March 17, 1955

Mr. Ivan E. Oakes, Executive Secretary
Committee on Natural Resources
301 State Office Building
Salem, Oregon

Dear Mr. Oakes:

Herewith is copy of a suggested memorial, the essence of which the State Mapping Advisory Committee would like to have the Legislative Assembly endorse and pass. I realize the wording may need to be changed.

By telephone you indicated you would see if you could get some legislator to father such a resolution. The Mapping Committee appreciates greatly your assistance in this matter.

Sincerely,

F. W. Libbey

F. W. Libbey, Chairman
State Mapping Advisory Committee

PLANNING BOARD

NATIONAL RESOURCES ~~COMMITTEE~~

FIELD OFFICE

FEDERAL COURTHOUSE

PORTLAND, OREGON

October 19, 1939.

Mr. Earl K. Nixon,
Director,
State Department of Geology and Mineral Industries
329 S. W. Oak St.,
Portland, Oregon.

Dear Mr. Nixon:

At the request of Mr. V. B. Stanbery, we enclose two copies of material furnished by you in connection with our Pacific Northwest Land Study.

Very truly yours,

Florence E. Wolfe

Florence E. Wolfe
Secretary

For the Regional Counselor

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DATA FOR STANBERY.

I. Factors affecting development of mineral deposits.

a. Demand for mineral products—speaking of industrial minerals other than gold, the demand for such minerals in any area is often in more or less direct proportion not only to the amount of population but to the kind of population. Oregon has been sparsely settled and the population has consisted to a marked degree of agricultural types. Portland in the lower Columbia is practically the only populous area which contains any substantial number of what might be called industrial types.

The above condition is responsible for a lack of demand of some of the minerals which are present in this State and for the lack of mining development of these deposits. For example, there is no great local demand for steel products because of lack of industries. Therefore, our iron ore is undeveloped. There is no large demand for coal because our population is principally agricultural and does not require coal as a fuel. Such materials as diatomite, pumicite, zinc, copper, tungsten, molybdenum, and chrome have small local demand not only because of the relatively small population but because we do not have an industrial type of consuming population.

Owing to the influx of population from other states and to the imminence of electrical power at reasonable rates, this demand, as it is affected by the amount and kind of population, is expected to be enhanced in the next few years.

b. Accessibility of country—the better mineralized areas in Oregon include the Blue Mountains, the Ochocos, the Cascade Range, and the Klamath Mountains or Siskiyous near the southern line of the state. For the most part the mines and mineral prospects in these areas are at high or relatively high elevations where they are inaccessible during periods of the year because of snow. In many parts of these areas it is difficult to build roads. Few roads have, therefore, been built and only trails lead back into the more remote points. Relatively speaking then, these areas are much less accessible then similar areas in the desert which are at lower elevation. Lately C.C.C. roads and trails and forestry roads and trails have been built into many parts of these mineralized areas and have afforded prospectors and mining people much easier ingress into the difficult regions. It is only in the last few years that cross-state roads and all-weather highways have made it possible to get into the back country in many parts of Oregon. The inaccessibility of the mineralized areas, therefore, has been an important factor which has slowed down or hindered development of a good many of the Oregon mineral deposits.

c. Availability of power---as power is one of the important elements of cost not only in the mining and milling of various ores and minerals but also in their reduction to finished products, the power item has, up to this time, been a hindrance to development of mines--- especially in the mountainous parts of this State. Whereas in California high tension power is available for almost the entire length of the Mother Lode belt of more than 300 miles, power at the mines in Oregon must for the most part be generated by steam made by burning wood, locally cut, in the old days, or by hauling in diesel oil as at present. The coming of Bonneville power apparently will release a number of minerals for utilization because certain of them in their reduction require substantial amounts of local low-cost electrical energy.

d. Type of minerals present as affected by progress of metallurgy--- the metallic minerals present in the mineralized areas in Oregon are, in the majority, of the so-called base or sulphide types. In the olden days the surface deposits, which were oxidized, could be readily treated by stamp mills and amalgamation---processes applicable only to "free" gold. The flotation process nowdays, which is common in the reduction of base ores, makes many of our Oregon base metal properties minable which for a period of 20 years or so were not commercial because the values could not be recovered. The fact that so many of our ores carrying gold, silver, lead, copper, and zinc could not be mined at a profit because of their type is a factor which hindered and held back the development of a great number of mineral deposits in this State.

e. Investors' reluctance due to smelly mining and oil promotions--- as in all other mining regions, this State went through a period of mining booms and wild stock promotions. The situation is just now changing to one in which the people of Oregon are coming to have respect for mining and respect for domestic mining investments. This is due in part to the attitude of the State Department of Geology and Mineral Industries, cooperating with the State Corporation Commissioner with the idea of preventing, by refusal to grant permits for the sale of stock to people who are ill-advised, propositions in mining and oil which are unsound. Nevertheless, the mining development of the State has been hindered by a lack of confidence in Oregon mining properties by its own people because of substantial losses sustained in the past through unfortunate promotions.

f. Lack of smelter facilities---there is no smelter in the State of Oregon. Were it possible to ship ores for the recovery of their precious metal and base metal values to a smelter within a radius of 100 miles, or even 200 miles, many mines would be in operation which cannot now operate on account of the necessity of shipping their ores or concentrates several hundred miles to existing smelters. Oregon mine

operators must ship to Salt Lake City; to Selby, California; or to Tacoma, Washington; and the distance is about the same from most Oregon properties to any one of the three. Freight and insurance charges are a very substantial part of the cost of production. This has been a factor which has hindered materially the development of Oregon mineral prospects. This is especially true in the case of lead and zinc ores which do not find ready market at either of the coast smelters.

g. Transportation--this factor has affected development of ore in Oregon for obvious reasons and has hindered the exploration of many properties. Neither railroad facilities nor highway facilities are available in most of the highly mineralized areas in this State.

