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(Reports on some manganese deposits in the Republic of Panama .1951.

by

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Introduction

Manganese has been mined in Panama at various times from about 1875 until 1920. No ore has been shipped during the last 23 years and, until a few years ago when war conditions began to affect the price of manganese ore, there was little interest in the Panama deposits. For the past three years various persons and companies have prospected many of the old deposits and have found a few new deposits, but no mining operations have begun.

In view of the fact that both the mechanical process of mining and shipping ore in Panama and the present economic conditions involve rather difficult problems, it seems appropriate to discuss a few of these problems with the purpose of showing that the mere presence of manganese deposits in the country does not in itself indicate that those deposits can be profitably mined. These comments result from field work done in 1942 and 1943.

Climate and topography as related to transportation

All of the manganese deposits examined are in areas of rather heavy rainfall. Annual precipitation in Panama ranges from about 80 inches along the Pacific coast to as much as 180 inches along the Atlantic coast. The rainy season includes the months from May to January, the rainiest months being October and November. Relatively little rain falls during the rest of the year, and the manganese area of Veraguas Province is said to receive less than one inch

per month throughout the dry season.

As a result of heavy rainfall, a large part of the country, especially east of the Panama Canal, is blanketed by a thick mantle of clay, and during the rainy season any unsurfaced road would become absolutely impassable for any vehicle except an oxcart. Moreover, road cuts in the deep clay overburden would tend to slump badly when wet and in most places continuous maintenance work would be necessary throughout the year.

In general, the country east of the canal and much of the hilly coastal land west of the canal consists of considerably dissected terraine of steep narrow ridges and deep canyons. Because of many necessary culverts and bridges, road construction would be difficult and expensive even under favorable climatic conditions. A railroad might eliminate some of the maintenance difficulties but the increased expense for bridges and excavations would probably more than offset the other difficulties avoided. The Hyatt railroad, from Nombre de Dios to the Boqueron River, is said to have cost in the neighborhood of $400,000. It was finally abandoned because of maintenance difficulties and expense before it had reached the nearest mine.

Mining technique

Only the Soledad Mine, near Nombre de Dios, has ever been worked underground. Here it was found that the thoroughly decomposed rocks persisted to a depth of at least 60 meters. Some difficulty was experienced in keeping stopes open as the soft clay tended to squeeze out into any opening. The most satisfactory method for alleviating this trouble was backfilling with material from a

quarry outside the mine, the ore chutes and manways being extended through the fill as stoping progressed upward. It is probable that similar conditions would be met elsewhere if underground mining were commenced, and backfilling or squaresetting of stopes as well as timbering of adits would be necessary.

The labor situation

There are probably no miners available in Panama, and it is almost certain that skilled miners would have to be brought in from outside. The employment of a great number of men by the Third Locks Project has caused a labor shortage throughout much of the Republic, but the present nearly complete cessation of this work would undoubtedly make available a considerable amount of unskilled labor. The average wage for a mining operation would probably be about $1.50 per day plus food, although in Veraguas Province the wage might be slightly lower. Food per man will average about $.50 per day.

Price of manganese in Panama

As no manganese ore has been offered for sale in Panama in the last few years the probable price of ore in the country is uncertain. At present the Metals Reserve Company is paying $.63 per unit or $31.50 per dry long ton for Cuban ore assaying 50 percent metallic manganese, and it is probable that this represents the order of magnitude of the price which would be offered for similar ore in Panama. In contrast to these present levels, the price paid in 1917-1918 for some of the Mandinga Bay ore (San Blas Province, Panama) was said to have been over $100 per ton. The Mandinga Bay operation

was successful because the deposits mined were less than two kilometers from a good deep-water anchorage which greatly facilitated ore handling. The writer is of the opinion that no manganese deposit in Panama could be profitably developed and mined at price levels corresponding to those in effect in Cuba.

Resumé

All available information indicates that Panama cannot be considered as a potential source of any appreciable amount of manganese ore during the present world conflict unless shortage of the metal forces the United States Government to finance mining operations. In any event, the cost of mining and shipping ore from Panama would undoubtedly be greater than the present value of the ore on the world market. All of the above problems, however, are secondary to the probability that none of the deposits examined by the writer contain a large tonnage of medium or high grade manganese ore.

Fig. 1

MAP OF
REPUBLIC OF PANAMA
SHOWING MANGANESE AREAS

0 5 10 20 30 40 50 miles

1 Bahia Honda
2 Montijo Bay - Ponuga
3 Boqueron River - Hyatt
4 Nombre de Dios
5 Mandinga Bay
6 Calzada Larga

Some deposits in the Province of Veraguas

Abstract

The manganese deposits described in this report are in the southern part of Veraguas Province in the vicinity of Montijo Bay. Three properties were examined. The Harriet, at Bahia Honda, is a lenticular deposit of partly oxidized manganese silicate. La Matilde, between Atalaya and Ponuga, is a deposit of siliceous manganese oxide, largely in the form of float, found at various places within an area some 1500 meters long and 300 to 400 meters wide. The Nuestro Amo property, three miles south of Atalaya, is a small deposit of partly oxidized manganese silicate.

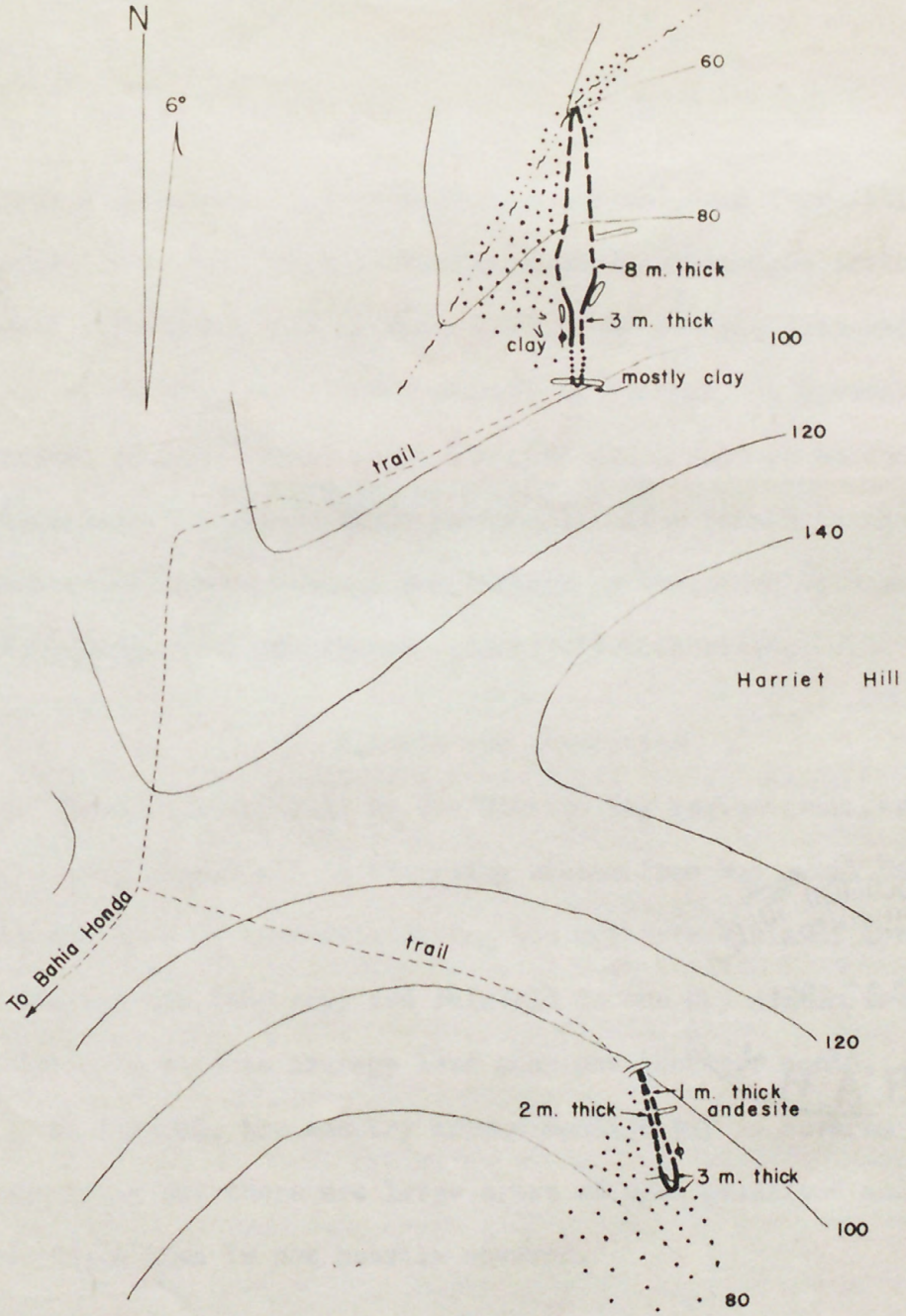
None of the deposits examined appeared to have sufficient high grade material to justify further work. The deposits may be considered as a potential source of perhaps as much as 50,000 tons only if and when ore containing around 25 percent manganese becomes commercially valuable.

General Considerations

Location

The manganese deposits of Veraguas Province described below are in the vicinity of Montijo Bay, a large shallow indentation on the Pacific Ocean side of the province. (See Fig. 1, localities 1 and 2.) The largest towns in the region are Santiago, 280 kilometers southwest of Panama City on the Panama City-David highway, and Sona, 50 kilometers west of Santiago. An all-weather surfaced road runs from

Fig. 2



Sketch Map of the

HARRIET MANGANESE DEPOSIT

Province of Veraguas, Republic of Panama

0 10 20 30 40 50 meters

Scale

Contour Interval 20 meters

Strike of vertical lens

Trench

Outcrop of partially oxidized manganese silicate

Boulders of " " " "

February, 1943

Santiago to Atalaya, 13 kilometers southeast, and from Atalaya a dry weather dirt road leads to Ponuga, some 24 kilometers south of Atalaya and 11 kilometers east of Montijo Bay. There is a fair natural landing field at Mariato 16 kilometers south of Ponuga. At present,(March 1943) Mariato, an old coconut plantation, is being used as headquarters for a Rubber Reserve Company field party collecting rubber in the vicinity. The country between Ponuga and Atalaya is traversed by numerous trails which render most of the area relatively accessible.

