

CHROME AND MANGANESE ORES IN CUBA

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INVESTIGATION BY GOVERNMENT BUREAUS

In view of the unusual conditions created by the war, the United States Geological Survey and the Bureau of Mines, Department of the Interior, have been studying the deposits of several of the minerals that are most essential to the successful prosecution of war. One part of this work consists in ascertaining, primarily for the information of the Government, the extent to which importations of some of these minerals from long distances may be curtailed, or possibly discontinued. Among these essential minerals are chromite, about 50 per cent. of the imports of which during the last few years has been brought from Rhodesia and New Caledonia, and manganese, for which the United States has been recently dependent on Brazil for 70 to 80 per cent. of its supply. These bureaus advised the Shipping Board and the War Industries Board as to the extent and rate at which these importations could be reduced.

Reports and notices calling attention to the domestic deposits which should be at once developed or brought to larger production have from time to time been published, but before conclusions could be formulated as to the development and use of some of the deposits of lower grades of ore it became necessary to obtain authentic and detailed information as to the location, character, quantities, and availability of the reported chromite and manganese deposits in the West Indies. A beginning was accordingly made in Cuba by a party consisting of Albert Burch, consulting engineer of the Bureau of Mines, and Ernest F. Burchard, geologist of the United States Geological Survey, under instructions of Secretary Lane. This party left Washington February 15, 1918, and at Havana was joined by E. I. Montoulieu, a Cuban mining engineer, who was detailed by the Treasury Department of Cuba to act as escort and associate throughout the work on the island. George A. Wright, of Baracoa, Cuba, an American mining engineer, who is familiar with the chromite deposits of the Province of Oriente, was attached to the party from February 25 to March 20. The field work, which was completed late in April, included examinations of such reported deposits of chrome and manganese ore as seemed to be of promise, without regard to stage of development, and a determination of the quantity and quality of ore likely to become available for shipment within the next year and a half.

The mining engineering data and the tonnage, estimates in part, in the following brief reports on the chrome and manganese ores of Cuba are taken from an unpublished report made by Albert Burch to the Director of the Bureau of Mines. All the analyses of chrome ores tabulated except two were made by R. C. Wells, of the United States Geological Survey.

CHROME ORES—DISTRIBUTION OF DEPOSITS

All the deposits of chrome ore in Cuba that have thus far attracted attention are within 25 miles and most of them within 10 miles of the north coast. There are about twelve groups of deposits, which display considerable diversity in quality, size and accessibility. One of the most westerly deposits is in the eastern part of the Province of Havana, and two are in the Province of Matanzas. The next group toward the east is in the Province of Camagüey, a few miles northeast of the City of Camagüey. Other groups of deposits are in the Province of Oriente, one near Holguín and another south of Nipe Bay, and there are three groups in the mountains near the coast between Punta Gorda and Baracoa.

GEOLOGY AND TOPOGRAPHY

All the deposits of chrome ore examined are in serpentinized basic rocks. Fibrous spots resembling asbestos commonly occur in serpentine near the ore bodies. The deposits are lenticular and tabular masses ranging in thickness from 1 foot to more than 50 feet, and reaching a maximum length of more than 200 feet, but they may include small masses of serpentinized peridotite. Thin veinlike streaks of ore have also been noted. The ore bodies appear to be characteristic magmatic segregation deposits and resemble many of those found in masses of serpentine in California and Oregon.

The ore is generally fine grained to medium coarse grained, and varies from spotted material consisting of black grains of chromite, ranging in diameter from a thirtieth to a quarter of an inch, embedded in white or light-green serpentine, to solid black material containing little or no visible serpentine. Fine seams of a green crystalline mineral, uvarovite, a calcium-chromium garnet, are occasionally found in the ore.

Most of the masses of ore are highly inclined, and certain of them that are exposed in ravines on steep hillsides in mountainous or hilly regions dip at about the same angle as the hillsides. The deposits west of Nipe Bay are in areas of moderate relief; those near Camagüey are in an area of very low relief. The deposits in the eastern part of Oriente Province, which are the largest, are in mountainous country and are very difficult of access.