II. Undeveloped deposits known to exist in commercial quantities that might be developed economically.

a. Diatomite--only one operator is producing diatomite on a commercial scale in this State, the Oromite Company at Terrebonne. Part of the reason for this is that it had been understood previously that only marine diatomite deposits were amenable to use as filters and fillers. However, this company has demonstrated that the fresh water deposits here in this State--or some of them--make an extremely high-class product when properly treated. It is probable that other deposits of diatomite may be found where transportation conditions will allow them to be produced at a profit. A deposit of 25 to 50 million tons of diatomite has been opened up at Harper in Eastern Oregon, but it lies idle for lack of demand and cheap transportation. As industries are developed on the lower Columbia, a much broader sales range should be available for this relatively new industrial mineral.

b. Refractory clays--these are practically undeveloped in this State, although relatively large quantities of them are known to exist and have been described in a report by the State Department of Geology and Mineral Industries and further development awaits an increasing demand which is anticipated as metallurgical industries develop as the result of the availability of Bonneville power.

c. Salt deposits--this State contains salt deposits, estimated by the U. S. Geological Survey as running into hundreds of millions of tons in Lake and eastern Klamath counties. The utilization of these deposits for by-products such as sodium sulphate, sodium silicate, sodium carbonate, and chlorine awaits a better demand for them which may come as an outgrowth of an increasing population and consequent increase in diverse industries which require these end products. (The State Department of Geology and Mineral Industries has arranged for a detailed research and economic study of these deposits to be carried out this summer and fall.)

d. Pumice and Pumicite--tremendous tonnages of these materials are present in the central and south-central Oregon. Their utilization depends on the development of better transportation conditions and more domestic requirements in industry.

e. Coal--whereas the production of coal from the Coos Bay district in years gone by reached a total of more than 100,000 tons annually in the last few years, principally due to the competition from oil, the production has diminished until it is now of the order of 10,000 tons per year. There can be no question but that there is a very substantial undeveloped tonnage of this important mineral resource. Dr. Diller, at one time head of the Department of Mines in Oregon, and also a well-known geologist of the U. S. Geological Survey, estimated that there is a possible tonnage of one billion tons of this sub-bituminous coal which may eventually be mined in this area. The field is almost unique among those in the United States by reason of its tidewater location.

Freight differentials of as little as 25 to 75 cents per ton have a very important effect on the utilization of all commodities of low unit value, of which coal is one. In other words, coal fields located within easy range of, or better yet, on deep water, have a very distinct advantage over coal fields which are located where a freight haul of even 100 miles is required to land the material on deep water for cheap transportation. During the time that the Coos Bay coal district was in its heyday and much of the San Francisco Bay area was heated by Oregon coal, it was mined and transferred directly from the tipple near the mine mouth to cargo carriers which landed it without transfer on San Francisco wharves. The water channels which are arms of Coos Bay have in some cases become shallow from disuse, but, it is stated, can be deepened to accommodate coastwise vessels without excess expense.

Coos Bay coal is classed as sub-bituminous by the U. S. Bureau of Mines, as it contains a large amount of volatile matter, runs from 9 to 10 thousand B.T.U. per pound, is rather high ash, and is non-coking. Tests made last year by the U. S. Bureau of Mines indicate that the coal is well adapted to the use of mechanical stokers. It goes without saying that because of high volatility it will offer an excellent material for powdered fuel. At the present time an exhaustive utilization study of this material is being made by the Oregon State Department of Mineralogy and Mineral Industries in cooperation with the U. S. Bureau of Mines. Samples have been taken in the standardized method which has been developed by the U. S. Bureau of Mines, proximate and ultimate analyses have been made; and selected samples from the various properties have been forwarded to Pittsburgh and Pennsylvania for use in carbonization tests. The results of the latter will not be known for some months. It is believed that the coal in this district will some day support a substantial by-product or hydrogenation industry. The tests now being made by the Bureau of Mines may result in our being able to recommend that certain industries may be able to utilize these coals and further develop the deposits at the present time, with consequent income to the community.

f. Sand concentrates--there are deposits of so-called "black sands" along the Oregon beaches and especially in the "back beaches" which have been receiving attention for the past 40 uears because of their known content of gold, platinum and platinum group minerals. It happens that

many of these deposits also contain substantial quantities of chromite. They also contain zircon and other accessory minerals of less value and importance. The failures to make commercial recoveries of the precious metals have been legion. However, it is believed that these concentrates, especially those that occur in the so-called "back beaches", contain tonnages of chromite which may become very valuable once the metallurgy is solved. It seems reasonable to prophecy that the deposits are known to exist in commercial quantities; but until the separation of the various minerals contained is accomplished economically, the deposits will, of course, have little or no value.

g. Chromite--more than 100 deposits of chromite in place have been discovered, according to a bulletin entitled CHROMITE IN OREGON, issued by the State Department of Mineralogy and Mineral Industries. These deposits are mainly in two districts--the Canyon City area of east central Oregon and the Josephine and Curry County districts of southwestern Oregon. The deposits are relatively undeveloped and the total tonnage is not known for that reason. After the Armistice in 1918 the price of chromite dropped to such a point that the material could not be mined and shipped out of the interior locations in this state at a cost which would allow it to compete with foreign chrome being imported into the points of consumption along the eastern seaboard from Rhodesia, New Caledonia, etc. Foreign chromite is mined for the most part by cheap coolie labor and can be delivered to eastern seabord points by cheap ocean transportation. There is no reduction plant for chromite on the west coast at the present time, nor has there been since the World War.

