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STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES
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MAIN WAR USES OF THE FIFTEEN MOST IMPORTANT STRATEGIC METALS

The well-nigh incredible increase in consumption of metals used in the war effort was beginning to make itself apparent in the statistical summaries of the U.S. Bureau of Mines as early as 1939 and 1940, as is shown by the figures in the following abstract of war uses of minerals. Undoubtedly these rising curves of consumption of metal steepened even more during 1941 and 1942, but the data to draw them is unavailable. Magnesium and aluminum production in particular, probably has doubled and redoubled in the last two years to amounts undreamed of even five years ago.

The following list gives the most important of the war uses, in probable order of their importance to the war effort:

Aluminum:

1. For transportation (planes, trains, automotive uses, ships). (40% of total consumption).
2. For foundry and metal working of small machine parts.
3. For electrical uses.

Sixty percent of the weight of most airplanes is aluminum. Other new uses include aluminum foil, bearings, coating for steel, die castings, and wrought aluminum.

Aluminum consumption rose 87% in 1939 and 35% in 1940 to a total of 454 million pounds in the latter year, and has probably continued to rise just as rapidly since.

Antimony:

1. For Babbitt metal and bearings. (Consumption up 30% in 1940).
2. For storage batteries (antimonial lead). (Up 15% in 1940).
3. For electrical cable-covering (antimonial lead).
4. For chemical uses, enamel ware, pigments. (Up 75% in 1940).

Consumption for 1939 was 11,000 pounds and for 1940, 18,000 pounds.

Chromium:

1. For stainless steel and other ferro-alloys. (About half of total consumption).
2. For refractory brick for furnace linings. (Less than half of total).
3. For chemical uses.

New uses include stainless and armor-plate welding rods, and for structural parts of airplanes where construction can in many cases be as strong per unit of weight as the lighter metals.

Consumption of chromite ore rose from one-third to two-thirds of a million tons in 1940.

Copper:

1. For shell cases and ammunition. (Consumption rose 79% in 1940).
2. For electrical material, rods, wire, etc.
3. For automotive industry, now includes military cars and tanks.
4. For shipbuilding.
5. For power lines.
6. For telephones.

Consumption of copper rose from 600,000 tons in 1939 to a million tons in 1940 and has doubtless increased another 30 to 50 percent since then.

Iron:

1. For transportation (shipbuilding, military vehicles, tanks, railroads, planes). (Probably nearly 40% of total consumption).
2. For construction.
3. For export to Allied Nations. (Was 17% of total in 1940).

New uses include graphitic steel for moving parts of rifles, machine-guns and machinery bearings; porous oil-soaked iron bearings; low-alloy steels to replace aluminum in trainer planes; steel shell cases instead of brass; stainless-clad instead of stainless steels.

Pig iron production was up 30% in 1939 and 25% in 1940.

Lead:

1. For batteries. (30% of consumption in 1940).
2. For ammunition.
3. For cable-covers.

Also of extreme importance is lead for solder, bearing-metals, for tetraethyl gasoline. New high-lead solders and lead plate are saving tin, and lead water pipe is saving copper.

Lead consumption increased 17 percent in 1940 to 782,000 tons.

Manganese:

1. For chemical oxidizing and desulfurizing agent in the production of steel.
2. For constituent of steels to replace stainless steel and in armor-plate.
3. For other non-ferrous alloys.
4. For dry batteries.

Other uses are in the chemical, ceramic, and pigment industries.

Magnesium:

1. For aircraft. (Used 70% of total in 1940).
2. For automotive trade (now mostly military vehicles).
3. For lightweight portable machinery.

Magnesium is used for structural alloys (castings, forgings, and sheets) 64%; for aluminum, zinc, and other alloys 32%; for other uses (magnesium wire, ribbon, shavings) 2%.

A spectacular increase in magnesium production has taken place, rising from six and a half million pounds in 1939 to eleven and a half million pounds in 1940, and probably has doubled again since that time.

Mercury:

1. For mercuric fulminate for explosive detonators.
2. For anti-fouling pigment for ship bottoms.
3. For medical preparations.

Other important uses include storage batteries, barometers, mercury boilers, mercury-vapor lamps, and in the manufacture of felt.

In 1939 about 21,000 flasks were used; in 1940, 27,000 flasks (of seventy-six pounds each).

Molybdenum:

1. For molybdenum-steels, replacing nickel and chromium and tungsten steels for high-speed tool steel.
2. For alloy steels for planes, railroads, and automobile parts.

The United States produces over 95% of the world's supply (34 million pounds in 1940), and due to the fact that it can be used as a substitute in alloys for less abundant metals, very little is now being exported.

Nickel:

1. For an essential component for stainless steel, as used in planes, ships, military vehicles, etc., etc. Over one-half is used in the transportation industry.
2. For electro-plating and chemical industries.

A 1939 consumption of 52,000 tons rose 136% over 1938, and rose another 63% to 83,000 tons in 1940.

Silver:

1. For photographic film in military reconnaissance.
2. For bus-bars in hydroelectric plants.
3. For replacing tin in solder.
4. For chemical and medical supplies.

Sixty-five million ounces were produced in 1939, and 72 million in 1940.

Tungsten:

1. For metal-cutting alloy tool steels (by far the most important use).
2. For lining big guns; for armor plate; in gun breeches; for cores in armor-piercing bullets.

Other important uses include the use of the metal itself in electric light and radio filaments. A "heavy metal" composed of compressed tungsten and nickel powder is used in X-ray and radio-active screens, and for circuit-breaker electrical contacts.

Consumption of tungsten rose from four to five million pounds in 1940.

Vanadium:

1. For ferrous alloy steels in machinery and tools.
2. For non-ferrous alloys.
3. For catalyst in the production of sulfuric acid, which is the basis for a large part of the chemical industry.

Vanadium production in 1939-40 remained stable at around two million pounds a year.

Zinc:

1. For brass shellcases and ammunition. (Up 33% in 1940).
2. For die castings of small machine parts and structural elements. (Up 38% in 1940).
3. For galvanizing of sheet metal.
4. For rolled zinc.

Brass (copper-zinc) is replacing bronze (copper-tin), and brass embossed dies are replacing steel dies.

In 1939, 607,000 tons of zinc were consumed, and in 1940, 719,000 tons were consumed.

John Eliot Allen

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KUIN RADIO TALKS ON THE MINERAL INDUSTRY

Mineral industry problems and developments are discussed over KUIN (1340 kc), Grants Pass, each Tuesday at 7:15 p.m. by Ray C. Treasher and Robert Bassett of the Department staff, stationed at Grants Pass.

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TITANIUM

Titanium, long one of the neglected elements, has only recently come into its own, and is now being used in a multitude of ways. Discovered in 1791 by W. Gregor in the magnetic sands of Cornwall and first isolated by Berzelius in 1825, as late as 1910 no important commercial application of the metal had been discovered. It was still considered a rare element, was practically unknown to the general public, and textbooks on chemistry scarcely mentioned it.

Now it is known to be one of the most abundant of elements, only eight others--oxygen, silicon, aluminum, iron, calcium, sodium, potassium, and manganese--being more common. It is very widespread; but generally it does not occur in large-sized deposits, which is possibly the reason it was so long overlooked. Of 800 igneous rocks analyzed by the United States Geological Survey, 748 contain some titanium. It occurs in almost all magnetic iron ores, in clays, soils, and many mineral waters, in the sun's atmosphere, in plants, and in the bones and flesh of animals.

Minerals: Titanium does not occur native, in the free state. The most important commercial ore is the mineral ilmenite, the ferrous titanite ($FeTiO_3$). It crystallizes in the hexagonal system, and is usually massive and compact, but also occurs in thin plates and in grains. Its hardness is 5.5 to 6 and the specific gravity is 4.7. It has a metallic to sub-metallic luster, iron-black color, black to brownish-red streak and is sometimes slightly magnetic without heating.

Three mineral oxides of titanium (TiO_2) are known, of which rutile is by far the most common. It is tetragonal, frequently twinned in many repeated elbows, is generally crystalline, but does occur massive. The hardness varies from 6 to 6.5 and the specific gravity is 4.2. It has adamantine to sub-metallic luster, a red, reddish-brown to black streak, is usually nearly opaque, but may be transparent.

Octahedrite (anatase) also crystallizes in the tetragonal system, but is usually pyramidal and the crystal axes have a different arrangement from those in rutile. It is somewhat softer, and is not so heavy. Its hardness is 6 to 6.5; specific gravity 3.8 to 3.95.

Brookite is orthorhombic and has a varied habit. It occurs only in crystals, has a hardness of 6, a specific gravity of 4 to 4.07 and an adamantine to sub-metallic luster. The color is hair-brown to black and it is translucent to opaque.

Rarer minerals which contain titanium are titenite (sphene) $CaTiSiO_5$, Perovskite $(CaFe)TiO_4$, Schorlormite $Ca(TiFe)SiO_5$, and Kielhauite $CaY(TiAlFe)SiO_5$.

It is sometimes difficult to identify ilmenite, or to determine whether a mineral, such as magnetite, is titaniferous. In such cases, quick chemical tests, such as are given below, may be of value.

Tests for Titanium:

1. A small amount ($\frac{1}{2}$ gram) of the finely powdered material to be tested is fused with 1 gram of sodium hypophosphite in a small crucible. If the melt is blue, titanium may be present. When water is added drop by drop to the cool melt the water becomes a pale pink color if the melt contains titanium. The addition of hydrogen peroxide gives an orange-red color in the presence of titanium. Ammonia causes the pink color to change to blue.

2. The powdered material is fused with potassium pyrosulfate until effervescence ceases. When the fused mixture is cooled it is dissolved in 10% sulfuric acid. When hydrogen peroxide is added the solution becomes a yellowish-orange color. Hydrofluoric acid or a fluoride destroys the color. A similar yellowish orange color is given by vanadium but this color is not destroyed by addition of fluoride ion.

3. Zinc when added to a hydrochloric acid solution of titanium produces a violet color. Tin interferes with this test.

4. The powdered mineral to be tested, mixed with microcosmic salt, is heated on charcoal or on a platinum wire in a reducing flame and if titanium is present, it produces a violet colored bead.

5. A small amount of the powdered mineral is fused with 3-4 times that amount of potassium bisulfate on a platinum lid. The melt is transferred to watch glass, mixed with a little water, and placed on a filter paper impregnated with chromotropic acid. If titanium is present a red to brown color appears. Sensitivity increases when a drop of HCL solution of stannous chloride is added to the melt on the watch glass and a few drops of chromotropic acid are added. In the presence of titanium not only the dissolved, but also the undissolved particles are tinted red.

Occurrence: Ilmenite is usually associated with magnetite; sometimes with hematite. In the ilmenite-magnetite ores, the ratio of titanium to iron is quite variable. There seems to be no sharp distinction between magnetite and titaniferous magnetite, or between titaniferous magnetite and ilmenite. The largest known titaniferous iron deposits are in Norway, Madagascar, Canada, and the United States.

Pure ilmenite, in place, as a minable body, is found only in nelsonite--a peculiar rock in which ilmenite (or rutile) and apatite are the essential minerals.

Ilmenite also occurs in the black-sands of beach deposits, associated with magnetite, monazite, zircon, quartz, and rutile. Important commercial deposits of these sands have been found in Florida, Brazil, India, and Africa. They also are known to occur at several places on the Oregon and Washington coast.

For many years most of the world's supply of ilmenite (and hence titanium) came from the beach sands of Travancore, India. One deposit, at Manavalakurichi (called "M.K.") has been worked since 1911, but until 1924 monazite was the only mineral desired; the ilmenite had no value. With the discovery of commercial uses for titanium and the increased demand for its ore, these stores of hitherto discarded ilmenite became important and valuable. Exploration uncovered a second deposit eighty miles farther north, richer than the first.

Concentration of these sands was accomplished first by wet tables to remove the bulk of the quartz. After drying in the sun, further concentration was carried out by dry tables and magnetic separators, to eliminate the zircon, monazite, rutile, and other minerals. The zircon and monazite were themselves separated and concentrated for commercial markets. The production of ilmenite from these two localities rose from 641 long tons in 1924 to 129,000 long tons in 1935. By the end of 1936 the total production was in excess of 700,000 long tons.

With the depletion of these deposits and the advent of war with its manifold problems of shipping, the United States has sought and found commercial deposits closer to home. The National Lead Company has recently begun large-scale mining of ilmenite in the Adirondacks. The deposit along Piney River, in Amherst and Nelson Counties, Virginia, has been known for many years. It is in the form of a dike of nelsonite which outcrops for 350 feet along the river in a bluff 70 to 80 feet high. It increases in width to 400 feet at the surface a short distance from the river and extends for 1300 feet without materially diminishing this width. In the next 600 feet it tapers down to about 100 feet. A wedge varying from 60 to 100 feet in width extends for another 1000 feet. The nelsonite is enclosed in a biotite-schist and dips 45° with the schist. It has been drilled to a depth of 400 feet and apparently continues below that point. The upper 75 feet of the nelsonite is weathered, rusty, and easily crushed in the hand. Below this it becomes fresh and hard. The ilmenite is black, the apatite comparatively clear, and enough chlorite is present to give the rock a greenish tint. Some pyrite occurs along cracks. Only the decomposed rock has been quarried (as of 1937). It contains 18.5% TiO_2 and if the analyses submitted are typical it should yield about 42.5% of concentrates. The remainder is mostly apatite. The hard rock below is said to be as easily treated as the weathered portion. If the depth of 400 feet is considered as obtaining along the length of the dike, and the specific gravity of the nelsonite be placed at 3.89, more than 4,400,000 tons of TiO_2 is indicated.

Other deposits in the United States are known to occur in Wyoming, Colorado, California, Minnesota, Rhode Island, North Carolina, and elsewhere.

Uses: The time honored use for TiO_2 is for pigment as it makes the whitest of all white paints. Because of its whitening and obliterating power it is unexcelled and is widely used, not only in paint, but also in rubber, linoleum, leather, plastics, soap, printing inks, paper, textiles, and ceramics.

For many years it has been used to a very small extent in alloying steel. Of late years its utilization for this purpose has increased markedly. Like aluminum, and to a greater extent than silicon, it has a strong affinity for oxygen. As a deoxidizer in steels it is often more satisfactory than aluminum, because its oxide is more easily eliminated and because at high temperatures it has an affinity for nitrogen as well as for oxygen. The presence of titanium in steel materially improves ductility and impact resistance, without unduly lowering the strength.

Perhaps the greatest increase in the use of titanium has occurred in the welding-rod industry. The oxide is applied as a coating and serves to stabilize the arc, thus permitting the deposition of a more homogeneous and a purer weld metal.

Titanium has also been used for filaments in electric lights. In the form of the tetrachloride it is used for making smoke screens to cover war movements and in sky-writing.

Market: Ilmenite, per gross ton and containing 60 percent TiO_2, brings $28.00 to $30.00, f.o.b. at the Atlantic seaboard depending on grade and impurities. Rutile, having a guaranteed minimum of 94 percent concentrate, sells at 8 to 10 cents per pound; 88 to 90 percent brings $95.00 per ton, c.i.f. New York. (Quotation as of November 20, 1941.)

The following are possible buyers:
American Zirconium Corp., St. Helena Ave., Baltimore, Maryland.
Belmont Smelting & Refining Works, Inc., 316 Belmont Ave., Brooklyn, N.Y.
The Chemical & Pigment Co., Div. Glidden Co., 6401 St. Helena Ave., Baltimore, Maryland.
DuPont de Nemours, E.I., & Co., Inc., (Krebs Pigments Department), Wilmington, Delaware.

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CLEARING HOUSE

No. 75-CH Want some party or company to take over and operate one or more of my mining claims of war minerals: deposits of manganese, mercury, nickel, tin, silver, and copper all in Oregon. Write Alfred A. Wright, 135 South Olive St., Los Angeles, California.

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OREGON'S MINERAL INDUSTRY

This issue of the Ore.-Bin reviews mineral industry activities in the state for the past year and summarizes present conditions.

Judged by possible future effects in increasing the value of the state's mineral production, there were two very important happenings in the industry in 1942. These were the starting of construction of concentrating plants for the treatment of chromite sands in the Bandon-Marshfield area, and the extensive exploration campaign begun and prosecuted by the Freeport Sulphur Company on the nickel deposit on Nickel Mountain near Riddle in Douglas County. Both of these projects are dear to the Department's heart since, in a measure, they both represent successful culmination of long-continued efforts of the Department to secure development of two of the state's important mineral resources by experienced operators.

In October, 1942, all gold mines, both lode and placer, were closed by War Production Board order. Only those very small operations which handle not more than 100 tons per month in the case of lode mines, and not more than 100 yards per month in the case of placers were allowed to continue. Any activity that rates as a "mining operation" must produce in greater quantities in order to carry on. The stated object of this closing order was to conserve critical materials needed in mining of war minerals and to divert labor from a "non-essential" industry to "essential" industries.

While the Department felt (and it has since been demonstrated) that the conditions of the order were unnecessarily strict and that it would fall far short of accomplishing what it was intended to accomplish, the fact remains that Oregon's four-million-dollar gold mining industry was anesthetized for the duration.

In the field of nonmetallic mining, most of the operations which could obtain adequate labor and operating materials worked at capacity throughout the year. Construction for war purposes was at a high level and consumed large amounts of Portland cement, sand, gravel and crushed rock. Maintenance work on roads was considerably below normal due to priority difficulties of road contractors. This condition caused a decrease in production of road metal.

The Department had originally planned to make a survey of the state's nonmetallic mineral production for 1942. But, because of the deluge of questionnaires sent to producers by Governmental agencies, the Department decided to refrain from adding another request for information to the already groggy operators. Therefore an exact estimate of the value of nonmetallic mineral production may not be made at this time. Such value of production probably exceeded $6,000,000 in 1942.

Present metal mine production is confined to quicksilver, chromite, manganese and antimony deposits. A relatively small amount of gold and silver is being produced by two properties in eastern Oregon which are allowed to operate because their shipments of ore to smelters are valuable as siliceous flux.

During 1943 a large increase in value of chromite production will result due to chromite sand operations. It is likely that there will be a greatly increased antimony production from both northeastern and southwestern Oregon. Some new quicksilver production will come in but output from some of the older properties will probably fall off, so that the amount produced in 1943 will be about the same as last year.

New base metal exploration is possible and highly desirable, but present Government regulations and tax policies are not conducive to new mineral developments by experienced operators.

Although WPB is eager to increase copper production, the RFC seems to be reluctant to make loans on small copper prospects.

Nothing substantial in the way of production may be expected from Oregon zinc properties until smelter facilities are available in the Pacific Northwest.

Mining labor has been insufficient in quantity and unsatisfactory in quality due to proximity of high-pay jobs in the shipyards and logging industry. There has been no base metal operation, other than quicksilver, in the state since the closing of the H. & H. mines in the Bohemia district as a result of inability to maintain satisfactory labor.

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PROGRESS REPORTS

Western Oregon

Chromite

A number of properties in southern Oregon produced chrome in 1942, and sold it to the Metals Reserve Company ore purchasing depot at Grants Pass. Brief descriptions follow:

Lloyd Lewis opened the Mount Sexton chrome property north of Grants Pass. Some ore was shipped.

Sherman Smith mined from several localities; most of his ore came from the deposit on King Mountain.

J. N. Grisson worked the Deep Gorge deposit on the Illinois River at the mouth of Briggs Creek.

Fisher and Anderson took ore from the Brown Scratch property on Briggs Creek.

George Gallaher worked the Van Gwyn located near the Brown Scratch.

McClung and Krueger opened the Illinois Chrome mine on the west side of the Illinois River.

Hammer and Neubert took out ore from the Black Beauty just across the river and below the Oregon Chrome mine. The owners of the Black Beauty state that they have uncovered more ore at a lower elevation. To date, it has not been necessary to use a single stick of powder in production of ore.

J. E. Kennedy mined low-grade ore from the Griffin property on the Illinois River near the mouth of Deer Creek and delivered several tons of concentrate to the stockpile.

Baker Brothers and Jones brought in ore from the Defense mine south of Mount Ashland.

Oregon Chrome mine near Oak Flat on the Illinois River is under lease to William Robertson who delivered ore to the stockpile in 1942 and continued ore shipments during January, 1943.

Eugene Brown, Grants Pass, stockpiled ore from the High Plateau at O'Brien before the winter closed the Oregon Mountain road. He moved this ore to the Grants Pass Metals Reserve during November and December. Brown has been one of the most consistent producers. His road was supposed to have been treated with winter maintenance by the Forest Service but confused instructions issued held up this maintenance until it was too late for this winter season. However, development work is in progress at the mine, pending early opening of the road. While the High Plateau is located over the line in California, all business connected with the operation is done in Oregon.

Drilling by the U. S. Bureau of Mines at the Sourdough mine on the north fork of Smith River was discontinued late in December. Ralph Mason, Grants Pass, manages the property for Rustless Mining Corporation.

The Pacific Company, which leased the Sordy property on Chrome Ridge in the Briggs Creek district discontinued operations for the winter. Plans are being made for resuming shipping as soon as snow conditions permit. John Day of Medford is president of the company and R. B. McGinnis is superintendent.

Crescent-Pacific Company, formerly operators of a dragline floating dredge on the Applegate River, have taken over the Hicks chrome property in California west of the High Plateau. Some ore was shipped during 1942, and development work is progressing during the winter months.

Coquille Stockpile: Delivery of chrome ore to the Coquille stockpile was not up to expectations. Kelland, Coy, and Rockard delivered ore from the White Rock property near Powers and one or two truckloads came in from deposits near Carpenterville. There have been numerous promises that shipments would be made.

Chromite sands: Construction of concentrating plants to treat the chromite sands of the Coos Bay district is progressing. The Krome Corporation will start producing primary concentrates within a few weeks. Humphreys Gold Corporation is constructing a primary concentrator near the Lagoons, north of Bandon. Porter Brothers have been carrying on extensive testing work in a treatment plant at Bandon. Defense Plant Corporation is financing a secondary concentrator located at Beaver Hill, northwest of Coquille, to treat concentrates from the various primary milling plants.

Quicksilver

The continued interest in quicksilver as an essential war metal is reflected in the prospecting, location, and examination of quicksilver deposits. Several old properties are being re-opened, and new occurrences have been found.

The Mountain King property on the divide between Sam's Valley and Evans Creek, has been explored and a 25-ton Herreshoff furnace was installed in 1942. Some quicksilver was delivered to the Grants Pass Stockpile.

The Buena Vista and Maud S. mines, north of Tiller on Deadman Creek, are reported active. The Buena Vista installed a furnace plant several years ago.

Work at the War Eagle mine, north of Beagle, is confined to the coal vein in which cinnabar is found. An attempt is being made to separate the coal from the cinnabar by flotation. As yet, no work has been done on the Rainier vein.

The Pacific Syndicate which owns the Webb-Taynor property started production from a Herreshoff furnace in 1942.

The Roxana group, north of the War Eagle, is being opened by a group of California men. Cinnabar showings are found over a wide area.

Milton Murphy and E. S. Noe have been developing their claims in the Rainbow group, on Brush Creek, near Steamboat Mountain, in the upper Applegate area, and have entered into a contract with Horse Heaven Mines, Inc. A 7000-foot access road has been built to the workings. This mineralized zone appears to extend northeastward into the head of Palmer Creek where cinnabar has been found on the Davisson claims.

Antimony

Emerson Merrick of Medford, Oregon, is operating the Blue Jay Antimony property on the Applegate River. Stibnite in kidneys that will permit shipment of 50 percent ore is mined from a persistent zone. Shipments are made from Medford. At present, development work is being carried forward and additional ore has been exposed.

Antimony prospects on Kanaka Gulch and Grouse Creek have been investigated but insufficient work has been done to encourage development. Specimens of high-grade ore are found. The Lowry Antimony produced during the last war but the high-grade lenses were mined out. To date, no new lenses have been found.

Nickel

The Freeport Sulphur Company is extensively exploring the nickel silicate deposits of Nickel Mountain near Riddle. An eight-mile access road to the property has just been approved and the Public Roads Administration is expected to start construction in the immediate future. The exploration of the deposit was started soon after the shortage of nickel developed in the war production program. If this property gets into production, it will be the only nickel mine in operation in the continental United States.

The ore being prospected is nickel silicate called garnierite- a greenish mineral that resembles some oxidized copper ores. Localities other than Nickel Mountain have been found southwest of Grants Pass along the west side of the Illinois Valley from Eight Dollar Mountain to the Oregon line. The ore is secondary and frequently is found in the red soil which overlies peridotite and serpentine areas.

Copper

The present shortage of copper has stimulated interest in southern Oregon copper deposits. Mines having a record of production include the Silver Peak mines, near Riddle; the Almeda, near Galice on the Rogue River; and the Queen of Bronze-Waldo-Cowboy group near Takilma. The Mammoth Lode is being explored near Railroad Gap, north of Trail. There are rumors concerning the opening of various other copper properties but as yet no actual work has been done.

The H. & H. mines which brought into production the Champion and Musick mines of the Bohemia district in Lane County were obliged to shut down both underground work and 100-ton concentrator because of inability to secure and hold a sufficient labor supply. Mine labor quit for the more highly paid jobs at shipyards, cantonments and logging camps. The H. & H. mill concentrates contained copper, lead and zinc, as well as silver and gold.

Manganese

Manganese deposits of southwestern Oregon were described in Department Bulletin No. 17. Many of them consist principally of rhodonite with superficial amounts of black oxide. The coastal region shows considerable promise of small production of low-grade ore. Shipments were made from the MacAdams property east of Langlois during 1942 and from a property east of Gold Beach.

Surface exploration by trenching was done at the Tyrrell deposit northeast of Medford in the Lake Creek area, and plans were made for further development.

Iron

Interest has been shown in iron ore deposits, either for use in the sponge iron pilot plant at Cascade Locks, or as high specific gravity material for ship ballast. There are reports that the Tolman iron property, north of Gold Hill, will be worked for ballast material, and it has been considered as a source of magnetite for sponge iron.

Gold

Gold operations were halted by the WPB order in October, 1942. However, prior to that time, most of the larger lode mines had discontinued production because of priority and labor problems. The several dredges also closed down.

Some of the gold operators have been getting into strategic mineral production but generally speaking, it is doubtful if the gold mine closing order has materially benefited the strategic minerals program. Men employed at the time of the closure were either too old to work in the larger mines in other areas, or they were not experienced in underground work. Often placer miners are prejudiced against work in underground mines. At the same time the order has worked considerable hardship on the small-mine operators, especially the placer miners who are limited to mining 100 yards of gravel a month.

Limestone

Southern Oregon limestones are noteworthy for their high calcium and low magnesium content. Many of the deposits are low in silica and analyses of 97 to 99 percent $CaCO_3$ are not uncommon. Washington Brick & Lime Company's quarry and kilns on Williams Creek have been producing high-grade chemical lime. Pacific Portland Cement Company's quarry on Marble Mountain has produced limestone for cement and paper mill use. Limestone was produced from the Beeman quarry on Kane Creek.

A much greater quantity of limestone should be used on Willamette Valley farms, and there is a shortage of industrial lime in the Portland area. Lower railroad freight rates out of Grants Pass would be a great stimulus to this industry.

Coal

Some interest was shown late in 1942 in the coal of the Medford area. Production was contemplated for Camp White use and to relieve the expected shortage of fuel, particularly fuel oil, for domestic use. The Camp White requirements called for a much larger output than could be obtained from the Medford coal properties. While the Medford coals are "dirty", beneficiation would produce a product that should have a local market, at least.

The Southport or Flannigan coal mine southeast of Marshfield was leased to the Loritan Investment Co. of which Paul Murphy, Oswego, is president. Production has been stepped-up to over 75 tons a day. A further large increase is planned. The coal is of sub-bituminous grade. The mine has been worked consistently on a small scale for many years.

Silica

The quartz quarry and silica plant of the Bristol Silica Company operated continuously throughout 1942 and so far in 1943. The rock is exceptionally pure silica and tests have shown its usability for metallurgical purposes. When quarried, it readily breaks into smaller sizes without excessive fines. Until recently, principal production has been for chicken grit, but shipments of metallurgical flux are increasing.

Clays

Use of brick in the construction of Camp White and Camp Adair has benefited the southern Oregon brick industry materially. In southern Oregon, the Klamath Falls Brick & Tile Co. has had a part in this production.

At Hobart Butte, Lane County, the Willamina Brick Co. quarried several hundred tons of refractory clay a month during 1942. The clay was shipped to Willamina for processing into fine brick. The U. S. Bureau of Mines is drilling this clay deposit to determine the quantity available for possible alumina manufacture. Similar drilling was done near Molalla, in Clackamas County, in the Ellis clay property. Department Bulletin No. 6, "Preliminary Report on some of the Refractory Clays of Western Oregon" by Hewitt Wilson and Ray C. Treasher, published in 1938, brought these deposits to the attention of the Bureau and formed the groundwork for the investigations.

Eastern Oregon

Chromite

The Seneca ore purchasing depot of the Metals Reserve Company received chromite shipments from several properties in the chromite area south of Canyon City during the 1942 season.