Climate and vegetation

The annual rainfall in the Montijo Bay region averages some 70 to 80 inches, nearly all in the rainy season from May until December. Less than one inch of rain fell during the writer's visit of three weeks in January and February, and rainfall in the dry season from January to April is said to average less than one inch per month.

In general, the country around Montijo Bay is covered by heavy vegetation, but there are large areas of open grassland and much of the jungle area is not heavily covered.

Harriet Deposit

Location and accessibility

The Harriet manganese deposit, also known as the Rosario deposit, is in the southwest part of Veraguas province on the west side of a prominent hill about one kilometer north of Bahia Honda. (See fig. 2.) The deposit lies at about 7° 47' N. Latitude and 81° 31' W. Longitude, 250 kilometers airline southwest of Panama City.

Bahia Honda is a fine natural harbor which has been charted by the

U. S. Navy (Hydrographic Office Chart No. 1040). It is about 400 kilometers by boat from Panama City, 110 kilometers by boat from Sona via the San Pablo river and Montijo Bay, and 95 kilometers by boat from Puerto Real, 18 kilometers by road south of Santiago. There is a trail between Sona and Bahia Honda, but the trip is said to be a very long and difficult one.

A small village on the north shore of Talon Island, in the center of the bay, is the only native settlement in the vicinity. The people work small farms along the north shore of the bay, and raise oranges, grapefruit, bananas, plantain, and rice. The waters of Bahia Honda are literally alive with fish which, together with the clams abounding in the mud flats bordering the bay, form an important part of the native diet. The mainland near the bay is covered with dense jungle, including a great amount of maria, a tropical wood of some value which the natives saw by hand into lumber that is sold in Sona.

The tides at Bahia Honda, as elsewhere along the Pacific coast of Panama, are very high, ranging from 10 to 18 feet, and at low tide mud flats from 600 to 1200 meters wide are exposed along the north shore of the bay. Between the manganese deposit and the bay is a belt of mangrove ranging in width from 100 to 600 meters.

Ownership, history and production

The Harriet deposit is on National Government land and is covered by three pertenencias, or mining claims, of five hectares each, a total of 15 hectares or about 37.5 acres. The claims are held by Horacio Velarde, of Panama City, and Captain Emmett Arnold, U. S. Army, Quarry Heights, Canal Zone.

The first prospecting was done in 1921, and a sizeable outcrop is said to have been found along the bottom of a small tributary of the Rio Luis, which flows into the bay directly north of Talon Island. At present the old prospect workings are completely covered by landslide and jungle, and the writer was unable to confirm the presence of the body. Mr. P. A. Davies of Santiago, who did the work in 1921, told the writer that he had been unable to locate the croppings during a subsequent visit a few years ago. A small amount of material, perhaps 100 tons, was transferred to the island for shipment and a 500 pound sample was taken for analysis. This sample is said to have assayed 47 percent manganese and 8 percent silica. Some still remains on the island, most of it having been used as foundation material for some of the native houses.

The next prospecting was done about 1935, when the entire area was cleared and a small amount of trenching was done on two outcrops on the west side of the Harriet hill. No further work has been performed, and there has been no production from the deposit.

Geology and manganese deposits - general

The deposit consists of two outcrops, one on either side of a small saddle on the west side of a prominent hill easily visible from the bay. Both outcrops lie at altitudes ranging from 60 to 100 meters, and are some two kilometers by boat and trail from the bay. The country is blanketed by dense jungle, and the area near the outcrops, cleared in 1935, is covered by an even denser second growth of small trees and shrubs.

The only rock exposed near the north outcrop is a red clay, but at the south outcrop one trench exposes a deeply weathered

volcanic rock, probably andesitic.

Deposits

The north outcrop is on the east side of a steep canyon and is a lens which strikes north and dips vertically. The lens is exposed intermittently over a length of 50 meters and ranges in thickness from three to eight meters with an average thickness of about five meters. It crops out over a vertical interval of 40 meters. The canyon at the lower end and a trench at the upper end clearly determine the length of the lens. The canyon wall below the outcrop shows numerous small boulders as does the creek bed for a considerable distance downstream.

The manganiferous material is a hard blue-black oxide mineral of the psilomelane type carrying some unoxidized manganese silicate and evidently, to judge by the amount of limonite present, an appreciable amount of iron. Three analyses of the rock, taken from a report by G. C. Riddel written in June, 1927, gave the following results:

	Mn	MnO_2	Fe	SiO_2
(1)	30.21	--	17.21	Not determined, but
(2)	40.61	39.93	--	should average about
(3)	34.66	36.94	11.94	25% in these analyses

The manganese oxide is the result of oxidation of a vein or bed of manganese silicate, either neotocite or bementite. The depth of oxidation is unknown, but the presence of unoxidized remnants in the surface material indicates that oxidation at depth will probably not be complete.

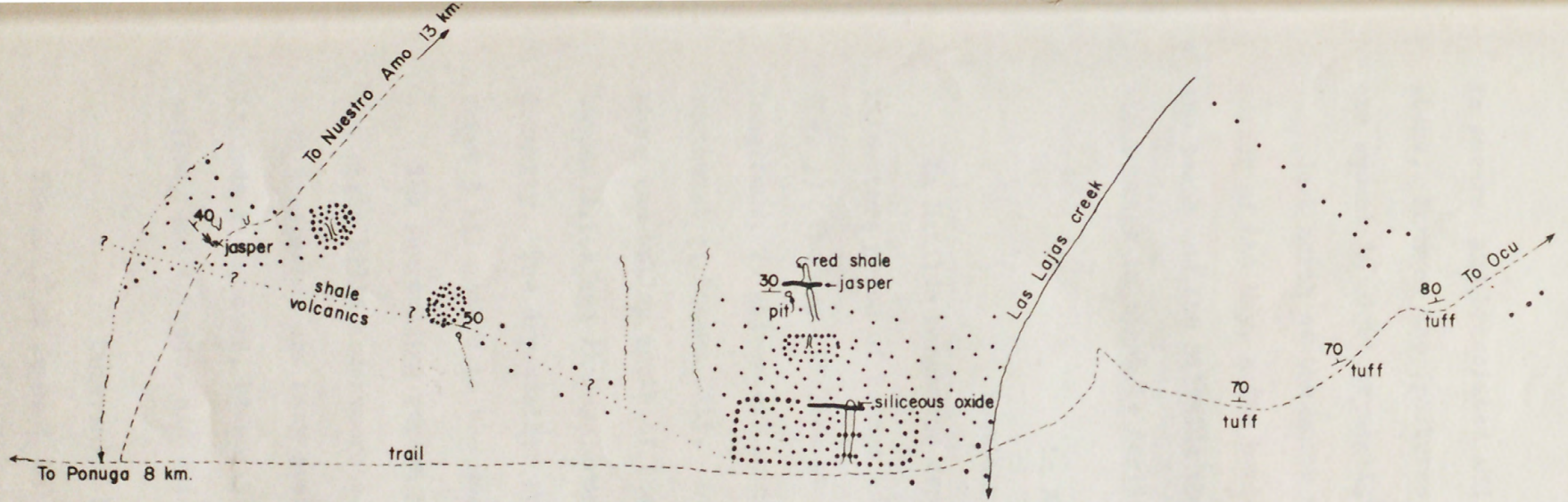
The second deposit is about 150 meters south and lies approximately along the extended strike of the north outcrop. There are no exposures between the two deposits, and the bodies appear to be entirely separate although perhaps localized along the same bed or shear zone. The deposit is a poorly exposed lens of siliceous manganese rock about 25 meters long and ranging in width from one to three meters. The strike is N. 15° W., the dip uncertain but probably steep. Manganese-bearing rock is exposed at only three places along the strike, and the body may not be continuous between them. On the hillside below are numerous boulders which have broken off the outcrop.

The rock consists largely of siliceous manganese oxide, both massive and in thin veinlets in jasper. It is similar to the material of the north deposit but more siliceous.

The writer made no attempt to find the best route for a road, but it appears that about 2.5 kilometers of road over easy grades would be needed to reach from the base of the Harriet hill, near the deposits, to the bay. Some of this road, perhaps as much as one-half mile, would be built through mangrove. Small boats can load at the waters edge at high tide and the ore could then be transferred to larger boats for shipment. However, because the deposit is small and the ore averages less than 40 percent of manganese, it is recommended that no further work be done.

Other manganese deposits near Bahia Honda

A lens of jasper in metamorphosed gray sandstone (?) crops out on a narrow point on the east side of the bay. The lens is eight meters long and has a maximum thickness of two meters. The jasper



Sketch Map of

LA MATILDE MANGANESE DEPOSIT

Province of Veraguas, Republic of Panama

0 50 100 200 300 400 meters

Scale

35 Strike and dip of beds

Contact - location uncertain

Trench or open cut

Boulders of siliceous manganese oxide

Spring

February, 1943

Fig. 3

is sheared and brecciated and faulted along the contacts with sandstone. Many of the fractures are filled with manganese oxide, but the amount in sight is negligible.

Just north of the mouth of the Managua River, in the northeast corner of the bay, a few boulders of manganese oxide are scattered on the beach and the hillside above. The oxide is very low-grade and the tonnage in sight is negligible.