The U. S. Geological Survey gives the impression that the deposits chromite in Oregon, which are probably commercial, are comparable in numbers and tonnages to those of California. The ores of the southwestern district in Oregon are almost altogether of the high grade variety, from which a shipping product of 48 to 55 percent chromic oxide may be made. The Canyon City area, which produced the largest tonnage during the war period, has some high grade deposits, but also contains a substantial number of medium grade, or so-called "disseminated" types.

The Canyon City ore is analagous to the chrome-picotite ores of the Phillipine Islands, which are difficult to concentrate by ordinary gravity methods. Work of research nature is now under way to determine if these lower grade ores can be utilized by a process which is somewhat similar to the process of depositing metallic manganese from aqueous solution recently developed by the U. S. Bureau of Mines. If this process is successful itwill mean that many deposits, in central Oregon especially, which are not commercial at the present time, may be utilized commercially in the near future.

The imminence of Bonneville power at reasonable rates leads us to believe that Oregon chromite deposits, which could not formerly be developed because of transportation difficulties, may be opened up and their product consumed in the vicinity of Bonneville.

h. Iron---the limonite ores of Columbia County have been known for a great many years. Sporadic attempts have been made to develop them and make pig iron from them by smelting in charcoal furnaces. The nature of the ore is such that it could not be shipped to furnaces at Seattle or San Francisco, or to any more distant point. The ore runs around 50 percent Fe, rather High in silica, moisture and phosphorus. It would make gray castings, of course, as is, or without mixture with other higher grade ores. However, it is not believed that any substantial development of these ores can be contemplated until there is a steel industry in the Portland area, or on the lower Columbia. There is no lack of fluxes with which to smelt this ore. The very highest grade limestone is available in this state. Coking coal is available not far distant in Washington. Electricity, presumably, will be available at low rates in the near future from Bonneville with which to smelt the ore electrically, or to use it in ferro-alloys. There is no lack of tonnage of foreign ores which would be required for a Columbia steel industry.

Large deposits of ore are developed, or being developed, in South America on which the freight rate to this area would be no greater than the rate to eastern seaboard points. Other deposits are known in California which are as yet undeveloped, but which would supply a very superior grade of ore---ore running better than 60 percent in iron and low in phosphorus. The question of demand for steel products must determine the time when these Columbia county deposits will be developed and utilized. Their location within a half dozen miles of the Columbia river would assure their utilization in the event of any demand for ore at a Columbia steel plant. A minimum estimate of available tonnage would be 1,000,000 tons, and the probable ore which is believed to be available would be several times that figure.

i. Copper---several copper smelters have been built and operated in Oregon in years gone by. One at the Alameda mine 20 miles down the river below Grants Pass; another 40 miles south of Grants Pass at Takilma; and another at Sumpter in eastern Oregon. These smelters produced mat which was shipped by team and wagon to the railroad. None of these smelters has been in operation now for many years.

Copper deposits, or ores containing enough copper to require smelting in a copper smelter, are known to exist and have been mined in the Homestead area along the Snake River in eastern Oregon, in the Sumpter district and in the Balm Creek districts of Baker County, in the Waldo district and the Galice districts of Josephine County, and in some isolated parts of the Cascade Range north from Roseburg. Unless these deposits contain enough gold to warrant their being shipped to the Tacoma smelter or to the Selby smelter on San Francisco Bay, they cannot be mined profitably. The deposits are known to occur in commercial quantities, but lack of smelter facilities has hindered their development.

j. Marble and Limestone--deposits of very beautiful black monumental or ornamental marble are known to exist, and have been developed to a certain extent, in the western part of the Wallowa Mountains in northeastern Oregon. This particular stone was mined for a considerable time and burned in a lime kiln at the town of Enterprise, which is on the railroad. Had this operation been in substantial production at the time of the building of the State Capitol at Salem, it is probable that a substantial quantity of it would have been utilized for trim because it is a very beautiful stone indeed. The high cost of transportation from the locality where the stone occurs to points of consumption is the principal factor which has hindered its development. The marble of the Oregon Caves area in Josephine County is well-known, and some of it could doubtless be sold if transportation facilities were available. At the present time, however, there is no railroad from the Grants Pass district out to a harbor at Crescent City. When, and if, that railroad and harbor development is completed, we may expect the exploitation of this marble product as well as many others in this southwestern Oregon area.

