STATE OF OREGON
DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES

PORTLAND, OREGON

THE ORE.-BIN

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CHROMITE -AN IMMEDIATE NATIONAL NEED

This issue of the "Ore.-Bin" is devoted to chromite - the ore of chromium necessary for making chrome steel. Oregon is one of the few states of the country which contains commercial deposits of chromite; therefore, we wish to emphasize points bearing on occurrence, production, and marketing of this vital mineral.

Tough, rugged, hard-bitten chrome steel will have a large share in winning the war. But chromite remaining in the ground will not make chrome steel. The chromite must be mined and transported long distances to steel mills or electric furnace plants in order to put it in fighting form. We cannot now depend on Turkey, South Africa, New Caledonia, and the Philippines to furnish the ore to us; we must produce it ourselves, and do it NOW. There isn't time for measured, long distance planning as to whether or not this and that are economic. This is an emergency and the essential thing is to get the chromite out.

The crying need is that those in authority should realize conditions under which lode chromite must be produced. They should realize that chromite occurs back in the mountains, far from a railroad; that access roads must be built; that the deposits vary in size over a wide range; that development is required; that encouragement must be given the prospector, for he, not the engineer for large operating companies, finds the ore; that the small operator has no capital for developing and mining his ore; and that he usually cannot prepay freight to a government stockpile, the location of which he does not know. Probably the most important of all the unique conditions governing production from these lenticular deposits -- sometimes small discontinuous and remote -- is the necessity of setting up machinery for buying ore in small lots. Only by providing such a market will maximum production be obtained.

Action is necessary if chromite is needed -- and we believe it is. Delay will be translated into American lives lost. A rattlesnake doesn't wait for you to find a club of just the right size, or remain coiled without striking so that you may take some practice swings before deciding on the most effective method and posture for delivering the lethal blow. True, a rattlesnake usually gives some warning before it strikes; and in this regard it is one up on the enemies we are fighting now.

WHAT IS CHROMITE MADE OF AND HOW MAY IT BE RECOGNIZED?

Chromite, the only ore of chromium is made up theoretically of three elements - chromium (Cr), iron (Fe), and oxygen (O), in the proportions of two parts of chromium, one part of iron, and four parts of oxygen. It is usually considered as a chemical combination of chromium oxide (Cr_2O_3) and iron oxide (FeO) and may be considered when pure to have the formula of $Cr_2 Fe O_4$. In nature, however, it also contains impurities of magnesium and aluminum in varying amounts.

Chromite is a hard, black, heavy mineral which is most readily recognized by its dark brown streak; that is, when it is scratched or powdered, it shows a dark chocolate color. This is also characteristic of some manganese ores, but the latter are nearly always much softer and lighter in weight than chromite.

Oregon high grade chromite occurs as small bodies, only a few feet in diameter, of hard massive ore, and as scattered crystals making up a varying percentage of the country rock. Lower grade deposits may occur as larger lenticular masses. Chromite also occurs as little pea-shaped aggregates of crystals disseminated in the rock, and may also form bands of higher grade material alternating with bands of rock. In certain areas along the coast chromite makes up an appreciable percentage of the "black sands" both on the present and old high beaches.

The marketability of chromite depends upon its grade, which must be determined by assay of its chromium and iron content. The assay laboratories of the State Department of Geology and Mineral Industries, located in Baker and Grants Pass, make assays of samples originating in Oregon free of charge. The State law requires that in return for this assay-service, the location of the property and certain other information be supplied on sample information blanks supplied by the Department.

HOW AND WHERE CAN I LOOK FOR CHROMITE IN OREGON?

Chromite is one of the few ore minerals which only occurs in certain very definite and easily recognizable types of rock. This means that unless one is prospecting in a region where these rocks occur, there is absolutely no chance of finding chromite deposits; and it therefore means that prospecting for chromite in oregon is considerably simplified because regions of chromite-bearing rock are fairly well-known and well-defined.

Chromite occurs only in serpentine, a dark green to brown, highly fractured, greasy-lustered rock, made up largely of iron and magnesium-bearing silicates, and in peridotite or "buckskin rock" (from which the serpentine is derived). Peridotite is a rock which is light tan or reddish-tan on its weathered surface and dark green upon a broken surface, and usually contains little crystals of a fine green platy mineral which stick out on the weathered surface to form rough knobs. When this "buckskin rock" lacks the crystals of this mineral and is uniform and fine-grained, it is known as "dunite", and in several parts of the State chromite deposits are found surrounded by dunite areas, which in turn lie within peridotite areas. Consequently, the prospector, in certain parts of the State, looks first for peridotite, then for dunite areas in the peridotite.

In areas where serpentine has formed, the chromite usually occurs associated with talc and a white or pale green and sometimes fibrous or platy "tremolite", which occurs in veins and fissures in the serpentine or peridotite. This is actually an alteration product of peridotite, and prospectors will follow along these veins of white or pale green mineral to pick up the chromite ore bodies occurring with it.