La Matilde Deposit

Location and accessibility

La Matilde manganese deposit is in a range of low hills about 8 kilometers north of Ponuga and 16 kilometers south of Atalaya. (See fig. 3) The deposit lies at about 7° 53' N. Latitude and 80° 54' W. Longitude, 25 kilometers south southeast of Santiago and 190 kilometers southwest of Panama City. The main trail from Ocu to Ponuga passes along the valley south of the hills, and the trail from Ponuga to Los Cerros Altos and Atalaya crosses the ridge near the west end of the property. The dry-weather automobile road from Atalaya to Ponuga lies about 3 kilometers to the west.

The surrounding region presents a deeply dissected terrain of low steep hills and numerous small canyons. Much of the district is open grassland, and many small farms are found nearby. Native crops include rice, corn, beans, yucca, yami, oranges, plantain, bananas, coffee, and tobacco, and chickens, hogs, and cattle are plentiful.

Ownership, history, and production

The Matilde deposit is on National Government land, and is covered by three pertenencias of five hectares each, a total of about

37.5 acres. The claims are held by Horacio Velarde of Panama City and Captain Emmett Arnold, U. S. Army, Quarry Heights, Canal Zone.

Exploration work has been performed on the deposit from time to time since 1920 or 1921, and it is thought that the main development work was done in 1921 and 1935. The area has been cleared at least once, and much of it is now covered with a thick mantle of second growth denser than the virgin jungle. There is no record of any commercial production from the property.

Just prior to the writer's examination the natives had been engaged in felling trees and shrubs preparatory to clearing for planting, and a considerable part of the area was covered by a dense blanket of fallen timber and brush three or four feet thick which effectively prevented any detailed examination.

Geology and manganese deposits - general

The Matilde deposit embraces three low hills separated by a broad valley between the west and middle hills and by Las Lajas creek between the middle and east hills. The manganese occurs in a thick belt of shale or mudstone and clay which dips about 30° north and overlies a series of volcanic rocks which are well exposed along the trail at the base of the hills. The volcanic rocks include acidic ash and tuff, andesitic and basaltic agglomerates, and amygdaloidal agglomerates. All these rocks are deeply weathered and accurate determinations are not possible in the field. The approximate contact between the sediments and the volcanics is shown on the map.

Deposits

The deposits or manganese will be described in order of occurrence from west to east.

West hill

The north and west sides of the west hill are more or less covered by boulders and nodules of manganese oxide over an area of roughly two hectares or five acres . Float is exposed in several trenches and the westernmost trench shows a thin bed of manganiferous jasper striking northwest and dipping 40° northeast. Near the east end of the float area a trench shows a thin mantle of high grade manganese oxide nodules resting on clay and jasper. The layer of manganese-bearing rock is about 25 cm. thick, and not more than 25 percent of the layer is oxide. The oxide is heavy material of the psilomelane type and appears to be present over an area roughly 50 meters in diameter. The actual size of the deposit could not be estimated because of the nearly total lack of exploration.

The material exposed in the trenches to the west and the remainder of the float are very low-grade, consisting largely of jasper and shale cut by thin veins of manganese oxide. There are also numerous small bodies formed apparently by the replacement of brecciated jasper by manganese oxide. Very little exploration work has been done and the average manganiferous material appears to contain less than 20 percent of manganese.

Near the base of the hill, about 150 meters southeast of the float area described above, is a heavy concentration of boulders of manganiferous rock, jasper, and dark chert. About one boulder in four over an area some 50 meters in diameter is manganiferous. These boulders are largely dark reddish black manganese silicate containing many small pockets of soft gray pyrolusite in groups

of radiating prismatic crystals. Not more than 5 percent of any specimen examined was manganese oxide. Fifty tons of such boulders and 150 tons of barren rock have been collected and placed in three piles, but no further prospecting has been done. The ore was estimated to contain about 35 percent of manganese.

A few pieces of jasper are found along the base of the hill between the float area and the broad valley which separates the west and middle hills. No manganiferous boulders were seen in the valley itself.

Middle hill

The largest concentration of manganese on the Matilde property is on the gentle slope near the base of the middle hill. A north-trending trench 60 meters long has been cut in a mantle of boulders of manganese oxide and jasper. At the south end of the trench and near the middle are heavy concentrations of boulders suggesting the possible presence of bodies nearby. The north end of the trench exposes a bed seven meters thick which can be traced for 50 meters to the west. Some of this bed is heavy bluish oxide of the psilomelane type, but the predominant rock is a deeply weathered jasper cut by many veins of manganese oxide and coated along fractures with films of manganese oxide.

The area covered by float is about 200 meters long by 75 meters wide and the float probably extends to a depth of at least one meter. It is estimated that carefully sorted ore from this blanket of float may contain about 25 percent of manganese, mostly oxide.

Beyond the north end of the trench the slope of the hill increases abruptly. Fifty meters up the slope is another trench which

exposes a similar mantle of boulders about one-half meter thick. About 25 percent of the boulders, some of which weigh more than a ton, are manganese oxide. There is probably an ore body near the upper end of the trench, but no rock was seen that is definitely in place. The ground around the trench was covered by a dense blanket of fallen timber at the time of examination, so the total area of float is uncertain, but float is probably present to a depth of one-half meter in an area some 50 meters long and 25 meters wide. The boulders contain probably about 30 percent of manganese.

Forty meters northwest of the second trench a pit five meters deep exposes bright red shale striking east and dipping 30° north. The shale contains numerous small interbedded lenses of jasper but no manganese. Five meters east of the pit a shallow trench 60 meters long is cut across a bed of jasper two meters thick which strikes east and appears to dip north. This bed can be traced westward to a point just above the pit, where its continuation, if any, is buried. The wall rock is red shale similar to that in the pit. The jasper carries a considerable amount of iron and very little manganese.

East hill

On the west slope of the east hill, between the Ocu trail and Las Lajas creek, a few boulders of good grade manganese oxide were seen, but the area is entirely unprospected and the source of these boulders has not been found. The quantity of oxide seen during the writer's examination was very small, although higher grade than anywhere else on the Matilde property.

Reported assays of the Matilde rocks give the following results:

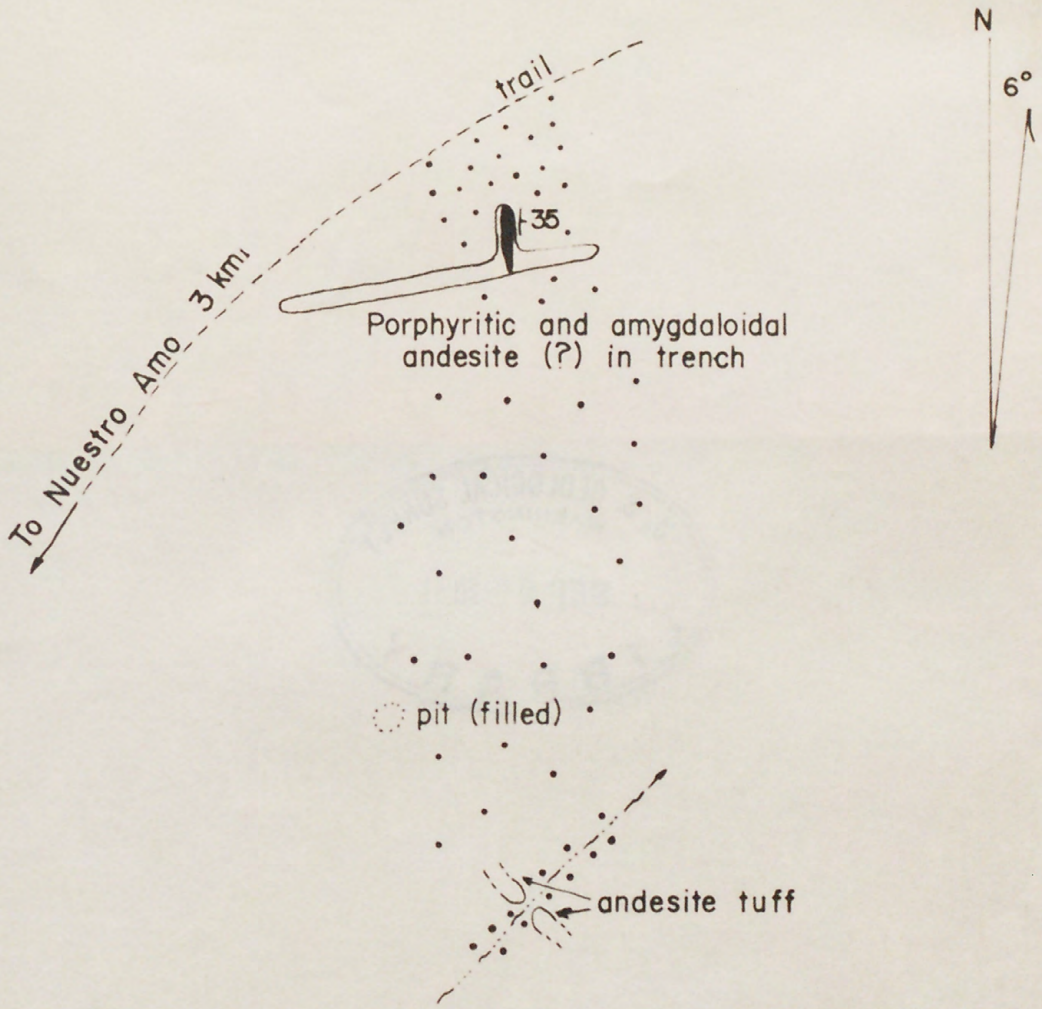
	Mn	Fe	SiO_2	Al_2O_3	Locality
(1)[a]	23.99	6.88	27.58	8.09	General sample from trenches
(2)[b]	31.61	5.66	15.34		West Hill
(3)	44.3	2.59	8.22		" "
(4)	40.6				" "
(5)	28.72	6.21	17.62		" "
(6)	30.07		13.24		" "
(7)	32.87	9.86	15.08		" "
(8)	24.8				Bed, lower trench, middle hill
(9)	36.10	7.94	17.3		Second trench, middle hill
(10)	44.6	4.36	7.26		Float, east hill
(11)	48.36	3.37	6.64		" " "
(12)	40.5	8.57	8.55		" " "
(13)	37.89	6.40	10.84		" " "

(a) From report by G. C. Riddel, June, 1927

(b) From report by Capt. E. L. Arnold, September, 1941.

