon in 1867 was discontinued in 1895, and the furnace at Irendale, Washington, ceased operating in 1919. In recent years there has been considerable interest in reviving the iron industry in this region. Rapid industrialization has greatly increased the demand for ferrous metals, and since the only source of supply at present is from scrap iron and pig iron shipped in from other parts of the country, a definite need exists for an iron-smelting industry in the Pacific Northwest.

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Reports of Investigations 5072 and 5079 may be obtained free of charge from Publications Distributions Section, U.S. Bureau of Mines, 4800 Forbes Street, Pittsburgh 13, Pennsylvania.

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#### MINERALS YEARBOOK PUBLISHED

The Minerals Yearbook for 1951 is now available and may be purchased for \$5.25 from the Superintendent of Documents, Government Printing Office, Washington 25, D.C. The Yearbook is a compilation by the U.S. Bureau of Mines of the production, distribution, and consumption of mineral commodities during 1951. Statistical information about Oregon's mineral industries appears under a number of chapter headings including those on Chromite, Mercury, Nickel, Sand and Gravel, Gem Stones, and State Reviews of Gold, Silver, Copper, Lead, and Zinc.

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#### NEW U.S. BUREAU OF MINES HEADQUARTERS

Headquarters of the five U.S. Bureau of Mines regions that will replace the present nine regions early next year have been announced in a recent press release by Interior Secretary Douglas McKay. They are: Albany, Oregon - Region I, comprising Idaho, Montana, Oregon, Washington, and Alaska; San Francisco - Region II, comprising California and Nevada; Denver - Region III, comprising Arizona, Colorado, New Mexico, North Dakota, South Dakota, Utah, and Wyoming; Bartlesville, Oklahoma - Region IV, comprising Arkansas, Kansas, Louisiana, Mississippi, Missouri, Oklahoma, and Texas; and Pittsburgh, Pennsylvania - Region V, comprising all other states.

Under the reorganization, all Bureau operations in a region, except those dealing with health, safety, coal-mine inspection, and helium, will be directed from regional headquarters.

The reorganization is based on the recommendations of a survey team appointed last year by Secretary McKay.

The territory of the new Region I remains essentially the same as when it was known as Region II except that Alaska has been added. Stephen M. Shelton is the Regional Director. Wing G. Agnew is the Chief of the Mining Division with headquarters at 1201 N. Division Street, Spokane 2, Washington.

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#### ALBANY LABORATORY TO DO TITANIUM RESEARCH

According to E&MJ Metal and Mineral Markets the Office of Defense Mobilization has instructed the General Services Administration to arrange a research and development contract for titanium production with the U.S. Bureau of Mines. The proposed contract calls for the work to be done at the Bureau's laboratories in Albany, Oregon, and Boulder City, Nevada.

(November 11, 1954)

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STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES  
Head Office: 1069 State Office Bldg., Portland 1, Oregon  
Telephone: Columbia 2161, Ext. 488

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THE PAYETTE AND IDAHO FORMATIONS

A Review

By

R. E. Corcoran<sup>1/</sup>

Introduction

Recent drilling<sup>2/</sup> for oil and gas, together with extensive leasing, in Malheur County has caused considerable interest to be focused on the geology of southeastern Oregon.

The two sedimentary rock units most widely exposed in the Vale-Adrian, Oregon, area where exploration has been most active are the Payette and Idaho formations of late Cenozoic age. The terms "Payette formation" and "Idaho formation" have long been in use in geologic and paleontologic reports, but interpretations regarding age and distribution have often been conflicting. For this reason it was thought that a review of the literature would be of value to those interested in the geology of the area.

Most of the published information concerning geologic investigations of these formations has dealt with the Idaho portion of the Snake River plains. In the fall of 1954 Prof. E. M. Baldwin of the University of Oregon Geography and Geology Department in company with the writer visited many of the Idaho localities mentioned in the literature in conjunction with field studies in the Mitchell Butte quadrangle, Oregon. Some of the observations made at the time of this visit are included in this review.