HAVANA AND MATANZAS PROVINCES

In the eastern part of Havana Province small pockets of chrome ore have been found at a point about two miles from the railroad. A little mining has been done here on the Elena claim, from which, it is reported, about 600 tons of ore have been shipped. In Matanzas Province small deposits of ore have been found on the Jack claim, about seven miles northwest of the railroad station at Mocha, and on the Ana Maria claim, about ten miles west of Cardenas. This claim is only two miles from a railroad, but no ore has yet been shipped from it. Considerable development work has been done on the Jack claim and there was a total stock of about 450 tons of ore on hand in February, 1918.

An analysis by the United States Geological Survey of a composite sample of ore taken from two bins at this mine gave the results shown under 1 in the following table, and analyses A and B, made by Ricketts & Co., of New York, represent samples obtained by trenching separately the two bins of ore.

ANALYSES OF CHROME ORE FROM STOCK AT JACK MINE, NEAR MATANZAS

	1	A	B
Cr ² O ³	43.0	36.52	35.84
Fe	13.0	12.3	11.85
Si O ²	5.4	6.66	6.73
Al ² O ³	15.0	....	....
S.	TRACE.	....	....
P.	NONE.	0.4	.03
Ni	PRESENT.	....	....

Probably no ore can be shipped in the near future from any of these deposits beyond possibly 500 tons, now mined. The geologic conditions in these areas, however, warrant further exploration.

CAMAGUEY PROVINCE

The deposits of chrome ore examined in Camagüey Province consist of three groups, which lie along a narrow zone beginning about nine miles northeast of the

City of Camagüey and extending southeastward to a point near the Camagüey & Nuevitas Railroad, two miles northeast of Alta Gracia station. Immediately north of Camagüey there is a nearly level plain, which extends northward for several miles and is covered with a thin mantle of ferruginous clay and limonite gravel. The deposits lie along the border of this plain, at its junction with some low hills that are outliers of a plateau south of the Cubitas Mountains, so that they are easily accessible by wagon roads. Float ore is found in this zone and broken ore caps ten of twelve small mounds that rise five to fifty feet above the surrounding surface. In this zone there are also about fifteen small outcrops of ore, most of them obscured by broken ore or rock débris. The claims known as the Teire, Leocadia and Ninas are near the west end of the zone, one near the middle of the zone is the Nona, and the easternmost one is the Victoria. Prospecting has been done here to obtain samples of ore for analysis, but it has not shown the nature or extent of the deposits in place. On the surface, however, there is a considerable quantity of ore in the form of broken blocks and coarse float, probably 20,000 tons, and if the deposits have not been completely eroded there may be as much more ore in place below the surface. The ore is not of uniform grade. Some is fine grained and compact, but the greater part is medium to coarse grained. A small part of the ore consists of granular chromite containing little or no foreign material, but the greater part is "spotted" ore—that is, ore consisting of grains of chromite embedded in a gangue of light-green to white serpentine.

Ten samples of ore from deposits near Camagüey contained 27 to 36 per cent. of chromic oxide (Cr_2O_3), as shown by analyses tabulated below. Only two of these samples contained less than 30 per cent. and few contained more than 35 per cent. The ore in these deposits is therefore of low grade, but it may be suitable for certain purposes. If it should require concentration sufficient water is believed to be available in small streams within a mile of the deposits.

ANALYSES OF CHROME ORE FROM DEPOSITS NEAR CAMAGÜEY

	9	10	11	12	13
Cr_2O_3	33.7	33.7	33.8	35.2	36.3
Fe	12.2	12.3	10.9	11.8	10.6
Si O_2	3.9	4.3	4.1	3.9	3.6
Al_2O_3	29.8	30.7	27.0	27.4	26.2
	14	15	16	17	18
Cr_2O_3	35.0	27.4	29.1	34.2	34.1
Fe	11.6	10.7	11.4	11.1	11.0
Si O_2	4.5	4.0	2.4	1.5	1.5
Al_2O_3	26.7	20.2	32.9	28.3	28.7
S. ....	....	....	....	NONE.	....
P. ....	....	....	....	TRACE.	....
Ni.	± 0.05	....

Samples 9-11 from the Teire, Leocadia, and Ninas claims, north-northeast of Camagüey; 12-16 from the Nona and an unnamed claim, northeast of Camagüey; 17-18 from the Victoria claim, northeast of Alta Gracia.

As these deposits can be reached by wagon roads that are already in existence or that might be laid out over nearly level ground they deserve prompt attention, notwithstanding the low grade of the ore.

