STATE OF OREGON
DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES

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THE ORE.-BIN

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CROSS-CURRENTS IN COPPER

According to Zay Jeffries in Mining and Metallurgy, November, 1941, the estimates of the Office of Production Management indicate an acute shortage of copper.

Nearly all available metal will be required for defense. This shortage will cause serious dislocations in civilian use since copper appears in a myriad of appliances and materials common in everyday life. This shortage is caused, in part by earlier substitution of copper for metals which were scarce, such as aluminum, nickel, and zinc. For example, large savings in General Motors 1942 cars were made in aluminum, nickel, magnesium, and zinc. However the average General Motors 1941 car required 51.9 pounds of copper; the 1942 car requires 55.1 pounds of copper.

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According to a recent news item in the Los Angeles Times, the Walker Mine in Plumas County, California's leading copper producer for many years, has closed down. The reason given for the action was that rising costs made it impossible to operate profitably with the price of copper fixed at 12 cents a pound. About 450 men were employed. Equipment included a cencentrating plant with a daily capacity of 2500 tons. During 1940 the mine produced 10,524,345 pounds of copper, 237,891 ounces of silver, and 14,176 ounces of gold from 437,450 tons of ore which gave 20,881 tons of concentrates. The mine was controlled by the Anaconda Copper Mining Company.

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Over a month ago the Quincy Mining Company, the Copper Range Company, and the Isle Royale Company, all operating in Michigan, were certified as being eligible to receive 1 cent a pound for copper over out-of-pocket costs, after increasing the pay of miners $1.00 a day. Now, according to the Mining Journal-Phoenix, Arizona, Representative Hook of Michigan has stated that the price to be paid the Quincy Mine is 16 cents a pound, and both the Copper Range and Isle Royale will receive 15 cents.

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During the first 7 months of 1941, the United States received the following quantities of copper from Chili: from ore, 306 tons; standard copper, 98,311 tons; electrolytic, 115,144 tons; total, 213,761 tons. (U.S.B.M. Mineral Trade Notes, October 20, 1941).

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Metals Reserve Co. has recently raised the price for South American copper from 10 cents to 11.25 cents a pound.

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ZIRCON AND ZIRCONIUM

Introduction

The most abundant zirconium mineral zircon, occurs in the "black sands" of the Oregon coastal area, and may be in such concentrations, in certain sections, as to be of commercial importance. Even if zircon does not, by itself, occur in commercial concentrations, possible operations for the recovery of chromite from these sands may recover zircon as a valuable by-product. The increased use of zirconium compounds and the cutting down of imports make domestic sources of the mineral take on added economic importance.

Historical

During the latter part of the last century zirconium compounds were used in incandescent mantles,but the quantity consumed was relatively small. Early in the present century large quantities of the natural zirconium oxide were found near Sao Paulo, Brazil and soon thereafter German manufacturing concerns began extending the uses of the material, especially as refractories and in ceramics. At about this time the Germans were reported to be using zirconium in making a steel alloy possessing remarkable qualities.

During the first World War period considerable research work was done, both by the United States Government and some private companies, on the use of zirconium in alloy steel. Following the war American companies began producing zirconium compounds in commercial quantities; and, particularly in refractory products such as brick, crucibles, and high-temperature cements production increased steadily. The various uses of zirconium compounds given below, illustrate the widespread use today.

Mineralogy and Distribution

Zirconium Minerals

U. S. Bureau of Mines Information Circular 6455 gives a list of minerals which contain material amounts of zirconium, together with a commercial classification, as given below:

Mineral	Composition	Inclosing Rock	ZrO_2 Per cent
Oxide:			
Baddeleyite (Brazilite)	ZrO_2	Igneous rocks deficient in silica, and in gravels derived from them	100
Zirconates:			
Zirkelite	$(Ca,Fe)_{0.2}(Zr,Ti,Th)O_2$	Magnetite-pyroxenite (jacupirangite)	52.89
Polymignite	$5RTiO_3 . 5ZrO_3 . R(Cb,Ta)_2O_6$	Elaeolite syenite	29.71
Silicates:			
Zircon	$ZrSiO_4$	Variable, Described below	67.2
Cyrtolite	Some cyrtolite is probably hydrated zircon	Granite, Pegmatite	66.93
Catapleiite	$H_2(Na_2,Ca)(Zr(OH)_2)(SiO_3)_3$	Elaeolite syenite	28.8
Elpidite	$H_6Na_2ZrSi_6O_{18}$	Elaeolite syenite(?)	20.48
Eudialyte (Eucolite)	$Na_{13}(Ca,Fe)_6 . Cl(Si,Zr)_{20}O_{52}$	Elaeolite syenite	16.88