Both the U. S. Geological Survey and the U. S. Bureau of Mines made investigations in the area.

Anthony Brandenthaler made some shipments of chrome which were delivered at Baker and were sampled and assayed by the State Department analyst under an arrangement with Metals Reserve Co. One shipment was made of float material found at the Winterville Placers near Whitney. Another shipment was made by Brandenthaler from a chromite deposit near Unity.

Quicksilver

Horse Heaven Mines, Inc., in northeastern Jefferson County continued to operate throughout the year and is the second largest producer in the state. During the summer of 1942, geologists of the U. S. Geological Survey mapped the deposit and made recommendations for further exploration.

In the Ochocos, Crook County, Cinnabar Mines, Inc., which controls the Number One and Blue Ridge Mines, installed a Gould rotary furnace. Some quicksilver was produced but it was found necessary to carry on development work in order to get an additional ore supply. The No. 1 shaft was sunk an additional 62 feet from the 100-foot level and drifts are being extended from this shaft to get under the ore shoots which had been discovered in the Blue Ridge Mine and which had been reportedly only partially mined out. The drift easterly from the No. 1 shaft is reported to have encountered the expected ore shoot and to have found ore of anticipated grade. Ray Whiting is superintendent.

The Mother Lode Mine, owned by R.F.C. and leased to Gilkey Bros., was active during the summer and fall of 1942. Underground exploration was done and some surface ore concentrated in a log washer.

The Taylor Ranch Mine produced early in the year. Work was suspended because of the need for further exploration in order to get an ore supply. This property changed hands in the summer of 1942.

Eickemeyer Bros., owners of the Maury Mountain Mine, obtained an R.F.C. Class C mining loan and drove a development tunnel for the purpose of draining some old development openings. This work was designed to open new ground for mining.

In southeastern Oregon the Bradley Mining Co. continued to mine ore at the Bretz mine and to furnace it at the Opalite mine.

Antimony

The Gray Eagle (Kohler) mine, near Baker, has shipped a car of low-grade antimony ore to the Midvale Smelter, Utah, and a car of high-grade to the Texas M & S Co., Laredo, Texas. These are the first shipments for 1943. During 1942, twenty-five tons of high-grade was shipped to Texas and 105 tons of unsorted ore to Utah. Recent development has shown a substantial tonnage of milling-grade ore in sight and plans are being made for installation of a small mill. Engineers of the United States Bureau of Mines are expected to examine the property in the near future in order to study the feasibility of a drilling program, since there are good indications of additional ore shoots on the vein. The ore is chiefly antimony oxides. Operations are under the direction of Mr. Smith of Boulder, Colorado, who has acquired an interest in the property. Mr. Pat O'Brien, Baker, Oregon, is owner.

Some other stibnite occurrences are known, notably in the Anthony Lakes district, but there has been little or no recent activity in prospecting there.

Tungsten

Some prospecting was done for scheelite in the Cliff mines east of Baker.

The Department mapped the geology of the Chicken Creek locality (approximately 175 sq. miles) where small stringers of scheelite occur sparsely in the granite of the area and where scheelite is known to be present in the placer gravels of Chicken Creek, formerly placered for gold.

Copper

Diamond drilling of surface croppings above the old glory hole and active underground development is being pushed by Cooley Butler on the old Iron Dyke mine, copper producer, at Homestead, Oregon. The development tunnel has already intercepted the shaft which is being dewatered, and has penetrated the ore body beyond for considerable distance. Present plans include bringing the assay office and various pieces of additional equipment here from their mine, the Scotia, in Grass Valley, California. The Scotia, being a gold mine is now closed. If sufficient ore is developed at the Iron Dyke - and the prospects are encouraging to date - a new mill will be designed and built near the tunnel entrance at Homestead. Fred Kalenborn, geologist for the Butler interests, is in charge of the work.

The Carnahan copper property on the Snake River north of Homestead, was reported to have been investigated and that exploration was planned.

The area surrounding the junction of the Imnaha and Snake Rivers containing copper occurrences was investigated by the Department during the summer of 1942. The copper veins in this area are small and in general quite low-grade. A G.M.I. Short Paper describing the ore deposits will be issued by the Department in two or three months.

Gold and Silver

The few gold lode mines were affected by the War Production Board closing order, but in general priority regulations and lack of an adequate labor supply discouraged lode mining even before the order was issued. The largest dredge operations, however, were in eastern Oregon and the shutting down of these was a blow to several communities. The largest of these placer operations were the Sumpter Valley Dredging Company, Porter Bros. Dredging Company, the Sunshine Mining Company, Burnt River Division, and the Western Dredging Company. The Ellis Mining Company, with holdings consisting of several of the famous old gold mines in the Borne district, continued shipments of ore to the Tacoma smelter until snow closed the road. Shipments will be resumed when the snow conditions permit. The mine is allowed to operate because of the value to the smelter of shipments as siliceous flux.

The Oregon King mine in Jefferson County, operated throughout the year and shipped in carlots to the Tacoma smelter and the International smelter at Salt Lake City. The silver content of the ore is of greatest value, but gold is also important. The ore contains small amounts of lead and copper. A mill was built at the property in 1942. This property also is allowed to operate because of the value to the smelter of its ore as a siliceous flux.

Some leasers shipped a small amount of siliceous gold ore from the Cougar Independence mine near Granite.

Limestone

The Oregon Portland Cement Company quarry, at Lime in southern Baker County, operated at capacity throughout the year. Most of the output went into the manufacture of Portland cement, but some stone was used in the Willamette Valley as agricultural stone. Some 20,000 tons of high-grade material was shipped to the sugar mill at Nyssa, and about 10,000 tons was sold to the sugar mill at Nampa, Idaho. The Oregon Portland Cement Company has kilns both a Lime and at Oswego near Portland.

Diatomite

The only large operation for production of diatomite was at the quarry of the Oromite Company at Lower Bridge west of Terrebonne on the Deschutes River. This company ships a high-grade processed material used mainly as a filter-aid.

Pumice

Some shipments of lump pumice were made from deposits south of Bend. Pumice brick and tile, light-weight construction materials, were manufactured by two companies.

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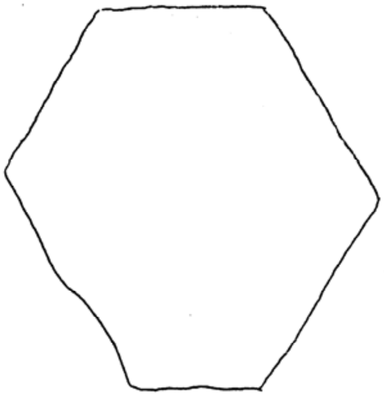
ROCK CRYSTAL WANTED

Quartz crystals as illustrated below are urgently needed by war defense industries for radio transmitters, optical instruments, etc. It is imperative that domestic sources be found as soon as possible.



1

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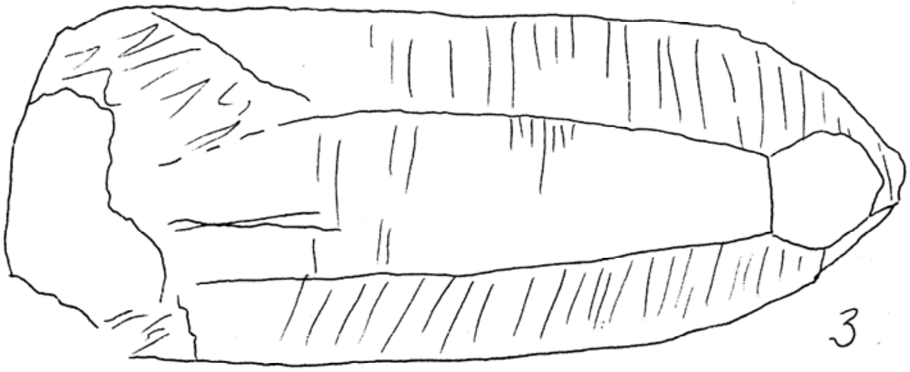

3

1. Section sawed from middle of crystal showing six-sided form.
2. Smallest size desired ($\frac{1}{2}$ pound). 3. Ideal size single crystal.

Material to be used must be perfectly transparent and free from flaws, fractures, inclusions and color, and not smaller than crystal No. 2. No. 3 crystal is an ideal size, but crystals much larger can be used. CAUTION! Even if crystals found are transparent, they still cannot be used unless they possess certain electrical and optical properties that can only be determined by laboratory tests. Colored crystals on the ground surface often indicate the presence of clear quartz underneath. If you find these crystals on your property, or know of property on which they are found in quantity, write at once giving full details. Two firms have been appointed by the Metals Reserve Co. as official agents for Oregon, and are equipped to test crystals for the qualities needed. They are:

(1) Radio Specialty Co., 403 NW 9th Ave., Portland (See Mr. Dillard or Ben Strohbach).
(2) Sentry Crystal Co., 206 W. Washington St., Portland (See Ray H. Rosenholm).

March, 1943 Portland, Oregon

STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES
Head Office: 702 Woodlark Bldg., Portland, Oregon

* * *

PILLOW-SHAKERS

Once I had a small dog. He was about three-quarters Boston bull, one-quarter mystery spaniel, one-quarter "coon dog", and the rest just pooch. He was the most playful, the cutest, cunningest, and the most worthless piece of brindle dog flesh that ever buried a bone, - and how we loved him! He didn't have any unusual habits, at least none for which he was well-known, affectionately or otherwise, in the community. I always hoped that he would some day pluck an errant two-year-old out of the wading pool in the park, or get bitten by a newspaperman, or in some manner become the hero of an episode sufficiently outstanding to mark him as a dog apart; but he always seemed to be in the wrong place at the right time.

But there was one thing in which this particular canine really excelled. He would take some limp object - we soon fixed up a small burlap and rag pillow - and just shake the hell out of it. He would go 'round and 'round and growl and take on, and really put on a show. The larger the audience at these impromptu performances, the greater the amount of vigor and feeling that was put forth by the lone actor. And the act usually continued as long as the audience cared to watch. As our attention died down, pooch's enthusiasm would wane; but he would keep a weather eye for a new-comer or some evidence of renewed attention. Either would set the dog off on another hysterical round of shaking the daylights out of the rag pillow.

There was always an element of uncertainty about these dog shows that added zest to such occasion. At the height of each of these paroxysms of pillow punishing, the dog would let go his hold in some manner and the pillow would go sailing off in some unpredictable direction. There was the time when the missile struck Aunt Jennie in the face and she all but swallowed her new teeth. Then, there was the evening the new Methodist preacher came up from the valley. The Reverend was squatting on his heels in the living room egging the dog on during one of the latter's most ferocious rag sessions when the pillow let go and smacked his reverence right in the noodle. It caught him off balance and right in front of the big, pot-bellied stove. As he toppled, the red-hot bowl of the stove seared the Reverend's back side and he howled like a banshee. There was the odor of singed serge and scorched preacher as he did a sitting broad jump that took him halfway to the kitchen sink where he sat himself in a big basin of water that someone had conveniently left. I'll always thank that dog for showing one man how to be himself.

Now, there are just a lot of people who go through life as "pillow-shakers". You'd be surprised how many there are, right now, even in this terribly serious war emergency. They're in the shipyards, the mines, the big industries, and especially in the distended personnels of the many Federal agencies. The "shakers" tie into a job and just shake hell out of it.

When it begins to get old, they cool off and slow down, until they remember that payday is coming, or the boss may be looking, then they grab the job in their teeth and start growling and bustling around and putting on a show again. They are ostensibly occupied with something, and that is as far as their thought on the matter goes. A dog's shaking the guts out of a rag pillow never gets the dog anything but exercise, because there's nothing constructive about shaking a pillow. The pillow comes out of the ordeal at best no better than it went in, so all the energy was wasted. That's pretty much the case with a lot of people. Some even have good intentions, and all the vigor in the world, and their show is always put on when the audience is largest, but we have never heard of a worker of that kind building a better mouse trap. God knows we need good mouse traps built in this war emergency.

E.K.N.

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COLUMBIUM AND TANTALUM

Introduction

The twins, columbium and tantalum, are very similar, especially in their geologic associations and in most of their chemical characteristics. Columbium, however, has a specific gravity only half that of tantalum (8.4 as against 16.6), melts at a temperature several hundred degrees below tantalum, and is more easily worked (more malleable and ductile) than tantalum.

Discovery

In 1801, C. Hatchett discovered a new element in an ore which had been sent to England more than one hundred years before by John Winthrop, first governor of Connecticut. It was named columbium after Columbia, the poetic name of America; and the mineral was called columbite. Tantalum was identified the following year by A. G. Ekeberg in some Finnish minerals resembling columbite. The name comes from Tantalus of Grecian mythology, because of the tantalizing difficulties encountered in dissolving the mineral in acids. Two similar elements were noticed by H. Ross (1844) in a German sample of columbite; one corresponded with the tantalum of Ekeberg; the other was called niobium after Niobe, the mythical daughter of Tantalus, Hatchett's columbium was evidently a mixture of these two elements.

Tantalum has preserved its individuality. Columbium and niobium are now considered synonymous, the former the generally accepted term, although the latter is preferred in Germany.

Occurrence

Commercially, columbium and tantalum are derived almost entirely from columbite and tantalite - columbate and tantalate of iron and manganese, both having the type formula $(Fe,Mn)(Cb,Ta)_2O_6$. The two elements occur also as minor constituents in several minerals, especially in association with the rare earths. These two minerals almost always occur together in an isomorphous series, sometimes one predominating, sometimes the other. The purest columbite comes from Nigeria, which long has supplied the United States with the major part of its needs. The best tantalite is found in the Pilbarra district of Western Australia, where concentrates containing up to 80 percent Ta_2O_5 (averaging about 65 percent) and less than 10 percent Cb_2O_5 have been obtained. Deposits have been uncovered in Belgian Congo bearing somewhat more tantalum than the Nigerian product. The Black Hills in South Dakota have produced intermittently since 1904, the concentrates containing up to 40 percent Ta_2O_5.

Columbite and tantalite are known to occur only in granites and pegmatite veins, associated with quartz, microcline, albite, cassiterite, tourmaline, wolframite, mica, etc. Many mines are located in detrital material derived from this parent rock. In the Pilbarra district of Australia both the lode and the detritus are worked profitably.

The rarer columbium and tantalum minerals, as indicated by their known occurrences, are associated with columbite and tantalite and are found alone only very rarely and in extremely small quantities.

Mineralogy

Since the two minerals are end members of an isomorphous series, grading insensibly from columbite, the nearly pure columbate, on one end, to tantalite, the nearly pure tantalate, on the other, the physical properties are best considered as of one mineral with variations between the limits of the end members. The crystal system is orthorhombic. Twins are common, usually heart-shaped contact twins, but penetration twins are also found. The crystals are prismatic, often occurring as short, rectangular prisms with the three pinacoids prominent. Thin tabular crystals also occur. One cleavage is rather distinct, parallel to the front prism face. Another cleavage, parallel to the side prism face, and hence at right angles to the first cleavage, is less distinctly developed. Fracture is subconchoidal to uneven. The mineral is brittle, has a hardness of 6, and the specific gravity ranges from 5.3 to 7.3, increasing with the amount of tantalum. The luster may vary from sub-resinous to sub-metallic, sometimes being brilliant. The color is black, sometimes showing a brownish tone. The streak varies from dark red to black.

Other minerals which contain high percentages of columbium and tantalum and which may well be ores if found in sufficient quantities are:

(a) Pyrochlore, a columbate of the cerium metals, calcium and other bases, with titanium, thorium, fluorine. It is isometric and commonly shows octahedral cleavage. The hardness is 5 to 5.5 and the specific gravity is about 4.3. Its color is some shade of brown (reddish-brown to a blackish-brown); the luster is vitreous, resinous on a fracture surface.

(b) Fergusonite, a metacolumbate (and tantalate) of yttrium with erbium, cerium, uranium; also iron, calcium, etc. It is tetragonal, and the crystals are pyramidal or prismatic in habit. It is brittle, has a hardness of 5.5 to 6, and the specific gravity is generally about 5.8. It may diminish to 4.3 if hydrated. The color is brown-black and the streak is pale brown.

(c) Samarskite, a columbate and tantalate of iron, calcium, uranium oxide, etc., and the cerium and yttrium metals. It is orthorhombic, crystallizing in rectangular prisms with roughened faces. One cleavage parallel to the side prism face is imperfectly developed. The fracture is conchoidal. It, too, is brittle. The hardness is 5 to 6, the specific gravity 5.6 to 5.8. It has a vitreous to resinous luster, often splendent. The color is velvet black and the streak, dark reddish-brown.

Field identification of columbite and tantalite

The occurrence of columbite-tantalite in granites or pegmatites or in detrital material derived therefrom should serve as a lead toward identifying this mineral. Its rectangular, prismatic form, its high specific gravity, and the sub-metallic luster, often with irridescent surface, are distinctive. Wolframite and tourmaline are probably most likely to be confused with it, especially wolframite. Tourmaline is rhombohedral, also shows prismatic form, but the faces are strongly striated vertically and the crystals are often much rounded, almost barrel shaped. The specific gravity of tourmaline is not more than half that of columbite. Wolframite is monoclinic, but often occurs in crystal forms very similar to those of columbite-tantalite, both prismatic and tabular. The prismatic faces of wolframite, however, usually show vertical striations. Cleavage is less well developed in wolframite than in columbite-tantalite. The specific gravity of columbite-tantalite is lower than that of wolframite, but specimens especially rich in tantalum are heavy enough to be indistinguishable from wolframite.

Uses

The uses of these metals are chiefly the result of their extreme resistance to corrosion, their gas absorbing qualities, their hardness, and their high melting points.

Stainless steels bearing columbium can successfully withstand high temperatures. They are welded more easily and resist corrosion better than the ordinary stainless steels. Columbium in chrome steel reduces air hardening and the physical properties, especially impact strength, are stabilized. Metallic columbium is similar to tantalum but is more workable and ductile.

Tantalum has been used in spinnerets for rayon making machines because of its resistance to corrosion. An electrolytically formed tantalum oxide coats the tantalum metal, is almost diamond hard, and is equally resistant to corrosion. There is no apparent wear or distortion to the spinneret holes. Tantalum was once used for metallic filament lamps. It replaced the old carbon filaments, being more efficient, but in turn has been superseded by tungsten for the same reason. Tantalum is used in electrolytic rectifiers (battery chargers) because of its pronounced valve action. Tantalum wire will permit an electric current to flow in only one direction, thus changing alternating current to pulsating direct current. Because of its hardness and its resistance to corrosion, tantalum is suitable for use in laboratory apparatus, dishes, calorimeters, cathodes, spatulas, and in dental tools. The metal is said to be unaffected by any chemicals or antiseptics used in dentistry or surgery. However, at high temperatures it oxidizes too readily and becomes brittle. For this reason it has found only limited use.

One of the greatest uses of tantalum, and certainly the most strategic use at the present time, is for the filaments and grid wires in vacuum tubes, which are used in radio broadcasting and receiving, X-rays, etc. Its remarkable faculty for absorbing gas at high temperatures enables it to act as its own "getter." Its high melting point is another beneficial property. It has a tensile strength two and one half times that of platinum, and next to tungsten it possesses the highest melting point and the lowest vapor pressure of all metallic elements.

In general it should be said that the material most sought after is columbite with a very small content of tantalum and tantalite with a very small content of columbium.

Metallurgy

The columbite-tantalite is finely crushed and fused with potassium hydroxide, converting the tantalum and columbium into soluble tantalates and columbates. The melt is then leached with water and filtered. The solution is neutralized with hydrofluoric acid which changes the columbium and tantalum into double fluorides with potassium. The potassium-tantalum fluoride is precipitated. The columbium, in the form of potassium fluoxycolumbate, being twelve times as soluble as the tantalum compound, remains in solution.

To obtain tantalum metal, tantalic acid is precipitated from the double fluoride and ignited, giving the oxide. This oxide is then reduced "in vacuo" to give the metal. (Aluminum may be used for this reduction.)

Metallic columbium can be obtained from the molten potassium fluoxycolumbate by electrolysis.

Chemical Tests

The chemical tests for columbium and tantalum are quite difficult and advanced tests, such as are given in Scott's Standard Methods of Chemical Analysis, should be consulted for accurate analyses. Two methods for qualitative determinations are outlined below:

1. The powdered mineral is mixed with an excess of potassium pyrosulfate and the mixture is fused in a platinum loop. The crushed melt is digested with ten drops of a solution composed of 5 percent sulfuric acid and 1 percent tannic acid. The digested mixture is

filtered by means of a micro-centrifuge or a micro-filtering device. The residue ranges in color from yellow to orange. The color of the residue is determined by the proportion of the two elements in the original mineral.

2. To distinguish between wolframite and columbite and tantalite, fuse powdered mineral with ammonium hypophosphite. If the melt is blue, wolframite may be present. If the melt is colorless and contains fine black particles add concentrated hydrochloric acid, bring to boiling, and add a small piece of metallic tin. An intense blue color indicates the presence of Cb and Ta.

The most positive identification of columbium and tantalum is obtained by spectrographic analysis.

Markets

In 1939 imports of columbium ore into the United States were reported by the U. S. Bureau of Mines as 109,132 pounds, valued at $37,062, or approximately 34 cents a pound. Over the same period imports of tantalum ore amounted to 56,561 pounds, valued at $82,990, or approximately $1.47 a pound.

The refined metals are worth several dollars a pound. Tantalum is critically essential for war use and the War Production Board would be greatly interested in a supply of tantalite.

The Metals Reserve Co. has posted the following price schedule for tantalite ores F.O.B. New York:

Percentage of Ta_2O_5 Contained in Tantalite Ore	Price per Pound Ta_2O_5 Contained
40%	$1.25
41	1.30
42	1.35
43	1.40
44	1.45
45	1.50
46	1.55
47	1.60
48	1.65
49	1.70
50	1.75
51	1.79
52	1.83
53	1.87
54	1.91
55	1.95
56	1.99
57	2.03
58	2.07
59	2.11
60	2.15
61	2.19
62	2.23
63	2.27
64	2.31
65	2.35
66	2.40
67	2.45
68	2.50
69	2.55
70	2.60

Maximum SnO_2 - 3.00%
Maximum TiO_2 - 3.00%
Combined Ta_2O_5 plus Cb_2O_5 - 70% Minimum

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TECHNICAL METHODS OF ORE ANALYSIS, by Low, Weinig, Schoder.

J. Paul Fitzsimmons

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MINING NOTES

During 1942, James K. Remson, Grants Pass, mined chrome at his Cyclone Gap property, located in Del Norte County, California, just south of the Oregon line. This chrome was hauled to the Metals Reserve depot at Grants Pass and then shipped to Sacramento. As soon as road conditions permit, operations at Cyclone Gap will be resumed. The U. S. Forest Service built several miles of access road to this property in 1942.

Mr. W. E. Marrion, Coquille, Oregon, has been mining manganese ore at the McAdams property, located near the Coos-Curry county line, east of Langlois. This ore has been hauled to the Metals Reserve ore purchasing depot at Coquille. Operations are continuing, and shipments will be resumed during March.

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CLEARING HOUSE

76-CH Powell Creek Mining Co. - Leon C. Osteyee, secretary, 580 Market St., San Francisco, wishes to sell mine equipment consisting of 160-c.f.m. portable G-D compressor, drifter, stoper, 3/4 yd. mine car, blasting machine, blacksmith outfit, 8" galv. ventilator pipe, 2000 feet mine rails, 2000 feet of 3/4" and 1" iron pipe, ore sacks, and miscellaneous tools and mine appliances. These items are located at Williams, Oregon, about 20 miles from Grants Pass, nearest shipping point.

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77-CH For Sale: Sirocco dust collector and suction blower nearly new. For details write Walter Osborne, Pistol River, Oregon.

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"The shortages of raw materials and manpower in this country are such that we cannot expect to end the steel problem by simply increasing steel-making capacity until it is sufficient to provide for all possible uses. We must instead determine the amount of the various kinds of steel which we will need to win the war and then proceed to increase steel-making capacity to that amount. Consequently throughout the war we must expect to have less steel that we could profitably use and we must make sure that the steel which we have is allocated and used efficiently and skillfully."

- Senator Mead of New York in "Additional Report, Interim Report on Steel", (Report No. 10, Part 3).

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April, 1943 Portland, Oregon

STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES
Head Office: 702 Woodlark Bldg., Portland, Oregon

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HAS GOLD LOST USEFULNESS AS A MONEY METAL?

OUR OWN QUIZ PROGRAM

1. Is it true that over a period of years a program designed to belittle gold as a desirable money metal has been and is being carried out in certain quarters, both here and abroad?

2. Have the Axis countries been especially active in such a program?

3. Is it not true that skilful propaganda can mould public opinion so that economic laws and beneficial conditions are subordinated to political considerations?

4. Can a people be forced to accept any kind of money or currency by means of bayonets and the threat of concentration camps?

5. Would some other commodity other than gold have equal or better characteristics as a medium of exchange or backing for currency?

6. Would people have confidence in a theoretical "work unit of value" base for currency (as has been advocated)?

7. Is it not true that people in all parts of the world have an age-old confidence in gold as money?

8. Is it not true that gold possesses the essential qualities of scarcity, beauty, and indestructability required in money?

9. Is it not true that the immemorial instinct of people to treasure gold is even more important in determining its suitability for money than its physical and chemical properties?

10. Have United States forces found it essential to use gold in paying for services in North Africa?

11. Is it not true that gold is now selling at a premium price above $35 an ounce in various parts of the world - in some places at a high premium?

12. Is it not true that, in Portugal, gold coins command premiums ranging from 150 to 200 percent and in Turkey, premiums up to 400 percent?

13. Is it true that Russia demanded gold from Japan as the consideration in the recent agreement which allows Japan to fish in Russian waters?

14. Is it not true that paper currency, even U. S. paper currency, now sells in various foreign countries at a discount while gold is at a premium?

15. Are governments hoarding gold with the knowledge that if they allow free redemption of gold, the people would demand too much of it?

16. Have governments found a more convenient means other than transfer of gold to settle international balances?

17. Is it true that "barter" was used as the means for paying for goods and services in very ancient times because money had not been invented?

18. Is it true that "barter" is never used by nations in settling balances unless those nations have no gold other than a slim backing for their currency?

19. Is it not true that the pitifully small amount of gold possessed by the Confederacy was the principal cause of its inability to obtain European assistance which fact led to its subsequent defeat?

20. Is it not true that the discovery of gold in California and the large amount produced during the middle of the last century provided a gold reserve which maintained the Union's credit and was a major factor in bringing about victory?

21. Is it not true that the new wealth created in this country by the production of the large amount of gold during the last century was the impelling force behind the beginning of the great industrial expansion in this country?

22. Is confidence in a nation's money policy and economic stability the warp and the woof of the whole fabric of that nation's business?

23. Is it not true that in order to plan his enterprise with assurance a business man must have confidence that the value of the money which is used will not fluctuate?

24. Is the foundation of free enterprise in this country the complete confidence of its people in the value of its money based on gold?

25. Is it not true that the dollar based on gold has become the standard for world trade?

26. With such evidence does it appear that gold has lost any of its attraction as the most secure protection against inflation, poverty, and the government manipulation of currency?

27. Also, does it not follow that the gold miner may look forward confidently to a continuing and increased demand for his product after the war when currency will need to be stabilized, based on gold, in order to insure international commerce?

F.W.L.

STREAK TESTS

A technique for determining "available alumina" qualitatively is described in "Mineral Industries", issue of October, 1942, published by the School of Mineral Industries, Pennsylvania State College. The method is interesting because of its possible application in indicating the presence of various elements and minerals in rocks by relatively simple tests, once the procedure is determined. As stated in the article, which is reproduced below, the method is being studied in order to prove its applicability in testing different minerals.

New Tests for Essential Ores

Aluminum oxide is one of the most abundant constituents of the earth's crust and to the layman, it seems hard to believe that a shortage of this raw material vital for our defense efforts actually exists. The explanation for this apparent contradiction is that most minerals and rocks contain alumina in compounds from which it is difficult and uneconomical to separate the pure aluminum. From an economic point of view, all the mountains of granite or the vast deposits of clays are of little help in solving the problem of aluminum shortage.

Mining alumina ores is based on a different principle than mining the ores of gold, silver, copper, and iron. The value of these ores is nearly always determined by their metal content only. In the case of alumina, however, we are interested not only in the Al_2O_3 content but even more so in the availability of the alumina which the ores contain.

Certain alumin0-silicates like leucite contain the alumina in a form where it can be easily leached out by diluted acids. Others, such as certain clay minerals, require a calcining process after which the alumina becomes available.

Before this war, aluminum production in this country was based on bauxite as a raw material. Today, prospectors are combing the country looking for other minerals containing alumina in an easily available form. This search, however, is extremely difficult. Very little information is available as to which of the minerals do contain the aluminum oxide in a form sufficiently reactive for extraction. On the other hand, minerals of this type are scattered in pockets among other similar minerals which, from the viewpoint of aluminum production, are practically worthless.