Besides the chrome-ore deposits examined by Messrs. Burch and Burchard in the vicinity of Camagüey others are situated about 20 miles north of Camagüey and just north of the east end of the Cubitas field of surficial brown iron ore. In this locality claims known as the Cid, Teyde and Yunque, which were examined by A. C. Spencer, of the United States Geological Survey, in 1907, all show noteworthy quan-

tities of chrome float, apparently of high grade, and the occurrence of tabular bodies of ore from 1 to 5 feet wide is indicated. On the Cid claim boulders of ore are distributed over a belt about 1,700 feet long, and on the Yunque the ore fragments are found in an area 150 by 250 feet. On the Teyde five separate deposits lie within an area measuring 1,200 by 3,000 feet. These deposits, one of which seems to be continuous for 900 feet, strike N. 10°—30° E.

ORIENTE PROVINCE

Small deposits of chrome ore occur on the Maria del Carmen claim, seven to eight miles northeast of Holguín, on the northwest slope of a low ridge of serpentine that lies between two higher ridges of steeply inclined limestone which stand about half a mile distant to the northwest and the southeast. Several prospects have been dug and one pocket has yielded about 150 tons of ore, which, with 25 tons of float that has been gathered, was ready for shipment in March, 1918. Analyses showed that some of the ore contained an average of 34.37 per cent. of chromic oxide, and that one sample, analyzed by the Bureau of Mines, contained 21 per cent. of metallic chromium, which corresponds to 30.6 per cent. of chromic oxide. The maximum content of chromium in pure chromite ($\text{FeO.Cr}_2\text{O}_3$) is 46.66 per cent., and the content of chromic oxide is 68 per cent. Late in July the company's consulting engineer reported that a large body of 40 per cent. ore had been developed, and that in all about 500 tons of ore was ready for shipment.

One of the larger deposits of chrome ore, the one that gives greatest promise of producing a considerable output in 1918 and 1919, is on the Caledonia claim, which is on the south slope of the Sierra de Nipe, about seven miles southeast of Woodfred, the headquarters of the Spanish American Iron Company's Mayari iron mines. The upper part of the ore body crops out on a steep hillside southeast of and about 300 feet above a mountain stream that flows into the Pinos, a small tributary of Mayari River. The ore body is roughly tabular in form, and, as shown by prospect trenches dug on the outcrop, is 10 to 30 feet thick. It dips toward the northwest at about the slope of the hillside (40° to 45°), and where it does not crop out it lies 30 to 50 feet from the surface. Two tunnels cut the ore at levels 100 feet and 200 feet below the top outcrop, and though the body has not been fully explored along the strike or in depth it may average 20 feet in thickness and may extend 200 feet along the strike and to a depth of 200 feet. The ore varies in quality, the better grade being in the western part of the deposit, where it carries as high as 48 per cent. of chromic oxide. Analyses furnished by the Spanish American Iron Company show a range of 35 to 48 per cent. of chromic oxide, 7 to 15 per cent. of silica, and 7.7 to 10 per cent. of iron for the whole body. By cobbing or by simple water concentration it may be possible to maintain a shipping grade of ore containing 44.5 per cent. of chromic oxide. The deposit contains about 50,000 tons of chrome ore, 25,000 tons of which should carry more than 40 per cent. chromic oxide and the remaining 25,000 tons between 34 and 40 per cent. of chromic oxide. By rough concentration, for which abundant water is available in the creek, this low grade ore should yield 15,000 tons of concentrates carrying about 40 per cent. of chromic oxide, so that about 40,000 tons of ore of this grade should be available.

This ore body lies close to the surface of the hillside and probably may be mined by an open cut. A zigzag trail of easy grade, descending 1,000 feet in 3½ miles, has been cut from the plateau down to the deposit. In March, 1918, the owners expected to begin at once packing the ore out on mules to the top of the trail, from which it could be carried 4½ miles by auto truck to the railroad at the Mayari iron mines. Routes had been surveyed and cleared for an aerial tramway 6,000 feet long, which would make it possible to increase greatly the rate of production. In eight

months in 1918 this mine, if equipped with 40 pack mules, could produce 1,300 tons of ore, but by using more mules could probably increase its output to 6,000 tons.

The Cayoguan group of chrome ore claims, which include the Cayoguan, the Narciso, and the Cromita Nos. 1, 2 and 3, are on both sides of Rio Cayoguan, about five miles above its mouth, which is in Moa Bay. The Cayoguan claim is on the right side of the river, about 60 feet above it, and about 750 feet above sea level. An outcrop that extends around the hill for about 300 feet and covers about 6,400 square feet has been prospected, and what appeared to be a fair sample of the ore contained 38.1 per cent. of chromide oxide.