General

Although the Payette and Idaho formations were first mapped as one unit, it has since been recognized that there are two mappable formations separated by a thick lava series. Early paleontological age determinations placed the Payette formation in the Eocene epoch of the geologic time scale. Later work, however, showed it to be late Miocene in age. The Idaho formation is Plio-Pleistocene in age.

Fossil remains of vertebrates, fresh-water mollusks, and leaves in both formations show that the sediments are continental lake and stream deposits. These sediments are widely distributed over the plains area of the Snake River from the general vicinity of Hagerman, Idaho, to Huntington, Oregon. Because the formations tend to dip toward the center of the Snake River plain, this region is sometimes referred to as the Snake River downwarp.

First fossil collections made

Clarence King (1878),<sup>3/</sup> one of the early-day Federal Survey geologists, visited the lower part of the Snake River basin around 1869 and collected a number of fossils from the "white sands and marls" at Castle and Sinker creeks,<sup>4/</sup> tributaries of the Snake River south of Boise, Idaho. Although the fossils were subsequently described by others, no lithologic description was given for the sediments from which they were obtained. Baldwin and the author found the beds in this vicinity grayish-white to cream, poorly sorted, loosely

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<sup>1/</sup>Geologist, Oregon Department of Geology and Mineral Industries.

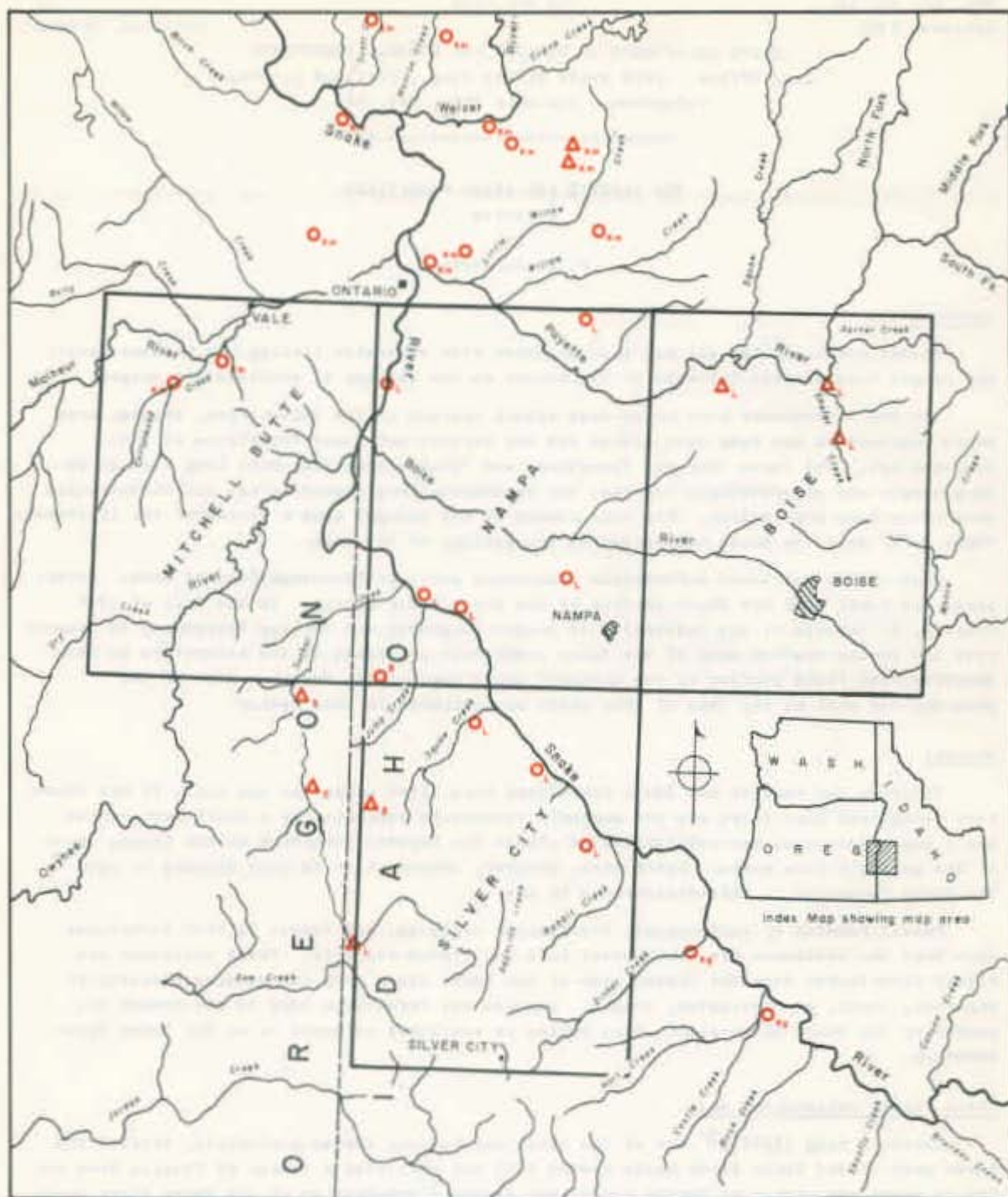
<sup>2/</sup>El Paso Natural Gas Co.; NE $\frac{1}{4}$  sec. 5, T. 20 S., R. 44 E., W.M., spudded in November 1954.