The valuable minerals do not possess characteristic properties such as density, cleavage, or color which would make them recognizable. The common "Streak Test", which for many ores has proved a valuable tool, is not significant, for even if the minerals do possess color this is more or less accidental and may be caused by impurities such as limonite or other accessory minerals. The search for suitable minerals, therefore, is seriously hampered at the present time, as only careful chemical analysis can answer the question of the value of a newly discovered deposit, and such analytical work consumes much time and man power.

It has been found that the "Streak Test", by which a streak, or scratch is made with the mineral on a hard unglazed porcelain plate, can be developed into a useful tool for recognizing and distinguishing colorless minerals. The new method consists of a process similar to the development of a photographic plate which contains a picture in a latent form. By immersing the plate in certain chemicals, the part which has been exposed to light becomes visible. A similar method of immersing the porcelain plate, which has on it the invisible streaks of the ore, into various chemicals has been developed. Here, those streaks which contain alumina in reactive or available form assume colors, whereas, other minerals containing the same or even a higher amount of alumina in a less reactive form remain invisible after the chemical has been washed away. The sodium salt of the alizarine sulfonic acid reacts with alumina, making the colorless streak visible. This alumina reagent however, reacts, too, with iron ores so that only alumina compounds which are relatively free from iron can be detected. The use of a morine solution causes the aluminous streak to assume a light yellow color which emits a green fluorescence when examined under filtered ultraviolet light.

For carrying out the test, well vitrified hexagonal floor tiles have been used as streak plates. Less vitrified ceramic bodies, certain wall tile, for instance, could not be used for it still contains reactive alumina from the decomposition of the clay from which it was made and consequently gives a positive test on its own account. Streak marks are made upon numbered sections of the tile with different minerals. The sample is then immersed, for instance, in the 0.4% solution of morine in alcohol and allowed to soak for two minutes. After the removal from the developer-bath the streak plate is washed with water and the excess of the reagent is removed. In case a reaction has taken place the streak is now clearly visible either in daylight or in the filtered light of an ultraviolet light source.

The method of developing a colorless streak has a wide field of application. Lead ores and zinc ores can be easily recognized and distinguished by a proper choice of chemicals. The magnesium content of a limestone or the distinction between limestone and dolomite offers no difficulty when a solution of Titan-Yellow is used for developing the magnesia. This method, even after the first preliminary experiments, has already indicated its usefulness for prospectors and D. E. Roudabush, a senior student in the curriculum in ceramics is now studying its applicability to different minerals as his senior thesis.

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Tourmaline, Rhodonite, and Scheelite Wanted

The Foote Mineral Co., 1609 Summer St., Philadelphia, is in the market for Tourmaline and Rhodonite in carlots, and would buy high-grade scheelite in small lots at a premium if specifications can be met.

Following are the respective specifications:

Tourmaline

Silica	(SiO_2)	Minimum	35%
Alumina	(Al_2O_3)	"	35%
Magnesia	(MgO)	"	6%
Boron oxide	(B_2O_3)	"	8%
Iron oxide	(FeO)	"	10%

Rhodonite

Manganese	(Mn)	(Approximately)	30%
Silica	(SiO_2)	"	30%
Sulphur	(S)	less than	0.1%

Scheelite

Tungsten Trioxide		68 to 70%
Arsenic	Maximum	0.01%
Molybdenum	"	0.05%
Sulphur	"	1.00%
Phosphorus	"	0.10%
Copper	"	0.01%
Tin		Trace
Antimony		Trace

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MAGNESIUM METAL

Production of light metals and light metal alloys is being expanded rapidly but the demand is huge compared to former peacetime markets. Whether or not postwar demand for the light metals will be sufficient to take care of the output geared to war production is problematical, but it seems reasonably sure that postwar needs will be greatly in excess of prewar output. Undoubtedly air transport will be used on a constantly increasing scale; and production of aircraft means production of the light metals, aluminum and magnesium.

Sources of aluminum other than bauxite are now being sought and studied. Unlimited sources of magnesium exist in this country in sea water, in underground brines, in magnesite, brucite, dolomite, and high magnesia silicates. All of these various materials are presently being utilized for the production of metallic magnesium except the last. The reason that the silicate has been relatively neglected is because the separation of magnesia from the silicate on a commercial scale would appear to be the most costly. The high magnesia silicates, however, offer certain advantages since they are known to occur in immense deposits, favorably located as regards transportation and power; and in addition olivine, the principal mineral of peridotite and dunite, contains a higher percentage of magnesium than any common natural material except brucite.

Experimental work on treatment of olivine to produce magnesium chloride has been done at the Minerals Testing Laboratory of the Tennessee Valley Authority, Norris, Tennessee, and at the State Experiment Station, Georgia School of Technology, Atlanta, Georgia. Some of this work is described by E. C. Houston and H. S. Rankin in Mining Technology, July, 1942, published by the American Institute of Mining and Metallurgical Engineers. The principal part of the paper is devoted to a description of the treatment of olivine by hydrochloric acid to produce magnesium chloride of suitable purity for electrolysis. The acid may be made from the chlorine obtained by electrolyzing the chloride. Purification of the leach solution by magnesia or magnesium hydroxide is discussed.

The experimental results indicated that olivine could be converted to magnesium chloride at low cost, but pilot plant work is always required in order to obtain information required to evaluate a process for commercial use. It is understood that considerable pilot plant work has been done since the paper was published.

In southern Douglas County, Oregon, particularly in the Nickel Mountain region, there are great masses of peridotite and serpentine containing between 40 and 45 percent magnesium oxide. This region is penetrated by the Southern Pacific Railroad and is tributary to Bonneville Power, assuming that a sufficient power market could be shown.

The location of a plant for production of magnesium or magnesium salts under postwar conditions would be based on economics, in which geography, power supply, market, and unit cost of production all would be weighed. It is logical to assume that favorably located high magnesia silicates will be given due consideration because of their relatively high magnesia content. The experimental work referred to was undertaken as a study of feasibility of commercial operation under peacetime conditions, rather than for wartime emergency demands.

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Oregon Chromite Sand Separator

Not Custom Plant

Some misapprehension exists concerning the Defense Plant Corporation separator plant which is under construction northwest of Coquille. The plant is designed to treat concentrates produced by the Krome Corporation and the Humphreys Gold Corporation, and will not under present plans of the management at least, accept custom material. Any prospective producer of chromite sand should communicate with the Metals Reserve Co., Washington, D. C. and should not attempt to deliver material to the separator plant near Coquille.

BRITAIN NEEDS SILVER

The following extract from the American Mining Congress Bulletin Service of April 16, 1943, is evidence of the critical need for silver in war industry. It is also a commentary on efforts which have been made to upset the domestic silver purchase program in order to reduce the Government price.

> "Lend Lease Silver: A memorandum covering a proposal to lend-lease silver to Great Britain, submitted by E.R.Stettinius, Jr., Lend-Lease Administrator, was viewed with "grave apprehension" this week by Senator Pat McCarran of Nevada. Announcement was made that the Senate Special Silver Committee will call upon the Treasury, Metals Reserve Company, Lend-Lease Administration and other government agencies for "substantial factual data" on the lend-lease proposal and the world silver situation. Particular comment was made concerning the statement in the memorandum that the Metals Reserve Company now has only 2.6 million ounces of silver in its stockpile, whereas very recently the amount was reported to be approximately 10 million ounces.
>
> "The text of the memorandum is as follows:
>
> "'1. It is proposed that about 3¼ million ounces of free silver from the Treasury stock be lend-leased to Great Britain.
>
> "'2. The British have stated that they urgently need a total of 5 million ounces of silver by the first of June. Two million ounces of this silver are needed early in April.
>
> "'3. The Treasury has certified that the British request for silver is a reasonable one. One-third of the silver is needed for essential war industry requirements and two-thirds for coinage (domestic and overseas).
>
> "'4. Mr. Batt, of the Combined Raw Materials Board, has stated that not more than 1-3/4 million ounces can be obtained from Canada and that the remaining 3¼ million ounces must come from the United States or Mexico.
>
> "'5. The position of the War Production Board is that the newly-mined silver situation, domestic, and foreign, is too tight to permit the United States or Mexico to furnish 3¼ million ounces of such silver to Great Britain. Metals Reserve Company has a stockpile of silver of only 2.6 million ounces.
>
> "'6. Treasury free silver not committed to the Defense Plant Corporation for non-consumptive domestic uses is needed by the Treasury for future domestic coinage needs.
>
> "'7. According to the War Production Board not all of the billion ounces of Treasury free silver committed to the Defense Plant Corporation is tied up, and sufficient silver is available to meet the British request.
>
> "'8. Metals Reserve will make 2 million ounces of silver available from its stockpile of silver within 30 days provided that it is assured that the silver will be replaced from silver subsequently obtained for lend-lease purposes.
>
> "'9. The British are willing to agree to return an equivalent number of ounces of silver at the end of the war.'"

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STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES
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TWO PROSPECTORS

The old time type of prospector who packed his singlejack, steel, pick, and muckstick, his bacon and beans, and his box of powder on a couple of burros and went into the mountains or desert to find a Goldfield, a Tonapah, or a Cripple Creek, is becoming extinct. That sort of prospecting meant back-breaking work, hardship and privation, but all these were accepted as a matter of course by this hardy soul. He wanted wealth, yes, but that was really secondary. He was obsessed primarily with the passion to discover a rich vein of ore, and the joy of discovery was the impelling force behind his search.

Only a person who has dug into a bunch of high-grade ore on his own can fully appreciate the motive force behind the prospector's search, or the intense satisfaction of accomplishment in his very rare successes. Bear in mind that we are describing the real prospector, not the bogus variety who did and does his prospecting in town, in hotel lobbies and in drink emporiums.

If you ever knew one of the old time prospectors, you knew a real, one hundred-percent individualist. He wanted no part of sham or deceit in his discoveries. He sometimes made mistakes in his judgment of mineral deposits and perhaps passed up valuable ones. He may have located and worked unprofitable deposits, but he worked the ground and not the public. He did his best to find a real mine and to make it pay.

In searching mountains and deserts for something real, something that would stand squarely on its own unassailable merit, he was sadly old-fashioned in his technique. If he had realized the value of publicity, his life work would have been so much easier. He needn't have toiled in the hills with a pick and shovel or battled the heat of the desert, or the snow of the mountains. The alternative would have been as sure then as it is now. Of course, in the old days he didn't have the radio and, of course, too he didn't know about lithium, beryllium, gallium, tantalum, columbium, ruthenium, zirconium, and other rare and somewhat mysterious elements now in great demand for war use. But he could have made out with gold, silver, and copper if he had only known the proper technique.

What he needed was a publicity agent.

For anyone who wishes to use the new prospecting method, the outline of procedure is simple. Variations in the method may be made according to the personal predilection of the "prospector" for some particular element, but it must be one in which the domestic supply is deficient. Preferably it should be one which is quite uncommon if not decidedly rare. Also the element should be relatively difficult to analyze.

The element is selected, the location, preferably rather inaccessible, is determined and the "discovery" is made. Some gullible person who has an entré into a newspaper office and likes to see his name in print is allowed to "scoop" the story. It would be well to promise him some share in the "discovery" so that his interest will not be altogether altruistic. Now the stage is set.

The newspaper announcement is made that an enormous new deposit of "promethium", or element "x", or U-237 is found in a not too definite locality. Minerals are the life-blood of war production and this is news because of its relation to the war. Modesty is out of place in the statements of metal content and size of deposit. The bigger and richer the better, and the more "newsy" it is. Radio commentators who are always hungry for something startling to announce will seize upon the news item and the deed is done. Almost instantaneously people in San Francisco, Denver, New York, and Washington, in fact every city and hamlet, read and hear the news. It goes without saying a great many of them, even if they don't know the difference between "promethium" and Betelgeuse, will believe the story and the "discoverer" becomes a personage. People in far off places hear his name. He becomes front page stuff and may even get his picture in LIFE.

In the subsequent interviews, there should be hints of the insidious work of the "promethium trust" which is trying to block efforts to get the much-needed "promethium" onto the market. Also there should be included hints of the successful machinations of the "trust" in buying Federal and State agencies who have to do with investigating such deposits. It can be averred that the trust and said agencies do not care if we lose the war so long as they can prevent the "promethium" from breaking their market control.

The "discoverer" is safe for a long while from the natural pointed inquiries as to why production from such a rich deposit is not started in order to supply Government needs, because people will be indignant at the "trust" and will not analyze the whys and the wherefores too closely. If a radio commentator or a magazine or both can be interested to go to bat in assailing the "trust" and its tools - and this is not difficult - the "discoverer" will ride the wave.

It takes time, money, and hard work to check on statements having to do with evaluation of mineral deposits, and as long as the public interest can be held, it is perfectly safe to make any claims.

The procedure looks "fool proof" but care should be exercised. If two or three "prospectors" succeed in making their "discoveries" at the same time, there will be too much competition for publicity and efforts may fail of that blight of publicity - monotony. That is the pitfall to be avoided. Specifically a certain quantity of gas will keep one balloon in the air, but if that same amount of gas is used for two or three balloons, they cannot get off the ground.

But, in any case, one effect seems assured. A certain "kick" may be derived from the technique, for after reading and telling about the discovery for a while, the "discoverer" begins to believe the story himself.

Any resemblance of persons or situations in this article to persons living or dead, or situations past or present, is, of course, purely coincidental. F.W.L.

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SUSPENSION ANNUAL ASSESSMENT WORK

H. R. 2370, approved by the President, May 3, 1943, suspends annual assessment work on mining claims in the United States and Alaska for the duration of the war. A claim owner is required to file an annual notice of his desire to hold his claims with the county recorder of the county in which his claim is located. There is no limitation placed on the number of claims, either lode or placer, to which exemption of assessment work may apply. It should be noticed that "desire to hold" should be filed each year.

THE RARE ALKALIES

Introduction

The elements lithium (Li), rubidium (Rb), and caesium (Cs) together with the elements sodium (Na) and potassium (K) form a group called the alkali metals. They show a remarkable affinity for oxygen and do not occur in nature in the metallic state. All of these elements are silvery-white metals and are soft enough to cut with a knife. They tarnish rapidly in air and decompose water, some of them violently, at ordinary temperatures. Rubidium and caesium oxidize spontaneously if placed in dry oxygen at room temperature and this property is utilized in certain types of vacuum tubes. Lithium, rubidium, and caesium are classed as "rare alkalies" because they occur less abundantly than sodium and potassium.

Lithium is the lightest of all metals and caesium is the most electro-positive of all the elements. Many of the properties of lithium more closely resemble those of magnesium than the properties of the other members of the alkali group. This is particularly true with respect to the facility of lithium in forming alloys with a number of other metals. Rubidium salts are absorbed from the soils by plants but rubidium cannot replace potassium in the plants. Plants do not absorb caesium, in fact, caesium acts as a vegetable poison.

The demand for the rare alkalies, particularly lithium, has risen sharply in the past few months and additional supplies of these minerals are needed. It is hoped that new sources will be found as the need for these elements becomes more generally recognized.

Discovery

LITHIUM was discovered by Arfvedson in 1817 while analyzing the mineral petalite. Arfvedson determined 5.76% lithia (lithium oxide, Li_2O) in petalite and also found 8.85% lithia in spodumene, and 4.30% lithia in lepidolite. At about the same time Berzelius showed that rubellite (pink or red tourmaline) contained lithium but black tourmaline did not. The name lithium is derived from the Greek, litheos, meaning stony, because it was believed that the presence of this element was confined to the mineral kingdom. It has since been found, however, not only in the mineral kingdom, but in the vegetable and animal kingdoms also. Metallic lithium was isolated by Bunsen and Mattheissen in 1855 by the electrolysis of the fused chloride.

RUBIDIUM AND CAESIUM were the first two elements to be discovered by means of the spectroscope. Bunsen and Kirchoff (1860) while investigating the mineral waters of Durkheim evaporated about 40 tons of water and studied the concentrate, using a spectroscope. They noticed two blue spectral lines not produced by any other known element. The name caesium from the Latin, caesius, meaning the blue of the sky, was given to the element producing these two spectral lines. Later these two investigators obtained the spectrum of an extract obtained from a sample of lepidolite and noticed two violet spectral lines not previously recorded. The element that produced these spectral lines was named rubidium from the Latin, rubidus, meaning darkest red. Compounds of these two elements are so like those of potassium that they cannot be distinguished from that element by ordinary tests. The most satisfactory means of detecting rubidium and caesium is by spectrum analysis. Metallic rubidium was first prepared by heating an intimate mixture of the carbonate with finely divided carbon. Metallic caesium was first prepared by heating the hydroxide with magnesium.

Mineralogical Occurrence

The habitat of the rare alkalies is usually pegmatitic minerals. Pegmatites are usually found where granites are not deeply eroded. Many pegmatites contain rare alkalies but the distribution of the rare alkali minerals is sporadic.

LITHIUM occurs in nature more abundantly than rubidium and caesium. Although lithium minerals are relatively rare, lithium is rather widely distributed in small amounts. It occurs in appreciable amounts only in a few minerals. L. Dieulafait lists 140 minerals containing lithium in Compt. rend. 98. 1545, 1884. Traces of lithium are found in milk, human blood, muscular tissue, soil, some plants (tobacco, seaweed, cocoa, coffee, sugar cane, etc.), certain mineral springs, seawater, and some meteorites. A list of minerals which contain lithium should include the following:

Mineral Name	Composition	Lithia (Li_2O) Content
Lepidolite	$KLi\ (Al(OH,F)_2)\ Al(SiO_3)_3$	4 - 6%
Petalite (Castorite)	$Li_2O \cdot Al_2O_3 \cdot 8SiO_2$.	2 - 5%
Spodumene	$Li_2O \cdot Al_2O_3 \cdot 4SiO_2$(traces Rb,Cs).	4 - 8%
Zinnwaldite	$(K,Li)_3FeAl_3Si_5O_{16}(OH,F)_2$	3 - 4%
Cryophyllite	$(LiNaK)_{16}F_{16}Al_4Si_{16}O_{43}$.	4 - 5%
Cryolithionite	$Li_3Na_3Al_2F_{12}$.	5 - 6%
Sikerite	Complex silicate.	3 - 4%
Irvingite	Complex silicate.	4 - 5%
Polylithionite	$(LiNaK)_{16}Fe_6Al_4Si_{16}O_{43}$.	9%
Beryl	$Be_3Al_2(SiO_3)_6$	0 - 1%
Triphylite	$Li(Fe,Mn)PO_4$.	8 - 9%
Lithiophilite	$Li(Mn,Fe)PO_4$.	8 - 9%
Amblygonite	$Li(AlF)PO_4$.	8 -10%
Natramblygonite	$Na,Al(OH)PO_4$.	3 - 4%
Rabenglimmer	Form of zinnwaldite	3%
Microcline	$K_2O \cdot Al_2O_3 \cdot 6SiO_2$	traces by replacement
Colored tourmalines	$4H_2O \cdot 2(Na,Li)_2O \cdot 3B_2O_3 \cdot 8Al_2O_3 \cdot 12SiO_2$	up to 2%
Cookeite	Hydrated lithium mica	up to 4%
Protolithionite	Lithium, iron mica.	up to 4%

Small amounts of lithium are found also in epidote, muscovite, orthoclase, and psilomelane.

RUBIDIUM AND CAESIUM occur together in some lepidolites, carnallite, certain mineral waters and as a trace element in a number of minerals. Rubidium salts are widely distributed in small amounts in substances such as ashes of beet-root, coffee, tea, oak and beech, in crude tartar, potashes, and mother-liquor from some potassium salt works. Caesium minerals and salts are less widely distributed than those of rubidium but traces of caesium are usually found in minerals which contain rubidium. An important source of rubidium is in the mother-liquor remaining after the extraction of potassium chloride (KCl) from carnallite. A list of minerals containing rubidium or caesium should include the following (in addition to lepidolite, spodumene, tourmaline, microcline, and beryl given under lithium minerals):

Mineral Name	Composition	Rubidia (Rb_2O) or Caesia (Cs_2O) Content
Leucite	$KAl(SiO_3)_2$.	traces of Rb_2O
Triphylite	$Li(Fe,Mn)PO_4$.	" " "
Lithiophilite	$Li(Mn,Fe)PO_4$.	" " "
Carnallite	$KMgCl_3 \cdot 6H_2O$	" " "
Mica and Orthoclase		" " "
Petalite	$Li_2O \cdot Al_2O_3 \cdot 8SiO_2$.	contain traces Rb_2O and Cs_2O
Rhodozite	$R_2O \cdot 2Al_2O_3 \cdot 3B_2O_3$.	R=K with some Rb and Cs replacement
Biotite	$(H,K)_2(Mg,Fe)_2Al_2Si_3O_{12}$	Cs and Rb occasionally replace K
Pollucite	$H_2Cs_4Al_4(SiO_3)_9$	31 - 37% Cs_2O
Pollux	$H_2O \cdot (Cs,Na)_2O \cdot Al_2O_3 \cdot 5SiO_2$	34% Cs_2O

LOCALITIES. Minerals containing the rare alkalies have been found in Maine, California, South Dakota, North Carolina, Oregon, Massachusetts, Connecticut, New Mexico, Colorado, Wyoming, Missouri, and Virginia. Due to difficulty of analysis of rare alkalies it is probable that a number of occurrences have not been recognized.

Chemistry of Recovory

LITHIUM salts are usually extracted from lithium minerals by any one of a number of processes depending upon the mineral source. Most lithium ores are mined selectively from workings at or near the surface, and are brought to commercial grade by hand sorting. Some lithium ores have been concentrated by froth flotation. Lithium chloride may be obtained directly by heating spodumene with a calculated quantity of lime and calcium chloride. Another chlorination process yields portland cement clinker and lithium chloride fume which is recovered in a Cottrell precipitator. Lepidolite has been successfully chlorinated by treatment with gaseous hydrogen chloride at about 935° C. for 13 hours. Two older, laboratory methods of obtaining lithium salts from the minerals are as follows: (a) The finely-powdered mineral is digested with hydrochloric or sulfuric acid and the solution is evaporated to eliminate the silica. Water is added and a calculated amount of sodium carbonate is added to the solution obtained by filtration to remove the iron, alumina, magnesia, etc. After filtering, the solution is concentrated by evaporation; excess of sodium carbonate is added, and lithium carbonate precipitates as it is only sparingly soluble in water. (b) Another procedure is to fuse the mineral with a mixture of barium carbonate and barium sulfate. The fusion mixture is taken up in water, filtered, and when barium chloride is added a precipitate forms. The precipitate and solution are evaporated to dryness. The dried residue contains the chlorides of the alkali metals present. When a mixture of absolute alcohol and ether is added to the dried chlorides, lithium chloride alone dissolves. Metallic lithium is obtained by the electrolysis of the fused chloride or by electrolysis of lithium bromide containing 10 percent of lithium chloride.

RUBIDIUM AND CAESIUM are usually extracted from minerals together. These two elements can be recovered from a silicate by the following procedure: The mineral is heated with a mixture of calcium carbonate and ammonium chloride, and the fused mass is cooled and extracted with water. The liquid is then evaporated to a small volume, and sulfuric acid is added to precipitate the calcium as the sulfate. After filtration, evaporation is continued until the greater part of the hydrochloric acid has been expelled. Sodium or ammonium carbonate is then added to complete the removal of the calcium salt. Upon the addition of chloroplatinic acid the caesium and rubidium are precipitated as the salts of that acid. By the action of hydrogen upon these salts the platinum is precipitated, while the caesium and rubidium chlorides are left in solution. Rubidium and caesium may be separated from the other alkalies and from each other by utilizing the different solubilities of the chloroplatinates, the chlorostannates, and of the alums.

Caesium and rubidium may also be separated from each other by employing the difference in solubilities of their carbonates in alcohol. Caesium carbonate is soluble in alcohol while rubidium carbonate is practically insoluble. Caesium can be separated from rubidium by treatment with antimony trichloride. The caesium salt $2CsClSbCl_3$ is precipitated while the corresponding rubidium salt is soluble in water. Metallic rubidium may be obtained by (1) heating the charred tartrates to a white heat; (2) by reducing the hydroxide or the carbonate with magnesium; (3) by reducing the hydroxide with aluminum; (4) by heating the chloride with calcium. Metallic caesium may be prepared by (1) heating caesium hydroxide with aluminum to redness in a nickel retort; (2) by heating caesium hydroxide with magnesium in a current of hydrogen; (3) by heating caesium carbonate with magnesium in a current of hydrogen; (4) by heating the chloride with calcium.

Uses

LITHIUM. The powerful fluxing action of lithia is one of the reasons for the use of lithium minerals and compounds in ceramics. The addition of certain minerals and compounds containing lithium lowers their fusion point, increases the fluidity, and decreases heating time and costs of ceramic batches. Shrinkage is neutralized and some of the qualities of the finished products are improved. Certain types of glass containing lithium possess the property of being transparent to ultraviolet and x-rays. Other lithia glasses have highly desirable optical characteristics. Synthetic lithium fluoride crystals have important optical properties.

Lithium forms important alloys with aluminum, magnesium, copper and other metals except those in the iron group. Lithium alloys are used as degasifiers in the manufacture of many alloys such as high-conductivity bronzes, copper-chrome-lithium alloys, copper castings, cast iron, and steel. The purified alloys thus obtained have superior qualities to similar alloys not degasified by the lithium alloys. The two most important of these degasifiers are 50-50 lithium-calcium and 98-2 copper-lithium.

Saturated solutions of lithium chloride are utilized in air conditioning and industrial drying plants where the removal of dust, odors, water vapor and other gases is required. A method for the purification of helium is based on the affinity of lithium for nitrogen.

In the chemical industry, lithium or lithium compounds are used in medicines and dental cements; for treating citrus fruits; for the treatment of cloth and paper; in the manufacture of luminous paint, photographic paper, and pyrotechnics; in curing meat; as an insecticide, in beverages, and as a constituent in special lubricants.

RUBIDIUM AND CAESIUM have rather limited use at the present time. Either rubidium or caesium is the active element in one type of photo-electric cell and both of the elements are used in various types of vacuum tubes where it is important that the last trace of oxygen gas be removed from the atmosphere inside the tube.

Identification

The three rare alkalies can be easily identified by means of their characteristic spectra. Each produces lines in the visible region of the spectrum and a spectroscope may be used, but for the identification of traces it is necessary to employ a spectrograph and utilize the red end of the spectrum beyond the visible range. For best results using a spectroscope it is desirable to convert these elements into chlorides before testing.

LITHIUM. The flame test method may be used to detect the presence of lithium in minerals and compounds. Both lithium and strontium color the flame crimson but the color due to lithium is not as persistent. A few drops of barium chloride added to the lithium salt in solution and tested in the flame gives successively the crimson due to lithium, green due to barium and then crimson due to strontium. Powdered gypsum should be added to the silicates in order to make the test. Lithium minerals do not become alkaline upon ignition, as do strontium minerals.[1]

Production

DOMESTIC PRODUCTION of lithium began in 1898 in South Dakota, and according to the U.S. Bureau of Mines the total domestic production through 1940 was about 77,000 tons valued at $1,400,000. The three states South Dakota, California, and New Mexico supplied most of this production. Of this total production about 30 percent was spodumene, 10 percent amblygonite and 60 percent lepidolite. In 1938 dilithium sodium phosphate (Li_2NaPO_4) production was started at Searles Lake. This compound was recovered from the brines and the lithia content of these compounds reached as much as 20 percent. This source has provided nearly half the raw lithium product needed for refined lithium salts in recent years.

WORLD PRODUCTION. The United States produces more than 50 percent of the world output of lithium ores. Southwestern Africa, Australia, Sweden, and Germany produce most of the remainder, and Canada, Portugal, Southern Rhodesia, and Spain contribute minor quantities. Commercial lithium deposits have been reported in India, Brazil, Madagascar and Russia.

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[1] U.S. Bureau of Mines Information Circular 7225.

Bohemia and Saxony ores were utilized in making lithium alloy metal used in bearing metal and hard aluminum alloy, "scleron."

Markets and Prices

Most of the mines containing lithium ore are owned by manufacturers and thus these ores seldom enter the open market. Prices quoted by Engineering and Mining Journal Metal and Mineral Markets were stable during 1941 and were as follows: spodumene $5 per 20 pounds of contained lithia, 6 percent minimum, relatively free from iron, tourmaline and quartz; lepidolite, ordinary grade (3 percent), lump, was quoted at $24-$25 a short ton f.o.b. mine; amblygonite, 8 to 9 percent lithia, $40 a ton f.o.b. mine. Prospective producers are advised to negotiate directly with buyers. Complete summaries of current prices for lithium ores and compounds with required specifications are published in U.S. Bureau of Mines Information Circular 7225.

Price per gram of metallic caesium is $14; of rubidium, $15.

Producers, Buyers, and Consumers

Lithium Producers, 1941[2]

American Potash & Chemical Co., Trona, Calif.
Black Hills Keystone Corporation, Keystone, S. Dak.
Black Hills Tin Co., Tinton, S. Dak.
B. M. Dilley, Custer, S. Dak.
Lawrence Judson, Keystone, S. Dak.
Maywood Chemical Co., Keystone, S. Dak.
United Feldspar & Mineral Corporation, Kings Mountain, N.C.