Chromite is sought for by its "float". These hard, loose pieces of ore weather out of the solid rock and work their way down the hillside perhaps into a stream bed. Therefore, the prospector searches, first, for float, and then attempts to follow the float up to its source. It is sometimes well worth while to use the gold pan in panning up streams and gulches to determine down which gulch the chromite came.

The chrome-bearing areas in Oregon are first, southwestern Oregon, particularly the western part of Josephine County, Curry County, and southern Coos County. It is also known to occur in parts of southern Douglas County and Jackson County. In this part of the State, the rocks in which chromite may be found occur in bands from a few hundred yards to ten miles in width and from a half mile to thirty miles in length. These bands nearly always run in a north-south direction, usually a little bit east of north. They are easily recognized by the fact that the only plant which flourishes on them is the scrub pine. Even buck brush, chaparral and salal will avoid areas of serpentine or peridotite so that when open prairies of grass or bare yellow rock studded with pine are found, it is fairly certain that serpentine or peridotite underlies them. In southwestern Oregon, the largest chromite deposits seem to occur in the bands running from Briggs Creek on the Lower Illinois River, northwest of Selma, south and west into California. Another band lies farther west of this one, and also contains some very large deposits.

The location of these serpentine-bearing bands may be seen on the following maps: (1) Riddle Folio No. 218, U. S. Geological Survey Atlas; (2) Port Orford Folio No. 89, U.S.G.S. Atlas; (3) Preliminary geologic maps of the Medford and (4) Grants Pass quadrangles. State Department of Geology and Mineral Industries. There is also available in the public libraries a geologic map of Curry County upon which the chromite-bearing rocks are outlined. This is contained in "A Preliminary Survey of the Geology and Mineral Resources of Curry County", Vol.2 No.2, Mineral Resources of Oregon, Oregon Bureau of Mines, 1914. A rough small-scale geologic map of western Josephine County is contained in (6) "The Mineral Resources of Southwestern Oregon", U. S. Geological Survey Bulletin No. 546, 1914.

A recent (1940) bulletin discussing the detailed geology of two chromite-bearing areas in southwestern Oregon is U. S. Geological Survey Bulletin No. 922-P. and Bulletin No. 9, State Department of Geology and Mineral Industries, discusses other deposits in both eastern and western Oregon.

In central Oregon, chromite-bearing rocks are found in the central part of Grant County, south of the John Day River, just east and west of Canyon City. This area is outlined on a map published in U. S. Geological Survey Bulletin 922-D. and also in Bulletin No. 9, "Chromite in Oregon" by the Department. In the eastern part of the State, chromite occurs in several small areas; one of them is on Conner Creek, six miles northwest of the Snake River; another is on Willow Creek, ten miles east of Malheur; another just west of

Sumpter, (see the geologic map of the Sumpter Quadrangle, published by this Department, for the serpentine areas in which chromite might occur in this region); and other is near Bull Run Creek, southwest of Unity, Oregon. It is possible that other small patches of chromite-bearing rocks may be located in other areas, but is is not probable.

Along the coast of southern Oregon, the present beaches, as well as old beaches formed thousands of years ago and uplifted so that they now may stand several miles back from the present coastline, frequently contain lenses of "black sand" which, in Curry and Coos Counties, contain appreciable amounts of chromite. These black chromite sands are derived from the wearing down of the rocks in the chromite-bearing regions drained by the Illinois, Rogue and other streams, and the concentration of these heavy minerals is effected by the selective "panning" action of the waves.

It is probable that these chromite sands will yield a larger tonnage of commercial chromite than the rock deposits. Since the sand is already crushed and sorted by nature, much lower-grade material can be handled commercially than under hard-rock conditions. Since the sands occur in fairly well-defined strips along the coast (see U. S. Geological Survey Circular No. 8, 1934 for map showing their distribution), and since they are usually of unconsolidated material, exploration is not too difficult. During the past summer, the State Department of Geology and Mineral Industries, in cooperation with the U. S. Geological Survey sponsored a W. P. A. project for the purpose of exploring three deposits of black sand north of Bandon by drilling and test pitting. Results of the exploration show that several hundred thousand tons of commercial chromite sand are present. Another commercial chromite sand area south of Bandon was explored during 1941. There are several other possible favorable areas between South Slough and Port Orford -- a distance of over 40 miles.

WHAT ARE SOME OF THE MINING AND MARKETING PROBLEMS?

Prospecting and Mining

Hard-rock chromite in Oregon may occur in discontinuous, irregularly-shaped, roughly lenticular bodies varying widely in size as well as shape. It may also occur disseminated as grains, and arranged in bands of varying grade. The occurrence as concentrations in marine sands has been described in previous pages.

After chromite float has been traced up to the place where it is found in place, development work is required in order to indicate the extent and attitude of the deposit. This work usually means, first, surface cuts and trenches and, second, underground work in the form of tunneling and shaft sinking. The amount of development required, will, of course, depend upon the size of the deposit. In the case of a small orebody, development work usually will extract all of the ore, and thus development and mining go hand in hand. Development to prove the extent of a large deposit, containing many thousands of tons, may most readily be done, at least in initial stages, by drilling.