H. K. Riddle, Kiesel Estate No. 1; SW $\frac{1}{4}$  sec. 8, T. 19 S., R. 47 E., W.M., spudded in September 1954.

R. W. Stamey; sec. 14, T. 19 S., R. 44 E., W.M., spudded in March 1954.

<sup>3/</sup>References at end of report.

<sup>4/</sup>See accompanying map.



Map showing region covered by this report

0 10 20 30 40 miles

Fossil Localities

Payette formation • ▲

Idaho formation • ○

Fossil collections by:

King K<sub>g</sub>

Lindgren L

Bowlsby B

Chaney C

Kirkham K<sub>m</sub>

Scharf S

State of Oregon  
Department of Geology & Mineral Industries

indurated, and somewhat massive. They are also often cross-bedded as well as sandy to clayey and occasionally tuffaceous. The beds are usually pedimented with the pediment dip nearly parallel to the bedding, that is, into the axis of the downwarp. An outstanding characteristic of the surface of these sediments is the presence of numerous fossil fish vertebrae.

#### Idaho formation named

Meek (1870) and White (1882) described fresh-water mollusks from the Sinker Creek area and assigned a Miocene age to them. Mammalian remains also from this locality were determined by Leidy (1872) to be of Pliocene age. Cope (1883) described an extensive fauna of fresh-water fishes from the fossil collections made by King and from a later collection by Wertman. On the basis of these determinations, Cope proposed the name "Idaho formation" for the sediments and assigned them a Pliocene age.

#### Payette formation named and type locality suggested

Lindgren (1898a, 1898b, 1904a, 1904b) was the first to do detailed mapping in the Snake River area of Idaho, the results of which were published by the U.S. Geological Survey as the Boise, Nampa, and Silver City folios and as a report on the mining districts.

Lindgren (1898a, 1898b) proposed that a large lake occupied the lower part of the Snake River valley during Miocene time and suggested the name "Payette formation" for the sediments. He stated that this formation was not the same as Cope's Idaho formation. A Miocene age for the Payette formation was given by Knowlton (1898) from determinations on fossil leaves obtained in the vicinity of Marsh post office and Herseshee Bend on the Payette River, and from Cartwright's ranch on Shafer Creek, a tributary of the Payette River. When Knowlton dated the Payette formation, he correlated its flora with that of the Bridge Creek beds of the John Day formation in Oregon. A few years later the Bridge Creek flora was dated by Merriam (1901) as upper Eocene, and Knowlton (1902) then changed his interpretation of the age of the Payette formation from upper Miocene to upper Eocene.

Although no specific locality was designated by Lindgren as a type section for the Payette formation, the name apparently was suggested by exposures along the Payette River in western Idaho. Because the fossil leaves used by Knowlton for the original dating were found in the vicinity of Marsh post office it is proposed here that this locality be considered as the type section.