Lithium-Ore Buyers

Associated Metals & Mineral Corporation, 40 Rector St., New York, N.Y.
Bergstrom Trading Co., Inc., Woolworth Bldg., New York, N.Y. (exporter).
Consolidated Feldspar Corporation, Trenton, N. J.
Corning-Glass Works, Corning, N.Y., (lepidolite)
Foote Mineral Co., 16th and Summer St., Philadelphia, Pa.
Harshaw Chemical Co., 1945 E. 97th St., Cleveland, Ohio.
E. J. Lavino & Co., 1528 Walnut St., Philadelphia, Pa.
Maywood Chemical Co., Maywood, N.J.
R. T. Vanderbilt Co., 230 Park Ave., New York, N.Y.
Varlacoid Chemical Co., 116 Broad St., New York, N.Y.

Consumers and Manufacturers

Abbott Laboratories, North Chicago, Ill.
American Fluoride Corporation, 151 W. 19th St., New York, N.Y.
Dow Chemical Co., 919 Jefferson Ave., Midland, Mich.
B. F. Drakenfeld & Co., 45 Park Place, New York, N.Y.
Foote Mineral Co., 16th and Summer Sts., Philadelphia, Pa.
General Electric Co., Lamp Department, 1133 East 152 St., Cleveland, Ohio.
Harshaw Chemical Co., 1945 East 97th St., Cleveland, Ohio.
Lithaloys Corporation, 444 Madison Ave., New York, N.Y.
Mallinckrodt Chemical Works, Second and Mallinckrodt St., St. Louis, Mo.
Maywood Chemical Co., Maywood, N.J.
Vitro Manufacturing Co., Corliss Station, Pittsburgh, Pa.
Lithium Corporation of America, Raymond and Commerce Bldg., Newark, N.J.
Metalloys Corporation, 730 Rand Tower, Minneapolis, Minn.

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[2] U.S. Bureau of Mines Information Circular 7225.

References

Bureau of Mines Information Circular 7225
Bureau of Mines Information Circular 7232
Mellor, A Comprehensive Treatise on Inorganic and Theoretical Chemistry
Paetington, A Text-Book of Inorganic Chemistry
Browning, Introduction to the Rarer Elements

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SPECIAL PREMIUM PRICE FOR COPPER

On May 1, Mr. Jesse Jones announced that a Special Additional Premium is now available under the premium price program, limited to small copper mines which produced less than 2,000 tons of copper during 1942 and which require increased revenue to obtain maximum production. Each individual case will be considered independently by the Quota Committee, Premium Price Plan for Copper, Lead and Zinc; and payment of a Special Additional Premium at a rate to be fixed for each mine on production in excess of a special quota will be made by Metals Reserve Company on the basis of recommendations made by the Quota Committee and approved by Metals Reserve Company.

The special quota and the special premium rate established for any mine may be increased or decreased at any time, or may be revoked at any time upon thirty (30) days' notice. Metals Reserve Company will not effect any settlement with producers based on the Special Additional Premium, in the event of termination of the program prior to July 31, 1945.

Payment of the Special Additional Premium for copper will be handled by Metals Reserve Company through the same channels and under the same procedure as heretofore followed in the program. Inquiries concerning eligibility for this Special Additional Premium on small copper mine production should be directed to Mr. Landon F. Strobel, Executive Secretary, Quota Committee, Premium Price Plan for Copper, Lead and Zinc, War Production Board, Room 2047, Temporary "R" Building, Washington, D.C.

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NO BERYLLIUM FOUND BY STATE DEPARTMENT IN THE JACKSON COUNTY DEPOSIT

No significant amount of beryllium was found by the State Department of Geology and Mineral Industries in representative samples obtained from the deposit reported recently as a new discovery of beryllium ore in Jackson County, Oregon. Spectrographic and chemical analyses of several samples of the rock gave results ranging from 0.001 to 0.002% beryllium oxide - an amount too small to be classed other than as a trace.

The rock is classified as an altered volcanic tuff or breccia, made up of fragments thrown out by volcanic activity. Some samples contain secondary quartz and chalcedony. No beryllium minerals could be found microscopically.

Beryllium is highly important in forming alloys useful in certain war equipment, and after the discovery was announced over a week ago, the Department received many requests for information concerning the deposit.

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NOTICE

Multigraphed forms which may be used as a guide for filing notice of desire to hold mining claims under the recent bill suspending annual assessment work on mining claims for the duration of the war may be obtained at the Portland office of the Department.

STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES
Head Office: 702 Woodlark Bldg., Portland, Oregon

State Governing Board			
W. H. Strayer, Chairman	Baker	Earl K. Nixon	Director
Albert Burch	Medford	F. W. Libbey	Mining Engineer
S. H. Williston	Portland	John Eliot Allen	Geologist
		H. C. Harrison	Spectroscopist

State Assay Laboratories

400 E. I Street, Grants Pass		2102 Court Street, Baker	
Ray C. Treasher	Field Geologist	Norman S. Wagner	Field Geologist

****

CARBON MONOXIDE AGAIN

On May 1 last, two miners working at the McIntyre mine, a small gold mine near the old Sanger mine north of Baker, started their gasoline engine-driven compressor and descended into the mine to begin work in a winze. They turned on the compressed air and soon were dead. Carbon monoxide had struck again.

The air compressor and automobile-type gasoline engine at this mine were set close together in a small, tightly walled and roofed building erected close to the collar of the shaft. The building had two doors and four 30-inch square windows. The exhaust pipe from the engine went down through an opening in the floor and out beyond the wall of the building. There was a break in the exhaust pipe, permitting exhaust fumes to enter the building through the floor opening. The intake of the air compressor was inside the building only a few feet from the engine exhaust pipe. If doors and windows of the building were closed, exhaust fumes would be drawn into the compressor and sent underground. Apparently such were the conditions pertaining to ventilation of the building when the two men went into the mine.

These statements are made not to chronicle this particular tragic happening, but rather to emphasize as pointedly as possible the danger of disregarding elementary safety practices. Both the discharge of the exhaust pipe of the engine and the air intake of the compressor should have been outside the building and so separated that there would have been no possibility of sucking the exhaust fumes into the compressor.

The vital function of providing the human system with sufficient oxygen is maintained through breathing air into the lungs where oxygen is absorbed by the red blood corpuscles or hemoglobin in the blood stream. The oxygen is transferred by them to the tissues. Carbon monoxide is absorbed by the hemoglobin three hundred times as readily as is oxygen. When 60 to 80 percent of hemoglobin in the blood stream becomes carbon monoxide carriers instead of oxygen carriers, death comes quickly.

Carbon monoxide is produced in the combustion of hydrocarbons such as petroleum products and may be present in the exhaust gases of gasoline engines in amounts up to 13 or 14 percent, probably averaging 6 or 7 percent. Concentrations of carbon monoxide of 0.1 percent and above are dangerous, and air containing 0.4 or 0.5 percent carbon monoxide produces unconsciousness and asphyxiation in a few minutes.

This deadly gas gives practically no warning. It is tasteless, colorless, and odorless. Its weight is very nearly the same as air.

Persons using internal combustion engines should give especial attention to the hazard of exposure to even low concentrations of exhaust fumes. Neglect of precautions which should be taken represents ignorance or negligence that might have fatal results such as those at the McIntyre mine.

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ICELAND SPAR

Introduction

Iceland spar is a variety of calcite that is transparent, waterclear, and perfectly crystallized. When free from mineral inclusions and other foreign particles, gas bubble holes or cavities, incipient cleavages, and cloudy or milky portions, it has great value for optical use. The demand for optical grade material is relatively small but the supply is so limited that the search for it has become world-wide.

Little did the discoverer of this mineral realize what far-reaching effects it was to have in furthering scientific research. It was discovered early in the 17th century in a stream bed in Iceland; hence the name. Little attention was given the discovery until 1669 when Erasmus Bartholinus first perceived its power to form double images (double refraction). His conclusions regarding this peculiar property were published in 1670, but it was not until 8 years later that the Dutch scientist, Christian Huygens, discovered the law governing the action of the refracted rays of light as they passed through the calcite crystal. In 1809 the French physicist, Etienne Louis Malus, discovered Iceland spar's polarizing effect on light rays, and he published a paper describing the phenomenon. William Nicol's work closely followed that of Malus, and in 1828 Nicol designed the prism which bears his name and which is used to this day as the means by which polarized light is obtained in most optical instruments.

Properties and Uses

Iceland spar (calcium carbonate) has the same properties as the more common varieties of calcite. It has a hardness of 3 and is easily scratched with a knife. Specific gravity is 2.71; luster is vitreous. It effervesces freely in hydrochloric acid.

The apparent brittleness of calcite is due to its well-known rhombohedral cleavage, perfect in all three directions with angles of intersection of 75° and 105°. The crystal habit is quite variable, and may be either scalenohedral or rhombohedral (hexagonal crystal system), often with modifying forms. The rhombohedral-shaped cleavage fragments from large crystals are sometimes mistaken for the outline of the crystals themselves. Calcite has two indices of refraction of widely different value; or, to be more explicit, light entering a crystal of Iceland spar is split into two rays which travel different courses at different speeds, (see fig. 1). These paths are markedly separated, more so than in most other minerals. This optical property of Iceland spar is the basis of its use in optical instruments.

Malus in 1809 discovered that light rays were polarized when they passed through Iceland spar. That is, he noticed that the rays of light from an ordinary source, after passing through the Iceland spar crystal, no longer sent out vibrations in all planes perpendicular (normal) to the axis of the ray; but instead sent out vibrations in only one plane perpendicular to the axis of each of the two rays, and that these two planes intersected at right angles, (see fig. 1). If both planes of vibration (or polarization) were parallel instead of perpendicular, the plane-polarized light could be directly employed in optical instruments. As the planes are not parallel, one plane of vibration or polarization must be eliminated. The two paths followed by light through Iceland spar are widely separated, therefore the elimination of one ray is possible; Nicol accomplished this in 1828 when he made the first Nicol prism. This prism is made by cutting the crystal the long way from one obtuse angle to the opposite obtuse angle. The surfaces are smoothed and then cemented together with Canada balsam (a clear cement having an index of refraction between the two indices of calcite). The edges of the crystals are then made perpendicular to the plane of the Canada balsam. The crystal is set in cork, blackened on the inside. Light entering the Nicol prism is broken into two different rays. One ray continues through the Canada balsam medium in an almost unaltered course; the other strikes the plane (or mirror) of balsam at such an angle that it is totally reflected toward the side and absorbed by the blackened cork, (see fig. 2).

Consequently, light vibrating in only one plane emerges from the Nicol. This light is very useful in determining the optical properties of minerals in a thin section of rock when examined by means of a microscope. The petrographic microscope uses two prisms oriented with their planes of polarization at right angles to each other. Additional optical properties can be determined by the use of the two prisms.

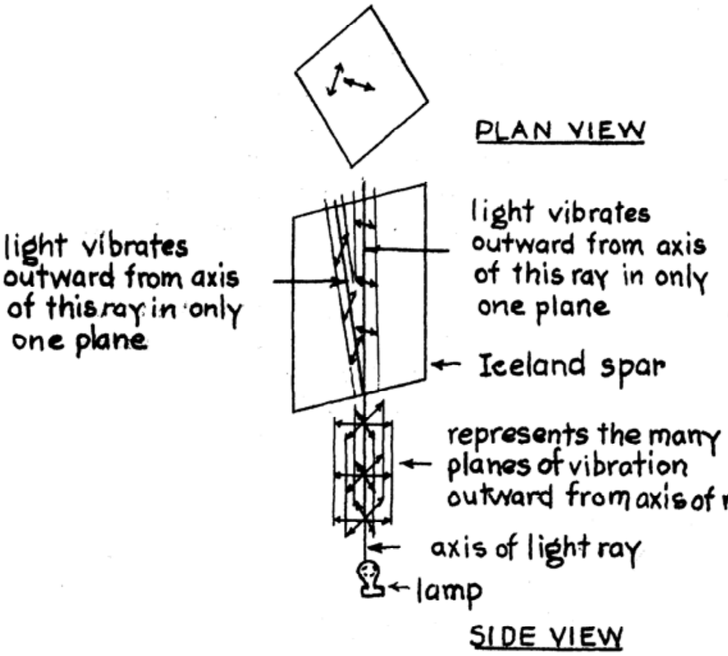

Figure 1. ACTION OF LIGHT PASSING THROUGH ICELAND SPAR

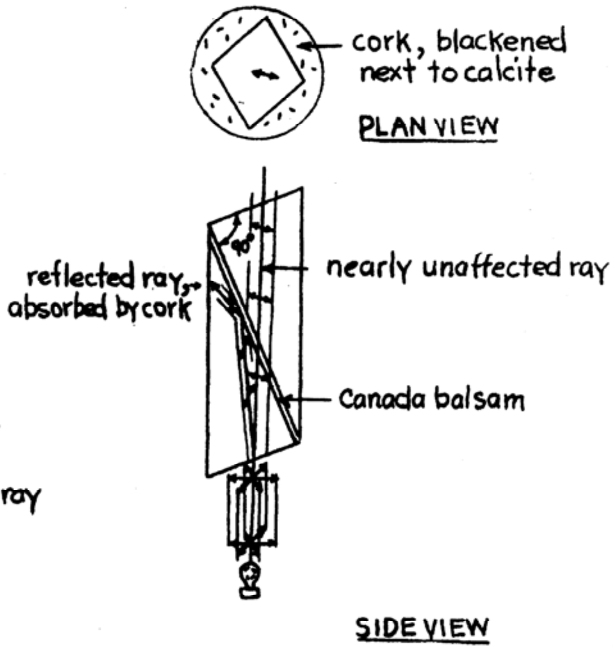

Figure 2. ACTION OF LIGHT PASSING THROUGH A NICOL PRISM

Nicol prisms or modifications thereof are used in other optical devices which aid in keeping a close check on the quality and uniformity of manufactured products. Thus colorimeters are used to compare the depth of a color with a standard; saccharimeters, to determine the sugar content of solutions; dichroscopes, to reveal dichroism (difference in color of a substance in different directions); photometers, to measure the intensity of light; spectrometers, to ascertain index of refraction; spectroscopes, to form and examine spectra; and polariscopes and polarimeters, used in polarized light studies. Iceland spar is also used in X-ray analysis in determining crystal structure.

Geological and Geographical Occurrences

Iceland spar is deposited from aqueous solutions, but the conditions under which it is formed instead of ordinary calcite are imperfectly known. Some authorities favor a theory of deposition from magmatic water instead of the more commonly held theory of deposition from meteoric or ground waters. Possibly, it may originate in both ways. Deposits are generally associated with basic igneous rocks such as basalt and diabase. Iceland spar occurs mainly as masses of crystal aggregates together with associated residual clay in cavities of the country rock. Some deposits which have a definite vein structure are found in sedimentary rocks and this spar appears to have been deposited from ascending heated water which dissolved calcium carbonate from underlying limestone areas.

Deposits of Iceland spar are scattered sparingly over the earth, and most of these deposits contain a relatively small proportion of optical grade calcite. The best known occurrence, now largely of historical interest only, is that in Iceland. Though discovered in the early 1600's, this deposit was not exploited until 1850. The country rock is an alternating series of decomposed and unaltered rock. The cavities were in part formed by the disintegration of the rock and contain red clay. The best crystals were embedded in this clay. As true of all deposits, many crystals were small. The first cavity opened is reported to have been almost entirely filled with pure crystals of enormous size, the largest a yard across. One of the large crystals taken in the early mining operations is in the British Museum. It is part of a larger crystal, measures 24 inches across by 16 inches thick, and is nearly free from fractures and inclusions.

In mining the Iceland deposit the country rock was blasted away to get at the cavity-fillings. Undoubtedly this blasting spoiled a considerable portion of optical grade calcite. Operations were discontinued for several years during the first World War. At that time a large pit about 100 feet long, 70 feet wide, and 50 feet deep had been excavated. It was filled with water to prevent weathering and later, when reopened, the grade of the crystals had deteriorated. It has since been worked only intermittently, and consumers have sought spar from other sources.

South Africa has supplied much of the demand in recent times. The more important deposits are in the Kenhardt district, northwest Cape Province. Their value was first recognized in 1920. The spar in this district occurs as variously sized, irregular aggregates in cavities in weathered diabase, and is removed entirely by hand operations. Prior to the present war much of the production went to Germany which was the world's leading consumer of Iceland spar. Some of the spar, however, reached the United States.

Small quantities of optical grade spar have been produced in Spain and shipped to both Germany and the United States. Deposits have been reported from Canada but no production has been reported. One deposit is said to be near the headwaters of Lake Creek in the Trout Lake mining district, about 20 miles from Ferguson, B. C. Deposits near Kamloops, B. C. are veins in limestone. Samples of Iceland spar were sent to the United States from Buenos Aires, Argentina in 1920 and proved promising, but nothing more is known of this source. In 1921 an American manufacturer reported that Iceland spar could be purchased in Brazil.

Several occurrences in the United States should be noted though domestic production has been relatively small. Large, relatively undeveloped deposits near Greycliff and Big Timber in Sweet Grass County, near Livingston, Montana, have been known since 1907. Some spar was produced which apparently was in part of optical grade, although the predominance of imperfect crystals appears to have made operations unprofitable.

Some optical-grade spar was produced from a deposit in the Warner Range near Cedarville, Modoc County, California in the 1920's. Specimens of crystal aggregates weighed as much as 80 pounds. Many of the crystals were twinned. Mining was by open cut and during the winter of 1920-21, about 1000 ounces was sold. Pieces weighing one ounce sold at the rate of $8 a pound with a premium of 50 cents additional for each one-fourth ounce increase in weight of the crystal. Originally thought to be an important source of supply, the deposit was worked out before 1925.

By far the most promising recent development is the deposit in the Copper Mountain mining district, Taos County, New Mexico, about 30 miles southwest of Taos. This occurrence is in a fault zone and although much calcite is present, optical-grade material represents only a small percentage and is found near the edges of the deposit where crystals have formed in a decomposed schist of clayey character. The quality is reported by consumers to be excellent. Production began in 1939 and high-grade rhombs as much as 17 pounds in weight have been recovered.

There are several promising deposits of calcite located on both sides of the Owyhee Reservoir, Malheur County, Oregon. These deposits are found in an area 9 miles square in the vicinity of the mouth of Dry Creek. The calcite forms definite veins in both basaltic extrusive rocks and overlying lake beds. The veins are quite constant in width and range from 8 inches to 25 feet. One vein about half a mile long averages 6 feet in width.

Crystals taken from some of these deposits are as much as 8 inches on a side. The veins have not been explored at depths greater than several feet. Clear pieces of float and pieces from larger crystals at even these shallow depths appear to approach optical grade. These deposits were examined recently by the Department.

Other possible sources of optical grade material are known in the western states. Production from near Indio, California, has been reported.

Mining Methods

Open-pit mining has been employed in recovering the spar from most deposits. The country rock is blasted away and the clay pockets containing crystals are worked by hand. Extreme care must be used at all times in handling Iceland spar. Equal care must be used in transporting it. It is generally well wrapped and then packed in sawdust for shipping. Undoubtedly the use of powder has ruined many crystals of optical grade and, if at all possible, its use should be avoided. Iceland spar is far more subject to flawing then marble (mainly recrystallized calcite), yet marble is recovered by channeling and wedging, using great care. If a deposit of spar is large and the quantity of optical grade material promising, the use of a channeling machine may be warranted. Wall cuts might be made along the vein and the vein matter removed by drilling and wedging. The chunks could thus be removed and reduced in size by means of wooden wedges. The use of unslaked lime in breaking the rock away from crystals is rather ingenious. A hole is drilled in the rock. A slender metal rod is inserted and the hole filled with lime. The rod is taken out and a cotton string saturated with water is suspended one-half inch from the bottom. The opening is then sealed and the water dripping from the string causes the lime to expand, breaking the rock with a minimum of damage to the spar.

Specifications

Iceland spar suitable for optical use should be at least one inch long and half an inch thick each way, though smaller pieces have limited use. Each piece must be absolutely transparent, free of all imperfections such as inclusions, cavities, foreign particles, internal irridescence or rainbow colors caused by incipient cleavages. Twinning planes or lamellae, even invisible to the naked eye, rule out some crystals for optical use, though these, if sufficiently large, may sometimes be cut down to avoid the twinning defect.

A twinned crystal can be identified by placing it over a dot or hole in a piece of paper. If the crystal is normal (untwinned) two dots appear which vary little regardless of the movement of the crystal along the paper. If, however, additional, indistinct dots appear, the crystal is twinned. The twinning planes can be seen sometimes by noting the surface reflections from a crystal.

Prices, Markets, and Consumption

There is no fixed price for Iceland spar of optical grade. It varies with the quality and size of the spar and the amount to be sold. A consumer company's reserve supply determines to a marked extent the price it is willing to pay. The price before the present war ranged from $7 to $35 a pound. Depressions or seasonal fluctuations have little effect on the price of Iceland spar. Since the war started, especially desirable crystals have brought a maximum price of $40 a pound.

The consumption in the United States before the war was probably not much more than 200-300 pounds a year. Yet there is a ready market both in the United States and abroad for optical-grade spar in peacetime. Since the war began, the demand has markedly increased. Polaroid Corporation, 718 Main Street, Cambridge, Massachusetts, uses a certain amount of sub-optical grade calcite in sizes not less than 2 inches on each edge. These sell for about $10 a pound, but this demand is reported to be met largely by Montana and California sources. Bausch and Lomb Optical Company, 626 St. Paul Street, Rochester, New York; Spencer Lens Company, 19 Doat Street, Buffalo, New York; and possibly others, demand colorless and absolutely perfect specimens at least one inch on each edge for certain uses at the present time. Still larger sizes are preferred. These sizes are urgently needed at present and command good prices.

When world conditions were favorable for international trade, many German manufacturers of optical instruments, several English, and one Swiss company were in the market for high-grade spar.

Samples for collectors, schools, and museums generally bring from $1 to $3 a pound, though crystals of high optical grade have the same value as those employed in optical instruments. Calcite sufficiently pure to be used in laboratories for standardizing purposes (standardizing spar) sells for $1 - $2 a pound.

Acknowledgements and References

Much of the information used in this report was obtained from the U.S. Bureau of Mines Information Circular No. 6468R.

Additional references include:

1. Oliver Bowles: U.S. Bur. Mines, Report of Investigations 2238 (1920), 6 pp.
2. H. H. Eiriksson: The Spar Mine at Helgustadir, Iceland. Trans. Inst. Min. Eng. (1920).
3. H. H. Eiriksson, Iceland Spar, The Quarry, London, vol. 29, No. 280, pp. 157-160, June 1920.
4. H. Herbert Hughes, Iceland Spar and Other Crystals of Related Uses, Industrial Minerals and Rocks, pp. 389-393, 1937.
5. C. L. Parsons, Iceland Spar in Montana, Science, n.s., vol. 47, pp. 508-509, May 24, 1918.
6. Anonymous, Resources and Commercial Applications of Iceland Spar, Eng. Mining Jour., p. 219, July 31, 1920.
7. Anonymous, Iceland Spar, Preliminary Report, pp. 53-58, California State Mining Bureau, January 1922.

W.D.L.

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QUICKSILVER SURVEY

Mr. Francis Frederick, consulting geologist of San Francisco, has been retained by the Department to make a survey of Oregon quicksilver deposits. This survey has as its object the study of possibilities of encouraging new production. Mr. Frederick has had a wide experience in examination and development of quicksilver properties. His report will be published as a department bulletin as soon as possible, probably this fall.

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NOTICE

The Portland office of the Department, 702 Woodlark Bldg., is in Zone 5, and the address of all mail to this office should include this zone number.

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July, 1943 Portland, Oregon

STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES
Head Office: 702 Woodlark Bldg., Portland, Oregon

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SPONGE IRON*

A great deal has been said about sponge iron, and not everything has been correct. I want to clarify at the start one of the points on which there has been misinformation and controversy. Sponge iron is not going to replace mass production of pig iron and steel - as made by the orthodox methods in blast furnaces and steel furnaces - certainly not in a hurry, if ever. Sponge iron is made from iron ores by removing most of their gangue and oxygen content without melting the iron. There are many ores from which the silica can only be separated economically by melting in the blast furnace. Furthermore, it is not in the province of sponge iron to replace the ordinary grades of iron and steel; but being a virgin metal of high purity it should be reintroduced as a leading quality metal for the production of the finest steels and for many special products requiring metal of the highest quality. In bringing about the rebirth of this old art, advantage can be taken of all that modern science has to offer as well as the latest technique in metallurgy and handling of materials.....

Sponge iron is the oldest form of iron known to man. The unsurpassed quality of the ancient irons as represented by Damascus swords, Toledo blades, the Delhi iron column in India, is due to the fact that they were forged from unadulterated virgin metal produced directly from the ores. Charcoal was the fuel. About the middle of the last century sponge iron went into the discard in the Western countries with the depletion of a handy supply of charcoal and of accessible, easily mined ores, under the growing competition of pig iron produced in blast furnaces using anthracite and coke, and of steel made from such pig iron and scrap, the supply of which was rapidly increasing. The puddling process, Bessemer steel, and finally, open hearth and electric steel, took its place.

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Anticipate Mesabi Range Exhaustion

Vitally important changes in the American iron and steel industry may soon begin to take shape. For nearly half a century the iron ore market has been dominated by the cheap and vast output of the Mesabi Range in the Lake Superior region; but now its great open pits are commencing to show signs of exhaustion. The demands of two world wars and the great building period of the twenties have brought this about sooner than expected. The Lake Superior region will be forced into more and more expensive underground mining and beneficiation of low-grade ores on a much larger scale than is practiced today. Concentrates made from the lean ores will gradually take the place of the cheap open-pit ores--but ores found in other parts of the country, low-grade as well as richer ores, may then again come

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*Parts of an address by Mr. H. A. Brassert made at Hartford, Connecticut, at an all-industry conference on strategic materials; and quoted from the Congressional Record of the 78th Congress under date of April 22, 1943.

into their own. If they are located near suitable supplies of solid, gaseous, or liquid fuel and near consuming centers, economics may once more be in their favor.....

There can be no question as to the suitable quality of the ores consumed in the old days. They were proved over a century and a half; the important question now is the actual tonnage and quality of the ores remaining in the untouched reserves; the possibilities for economic exploitation; the cost of production.....

Ways of Making Sponge Iron

There are many ways in which sponge iron can be made. The ancients mixed the iron ore with carbon and brought it to a sufficient temperature so that a pasty or liquid slag was formed which could be squeezed or hammered out of the mass of metal. The metal was forged or reheated and forged--sometimes several times--for the production of the highest quality bars. The original forges were open fires blown with hand bellows, and later with bellows driven by water wheels. Out of these small Catalan fires, shaft furnaces were developed; but still the metal produced was a low carbon metal which could be forged directly and which was not brought to the molten state. It was only when the height of the furnace was increased so that the metal absorbed more carbon from the charcoal and its fusion point was thereby lowered that molten pig iron could be produced. As long as this pig iron was made from charcoal blown with cold blast, it was still reputed as a superior metal. When the furnace grew larger, hot blast was introduced, and the fuel became anthracite and finally coke, more impurities were absorbed by the pig iron and some of them went into the steel. Metal made in the puddling process was also adulterated by the use of half of the metal in the form of pig iron and some of the gangue of the ore was retained. The removal of the silicon, carbon, surfur, phosphorus in the pig iron has been the task of the steel processes developed in the past 75 years, first the Bessemer, then the open hearth and last, the electric furnace. But the removal of sulfur and phosphorus could never be complete; and in these processes nitrogen and hydrogen, which we know are detrimental, are absorbed by the metal, though present in exceedingly small quantities. Whether the absence of nitrogen and hydrogen in sponge iron made without melting--especially of that made at relatively low temperatures--is the answer, modern scientific research will soon tell us. At any rate, the quality of the original virgin metal made directly from pure ores in the Catalan forges without melting has never been reached.

The New Sponge Iron Process

The process I prefer to use is a new method for making sponge iron--by gaseous, low temperature reduction and compacting to produce a dense, metallic structure. It uses gases instead of solid carbon as a reducing agent, and operates at very low temperatures, between 1,300° and 1,500° F. for most hematites, and between 1,100° and 1,300° F. for magnetites, in accordance with the kind of gas used, pure hydrogen requiring the lowest temperatures. The blast furnace works at a temperature of 3,000° F. The gases I prefer to use are hydrogen or gases containing high percentage of hydrogen. The process produces a continuous stream of porous, spongy, reduced fines which are immediately compressed or briquetted into a dense, heavy stock while still hot and protected by a reducing atmosphere against reoxidation. These briquets can be made into finished steel either by melting in the open hearth or electric furnace, or they can be used directly for the production of bars and shapes by forging, rolling, or extrusion; or the reduced powder, if made from sufficiently pure ore concentrates, may be used by itself or mixed with other metals or suitable substances in the powdered metal industry for the production of many high quality metal parts and new commercial articles.