The Narciso claim, which nearly surrounds the Cayoguan, includes, at a distance of about 600 feet south of the Cayoguan, an ore body that crops out on a steep hillside about 500 feet above the river. A sample of ore from this outcrop showed on analysis 34.8 per cent. of chromic oxide.

The Cromita claims, on the left side of the river, contain three known ore bodies and hundreds of tons of boulder float ore in an arroyo. The ore bodies are exposed in the river bluff at a height of 150 to 300 feet above the river. The most northerly ore body shows a face 20 feet wide and 15 feet high and has been prospected by an open cut. A sample taken from this cut contained 31.9 per cent. of chromic oxide. The middle body, which includes an outcrop 75 feet long and 50 feet high, has been penetrated 35 feet by a cut and a tunnel. A sample from the fines of the tunnel dump carried 25.9 per cent. of chromic oxide. The southerly ore body is exposed to a length of about 60 feet and a height of about 40 feet. Its thickness has not yet been determined. A sample from the outcrop contained 40.5 per cent. of chromic oxide. The geologic conditions indicate that the middle and southern bodies, which are about 75 feet apart, may possibly be connected within the hill. The following analyses show the general composition of the ore in this locality:

ANALYSES OF CHROME ORE FROM THE CAYOGUAN GROUP OF CLAIMS,
NEAR MOA BAY

	2	3	4	5	6
Cr ² O ³	38.1	34.8	31.9	25.9	40.5
Fe	11.7	10.2	11.9	13.0	11.2
Si O ² .....	.9	2.4	4.3	12.5	1.9
Al ² O ³	27.0	29.0	25.2	20.1	25.7
S. ....	....	....	....	TRACE.	NONE.
P. ....	....	....	....	TRACE.	NONE.
Ni. ....	....	....	PRESENT.	TRACE.	PRESENT.

Sample 2, Cayoguan claim; 3, Narciso claim; 4, Cromita claim, north body; 5, Cromita claim, middle body; 6, Cromita claim, south body.

The deposits of the Cayoguan group contain probably about 22,500 tons of available chrome ore, but possibly may yield 60,000 tons or more. These estimates include 2,000 tons of float ore in Cayoguan River and a tributary arroyo.

This group of deposits is about eight miles by trail from an old wharf at Punta Gorda, to which a road will have to be built down the valley of the Cayoguan, a narrow gorge bordered at many places by steep cliffs. Three kinds of road have been suggested—a road for oxcarts, a light tramway for mule cars, and a narrow-gauge steam railway. A road for oxcarts appears to be most practicable in view of the quantity of ore available and the small possible daily output.

The next deposit toward the southeast that was examined is on a claim known as the Potosí, which is on Saltadero Creek about four miles above its mouth. This creek is a tributary of Yamanigüey River, which enters Canete Bay about four miles below the mouth of the creek. The ore body is a steeply dipping lens that reaches a depth of more than 100 feet and at one place has a thickness of 25 feet and a

length along the strike of 45 feet. The upper edge crops out about 325 feet above Saltadero Creek and about 600 feet above sea level. Below this outcrop the ore body has been prospected by two drifts, started respectively 50 and 100 feet below the outcrop, and by a crosscut around the hillside about 80 feet distant from and a little lower than the upper drift. All these openings reach the ore body within short distances, but do not intersect it in such a way as to show definitely its dimensions.

The ore is medium to coarse grained. Some of the material in the drifts is spotted, but most of the outcropping and float ore is black and of good appearance. According to analyses that accompany the report of G. W. Maynard, an engineer who prospected the deposit in 1903, the representative ore contains 35 to 41 per cent. of chromic oxide, 1.4 to 15 per cent. of iron, 1.5 to 5 per cent. of silica, 5 to 17.5 per cent. of magnesia, and 25 to 29 per cent. of alumina. The ore body contains small masses of peridotite, which may reduce materially the quantity of serpentine and of olivine. This deposit contains 10,000 to perhaps 20,000 tons.