#### Distinction made between the two formations

On his published maps Lindgren does not show the Idaho and Payette formations as separate units. However, in the text of the Silver City folio the continental sediments were separated into two main groups: (1) the high lake beds on the western side of the quadrangle which are called the Payette formation, and (2) the beds below 3000 feet in the Snake River valley which are called the Idaho formation. A fossil flora from the "high lake beds" (the Payette formation) was determined by Knowlton to be identical with that found at Marsh post office. A large fresh-water molluscan fauna and some silicified mammalian remains were collected from the beds below 3000 feet (the Idaho formation) in the Snake River valley approximately 13 miles northwest of the Sinker Creek fossil locality, and these were stated to be of Miocene or Pliocene age by Lindgren (1904b). The distinction between the two formations was made not only on fossil evidence but also on the difference in petrographic character and topographic position. Lindgren, however, misinterpreted the stratigraphic position of the Payette formation, as he shows it on the cross sections in the Silver City folio to be overlying a lava series. Work done later by Buwalda (1924) and Kirkham (1931) showed the true position to be under the lavas which in turn are under the Idaho formation.

Russell (1902, 1903) and Washburne (1909) accepted Lindgren's definitions for the Payette and Idaho formations as he described them in Idaho but did not map the two separately.

### Miocene age for the Payette formation established

Umpleby (1913) working in Lemhi County, Idaho, found lake beds at a relatively high elevation near Hailey that contained a fossil flora which Knowlton dated as Miocene. Because of similarity in topographic position and lithology to the Payette formation near Marsh post office, Umpleby inferred that the two could be correlated and suggested that the Payette formation might be of Miocene age rather than Eocene as Knowlton had previously indicated.

Merriam (1917), in discussing the problem, did not feel that the Idaho and Payette formations had been satisfactorily separated and stated that the upper part of the Idaho formation might be as young as latest Pliocene or earliest Pleistocene.

Buwalda (1921, 1924) made two mammalian fauna collections in the Silver City quadrangle from beds he called "Payette." One collection was below the lava series and the other above. According to him the lower fauna was of middle Miocene age, whereas the upper fauna was upper Miocene or lower Pliocene.

A fossil leaf collection made by Chaney (1922) from sediments beneath the lava series was determined by him to be of Miocene age.

Bryan (1929) working in the vicinity of the Owyhee reservoir in Malheur County, Oregon, followed the work of Lindgren and called most of the sediments overlying the lava series "Payette formation" but suggested that they might include the Idaho formation.

### Lava series recognized as a separating unit

Kirkham (1931) found that the Payette and Idaho formations in Idaho, as well as in adjacent areas in eastern Oregon, are separated by great thicknesses of rhyolitic and basaltic lavas. In measuring the Payette formation he found a maximum thickness of approximately 1,200 feet in the vicinity of Lindgren's leaf locality near Marsh post office. For the Idaho formation, he found the maximum thickness on the south side of the downwarp along Little Squaw Creek to be 7,275 feet while on the north side along Little Willow Creek it was 18,633 feet. He reported fossil leaves of Miocene age from the Payette formation and a flora and fauna of Pliocene or later age from the Idaho formation.

Scharf (1935) collected a vertebrate fauna from sediments beneath the lava series in Sueker Creek a few miles west of the Idaho-Oregon boundary. On the basis of the fossil assemblage, a Miocene age was assigned and the beds were considered as part of the Payette formation.

In the spring of 1954, H. M. Dole of this Department and the writer (Dole and Corcoran, 1954) made a reconnaissance survey along U.S. Highway 20 from Vale to Buchanan, Oregon. It was shown that the lake beds in the Vale area dip gently to the northeast into the Snake River downwarp and that these sediments are separated from another underlying unit of terrestrial lake beds, which crop out farther to the west, by a series of lavas at least 5,000 feet thick. The upper lake beds were assigned to the Idaho formation and the lower to the Payette formation.

### Summary

The field distinction between the Idaho and Payette formations of eastern Oregon and southern Idaho is made difficult by the similarity in environment of deposition, source rocks for the sediments, and tectonic setting.

The early-day field geologists in the area did not divide the formations into separate units on their maps, although they recognized that two ages of rocks were present. Failure to recognize the stratigraphic position of a lava series that occurs between the two formations has been responsible for some of the misunderstanding that accompanies the use of the terms both in the literature and in the field. Paleontological control for dating the formations has been good but due to an early misinterpretation some confusion has attended the

age of the Payette formation. It is now known that the Payette formation is middle to upper Miocene in age and the Idaho formation is Plio-Pleistocene in age.

