

STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
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INVESTIGATION OF SALEM HILLS, OREGON. BAUXITE DEPOSITS

A Progress Report

By

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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

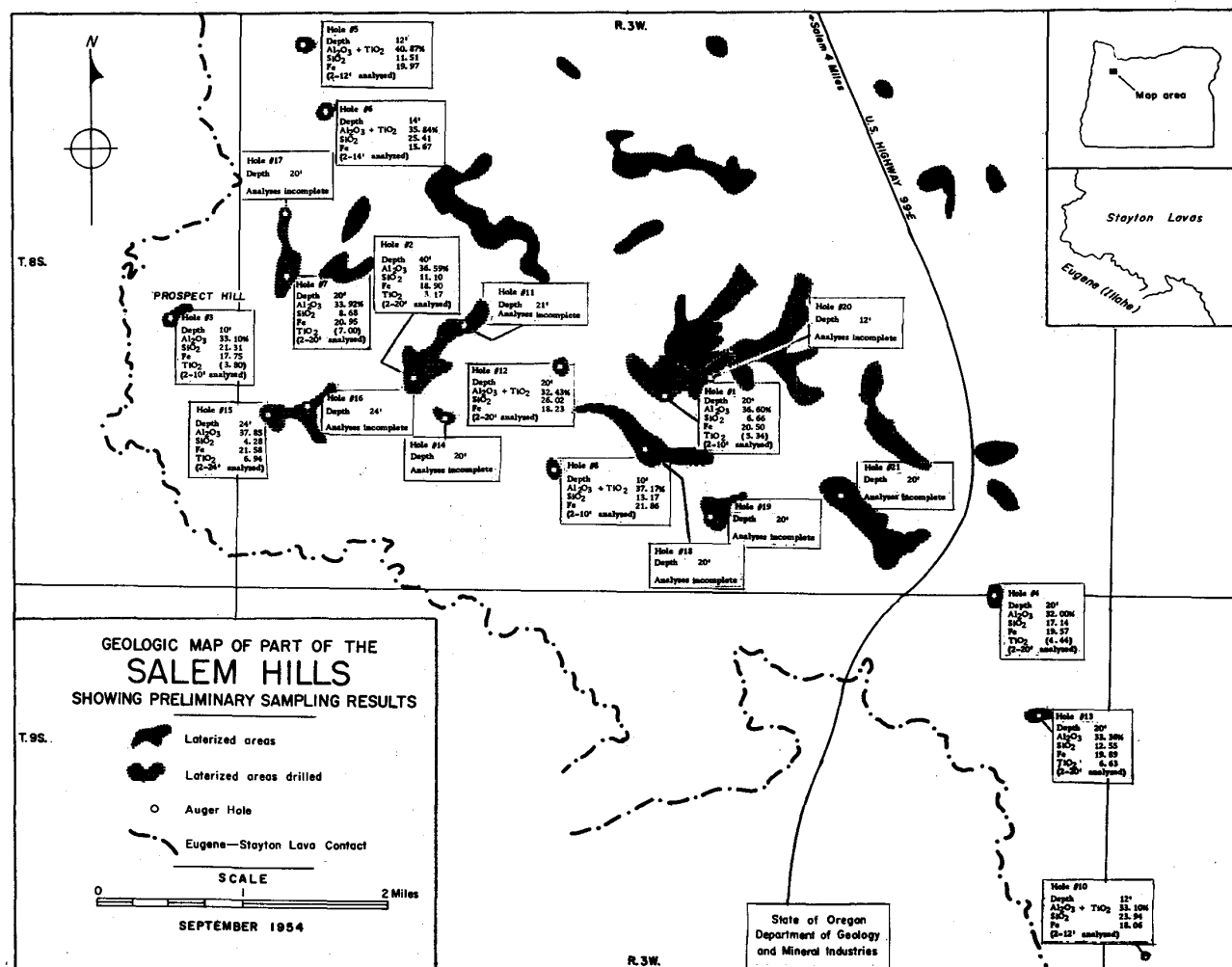
The area under discussion comprises a fairly narrow strip of land approximately 2 miles wide having a general northwest-southeast trend in T. 8 S., Rs. 2 and 3 W. This area lies approximately 7 miles south of Salem in Marion County and is easily accessible from U.S. Highway 99E via a network of graded 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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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 Al_2O_3 content (± 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 Al_2O_3 , SiO_2 , 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