The work of getting this ore to the coast involves a difficult problem in transportation. The gorge of Saltadero Creek is too narrow and winding and in places too steep to permit the construction of any kind of road except at great expense, and even if a road could be built down to the mouth of Yamanigney River it is doubtful whether steamers of proper draft could enter Canete Bay. The only feasible plan is that of constructing an aerial tramway, about three miles long, from the deposit over the mountain and down to a point on the coast about two miles southeast of Canete Bay, from which a cart road or light tramway may be built possibly nine miles southeastward to Taco Bay, where there is fair anchorage for steamers.

A small body of chrome ore occurs on the Constancia claim, three-quarters of a mile south of Navas Bay, about 100 feet above sea level. The ore body appears to extend about 50 feet along the face of a gently sloping hill and has been opened by a cut 25 feet long and 5½ feet deep. The ore is not of uniform quality. It is mostly "spotted" ore—that is, it is chromite mixed with much serpentine gangue, but about six feet of better ore is exposed in the cut. A representative sample of the poorer ore contained 27.6 per cent. of chromic oxide, and a sample of the better ore contained 39.4 per cent. of chromic oxide, as indicated in the table given below:

ANALYSES OF CHROME ORE FROM CONSTANCIA CLAIM, NEAR NAVAS BAY

	7	8
Cr ² O ³	27.6	39.4
Fe	11.9	11.5
Si O ²	8.9	4.9
Al ² O ³	25.3	20.5

7. *Mixed ore*; 8. *clean ore*

The ore might perhaps be concentrated. No estimate of the quantity of ore in this deposit could be made. Very little float was seen near it and there are no indications of the occurrence of a large deposit. Water for concentration is available nearby in Navas River, and a road could easily be built to Navas Bay, which, however, is not deep enough for steamers, so that the ore would have to be lightered four miles northwestward to Taco Bay, or ten miles southeastward to Baracoa.

It is credibly reported that a body of at least 10,000 tons of ore similar to the low-grade ore at the Constancia claim lies to the mountains eight miles north of Navas Bay, but this deposit could not be examined within the time available.

SUMMARY

The reserves of marketable chrome ore in Cuba range from 92,500 long tons to 170,000 long tons, but only about 2,000 tons of ore can probably be shipped in 1918 unless greater efforts to exploit it are made. The large known deposits of chrome ore

in Cuba—those of the Caledonia, Cayoguan group, and Potosí claims—are near the northeast coast of Oriente, in a region difficult of access. They may yield 72,500 to possibly 130,000 tons of ore, most of which can be brought to present commercial grade by simple concentration. With suitable transportation facilities and mining equipment and sufficient labor most of this ore could be mined and shipped within two years after these conditions had been established. At the time of the examination only one deposit was ready for production and on a very small scale, but it seemed that the rate of production could be greatly increased by the employment of more miners and pack animals. It would require some time to put the other deposits in this region in shape for production.

The next largest known group of deposits is near Camagüey. They are very easy of access, but are of lower grade than those in Oriente Province. They appear to contain 20,000 to 40,000 tons of ore, most of which can be gathered by hand from the surface.

Near Matanzas, Cárdenas and Holguín there are small stocks of ore that are ready for shipment, perhaps 1,000 tons in all. The ore near Holguín is of medium grade, but that near Matanzas and Cárdenas is generally of lower grade. The expense of hauling the ore is reported to be almost prohibitive.

MANGANESE ORES—DISTRIBUTIONS OF DEPOSITS

Manganese ore is found in Cuba in Oriente, Santa Clara and Pinar del Río Provinces, but only in Oriente Province does it occur in large commercial quantities. In Oriente Province the deposits are in three areas, one north and northeast of Santiago de Cuba, another south of Bayamo and Baire, and the third on the Caribbean coast between Torquino Peak and Portillo. The first two include the only extensive deposits on the island. In Santa Clara Province a little ore has been found near Caribbean coast west of Trinidad, and in Pinar del Río Province a little ore occurs north of the City of Pinar del Río and farther west near Mendoza. All these deposits were examined, but as only the deposits in the two areas in Oriente Province mentioned above give promise of considerable production only these will be described here.

GEOLOGIC AND TOPOGRAPHIC FEATURES

The manganese ores of Cuba occur principally in sedimentary rocks such as limestone, sandstone and shale, which are in places metamorphosed, but in the most heavily mineralized localities are associated with masses of siliceous rock locally termed "jasper" and "bayate." At one locality the manganese and its siliceous associates are in igneous rocks, such as latite-phyry and latite.