Mineral	Composition	Inclosing Rock	ZrO_2
Hainite	Related to lavenite, wohlerite, etc.	Phonolite	Unknown
Hjortdahlite	$4Ca(Si,Zr)O_3.Na_2ZrO_2F_2$	Elaeolite Syenite	21.48
Lavenite	$(Na_4,Ca_2,Mn_2,Zr)((Si,Zr)O_3)_2$	Elaeolite- or augite Syenite	31.65
Lorenzenite	$Na_2Si_2(Ti,Zr)_2O_9$	Pegmatite	11.92
Rosenbuschite (Zircon pectolith)	$Na_2Ca_3((Si,Zr,Ti)O_3)_4$	Elaeolite syenite	20.10
Wohlerite	$(Na_2,Ca)(Si,Zr)O_3.RCb_2O_6$	Zircon syenite	22.72

Commercial Ores of Zirconium

Name		Formula	Per cent ZrO_2
Baddeleyite	(distinct crystals)	ZrO_2	96.5-98.9
Brazilite		ZrO_2	71.93
Zircon		$ZrO_2.SiO_2$	67
Zirconia ore:	1. Favas (alluvial pebbles)	ZrO_2	59-92.4
	2. "Zirkite" (Brazilite	ZrO_2	71.93
	2. "Zirkite" (Zircon	ZrO_2SiO_2	67
	2. "Zirkite" (unnamed		
	2. "Zirkite" (Mixture (Zr silicate		
	2. "Zirkite" (Mixture (Orvillite(?)		

Zircon occurs in greater quantity and is more widely distributed than any other zirconium mineral. As noted above, it is the orthosilicate with the formula $ZrSiO_4$. The theoritical composition is 67.2 percent zirconia (ZrO_2) and 32.8 silica (SiO_2). It occurs as crystals and grains in rocks and sand. The usual color is a shade of brown, but, less commonly; the colors are various. The crystals are tetragonal, commonly in square prisms. Zircon has a hardness of 7.5 (harder than quartz) and a specific gravity of 4.7 (about the same as Ilmenite and chromite). It is classed as infusible, is insoluable in most acids, but is attacked by concentrated sulphuric acid. Zircon from some localities is fluorescent. From the Oregon marine sands it fluoresces a beautiful yellow.

Zircon is found in all classes of crystalline rocks. Because of its hardness and specific gravity it collects in sands and gravels and hence occurs in many sedimentary rocks.

In only a relatively few places in the United States does zircon occur in commercial concentrations. Probably the greatest production has come from the Florida beach sands at Mineral City near Jacksonville. Other beach deposits are known on the Atlantic Coast as well as in the marine sands of the three Pacific coast States.

The only domestic deposit in rock that has produced on a commercial scale is near Tuxedo, Henderson County, North Carolina, where zircon occurs in pegmatite and gneiss.

The best known foreign deposits are in Brazil, Australia, Ceylon and the tip of the Hindustan Peninsula, Norway, the Ural, and some other European countries.

Baddeleyite, the name given the natural oxide (ZrO_2) crystals, is found in commercial quantity, only in Brazil. When the oxide occurs in fibrous or botryoidal form it is termed brazilite. The trade name "Zirkite" is applied to a mixture of baddeleyite and brazilite. Baddeleyite crystals are yellow, brown, black or colorless. Hardness is 6.5 and specific gravity 5.5 to 6.0.

Concentration

Commercial deposits of zirconium usually contain the titanium minerals, ilmenite and rutile, as well as monozite. In Brazil, screening and electromagnetic separation are employed in obtaining a concentrate. In Florida the process employed has been to make a wet concentrate on shaking tables. After drying, electromagnetic and electrostatic methods are used to separate zircon, rutile, ilmenite, and monazite.

Preparation of Zirconia

Zirconia is the most important commercial compound. While the native oxide contains some impurities it may be used without further treatment for some refractory purposes. For enamels and salts in which purity is essential a chemical treatment is necessary to obtain the pure oxide. A number of processes have been patented for this purpose. One method outlined in U.S. Bureau of Mines IC 6455 is as follows:

"The ore is heated with excess of lime and an amount of carbon insufficient for the reduction of the lime. Calcium carbide may be used in the place of the carbon. The product is treated with hydrochloric acid, the silica removed, and the zirconyl chloride then purified."

To obtain pure oxide from zircon the powdered material may be treated in the electric furnace in which the silica and other oxides are volatilized leaving the pure zirconium oxide as a residue. Other methods involving chemical treatment may be employed.