The remaining analyses are from the same report.

Further exploration, including clearing, will probably develop additional manganiferous material. Deeper trenches are needed to determine the location of the bodies from which the float has been derived, and many additional trenches must be dug to determine accurately the size of the areas in which float is found and the depth to which it extends.



Sketch Map of the

NUESTRO AMO MANGANESE DEPOSIT

Province of Veraguas, Republic of Panama

0 5 10 15 20 25 meters

Scale

35 Strike and dip of lens

Lens of manganese oxide

Pebbles of " "

February, 1943

After the construction of a road from the Matilde to the Atalaya-Ponuga road, ore could be trucked either to Port of Ponuga or to Balboa, Canal Zone, via Atalaya and Santiago. From Port of Ponuga ore could be carried 8 kilometers by barges and loaded for shipment at a deep-water anchorage in Montijo Bay. The writer was told that a road 6 kilometers long can be built to connect with the Atalaya-Ponuga road about 8 kilometers north of Ponuga. It is possible that the trail from the Matilde to Ponuga could be converted into a dry-weather truck road for a part of this distance.

The low grade of the material in sight does not appear to justify any further work until more economical methods for concentration have been developed.

Nuestro Amo deposit

Location and accessibility

The Nuestro Amo deposit is on the top of a low ridge 3 kilometers west of the small village of Nuestro Amo. (See fig. 4.) This village is 4 kilometers south of Atalaya and can be reached by automobile during the dry season. The trail between the village and the deposit passes over fairly level country which offers no serious obstacle to road building.

Ownership and history

The deposit is on National Government land and at present the mineral rights are unclaimed. The property was prospected at the same time as the Matilde deposit to the south, but the writer saw no evidence of former work. A pit 5 meters deep is said to have been in good oxide for its full depth but this pit is now completely filled and

even its location is uncertain. There has been no production from the deposit.

General geology

The Nuestro Amo deposit lies in relatively open country of low relief. Along the trail from the village to the property are good exposures of andesitic and basaltic tuffs and agglomerates and many residual boulders resulting from the weathering of the agglomerates. In the vicinity of the deposit amygdaloidal andesite is exposed in a trench and andesite tuff crops out near a small canyon on the south edge of the property.

Manganese deposit

Manganese-bearing rock was seen at two places on the property. A trench 20 meters long exposes a lenticular body three meters long with a maximum thickness of one-half meter. The lens strikes north and dips 35° east. The wall rock is a deeply weathered porphyritic amygdaloidal volcanic rock, probably andesitic, the amygdules consisting largely of either calcite or greenish opal. A few small pieces of float are found in the area between the trench and the trail to the north.

The lens is composed of deep red or reddish black manganese silicate which has been superficially altered to a heavy bluish oxide of the psilomelane type containing small pockets of soft black powdery oxide. The oxide is high grade, containing over 50 percent manganese, but the amount in sight is very small.

Some high grade float is found in the canyon on the south edge of the property, but here also the quantity is negligible.

Analyses of the Nuestro Amo rock are reported as follows:

	Mn	Fe	SiO_2	Al_2O_3	P
(1)[a]	50.5	1.72	9.65	3.72	.074
(2)[b]	48.9	1.49	10.08		
(3)	48.9	1.15	8.35		
(4)	52.7	.87	7.99		
(5)	51.4	1.38	8.27		

(a) Taken from report by G. C. Riddel, June, 1927.

(b) Taken from report by Capt. E. L. Arnold, Sept., 1941. Other analyses also from Arnold's report.

Additional trenching might uncover the body previously reported, but at present the property is considered to have no value.

Hyatt deposits, Province of Colón

Abstract

The Hyatt manganese deposits are near the Boquerón river, in the eastern part of Colón Province 40 kilometers northeast of Colón. Mine No. 1 is 7 kilometers north of Madden Lake, Mine No. 2, 8 kilometers farther north. These are the largest high grade manganese deposits seen by the writer in Panama.

Mine No. 1 consists of two outcrops and two elongate areas of float extending north and east from the main outcrop. The manganese mineral is a hard, somewhat siliceous oxide associated with jasper. The country rock is deeply weathered metamorphosed tuff. Average grade is about 40 percent manganese.

Mine No. 2 is divided into two parts by a ridge. The main outcrop and float area of manganese oxide are on the south side of the ridge. The oxide is nearly all soft pyrolusite and is high grade, averaging about 50 percent manganese. The country rock wherever exposed is red clay, probably resulting from the decomposition of an andesitic breccia.

Origin of the oxide at the Hyatt deposits is uncertain because of lack of exposures and development. The oxide at Mine No. 1 is thought to have originated at least in part and perhaps entirely from the oxidation of a rhodonite-piedmontite rock which was formed perhaps by the metamorphism of a bed or vein of manganese carbonate. The oxide at Mine No. 2 was probably formed by replacement of jasper which had replaced shale or tuff, although jasper was found only in boulders below the main outcrop.

Reserves are estimated at 15,000-20,000 tons of ore containing 40-50

plus percent of manganese. The amount of ore in sight and reasonably expectable is not considered large enough to warrant expenditure of the large amount of money necessary for road construction. The country is so rugged and the yearly rainfall so heavy that transportation of any kind would be very expensive. Mine No. 2 is worth a small amount of additional exploration by drilling, but the chances of its becoming a deposit of commercial importance are small because of its great distance from established transportation.

General considerations

Location and accessibility

The manganese deposits of the Hyatt Panama Manganese Company are on the west side of the Boquerón River, about 40 kilometers east-northeast of Colón. (See fig. 1, locality 3.) The Boquerón flows into the extreme north end of Madden Lake. Mine No. 1 lies at 9° 23' N. Latitude and 79° 34' W. Longitude, between two forks of Mine Creek, a small tributary which enters the Boquerón from the west about 7 kilometers above Madden Lake. Mine No. 2 lies at 9° 27' N. Latitude and 79° 33' W. Longitude, on a high ridge between the Boquerón and Candalosa Rivers about 8 kilometers airline north-northeast of Mine No. 1. The distance along the Boquerón between the two mines is approximately 10 kilometers.

The deposits may be reached from Panama City or Colón by way of Madden Lake. The recently completed Trans-Isthmian Highway, which connects Panama City with Colón, skirts the south end of Madden Lake at Madden Dam. The Boquerón River enters the lake about 21 kilometers north of the dam, and can be reached by launch. The river is navigable for small power boats for some 2 1/2 kilometers upstream; beyond this point

there are many rapids which can be traversed only by cayuca. During the dry season, from January until April, the Boquerón may be very low and at times even cayuca travel is difficult.

Several hundred meters above the mouth of Mine Creek begins a series of falls which prevents further travel by cayuca. The river here descends about 10 meters in a distance of 100 meters, rushing through a narrow gorge carved in hard rock. Between the two mines the writer's trail followed in part the old Camino del Rey, which the Spanish used in the 16th and 17th centuries to transport gold from Old Panama to Porto Bello. Scattered patches of cobblestones form the only remnants of this once important road.

The deposits may also be reached by trail from Nombre de Dios, a small village on the north coast of Panama about 55 kilometers by boat northeast of Colón. Mine No. 2 is about 25 kilometers south-southwest of Nombre de Dios, Mine No. 1, 8 kilometers farther south. The trail follows the route of the old Hyatt railroad.

Geography, climate, and vegetation

The Hyatt deposits are in a deeply dissected rugged terrain, and deep narrow canyons and sharp ridges are the predominant features. The highest point in the vicinity is Cerro Bruja, 3200 feet high, on the divide between the Chagres basin and the Caribbean slope. Maximum relief at Mine No. 1 is 80 meters, at Mine No. 2, 120 meters.

The area is one of heavy rainfall throughout the year, and the dry season is dry in a relative sense only. Average yearly precipitation is probably about 150 inches. The runoff after a rain is rapid, and the Boquerón may rise several feet in the course of a few hours following a heavy rain. Camp sites must be chosen with such a possibility in mind,

and the classic sandbar camp may prove unsatisfactory at times. The heavy precipitation has resulted in deep weathering of the rocks, and most of the area is blanketed with a thick mantle of clay. The few outcrops available are along stream courses, and ridge crests.

The Boquerón basin is covered by jungle which, although in places nearly impenetrable, usually does not offer great difficulty to walking. Some parts of Mine No. 2 are covered with a very dense second growth. There are no inhabitants in the area and the only trails are a few overgrown hunters' paths and some remnants of the Camino del Rey. The writer and his crew cut about 8 kilometers of trail between the two deposits, but these trails will be completely overgrown in a few years.

Ownership, history and production

The deposits are owned by the Panama Manganese Company, of which Dr. Dennis F. Reeder, of the Panama Hospital, Panama City, is the president. The titles are apparently clear and definite, a condition seldom met with in Panama. The company does not intend to work the deposits, but will lease them for mining.