Mining of small ore deposits is done by hand, since the quantity of ore available may not warrant purchase of power drilling equipment. For large proven deposits, power equipment applicable for mining any lode deposit would be suitable. Speaking generally, however, power equipment should be kept at a minimum in advance of fairly accurate knowledge of the extent of the orebody.

Small deposits usually require hand sorting as the ore is mined, in order that all waste be removed, and only the best ore obtainable retained for shipment. In mining larger deposits, hand sorting for removal of waste, in so far as practical, should be done.

Concentration by milling equipment may be commercial provided the proven extent of the deposit warrants the necessary capital expenditure and provided the ore is of such character that sufficiently high grade grains of chromite may be mechanically separated from the gangue. In the case of commercial chromite marine sands, a concentrating plant is essential and requires specialized operation. Such operations should not be undertaken except by technically qualified operators. In all cases where milling plants are contemplated, design should be by a qualified metallurgist and planned only after proper testing work is completed. Some low-grade chromites are not amenable to treatment mechanically so as to produce a satisfactory concentrate.

Unit cost of mining (cost per ton) is an elastic figure, but is usually meant to include all costs incident to getting the ore to a stockpile at the surface or to mill storage. Very little information on the cost of mining chromite in the United States is available, since up to 1941 practically all chromite consumed in this country was imported.

Costs will vary widely depending upon the size, type, and location of the deposit, and upon the experience of operators. This is true for any mineral deposit, but is especially applicable to discontinuous, lens-like orebodies in the mining of which the proportion of dead work to total quantity of ore removed is high.

In the cost of mining lode chromite, as in other lode deposits, the labor cost would be by far the largest single item and might be 70 or 80 percent of the total mining cost. Added to this would be the cost of explosives, sorting, power, timbering, supervision, assaying, and any dead work necessary in opening the deposit. Unit cost of mining small or medium-size deposits may be $6.00 or $7.00 and up per ton.

Mining of chromite sand in back-beach deposits would be under wholly different conditions from those of lode deposits. Only relatively large-scale operations will be practical, and it will be necessary to employ modern, earth-moving equipment, especially in clearing and stripping operations.

The critical factors in lode chromite production are grade and size of deposit, together with transportation facilities. The last is especially important and may be the determining factor as to whether or not a deposit can produce at a profit The critical factors governing operation of a chromite sand deposit are thickness of overburden, grade and extent of chromite sand. The importance of determining proper method of concentration has been mentioned above.

Marketing

Prior to the present emergency, the market for chromite was principally in the East and all quotations were at a price delivered at Atlantic seaboard. Since domestic supplies became critical, Government buying became increasingly important in the market; at present Federal government prices and specifications, as well as allocations, determine the market.

Chromite is bought on a dry, long ton (2240 pounds) basis. "Dry" weight is determined by taking moisture samples of shipments at stockpile. The loss in weight by drying these samples at 212 degrees F. is the basis of deduction in weight of shipments. For example, a producer ships 50 long tons of ore as determined by railroad shipping weights. At the point of unloading on stockpile, moisture is found to be 5 percent. The "dry" weight paid for is $47\frac{1}{2}$ tons. Transportation charges are on the wet weight but, as noted later, according to Government specifications, a freight allowance is made by the buyer to cover all railroad freight. The seller would pay wet weight transportation charges on ore delivered from mine to railroad.

Present Government prices and specifications are given as a supplement to this issue of the Ore-Bin. Since certain specifications apply to both chromite and manganese ore, prices and specifications for both kinds of ore are given.

Briefly, the Metals Reserve Co. (Government buying agency) will purchase ores according to these specifications at a designated stockpile. Seller is to deliver ore on board cars at the Seller's nearest convenient rail station to Buyer's stockpile. Rail freight is prepaid by Seller but is refunded by the Buyer. Upon arrival of the shipment at the designated stockpile, the ore is sampled, as unloaded, moisture is determined, and settlement for shipment made as soon as analysis and weight of shipment are received by Buyer. Contracts between Buyer and Seller are to be made. Minimum quantity to be delivered under such a contract would be 1000 tons in eighteen months, but payment would be made for each carlot received. At least 20 percent of the total amount specified in the contract must be delivered in six months.

Three classes of ore are defined depending on chromium oxide (Cr_2O_3) content and chromium to iron (Cr to Fe) ratio. A base price is established. An increase in price is allowed both for each unit increase in chromium oxide content and for each tenth increase in chromium to iron ratio. A unit is one percent; chromium to iron ratio is explained in detail below. Also given are graphs by means of which Government prices may be found for various grades of ore, and the chromium to iron ratio estimated provided the chromium oxide and iron or iron oxide are known.

COMPUTING CHROMIUM TO IRON RATIO

As stated above the market price of chromite depends not only on the chromium oxide content but also on the chromium-iron ratio. For example, an ore that assays 48 per cent chromium oxide (Cr_2O_3) and has a chromium-iron ratio (Cr:Fe) of 3 to 1, is classed as metallurgical ore and commands a premium price. However, the chromium-iron ratio does not, as is sometimes assumed, mean a chromium oxide (Cr_2O_3) to iron oxide (FeO) ratio of 3 to 1. It means a ratio of metallic chromium to metallic iron of 3 to 1. Chromium assays usually are reported as chromium oxide and the iron content may be reported as iron oxide; so to obtain the Cr:Fe ratio certain computations are necessary.