A number of very high-grade limestone deposits are known in this state, especially in the southwest Oregon area, which may some day be developed when there is more demand for this product and when better and cheaper transportation facilities come. Much of the limestone which has been tested and which is now being produced both in Baker County and in Josephine County has a lime content of 96 to 98 percent. Other such deposits are known to exist in commercial quantities, but their future development awaits a larger consuming population in this area and better transportation facilities.

k. Agricultural limestone--large deposits of relatively low grade limestone running of the tenor of 60 to 75 percent lime are present in the Willamette Valley. These have not been used to much extent for agricultural purposes because the neutralizing value of the stone is much lower than in the case of the high calcium stone from eastern or southern Oregon. As the cost at point of consumption of this high calcium stone, running at least 95 percent lime, is of the order of $6.00 per ton, there is a continuing demand for agricultural lime, especially in the Willamette Valley, for neutralizing acid soils. Experiments are being carried out by this department (the State Department of Geology and Mineral Industries) for the purpose of trying to beneficiate this stone and to raise the lime content up to more than 90 percent. The process being tried is ordinary soap flotation, which is employed in various metallurgical processes in the mining industry. If this process proves successful it is not unlikely that substantial tonnages of this low grade limestone, which are known to exist within a few miles of the points at which it will be used, may be developed so that the farmers may obtain the product for a price they can really afford to pay.

1. Zinc—with one exception there has been practically no interest in the development of zinc deposits in Oregon because of the lack of smelter facilities. The exception is a property on the Santiam River which has been quite thoroughly developed, and in which a deposit of about 300,000 tons of lead and zinc ore has been practically proven. The gross value of this ore is nearly $12 per ton at the present price of zinc and lead, which makes a gross value of this indicated ore well over $3,000,000.

There are no zinc smelters on the West Coast. The ore might be smelted at Great Falls, Montana; Wallace, Idaho; Trail, British Columbia; Amarillo, Texas; or in Belgium. But to ship the concentrates to any of these points would not be economical. Other deposits of zinc, usually in combination with gold, silver, lead and copper, are known all along the Cascade Range. However, in most cases—and the ores are all of base or sulphide type—the gold content is too small to warrant shipping this material to a smelter where the gold, silver and copper may be paid for, but where the zinc may receive a penalty. These deposits will doubtless be exploited as soon as smelter facilities are available in the Columbia River area. A larger consuming population, and therefore greater demand for zinc and zinc products, in this area, will doubtless lead to the creation of smelter facilities in the next few years.

III. a. Gypsum—certain deposits of gypsum are known in this state; in fact, in recent months there was a "rush" to stake claims for gypsum for fertilizer in central Oregon. Gypsum at one time was produced in commercial quantities on Connor Creek in eastern Baker County, but the operation was terminated because the gypsum changed to anhydrite, as the deposit was mined deeper. Further investigations of gypsum in this state are justified and should be made.

b. Borates—about 30 years ago borax was produced and hauled across the plains with mule teams from points in Malheur County to Winnemuca, Nevada, and shipped from there to points of consumption. In recent months, Oregon State Agricultural College soil authorities have found that the element boron is an essential for fertilizing certain types of crops, and this product is now in especial demand in the Willamette Valley and in the Deschutes country, according to our information. The existence of the borate deposits in southwestern Oregon is well known, but their quantity and the economics of their production should be determined.

c. Oil and gas—gas is now being produced in commercial quantities in the Coos Bay district. Two wells located 3 or 4 miles south of Coquille produce "dry" gas, probably coal gas, which is now about to be placed in the city mains at Coquille. As the area has been geologized by the U. S. Geological Survey, the information published in the Coos Bay Geological Atlas, it is well-known that anticlinal structures which commonly produce gas and oil are known to exist. As to whether any

oil will ever be produced, of course, is not known. But the facts that some gas, although so far as is known, not of pertroleum type, is being produced, it is reasonable to presume that with further drilling a further gas production may be expected.

In various parts of Oregon there are beds of geologic age which produce both oil and gas in certain other states and in other countries. Oil structures are also present. It is also known that these structures are fractured and broken in many instances and that the rocks in the areas in question are in some cases metamorphosed to such an extent that the rock is too impervious to allow migration of petroleum. For these reasons oil drilling has been discouraged in central and eastern Oregon. No drilling in western Oregon, so far, has actually encountered petroleum, nor so far as we know, has struck a bonafide "show" of oil. However, the story persisted for many years that oil or gas would never be found north of Bakersfield, California.

Some months ago a well came in at Willows, California, producing about 50,000,000 cubic feet of gas per day. The same Lower Tertiary beds, that exist in the California oil fields, although rather deeply buried, are also present in Oregon; and it is not impossible that some day oil and gas may be produced in Oregon. It is believed that the Coast Range area of Oregon, which is less fractured and contains broader structures underlain by rocks which are petroleum bearing elsewhere, is the more likely area in Oregon for oil investigations.

d. Tin—some weeks ago a bona fide occurrence of stream tin, the first authenticated reported from this state, was discovered in a placer channel near Hereford in Baker County, Oregon. The origin of this is uncertain, however. It may have come from the weathering and breaking down of the old Cretacheous placer channel a few miles to the north, or it may have come from the grano-diorites which are exposed around the head of Pine Creek in which the tin was found. As tin is one of the two or three minerals which are not being produced in the United States, and one of the most important of the strategic, or deficiency, metals, further investigation into the origin of this stream tin is warranted.

e. Nickel—nickel is another of the so-called deficiency or strategic minerals which is not produced fromaa primary ore in the United States. Canada has practically a world monopoly on nickel. In discussing the nickel situation with the chief geologist of the U. S. Geological Survey, who had occasion to examine the Oregon nickel deposit near Riddle in Douglas County, the writer learned that this is one of the two nickel deposits in the United States which seems to deserve careful investigation. The other deposit is in North Carolina. Under the circumstances the U. S. Geological Survey has agreed to carry out this investigation. The deposit in question is known as Nickel Mountain.