The Hyatt deposits were discovered about 1915, and some exploration work was carried out in 1917-1918 under the direction of James Hyatt. In 1920 the Hyatt Panama Manganese Company was organized, and a narrow guage railroad was built from the west side of Nombre de Dios bay to within 1500 meters of the mouth of the Candalosa River. The railroad crosses a gap in the Chagres Basin-Caribbean divide at an elevation of 270 meters, and is 25.5 km. long. Construction and maintenance of the road in this rough country of heavy rainfall proved most difficult, and the line was abandoned a few years later. The venture is said

Topographic and Geologic Map of

HYATT NO. 1 MANGANESE DEPOSIT

Province of Colon, Republic of Panama

0 10 20 30 40 50 meters

0 50 100 150 200 feet

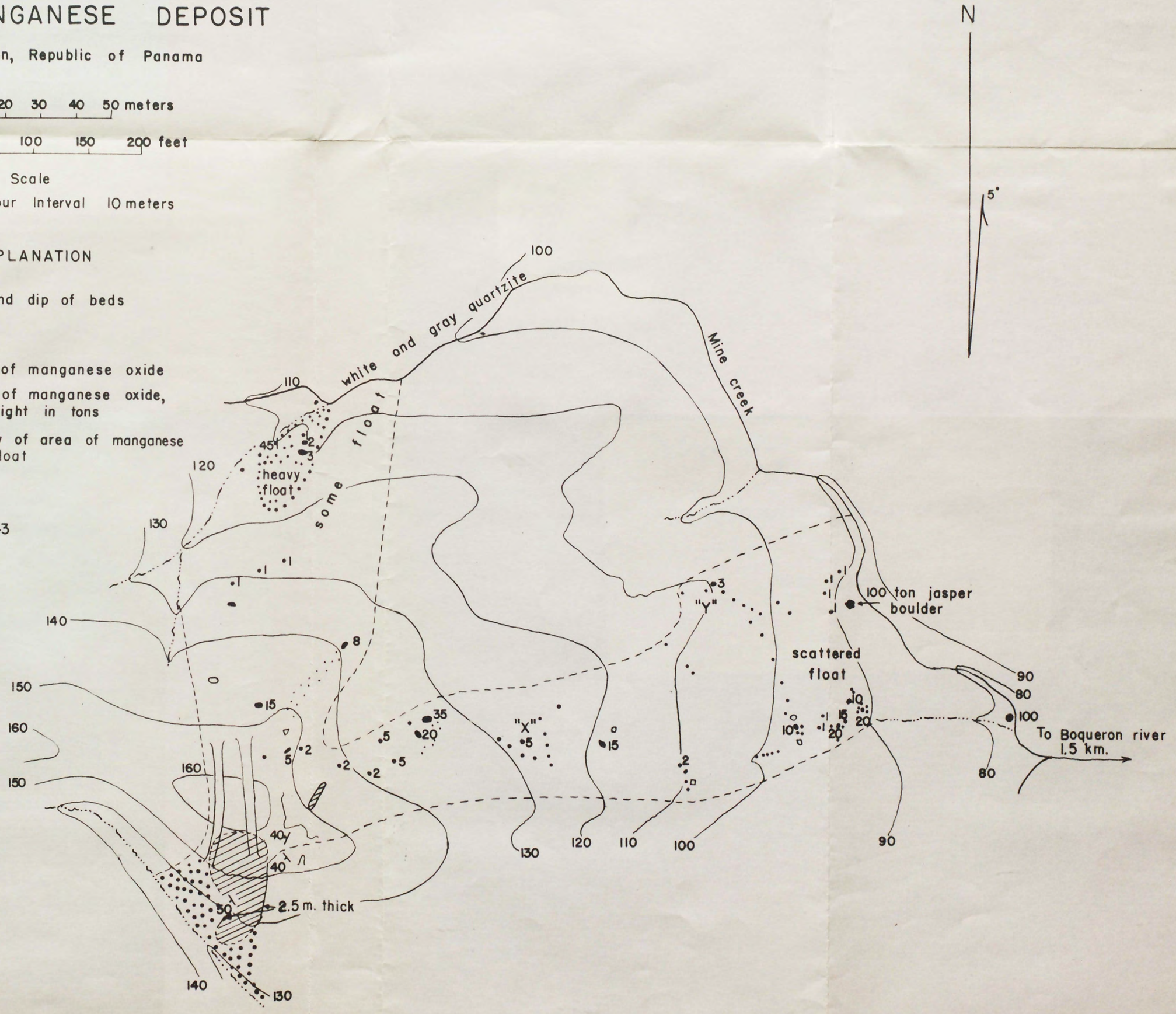
Scale

Contour Interval 10 meters

EXPLANATION

- 25 — Strike and dip of beds
- Trench
- Pit
- Outcrop of manganese oxide
- ● 10 — Boulder of manganese oxide, with weight in tons
- Boundary of area of manganese oxide float

March, 1943



to have cost in the neighborhood of $400,000.

At present the railroad is in a bad state of disrepair. All of the bridges, of which there are a great number, are useless, and much of the trace has been buried by landslide. The rails are in fair condition, but many of the ties have rotted away completely.

The only ore produced by either mine is a few tons said to have been removed from Mine No. 1 and shipped by cayuca to Colón for assay.

Mine No. 1

General

Hyatt Mine No. 1 is on a steep asymmetrical ridge between two forks of Mine Creek, about 1 kilometer west of the Boquerón River. (See fig.5.) Most of the area is covered with red and brown clay, but along the north fork are many exposures of fine-grained gray and white quartzite, utterly devoid of bedding. This rock is overlain by a deeply weathered gray schist which strikes north and dips 45° west. The contact is not exposed but is probably near the fork of Mine Creek just north of the main ore body. Near this ore body several pits expose a gray highly micaceous schistose rock containing numerous round and elongate "augen" of pink and gray sandy material. This rock is thought to be a metamorphosed tuff which forms the walls of the deposit.

Manganese deposits

The main outcrop is a sheet of manganese oxide, striking northwest and dipping 50° SW, which forms a dip slope on the south side of the ridge. It ranges in visible thickness from one to three meters and is assumed to average about two meters thick. The position and shape of the outcrop are shown on the map. On the ridge below the outcrop is a heavy

blanket of float, and float is found all the way down the canyon to the fork. Two parallel trenches 30 meters long are cut through the crest of the ridge, and each shows the upper edge of the oxide sheet in place at the south end of the trench. The remainder of the trenches show clay and jasper with a few thin stringers of manganese oxide. The clay is probably the weathered remains of the schistose rock exposed in nearby pits. Oxide is in contact with jasper at the south ends of the trenches, and appears to have been replaced the jasper in places.

The mineral is a hard blue-black psilomelane type oxide containing numerous small pockets of soft oxide and, along the west side of the outcrop, pockets of rhodonite and piedmontite. Some of the oxide, as at the south end of the west trench, is crudely banded, the bands being alternate layers of manganese oxide and quartz. The oxide is generally somewhat siliceous, averaging about 40 percent manganese. The outcrop has an area of 540 square meters and an assumed average thickness of two meters.

Thirty meters northeast of the main outcrop is an outcrop of similar rock striking N. 30° W. and dipping 70° SE. The outcrop is 10 meters long and about two meters thick, lensing out at both ends. A pit on the southeast side shows solid oxide to a depth of five meters, in contact with red clay. The oxide is hard pure psilomelane-type material which appears to be somewhat higher grade than that of the main outcrop. Numerous boulders of similar oxide lie on the flat area below the outcrop. One boulder weighing about 35 tons has been trenched on two sides, and the clay exposed in the trenches is heavily charged with fragments of manganese oxide to a depth of nearly a meter.

The rest of Mine No. 1 consists of two elongate areas of float, one extending north from the main outcrop 120 meters, the other trending about ENE. down the main ridge to Mine Creek, a distance of about 200 meters. The area between these two tongues is nearly devoid of float.

The north-trending tongue ranges in width from 30 to 50 meters, but the float is widely scattered. A few large boulders, weighing up to 15 tons, are found on the slope immediately below the ridge top and were probably derived from the main outcrop. At the bottom of the hill, on the south side of Mine Creek, is a heavy concentration of boulders of manganese oxide in an area of 250 square meters. These boulders, which weigh up to 5 tons, probably represent a small broken-down outcrop, as the slopes above are practically barren. The boulders are hard oxide surrounding cores of dark brown manganese silicate, the oxide carrying small pockets of porous silica which may have been freed by the oxidation of the silicate. The material is not high grade, averaging 30-35 percent manganese.

The rest of the north slope is sparsely covered with float, and no other concentration suggesting an undiscovered body was found.

The east-trending tongue shows considerably more float. Ninety meters northeast of the main outcrop, at a point marked "x" on the map, numerous boulders weighing up to 15 tons are found in an area of about 600 square meters. The boulders are hard oxide carrying considerable free silica and appear to be lower grade than the material from the body to the west. The boulders may represent the broken-down outcrop of another small body. The average grade is perhaps 35 percent manganese.