In order to give a comparison of zirconia with other refractories the following table is given (taken from U.S. Bureau of Mines Bulletin 186):

Melting Points of Refractories

Substance	
Magnesia (pure)	2,800 degrees C
Zirconia	2,500-2,950
Lime (pure)	2,570
Carborundum	2,200
Alumina (pure)	2,050
Silica	1,700

Preparation of Zirconium

Early investigators described three forms of the metal, i.e., amorphous, graphitic and crystalline. More recent work has cast doubt on the purity of the so-called graphitic and crystalline forms. Because of its affinity for oxygen, nitrogen, carbon, and silicon, the pure metal is prepared with considerable difficulty. Briefly, the metal powder is obtained by reduction with calcium, sodium or potassium. Various methods of production are discussed in U.S. Bureau of Mines Bulletin 186.

Prices

Prices quoted from Engineering and Mining Journal Metal and Mineral Markets.

Zircon ore: Latest quotation October 9, 1941

Per ton, f.o.b. Atlantic seaboard, minimum 55% ZrO_2 $60 @ $70

Zircon ore, carload lots: Latest quotation February 6, 1941

Per ton, f.o.b. Atlantic seaboard, minimum 55% ZrO_2 $70

5 ton lots $75

Zirconium: Per pound, commercially pure, powdered $ 7.

Zirconium alloy: 12 to 15% zirconium, 39 to 43% silicon per gross ton $102.50 @ $107.50

35 to 40% zirconium, 47 to 52% silicon per pound 14 @ 16¢

Prices of zirconium and zirconium alloy latest quotations October 30, 1941.

The prices quoted are unchanged since the beginning of the year, and therefore represent a stable market demand, and stable source.

Imports (from U. S. Bureau of Mines Minerals Yearbook Review of 1940)

Zirconium	1938		1939		1940	
	Quantity	Value	Quantity	Value	Quantity	Value
	lbs.		lbs.		lbs.	
Zirconium ore	4,183,506	$ 62,111	6,865,026	$ 49,919	33,690,506	$252,749
Ferrozirconium, Zirconium Ferrisilicon	244,126	13,520	799,269	50,169	533,055	37,126

Uses of Zirconium Compound

1. Clear and perfect zircon crystals are used as gem stones, exceeded in brilliance and fire only by the diamond.

2. Zirconia is used in the preparation of very refractory cruicibles, brick for furnace lining, cement for coating other refractories because of its high strength, hardness, freedom from spalling resistance to chemical and physical wear, all of which are most pronounced in precious metal refining and in electric furnaces.

3. Zircon is used in vitreous porcelains where the addition of 30 to 70% zircon gives a long firing range, exceptional mechanical strength, good heat shock resistance and remarkable dielectric strength at high temperatures. It has been used as the refractory in spark plugs.

4. Zircon is used in heat resisting glass - a use which may become of greatest importance for this versatile mineral. Zircon gives great impact strength and thermal endurance, chemical durability and resistance to such chemicals as caustic soda.

5. It is used as an opacifier in all kinds of vitreous enamel ware, replacing tin oxide and antimony oxide. It is also used in many laquers and automobile enamels as an opacifier. These enamels are non-poisonous and the same opacity is obtained with 2 percent zirconium, as with 6 percent antimony.

6. Zirconia is used in place of lime in the calcium oxide cylinders in Drummond's lamp. Mixed with magnesia, thoria and yttria it is used as the glower filament in Nernst's lamp. It is also used in the Bleriot lamp, extensively used abroad.

7. Zirconia is used in incandescent mantles.

8. Zirconium carbide is used as a filament in incandescent lamps.

9. Zircon is used in sand molds for stainless steel and alloy castings.

10. Zirconium carbide has been experimentally used as an abrasive, and has a hardness of that of topaz. (8)

11. Zirconium gives increased tensile strength, toughness and some malleability to alloyed metals.

12. Zirconium added to steel is a powerful deoxidizer, reduces metallic oxides and scavenges nonmetallic inclusions but does not remain in the steel as an oxide as does aluminum. It combines with nitrogen and sulphur, removing them from the melt. The minute nitride crystals have no effect on the mechanical properties of the alloy. The resulting zirconium sulphide is malleable.

13. "Cooperite" is a zirconium-nickel alloy for edge tools, machine tools, knives, razors, etc. It is unaffected by acids and can be worked at a red heat. It is also used in toasters, irons, etc. The addition of 25-30% zirconium gives a high speed cutting tool.