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## OIL AND GAS CONSERVATION WEEK PROCLAIMED BY GOVERNOR

The week of November 29 through December 4, 1954, was proclaimed as Oil and Gas Conservation Week by Paul L. Patterson, Governor of the State of Oregon. This State is one of many in which similar proclamations were issued. The need for conservation of natural resources is being recognized by progressive officials and agencies more than ever before. The State of Oregon is cognizant of this need. The 1953 Legislature passed a new oil and gas conservation law, even though the search for oil and gas in the State is in its infancy. In July, Oregon became an associate member of the Interstate Oil Compact Commission, a national organization whose sole purpose is to promote and encourage the conservation of oil and gas and to prevent physical waste.

Governor Patterson's proclamation was as follows:

WHEREAS, the conservation of oil and gas is of the utmost importance to the prosperity and well-being of all the citizens of the State of Oregon and of the United States and provides an effective guarantee of the security of our nation, and

WHEREAS, every citizen of the State of Oregon and of the United States should encourage and lend his support to the conservation of these great natural resources and the prevention of physical waste, and

WHEREAS, the Interstate Oil Compact Commission, consisting of 28 states, including the State of Oregon, will celebrate its 20th anniversary at a meeting to be held in Chicago, Illinois, on the 2nd, 3rd, and 4th of December 1954 at which time the cause of oil and gas conservation will be emphasized and accomplishments of the Compact reviewed,

THEREFORE, I, Paul L. Patterson, Governor of the State of Oregon, do hereby designate the week of November 29, 1954, through December 4, 1954, to be OIL AND GAS CONSERVATION WEEK, and call to the attention of all citizens the importance of this program of conservation that has led to great development of gas and oil and petroleum products.

November 18, 1954

Paul L. Patterson, Governor of Oregon

## LIBBEY HONORED BY AIME

The December meeting of the Oregon Section, American Institute of Mining and Metallurgical Engineers, was held in honor of Mr. Fay W. Libbey who retired as Director of the Oregon Department of Geology and Mineral Industries on November 1. Alex Leipper, Vice-Chairman of the Section, acted as master of ceremonies and presented to Mr. Libbey on behalf of the group, a scroll, a copy of which is shown below.

Honored guests present at the ceremony were the members of the Governing Board of the Oregon Department of Geology and Mineral Industries. Niel Allen, speaking for the Board, highlighted some of Mr. Libbey's accomplishments while with the Department, first as a mining engineer and for the past ten years as Director. Mr. Allen stated that it was Mr. Libbey's

recognition of the possibilities of the laterite of northwest Oregon that culminated in extensive exploration by a major aluminum company, with the result that large areas of high-iron bauxite were determined to be present in Washington and Columbia counties. At the time of his retirement Mr. Libbey was directing the exploration of similar material in Marion County. It was while he was Director that the \$25 million Hanna Nickel Smelter was built at Riddle in southwest Oregon to process the ore found at Nickel Mountain. Under his direction the Department has issued forty-one bulletins and maps. The monthly publication, *The Ore.-Bin*, has been almost entirely his work. Its popularity was demonstrated in a recent issue which showed that the circulation has been climbing steadily and passed the 1,000 mark in 1954.

Fay Bristol, President of the Oregon Mining Association, expressed the appreciation of his group for the assistance which Mr. Libbey has so frequently given, and stated that the chrome stockpile at Grants Pass and the Government purchase plan for domestic chromite is in great part due to the efforts of Mr. Libbey.

Governor Patterson could not attend the meeting but sent the following telegram:

"Mr. Mason L. Bingham, Chairman of the Governing Board

"I WISH MY SCHEDULE PERMITTED ME TO JOIN IN PAYING TRIBUTE TONIGHT TO MR. LIBBEY FOR HIS OUTSTANDING SERVICE AS DIRECTOR OF GEOLOGY AND MINERAL INDUSTRIES. NOT ONLY DID HE RENDER A LOYAL AND FAITHFUL SERVICE BUT HE CONTRIBUTED SO MUCH TO THE GROWTH AND DEVELOPMENT OF THE INDUSTRY. I KNOW THE PEOPLE OF OREGON ARE GRATEFUL TO HIM FOR HIS UNTIRING EFFORTS. PLEASE CONVEY MY PERSONAL GREETINGS TO MR. LIBBEY AND EXPRESS MY BEST WISHES TO ALL FOR A MOST ENJOYABLE EVENING.