The Brassert-Cape reduction unit which is now being installed at the Republic Steel Corporation's plant at Warren, Ohio, is a modification of the well-known Herreshoff furnace, with a slotted hearth installed for final reduction in the bottom of the structure. The Herreshoff furnace is a highly developed unit long used for many purposes such as roasting, calcining, drying, and desulfurizing materials. Its use for reducing iron ores at low temperatures by hydrogen, however, is new. The main structure of the furnace has not been changed except for the addition of one or several slotted hearths at the bottom of the usual 10 or 12 superimposed rabbling hearths. In the slotted hearth, the reducing gas bubbles through the ore bed in such a manner that no grain of material can leave the furnace without having been in contact with the gas. In fact, the charge is moved across the hearth and out of the furnace primarily by the gas.

The Herreshoff furnace is a simple cylindrical vertical unit with a slowly revolving, hollow shaft in the center. Rabbles or teeth are mounted on the shaft and move the ore across the hearths successively, inwardly and outwardly, turning the ore and exposing all of it to the gas. The ore drops from one hearth to the other while the gas flows upward, each time flowing through the dropping ore and passing over the ore in each hearth as it is turned over by the rabbles. An additional quantity of gas is injected directly into the ore through the rabble arms which are hollow, and get their supply of gas from the central shaft. On the upper Herreshoff hearths the ore is dried and preheated, and on the lower hearths it is partially reduced. If it requires roasting on account of sulphur, or if requires calcining, this is also accomplished in the top hearths. At any rate, the ore is preheated and prereduced to the desired degree before it reaches the final slotted reducing hearth or hearths in the bottom.

We have designed two forms of this hearth, one a V-type, in which there are a number of concentric small V-shaped troughs placed across a large V which serves as gas container. The gas bubbles through the fine slots in the bottom of the multiple V's, and imparts to the ore bed a state equivalent to fluidity so it flows around the hearth to the discharge end. The gas ducts are so designed that any ore fines falling through, in case the gas flow is interrupted, may be easily removed through the bottom.

The other type of hearth is built of radial segments, forming inclined slots between them which resemble the blades of a turbine. The gas flows through these slots into the ore bed, moving the bubbling, fluent ore stream spirally outward toward the point of discharge. This hearth design has been adopted for the Republic plant. The gas is introduced into the ore bed, and the rate of travel of the ore fines is retarded and regulated by the rabble teeth. The hearth is constructed of easily-removable sections. The design of the slots prevents any ore fines falling through when the gas flow is interrupted.

The only mechanical parts in the furnace are the rabbles which propel the ore charge in the Herreshoff hearths and which are meant to break up any possible gas locks in the slotted hearths. The operation of the reducing furnace is entirely automatic and thermally controlled. Provision is made for the introduction of gas at various levels and exact temperatures can be maintained in all of the hearths. The problem of sticking, due to local temperature rises, the bane of former reduction processes, has thus been solved successfully.

Apparatus is Simple

Hundreds of Herreshoff installations have given many long years of satisfactory service at higher temperatures than are required for the gaseous reduction of iron ores. Compared to the blast furnace which, with its auxiliary equipment, is an intricate apparatus, the Brassert-Cape low temperature reduction unit is a comparatively simple apparatus. It works at low temperatures, whereas the blast furnace in its lower portion has to deal with temperatures of around 3,000° F. As stated before, the blast furnace lining has to be protected at the various stages against abrasion by the descending stock, against corrosion by gases, slags, and sheer fluxing by the high temperatures in the bosh and hearth. The armament of the lower part of the blast furnace is not unlike that of a battleship. The blast furnace is about 100 feet high and charged not continuously, but by batches with an intricate electrically controlled apparatus. The Herreshoff furnace on the other hand, is only about 40 feet high and smaller in diameter. Operating temperatures in our process will in no case exceed 1,500° F. The wear and tear in the Herreshoff is, of course, infinitely smaller, if only on account of this temperature difference. The ore is charged at the top continuously by a simple, well-known type of feeder; it moves through the furnace at a controlled rate. At the bottom, the revolving rabbles control and insure uniform delivery of the reduced fines into the chute which feeds the briquetting rolls.

The feeding of the ore, its movement through the furnace, its discharge into the briquetting rolls, are continuous and entirely automatic. In the blast furnace, charging of the raw materials, discharging of the slag and iron is done in batches. It is not continuous. The danger of explosions in the Brassert-Cape reduction furnace has been eliminated, since the entire apparatus is enclosed and constantly under a positive gas pressure.

The complete low temperature gaseous reduction plant consists of a number of units. First, there is the gas preparation plant; if the gas contains sulfur, gas desulfurizing apparatus must be installed; where natural gas is used a gas re-forming or cracking plant is needed. The prepared gas next passes through a heat exchanger and then through a preheater before entering the furnace. For the compacting of the reduced ore at the bottom of the furnace, briquetting rolls are provided, placed immediately underneath the discharge of the reduced ore fines. Here the iron powder is compressed while still hot and under a reducing atmosphere, forming dense melting stock briquettes. Miscellaneous equipment for the handling of the raw material and of the finished product, such as cranes and endless belts, a gas washer for the cleaning of the spent gases, control apparatus and instruments, complete the installation.

The gas from the coke oven mains flows through the various preparatory stages and into the reduction unit. The spent gases issuing from the top are washed to remove the water vapor, the product of the reaction. Half of the gas is returned into the direct reduction unit; the other half is sent back into the steel mill gas main, there to be consumed in steel making and heating furnaces. The removal in the process of ore reduction of some of the hydrogen contained in the coke-oven gas results in an increase of its heating value and its luminosity, so that the gas becomes more suitable both as fuel in the steel works furnaces and for other uses.

Low Operating Costs

The cost of operation and maintenance of a low temperature unit will naturally be less than that of a high temperature melting apparatus such as a blast furnace, with all its expensive machinery and equipment. The operation of the low temperature reduction plant is entirely continuous, practically automatic and under complete control. It is certainly cheaper to operate than a blast furnace and its coke plant, both of which are high-temperature equipment which have to be discharged periodically, and still have manual and intermittent features in the operation and much complicated auxiliary equipment.

In my experience, a great many ores have been investigated; and it was found that it was easier to work with our high-grade eastern magnetite concentrates than with any other ores. Most minerals in which the gangue is free can be used for this purpose. Such ores will be subjected to magnetic concentration before or after reduction and before briquetting. Iron ores become magnetic upon being reduced wholly or partially to the metallic state. Therefore, magnetic concentration becomes possible after passing the ore through the low-temperature gaseous-reduction process, even when using hematites and other non-magnetic ores. As long as the temperature remains below the limit of magnetic permeability, as it does in this case, this magnetic concentrating step might be taken after reduction while the reduced ore fines are still hot. Or they can be submerged in a cooling liquid and then subjected to wet magnetic concentration, reheated in a reducing atmosphere and briquetted. At any rate, the continuity of my process need not be interrupted.

There are however, ores in which the gangue, although free, is so intimately associated with the iron oxides that separation by washing, flotation, magnetic, electrostatic separation, or air tabling is not economically feasible. In that case, the excess gangue left in the ores after possible concentration enters the sponge iron briquettes with the reduced iron. The briquettes can then be melted in a cupola, a rotary or tilting furnace, and the molten gangue separated by the usual way from the molten metal by flushing it off with the molten slag. The molten metal, free from gangue, is transferred to the open hearth or electric furnace for conversion into steel.

Then there are many ores in which the iron oxides are so finely dispersed or intermingled with the gangue that no adequate separation is possible except by exceedingly fine grinding, causing the formation of slimes which cannot be handled. Or the oxides may be chemically combined with all or some of the gangue compounds. Such ores cannot be used for the production of iron and steel except by melting in the blast furnace or by chemical solution.

I believe that the direct reduction process offers the proper method for the recovery of titanium, vanadium, and chromium values contained in ores which cannot be worked economically at present. Pyrites residues and roll scale are other possible raw materials.

Sponge iron is an excellent raw material in the manufacture of high-quality steel on account of its great purity, the practical absence of sulfur and phosphorus, the fact that it is not contaminated like scrap with harmful and uncertain constituents, and also the absence of nitrogen and other harmful gases.

Far Too Good To Replace Scrap

The sponge iron produced in the low-temperature reduction process is far too good a material merely to replace scrap, even the highest grade of scrap, although in the present emergency that will be its first function. The full value of this product can only be shown when used substantially alone in the making of the finest steels.

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Thus the new low-temperature gaseous reduction process offers a chance to industry to revert from the highly centralized integrated units to economical small-scale operation. This makes possible the distribution of a number of small sponge-iron plants feeding local industries and creating employment in small towns and rural communities without disturbing the economic equilibrium of the industry at large.

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MINING NOTES

Southwestern Oregon

The Pacific Company, which has leased the Sordy Chrome property south of Galice, has shipped its fifth carload of ore in 1943. Work was delayed this spring by unusually heavy snowfall. The access road to the Sordy property, built last year by the Siskiyou National Forest Service, is in good condition. Gravel has been placed on the softer spots. One chrome area is being diamond-drilled by the company. The ore shipped was mined on the Violet claim.

Some chrome has been shipped from the Illinois River area throughout winter. William Robertson of the Oregon Chrome Mines, and Hammer and Neubert were the principal shippers. Both Fisher and Anderson, and James G. Gallaher, have chrome ready to ship from their claims on Red Dog Creek. Chromite property owners west of the Illinois River are active and are preparing to ship. The Sinnick interests are building a road to the Chetco divide where their property is situated.

Several chrome operators have been investigating the possibilities of concentrating low-grade ores. These ores contain high-grade chromite grains mixed with gangue. Baker Brothers and Jones have a small concentrator in operation on Bloody Run about 3 miles east of Grants Pass. It is reported that the plant has a capacity of 18 tons of ore per 8-hour shift.

Work on chrome properties in northern California was held up by snow conditions until late in the spring. A period of pleasant spring weather was followed by rain storms which softened the roads and made hauling difficult. Heavy hauling from some of the properties was begun during the latter part of June. At the High Plateau mine a lower adit has been driven to cut new ore. It is reported that the Crescent-Pacific Company has encountered additional ore on their property west of the High Plateau. Development work is being done at High Divide, where a shaft is being sunk to cut additional ore. It is reported that the Tyson or French Hill deposits are showing up remarkably well. Men and equipment have gone into the Cyclone Gap property of J. K. Remsen and shipments will be made as soon as road conditions will permit. Mr. Remsen is also operating the Snowy Ridge chrome property on the Oregon-California boundary, southwest of Ashland, Oregon.

Anthony Brandenthaler, O'Brien, Oregon, is preparing to ship copper ore from the old Waldo copper mine in the Takilma district, southern Josephine County.

The Grants Pass field office of the Department has been moved from 400 East "I", to 714 East "H" Street. Part of the laboratory equipment has been moved to the Portland office of the Department where the assaying will be done. Although no assaying will be done in Grants Pass for the duration, samples from western Oregon should be submitted to the Grants Pass office where assay records are filed as they were before suspension of local assay work.

Northeastern Oregon

The Mother Lode quicksilver property near Round Mountain, east of Prineville, Crook County, operated by Gilkey Brothers, is installing a washing and concentrating plant to treat ore from surface mining. A contract has been let to Louis Johnson of Eugene to supply the plant with about 1000 yards of material per day. About 10 tons of concentrates will be produced and furnaced. The plant is expected to be in production by the last of July.

Anthony Brandenthaler has taken an option on the Gray Eagle antimony mine near Baker. Extensive development work is planned and antimony ore now in sight will be shipped. Operations are expected to start about July 20.

The Ellis Mining Company with extensive holdings in the Bourne district, Baker County, supplies siliceous ores to the Tacoma smelter.

The Shanghai Gulch placer mine owned by Mr. H. P. Lambert, Sparta, Oregon, has been leased to Mrs. L. Muegge and Mrs. E. Warfel, Baker. A vein of quartz crystal found on the property is being investigated in order to determine optical quartz possibilities.

The Iceland Spar claims located about 25 miles south of Vale, Malheur County, and owned by William Metavia and M. P. Tonning, Boise, Idaho, are under lease to W. M. Schmeykal and F. L. Muckensturm, Boise, Idaho, who are doing development work. This property was investigated by the State Department recently and specimens of possible optical grade have been obtained from near the surface. Better quality material is being sought by deeper development work.

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August, 1943 Portland, Oregon

STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES
Head Office: 702 Woodlark Bldg., Portland, Oregon

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ALUMINUM FROM CLAY

Introduction

Light metals in large quantities are essential to winning the war. They may be expected to occupy an increasingly important position in the post-war picture. We have ceased to marvel at rapid travel by air to nearly any point on the earth's surface, but we fail, generally, to credit light metals and their alloys for their part in air-travel development. Aluminum is by far the most important of the light metals, and in years to come bids fair to become second only to steel among the metals in industrial importance.

Bauxite, essentially aluminum oxide and combined water, has been the ore from which aluminum has been reduced, except in Germany. There, because of pre-war deficiency in bauxite, some aluminum (reported to be approximately 50,000 tons a year) was made from clay.

High-grade bauxite, formerly used exclusively for domestic production of aluminum, contains 55 percent or more alumina (Aluminum oxide) and 8 percent or less of silica. Clay, on the other hand, is composed essentially of aluminum silicates which contain a much lower percentage of alumina and very much higher percentage of silica which is chemically combined and must be separated. Therefore it is evident that bauxite is superior to clay as a source of metallic aluminum. Why then consider clays in competition with bauxite? The answer is that, measured by the present and potential demand for metallic aluminum, the United States is lacking in suitable bauxite reserves. It follows that the United States is dependent on foreign bauxite for its aluminum. This may be satisfactory in peace time, but it should not be necessary to emphasize the hazard of depending entirely on foreign sources of such a vital material. We have experienced the unpleasant results of our own negligence in establishing sufficient and safe supplies of such necessities as rubber, tin, and quinine.

United States Bauxite Resources:

Government agencies in 1941 estimated that domestic high-grade bauxite reserves amounted to 9,343,000 long tons, and that low-grade bauxite having an average grade of 50 percent alumina and 17 percent silica totaled approximately 17,337,000 tons. By far the largest part of domestic bauxite - about 85 percent - occurs in Arkansas.

Since 1941 a considerable part of this reported reserve of high-grade bauxite has probably been used up. Pilot-plant work on utilization of low-grade bauxite has been done and some of this material is now being used. Probably most of our ore, however, is presently coming from Surinam and British Guiana, as the submarine hazard has considerably lessened.

Foreign Bauxite Reserves

Foreign deposits of greatest importance to this country are those in British Guiana and Surinam (Netherlands Guiana). Large reserves are known and unprospected areas which are potentially important cover many square miles. Shipments of bauxite from both countries, mainly to Canada and the United States, have increased several times in volume during the past few years.

In Europe the best known bauxite deposits are in France, Hungary, Italy, and Yugoslavia, all of which production is controlled by Germany. Complete information on U.S.S.R. is not available, but a large aluminum industry has been built up.

Important deposits of bauxite occur in the Netherlands Indies, also in India, Northern China, and Indo-China. The Island of Bintan in the Netherlands East Indies has produced high-grade bauxite for many years. Most of the production went to Japan. At the present time Japan controls very large reserves in conquered areas and is reported to be exploiting the deposits as rapidly as possible.

Bauxite deposits have been developed in Southern Rhodesia, Brazil, and Australia, and occurrences are known in various other countries including Venezuela and Honduras.

Clays

True clays are finely-divided aluminum silicates which contain water of combination. Commonly, clays are plastic when wet, but the term is also applied to compacted earthy rocks which have little or no plasticity. The principal clay minerals are kaolinite, dickite, nacrite, montmorillonite, beidellite, halloysite, allophane, and nontronite. Clay deposits contain varying percentages of impurities, and it follows that there is a wide range in the composition of clay deposits.

Next to stones for weapons, probably clay is the most ancient of man-used rocks or minerals. Down through the ages use of clay has been intimately connected with man's daily life - in houses, in household utensils ranging in type from the Latin American olla to the finest Dresden china, for refractories, for tiles of wide variety, for foundry materials, oil-well drilling mud, for filtering and bleaching mediums, for a wide variety of "fillers", for sanitary wares, sewer pipe, electrical porcelain, terra cotta, and abrasives. Finally, we come to the latest use and possibly that of greatest future importance - a source of metallic aluminum.

Clays may be classified according to use, mineral characteristics, geological occurrence, or burning qualities. If classified according to burning characteristics, in general high alumina clays are the best refractories.

"Alumina from Clay" Project

In 1938 refractory clay deposits of western Oregon were described by Wilson and Treasher*, and this report was the basis of the clay exploration program in Oregon conducted by the U.S. Bureau of Mines and the U.S. Geological Survey. Two primary factors influenced the Federal bureaus in their selection of deposits to be explored. These factors were high alumina content and favorable indications for developing a large reserve in millions of tons. Deposits near Molalla in Clackamas County and at Hobart Butte in Lane County were selected for investigation. Extensive drilling and sampling has been done at both deposits with encouraging results, so that these deposits, together with a third at Castle Rock, Washington, are known to be satisfactory in quantity and quality for an "alumina from clay" project. Such a project has been set up by the Columbia Metals Company, Seattle, based on the ammonium-sulphate process as developed by the Chemical Construction Corp., a subsidiary of the American Cyanamid Co. The process has been examined and approved by the Alumina Committee of the National Academy of Sciences, and the War Production Board has authorized a semi-commercial plant, reportedly with a capacity of 50 tons of alumina a day. The crude clay requirement would be of the order of 200 tons a day. Possible sites for the plant have been investigated by a representative of the War Production Board and by engineers of the Chemical Construction Corp. but no decision has been announced. The latest report is that the matter is in abeyance, the reason given being manpower shortage in northwestern Oregon and Washington.

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* Bulletin No.6., Preliminary Report of Some of the Refractory Clays of Western Oregon by Hewitt Wilson and Ray C. Treasher, Oregon Dept. of Geology and Mineral Industries.

Aside from clay, the main raw materials required for the process are ammonium sulphate, sulphuric acid, oil or coal or both, and limestone. Ammonium acid sulphate is added to the calcined clay and the mixture digested. Aluminum goes into solution as ammonium aluminum sulphate, and may be separated from the solids - mainly silica, metallic oxides, and insoluble sulphates. The soluble sulphates are then subjected to a series of crystallizations and precipitations until pure aluminum hydroxide results. Alumina (Al_2O_3) is obtained from aluminum hydroxide ($Al_2(OH)_3$) by calcining.

It may be pointed out that the end product in the first step to obtain metallic aluminum is alumina, the oxide, whether the original material be bauxite, clay, alunite, or any other aluminous material. After the alumina is obtained the reduction to metallic aluminum by electrolysis in a cryolite bath is a standard process.

Importance of Pilot Plant

Supplies of clay for the production of alumina are limited only by the "cut-off" point of percentage of available alumina contained. Naturally, physical characteristics of the deposit, location and transportation facilities, water supply, and availability of electric power and fuels have a direct bearing on the feasibility of any project. But generally speaking domestic reserves of high alumina clays are very large. However, they are of no value whatever as a source of alumina unless a workable process for treatment is developed in detail in a large pilot plant. Only a plant operating under actual working conditions on a scale large enough to simulate a commercial operation would provide the information required for design of a large commercial plant or plants. This is a matter for the government as it is of direct interest to all the people. The outcome of a future war might depend upon our ability to produce aluminum from domestic deposits. The large aluminum companies have sources of supply of bauxite in the Guianas, and do not have the necessary incentive now to build an "alumina from clay" plant which, so far as we now know, would be "high cost" compared to a plant using bauxite.

Plant Location Should be in Northwest

According to present practice alumina is made in plants located at East St. Louis and Mobile. The required amount is then transported across the continent to reduction plants in the Northwest where ingot aluminum is produced. This is indeed an excessive amount of transportation. An alumina plant located in the Northwest, preferably on tidewater, would appear to be the logical answer.

Oregon high-alumina clays are relatively high-grade and occur in large quantities - of the order of many millions of tons in the two deposits partially explored. Other unexplored deposits in western Oregon are known. Particularly favorable conditions for an alumina plant prevail in northwestern Oregon due to the availability of Bonneville power, coal, nearness to ocean transportation, excellent working conditions, and proximity to established aluminum reduction plants at Vancouver, Troutdale, and Longview. No other part of the country has so many favorable conditions.

Prices

Aluminum was first isolated in 1825. It remained more or less of a laboratory curiosity for many years. In 1855 the price was $113 a pound. In 1886 Hall in this country and Heroult in France simultaneously discovered that metallic aluminum could be produced electrolytically from a cryolite bath. This discovery gave birth to the aluminum industry. In 1890 the price was $2.38 a pound. By 1900 the price had been reduced to 23 cents a pound, and now the nominal quotation for ingot aluminum is 15 cents a pound. These successive reductions in price reflect the striking growth of the industry. As the scale of operations increased, unit costs were reduced. But reduction in costs was not due entirely to increased scale of operations. In no other industry has the skill and ingenuity of American metallurgists been more clearly evident.

Domestic crude bauxite (not dried), 50 - 52 percent alumina, is quoted by the Engineering and Mining Journal as $5.00 per long ton (2240 pounds). Of course no comparison of the value of crude clay on the basis of alumina content may be made from this quotation because there is no present market for clay for production of aluminum. The only means available of arriving at a gross, potential value of clay suitable for production of aluminum is to multiply the aluminum content of the clay by the market price of aluminum. This gives a distorted figure, as the "alumina from clay" plant must sell its alumina to an established reduction plant at a price set by the reduction plant. This price has been reported to be $50 per ton plus freight.

It is of interest to compare this price for alumina with the gross value of metal contained. Alumina contains over 50 percent aluminum - say 1000 pounds to the ton. This means a gross value of $150 per ton for material costing $50 a ton. The difference is of course used up to a considerable extent in labor and cost of power and supplies required to produce aluminum from alumina, plus amortization of plant. Nevertheless the industry has been very profitable, and, as it is quite well known, it is largely controlled by a single corporation.

Post-War Prospects

Of all the non-ferrous metals, aluminum is in the most favorable position for post-war business because of its increasing use as a structural material. The industries which are likely to expand most in the post-war world - those connected with transportation - will require large quantities of the metal. Compared to the copper industry, which is taking a beating in this war in depletion of ore reserves and in rigid price restrictions according to various quotas, the aluminum industry should go into the post-war period stronger than ever. There has been no price restriction on metallic aluminum except that established as economic by the industry itself. There has been depletion of domestic reserves of high-grade bauxite, but the known reserves of this grade have never been large. In recent years the industry has depended largely on the reserves in the Guianas. In point of contained metal these foreign deposits are very large, with additional large potential reserves in unexplored areas.

From a long range viewpoint the aluminum industry is youthful; it is still growing. On the other hand the domestic copper industry shows signs of age - premature age. Its output will shrink because of excessive depletion of reserves and burdensome taxes - conditions largely due to short-sighted policies of Washington bureaus. In normal times aluminum and copper are competitive in certain lines. Undoubtedly aluminum will be in a relatively favorable competitive position in seeking post-war business. Expansion in application of light metals and their alloys will continue, and domestic high-alumina clay deposits may, in the future, easily prove to be the backbone of the aluminum industry. It will be necessary to turn to them in time, and it would be the part of wisdom to work out the metallurgy on a commercial scale before another emergency strikes.

F.W.L.

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NEW FORM FOR ACCESS ROAD APPLICATIONS

In order to standardize the original application for access road assistance, the Public Roads Administration has prepared Form PR-DA-3 to be used by applicants. These forms provide the minimum of information necessary to initiate a project of construction, improvement, or maintenance of access roads to sources of raw materials. Use of the new form does not change the procedure for obtaining assistance. Forms PR-DA-3, which should be filled out in duplicate, may be obtained at the Portland Office of the Department or from district offices of the Public Roads Administration.

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"DOC"

A Tale of the North Country*

I first met "Doc" in Dawson about 1898. He must have had more of a name than that, 'though I have never heard it. At that time he looked to be about 35 years old - a youngish man whose hair was prematurely graying at the edges. Doubtless one reason for his youthful appearance when I saw him recently was a splendid new set of teeth that he had just had made in Vancouver, B. C. He was so proud of them that he made the trip down to Portland so I could see them. During our visit Doc gave me the substance of the story that follows.

Doc is a placer miner and has a sizeable concession near the head of the Stewart river among the "Four-leaf Clover" lakes. Last winter he drifted a lot of old white channel stuff that proved pretty good; anyway he had between a ton-and-a-half and two tons of gold-dust and nuggets at the clean-up in May. That's a lot of gold in any man's country; too much to mush out with pack-sacks or sleds; and anyway there were'nt enough mules in the Yukon basin to handle it. So Doc started in a woods-made canoe, down the Stewart river for Selkirk in order to arrange for a couple of pontoon planes to come in from Carcross and take the gold out to the railroad.

Running the Stewart proved easy the first two days but on the third a land-slip decided to occupy a bend in the river at the same time that Doc and his Canadian "white water man" were shooting past in their canoe. Doc was the only survivor, - sans everything in the way of equipment save his Hudson's Bay knife and a waterproof match case, but minus his false teeth. He was about 175 miles due east "from the knowledge of Providence", in the west foothills of the Canadian Rockies and no eats. But Doc was resourceful - which goes without saying if a man sticks with the Yukon country for nearly half a century. He noticed bear signs along the bank of the river and so, there being an old spruce burn nearby with plenty of down logs, he rigged a deadfall where any inquisitive bear examining the fishing prospects would be sure to see it. He had no bait, but come dusk he ensconced himself in the machine as bait, taking the fifty-fifty chance that the bear would come from the right direction, which he did. When his bearship tripped the key-log he got his furry old back broken. Doc promptly finished the job with his Hudson's Bay knife - which tools are probably better than the legendary Toledo blades for edgeholding ability.

Doc built a fire, cut off a hunk of bear-meat and roasted it, but the bear was no spring chicken and had evidently had a hard winter. Doc says "Multiply the toughest steak you ever saw by about 2,000, subtract the gravy and you have some idea." He simply couldn't "gum" that bear-meat, and that was a finality. But resourceful Yukoner that Doc was, he wasn't going to be stuck. He whittled down an unsplittable Yukon birch, cut some pieces off and by dint of taking some clay impressions of his jaws and faithfully copying them he soon had the groundwork of a set of teeth. Next, he took the bear's jaws over to a convenient rock-pile, knocked out an assortment of teeth, bored holes with the knife point in his wooden frames, mounted the teeth therein and proceeded to eat that bear with the bear's own teeth.

Next he shouldered a large hunk of meat and a piece of hide to sleep under, and made the distance to the Yukon opposite Fort Selkirk in less than a week. He shortly spotted a couple of chaps in a boat and by signaling them induced them to come close enough for a good look. They would come no farther, because Doc was wearing his handicraft, had two weeks of grizzled beard, and his bearskin over his shoulders.

Those boatmen beat it across to the CNWMP station at the fort and shortly afterwards three brave "mounties" armed with rifles came and rescued Doc. They knew him and from then on his troubles were over, except that he had to come out and get some teeth that fitted better because the ones he made so fortuitously made his gums somewhat sore.

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*This story was related by Geo. F. McDougall, consulting engineer and patent expert and good friend of the Dept. "Mack", who made the Klondike rush and stayed there some years because it seemed like a good idea, has a fund of stories and his own way of telling them. He does not vouch for the accuracy of North Country stories beyond his own ken. Would you?

COAL UTILIZATION

The following is taken from the July, 1943 issue of Oregon Purchasing News, published by the Purchasing Agents' Association of Oregon. The item is timely in that both transportation and fuel supplies are so critical.

The British program which expects to obtain 30% greater energy from coal utilization and also obtain a more direct production of coal by-products (British Coal Utilization Research Association) might well be given more attention in this country. For the most part we are primitive in our coal utilization. Coal will absorb about 25% of water, and common practice is to ship water-soaked coal. Not only is it wasteful in transportation to ship raw coal, but it is wasteful to have to drive off the contained moisture in burning. Dried and briquetted coal gives high efficiency, burns regularly and evenly, permits use of lower grades, gives off less smoke. Introduction of the chemical by-product plants at the mine mouth also provides better utilization of all grades of the coal, furnishes the moisture-proofing material for the briquettes, and would diversify industrial jobs in districts now hampered by single-industry stagnation. In this country some research has been along the lines of mixing powdered coal with fuel oil for burning under industrial boilers (U. S. Bureau of Mines). As much as 40% powdered coal is mixed with the oil. Results of the efficiency tests have not yet been published.

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BULLETIN PRICE REDUCED

The price of Department Bulletin No. 4 by H. C. Schuette issued in 1938, has been reduced from $1.15 to 50 cents. A survey of quicksilver deposits of the state is being made for the Department by Francis Frederick, consulting geologist of San Francisco, and results will be published as a bulletin sometime this fall. This report will not, however, duplicate discussions of the economics of the industry and metallurgy given in Bulletin No.4.

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BERYL SALABLE AT METALS RESERVE DEPOTS

Metals Reserve Company will purchase clean beryl crystals delivered in sacks or other suitable containers at Purchase Depots under the following schedule:

Specifications: For beryl ore to be acceptable, the BeO content must be 8% or more and in the form of clean crystals, cobbed free of waste.