At the point marked "Y" on the map several boulders of manganese

Topographic and Geologic Map of

HYATT NO. 2 MANGANESE DEPOSIT

Province of Colon, Republic of Panama

0 10 20 30 40 50 meters

0 50 100 150 200 feet

Scale

Contour Interval 10 meters

EXPLANATION

45 Strike and dip of beds

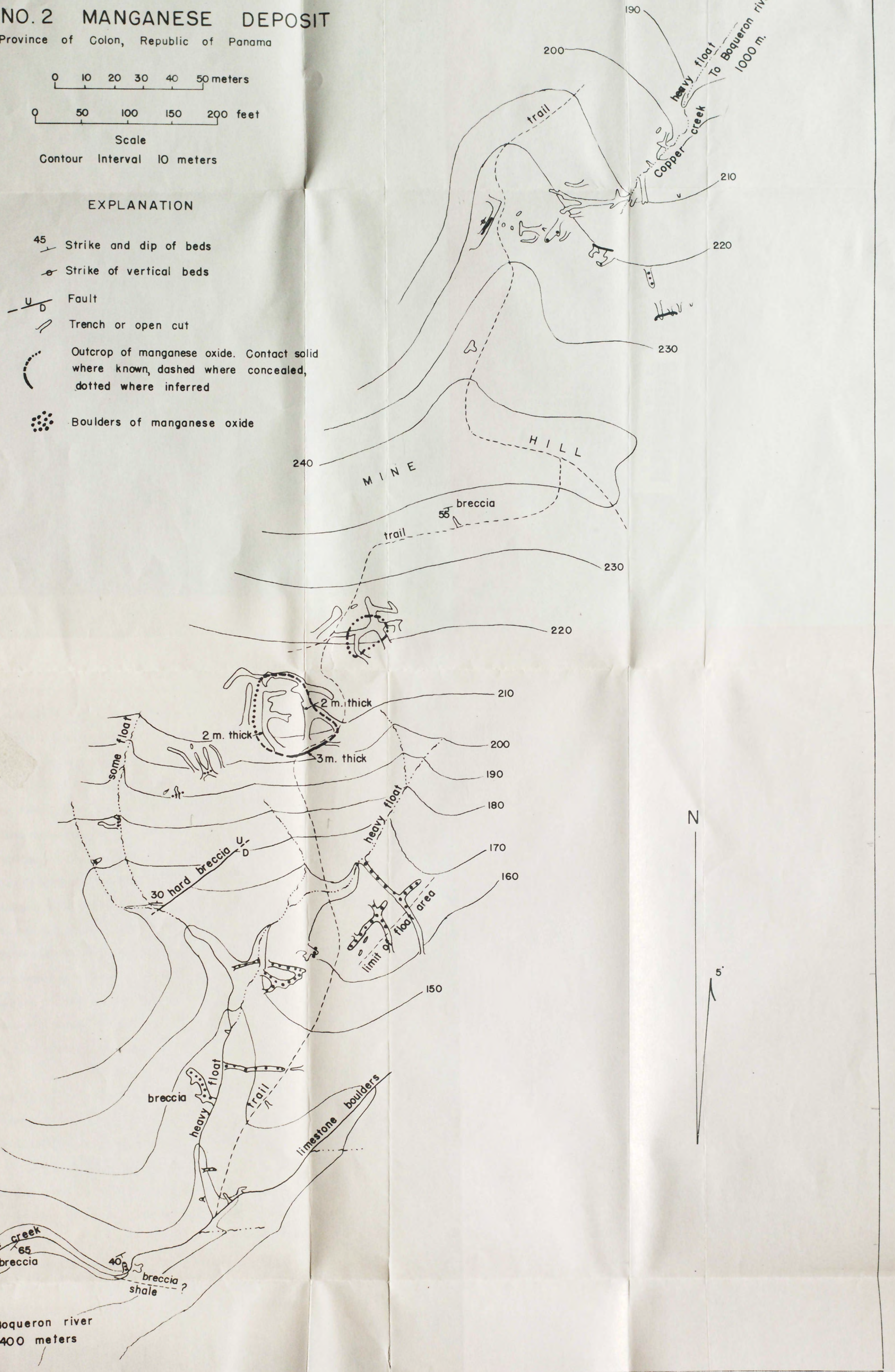
Strike of vertical beds

U / D Fault

Trench or open cut

Outcrop of manganese oxide. Contact solid where known, dashed where concealed, dotted where inferred

Boulders of manganese oxide



oxide are found on the crest of a narrow northeast-trending ridge. From this point a train of boulders extends east and southeast nearly to Mine Creek. These boulders have probably come from a body somewhere near Point "Y" that is either concealed or completely eroded away, as the area between "X" and "Y" is nearly barren of float. Thirty-five boulders weighing from 1 to 20 tons were measured, and there are innumerable smaller ones. One 12-ton boulder consists of 1/3 jasper and 2/3 hard manganese oxide, the contact between jasper and oxide being very sharp. Some of the boulders are mixed high grade oxide and oxide containing a little free silica, others are mixtures of jasper and oxide, and one boulder weighing about 100 tons is entirely green and gray banded chert. Most of the boulders, however, are hard bluish-black manganese oxide averaging 40% manganese. An area of 2000 square meters is more or less covered with these boulders.

In Mine Creek just above the fork is a boulder of hard oxide weighing about 100 tons. Its source is unknown.

Origin

The main outcrop appears to have had a rather complex history, and lack of exploration of the main outcrop itself as well as the great difficulty in breaking off specimens for examination permit of no more than a few general statements. As practically the only exposures are natural ones, it is impossible to determine whether the oxide is largely primary or, if not, just what the principal primary mineral or minerals are. Along the west side of the outcrop there are a few partially oxidized pockets of rock composed of finely crystalline rhodonite carrying scattered crystals of piedmontite and a few isolated patches of some carbonate, probably manganiferous.

The origin of the rhodonite is not known; in one thin section examined, it appears to be replacing a carbonate. The rhodonite-piedmontite rock was seen at only a few places along the west side, and it is thought that the deposit is almost entirely manganese oxide. The siliceous nature of the oxide suggests that it may have originated by the oxidation of a manganese silicate such as rhodonite. The rhodonite in turn may have been formed by metamorphism of a vein or bed of manganese carbonate or may be a primary hydrothermal mineral.

No manganese minerals other than oxides were seen anywhere else in the area, with the exception of the boulders near Mine Creek north of the main outcrop, which are composed of a dark brown manganese silicate, either bementite or neotocite, which has been partially oxidized.

Mine No. 2

General

Hyatt Mine No. 2 is divided into two parts by the high ridge between the Boquerón and Candalosa[1/] rivers. (See fig.6.) The south

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1/ In using this name the writer follows the nomenclature of the U.S. Army Engineer map of the Pequeni quadrangle. Other reports have called this river the Diablo, which is shown by the Army map to enter the Boquerón several miles farther north.

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deposits are near the headwaters of Manganese Creek, a small tributary of the Candalosa, and the north deposits are at the headwaters of Copper Creek, which flows into the Boquerón. As at Mine No. 1, the area is blanketed with a thick cover of clay, and the few available outcrops are either along stream courses or in pits near the deposits. Along the Boquerón above and below the mouth of the Candalosa are

exposures of thin-bedded siliceous gray limestone, which is tightly folded and contorted. The limestone in general strikes northeast and dips are usually steep. Along Manganese Creek are outcrops of sheared greenish volcanic breccia, highly altered and probably andesitic. The breccia fragments are largely amygdaloidal andesite, the amygdules being calcite, limonite, and green opal. The breccia strikes northeast and dips from 40° to 65° southeast. It is in contact with shale about 70 meters from the mouth of the creek.

About 70 meters south of the main outcrop of manganese oxide, a different breccia forms a fault scarp 8 to 10 meters high. The breccia fragments are commonly less than 5 cm. in diameter. The rock is too badly weathered to determine accurately, but it is acidic, perhaps rhyolitic, in composition. A soft, deeply weathered breccia, exposed near the base of the scarp, underlies the cliff-forming breccia. Decomposed breccia is also exposed in a few cuts along Manganese Creek, and in a cut near the summit of Mine Hill. It appears that the manganese oxide occurs in breccia, although the only rock exposed in contact with the oxide is red and brown clay containing small fragments of rock, possibly shale, which are weathered beyond recognition.

The general structure of the area is very obscure, but predominant dips are to the east and south, and the breccia appears to be overlain by shale which is in turn overlain by limestone.

South deposits

The main outcrop is at the top of a steep hill 90 meters above the mouth of Manganese Creek, and forms a steep cliff 5 meters high at the edge of a flat bench about 20 meters wide. The outcrop, as exposed

in trenches and in the cliff, has an area of about 700 sq. meters. Most of the trenches are partially caved and the attitude of the body as well as the total area it underlies are uncertain, but the roughly circular shape of the outcrop together with the bench at the top of the steep slope suggest a flat-lying body. Exposed thicknesses range from two meters in two of the trenches to three meters in the cliff face. According to a report by Edmund B. Kirby, shale was exposed in a cut at the base of the cliff some 6 meters below the bench. This cut has long since caved.

The cliff presents the best exposures. The upper two meters of the cliff consists of red clay-stained black by manganese oxide in places, and containing admixed specular hematite. The lower 3 meters is massive soft manganese oxide overlain by a thin uneven layer of specularite, and the hill below the cliff is covered with tiny flecks of bright specularite. Some of the manganese oxide contains streaks of red clay, or a few thin veins of specularite. The oxide is largely dull gray pyrolusite and is very high grade, averaging in the nieghborhood of 50% manganese. Near the base of the cliff is an irregular mass of brownish-black manganiferous calcite, partly oxidized and cut by veins of calcite and malachite. Only a small amount of carbonate was found, and it is doubtful whether this is the primary mineral of the entire body. All analyses known to the writer show a small but persistent percentage of copper.

Analyses of the south side oxide give the following results:

Number	Mn	MnO_2	MnO	Fe_2O_3	Al_2O_3	CaO	MgO	SiO_2	S	P	CuO
1	55.3	84.00	2.86	.47	.51	.54	.12	7.58	.01	.07	.88
2	52.19	82.11	.23	1.81	.76	.02		8.88		.04	1.05
3	56.15	88.44	.18	.37				5.32		.058	.8

Note: Analysis 1 from report by J. D. Sears, 1919
Analyses 2 and 3 from report by Stuart St. Clair, 1940

The outcrop, has an exposed area of 700 sq. meters and an assumed average thickness of 2 meters. Further exploration by drilling, either horizontally at the base of the cliff or vertically from the bench above, may prove the existence of a larger ore body, but present development does not indicate that the chances for finding more are good.

Fifty meters northeast, near the upper edge of the bench, another system of trenches outlines a small, apparently flat-lying oxide body about 100 sq. meters in area and having an average thickness of probably less than 1 meter. The oxide is soft pyrolusite similar to that of the main body.