The sedimentary rocks with which the manganese deposits are associated are in some places nearly horizontal but generally show dips ranging from a few degrees to 45 degrees or more. These inclined beds usually represent portions of local folds. Some faulting is shown in the vicinity of certain manganese deposits and may have influenced the localization of the deposits.

The area north of Santiago and that south of Bayamo are both north of the mountain range known as the Sierra Maestra, but that on the coast east of Portillo is at the south base of this range. The area north of Santiago is, broadly speaking, in the basin formed by the Sierra Maestra on the south and the Sierras de Nipe and del Cristal on the north, the greater part of which is drained westward by Río Cauto and its tributaries, and small parts of it by Río Purgatorio and Río Guantánamo to the south and east. The deposits of manganese ore are found on both sides of the basin. The deposits in the area south of Bayamo are in the foothills of the Sierra Maestra, drained by Buey, Bayamo, Yao and Cautillo Rivers.

The deposits in the two areas north of the Sierra Maestra show an interesting

concordance in altitude. They stand from 500 to 1,200 feet above sea level, and most of them are at altitudes near 600 to 700 feet, suggesting a relation between the deposition of the manganese and a certain stage in the physiographic development of the region. Most of the manganese ore deposits are above drainage level on the slopes of hills of moderate height, the maximum relief in the immediate vicinity of the deposits seldom exceeding 500 feet.

TYPES OF MANGANESE ORE DEPOSITS

The deposits of manganese ore examined in Cuba are rather diverse but may be grouped into three general physical types—bedded deposits, irregular masses associated with siliceous rock or “jasper,” and deposits in residual clay. The bedded deposits comprise several varieties, one of the most common consisting of poorly consolidated beds of sandy chloritic material cemented with manganese oxides that fill inequalities in the surface of hard rocks. Other bedded deposits clearly replace limestone, shale, conglomerate, or other rocks, and tabular masses of ore are interbedded with strata of nearly horizontal limestone.

The ore consists largely of pyrolusite, but many deposits contain psilomelane, manganite, and wad, or mixtures of all these minerals. The richness of the deposits varies considerably. Most of the richest masses are associated with the “jasper,” but masses that have replaced limestone thoroughly are also rich.

DISTRICT NEAR SANTIAGO

The deposits of manganese ore examined in the Santiago district comprise the Ponupo group, the Ysobelita, Botsford, Boston, Pilar, Dolores, Laura, San Andreas, Cauto (Abundancia), Llave and Gloria mines, and the Caridad and Valle prospects. All these properties except the two prospects were producing ore. A few small producing mines in the district were not visited. The Ponupo, Ysobelita and Boston mines were opened many years ago and have produced a large quantity of ore. The Ponupo and Ysobelita are still relatively large producers, though the grade of ore is not now so high as that of the ore shipped in the earlier days.

The three types of manganese ore deposits and their several subordinate varieties are well displayed in this district, especially at the Ponupo group of mines. Here, at the Generala openings, bedded material fills solution cavities and crevices in limestone, in some places to great depths. At the Sulfana opening manganese oxides have replaced shaly and sandy conglomeratic beds that dip N. 10° E. at an angle of about 18°. This deposit is apparently a lens, having a maximum thickness of about 20 feet, the lower half of which is richer in manganese than the upper half. At the Juanita opening manganese has in spots replaced limestone. At the Balkana opening the ore is found in siliceous rock, or “jasper,” that apparently fills a large fissure in limestone. At the Vincidora openings ore is associated with “jasper” and also occurs in lumps in residual clay in pockets between boulders of “jasper.”

The Ponupo mine is directly connected with the Cuba Railroad at La Maya by a branch about two miles long, and a narrow-gauge track from Cristo, on the Cuba Railroad, to the Ysobelita mine, a distance of about three miles, is reported to be practically completed. Extensions of this line to the Boston and Pilar mines could be made without great additional outlay. The Dolores and Laura mines are near the Guantánamo & Western Railroad, near Sabanilla station, and the Cauto mine is adjacent to the Cuba Railroad at Manganeso station. The other mines are one to eight miles from railroad, to which the ore is hauled mainly by oxcarts. In the rainy season the roads are impassable, and even in the dry season they include many difficult places, so that the quantity of ore hauled is less than can be mined.

The ore is mined by hand, mostly from open cuts, though short drifts and tunnels have been run into lenses of ore at the Ponupo, Cauto and Laura mines, and a slope has been driven on a thin tabular mass of ore between strata of limestone dipping about 34° at the Botsford.