Price and Quantity: Large Lots (in excess of 2000 pounds), payment will be made after weighing, sampling and analysis (this includes moisture determination) on the basis of $120 per dry short ton for 10% BeO grade ore, with an increase of $12 per dry short ton for each one percent (1%) of BeO in excess of 10%, and a decrease of $12 per dry short ton for each one percent (1%) of BeO below 10% to a minimum of 8% BeO. Fractions prorated.

Small Lots (200 to 2000 pounds), which do not warrant the expense of sampling and analysis will be purchased, after weighing, on sight inspection by the Agent on the basis of $120 per dry short ton for 10% BeO grade ore. To be acceptable on sight inspection, that is, without sampling and analysis, the beryl crystals must be clean and all waste material cobbed off and free of inclusions of feldspar, mica or other deleterious material. This procedure of purchasing small lots of beryl ore will from time to time be revised as to price if analysis of composite samples of such lots at any Purchase Depot necessitates it.

(From Metals Reserve Company circular July 26, 1943)

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September, 1943 Portland, Oregon

STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES
Head Office: 702 Woodlark Bldg., Portland, Oregon

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CERAMICS

Introduction

To many people the word "ceramics" brings to mind the familiar wayside pottery with its assortment of stoneware mugs and pitchers, hand-thrown pots, and bright-colored tiles. The ceramic industry, however, includes a far more extensive field; it involves all the silicate industries, bringing into play physics, chemistry, geology, mineralogy, and applied engineering principles, as well as the skill and talent of the designer.

The word "ceramics" is derived from the Greek, "keramos", meaning "potter or pottery", and "keramos" is further related to the Sanskrit word meaning "to burn". Thus a ceramic product is one made of an earthy, non-metallic raw material, requiring a firing operation.

History

Pottery is known to have existed eight to ten thousand years ago but information concerning ancient ceramic ware is meagre. The first evidences of clay work were found in the region of the Nile Valley in Egypt, where the products were sun-dried and consisted mainly of containers and adobe brick. It has been suggested that the discovery of applying higher temperatures to ceramic ware was accidental, but the date of any such discovery is unknown.

Since ancient time each civilization, including the Greek, Roman, Byzantine, Moorish, and Far-Eastern, has made its contribution to ceramics, but until the eighteenth and nineteenth centuries the main developments were of an artistic nature.

The Renaissance, however, produced Galileo, Copernicus, and Kepler, and with them the advancement of optical glass. About the same time Marco Polo was laying the cornerstone for trade with China, where the highest degree of perfection in the manufacture of porcelain had been attained. The Chinese had been most fortunate in finding a white-burning clay which became the envy of all Europe. It was then that imitations of the white Chinese porcelain began to appear. This was an important step, for with it came the creation of engobe ware, majolica, faïence, and soft-paste porcelain. During this period Holland was producing the blue and white Delft ware, and Germany was excelling in salt-glazed stoneware. The picture would not be complete unless we mention the fine English wares of Wedgewood and Spode. In considering the history of ceramics up to the nineteenth century, one can understand the natural association of art pottery with the word "ceramics".

It was not until the middle of the nineteenth century that the first refractories were manufactured on a commercial basis. Enamels applied to utilitarian products as well as the development of lime-gypsum type plasters are also of recent date. Within the past hundred years there has been continual development in such products as spark-plugs, enameled stoves and refrigerators, glass of all sorts, structural units, and abrasives.

Clay

Of all ceramic materials clay is by far the most important. It has been defined as "an earthy or stony aggregate, consisting essentially of hydrous silicates and alumina, plastic when sufficiently pulverized and wetted, rigid when dry, and vitreous when fired at a sufficiently high temperature." Clay is not a pure mineral but rather an aggregation of minerals of which kaolinite ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$) is usually a primary constituent. Such minerals as montmorillonite, beidelite, and allophane are clay-like in character and are classified along with kaolinite as clay minerals. Bentonite, for instance, is a clay whose primary constituent is montmorillonite, but those clays used in the ceramic industry are mainly of the kaolinite variety.

Clay is formed by the decomposition of igneous rocks of which granite is a common example. Granite contains feldspar as an essential constituent and feldspar is the mineral from which clay is derived. Temperature changes, water, freezing and thawing, plants, wind, and glacial action disintegrate the original rock mechanically, while water, carbon dioxide, soil acids, and oxygen may react chemically with the rock. The resulting products are mainly kaolin (clay) and silica.

Clays vary both chemically and physically, and several different systems of classification have been set up. In the main the ceramist is acquainted with a few basic but decidedly different types of clays, and it would be well to consider here the more commonly used types.

The so-called common clay includes those varieties which fire to red or buff colors and are usually employed in the heavy clay products industry. The specific uses of common clay are for making common brick, structural units, sewer pipe, etc.

Refractory clays include those types which are capable of withstanding high temperatures. They are often referred to as fire-clays, but the specific uses of each clay usually result in such designations as pot clays, retort clays, and bond clays. Bond clays are very plastic and are generally of the ball clay variety, which is described below. The refractory clays are generally buff-burning, although some white-burning kaolins are employed in making fire-brick. Refractory clays are used mainly for fire-brick and refractory cements.

The whiteware clays are white-burning, light-colored, and fine-grained when fired in the range of cone 4 (2129°F.) These include the kaolins and ball clays and are used in suitable combination with feldspars and flint in the production of dinnerware and electrical porcelain.

Ball clays are fine-grained and highly plastic. They usually contain a varying amount of organic material and for this reason tend to burn to a cream color. The ball clays are used principally as the plastic ingredient in ceramic bodies.

China clays are composed mainly of kaolinite. They are white-burning at high temperatures and light-colored in the raw state. At the same time they are coarser-grained and less plastic than ball clays. The residual kaolins like English china clay and North Carolina kaolin are less plastic but whiter than the sedimentary kaolins, of which Georgia and Florida kaolins are good examples. The china clays are used in dinnerware, wall and floor tile, insulators, etc., and may be sometimes classified under whiteware clays.

Sagger clays are used for kiln furniture (receptacles for holding and protecting ware to be fired) and consist of a mixture of sandy ball clays. Wad clays, which are used as separators between various pieces of kiln furniture, are also made up of sagger clays.

Processes and Products

Although there is a wide variety of ceramic products, the fundamentals of ceramic production can be boiled down to a few processes. First the clay must be taken from the earth. In some cases it is necessary to remove some of the contained impurities, while in others the clay may be used as it is found. The choice of procedure depends on the product to be made as well as the natural purity of the clay itself. Washing and screening are the principal methods of purification, although at times electrical methods are employed to remove the iron.

Preparation of the clay mix is the next step and the method used depends on the forming process to be used and the properties desired in the final product. The preparation of the clay consists of adding water and thorough mixing. In Table I the various forming processes are listed.

Table I

Process	Percent Water	Forming Method
Casting	20 - 40%	Poured into molds of Plaster of Paris
Soft-Mud	30%	Thrown into wooden or metal molds
Stiff-Mud	25 - 30%	Extruded from extrusion machine or jiggered
Dry-Press	2 - 18%	Pressed to shape in a hydraulic press

Cast ware is most dense; soft-mud and extruded or jiggered ware is intermediate; and dry press ware is most porous.

After the ware has been formed, it is then dried as it is essential that the mechanically contained water be driven off before the firing of the ware. Drying may be accomplished in various ways. Waste heat from cooling kilns is often utilized in drying, while common brick are frequently air-dried. In some instances special procedures make use of driers built specifically for the purpose.

Finally the ware is fired to a temperature which has been predetermined by experiment. Some clays have a wide maturing range which allows for a wide variation in firing to obtain a good product, although the heat treatment for a given product always is kept constant to insure uniformity. The firing is done in heated chambers called kilns, which may be up-draft, down-draft, or horizontal-draft, periodic or continuous, depending on the type of firing to be done and the amount of ware to be produced.

This description covers briefly the fundamentals involved in producing most ceramic ware, but it must be remembered that a detailed procedure is required for each product. It must also be kept in mind that the above procedure does not apply to the glass, enameling, and abrasive industries.

The following is a classification of ceramic products according to Wilson:

Structural Ceramics

1. Common Brick
2. Paving Brick
3. Face Brick
4. Sewer Pipe
5. Drain Tile
6. Hollow Block
7. Terra Cotta
8. Conduits
9. Roofing Tile
10. Flue Lining
11. Floor Tile
12. Wall and Fireplace Tile

Refractories

13. Fire-clay Brick
14. Magnesia Brick
15. Silica Brick
16. Chromite Brick
17. Bauxite and Diaspore Brick
18. Special Refractories

Pottery

19. Tableware
20. Kitchenware
21. Art Pottery
22. Sanitary Ware
23. Stoneware
24. Chemical Porcelain and Stoneware

Glass

25. Household
26. Window
27. Bottle
28. Lighting
29. Optical Glass
30. Glazes, Enamels, and Artificial Stones
31. Quartz Glass

Enameled Metals

32. Household and Kitchen
33. Sanitary
34. Chemical
35. Advertising

Abrasives

36. Silicon Carbide
37. Aluminous Abrasives

Cements, Limes, and Plasters

38. Portland Cement
39. Building, Agricultural and Chemical Lime
40. Calcined Gypsum Products
41. Magnesia Cement
42. Dental Cement

Insulation

43. Electrical Insulators
44. Thermal Insulators

The broad range of ceramics is shown by the marked contrast between fine chinaware and common building brick, between the porcelain bathtub and the lining for a steel furnace, between the beer bottle and the lens for a large telescope, yet these are all ceramic products. As ceramics reaches into so many phases of our daily life, the growth of the industry in this country reflects the growth of industry in general and growth of population, as well as the development of suitable domestic sources of the raw materials necessary for its varied finished products.

The dollar value of ceramic products in the United States has increased many fold during the past fifty years. The growth of the glass and refractories industries has been especially marked.

In Oregon and the Northwest in general, the ceramic industry is in its infancy. With ceramic materials, as with other non-metallics, local or nearby markets are all-important. In general, such materials will not stand high transportation costs. Therefore, Northwest markets for ceramic products are essential. Industrial growth and the resulting growth in population appear to be assured for the Pacific Northwest. Consequently the ceramic industries in Oregon and Washington will surely grow and expand.

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Esther W. Miller

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FEDERAL GOVERNMENT REGULATIONS AND THE SMALL MINE OPERATOR

by

A. M. Dixon

There is a lack of materials for all industrial and civilian needs due to the enormous war demands. Therefore, governmental regulation of supply and demand is essential in order to conserve materials and to distribute them to the operations most important in the war program. These regulations seem burdensome and at times unnecessary, but it should be remembered that maximum war production is all important and that all efforts and regulations are concentrated to that end.

Large mining companies are able to maintain a department concerned solely with governmental regulations. The small mine operator, however, must look after such matters himself and is sorely beset at times to know what to do in order to keep his mine a going concern. Most of his problems have to do with procurement, and this article outlines procedures to follow in order to obtain supplies. It also briefly summarizes functions of the various federal agencies in relation to the mineral industry.

All mining operations, including those of sand and gravel, and non-metallic mining as well as metal mines come under W.P.B. Preference Rating Order P-56. The Mining Division of the War Production Board administers priorities to the mining industry. The definition of a mining enterprise is very broad, encompassing all metal, coal, and non-metal underground and surface mining, and exploration. There are also numerous other industries which exploit mineral resources such as sand and gravel, crushed rock, salt production, diatomaceous earth, silica sand, etc. Production of raw material is covered through all processing stages until a salable commodity or product for shipment to a smelter or to a consumer is produced. (i.e. Copper is covered from its natural occurrence underground through mining, milling, and concentrating; sand and gravel are covered through mining, washing, and grading processes until ready for delivery; lime, cement, gypsum, and similar non-metallics are covered through packaging.) However, "hot-mix", concrete mix, fabrication of wallboard from gypsum and the like are not covered by Preference Rating Order P-56.

Priorities are obtained by the following procedures:

(Please note that Controlled Materials Plan Regulation 5 does not apply to mines, and controlled materials cannot be obtained under said regulation.)

1. Preference Rating Order P-56, as amended May 5, 1943, provides:

a. A rating of A-2 for maintenance, repair, and operating supplies for all mines (no special applications or serial number required). If higher ratings are required, Form WPB-2910 (metal mines) or WPB-1915 (non-metallic mines) should be filed. Never use WPB-541 (PD-1A) unless it is so specified by a particular restricting order as an "E", "L", or "M" order.

b. Substantial enterprises may be granted serial numbers permitting a quarterly dollar and weight value quota for maintenance, repair, and operating supplies for high priority -- currently AA-1. Applications for serial numbers should be made on Form WPB-1212 for metal mines; on Form WPB-2758 for non-metallic mines; and on Form WPB-2784 for coal mines. The completed forms should be sent to the State Emergency Coordinator of Mines for his certification (in Oregon, Mr. E. K. Nixon, Emergency Coordinator of Mines, Woodlark Building, Portland, Oregon) or to the Regional Technical Advisor, or direct to the Mining Division, Washington, D. C. Form WPB-2952 should be used for core or churn drilling. Quarterly quota applications are made on Forms WPB-2937, WPB-2938, and WPB-2939, formerly the PD-400 series, A, B, and C for metal, coal, and non-metallic mining operations, respectively. These quarterly quotas allot controlled critical materials with a high priority rating to the mining operation. Failure to submit quarterly quota forms will result in cancellation of the mining operation serial number.

2. Form WPB-617, application for permission to begin construction, should not be filed unless so recommended by the field representative of the Mining Division since certain types of construction of new facilities or expansion can sometimes be more expediently authorized under P-56 insomuch as mines are exempt from cost limitations under L-41 where the construction is an integral part of the mining operations. However, in the case of bunk houses, residences, and cook shacks, these are not considered directly connected with the mining operation and authority for such construction is obtained from the Federal Housing Administration field offices having jurisdiction over the location. Mill buildings are considered directly connected with the mining operation. If construction of mining facilities is to be done under P-56, the entire project must be presented to the proper section of the Mining Division, War Production Board, Washington, D. C. Usually, materials are secured by filing a supplementary quota request (Form WPB-2937, metal mines) and application for new material and equipment on Form WPB-2910.

3. Mines may receive emergency priority assistance from the War Production Board field offices. This is the only type of direct priority assistance field offices can give to mines and this is usually only in the case of actual breakdowns which are real emergencies.

4. The Mining Division maintains an expediting unit which gives assistance in obtaining material urgently required for important operations.

5. Under the Access Roads Section of the Mining Division, recommendations are made for construction of roads to mining enterprises where there is shown to be an actual need for the road and that a substantial tonnage of critical metals or minerals can be produced. To initiate an access road to a mineral deposit, Form PR-DA-3 should be obtained from the Public Roads Administration, completely filled out, and returned to them. Most mining properties in this area are located in the National Forest Reserve and when such is the case, the Public Roads Administration works in close cooperation with the Forest Service.

Detailed information concerning access roads within the National Forest can usually be secured from the District Engineer of the Forest Service.

The Public Roads Administration may have the Forest Service build the road after it has been approved or it may be built directly by PRA. After an application has been submitted to the Public Roads Administration and an estimate for the cost of construction submitted to the District Engineer, he will then secure a report from the United States Geological Survey or the United States Bureau of Mines. This report will then be forwarded to his superiors and the Public Roads Administration will send the application to the War Production Board, Washington, D. C. for approval.

Rationing of gas and tires for passenger cars, as well as food, is controlled by the Office of Price Administration, and County Rationing Boards have jurisdiction over these matters. Allotments of gas and tires for trucks, together with purchase of new trucks, are under jurisdiction of the Office of Defense Transportation.

Operating labor problems are in the province of the War Labor Board. Matters connected with hiring labor are under the jurisdiction of the War Manpower Commission and the United States Employment Service.

Use and purchase of explosives are controlled through the issuance of explosives licenses usually handled by County Clerks of the counties in which the mines are located. Regulations governing sale and storage of explosives are made and supervised by the United States Bureau of Mines. Bureau safety engineers make periodic inspections in order to check closely possession and storage of explosives, and on recommendation of the safety engineers, an explosives license may be cancelled. Such cancellation is made if there is evidence that a licensee is not storing, using, or properly safeguarding explosives in his possession.

The Metals Reserve Company, a subsidiary of the Reconstruction Finance Corporation, was formed to expedite production of needed minerals and also to provide a direct market for many of these minerals. The Metals Reserve Company pays through established smelters a premium price on domestic production of copper, lead, and zinc in excess of monthly quotas established by the War Production Board and the Office of Price Administration. A ceiling price for these metals was established by the OPA. The premium payment is the difference between the unit ceiling price and 17¢ per pound f.o.b. Connecticut Valley, copper; 9¼¢ per pound New York, lead; and 11¢ per pound East St. Louis, zinc. In order to establish quotas and hence make producers eligible for premium prices, all cases are reviewed by the Metals Reserve Company with the advice of the War Production Board.

The Metals Reserve Company has established ore purchasing depots at various points and will buy directly or through agents certain minerals and ores such as mica, chrome, manganese, tungsten, tin, antimony, molybdenum, quicksilver, and beryllium.

The Reconstruction Finance Corporation makes mining loans and maintains field offices with technical personnel who make examinations of mining properties in conjunction with loan applications.

The United States Bureau of Mines, through its regional offices, examines mines and prospects which may qualify for exploration by the Bureau. Approved projects generally take the form of drilling, trenching, or at times underground work in order to show extent and quality of the ore deposit. Usually, such projects include metallurgical testing work.

In order to conserve manpower and critical materials, gold mines (non-essential) were closed in October, 1942, according to W.P.B. Limitation Order L-208. This order is still in effect. All requests for relief from this order should be made to the Deputy Administrator, Limitation Order L-208, Mining Division, War Production Board, Temporary "R" Building, Washington, D. C.

The Mining Division of the War Production Board maintains an office at 822 Bedell Building, Portland, Oregon with a Regional Technical Advisor in charge, who serves the mining industry in relation to the war effort, particularly to assist in clarifying priority problems.

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WHAT'S DOING IN THE DEPARTMENT THIS SUMMER

All work of the Department is aimed directly or indirectly at aiding the war effort. During the summer, a considerable portion of the Department's activities has been in connection with the exploration of Coos Bay coal. Three staff members are putting in full time in the district. The job is in charge of John Eliot Allen, chief geologist. Dr. Ewart Baldwin is assisting largely in geologic investigations. Ralph S. Mason takes care of the drilling, purchasing, and supervising of labor. Although the general geology of the Coos Bay district is known, having been published in folio style by the U. S. Geological Survey forty years ago, it has been necessary to work out detailed geology to assist in the current exploration. Stratigraphic studies which should correct minor errors in the older work are under way. In planning the drilling and exploration, emphasis has been placed on finding stripping coal in deference to the manpower situation and because strip or open pit coal can be produced for next winter's use.

Ray C. Treasher, field geologist with headquarters at Grants Pass, has been dividing his time among quicksilver, coal, antimony, copper, and other strategic properties, and has completed in preliminary form compilation of a geologic map of the entire southwest quarter of the State.

N. S. Wagner, field geologist at Baker, has been putting most of his time on an antimony report which, when completed within the next month, will cover all known antimony prospects in the State. He has also been spending some time on base metal properties in the Blue Mountains and on optical calcite in Malheur County.

Dr. H. C. Harrison has kept the M - G set in the spectrographic lab singing full time and overtime on everything from the elements of deep-seated ores to the contents of the stomachs of poisoned cows. Most interesting are Harrison's studies of soil deficiency elements having a bearing on war food production and his analysis of alloy metals. Esther Miller, our ceramic engineer, assists Harrison in the spec lab, is accumulating data and equipment for clay testing, and doing some certain research.

Dr. Wallace D. Lowry, assistant geologist, after winding up in succession a vanadium problem in Coos County and a report on optical calcite in southeast Oregon, has been working the past month on foundry sands. We hope to produce a high enough grade foundry sand to cut down long rail shipments of this product from the middle west to Portland.

L. L. Hoagland has been doing all of the chemical and other analyses possible in our consolidated laboratory at Portland, although handicapped by difficulty of getting contractors to complete the plumbing, electrical and ventilating laboratory facilities.

Mrs. Owen and Mrs. Priestaf run the multigraphing or "printing" part of the establishment, take care of the library, file publications and keep the card indices.

F. A. Steeble handles the accounting, all orders and requisitions, payrolls, and the equipment inventory of the Department.

June Roberts, secretary, does a large part of the typing of the Department and has charge of the correspondence files.

Mrs. Furniss, stenographer, takes care of her share of the correspondence, mailing of bulletins, and desk inquiries.

F. W. Libbey, mining engineer, is acting director in Mr. Nixon's absence. Libbey proof-reads and edits manuscripts, edits the "Ore.-Bin" material, assembles mineral production statistics, and handles many mail and personal inquiries.

Mr. Nixon, in addition to administration, has been giving considerable time to mineral industry phases of the Department's activities. He also handles the largest percentage of the Departmental correspondence. He tries to spend at least one-third of his time in the field.

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CLEARING HOUSE

78-CH Mrs. Rena L. Culbertson, 703 Oak Street, Hood River, Oregon, wishes to sell one 5-ton "Champion" type quicksilver retort 36 inches in diameter by 8 feet long. Everything complete, price $1500 cash, located on property about 25 miles east of Prineville. Other equipment for sale includes a drill, cars, rails, compressor, and other machinery. The mine, formerly operated by Staley and Culbertson, is also for sale.

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October, 1943 Portland, Oregon

STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES
Head Office: 702 Woodlark Bldg., Portland, Oregon

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HUMPHREYS SPIRAL GRAVITY CONCENTRATOR

Treats

OREGON BLACK SANDS

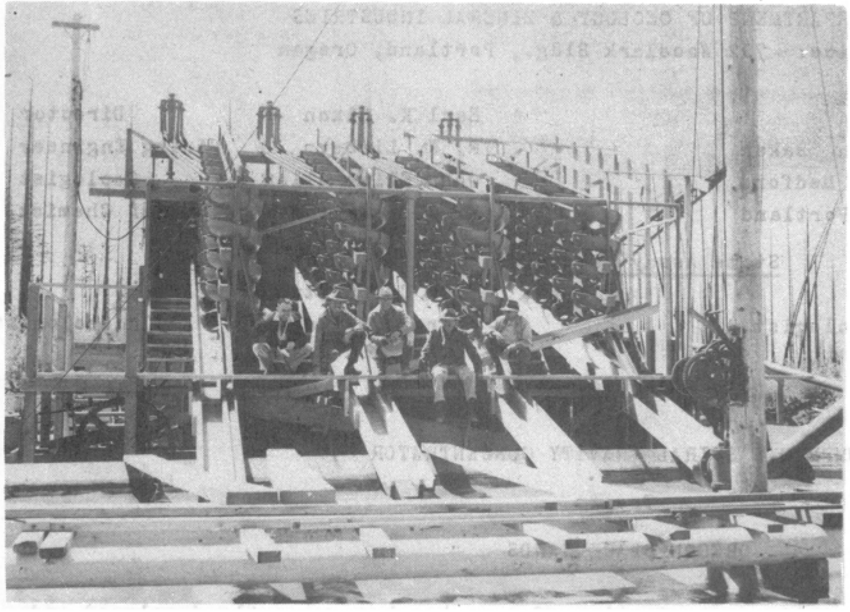
A major innovation in gravity concentration of ores has been recently developed and tested in large-scale operation by the Humphreys Gold Corporation, Denver, Colorado; and a plant employing the process is now treating 1000 long tons daily of chromite-bearing black sands at the Lagoons, located near the coast between Marshfield and Bandon in southwest Oregon.

This plant, which treats sand containing from 5 to 15% chromic oxide, raising this content to 20 to 30% in one simple operation, is contained in a small one-story building 24 by 28 feet square. The only moving parts in the plant itself are the motors and pumps which raise the sand and water, and the drag and stacker belt assembly for the finished concentrate. One man is sufficient to supervise and control the entire concentrating procedure.

The heart of this new method of treatment, which may prove adaptable to other materials susceptible of gravity separation, is the "spiral", which was first developed by Mr. I. B. Humphreys as a method of saving fine gold in placer operations. The first model was made from a tire casing, cut apart and stretched. The spirals in the black-sand plant are of cast iron, each unit comprising 120° of arc with an outside radius of 13 inches and a slope of 10 degrees. Twelve units are bolted together to form a stack, giving four complete revolutions to a stack, with a drop of 18 inches for each revolution. There are six stacks in each bank, which slopes at 20° so that each stack is lower than the preceding one. The Lagoons plant originally contained four banks; a fifth bank was installed late in August.

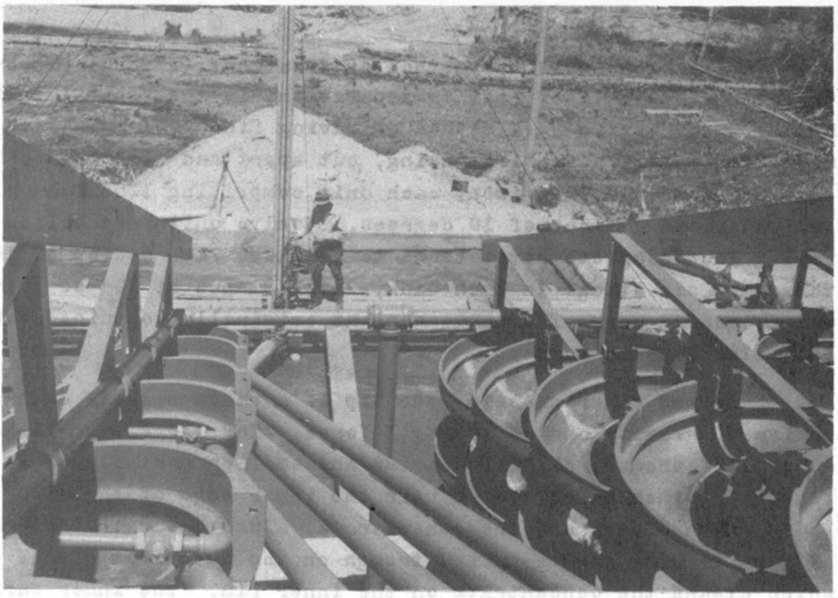
Sand and water entering the top of a stack spirals downward under the combined action of gravity and centrifugal force. The larger and lighter particles move to the outside of the spiral; the heavier and smaller particles move downward near the inner edge. One-inch holes, bored near the inner edge of each 120° unit, contain an adjustable knife which bleeds off the concentrate. Just ahead of the knife, an adjustable length of pipe leading from a raised trough on the outer rim of the spiral provides wash-water which cleans the concentrate on the inner rim. The inner surface of the spiral has a semi-circular cross-section with a radius of 8 inches.

At the mine, located near the plant, a Bucyrus-Erie dragline with 1½-yard bucket excavates the sand which is largely unconsolidated, and transfers it to a dry-land washing plant mounted on caterpillar treads. The sand is washed through a trommel to remove wood and trash and is then pumped through a 10-inch hose to a wooden storage sump built



VIEW OF HUMPHREYS SPIRAL CONCENTRATORS AFTER THEY WERE INSTALLED BUT BEFORE BEING HOUSED.

TOP VIEW OF HUMPHREYS SPIRAL CONCENTRATORS.



in the form of an inverted pyramid 40 feet square with 45-degree sides. Fresh water and middlings returned from concentrators are also fed to the storage sump.

A double-walled vertical pipe is suspended in the center of the sump from a pulley (the outer wall is bolted to the apex of the sump but raised sufficiently so that sand and water may be drawn in at the bottom). Agitation is effected by water pumped in through the inner pipe which may be raised or lowered in order to vary the amount of agitation required to keep the sand in suspension so that it may be pumped out through the outer pipe to the plant. Density of feed is quite variable.

The flow to the plant is split, first to serve each of the four banks of spirals and further to serve each stack, by an ingenious system of pipe distribution which assures an even flow to each stack.

The lower bleeder pipes in each spiral discharge a middling product into a launder which empties into the storage sump. When so desired, concentrates may be sent to the sump and re-treated. A high circulating load is maintained.

Concentrates are partially dewatered in a small drag classifier ahead of the stacker belt. They are loaded by clamshell-bucket into 10-ton trucks and hauled over a new access road to the Defense Plant Corporation's secondary concentrator located on a railroad spur at Beaver Hill, Oregon, 12 miles east of the Lagoons. Until late in the summer the concentrates had to be trucked by way of Bandon, a round trip of 59 miles.

The mill is electrified; draglines, bulldozers, etc., are gasoline or diesel-operated.

J.E.A.

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POST-WAR MONETARY STANDARD

(Reprinted from Bulletin Service of American Mining Congress, issue of October 1, 1943.)

A monetary system based on gold and silver by international agreement among leading commercial nations was advocated in a statement by Francis H. Brownell, chairman of the American Smelting and Refining Company, this week. Such action, according to Mr. Brownell, would retain every advantage of the international gold standard and yet assure an adequate supply of monetary metals for the post-war era.