If the assay report shows that both chromium and iron are reported as oxides and the Cr:Fe ratio is desired, the following methods are used:

(1) The metallic chromium (Cr) content is 68.42 percent of the chromium oxide (Cr_2O_3) reported.

Example: If an ore is reported to contain 50 percent Cr_2O_3, the metallic chromium (Cr) content would be 0.6842 x 50 or 34.21 percent.

(2) The metallic iron (Fe) content is 77.73 percent of the iron oxide (FeO) reported.

Example: If an ore is reported to contain 20 percent FeO, the metallic iron content would be 0.7773 x 20 or 15.55.

(3) The chrome-iron ratio of an ore such as given in (1) and (2) would be 34.21 divided by 15.55 $\left(\frac{34.21}{15.55}\right)$ or 2.2 to 1 (2.2:1).

(4) The steps under (1), (2), and (3) may be simplified and the chrome-iron ratio found in one computation as follows: multiply the percentage of chromium oxide (Cr_2O_3) by 0.88 and divide by the percentage of iron oxide (FeO).

Example: If an ore is reported to contain 50 percent Cr_2O_3 and 20 percent FeO, the chrome-iron ratio would then be $\frac{50 \times 0.88}{20}$ or 2.2 to 1.

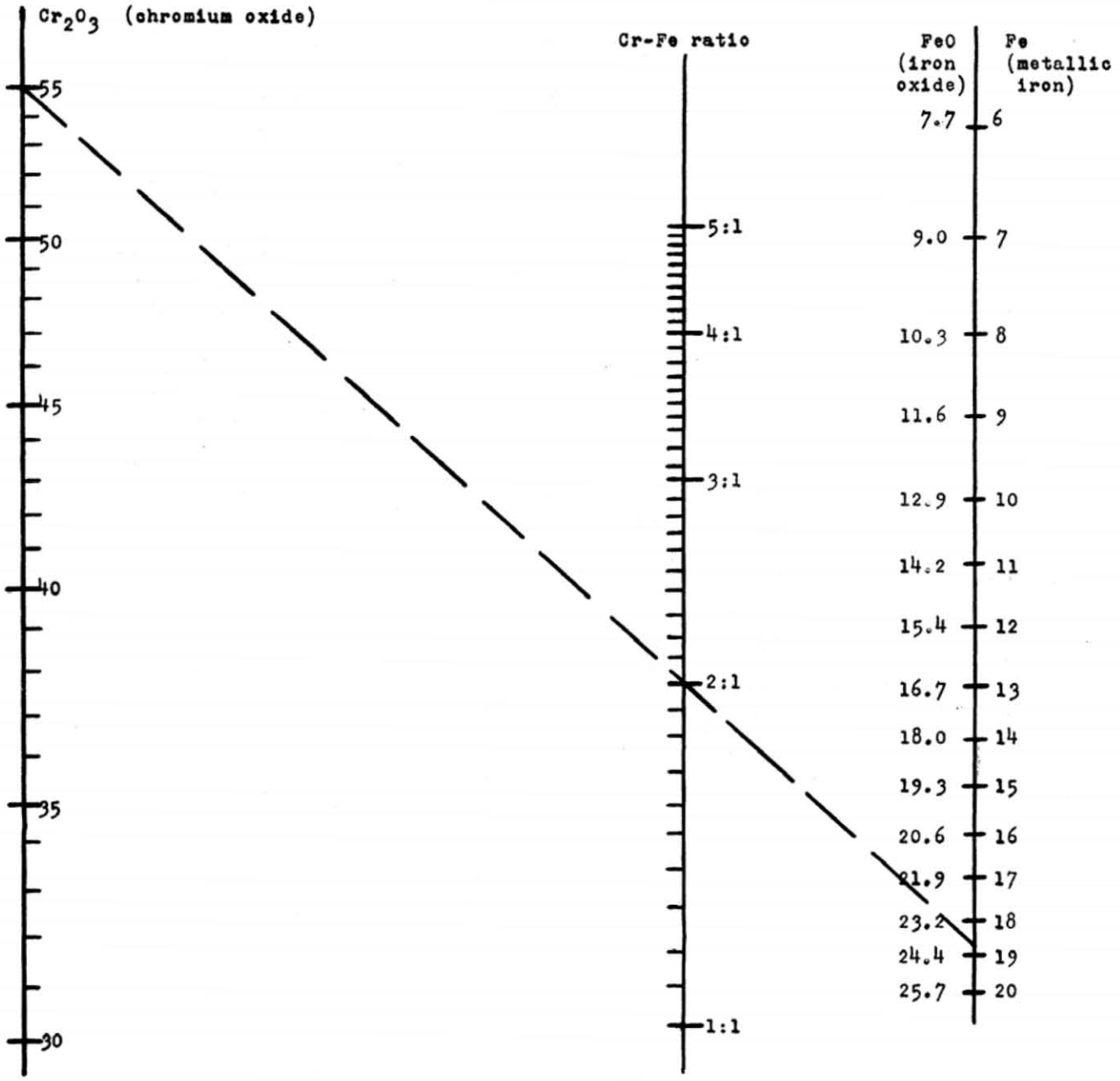
This ratio of chromium to iron may be obtained from the following chart. Knowing the percentages of chromium oxide and iron or iron oxide, it is necessary only to place a straight edge or ruler at the points of known percentages of chromium oxide and the corresponding iron oxide or iron on the outside vertical lines. The point of intersection of the straightedge with the inside line will be the chromium-iron ratio.