High-grade ore may be selected in mining the richer parts of the deposits, but most of the ore requires mechanical treatment, such as log washing and jigging, to free it of clay sand and other impurities, and, though it is thus possible to maintain a shipping grade of ore, much is now lost in the tailings, not alone because the concentrating apparatus used is simple and crude, but because the recovery of finely divided manganese oxides is very difficult and has not yet been successfully accomplished. At one mine ore is cleaned by raking over a horizontal screen in a stream of water. Log washers were in operation at four mines and were under construction at two others. At one mine a system of washing, screening and jigging is employed.

The daily production of manganese ore about the middle of March, 1918, in this district was between 280 and 300 tons a day. The output was curtailed later, in the rainy season, which begins about the first of June, especially that from the smaller mines, which are dependent on oxcart haulage, but the curtailment will be more than offset by the increase in shipments after the railroad from Cristo to the Ysobelita mine has been opened.

The approximate average composition of a large proportion of the ore now shipped is as follows:

Manganese	38.885	Per Cent.
Silica	12.135	" "
Phosphorus .....	.084	" "
Moisture	11.201	" "

The total output of manganese ore during 1918 from the district near Santiago will probably reach 110,000 tons, the greater part of which will contain between 30 and 45 per cent. of manganese, only a few thousand tons containing more than 45 per cent.

The reserves of merchantable ore in this district are estimated at 600,000 to 700,000 long tons.

DISTRICT SOUTH OF BAYAMO

The manganese deposits that were examined in the district south of Bayamo consist of the Manuel, the Costa group (Costa, Carbayon, Daniel, Oviédó, Vicente and other claims), 18 to 23 miles by wagon road southwest of Bayamo; the Francisco and Cádiz, 15 to 20 miles southeast of Bayamo; the Guisa, Llego and Charco Redondo, 7 or 8 miles southeast of Santa Rita, and the Adriana and San Antonio mines, 9 to 10 miles south of Baire. Other deposits, farther southeast, are in what is known as the Los Negros district.

Little mining has been done in this district, and as most of the deposits, like the Cuban manganese deposits generally, are richer near the surface than deeper, it is still possible to produce high-grade ore here by selective mining. Deposits of "milling" ore are also available and will undoubtedly be developed later if prices remain favorable.

The ores at the west end of the district, on the Manuel and Costa group, occur in irregular masses of "jasper" or "bayate" associated with latite porphyry, and those of the other properties farther east are associated chiefly with limestone and comprise bedded and residual deposits.

The development of the deposits south of Bayamo is handicapped by their remoteness from the railroad and by the lack of good wagon roads. The owners of the Manuel mine and of the Costa group will soon make use of a road by way of Buycito to Julia, a station on the Cuba Railroad between Bayamo and Manzanillo,

a few miles nearer than Bayamo. This road is being improved, and bridges that will soon permit motor trucks to be used over part of it are being built. Strenuous efforts are made in this district to get ore to market. Some of the ore is now carried 10 to 25 miles in sacks on the backs of mules and in oxcarts, and in the dry season a motor truck carries ore 15 miles from a mine to Bayamo, fording Bayamo River many times and standing hub deep in the water of Guama River to load the ore from a wharf.

Most of the mining operations in this district are on a small scale and rather simple. The developments on the Manuel, Oviedo and Carbayon claims consist of open cuts in which the ore is broken and hand cobbled. At the Chareo Redondo a thin-bedded deposit has been stripped of an overburden of argillaceous limestone to a thickness of eight feet and the ore is taken up in lumps and blocks. At the Adriana the ore body lies between beds of limestone that dip about 45° and is mined from underground drifts turned off from a main incline, through which the ore is hoisted by cable.

No mechanical apparatus for concentrating the ore had been installed in this district at the time it was visited. As stated above, the "cream" of the ore is now being skimmed off, and until better roads are available it is doubtful whether it would be profitable to attempt the mechanical concentration of low-grade ores. Plenty of water, however, is available, and if the cost of transportation can be reduced sufficiently these ores may also be utilized.

It was estimated in April that the output of manganese ore from this district during 1918 would probably not exceed 12,000 tons, half of which would be high-grade ore carrying between 45 and 55 per cent. of manganese, but developments since then indicate a larger output.