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A monetary system based on a fixed ratio of silver to gold arrived at through international agreement, Mr. Brownell states, would have the following advantages: (1) the volume of standard money would be immediately increased, particularly outside of the United States, to meet the larger needs of the post-war world, thus enabling nations to maintain stability of their currencies; (2) the yearly addition to the world's stock of standard money would be expanded, for the normal annual output of some 40 million ounces of gold would be supplemented by production of some 270 million ounces of silver; (3) the stock of monetary metal could be expanded further, if found necessary, through drawing in considerable quantities of silver from the arts; (4) nations whose populations desire would be able to restore the coinage of standard money on a large scale; (5) if a world-wide shortage of standard money should again threaten, it could be corrected through stimulating silver production and lowering the ratio of silver to gold by international agreement; (6) the monetization of gold and silver would not make the International Stabilization Fund plan unnecessary, but would rather help assure the success of any such plan by facilitating each nation's ability to replenish its credit on the books of the International Fund through its power to deposit silver, as well as gold, for the purpose; (7) this is the only monetary plan that assures the world at large will possess an adequate stock of monetary metals, no matter how large domestic and external trade becomes, nor at what points world prices are stabilized; and (8) a much larger number of nations would be themselves producers of standard money and thus would be aided in maintaining the stability of their currencies through the production of monetary metals within their borders.

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LIMESTONE DEPOSITS IN OREGON

NAME	OWNER	LOCATION					RESERVES Tons	ANALYSIS	REMARKS
		County	Sec.	T.	R.	Nearest R.R. Shipping Point			
Dallas Quarry	Oregon-Portland. Cement Co. Portland, Ore.	Polk	1 2 11 12	8S	6W	On spur of Southern Pacific 3 mi. from Bridgeport	Fairly large-in hundreds of thousands of tons	SiO_2 24.08 Al_2O_3 } 15.66 Fe_2O_3 } CaO 31.58 MgO 2.74 CO_2 20.24 H_2O 3.56 Undet. 2.14 Total 100.00	Has produced cement rock for Oswego plant for number of years.
Lime Products Co. Quarry	T.T.Leonard Silverton, Ore.	Polk	11	8S	6W	Dallas- 4 mi.	Approx. 500,000	$CaCO_3$ from 50% to 80%	Stone is quarried and crushed for ag. stone
Marquam Quarry	T.T.Leonard, Silverton, Ore.	Clackamas	2	6S	1E	Molalla- 6 mi.	Approx. 500,000	$CaCO_3$ from 50% to 70%	Shell-marl beds. Some stone has been used as ag. rock.
Oden-Hatfield Property	R.V.Hatfield Roseburg, Ore	Douglas	33	27S	4W	Roseburg- 11 mi.	?	"Good grade" (No analysis)	Marble sawed for County Court House at Roseburg.
Harrington Deposit	W.K.Harrington, Roseburg, Ore.	Douglas	21	28S	5W	Roseburg- 11 mi.	Possibly 12,000 tons per foot of depth	$CaCO_3$ 97.6% Insol. 2.4	Lenticular deposit unexplored.
Bristol Quarry	F.I.Bristol, Grants Pass, Ore.	Jackson	6	37S	3W	Rogue River- 5 mi.	?	$CaCO_3$ 97%	Lenticular deposit undeveloped. Reserves could be fairly large.

NAME	OWNER	LOCATION					RESERVES Tons	ANALYSIS	REMARKS
		County	Sec.	T.	R	Nearest R.R. Shipping Point			
Hurricane Creek Deposits	Mr. R. Green Imperial Hotel Portland, Ore.	Wallowa	10	3S	44E	Joseph - 4 - mi.	20,000,000 Approx.	SiO_2 0.12 Al_2O_3 Trace Fe_2O_3 Trace MgO 0.28 CaO 55.62 Na_2O 0.11 K_2O Trace H_2O 0.10 CO_2 43.67 Total 99.90	Spec. gravity 2.71. All parts of deposit do not contain such high-grade stone. Pyrite shows in places.
ORC Quarry at Lime	Oregon-Portland Cement Co. Portland, Ore.	Baker	27	13S	44E	On main line-U.P. Ry.	Large - in excess of 40,000,000	SiO_2 1.99 R_2O_3 0.47 CaO 54.07 MgO 1.03 Loss on ignition 42.88 Total 100.44	Supplies stone for cement kilns at Lime and Oswego, Oregon. Also sells sugar-mill rock & ag. stone.
Conner Creek Deposits (Marble Mtn.)		Baker	5 27 28 29 32 33 34	12S 11S	45E 45E	4 mi. from Homestead Branch U.P. Ry.	Very large; in excess of 300,000,000	SiO_2 None Al_2O_3 None Fe_2O_3 None MgO 0.52 CaO 55.65 Na_2O Trace K_2O Trace CO_2 43.93 Organic None Total 99.84	Spec. Gravity 2.68. Considered to be one of largest bodies of easily accessible high-grade limestone in state.

NAME	OWNER	LOCATION					RESERVES Tons	ANALYSIS	REMARKS
		County	Sec.	T.	R.	Nearest R.R. Shipping Point			
Lostine R Deposits	Mr. R. Green Imperial Hotel Portland, Ore.	Wallowa	3	2S	43E	Lostine, Approx. 6 mi.		SiO_2 0.92 Al_2O_3 0.34 Fe_2O_3 Trace MgO 0.52 CaO 54.50 Na_2O Trace K_2O Trace H_2O 0.10 TiO_2 Trace CO_2 43.18 P_2O_5 Trace FeS_2 0.24 Total 99.80	Spec. gravity 2.72. Relatively accessible. In places contains pyrite. Three quarry sites.
Black Marble Quarry	Northwest Lime Company, James Cole, Atty Couch Bldg. Portland, Ore.	Wallowa	19	2S	44E	Enterprise Approx. 5½ mi.	2,000,000 to 3,000,000	SiO_2 1.17 Al_2O_3 0.17 Fe_2O_3 0.12 MgO 1.23 CaO 53.15 Na_2O 0.08 K_2O 0.08 H_2O 0.10 TiO_2 Trace CO_2 42.05 P_2O_5 Trace SrO 0.4 FeS_2 None Organic 1.75 Total 100.54	Spec. gravity 2.70. Elev. 7000 ft. Formerly quarried and hauled to lime kilns on RR at Enterprise. Burning produced high calcium lime - about 94.25% CaO.

NAME	OWNER	LOCATION					RESERVES Tons	ANALYSIS	REMARKS
		County	Sec.	T.	R.	Nearest R.R. Shipping Point			
Marble Mtn. Quarry	Pacific-Portland Cement Co., 417 Montgomery, San Francisco.	Josephine	19	37S.	6W	On leased spur track to Grants Pass - 12 mi.	Considered large in millions of tons.	SiO_2 0.87 Al_2O_3 0.35 Fe_2O_3 0.31 CaO 54.60 MgO 0.80 Ig.loss 43.41 Total 100.34	Most of production goes to cement kilns at Gold Hill, Ore., but paper mill rock and ag. rock are also sold.
Washington Brick and Lime Quarry	Washington Brick and Lime Co., Spokane, Wash.	Josephine	22	38S	5W	Grants Pass - 26 mi.	?	SiO_2 0.05 Al_2O_3 0.21 $\left.\begin{matrix}Fe_2O_3\\FeO\end{matrix}\right\}$ 0.28 CaO 55.61 MgO 0.34 Ig.loss 42.88 Total 99.37	Lenticular deposit. Stone is sorted and most of production is burned to "chemical lime".
Jones Limestone Quarry	F.I.Bristol, Grants Pass, Ore.	Josephine	31	38S	5W	Grants Pass - Approx. 26 mi.	?	SiO_2 0.13 $\left.\begin{matrix}Al_2O_3\\Fe_2O_3\end{matrix}\right\}$ 0.38 CaO 55.55 H_2O 0.26 CO_2 43.63 Total 99.95	Lenticular deposit, unexplored. Some marble monuments formerly produced. Analysis shows quality of the pure marble.

Other deposits which may be less important because of accessibility, size, or grade are as follows:

Imnaha River deposits,	Wallowa County	Byron property, northeast of Olalla,	Douglas County
Eagle Creek "	Baker "	Lively property, near Gold Hill,	Jackson "
Sisley " "	" "	Seattle Bar property, on Applegate River,	" "
Durkee region "	" "	Briner deposit, southwest of Phoenix,	" "
Suplee " "	Crook "	Bear Gulch deposits, near Little Applegate River,	" "
Fisher property, south of Roseburg,	Douglas "	Millionaire Mine deposit, east of Gold Hill,	" "
Dodson " " " "	" "		

References: (1) Moore, B.N., Non-Metallic Mineral Resources of Eastern Oregon; U.S.G.S. Bulletin 875. (2) Hodge, E.T., Market for Columbia River Power Using Northwest Minerals, Sec.III, Northwest Limestone; War Department, Office of Division Engineer, Portland, Oregon. (3) Mines Handbook, Bulletin 14, State Department of Geology and Mineral Industries, Portland, Oregon.

PRINCIPAL USES OF LIMESTONE

LIMESTONE

- Lime
  - Calcium Carbide
    - Acetylene
      - Cyanamide
      - Cyanide
      - Ammonia
      - Nitric acid
  - Plasters
  - Sand lime brick
  - Water treatment
- Carbon dioxide
  - Dry ice
  - Liquid carbon dioxide
- Chemical industry
  - Hypochlorite
  - Calcium chloride
  - Metallic calcium
  - Preparation of glycerine
  - Greases, soap, candles
  - Soda ash, caustic soda
  - Insecticides, disinfectants.
  - General alkalizer
- Portland cements
- Aluminous cements
- Building stone
- Monumental stone
- Metallurgical flux and reagent
- Refractories (High magnesia limestone)
- Glass making
- Mineral wool
- Ceramics
- Whiting
- Chalk
- Pulp & Paper
- Sugar
- Textile industry
- Agricultural uses

November, 1943 Portland, Oregon

STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES
Head Office: 702 Woodlark Bldg., Portland, Oregon

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THE SMALL MINER - FINISH!

There's an old time miner's song that begins, "Oh, the miners came in forty-nine..." and with occasional reference to strong drink and indelicate women, it carries on through several stanzas with the lilt, lingo, and lurid deviltry of an early day gold camp. It isn't a song one sings in mixed company, but it goes big at engineers' stag smokers. The writer, as a cub engineer, first heard it on the Mesabi and Michigan iron ranges many years ago. In the last dozen years, since living in the west, we've heard the song more often. It's the same old song, not altered a hair; but its heroes, the miners - Lawd, how dey's changed!

More than once in very recent years - since the coming of OPA, and WFA, and WPB, and ODT, and PAW, and WMC, and the other oft-damned, trinomial contrivances - the writer has paused by the trail into Sailor Diggins or some other fabulous gold strike locality, and tried to re-create in his mind the conditions that brought fame to the spot. Like as not some sourdough got "likkered up" and talked about his find. There was a stampede. And, brother, in those days, whether the stampede was across forty or four hundred miles of country, the miners were not deterred one whit by prohibition or act, natural or otherwise, of God or man - least of all by any such unborn innovations as gas rationing, job freezing, tire shortages, food coupons, high labor rates, directives, quotas, limitations, priorities, fear of income taxes, or by any other of the present day impediments to the exercise of private enterprise. We've tried deliberately to conjure up a picture of these old-time miners, mentioned in the song, negotiating for a copper quota; being told by an RFC engineer how to run their diggings; trying to get a priority on drill steel; quibbling with a ration board about gas, tire, and food rations; paying most of the gold from a bonanza find in income taxes; making out old age compensation forms; or being told by a "callow collegian" in the War Manpower Commission that they are frozen to their jobs and can't go down the trail whenever they goddam please. We can't picture them. You try it.

If the essence of this yarn is the passing of the small miner, let's try to be logical and dispassionate, and see whether he was any good in the beginning - whether he is worth keeping. If not, then let's bury him - with his boots on as he would have liked; if he IS worth keeping, let's carry on with all vigor to set the stage for his triumphant return as soon as the present terrible conditions are over.

They say that the early day miner with his pick, pan, sow-belly, and burro "made" the west, that is, the so-called western mining states. We don't know; no one can prove the point as an engineer would prove a methematical formula. But it's certain that sourdough prospectors, gold miners and other miners had a lot to do with the moving about, hither and yon, of quite sizeable chunks of population - as when word of a new Klondike, or Comstock, or Alder Gulch, or "find" on the Mother Lode, travelled along the grapevine. And how many thriving communities between the Mississippi and the Sierra Nevadas germinated from a few stragglers that fell by the wayside on their trek toward a gold fortune in California around the middle of the last century? The number is legion.

The old time miners were individualists; each went about his business in his own way; each knew exactly what he wanted. There was little indecision; in fact, there was much truth in the saying about "the quick and the dead"; as evidence, read the ages on tombstones in many of the old "Boot Hill" cemeteries from southern Oregon to the southern Mother Lode. In those days there was sound basis for individual initiative - there was real incentive - incentive to work hard and if necessary to take personal risks. The race was what one made it and the reward was ample if one "struck it". We hear you say facetiously to us, "Then how would you like to swap the present for the past, and go back to those 'good old days' when men were men, when women wore dresses, when price had some relation to a willing buyer and a willing seller, when....?" Of course, we'd hedge a minute before answering, but we'd say quickly that, whatever you may think of those good old days of the dim past, the present set-up in mining leaves a whole Hell of a lot to be desired.

But, through the years, conditions have changed for the small miner. (By small miner we mean from single prospector to little "mine" with three or four workmen.) In the early days the individual miners formed groups for protection against Indians, thieves, and racketeers; a little later, as the ores became leaner or the mines went beyond windlass depth, miners formed associations and companies in order to make the diggings pay. Such groups, at least some of them, were the beginnings of some of the big-name mining corporations and bonanza operations that are known today. So even the large mining corporations owe a debt to the small miner. As a rule, they encourage the little fellow to carry on. At one time or another, miners go prospecting on their own. They sometimes find little mines and some of the little mines make big ones. When pickings are slim the small miner and prospector frequently go back to work at the established mines, and the mine operators are pleased with this arrangement. It has been an adage that prospectors and miners "find" mines, but that engineers and the larger mining companies "make" the mines. Regardless of who "made" them, it probably is true that most of the hard rock, precious metal mines were discovered by the small miner or prospector.

Various persons have said, in effect, "The bonanzas have all been found; the prospector and small miner are through; mines in the near future will mainly be 'developed' by the larger companies from the marginal deposits or from 'big low grades', or on technology, where the little fellow hasn't a chance." We agree that the trend is definitely in that direction; that the "good little mine" is becoming harder and harder to find, and that the very great bulk of all mineral and ore production comes, and will continue to come, from the larger mines. But we will fight 'till Hell freezes solid for the small miner or prospector who has the guts, or the stupidity, or the cunning, or the asininity, or the clairvoyance, or the inspiration, or whatever it takes to drive with main strength and awkwardness, and at his own expense, a drift that the writer as a supposedly competent engineer might not recommend that his client drive. Inconsistent, you say? Not at all. The congenital and indefeasible right of every American citizen - acting on the profit motive - to make a damn fool or a millionaire of himself by poking a tunnel into any hill on free range where his fancy dictates, is, in the writer's opinion, the very essence of free enterprise, which in turn is the essence of Americanism. If that isn't worth standing up for, then we had better try to give the whole business back to the Indians. Private enterprise and the profit incentive built this country, and when anyone, any group, agency, or entity tries to repress the operation of these two basic American concepts, the motives of such persons or groups should be meticulously scrutinized.

About this last-of-the-bonanza matter - we recall hearing in recent years from the lips of one of the Holmes brothers the story of the finding and developing of the famous Silver Queen mine near Mojave, California, by himself and three partners. When the news got around the property was promptly sold for a million dollars to one of the largest gold companies, the small miners profiting hugely. A few other instances of the last ten years could be cited. The person who thinks that all the bonanzas have been found does not take into consideration extensive areas of potential mineralized ground in the mountainous and inaccessible corners of the West.

As to the small miner's worth, he is very much a part of the local economy in a mining community. Through the years he has been buying his grub and supplies from the local stores. In 1938 a statistical survey was made in the Grants Pass, Oregon, community to determine what the small miners' dollars meant in retail stores. When the results of a canvass of 80% of the establishments were footed up, the total (well over $600,000.) was so large the canvass was discontinued. It was thought that the public would receive any such amazing figure with skepticism. Even so, many thousands of dollars in cash purchases by miners were omitted from the figures, as there was no separate record or segregation of them.

There are a few mineral products to which the small miner's style of operation is particularly adapted. Mica is one of these. It comes in small bunches and "pockets" and is therefore mainly a small miner's proposition. Hard rock chromite is another. Quicksilver is a third. Almost invariably, quicksilver mines are discovered by prospectors by panning and "pocket hunting". A smart miner can make a "shoestring getaway" by cobbing out and retorting high-grade quicksilver ore. Sometimes one turns up a property where a furnace must be installed. That requires financing and a technical operation beyond the ability of most small miners. However, the actual and total contribution of the prospector and small miner to the mining industry is out of all proportion to the dollar value of his product in comparison with the industry total. That fact is too commonly forgotten.

As to whether the prospector and small miner are worth saving - no one except the least informed has any doubt. They are. If for no other reason than their past record and contributions, the little fellows, as an institution, are worthy of their niche in the hall of the immortals. In the war effort, they have in their way responded as well proportionately as the big fellows, although under great difficulties.

Granted that the small miner has earned his "keep", let's follow him rapidly through the last twenty years, study his habits a bit, and try to figure a way of getting him back as soon as possible.

In the early "20's" he did rather well. Times were average, wages were average, and prices of metals were average. In the late "20's" mining incentive, in the form of higher prices for ores or metals, became more evident, but both wages and cost of supplies went up proportionally. However, as most people had money to invest and wanted really quick action, they put their money largely in securities, the day-to-day prices of which they could watch in the newspapers. Nevertheless, money for small mining was ample, so the prospector and small miner thrived.

Then came the crash of 1929, almost everybody lost money; security and metal prices hit bottom. Much of the incentive for small mining vanished, except in the case of gold. Gold saved the day. We have seen ex-bankers, ex-brokers, ex-bond-salesmen, and ex-almost-everything working with pick, shovel, and rocker or long tom on the gold streams in various parts of the west. These people stayed off relief and, as they put it, retained every iota of their self-respect as well as their health. The sight of a man, obviously a former executive, professional man, or technician, swapping a few pennyweights of gold dust for pancake flour, beans, salt pork, and tobacco in a wayside store in the gold country, gave an observer a bit of insight into a corner of the true American character, and revived one's faith in it. That kind of character just won't be licked. The seasoned sourdough helped the greenhorn; some mutual respect was developed, no one starved.

In 1935 the price of gold was upped to $35. per fine ounce, and that acted as a tremendous stimulant both to big and small gold operations. Then came the early years of World War II - 1938, 1939, and 1940. It was plain that in the event of the United States' getting into it, the country would be woefully short of reserves of a considerable list of so-called strategic ores. Should we develop limited and sub-marginal domestic deposits, or buy foreign ores? The Federal buying agencies preferred the cheaper and higher-grade foreign ores. The larger domestic consumers did, too, for some of them had substantial foreign holdings. So the Federal agencies called for bids. Some contracts were let, but precious little ore was delivered. Domestic operators, mainly little fellows, were out of the running with few exceptions. Metals Reserve Company began raising the price of strategic ores a little in the late summer of 1941 but only on substantial contract deliveries. The small chrome and manganese producers were suspicious of contracts, and couldn't finance production facilities to meet the contracts anyway.

The jolt of Pearl Harbor left the small miners - such as the chrome operators of northern California and southern Oregon - anxious to produce strategic ores. They were just fit to be tied. The going ore prices were too low to permit them to produce. They thought the government wasn't interested in their small contributions. In late February 1942 Metals Reserve Company agreed to the establishment of the first four stockpiles for the local purchase of chromite in truck-load lots direct from small miners and prospectors. In May those purchase depots got going. Since that time, similar local strategic-ore purchase depots have been installed in various parts of the country from North Carolina to the west coast.

Neither the Metals Reserve Company nor the sponsors of the local stockpile idea (which included the writer) anticipated that the tonnages of ores to be delivered by the small operators would be tremendous. It was believed however that the nuisance and cost of purchasing the ores would be well compensated by the favorable effect on both miner and citizen morale in all parts of the mining country, and that the strategic ores purchased, depending on the then-increasing submarine menace, <u>might</u> have value out of all proportion to the effort of obtaining them. The submarine menace finally diminished, but otherwise the local purchase-depot program worked out about as expected. The small miners and prospectors hit for the hills. And were they proud when telling of getting out a few tons of high-grade chromite - enough to alloy the steel for a couple of tanks or a dozen airplanes!

But no sooner did the government make it possible for the small miner to make his contribution to the war effort in certain sections of the mining country than outside influences began to cramp his style. First came the matter of priorities. Mine operators had to rate as going concerns, "necessary to the war effort", or they could get little relief in buying supplies, repairs and replacements. Usually they couldn't. WPB encouraged the big operators, discouraged the little ones (not alone in mining). When the small miner had enough of an operation to rate a serial number under P-56, he was plagued by confusing and endless forms to fill out, and by exasperating delays in obtaining supplies and repairs.

Next came rubber and gasoline rationing. These put a further "crimp" in the small miner and prospector who couldn't readily get tires for rough mountain roads. Then came food rationing. He couldn't go to the stores and freely buy staple groceries for his camp. Through all this the small miner (and others not so small) was saying, in effect, "Who in tarnation is running my mine? Am I or some crackpot in Washington who knows nothing but paperwork? Does the government really want these strategic ores anyway?" (How many times has the writer been asked these questions!) The stories of difficulties, heartaches, delays, and hindrances to the war efforts of the small mining operators that came as a result of alleged stupidity and lack of understanding of mining and local conditions by government personnel kept coming from all directions. It was impossible to convince small miners that WPB was trying impersonally to rate strategic mineral operations in proportion to their calculated value to the war effort. Under that formula - justified by WPB because of war exigencies - the small miner didn't rate, whereas the large operators did.

Then, in the fall of 1942, WPB threw out gold mining all over the country. That knocked the last stull from under the small miner and prospector, who could always make beans if necessary on a gold stream. It took his hole card; left him bare to the breezes.

To those small mine operators who stuck to strategic minerals through patriotism or virtual necessity, the going became harder and harder because of the loss of labor to high pay jobs in the shipyards and other war industries. It became almost impossible to get men to haul ore, cut timber, and do mechanical and road work. In the mining country there were left, for the most part, only the quite old men and the partially disabled. Sma [illegible] and prospecting virtually ceased, and that is the present situation.

From the beginning WPB has taken the attitude that it could not gamble on war mineral production, that it must encourage the larger operations because of their higher efficiency - more tons-per-man, their greater "know-how", their better organization, their financial competency, and because most of them had known ore reserves. So the larger operations got the priorities on materials and supplies, also the labor - that which did not leave for higher pay jobs. It might be remarked that the large companies were in a position to look after their own interests in various ways in Washington, whereas, the individual small miner could not. Although against overwhelming odds, a very few members of Congress from mining states, and, conspicuously, the small miners association in Arizona, kept alive in Washington the cause of the small mine operator.

What does the after-the-war picture look like, as it may affect the small miner and prospector? Let's make some prophecies. Most manufacturing and the bulk of the production of minerals and ores will be, more than ever, concentrated in the larger operating companies for they are in a position to consolidate the gains of various kinds they have made within the emergency period. The larger companies are 'in' and can't get out; the little fellows are out and can't get in, or don't want in. The larger companies, better than any other group, may put into effect after the war new manufacturing techniques, new production "wrinkles" and new research discoveries, all of which should have a bearing on a company's ability to survive; they should also be in better position to protect themselves against adverse trends such as regimentation, excess government interference, high taxes, difficult labor relations, and increasingly difficult competition. Wages, and therefore supplies and facilities, will probably be relatively high in cost; whereas the price of metals, except gold, will be relatively lower in price as compared with present quotations. The prices of metals will go down considerably before the costs of the labor and supplies decline. Speaking generally, the trend seems toward continuing government controls of various kinds with lessening of local controls and less freedom of individual action.

Most important, any way one looks at it, is the fading away of our good, old-fashioned things called "free enterprise" and "private initiative" and "profit motive". The "enterprise" isn't free any more. It's held back by a combination of anchors such as special regulations, and directives, and ceilings, and limitations of various kinds. Private initiative has become much subdued because the incentive has diminished; freedom of action has been curtailed by various restrictions. And the profit motive.....well, we have the motive left, but not the profit.

The dream of prospectors and small miners since the beginning has been the making of a strike - of becoming wealthy over night, of having money with which to buy whatever the heart desires, money to provide for decent and comfortable old age. Now, even the most backward prospector in a remote mountain cabin knows that, if he should hit the jackpot, income taxes would take away most of his winnings. He never heard of the economic law of vanishing returns but his lessened activity demonstrates the law. He feels that a penalty has been placed on pioneering - and he's right.

Again, gold in the after-the-war period holds forth some attraction to the small miner and prospector, but on the whole the future for him is certainly not bright. If a stockpiling law is passed to maintain, for a time, production of domestic minerals that can be produced by the small operators, the latter will carry on and prosper - if some of the present restrictions and impediments imposed by the government can just be lifted. Stockpiling of ores for future emergency consumption is sound if properly planned and carried out. The idea must be woven into a plan for the encouragement of production of the scarce domestic ores. Congress should be smart enough to see that domestic production of deficiency ores, while probably uneconomic in peace time, may make sense nevertheless and should be encouraged.

It is common sense to subsidize, if necessary, investigation, production, and accumulation of deficiency ores in peace time, rather than wait until a war catches us and then subsidize them on the spur of the moment, when every other facility we have is taxed to the limit. But matters don't always go according to logic. Both the large company consumers of critical materials that were coming from foreign sources and the government itself were guilty of letting us go far beyond the danger point in this war emergency before putting in effect adequate measures to try to produce similar or substitute domestic materials for the war effort. During that 'guilty period' the small miners and prospectors, wanting to get in and pitch, were shouting their heads off; now, they are silent - too hungry to shout. Later, we hope they come back and go into the hills with joy in their hearts, but.........

Meantime, "Adios, old timers." .....Anyway, "Hasta la vista."

E.K.N.

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WPB REVISES MINERALS POLICY

The War Production Board issued a statement October 27, 1943, reviewing the Board's action restricting marginal mineral production. The Board has acted because of three changed factors in the mineral production program, these being increased mineral production, revised military requirements and a greater need for marginal manpower than for marginal minerals.

The chief methods of conserving manpower in mineral production have been:

(1) Allocating soldiers who have been released to the Enlisted Reserve Corps (as well as other labor) under a system of mine labor priorities.

(2) Conserving the use of critical materials and equipment, and production of which requires labor, and

(3) Utilizing manpower in the mining industry in such a manner as to produce the required amount of minerals with the minimum number of men. By these means, labor can be most effectively employed to attain the goals of the "must programs".

Accordingly, the following actions have been taken:

(1) The Production Executive Committee has decided that after stockpiles of ferro-alloys (vanadium, tungsten, molybdenum, cobalt, etc.) reach recommended levels, domestic production and imports will be kept in balance with the then current consumption. This will insure a supply of ferro-alloys adequate to meet the needs of the war and avoid excessive accumulations which would be costly both in dollars and manpower. In this connection, arrangements have been made for reducing the government purchases of certain ferro-alloy minerals.

(2) Premium prices in the B range have been denied to lead mines not already operating, and to lead mines having a low labor productivity and located in areas in which there is serious shortage of labor.

(3) Premium prices in the B and C ranges have been denied to zinc mines not already operating, and to zinc mines having a low labor productivity and located in areas in which there is serious shortage of labor.

(4) The Government is not now financing new zinc projects.

(5) It has been determined that no new government purchase contracts should be entered into for the import of chemical chromite, vanadium and cobalt.

(6) Operations in low-grade chrome mines in Montana are to be put in standby condition and labor is to be diverted to mines producing more critically needed minerals.

(7) Contracts with the larger domestic graphite companies are to be canceled; the mines of these companies are to be held in a state of readiness for the duration of the war and no more graphite is to be stocked by them.

(8) Domestic production and imports of mercury for the year 1944 for both private and government purchase are each to be reduced to approximately 70 percent of the 1943 amount.

(9) The production of bauxite in Arkansas by the three major producers is being sharply cut.

These administrative actions have been called for by the need to direct national effort to attain maximum over-all output in an all-out war. The Mineral Resources Operating Committee is periodically reviewing each mineral to determine the supply rate that should be planned in order to meet requirements and stockpile objectives. Administrative action will be taken from time to time on specific cases to meet these objectives and in keeping with the basic minerals and manpower policies established by the Congress and the President, and the directives issued by the Chairman and the Executive Vice Chairman of the War Production Board.

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THEY SAID

> The history of the several efforts which have been made to get preliminary plants for the production of alumina from clay into existence is a record of delay and disappointment. Although such development should have been started more than 2 years ago, it has not yet begun, and there is no evidence as of this hour to indicate it ever will be begun on a scale that will insure national security of an aluminum supply in the face of any war reverses.

From speech by Hon. Harris Ellsworth of Oregon on "The Aluminum Situation" delivered in the House of Representatives, October 27, 1943.