Thus, on the chart, the broken line drawn represents a straightedge connecting the points represented by the assays 55 percent chromium oxide (Cr_2O_3) and 18.8 percent iron oxide (FeO). The intersection on the middle line gives a chromium-iron ratio of 2 to 1.

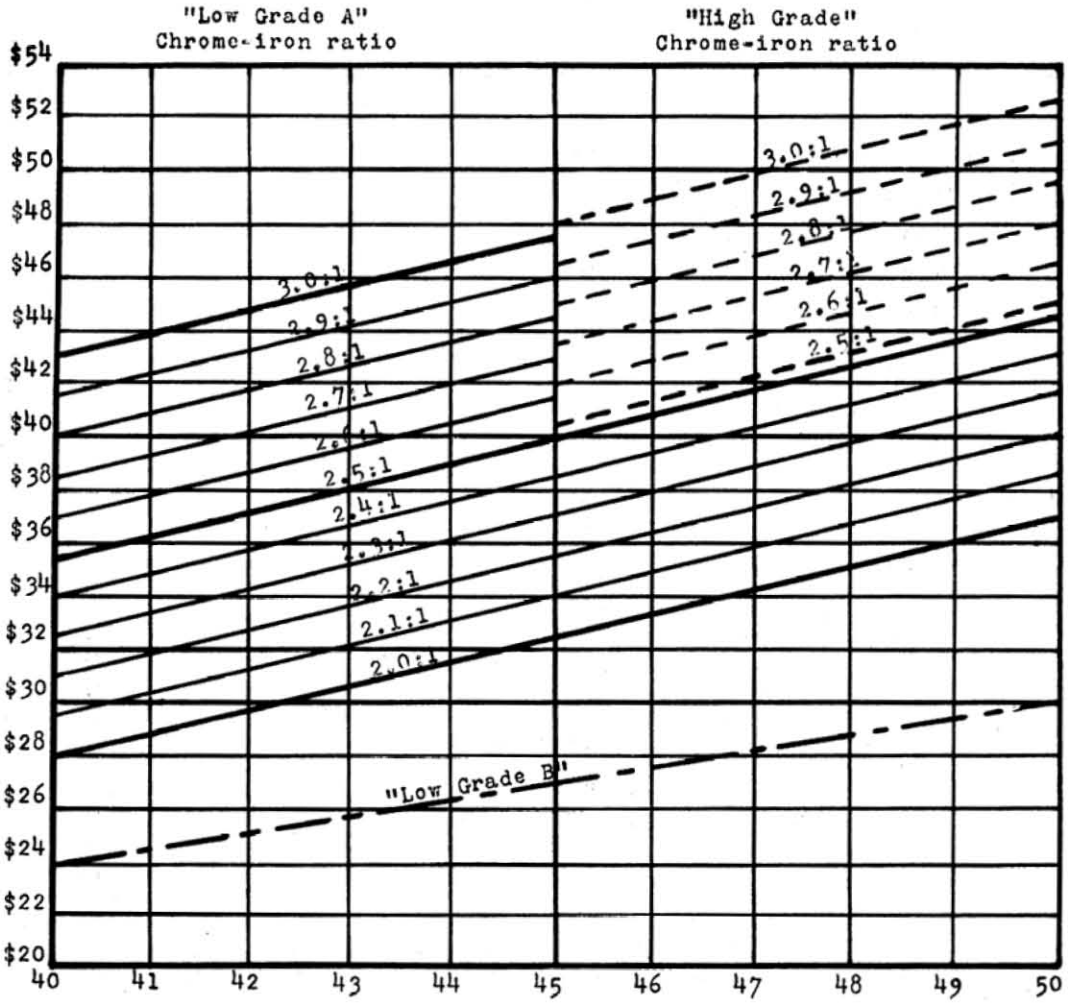
While this method is accurate enough for usual purposes, in order to check such ratios in control samples of shipments, it may be necessary to use the computation method outlined on this page (5).