The reserve of manganese ore in this district is estimated at about 50,000 tons, most of which is in the western part, and this estimate does not include the Los Negros district, which lies farther southeast, 25 to 30 miles from the railroad. The Los Negros district is not now producing ore and it was not visited by the Geological Survey-Bureau of Mines party, but engineers who have examined the district believe that it may yield a large output of high-grade ore from many small deposits.

CONDITIONS AFFECTING MANGANESE INDUSTRY

Although the owners and operators of manganese properties in Cuba desire to speed up production while the need for the ore is great and the prices are good there are certain hindrances, aside from climatic conditions, which tend to retard their output. These hindrances can be removed to some extent if not altogether. For instance, it has been difficult to obtain and hold a sufficient number of miners at certain mines because an adequate supply of staple foodstuffs could not be furnished to them, so that they left the mines and went to work in sugar mills, where they more easily obtained food to their liking. Mining has also been handicapped by shortage of explosives.

Difficulties of transportation of ore from mines to railroads have been mentioned, and there seems but little chance for improvement without assistance from the Cuban Federal Government in building and improving cart roads. Haulage by caterpillar tractors may eventually supplant some of the haulage by animals.

The high cost of animal haulage, of course, prevents the production of ore from many deposits at a distance from railroads. The limitation of this traffic to five or six months of the year handicaps production in still another way, for, though mining might be carried on during practically the whole year, ore would have to be stacked up for many months awaiting the drying of the roads, and this storage of ore would require the locking up of considerable capital, which few of the smaller operators can afford.

Shortage of railroad cars and the inability of the Cuba Railroad to handle adequately all the manganese ore during the dry season, when traffic is heaviest because the cane-grinding season also falls in this period, is also a serious handicap to the output of ore. For a time during the spring of 1918 a shortage of ships permitted ore to accumulate at the docks in Santiago faster than it could be removed, but it is understood that conditions there are better now.

The marketing of ore by small producers is attended by more or less friction between buyers and sellers over sampling and analyses. It has been suggested that the United States Government detail two men, one of them a chemist and the other a man who has had experience in sampling ore, to act as umpires at Santiago in the sampling and analysis of manganese ore. It is believed that their work would encourage small producers to steadier efforts, and that the service might be made self-supporting by charging the cost to the interested parties.

The production of manganese ore seems to have been handicapped by the attitude of some owners of lands and leaseholds, who have raised the price of royalties so high as to discourage operations. In the course of its trip the Government party heard complaints of many forms of sharp practice, which undoubtedly are not conducive to a hearty co-operation between property owners, miners and buyers of manganese ore.

SUMMARY

Despite the handicaps outlined above the operators of manganese mines are striving to increase their output and there is a strong interest taken everywhere in Cuba in developing manganese prospects.

If railway cars and ships are provided for transporting the ore, food for the mine laborers, and explosives for blasting, the outlook for a steadily increasing production in 1918 and 1919 is good. It is believed that the total output for 1918 should be between 110,000 and 125,000 tons, more than 90 per cent. manganese, the remainder being of still higher grade. After the completion of a narrow-gauge track to certain important mines east of Cristo, in the Santiago district, in the summer of 1918, an increased output in 1919 is assured.

The reserves of manganese ore in Oriente Province are estimated at 700,000 to 800,000 tons, more than 85 per cent. of which are in the district northeast of Santiago.

PUBLICATIONS RECEIVED

Mr. William E. Richards, Counsellor at Law, New York, has published a booklet entitled *Trade-Marks*. The work is designed to serve as a convenient handbook, presenting in concise form for ready reference the features most necessary to be available to lawyers and manufacturers to enable them to readily understand the leading points of the law and practice on this subject matter, and to take the necessary steps to secure protection for this class of property.

tions showing steel structures which the company has designed and erected in the United States and abroad, the catalogue contains much information useful in quoting on foreign inquiries, as well as valuable tables in English and metric units covering all classes of structural materials, with notes.

A domestic edition of the catalogue, with additional illustrations and data, is announced for issue in the near future.

EXPORT FINANCE CORPORATION

The Belmont Iron Works of Philadelphia and Eddystone, Pa., has issued an attractive catalogue in folder form printed in English, French and Spanish, for export trade use. In addition to illustra-

The Export Finance Corporation, 40-42 Wall Street, New York, announce the opening of a branch of their business in Cuba, in association with Allen & Moskowitz, Havana.