f. Platinum--platinum is known to occur in the sand concentrate deposits mentioned above. At one mine in eastern Oregon a sample was recently taken of the mineralized zone, and assayed at the state assay laboratory at Baker. It showed a content of $40 per ton in platinum. This is the first instance of finding platinum in place that we know of in the state. Whether or not it is in commercial quantities is not known. Various types of recovery apparatus are being developed for the treatment of "black sand" concentrates that are present in southwest Oregon and along the coastal beaches and "back beaches". This, of course, should be attacked on the bases of orthodox metallurgical procedure and not as it has been, for the most part, in the past. It is probable that the concentrates may be treated, the platinum and other minerals recovered, by electrostatical or other recently developed metallurgical methods. These investigations should be carried out.

g. Cobalt and Antimony--at the present time these minerals are principally produced in foreign countries and imported for domestic consumption. Some deposits of cobalt and antimony are known to exist in this state. The areas in question are near Prairie City and on the upper Applegate River southeast of Jacksonville. Investigation should be made as to the probable tonnages of these minerals.

h. Manganese--there are a large number of manganese deposits in this state. Most of them, however, are known to be of the rhodonite, or manganese silicate, variety. Certain exceptions are known. One property which has apparent merit, known as the Tyrell deposit, is located about 15 miles east of Medford. It produced several hundred tons of high-grade manganese concentrate during the World War period. It lies as a blanket deposit. The minerals pyrolusite and manganite occur in a brecciated volcanic tuff. The ore in place only runs of the order of 3 to 10 or 15 percent manganese, but as the manganese dioxide occurs in the interstices between grains in the brecciated zones, the ore concentrates vary readily by tabling or other common gravity methods. No tonnage figures can be given because the deposit has not been drilled out. Another occurrence of manganese-bearing rock is known in southwestern Grant County about 50 miles southwest of Canyon City. This justifies further exploration and investigation also.

If sufficient tonnage of the siliceous manganese ores could be developed in southwestern Oregon, it would be feasible to undertake some metallurgical work pointed toward the manufacture of metallic manganese. However, with the present lack of development and the lack of knowledge as to probable or prospective tonnages, investigation would not be justified at this time. Those deposits, which are of manganese dioxide however, should be investigated because the mineral in this form can be readily used in the manufacture of ferro-alloys, and there may soon be a demand for manganese created by the installation of a ferro-alloy plant in the Bonneville area.

i. Silica--a large deposit of very high-grade silica has recently been opened up near the village of Rogue River, Oregon. This deposit, which is not described in any literature, runs more than 98 percent SiO_2. The phosphorous content, however, is about .039 percent, which approaches the upper tolerance for phosphorous in metallurgical silica. Certain deposits of pumicite have recently been investigated and have shown silica assays of higher than 90 percent, which is rather unusual for this type of volcanic material. Nevertheless, it may some day furnish a source material for silica.

Since much of Oregon is covered by basic igneous rocks there is a consequent paucity of silica sand. No deposits of silica sand, the common material from which glass is made, are known in the state. Further explorations should be made for deposits of high-grade silica in place, but at points more favorably located for cheap transportation.

j. Building and monumental stone--at the present time almost all of the better grade of building and monumental stone, that is to say, granite and marble, is imported from sources outside of Oregon. Some of the granite comes from California, some from Texas, some from Georgia, but most of it from Vermont. Granite of most excellent grade is now being produced in a small way near Ashland. Another small quarry of high-grade stone is located near Prairie City, and a third near Haines. All of these are hindered by being located where transportation is costly. Searches should be made for the most commonly used classes of monumental and building stone. It is not unlikely that granite stone of monumental grade may be found at some point in the Coast Range at a reasonably eary date, as samples have been brought in.

k. Nitrate--a deposit of nitrate has been discovered not far from Jordan Valley in extreme eastern Oregon. It occurs as a secondary mineral, filling the minor cracks and incipient fractures in a rhyolite flow about 100 feet thick. It is just possible that the material might be operated commercially by drilling the flow with churn drills, pumping water from the river into the holes, allowing the nitrate to leak out and recovering it from drifts or tunnels located near the base of the deposit. As there is a considerable demand for nitrate fertilizer, further investigation of this and similar deposits is justified. It will stand cost of transportation.

l. Tungsten and molybdenum--Known deposits of both tungsten and molybdenum have been found in several parts of Oregon, but so far as is known those which have possible commercial value are confined to localities in the Wallowa Mountains. These were visited and mapped during the summer field season of 1938 by the Oregon Geological Survey. Not enough sampling has been done as yet to determine what are the commercial possibilities; but inasmuch as the zones which are mineralized carry for considerable distances--as much as 2 and 3 miles in length--it is felt that further investigation and sampling of

these deposits is outstandingly justified. About half the tungsten consumed in the United States is produced domestically, or could be produced domestically. The remainder comes principally from China.

Owing to the chaotic condition in China at the present time, development of domestic tungsten reserves is highly desirable. Tungsten is one of the strategic or deficiency minerals. The minerals scheelite (calcium tungstate) and molybdenite, the principal ore of molybdenum, occur together in the Wallowa Mountains as contact-metamorphic deposits of considerable thickness. Whether or not they are large enough and good enough to mine must be determined by the amount of mineral present in the rock. Both minerals can be concentrated readily by ordinary gravity methods.