Paul L. Patterson  
Governor of Oregon"

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*This scroll is presented to  
Fay Wilmott Libbey  
by the members of the Oregon Section,  
American Institute of Mining & Metallurgical Engineers, as a token of merit and respect  
and affectionate regard, especially in appreciation  
of his long service to the mineral industry  
as Director of the State Department of Geology  
and Mineral Industries, as Chairman of the  
Oregon Section, and as one of the Directors  
of the Institute.*

*December 10, 1954*

## OIL LAND LEASING IN OREGON INCREASES

Total amount of land leased in Oregon for oil and gas exploration is well over a million acres. Most of this has been leased since July 1954. This indicates that the next few years may show a real effort on the part of the major oil companies to determine if oil and gas occur in the State in commercial quantities.

The amount of Federal land leased in Oregon for oil and gas prospecting has increased nearly 500 percent since July. Records on file in the Portland office of the U.S. Bureau of Land Management show that in the 5-month period from July 1, 1954, to December 1, 1954, 246 new applications for leases were made. Total area involved was estimated to be around 582,000 acres. In the 12-month period from July 1, 1953, to June 30, 1954, 128 new applications for leases were filed involving an estimated 109,000 acres. These figures are impressive when compared with the 33,000 acres of Federal land leased in the 28-year period beginning in February 1920, when the Mineral Lease Act became effective, and ending July 1949. These figures do not include leases made either on Federally acquired lands or on Indian lands but they are thought to represent the bulk of the land leased.

The amount of State-owned land currently leased for oil and gas investigations totals 68,579 acres. Seven counties are represented, of which Lake County has the largest amount. Others are Malheur, Crook, Deschutes, Benton, Lincoln, and Coos counties in that order.

County-owned land under lease may equal that held by Federal leases. Information from 24 of the 36 counties in the State shows 367,000 acres leased. Coos and Douglas counties have the largest acreage while only three other counties, Deschutes, Linn, and Clatsop, make up the remainder. No information was received on County-owned lands in southeastern Oregon where considerable State and Federal land was leased.

Activity by the oil companies in Oregon is definitely a contributing factor to the economy of the State. This is especially noticeable to the counties in which the leasing and drilling are taking place. Besides the supplies purchased for drilling and the money paid in salaries to the geologists, drillers, and leasing agents of the companies, a fee is paid to hold the land under lease. This is in the form of a direct payment on State and County lands, and in the case of most Federal lands  $37\frac{1}{2}$  percent of the fee is returned to the State for distribution to the counties in which leases were made. The office of the Secretary of State reported that for the first six months of 1954 this amounted to \$26,458. The last half of the year should return several times this amount. However, of much greater importance to the State would be the discovery of oil or gas in commercial quantities. At this time when Oregon is working toward developing new industries, the interest that is being shown in prospecting by the major oil companies is a notable development.

H.M.D.

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## AREA IN MALHEUR COUNTY TO BE GEOLOGICALLY MAPPED

At a meeting of the Governing Board of the State of Oregon Department of Geology and Mineral Industries, held in the State Office Building, December 11, 1954, a program was authorized to map the Mitchell Butte quadrangle, Malheur County, Oregon. The area to be mapped embraces approximately 850 square miles. Vale is located near the northern margin of the map area, the Oregon-Idaho line forms part of the eastern margin, and the Owyhee Reservoir is in the south-central part.

The Governing Board, in making the announcement, noted that the geologic mapping of the Mitchell Butte quadrangle would be a component part of the State Geologic Map. They also stated that this was a basic step in providing assistance in exploration of the oil and mineral development of that part of the State.

R. E. Corcoran, geologist with the Department, will be in charge of the mapping project. Field work will commence early in the spring of 1955. The Board action authorizes completion of the field work and the publication of a geologic map and report.

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