NOMOGRAPHIC CHART FOR THE DETERMINATION OF

CHROME-IRON RATIOS FROM ASSAY DATA



GRAPH SHOWING VALUES OF CHROMITE ORE
ACCORDING TO METALS RESERVE COMPANY
SPECIFICATIONS AS OF 12/19/41



(Specifications governing "High Grade A" "Low Grade A" and "Low Grade B" are given in the attached appendix)

In order to obtain the value of ore from the graph both the percent of chromium oxide and the chrome-iron ratio must be known. Select the point on the horizontal line along the bottom of the graph corresponding to the known percent of Cr_2O_3. Next find the point vertically above this Cr_2O_3 percent and on the inclined line corresponding to the known chrome-iron ratio. From this point on the inclined line a horizontal line will intersect the "value" vertical line on the left side of the graph at the point corresponding to the value (to the nearest dollar) of the ore. If the chrome-iron ratio is less than 2 to 1 "Low Grade B" line should be used.

CHROMITE IN OREGON MARINE SANDS

A report on tonnage explored and the economic importance of chromite-bearing black sands in the Coos Bay district is released by the Oregon Department of Geology and Mineral Industries and the U. S. Geological Survey.

The estimates of tonnage are based on results of field exploration by churn drilling and test pitting during 1941 mainly under a W. P. A. project sponsored by the Oregon Department with supervision mainly furnished by, and in cooperation with, the U. S. Geological Survey. Coos County authorities also aided in the investigation by contributing funds. Forty-four holes were drilled with an Empire drill, eight holes were put down with a standard Keystone type drill, and thirty-five test pits were sunk, the latter at points where the black sand lens was shallow. Estimates of tonnage of chromite are given under three classifications, namely, "proved", "probable", and "possible". For the purpose of this estimate, "proved" ore is taken to indicate that quantity of ore lens material located in areas bounded by drill holes; "probable" ore includes known extensions or fringes beyond the drilled areas, the exact dimensions, or some of the boundries of which, are uncertain; and the "possible" classification is used for the chromite-bearing black sand lens in one area outside that already estimated as "probable". The "possible" tonnage was estimated by taking an arbitrary but reasonable length, a width, evidence of which was obtained at one locality only, and a thickness and chromic oxide content as determined by four churn drill holes.

Only three general areas of back-beach deposits, about seven to nine miles north of Bandon in Coos County, were explored. The total tonnage and chromic oxide content of the material estimated in the three areas under the above named classification are given below:

Tonnage and Chromic Oxide in Chromite Sand North of Bandon

PROVED			PROBABLE			POSSIBLE		
Long tons	Cr_2O_3 %	Equivalent to 40% Cr_2O_3 long tons	Long tons	Cr_2O_3 %	Equivalent to 40% Cr_2O_3 long tons	Long tons	Cr_2O_3 %	Equivalent to 40% Cr_2O_3 long tons
239,100	7.6	45,739	104,039	7.1	18,104	196,220	5.8	28,452

It was recognized at the beginning of the work that all the chromite sand in the area could not be explored with the funds available; therefore the object of this exploratory work was to ascertain by attacking a few known and probably representative deposits whether or not important tonnages of commercial chromite exist in the district. The answer seems to be definitely yes, especially in the light of the war emergency that recently developed wherein shipments of chromite from across the Pacific have been interfered with or cut off. The exploration by drilling and test pitting and the results in terms of tonnage and grade of material in the lenses at various points may serve as a yardstick for further mining development in the black sand areas of Coos and Curry Counties.

The figures given above relate not to the present ocean beach, but to a portion only of a back-beach lens or deposit, which is only one of a series of such deposits, along a stretch of country from Coos Bay to beyond Port Orford on the south, a matter of about forth-two miles. This series of deposits has been mined at various points in years gone by for the gold and platinum metals content of the black sand. In recent months exploration has been carried on in one or more of these deposits between Bandon and Port Orford with the idea in mind of developing them for their chromite content. No definite report may now be made on the future of the whole coastal area of chrome-bearing deposits; however taking into account also the possible additional present-beach deposits and the demonstrated content of additional minerals contained in the sand, including zircon, garnets for abrasives, and possibly ilmenite, there is a very good chance that such deposits may become important.

During the past year, Professor George W. Gleeson, head of the Department of Chemical Engineering at Oregon State College, has carried out in partial cooperation with the Oregon Department a large amount of metallurgical work on the treatment of the black sands from the properties covered by estimates above. This work has gone far toward demonstrating the commercial feasibility of developing the black sand deposits, especially in the light of the demand for chromite as a strategic mineral under the war emergency.

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Prices for Copper, Lead and Zinc Advanced

The following release has been received by the Department:

"FEDERAL LOAN AGENCY

WASHINGTON

January 12, 1942

"Federal Loan Administrator Jesse Jones today announced that at the request of OPM and OPA, Metals Reserve Company has agreed to stimulate the production of zinc, lead and copper through paying a higher price for these metals for production in excess of 1941 output.

"Details of the plan and quotas for individual producers will be announced by the Price Administrator.

"Mr Jones' letter to William S. Knudsen and Leon Henderson follows:

"'January 12, 1942

"'Gentlemen:

"'You are advised that, in accordance with your suggestion, Metals Reserve Company will, at your request, for a period of two and one half years from February 1, 1942, pay 11 cents per pound East St. Louis for zinc, 9¼ cents per pound New York for lead, and 17 cents per pound Connecticut Valley for copper, for increases above 1941 production governed by quotas to be fixed by you with our approval.