IV. a. Electromagnetic and electrostatic separation— the former is an old process of mineral separation based on the magnetical properties of the minerals treated. It can be used to separate magnetite and certain other metallic minerals from concentrates, and probably will be used in some combination sooner or later in the treatment of black sand concentrates from southwestern Oregon and the Oregon Coast.

Electrostatic separation is a newer process developed rather recently and has been found of tremendous advantage in the separation of minerals which are only slightly magnetic. It is used also in the separation of non-metallic minerals such as quartz and calcite. It would probably be used in connection with magnetic separation in treatment of black sand concentrates. Detailed metallurgical studies should be made on this problem.

b. Improvements in Flotation--very important improvements have been made in flotation for the separation of metallic and non-metallic minerals in recent years. Now it is possible to separate with a high degree of accuracy such minerals as iron sulphides, copper sulphides, zinc sulphides, lead sulphides, and arsenic sulphides, thus making it possible to"select" the desired mineral or combination which the mine operator wishes either to ship to the smelter or to reject as waste. This process of selective flotation has made some ore deposits in Oregon commercial which were not so 20 years ago when the various minerals could not be separated one from the other. Selective flotation is principally valuable in the treatment of the base ores of the Cascade Range and of the Blue Mountain area in eastern Oregon, as well as in the Cornucopia. It may be adaptable to other refractory ores.

c. Roasting in rotary furnaces and cyaniding—only recently the process of cheaply roasting base sulphide ores, especially those with a high arsenic content, in a rotary furnace and cyaniding the oxidized product thus formed has been worked out successfully. In areas in Oregon, like the Bourne and Sumpter districts, where transportation

on concentrates is a factor, this new practice may become extremely important. What is does is to eliminate the necessity of shipping any concentrates from the property to a smelter.

The ore from the mine is crushed and treated in a flotation mill, and the sulphides which contain the precious valuation are then roasted with the elimination of sulphur and arsenic. With the product then in the oxidized condition it can be cyanided easily in the standard manner, and a cyanide precipitate produced. This precipitate, a black sooty powder, is then melted into gold bullion and the bullion shipped direct to the mint. Tests as to the adaptability of this method should be made.

d. The U. S. Bureau of mines has recently succeeded in producing metallic manganese electrolytically in much the same fashion that electrolytic copper is produced. The process is to roast the manganese ore, get it into a sulphate solution, then precipitate the manganese on steel plates. Metallic manganese running more than 99 percent Mn may be used in industry and in blast furnace practice instead of ferro-manganese as at present. With Bonneville power available it may be possible at some time in the future to reduce the manganese from Oregon deposits electrolytically in this manner. Process may also apply to chrome.

e. Direct smelting--iron ore to steel--This is a process which has been worked on for two or three years by a group in Portland; and, according to metallurgists, has a very fair chance of success. No publicity has been given the process, but it is understood that it involves drying and grinding of the iron ore and mixing with the flux. The combination is introduced into a special type of oil burning furnace arranged for continuous feed. The result is an ingot which, up to the present time, has been reheated in an electric furnace in combination with metallic alloys for the formation of satisfactory material for special steels.

f. Electric furnace--recent developments in electric furnace manufacture and technology lead to the probability that the efficiency of the two most widely used foreign electric furnace methods may be considerably improved upon. Improvements in question involve the preheating of the furnace feed by gases from the furnace itself, together with an arrangement whereby the process is made continuous by method of tapping the furnace both for the removal of slag and molten metal. The imminence of Bonneville power, again, may encourage the installation of this newer type of electric furnace for reduction of metals in the Portland area.

g. Jigging--in very recent years precious metal recoveries have been enhanced by the development of new types of mineral jigs. At the moment they are being installed on dredges in Oregon and in other states for the recovery of fine gold and higher over-all recovery of gold, and they are also being installed usually between the classifier and the flotation cells in gold mills for the recovery of

coarse gold particles in the feed. The net effect of various seemingly minor improvements in metallurgy, such as jigging, is to make possible the exploitation and development of mineral properties which are of marginal grade which sometimes could not be operated successfully with the older types of mineral recovery apparatus. More study on new methods of mineral recovery are well justified.

h.. Coal By-Product Tests. --Some amazing improvements have been made by the U. S. Bureau of Mines research laboratories in the treatment of various types of coal for their by-product contents. The so-called low temperature volatilization methods seem to have great promise. They may be particularly adapted to the utilization of Oregon subbituminous coal in the future. The tendency of all such research work is to increase the usable number and quantity of by-products and to diminish the cost of removal of these products from the coal. At the present time gasoline is being made on a large scale from coal in Germany where hydrogenation is very popular. Hydrogenation plants are also operating in England and in Japan. In these countries the high cost of hydrocarbon products necessitates efforts to utilize coals. In this county the high cost of transportation and distribution on gasoline products justifies such researches with the point of making the product less costly to the consumer.

5. a. Reconnaisance Geologic Survey.--Geologic mapping, areal and structural relationships, and economic studies.--A very large portion of the state has not as yet been covered by areal geologic survey. Many individual districts, and in some cases 30 minute quadrangles, have been mapped by the Geologic Survey and by other agencies, both official and private. However, no attempt had been made to cover the state in a systematic manner until the job was started by this department. Years will be required for completion of the job because of the tremendous area involved. It is well known that certain classes of mineral deposits are commonly associated with known classes of rocks. Some minerals occur only, for example, in acid igneous environments, others only in basic igneous rocks. By having the state mapped in detail as to its areal geology, engineers can form valuable opinions as to the probabilities of finding certain deposits in given areas. This is the value of areal geology.