14. Zirconium is used in photoflash bulbs, as ammunition primers and for spot welding electrodes.

15. It is used as a flashlight powder, when combined with 40% magnesium.

16. Zirconium substitutes for platinum in chemical laboratories, in dental laboratories and in scientific apparatus.

17. Zirconium is used in thermocouples in pyrometers and various heat measuring instruments.

18. Zirconium oxide produces a nonpoisonous, nondiscoloring white paint. The oxide is also used in ink and water color paints.

19. Zirconia is a substitute for bismuthyl nitrate as a lining for the stomach in X-ray photographs.

20. Finely divided zirconia is incorporated with rubber before vulcanization, and increases the toughness and accelerated the process of vulcanization.

21. Zirconium nitrate is a food preservative; it is used also in incandescent mantles.

22. Zirconium acetate has been used in the place of stannic salts for weighting silk.

23. Zirconium hydroxide has been considered for the purification of water.

24. Zirconium compounds are used as mordants in dyeing and in the preparation of lac dyes.

25. Zirconyl tannate may replace sodium tungstate or stannate in rendering cloth noninflammable.

26. Zirconium tetrachloride has been suggested for a chlorinating agent.

27. Zirconia has been used as a polishing agent and for toilet powders because of its hardness, chemical stability and volume.

28. According to the U.S.B.M. Minerals Year Book, 1941; zirconium "has a unique combination of high corrosion resistance and ability to absorb large volumes of certain gases. Below 100° C the metal is immune to attack by some of the most corrosive agents known. At 500° to 860° C. it can absorb great quantities of hydrogen, and at higher temperatures oxygen, nitrogen, carbon monoxide, carbondioxide, and other gases. Zirconium, accordingly is particularly well suited as a "getter" in vacuum tubes and chemical processes to improve and maintain high vacuum."

29. Also from the Minerals Yearbook - "An interesting property of zirconium and of titanium metal is that, when drawn across glass or a glazed ceramic surface, they leave a brilliant, silvery adherent streak. This affords a means of decorating high-grade glassware and pottery without the present necessity of using platinum compounds, followed by a special firing operation.

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List of Possible Buyers

Abel Bros. & Co. (Inc.), 16 Maiden Lane, New York, N.Y.
Jerome Alexander, 50 East 41st St., New York, N. Y.
Eimer & Amend, 201-209 East 13th St., New York, N. Y.
The Exolon Co., Commercial Ave. and Erie R. R., Blasdell, N. Y.
Foote Mineral Co., 1609 Summer St., Philadelphia, Pa.
The Harshaw Chemical Co. of New York, 150 Nassau St., New York, N. Y.
(Successors to the Superfos Co., Inc.)
O. Hommel Co., 209-211 Fourth Ave., Pittsburgh, Pa. (Buyer of ore)
Juergens & Anderson Co., 53 East Washington St., Chicago, Ill.
Levere Co., 94 Canal St., New York, N. Y.
A. D. Mackay, 26 Cortlandt St., New York, N. Y.
F. E. Morse Co., 218 South Wabash Ave., Chicago, Ill.

National Sales Corporation, 31-35 East 13th. St., Cincinnati, Ohio.
Norton Co., Worcester, Mass.
Philipp Bros. (Inc.), Woolworth Bldg., New York, N. Y.
The Roessler & Hasslacher Chemical Co., 10 East 40th St., New York, N. Y.
Rogers Brown & Crocker Bros. (Inc.), 21 East 40th. St., New York, N. Y.
Wm. H. Taggart, 17 South Desplaines St., Chicago, Ill. (Buyer of silicate)
Titanium Alloy Manufacturing Co., 94 Fulton St., New York, N. Y.; 6007 Euclid Ave., Cleveland, Ohio.
Varlacoid Chemical Co., 15 Moore St., New York, N. Y.
Vitro Co., 928 Fulton Bldg., Pittsburgh, Pa.

(from I.C. 6455 p.28)

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ONE BILLION

The following illuminating comment is copied from the Oregon Voter, issue of Nov. 8, 1941.

"HOW BIG IS $1,000,000,000?--"'It is beyond our ability to comprehend," commented a speaker recently at a Portland meeting; "we are only familiar with small sums, and our experience supplies no measuring rod." We suggest two ways of figuring it. We all know something of the vastness of the United States and the great number of its population. All of us know what one dollar is. One dollar to a billion dollars is in the same proportion as two city blocks in Portland compared with the entire area of the continental United States. Perhaps we know what $10,000 is; such a sum is reasonably within our comprehension. Compared with one billion dollars, it bears the same proportion as the population of one of Portland's election precincts does to the entire population of the continental United States. By that same comparison, if our national debt gets to be $100,000,000,000 as predicted, the proportion of that debt which would rest on this one election precinct would be $1,000,000. That would average $2,000 for each registered voter in the precinct."