Manganese oxide crops out at several places southwest of the main outcrop, but exploration has shown these deposits to be very small. Heavy float is found along the middle fork of Manganese Creek and along the main creek all the way to the mouth. Float is also found along the nose between the two main branches, the largest boulder seen weighing about 15 tons. Many of the trenches show rounded concretionary masses of mixed manganese oxide and clay resting in clay. These masses are thought to be concentrations of manganese oxide leached from outcrops above and redeposited by surface waters. The concretions range from a few cm. to 30 cm. in diameter, and are found to a depth of at least 3 meters. The oxide is very soft and can be easily cut with a machete. It averages about 40 percent manganese, the principal impurity being clay. Very few concretions are found in any trench, and their low concentration together with extreme softness would make mining difficult

and expensive. The amount of concretionary oxide is impossible to estimate, but, as it is found over an area 180 meters long and from 10 to 50 meters wide, the tonnage may be considerable. Much of this may not be recoverable,however, because of mining difficulty, and no estimate of tonnage has been made.

North deposits

The north deposits lie on the north slope of Mine Hill at the headwaters of Copper Creek. The manganese-bearing area is about 200 meters north-northeast of the main south outcrop. Deeply weathered volcanic breccia is exposed on the hill between the two areas, but no manganese oxide was seen near the summit on either side. The deposit consists of several small oxide bodies and numerous boulders exposed in shallow trenches on a gently sloping bench. None of the bodies appears to be connected with any other, and exploration has failed to find any appreciable amount of oxide. Most of the trenches are barren.

Just west of the trail, at an altitude of 225 meters, an open cut exposes an outcrop of manganese oxide 8 meters long and less than one meter thick. The outcrop strikes N. 20° E. and dips vertically. Twenty-five meters east a trench exposes several large boulders, and 45 meters east is an outcrop 5 meters long and about 1 meter thick. This body appears to be flat-lying. Thirty meters farther southeast two trenches expose a few boulders which may indicate the presence of a small body. None of the outcrops appear to be connected, as trenches between them are barren. Copper creek caries heavy float near its headwaters and float is found all the way to the Boquerón.

The oxide is very high grade soft bluish-gray pyrolusite similar to that on the south side but perhaps slightly higher grade. Near some of the bodies the surrounding clay is heavily impregnated with manganese oxide.

An analysis of the north side oxide, taken from a report by Stuart St. Clair written in 1940, gives the following results:

Mn	52.57
MnO_2	82.56
MnO	.41
Fe_2O_3	.95
SiO_2	7.15
CuO	.73
BaO	.23
P	.071
Al_2O_3	.76
CaO	.02

It has been suggested that perhaps the south and north deposits are connected as a flat-lying sheet under Mine Hill. Although this is possible, the small extent of the two deposits as compared with the great distance between them makes such a condition decidedly improbable.

Origin

Little can be said about the origin of the oxide at Mine No. 2. Exploration is inadequate, most of the old trenches are caved, and oxide is found in contact with nothing but clay. It is not known whether the primary minerals is manganese oxide, as no other manganese mineral was seen except a small amount of what is probably manganiferous calcite. However, some information is available from the boulders in Manganese Creek. Some of these show irregular isolated patches of jasper surrounded by manganese oxide which has replaced the jasper; others have small clay-filled pockets which may represent leached jasper remnants. The oxide of these boulders is, however, hard and siliceous as compared with the soft pure oxide of

the main body. A number of the boulders show two separate oxides, the earlier mineral having been brecciated and then cemented with a later generation of oxide. The earlier oxide is often more coarsely crystalline than the later.

The origin of the main body is most uncertain, but the writer believes that the deposit is similar to other manganese deposits of eastern Panama in that the oxide is epigenetic and has been deposited by ascending solutions. The primary mineral may have been the hard psilomelane-type oxide which is commonly found in these deposits, the soft pyrolusite being formed by alteration of the earlier oxide, perhaps by surface waters which removed part of the oxide and redeposited it in the concretion-like masses found below the outcrop. The specular hematite is later than the manganese, as it is found along a shear zone and in thin veins in the main body as well as along the upper contact of clay and oxide. Mine No. 2 is the only deposit seen by the writer in Panama at which specular hematite is found. The veinlets of malachite are confined to the irregular mass of manganiferous calcite found near the base of the main body, and it is thought that both the carbonates are later than the manganese oxide.

Some deposits near Nombre de Dios, Province of Colón

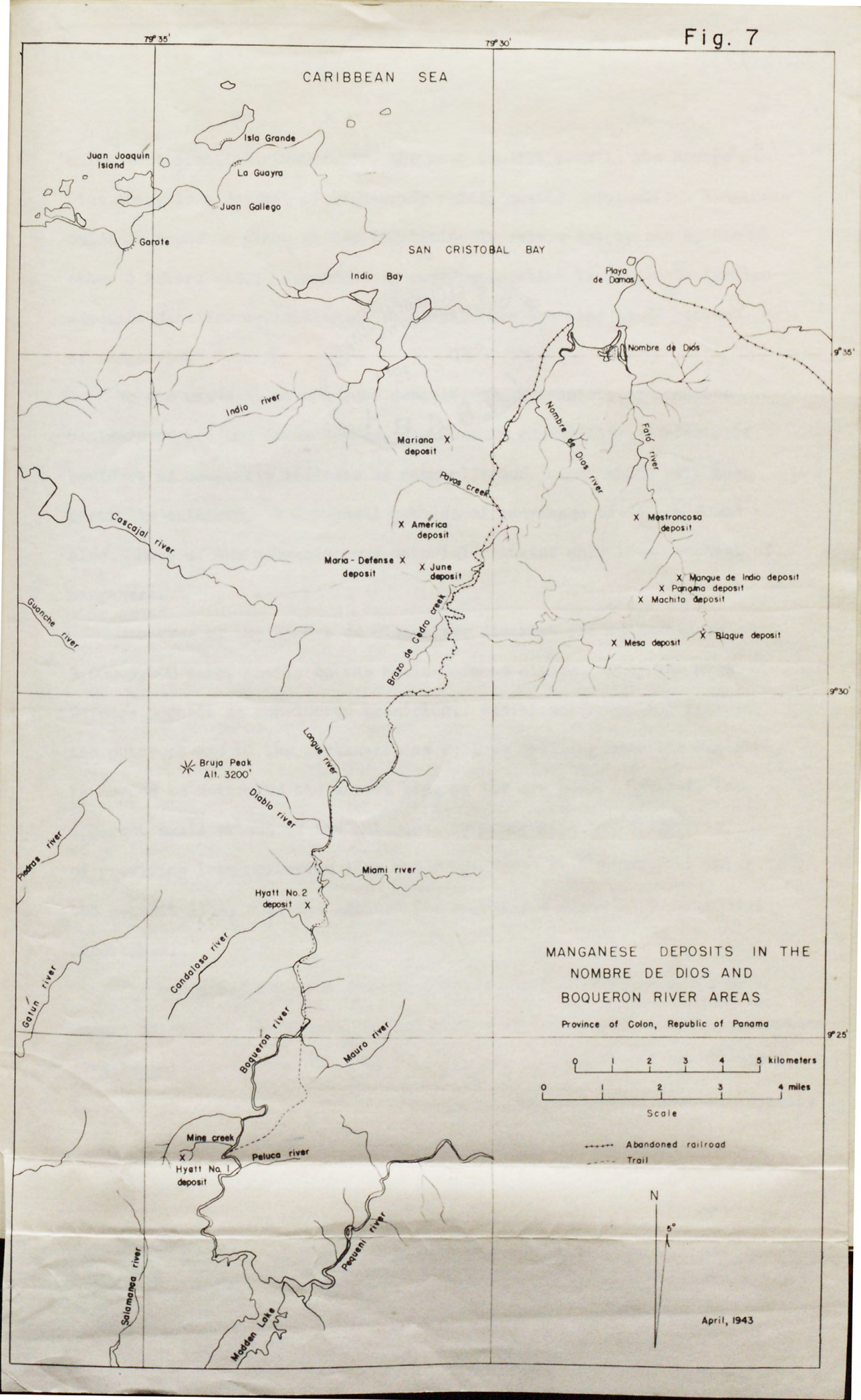
Abstract

The manganese deposits described in this report are in the steep hills south of Nombre de Dios, a small town on the north coast of Panama 50 kilometers northeast of Colón. About 60,000 tons of high grade ore were produced during 1895-1902 from several mines to the east of Nombre de Dios; no production is known from the deposits mentioned in this report. All of the deposits described except the Mariana are in the watersheds of the Fató and Nombre de Dios rivers.

Five deposits in the Fató River area were examined: Mostroncosa, Mangue de Indio, Panama, Machita, and Blaque. At none of them was any appreciable amount of good ore found. The deposits consist of boulders of manganese silicate or manganiferous jasper imbedded in red or brown clay; at one, Mangue de Indio, three small bodies of similar rock were found in place. The boulders often show a thin film of manganese oxide on the surface, but the total amount of oxide is very small. Reserves of the area are estimated at 12,000-15,000 tons of rock averaging 15-20 percent manganese, almost entirely in the form of silicate or manganese-bearing jasper.

In the Nombre de Dios river area, 5 deposits were seen; Mariana, América, María-Defense, June, and La Mesa. Mariana is a deposit of small boulders and pebbles of manganese oxide imbedded in clay. No oxide definitely in place was seen. Ore averages about 45 percent of manganese. América consists largely of boulders of manganese silicate or manganiferous jasper which have been slightly oxidized. A few small boulders of good

Fig. 7


79° 35'
79° 30'
CARIBBEAN SEA
Isla Grande
Juan Joaquin Island
La Guayra
Juan Gallego
Garote
SAN CRISTOBAL BAY
Indio Bay
Playa de Damas
Nombre de Dios
9° 35'
Indio river
Mariana X deposit
Nombre de Dios river
Faló river
Pavos creek
Cascajal river
X America deposit
X Mestroncosa deposit
María - Defense X deposit
X June deposit
X Mangue de Indio deposit
X Panquina deposit
X Machita deposit
Guanche river
Brazo de Cedro creek
X Mesa deposit
X Blague deposit
9° 30'
Bruja Peak Alt. 3200'
Lorque river
Diablo river
Piedras river
Miami river
Hyatt No. 2 deposit X
Candelosa river
Gatun river
Boqueron river
Mauro river
9° 25'
Mine creek
Peluca river
X Hyatt No. 1 deposit
Pequeni river
Salamanca river
Madden Lake
MANGANESE DEPOSITS IN THE NOMBRE DE DIOS AND BOQUERON RIVER AREAS
Province of Colon, Republic of Panama
0 1 2 3 4 5 kilometers
0 1 2 3 4 miles
Scale
Abandoned railroad
Trail
N
5°
April, 1943

oxide were seen. María-Defense, the best deposit seen in the Nombre de Dios area, is a deposit of high-grade oxide, mostly pyrolusite. Manganese oxide is found in place at two localities 18 meters apart, one 4, the other 6 meters wide. Considerably more exploration is needed to furnish adequate data for estimation of reserves. Ore contains 45-50 percent of manganese.