Some parts of the state may be covered adequately by reconnaissance surveys only. Those parts are the arid regions of southeastern Oregon and portions of the state which are not heavily covered by forest growth. Other portions, particularly the more mountainous regions along the Cascades, the Coast Range, the southwestern counties, and the Blue Mountains must be covered by detailed traverse because reconnaissance mapping is manifestly impossible. Following areal geologic mapping economic surveys are desirable where the presence of desirable minerals is indicated by the work already done. The specific kinds of exploration and investigations, then, which are suggested as being of most critical nature in this state are geologic surveys of both reconnaissance and detailed kind.

b. Topographic Mapping.---Since only half of the state has been covered by topographic maps and since topography is almost essential as a base for control in geologic mapping the completion of the topographic map of Oregon is critically needed. It is the habit of the U. S. Geological Survey to cooperate with the various states, matching dollar for dollar with Federal funds and funds supplied by the states themselves. Eventually, of course, the state will be mapped in any event by the Federal agencies; but judging by the experience in other states over the past 70 years, another 70 years may be required for the completion in this state. Meantime, topography is being obtained in the coastal area by the 29th Engineers, the only strictly topographic unit of the War Department. The U. S. Geological Survey, with funds furnished by the PWA, is doing some topographic work in the area bordering the coast about opposite Eugene. However desirable the present work is, it is not as urgent as is the need for topography in the well-known mineralized areas in the Cascades, in the Ochocos, and in the Blue Mountains. Any future planning for work by Federal agencies in this state should by all means include projects in topographic mapping.

c. Detailed Geologic Surveys.---At the present time the U. S. Geological Survey has a party in the field mapping the Grants Pass quadrangle. Last year this same party finished the detailed mapping of the Medford quadrangle and the areal geologic map in colors was recently issued by this department. Next field season this same party should complete the Kerby quadrangle which adjoins the Grants Pass on the west. This work of the U. S. Geological Survey is being done in cooperation with the State of Oregon, a portion of the funds being supplied by an appropriation of the State Department of Geology and Mineral Industries.

During the field season of 1938 the Oregon Geological Survey, a part of this department, covered in reconnaissance manner some 350 square miles of territory in the Wallowa Mountains and issued a colored map of the area. This summer field season of 1939 the Oregon Geological Survey will complete detailed geologic mapping of a 30 minute quadrangle in the quicksilver district of the Ochoco Mountains, east and south from Prineville. The selection of areas to be mapped by this department in its geological survey of Oregon is determined by the mineralization of the areas in question, their accessibility, the amount of timber covering, and by whether or not they have been covered by topographic survey. At the moment a detailed geologic survey by this department of the Portland area, which embraces most of Multnomah County, is in progress. Next field season this department intends to begin detailed geologic mapping of the Tiller quadrangle in the quicksilver district south and east of Roseburg, Oregon.

Detailed geologic surveys as distinct from reconnaissance surveys are especially valuable to examining engineers who are sent in by mining companies to look into the mineral possibilities of the various sections of Oregon. Detailed Geologic Surveying then is a specific kind of investigation which needs particularly to be carried out in this state.

d. Economic Studies of Mining Problems.---Such studies of known mineral deposits in various parts of this state are desired for a number of reasons. Among these are the necessity of determining whether or not these deposits, if in operation, could produce a product which may be the basis of an industry not now in existence in this part of the country. Most manufactured or fabricated products are imported into Oregon, whereas agricultural and unfinished products are exported. It is not unlikely that some Oregon products could be utilized here if the economics of their operation were studied and analyzed. Economic surveys include cost analyses of mining quarrying, milling, transportation to point of manufacture, and cost of manufacture. The total of these costs compared with costs in similar industries in other parts of the country may indicate the feasibility of encouraging local industries.

e. Geophysical Work.---In the last 15 years the finding of mineral deposits and the delineation of geology by electrical and geophysical methods have become extremely important aids in the mining industry. The depth and contours of deeply covered oil bearing horizons are mapped by electrical and seismographic means. Deeply-buried placer channels can often be outlined without digging or drilling by geophysical or electrical means. The crop of quartz veins, the location and extension of faults and fractures can, in a majority of cases, be determined by geophysical means even though the features in question are buried under many feet of soil or overburden. Inasmuch as the emplacement of metallic ores in Oregon is commonly and closely related to the deformation of the rocks, that is to say, the faults and fractures, any means of determining the location and continuity of such features may be of tremendous aid in finding and following ore deposits. In the future it is our unqualified opinion that geophysical work will be of great assistance in finding new deposits in this state.

Some geophysical work was done on chromite deposits in southwest Oregon a yearandhá half ago by the U. S. Geological Survey. The net result of the work was to point to the probability that such methods could be used with considerable success in finding new deposits and in outlining continuations of know deposits. Geophysical methods are being used at present by one of the larger quicksilver companies in this state in outlining fault conditions in the vicinity of their mine. Geophysical work at present is rather expensive, therefore it can only be attempted by well-financed groups. It is almost out of the question for the small operator or individual. As larger groups and corporations come into this state as they are doing more and more, geophysical work will be done as an aid in finding mineral deposits, and as a method of lessening the cost of mining exploration.

f. Magnetic Surveys.---The magnetic compass and dip needle have been used for a great many years in mapping and finding deposits of magnetic ore in various parts of the world. It is believed that this method may be used to advantage in outlining the presence of buried deposits of "black sand" and chrome sands in the "back beach" areas along the Oregon coast.