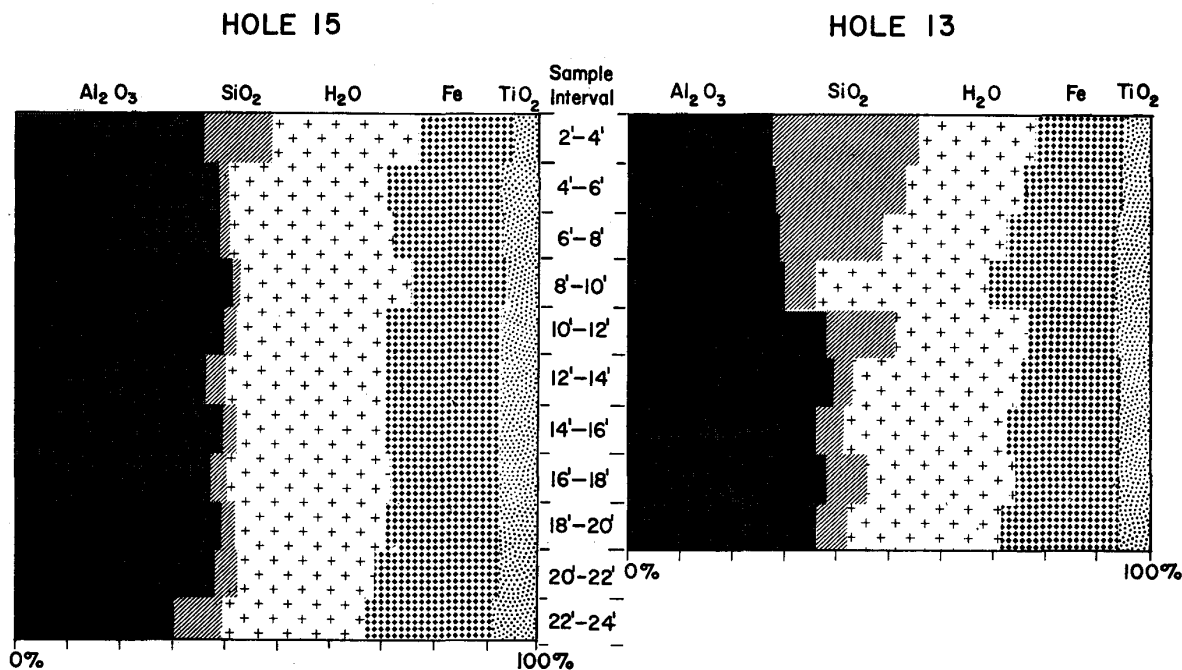
Results of the analyses of the first 13 holes show a general decrease downward in the amount of Al_2O_3 with a consequent increase in SiO_2 . The Fe usually attains a maximum percentage at depths from 8 to 14 feet although it does not show the variability that is characteristic of the SiO_2 and Al_2O_3 . In the Salem Hills bauxite there appears to be a definite relation between the quantity of Fe and TiO_2 . The TiO_2 content increases proportionately to the Fe with an approximate Fe: TiO_2 ratio of 3:1. There is also a similar relation between the quantity of Al_2O_3 and 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 Al_2O_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 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 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 Al_2O_3 with depth at the expense of the SiO_2 . Although the overall average of the hole is 33.36 percent Al_2O_3 and 12.55 percent SiO_2 , the lower 12 feet averages 35.87 percent Al_2O_3 and 6.99 percent 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 ₂ O ₃	Percent SiO ₂	Percent Fe	Percent TiO ₂	Percent Al ₂ O ₃	Percent SiO ₂	Percent Fe	Percent TiO ₂
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				

** Average TiO₂ content for
bottom 10 feet.

* Figures in brackets are calculated.
Bracketed TiO₂ percentages appearing
on map are composite analyses rather
than weighted averages.

Bibliography

- Allen, V. T.
1948 Formation of bauxite from basaltic rocks in Oregon: Econ. Geology, vol. 43, no. 8, Dec. 1948.
- Allison, I. S., and Felts, W. M.
1954 Geology of the Lebanon quadrangle, Oregon: Oregon Dept. Geol. and Min. Ind. (in press).
- Bardossy, G. Y., and Bardossy, S. L.
1954 Contributions to the geochemistry of titanium: Acta Geologica. Academiae Scientiarum Hungaricae Redigit Szadecsky - Kardoss E. Tomus 11, Fasc. 3-4, Budapest 1954.
- Eyles, V. A.
1952 The composition and origin of the Antrim laterites and bauxites. Gov't. of Northern Ireland, Mem. of the Geol. Survey, 1952.
- Fredricksen, A. F.
1948 Mode of occurrence of titanium and zirconium in laterites: Am. Mineralogist, vol. 33, nos. 5 and 6, May - June, 1948.
- Libbey, F. W., Lowry, W. D., and Mason, R. S.
1945 Ferruginous bauxite deposits in northwestern Oregon: Oregon Dept. Geol. and Min. Ind. Bull. 29, 1945.
- Munderff, J. M.
1939 The geology of the Salem quadrangle, Oregon: Oregon State Coll. Master's Thesis, 1939.