"'This price will apply also to mines which were not operated at all in 1941, and to new mines, but will not apply to production already arranged for by specific agreement. Consideration will be given to a longer purchase agreement than two and one half years where the expansion of facilities is necessary.

"'Any metals so acquired by Metals Reserve Company which are not used for or by the government will be subject to your allocation at the ceiling price fixed by the Price Administrator. By this procedure we should get maximum production of these critical and strategic metals for war purposes without increasing the price to the consumer.

"'Sincerely yours,

(Signed) Jesse H. Jones

Administrator'"

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CLEARING HOUSE

56-CH Eugene Mee and John O'Brien, 107 Washington St., Medford, Oregon desire to sell new cinnabar prospect in sec. 19, T. 41 S., R. 2 W., Jackson County, Oregon. Development consists of one opencut, one shallow drift and two shallow shafts- average value reported as 1 percent. Accessible to road; water available; no equipment; altitude, 4500 ft.

57-CH Albert Weathermoon, Bridgeport, Oregon, desires to sell his placer ground located on Clarks Creek about 8 miles from Bridgeport. Ground consists of 55 acres of deeded land and one unpatented placer claim. Little testing work has been done, but gravel is reported to average 12 feet in depth and channel is believed to be 100 feet in width.

58-CH J. H. Curnow, O'Brien, Oregon wishes to sell undeveloped scheelite property, reported to assay 0.96 percent WO_2; with pan concentrates running 85 percent WO_2. Owner states float found for over a mile; one outcrop 6000 tons.

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Supplement to Ore. Bin January 1942, Vol 4. No.1

METALS RESERVE COMPANY

Washington, D.C.

December 19, 1941

Superseding Schedule dated November 14, 1941

INFORMATION CONCERNING PURCHASE OF DOMESTIC MANGANESE AND CHROME ORES

For the benefit and guidance of producers desiring to make offers of low grade manganese and chrome ores, Metals Reserve Company herein provides information describing in detail the specifications, price schedules, conditions of shipment and delivery, sampling and analysis which will be included in contracts for the purchase of manganese and chrome ores.

The present purchasing policy of the Metals Reserve Company is subject to change without notice, and the terms and provisions of each contract will be based on conditions and circumstances existing at the time of acceptance. The policies herein outlined do not apply to ores originating outside the limits of the continental United States.

MANGANESE ORES

1. QUANTITY - One thousand to ten thousand tons per contract. In cases involving large investment in plant and equipment for beneficiation of ore, contracts may be let for larger tonnages and on such terms as may be deemed appropriate in each case.

2. QUALITY - Purchases of domestic manganese ores will be of three grades, with the following specifications:

	High Grade	"Low Grade A"	"Low Grade B"
Manganese - Minimum	48.0%	44.0%	40.0%
Alumina - Maximum	6.0%	10.0%	No Maximum
Iron - Maximum	7.0%	10.0%	No Maximum
Phosphorus - Maximum	0.18%	0.30%	0.50%
Silica - Maximum	10.0%	15.0%	No Maximum
Zinc - Maximum	1.0%	1.0%	1.0%

Size of ore: None which will not pass a 6-inch screen, and not more than 12½% of fines which will pass a 20-mesh screen.

Buyer may reject any shipment which does not conform to the applicable requirements and specifications as set forth above.

3. PRICE - Effective December 19, 1941, contracts will be considered on the following schedule for domestic ores, within the continental United States (excluding Alaska); all prices per long ton (2240 pounds) of dry weight, f.o.b. discharged onto stockpile designated by the Buyer.

High Grade - Base price, $36.00 per long dry ton for ore containing 48.0% manganese with increase of seventy-five cents(75¢) per ton for each unit (22.4 pounds) in excess of 48.0%; fractions prorated.

"Low Grade A" - Base price, $28.60 per long dry ton for ore containing 44.0% manganese; plus an increase of sixty-five cents (65¢) per ton for each unit (22.4 pounds) in excess of 44.0%; fractions prorated.

"Low Grade B" - Base price, $22.00 per long dry ton for ore containing 40.0% manganese; plus an increase of fifty-five cents (55¢) per ton for each unit (22.4 pounds) in excess of 40.0%; fractions prorated.

An allowance per long ton shipped equal to the freight tariff per long ton from the Seller's nearest convenient rail station to the buyer's stockpile will be made, in addition to the above prices.

The cost of sampling, analysis by the Buyer, weighing, and unloading onto the stockpile will be for the account of the Buyer.

Under the contract, each lot will be priced under the grade the specifications of which it meets. Thus a lot carrying 45% manganese but also 0.50% phosphorus would be priced as "Low Grade B".

4. SHIPMENT AND DELIVERY - The Seller will give such advice regarding shipment and arrival as Buyer may require at least ten days before the arrival of any shipment at stockpile; otherwise, any demurrage at the stockpile will be for Seller's account.

Shipment will be made in flat bottom gondolas, if available, in lots of not less than one carload, to the stockpile designated by Buyer. The Seller will prepay the freight to such stockpile, where the ore will be weighed in cars, light and loaded, on track scales, and sampled for moisture. The lot will be sampled as unloaded and upon receipt of analysis, the Buyer will advise the Seller as to whether the ore is acceptable and under what classification.