g. Spectroscopic analysis of Ores and Minerals.—This method of qualitative determination of the elements contained in mineral substances has now been developed to such a high degree that spectroscopic determinations approach quantitative results in determining the mineral content of an ore. Not only the approximate amount of a desired element is ascertained, but all of the elements which are present can be identified. We have reason to suspect that there are rare elements, or useful elements not commonly recognized which are present in some of the mineral deposits in this state. Spectroscopic analysis gives the entire picture easily, quickly. To make a complete quantitative chemical analysis of an ordinary piece of ore might cost up to several hundred dollars and require several weeks time. In fact, there are only a few laboratories in the United States that have facilities for determining all of the elements. The spectroscope determines quickly, and may indicate the presence of little suspectd but valuable mineral components. Many times we would like complete spectroscopic determinations of ore and mineral substances in this state; but, lacking spectroscopic equipment, the samples must be sent away to some private laboratory at a considerable cost. It is believed that spectroscopic studies would be of especial value in obtaining facts on mineral deposits in Oregon.

h. Cost Studies Based on New Improvements in the Handling Equipment.—In recent years new types of equipment have been developed for the rapid and relatively inexpensive handling of mineral materials in quantity. Gravel and road material which, 20 years ago cost 25 cents to $1 per yard to handle by the then existing types of equipment, can sometimes be handled now with new equipment for 5 to 10 cents per yard. These developments have a direct bearing on the utilization and exploitation of low grade mineral deposits. Among these new developments may be mentioned the LeTurneau, or carry-all, the diesel or caterpillar-type tractor, the bulldozer, diesel powered shovels and drag lines, slack line cable systems, and belt conveyor systems for handling of earth material and ores. All of these new developments have a tendency to make available new ore deposits which could not formerly be classed as ores because the cost of producing or handling them precluded their production at a profit. Another study which is nearly complsted at the present time is as to the feasibility of resurfacing ground which has been mined by dredges. Cost studies of operations using some of these methods of cheap handling are well justified in this state, as a possible means of encouraging the bringing into operation of low grade or marginal mineral deposits.

i. Precipitation of Suspended or Colloidal Material from Solution. The reason for the need for studies of this type is to determine the feasibility of rendering innocuous some of the effluents from mining, milling and industrial operations in this state. Certain precipitants and electrolites have been found to be very effective in clarifying muddy water or effluents from factories or plants where the wastes carry particles in suspension. Some suspensoids react rapidly, some do not. It would be extremely desirable for some research agency to carry out experiments along this line. Some of the antagonism generally expressed against the industrial practices in placing wastes in the streams of the state might be eliminated by proper precipitation of these materials from suspension.

j. Fertilizer Processes and Flotation.---Studies began by this department, but which may possibly not be carried to completion for lack of facilities, should be made of the possibilities of manufacturing agricultural limestone from available low-grade limestone deposits.

At the present time a so-called mineral fertilizer said to be very effective, is being shipped into this state from Washington and sold alledgedly at $30 per ton. It is very likely that the mineral content of this fertilizer could be duplicated synthetically from materials available in Oregon at locations much closser to the points of consumption. Studies of such matters are outstandingly justified.

k. Mineral reduction of Concentrates by So-Called "Fuming" furnaces.--An experimental plant located in this state but used as a pilot plant has been in operation for the last year or two. The process involves relatively fine grinding and drying of complex sulphide ores, blowing them into a furnace or stationary kiln heated by an oil furnace, voltilizing the sulphur and alledgedly the metallic contents as well and cooling and precipitating the gases in cooling towers. It is stated that the process accomplishes the elimination of sulphur and silica and the reprecipitation of gold, silver, lead, zinc, and copper in the bag precipitate. Whether or not this process will be commercially successful is not known, but in any event if a plant located near a mine could successfully eliminate the sulphur and silica, and thus concentrate the desired metallic values into a portion of the original weight, it would be a desirable accomplishment. It would eliminate excessive transportation charges on sulphide concentrates from the usually inaccessible mine locations up and down the Cascade Range and other mountainous mining areas of the state. A thorough study of this process would be desirable and justified in the light of the possibility of its good to the mining industry in this state.

NATIONAL RESOURCES COMMITTEE
FIELD OFFICE
FEDERAL COURTHOUSE
PORTLAND, OREGON

June 19, 1939

Mr. Earl K. Nixon
Oregon State Department of Geology and Mineral Industries
329 S. W. Oak Street
Portland, Oregon

Dear Mr. Nixon:

Following our conversation this morning, I am sending you enclosed copy of the outline for a twelve to fifteen page report on Mineral Resources and Mining to be included with our regional report on migration, land development, settlement, and public works in the Pacific Northwest. Also enclosed is a preliminary mimeographed copy of the Conclusions and Recommendations for this section of the report. Please keep these Conclusions and Recommendations confidential as they are subject to change.

As discussed with you over the telephone, the mineral resources section of the regional report will include a description of the present status of mineral development in the four Pacific Northwest states, the possibilities for greater development of the region's minerals, and ways and means by which this greater development can be achieved. The objective is to show how larger economic opportunities can be created in the Pacific Northwest through greater use of the region's minerals and how this might be brought about.

It will be very much appreciated if you would send us ~~the~~ material on the following items listed in the outline:

1. Factors affecting development of mineral deposits.

2. Undeveloped deposits known to exist in commercial quantities that might be developed economically.