Incidentally, as to "bigness" (but far less illuminating), a billion dollars is equivalent to approximately 1,626.5 cubic feet of pure, solid gold, or a cube measuring 11.8 feet on a side, and weighing approximately 981 tons.

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NEWS NOTES

Baker County

Cornucopia Gold Mines, Inc.- According to reports from Cornucopia the Cornucopia Gold Mines, Inc. ceased operation on October 31, 1941. Future plans are indefinite.

Cracker Creek Gold Mining Co.-Located on Cracker above the town of Sumpter. Under lease to John Arthur of Baker. Properties operating under this lease are the North Pole, Tabor Fraction, Columbia and E. & E.

Burnt River Division, Sunshine Mining Co.-The new bucket line dredge of Sunshine mining Co. began operation on October 20, 1941. It is located 4 miles northwest of Whitney on Burnt River. Its capacity is 2500 yards. Harry B. Murphy, Boise, President. J. F. Gunn, Dredgemaster.

Granite County

Porter and Co.- Located at the mouth of Clear Creek, 2 miles west of Granite. Bucket line dredge. 3800 yards capacity. R. B. Porter, Baker, General Manager. A. E. Murray, Baker, Manager.

Cougar-Independence Mine- The mine is located three miles north of Granite. Ninety tons of ore are mined and milled per day. Latham Flanagan, and H. S. and L.S. Van Kirk, all of Pittsburg, Penn., owners. G. T. Vandel, Manager.

Ralph Davis, Inc. - Located on North Fork of John Day River, 16 miles east of Dale. Dragline and floating washing plant. 4000 yard capacity. Ralph Davis, Pres.

Western Dredging Co.-The bucket line dredge (capacity 5000 yards) is being moved from its present location at John Day to new ground near Mt. Vernon. Walter Williams, dredge superintendent.

Malheur County

Sunday Hill Mine - The Sunday Hill Mine located in Mormon Basin is being opened up for examination by Jack Isgrig, Ben O'Frary and Claude Lawton, all of Baker. William Phelan, Huntington, Owner.

Colt Placer- Located on South Fork of Dixie Creek. Has been operated by Carl R. Suksdorf and Co., Huntington, Oregon, during the summer. Dry land washing plant of 1000 yard capacity.

Jefferson County

Oregon King Mine- Located four miles east of Ashwood, Oregon. At present shipping ore to Tacoma smelter. Fifty ton flotation mill has been ordered from Denver Equipment Co. E. Rohlfing, Manager. C. J. Young, Superintendent.

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QUICKSILVER PRODUCTION

In the Monthly Mercury Report released November 6, the U. S. Bureau of Mines gives domestic production for September as 4,200 flasks compared to 4,100 flasks in August. This is believed to be the highest monthly rate since the days of large production of the New Almaden and New Idria in California during the period 1875 - 1883.

Domestic consumption in September amounted to 3,700 flasks.

Consumers and dealers stocks on hand at the end of September were reported as 12,100 flasks, and producers stocks were at least 616 flasks, compared to 11,600 and 557 flasks respectively at the end of August.

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CLEARING HOUSE

Mr. L. E. Klump, 719 Lawnridge St., Grants Pass, Oregon, owner of the Greenback Mine in the Graves Creek section, desires to sell or lease this gold mine. The owner states that the mine is in good physical condition; that the main workings are open for inspection, and that two new ore bodies parallel to the Greenback vein have been opened up.

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Mr. C. P. Spence, 814 Columbia St., Hood River, Oregon wishes to sell or lease quicksilver property consisting of two mining claims near the Nesbit mine on the Oak Grove Fork of the Clackamas River.

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DEFENSE PROGRESS

The following statistics are taken from Defense, Official Weekly Bulletin of Defense Agencies In The Office For Emergency Management, issue of November 4, 1941.

Manpower	
United States Army, Oct. 9	1,588,500
Navy and Marine Corps, Oct. 1	366,629
Nonagricultural workers, Sept.	*40,065,000
Percent increase since June 1940	13.1
18 defense industries, Sept.	*2,660,500
Percent increase since June 1940	64.8

Finance (June 1940 to latest reporting date)	(In millions of dollars)
Authorized program Oct. 31	*63,962
Contract awards Oct. 15	*39,263
Total disbursements Sept. 30	10,745

Production	
Paid on contracts, June 1940-September 30, 1941	$8,464,000,000
Military aircraft, September	1,914
Combat vessels in September	*6
Merchant ships, September	*9

(Week ended October 25)	Strikes	Workers
Significant defense strikes in progress during week	11	13,900
Number settled	6	11,400

*Preliminary.

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