Schlieker, H. G.

1954 Columbia River basalt in relation to stratigraphy of northwest Oregon:
Oregon State Coll. Master's Thesis, 1954.

Thayer, T. P.

1939 Geology of the Salem Hills and the North Santiam River Basin, Oregon:
Oregon Dept. Geol. and Min. Ind. Bull. 15, 1939.

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.

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.

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."

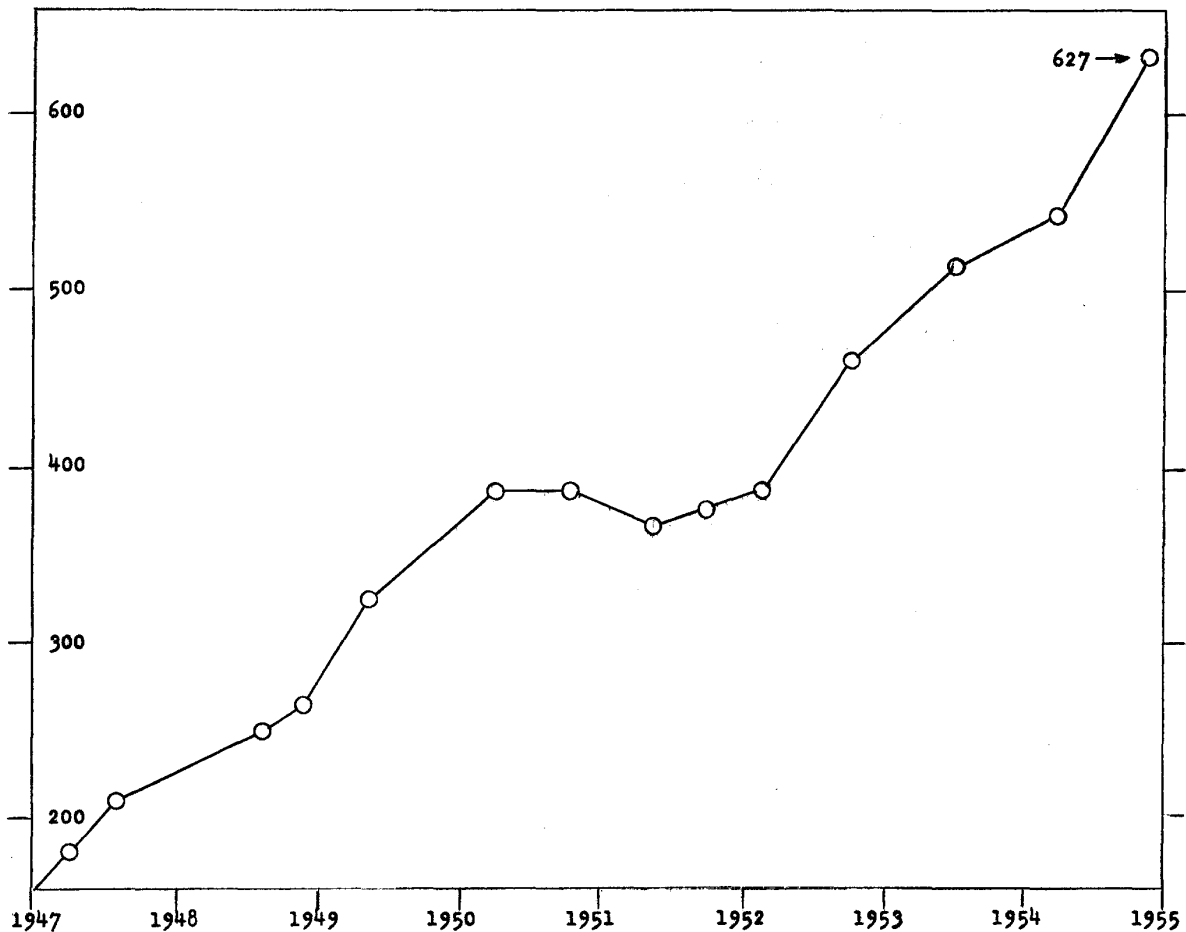
ORE.-BIN MAILING LIST REACHES 1,000 MARK

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



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.

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.

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 Cr_2O_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.

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 Cr_2O_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.

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.