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> I doubt if the mortality rate in legitimate mining enterprises is any greater than in farming, manufacturing, railroading or any other field. I feel sincerely that to view mining as a part of a matured economy is to court disaster. To depend alone upon a centralized governmental control of development of natural resources is to sacrifice the spirit of endeavor which is our heritage from the founding fathers.

Allan S. Richardson, Securities Commissioner, State of Colorado, speech before The National Association of Securities Commissioners, as quoted in Mining Congress Journal, October, 1943.

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> I believe that mining requires more courage than any other occupation. It is like shooting in the dark from one round to another, for one cannot see inside the Mother Earth. An individual who opens up a prospect requires courage and vision. That is why we must encourage new miners and render geological, metallurgical, and mining help - as well as financial aid when advisable.

A. C. D. in Deco Trefoil, October, 1943.

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> A time there was when coin everywhere freely circulated on the basis of its weight and fineness. Regardless of mintage, whether pistole or guinea, louis, florin or thaler, it was placed on the scales, its weight and value determined, and it crossed all borders with no questions raised because all knew that an ounce of gold or an ounce of silver still weighed 480 grains on either side of any frontier. Here, then, was genuine "monnaie courante," which all understood and all accepted, east and west, rich and poor alike, each with the medium best suited to his needs. If that system worked, and work it did, why not restore it?

"Go Back to Hard Money Which is What the People Want" by Rene Leon in Mining and Contracting Review, September 30, 1943.

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The luncheon was addressed by Brig. Gen. Ray Hays, Adjutant General of California, who urged the mining industry to exert every effort toward a decentralization of government. General Hays traced the development of our present bureaucratic centralization over a period of 20 years and laid much of the blame for the start toward present conditions upon the counties' willingness to shift their responsibilities upon the states and upon the latter's desires to seek Federal aid in order to avoid noticeable taxation. A return to the assumption of its own responsibilities by each political subdivision must take place before the threat of complete centralization is averted, General Hays warned.

Speech at meeting of Board of Governors, California Chapter, A. M. C., San Francisco, September 16, 1943. Mining Congress Journal, October, 1943.

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In 1942 (calendar year), 54 million ounces of silver were produced in the United States. The United States Treasury purchased 47.8 million ounces of the domestic silver, and during the first half of the year it bought also small quantities of foreign silver -- 14 million ounces. The Treasury's total purchases in 1942 were thus 62 million ounces. Actual gross industrial consumption (table 2) was estimated at 121 million ounces. most of which was obtained from imports or stocks.

In addition to industrial consumption, the Government itself consumed a large quantity of silver during 1942 in the manufacture of subsidiary coins. The precise figure is not available; in the fiscal year 1942 the quantity so consumed was 91 million ounces (including 12 million ounces of silver minted for foreign countries). Assuming that the same amount was minted in calendar year 1942, the total industrial and coinage consumption in that year was about 212 million ounces. Deficits were drawn from stocks, partly from those held by the Treasury and partly from the stock pile acquired by the Metals Reserve Company.

Thus far (through June) in 1943, both domestic production and imports have declined. Total requirements, however, are expected to be larger than in 1942. It has been estimated that the industrial consumption, both for strategic and nonessential products, will be from 159 to 169 million ounces, including about 30 million ounces for nonessential purposes. If coinage requirements in the calendar year 1943 should be the same as in the fiscal year 1942, namely 91 million ounces, the total requirements for industrial use and coinage would be somewhere between 250 and 260 million ounces. Even if all consumption for nonessential purposes were to be eliminated, it would still be necessary to draw on existing stocks for supplies.

From "Silver in Wartime" by staff of United States Tariff Commission published September, 1943.

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THIS CHRISTMAS

THIS IS THE MOST SOBERING CHRISTMAS SINCE THE FIRST ONE, NINETEEN HUNDRED FORTY-THREE YEARS AGO.

AT NO OTHER CHRISTMAS TIME HAVE THERE BEEN SO MANY ALLEGEDLY CIVILIZED NATIONS, WITH SO MANY MILLION SOLDIERS, ALL SO COMPLETELY EQUIPPED WITH WEAPONS OF DESTRUCTION, AND ALL SO HIGHLY AND SCIENTIFICALLY TRAINED IN THE BUSINESS OF MURDER, LOCKED IN DEADLY COMBAT ON SO MANY FRONTS.

NEVER BEFORE IN HISTORY HAVE SO MANY MILLION CIVILIANS IN THE WORLD BEEN GIVING THEIR DAILY EFFORTS, THEIR WORLDLY GOODS, THEIR INCOMES, AND THE NATURAL RESOURCES AND RAW MATERIALS OF THEIR COUNTRIES - IN THE USELESS, DEGENERATE THING CALLED WAR.

THE LIE, IT SEEMS, IS GIVEN TO THE SUBSTANCE OF OUR CIVILIZATION, WHEN, WITH ALL OUR VAUNTED LOGIC, OUR SCIENCE, OUR CODES OF DECENCY AND OUR RELIGION, A CHECK IS NOT PROVIDED AGAINST THE INDIVIDUAL ASCENDANCY OF AN AMBITIOUS MADMAN - SCHICKELGRUBER - THAT LED TO THE ULTIMATE MAELSTROM OF WORLD CONFLICT INTO WHICH WE HAVE BEEN CAST. THE CARNAGE OF THIS WAR IS AN EVEN GREATER CRIME AGAINST THE BASIC CONCEPT OF RELIGION THAN IT IS AGAINST THE ESSENCE OF CIVILIZATION. WE EXPECT MORE FROM RELIGIOUS TRAINING, BUT NOT FROM CIVILIZATION - JUDGING BY THE HISTORY OF PAST CENTURIES.

THEN WHERE DOES THE DIFFICULTY LIE? IS IT WITH RELIGION? NO.

THERE IS NOTHING EITHER IN THE CHRISTIAN RELIGION OR IN THE MEANING OF THE GOLDEN RULE OF HUMANITY THAT WOULD HAVE DETERRED THE COMBINED CIVIL RULERS OF EUROPE FROM TAKING SCHICKELGRUBER BY THE SCRUFF OF THE NECK AND SETTLING HIS CASE ABOUT 1937, IN THE LIGHT OF THE SINCE-DEMONSTRATED CRIME THAT WAS IN THE MADMAN'S HEART IN THOSE YEARS. THE TROUBLE ISN'T WITH RELIGION, IT'S WITH THAT QUIRK OF HUMAN NATURE THAT CAUSES MAN TO SHIRK RESPONSIBILITIES, TO TAKE THE PATH OF LEAST RESISTANCE, TO PROCRASTINATE.

LET'S HAVE MORE OLD-FASHIONED RELIGION, MORE COURAGE - AND MORE CHRISTMASES AS OF YORE, WITH PEACE AND GOOD WILL TO ALL MEN AS THE UNDERLYING SENTIMENT. THAT IS OUR PRAYER.

EARL K. NIXON AND THE STAFF OF
THE OREGON DEPARTMENT OF GEOLOGY
AND MINERAL INDUSTRIES

December, 1943 Portland, Oregon

STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES
Head Office: 702 Woodlark Bldg., Portland, Oregon

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PETROLEUM SUPPLIES AND HYDROGENATION

A bill known as S. 1243, introduced by Senator O'Mahoney of Wyoming, has for its stated object the authorization of "the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances in order to aid in the prosecution of the war, to conserve and increase the oil resources of the nation, and for other purposes." The Bureau of Mines, acting under the direction and authority of the Secretary of the Interior, is the agency designated to carry out the purposes of the Act. Hearings on the bill were held during August 1943 by a joint subcommittee of the Senate Committee on Public Lands and Surveys and a subcommittee of the Committee on Mines and Mining of the House of Representatives. A report on the hearings has recently been published by the Government Printing Office under the title Synthetic Liquid Fuels.

In many hearings before Congressional committees or subcommittees, discussions and statements as shown in published reports are often made by witnesses who have not had adequate experience in the technical fields concerning which they testify. From the report of these hearings on synthetic fuels, however, one gains the impression that most witnesses were thoroughly informed on the matters they discussed. There was a rather surprising unanimity of opinion on the need for planning now on utilization of synthetic fuels to supplement our decreasing domestic petroleum supplies.

It is not the purpose here to comment on the merits of the bill itself, but rather, because of the large amount of authoritative testimony given, to set forth a few of the highlights of the subject matter as presented by some of the expert witnesses.

Brief extracts of the testimony are given below:

> "In Europe the development of synthetic oil has been dictated by necessity. It has been an essential ingredient of survival. In fact, a substantial - if not a major part - of the fuel employed by our Axis enemies, particularly Germany, for fighter planes, bombers, tanks, trucks, and other ground vehicles, as well as the Diesel fuel for submarines, is the synthetic type made from brown coal.
>
> "The Japanese have exploited the oil-shale deposits of Manchukuo and have built plants to produce a substantial part of their liquid-fuel requirements therefrom.
>
> "Only the United States, apparently lulled by the delusion that we possessed an infinite supply of petroleum, has neglected to develop synthetic-oil facilities to the stage where they could be utilized when necessary."

.....Ralph K. Davies, Deputy Petroleum Administrator for War.

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> "In modern warfare as we know it today, liquid fuels are absolutely essential. Over half (in north Africa 65 percent) of the tonnage of all supplies for our Army overseas is petroleum products."

.....Brig. Gen. E. R. Covell, Director, Fuel and Lubricant
Division, Quartermaster General's Office.

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"You will note that the overwhelming proportion of crude reserves of the world, outside of the United States lies in Russia - 8,500,000,000; Venezuela, 5,600,000,000; Dutch East Indies, 1,[illegible]50,000,000; and the Persian Gulf countries grouped together, 16,450,000,000." (all in barrels, Ed.)....

"I am impressed at the present time by the higher grade of the prospects which we know in the foreign countries when compared to those in the future in the United States. That is to say, the oil is easier to find abroad, and is found in larger quantities, I might add parenthetically, because we have done the easiest things in the United States already. I might add that the 300 fields that have been found abroad in the last 20 years have had an average estimated ultimate production of about 100,000,000 barrels each, while the average field found at the present day in the United States does not exceed 2,000,000 barrels, average, each.

"Now, I want to call your attention here to the geographic distribution of these areas in the Near East and in Russia, and their overwhelming importance in the world's oil trade of the future. These areas are as far as possible removed on this globe from the United States. Bahrein, here, where there is an American refinery at the present day, is exactly 12,000 miles from San Francisco in both directions."

.....James Terry Duce, Director, Foreign Division, Petroleum Administration for War.

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"The next point which I might discuss is the trend of exploratory drilling during the last few years. In spite of the fact that these new discoveries have fallen off, the efforts of the industry to find new oil have been substantially increased.

"The number of geophysical crews, which is one of our best measures of the exploratory effort, has gradually increased. Around 1937 there were about 200 crews in the field, and at the present time this number has increased to approximately 350, which is the maximum for all time.

"So that the effort of the industry, as far as finding oil is concerned, has been consistently increased, although the tendency to find the oil has decreased.

"The same thing is true also of the number of wildcat wells drilled. In 1937, 2,224 wildcat wells were drilled and in 1941, 3,264. So you see that there has been a very definite increase in wildcat drillings. although the discoveries have fallen off."

.....William B. Heroy, Director of Reserves, Petroleum Administration for War.

***

"When we entered the present war we complacently assumed that our supplies of crude petroleum were adequate for any emergency - that our chief and only worry might be the problem of distribution or, in other words, transportation. As the war has progressed the demand has increased at an unprecedented rate. Civilian use has been continuously curtailed to divert more and more oil to war use, and yet the demand increases insatiably. The draft on many of our producing oil fields is now heavier than it should be if our chief objective was solely economic and efficient operation. The search for new sources of supply has been greatly accelerated, yet since 1938 there has been an average decline in the annual addition to our reserves. Thus a disconcerting and probably significant element is introduced into the national picture. Once again the specter arises to plague us as to whether we have at last gone 'over the top' and are now on the slow decline toward inadequate reserves."....

"The production of liquid oils from coal or oil shale comparable to those derived from crude petroleum should occasion little wonder. The raw materials are all hydrocarbon substances. Geologic evidence indicates preponderantly that all were derived chiefly from living organisms, either plant or animal or both. Compared to normal crude oil, coal contains an excess of carbon; hence to bring it up to the grade of crude oil, hydrogen must be added. Accordingly, the German process is commonly referred to as the 'hydrogenation of coal.'

"Oil shales contain finely comminuted fragments of organic matter, which have apparently been arrested in their conversion by natural distillation to liquid oil. Essentially the problem of producing liquid oil from coal, oil shale, or other solid hydrocarbons, falls into the general pattern of the very flexible chemistry of the hydrocarbon group and the basic processing will be fundamentally related."....

"Another important factor that may further increase the demands on our coal reserves is the rapid depletion of coal of high rank and quality in many foreign countries which may result in increased exportation of coal from the United States. Therefore, the future demands on our coal reserves are not quantitatively predictable but may well be far greater than the maximum production for any year in the past (678,211,904 net tons in 1918.)"....

"Now, with regard to the oil shales, the Geological Survey has estimated that price permitting, approximately 92,000,000,000 barrels of crude oil is recoverable from oil-shale deposits of the United States. This is approximately double the sum of all the oil produced to date, plus the present estimated reserve. Of this estimated quantity 75,000,000,000 barrels lie in oil shales of Tertiary age that crop out chiefly in northwestern Colorado and northeastern Utah and subordinately in Wyoming and Nevada. The estimated total quantity includes also approximately 17,000,000,000 barrels believed to be recoverable from black shales of Devonian age in Indiana and Kentucky. Since those estimates were made (1928), apparently large additional deposits of oil shale of Ordovician age have come to light through exploratory surveys in Nevada. It is germane to point out here that in order to use this great potential resource of mineral fuel it would be necessary to establish a mining industry comparable to the bituminous coal-mining industry at its peak of productivity during the last World War."

.....W. E. Wrather, Director, U. S. Geological Survey.

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"Crude oil and natural gasoline are produced and consumed at a rate estimated at more than 1,400,000,000 barrels per year, whereas our known crude oil reserves are only approximately 20,000,000,000 barrels. Our present rate of production exceeds the rate of new discoveries several fold and this situation has existed for the past 5 years.

"For example, last year the rate of discovery of new fields and extension of old fields was only 60 percent of production during the same period. Based on present information with regard to our proved reserves and the rate of consumption and production, estimates with regard to the length of time which our petroleum supplies will last are as low as 14 years and, with present techniques of finding oil, the life expectancy of our petroleum supplies barely exceeds 30 years. However, it cannot all be produced in this time for the most efficient production, which means that we shall have to resort to imports to meet our requirements. To complete the picture of our natural-fuel resources: at the present rate of production of 3 trillion cubic feet per year our natural-gas reserves of about one hundred trillion cubic feet will last in the order of only 30 years.

"On the other hand, our oil shale deposits will produce an estimated 92 billion barrels of oil, and our coal deposits which are our largest single natural-fuel resource in round figures amount to an estimated three thousand billion tons.

"It is apparent that coal is the principal source of our fuel supplies for the future, and it is quite certain that with the necessary development there is sufficient coal available to supply both our liquid and solid fuel needs for more than a thousand years.

"Fortunately, the technical and scientific requirements for the production of synthetic liquid fuels from coal and natural gas have been prepared and the ground work is laid for the rapid development of commercial processes leading to the production of practically unlimited supplies of liquid fuels from our resources of greatest abundance, namely coal, oil shales, and natural gas."....

"There are two principal processes for the production of synthetic fuels from coal and natural gas. One of these is the Bergius process, which was developed to a commercial stage by the I. G. Farbenindustrie in Germany and which comprises direct hydrogenation of coal or preferably mixtures thereof with hydrocarbons, to motor fuel and intermediate products. Commercial production by this process began in Germany in 1926 and has increased to an estimated production of approximately 95,000 barrels or more of gasoline per day. The Imperial Chemical Industries at Billingham, England, built and operated a similar direct coal hydrogenation plant, having a capacity of 3,500 barrels of gasoline per day.

"The second process, known as the indirect process, is that of Fischer-Tropsch, wherein coal, lignite, or natural gas is first converted to water gas, or more specifically a mixture of carbon monoxide and hydrogen and then the mixture of gases in proper proportions is passed over a catalyst at relatively low pressures (1 to 10 atmospheres) and temperatures preferably of the order of 350° to 400° F. to produce gasoline, Diesel oil, waxes, and other products.

The Fischer-Tropsch process has also been developed in Germany with four installations, having a total estimated capacity of about 7,000 barrels of gasoline per day in 1940, which from information received by us has been increased severalfold since."....

"Now, as to the Bergius process for direct hydrogenation of coal: This process is carried out by mixing a small amount - usually less than 1 percent - of a catalytic material such as a compound of tin with approximately equal parts of finely powdered coal or lignite and heavy oil previously obtained from the process, and pumping this paste into a high-pressure chamber together with hydrogen gas at pressures of 3,000 to 8,000 pounds per square inch. The temperature of the reacting mass is maintained at 800° to 900° Fahrenheit.

"The oil product from the reaction vessel is separated from the solid residue of ash-forming material and unliquefiable carbonaceous matter and is distilled into light-, middle-, and heavy-oil fractions. The light oil is further treated by passing it into a vapor-phase zone containing a fixed catalyst such as molybdenum or tungsten sulfide. The gasoline product has an octane rating of 70 to 75 which, by the addition of tetraethyl lead, can be increased to from 80 to 85 or higher.

"Four or five tons of high-volatile bituminous coal are required for the production of 1 ton of gasoline - 0.56 to 0.70 short tons of coal per barrel of gasoline.

"This figure includes the coal needed for power, steam, and hydrogen used in the process; 6.5 tons of sub-bituminous coal, or 9 tons of lignite, are required for the production of 1 ton of gasoline - 0.90 ton to sub-bituminous coal or 1.25 tons of lignite, respectively, per barrel of gasoline. These figures are based on recycling the oils heavier than gasoline to form lighter oils. It is possible to operate the process so that a portion of the yield consists of heavier oils similar to kerosene and fuel oil and the Bureau of Mines has developed a modification for the production of a heavy bunker C oil by hydrogenation at lower pressures of about 1,000 pounds per square inch.

"High-pressure hydrogenation has developed into an extensive technology for the synthetic production of motor fuels and lubricating oils. In general, the reaction results in conversion of approximately 60 percent of the coal into oils and tars or products corresponding to 'synthetic crude oils' capable of producing relatively high-octane gasoline. The hydrogenation process is also adaptable to the treatment of heavy asphaltic petroleum, shale oils, and tars."....

"Fischer-Tropsch process: In the indirect hydrogenation process known as the Fischer-Tropsch process coal, lignite, or natural gas is reacted with steam to form water-gas, a mixture of carbon monoxide and hydrogen. The mixture of gases in proper proportion, after purification, is passed over a catalyst at relatively low pressures (1 to 10 atmospheres) and temperatures ranging from 360° to 530° F.

"Iron or cobalt catalysts alone or mixed with various oxides, have been found to be satisfactory. By increasing the pressure and using a somewhat different catalyst, for example iron containing various alkalies, a mixture consisting of alcohols, ketones, and aldehydes resulted, thus forming the basis for the production of various chemical derivatives and products.

"Seventy-two percent of the theoretical yield or 1.4 gallons of synthetic oil per 1,000 cubic feet of synthetic gas has been obtained.

"That is, by 'synthetic gas' there, we mean the water gas we get from the coal. We get about 1.4 gallons per thousand cubic feet. When natural gas is employed about 3 to 5 gallons of crude-oil-like product per 1,000 cubic feet is produced. One ton of the primary products is obtained from about 4.5 tons of coke which, in turn, requires the carbonization of 5 to 6 tons of bituminous coal or about 0.70 ton of coal per barrel of motor fuel.

"In other words, here again, as the previous witness indicated, you can use manufactured gas from coal, you can use natural gas, you can use coke; you can use anything that has carbon in it that will burn, and the yield depends on the quality of the raw material.

"The octane rating of the gasoline is quite low (about 50-octane) and as is usual, increases with the lower-boiling fractions. Reforming and adding tetraethyl lead to the gasoline will bring it up to a fairly satisfactory motor gasoline.

"The Diesel oil on the other hand, as would be expected, due to its high paraffinicity has a high-octane value, so that the process is eminently suited to produce this product. The paraffin wax and naphthenes have been found quite useful for the production of synthetic fatty acids by oxidation and subsequent conversion into soaps. The conversion of the olefin components of the lower-boiling fractions into lubricating oils by polymerization employing aluminum chloride has also been established.

"In other words, in addition to being able to get gasoline, Diesel oil, wax, and things of that kind from the Fischer-Tropsch process, you can, by further manipulation, produce good quality lubricating oil.

"The first Fischer-Tropsch industrial plant was put into operation in Germany in 1936 and by 1940 over 1,000,000 tons of liquid products were being produced annually in Germany by this process. Plants have also been built in other countries."

.....Bruce K. Brown, Assistant Deputy Petroleum Administrator
for War.

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"Now, coming to compressed hydrocarbon gases, in Europe there are 110,000 motor vehicles, busses and trucks that are operating on natural gas, methane and ethane, propane from the coal hydrogenation units, the Fischer-Tropsch process, and natural gas wells, and some trains are operating on compressed gases. Natural gas is largely methane. You can compress that under 4,000 or 5,000 pounds' pressure in the cylinder, liquefying it, and you operate your motorcar just the same as if you had gasoline in the tank. Germany and Italy have many filling stations exactly the same as our gasoline filling stations, only the gasoline is under these high pressures. The tanks are rather heavy, they weigh from 150 to 200 pounds, and some of the trucks have as many as six or eight of them under the running board."....

"Many European cities are utilizing the methane gas from the sewage of the cities and compressing it into a liquid for motor fuel. They are also using, in some motor vehicles, a mixture of carbon monoxide and hydrogen under high pressure as a motor fuel. I bring that in to indicate that the water gas produced from coke or natural gas, if you wanted to use that kind of a mixture, can be a form of motor fuel.

"They are also using acetylene in Europe with or without ammonia as a motor fuel, deriving their acetylene from coal. I do not know the manufacturing cost of making acetylene from coal, but I would not be surprised if it is the order of about 5 cents per pound of acetylene."

.....Gustav Egloff, Director of Research, Universal Oil
Products Co., and President, American Institute of
Chemists.

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AGRICULTURAL LIMING MATERIALS USED IN 1942

According to Rock Products, September 1943, Oregon used 26,500 tons of liming materials on farms in 1942. This quantity of liming material contained 50 percent, or 13,250 tons, of effective calcium oxide, and is equivalent to 7 pounds of effective oxide per acre of Oregon's cropland.

Statistics of other states present an interesting comparison. Illinois, the largest consumer of liming materials on farms, used 3,773,000 tons of such materials having an effective calcium oxide content of 1,584,660 tons. The unit figure for Illinois was 157 pounds of calcium oxide per acre of cropland. Kentucky had the largest unit consumption, with 186.5 pounds of calcium oxide per acre of cropland. In Kentucky the total amount used was 1,469,804 tons of liming materials containing 606,842 tons of effective calcium oxide.

All of the six New England states used 312,607 tons of liming materials containing 159,196 tons of the oxide. The average unit figure was 84 pounds per acre of cropland. The lowest unit use was in Maine with 53 pounds per acre of cropland. The greatest unit use was in Connecticut with 140 pounds.

The six Mid-Atlantic states of New York, New Jersey, Pennsylvania, Delaware, Maryland, and West Virginia consumed 1,821,437 tons of liming materials containing 967,393 tons of oxide. The highest unit use was in West Virginia with 137 pounds; the lowest was in Delaware with 50 pounds.

Ten Midwestern states (Ohio, Indiana, Illinois, Kentucky, Michigan, Wisconsin, Minnesota, Iowa, Kansas, and Missouri) used a total of 13,374,498 tons of liming materials having a lime oxide content of 5,621,784 tons. The average unit figure for these states was 75 pounds of oxide per acre of cropland.

Some of the southern states as well as the Pacific Coast states used a very small amount of lime on farms. In 1942 Texas used only 2,327 tons of liming materials containing 1,004 tons of lime oxide, or 0.06 pound of oxide per acre of cropland.

California used only 2.1 pounds of calcium oxide per acre of cropland, and Washington used 2 pounds.

A far wider use of lime on farms has been urged by state and federal farm bureaus for years. Farmers realize the need for liming and in those states where lime can be delivered cheaply enough the largest unit amounts are used. In Oregon the price to the farmer is high compared to the East and Midwest, and the effect of price is reflected in the figure for unit consumption.

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PAST TENTS

Note: For several years we've been on the point of starting a "Past Tents" series in the Ore.-Bin, but each time.....well, never mind. Anyway, it starts with this issue.

What engineer or geologist is there among us who doesn't have "a past"....that is, who of our genus cannot open his book of memories to an unselected page, and read thereat a yarn or anecdote about when he camped on an Andee and such-and-such happened, or about the time while surveying in the Upsidedown Lake country that the Indian guide sat down on a hornets' nest, or about when.......you get it.

Such accounts, based on true experiences, set the engineer and geologist apart from run-of-mine humans who are born, who live, and then die without veering from a fixed, prosaic groove. In truth, most men in our calling have done more Daniel Booning than most of us have stopped to realize.

Contributions to this series of "Past Tents" from any and all of the profession are herewith solicited and welcomed. Prize for the first story accepted from outside our department will be an 11x14-inch enlargement from a camera shot by the writer, taken of a certain scene in the Yukon a few years ago. It's worth framing.

(If the title, "Past Tents," a seemingly obvious name, has been previously used by anyone for a story or series such as this we are not aware of it. If through lack of adequate search we are plagiarizing, we are truly sorry.)

***

No. 1. "Murder in the Meadow"

I took a good long look through the alidade telescope at the distant stadia rod, trying to count the big red dots which seemed to be moving up and down, dodging the little lambent heat devils that were making a writhing serpent of the four-inch wide, painted rod.

(It was August, somewhere around Junction City, Kansas, and as hot as it can get on the limestone-edged mesas of that country. My buddy and I were mapping structure to get a line on oil possibilities. Our boss had cautioned us to be very careful and diplomatic with the country people because a couple of crafty oil promoters had been through recently, had gypped the local ones out of some leases and bonus money, and had left the natives in general quite hostile to strangers that even smelled of oil. It seemed one rancher had sworn to shoot any oil man on sight.)

Another glimpse through the eyepiece - to set the middle hair on a given dot - and a somewhat startling object moved slowly into the field of view. It was a pair of grey, floppy-eared mules hitched to an old-fashioned buckboard, driven by a dyed-in-the-wool, old western plainsman. Even in 1915, this was a disappearing type in that part of the country.

I twisted the focusing screw a mite and moved the instrument slightly in order to take a better look at the approaching outfit, still a quarter mile away. The high magnification of the transit brought the object up to within yards of me.

The driver wore a dilapidated ten-gallon hat, blue shirt, and corduroy trousers tucked in the top of cowboy boots, one of which was resting on the step of the conveyance. The man was elderly, gaunt, and mustachioed; and he kept looking intently in my direction. The sleepy mules jogged slowly toward me along the dusty road which I now noted ran within a dozen yards of where my plane table and tripod were set up.

By the time I'd waved the rodman on, calculated elevation and corrected distance for the shot, drew a new line on the plane table map, and made jottings in my notebook, the western stranger had moved up almost opposite me. Still he stared, as I now could plainly see through the corner of my eye. It was a bit disconcerting, this scene from a Pearl White or Bill Hart thriller - at least, my imagination started doing didoes. That old sinner in the buckboard (I thought) probably could shoot the buttons off my hip pockets without stopping the mules.

And then came reality, indeed.....As the vehicle came just opposite me and not thirty feet away, old 'Kit Carson' hollered, "Whoa," and his deep voice seemed to come out of the earth. I wasn't feeling so well. The man glared at me for a moment without moving. My condition didn't improve. Then, cat-like, he hopped out over the wheel of the buckboard, pulled a club about four feet long out of the back, bent over and picked a slab of rock out of the road, and started over toward the fence in my direction.

Now, gentle reader, you doubtless have heard your wife (otherwise, the object of your affections) say, while describing the plays at a particularly vicious bridge game, "I was just petrified!" - And you knew damn well that she wasn't petrified or paralyzed or anything like that. Well, mister, your wife probably never stood by a geologist's plane table in the edge of a meadow in central Kansas - separated by twenty feet and a two-wire fence from a mad-man holding a club in one hand and a five-pound hunk of Permian limestone in the other. There are times when one's misdeeds pass fleetingly in review. For me, this was one of those times.

And then my mustachioed ogre dropped his eyes, dismissing me, twisted his club into the slack top wire of the fence, and turned the club propeller-like a couple of turns thus stretching the wire taut. Dropping the club, he then walked over to the nearest post, took a staple from his pocket, and, using the slab or rock as a hammer, drove the staple into the post, thus fastening the newly tightened fence wire. Then he sauntered back to the buckboard, vaulted up into the seat, and called, "Gitty-up," to the mules.

I sat down weakly in the shade of the plane table.

E.K.N.

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