If the lot is ascertained to be unacceptable under the above specifications, the Seller will not be entitled to any allowance for prepaid freight and will be held responsible for the removal of this shipment from the stockpile location. Upon failure so to remove the shipment within fifteen days of due notice, the Buyer may, at his absolute discretion, remove such shipment and the cost of such removal shall be for Seller's account; or Buyer may, at his option, otherwise dispose of such shipment without any liability therefor. In the event that Seller fails to repay Buyer for the cost of removal, within fifteen days thereafter, Buyer may cancel the contract forthwith.

5. PAYMENT- As soon as moisture and analysis determinations are received, the Buyer will promptly pay the Seller in accordance with the weight certificate and the above schedule.

6. WEIGHTS - The weight paid for will be net railroad track scale weights (weight of loaded car less weight of empty car), less moisture as determined by standard practice.

7. SAMPLING AND ANALYSIS - Each lot will be sampled at the time of unloading onto the stockpile by a sampler designated by the Buyer, three samples being taken, one each for Seller, Buyer and Umpire, and analysis made for manganese and other guaranteed elements. Usual provisions will be made for splitting limits and settlement by average of Seller's and Buyer's analyses, or by trade practice if samples are sent to Umpire. Moisture samples will be taken in accordance with standard practice. Seller may have representative at sampling at his own expense.

8. TERM OF CONTRACT - Deliveries must be completed within eighteen months of date of signing of contract. If delivery of 20 percent of the tonnage contracted for has not been made within six months of date of signing the contract, the Buyer may cancel the contract forthwith.

CHROME ORES

The same general program and conditions will be followed on contracts for the purchase of chrome ores as outlined above for manganese ores, except as to quality and price.

1. QUALITY - Purchases of domestic chrome ores will be of three grades, with the following specifications:

	High Grade	"Low Grade A"	"Low Grade B"
Chrome (Cr_2O_3) - Minimum	45.0%	40.0%	40.0%
Chrome (Cr) - Iron (Fe) Ratio - Minimum	2.5 to 1	2.0 to 1	No Minimum
Silica - Maximum	11.0%	13.0%	No Maximum
Phosphorus - Maximum	0.20%	0.50%	No Maximum
Sulphur - Maximum	0.50%	1.00%	No Maximum

2. PRICE - Effective December 19, 1941, contracts will be considered on the following schedule for domestic ores within the continental United States (excluding Alaska); all prices per long ton (2240 pounds) of dry weight, f.o.b. stockpile designated by the Buyer.

High Grade - Base price, $40.50 per long dry ton for ore containing 45.0% Cr_2O_3 and with a ratio of chrome (Cr) to iron (Fe) of 2.5 to 1; with an increase of ninety cents (90¢) per ton for each unit Cr_2O_3 in excess of 45.0% Cr_2O_3; with an increase of one dollar fifty cents ($1.50) per ton for each tenth increase in chrome-iron ratio to a maximum of 3.0 to 1. The chrome content of any ore is 68.4% of its chromic oxide (Cr_2O_3) content.

"Low Grade A" - Base price, $28.00 per long dry ton for ore containing 40.0% Cr_2O_3, and with a ratio of chrome (Cr) to iron (Fe) of 2.0 to 1; with an increase of ninety cents (90¢) per ton for each unit Cr_2O_3 in excess of 40.0% Cr_2O_3; with an increase of one dollar fifty cents ($1.50) per ton for each tenth increase in chrome - iron ratio to a maximum of 3.0 to 1.

"Low Grade B" - Base price, $24.00 per long dry ton for ore containing 40.0% Cr_2O_3, with an increase of sixty cents (60¢) per ton for each unit in excess of 40.0% Cr_2O_3. Requirements as to amount of fines are waived on this one class of material.

Fractions prorated in all cases.

An allowance per long ton shipped equal to the freight tariff per long ton from the Seller's nearest convenient rail station to the Buyer's stockpile will be made in addition to the above prices.

The cost of sampling, analysis by the Buyer, weighing, and unloading on to the stockpile will be for the account of the Buyer.

Under the contract, each lot will be priced under the grade which specifications it meets. Thus a lot carrying 45.0% Cr_2O_3 and 0.50% phosphorus would be priced as "Low Grade A".

APPLICATIONS FOR CONTRACTS

Requests for information about contracts and offers of sale of manganese and chrome ores should be addressed to Metals Reserve Company, Washington, D.C., and should contain the following information:

1. Name of applicant, with business references, and statement of experience of applicant in connection with mining the above types of ores, other ores or non-metallic products.

2. Description of the mining property from which it is expected to offer production, with data to show that ore is available, or can probably be made available in quantity to meet the contract requirements.

3. Statement of the tonnage offered for sale, rate of delivery, complete analysis of the ore to be delivered, and the location on railroad from which shipments will be made.

The ORE.-BIN
State of Oregon
DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES
702 Woodlark Bldg., Portland 5, Oregon
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