No ore was seen at the June deposit, which consists of numerous boulders of red and brown jasper. La Mesa is essentially a deposit of boulders of manganese silicate of manganiferous jasper which have been partially oxidized. A few small pebbles of manganese oxide are found also. Most of the manganiferous material contains only 15-20 percent of manganese.

Reserves of the Nombre de Dios river district are estimated at 3,000-5,000 tons, mostly on the María-Defense claims. Only the María-Defense deposit is considered promising. Additional trenching between the outcrops and to the northwest, as well as drilling near the outcrops, is needed to determine the actual size of the ore body. However, the apparent small extent of the outcrops, together with the difficulty of providing transportation into the rough Viejo Peak country in which the deposit lies, militate against its becoming a deposit of commercial importance.

The manganese deposits described below are in the hills south of Nombre de Dios, a small town on the north coast of Panama about 50 kilometers airline northeast of Colón. The deposits lie between 9° 30' and 9° 35' N. Latitude and between 79° 27' and 79° 33' W. Longitude. (See fig. 1, locality 4, and fig. 7.)

Accessibility

Nombre de Dios is on the south shore of Nombre de Dios Bay, a semi-circular open bay about 64 kilometers by boat from Colón. The town is separated into two parts by a channel excavated by dredges at the time of the building of the Panama Canal. The sand dredged was used in the construction of the Gatun Locks. During the dry season, from January until May, the bay is swept by the trade winds and may become very rough. At such times the only safe anchorage is at Playa de Damas, about 2.5 km. north-northeast of the town. From Nombre de Dios trails lead to Porto Bello, 21 km. west, and to several small villages along the coast to the east.

Climate and vegetation

The Nombre de Dios region is one of very heavy rainfall, the yearly average being in the neighborhood of 160 inches. Most of the precipitation occurs between May and December. During the rainy season the Nombre de Dios and Fató rivers are navigable by cayuca for many kilometers; during the rest of the year these rivers dry up considerably and numerous bars and shallows make cayuca travel impracticable.

For several kilometers inland the flat coastal plain is dotted with banana plantations and small farms, and coconut palms line the coast for miles both east and west of town. Principal crops raised are rice, beans, bananas, and coconuts. The town was once an important banana center, but since the advent of war the industry has been neglected and the natives now sell practically nothing but coconuts and copra.

Ownership

The ownership of the Nombre de Dios deposits described below is

somewhat confused because of overlapping and conflicting claims. Much of the confusion is due to the method of staking claims in Panama. Anyone may denounce a mining claim and receive a provisional one-year title which carries with it the right to prospect. If mining operations have not begun within the stipulated one-year period, the title is lost. However, provisional title may be granted when the claim has actually been denounced earlier by another person, or it may be granted for a claim within an area to which clear title has been previously obtained by another person. When two titles conflict, the earlier, if it is in order, is recognized as the legal title.

In the Nombre de Dios area the principal claimants are Pinel-Ami, Velarde, the Panama Colombia Company, Isthmian Limited, and Reginald Laxton-Ferdinando. The Pinel-Ami claims, apparently with title in perpetuity, cover what in this report are known as the Mariana, América, María-Defense, June, and possible the Mangue de Indio, Panama, and Machita deposits. Mr. Edward C. McKay, president of the Panama Colombia Company and Isthmian Ltd., states that his Panama Colombia Company has first rights to a lease of these properties; at present, to the writer's knowledge, this lease has not been negotiated. These deposits, with the exception of the América, were denounced in 1942 by Reginald Laxton-F., a former associate of McKay. Laxton's provisional titles, which appear to have little value, expire in June, 1943.

It is believed that the Velarde claims are owned, with clear title, by Horacio Velarde of Panama City. These two claims, San Nicolás and La Esperanza, cover the Mostroncosa deposit which was denounced by Laxton in 1942.

McKay also states that his Isthmian Ltd., holds provisional title

to 609 claims which cover, among other things, La Mesa and probable the Blaque deposits. These deposits were denounced by Laxton in 1942, after the Isthmian Ltd. denouncement, and ownership is uncertain.

History of the manganese industry at Nombre de Dios

Nombre de Dios has been intimately associated with manganese mining in Panama since the industry's inception some 48 years ago. In 1895 the Caribbean Manganese Company built a narrow-gauge railroad from Playa de Damas to the Soledad mine, south of Viento Frio, and between 1895 and 1902 shipped about 40,000 tons of high grade ore. Unsettled political conditions, culminating in Panama's secession from Colombia in November 1903, caused a cessation of operations, and the railroad has been abandoned ever since.

In 1920 the Hyatt Panama Manganese Company constructed a narrow gauge railroad from the west side of the bay to their Mine No. 2 on the Boquerón River, some 25 kilometers south. Before the railroad was completed, and before any ore had been shipped, the company went bankrupt and the line was abandoned. It now serves as a trail to the Boquerón River and Madden Lake.

No ore has been shipped since 1902, and there had been little interest in the area until the outbreak of war in 1939. In 1940, the Union Carbide Company reopened the Soledad mine and conducted an intensive exploration program. At the same time, many deposits north and west of the Soledad were cleared and trenched by other interested parties, mainly Edward C. McKay and Reginald-Laxton-Ferdinando. Some of these deposits, along the Nombre de Dios and Fató rivers, are described in this report.

The deposits in this area have been examined by many mining engineers

and geologists, and estimated tonnage and grade of ore in the various deposits given in their reports range from reasonable to utterly fantastic. It appears that tonnage estimates in several reports have been based upon the examiner's hopes rather than on information actually available. It will be noted that the writer's estimates of tonnage and grade of ore in the area are in substantial disagreement with several of the former reports.

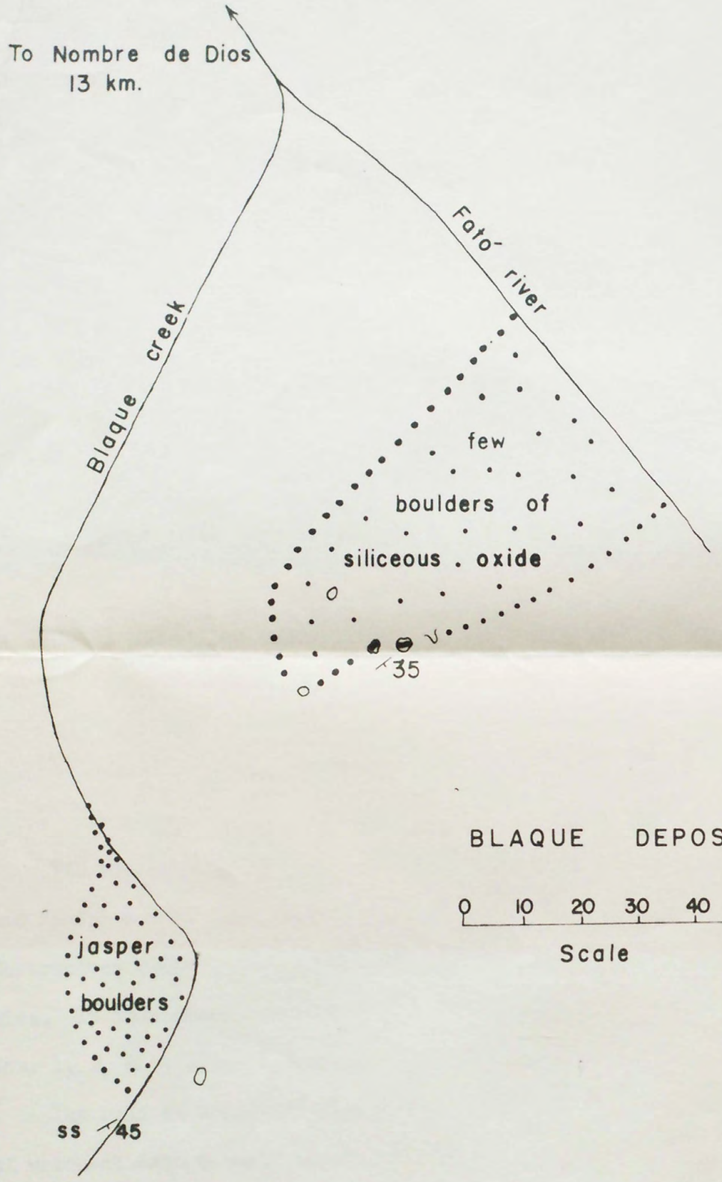
Geology and ore deposits

The country south of Nombre de Dios is, for several kilometers inland, a flat plain drained by the Nombre de Dios and Fató rivers. Many low hills rise from the plain, and the foothills of the San Blas Cordillera are reached some 3 or 4 kilometers inland.

No effort was made to study the areal geology, but a few generalizations may be hazarded. The rocks are largely sandstone and shale; in a few places limestone and tuff were seen. These rocks are more or less flat lying near the coast; farther inland dips become generally steeper though usually less than 45°. The sediments in general dip to the south, at least wherever attitudes were observed in the vicinity of the deposits. No intrusive rocks were seen in place, but diorite float was found near Blaque Peak and it is possible that some of the high peaks have a core of igneous rock.

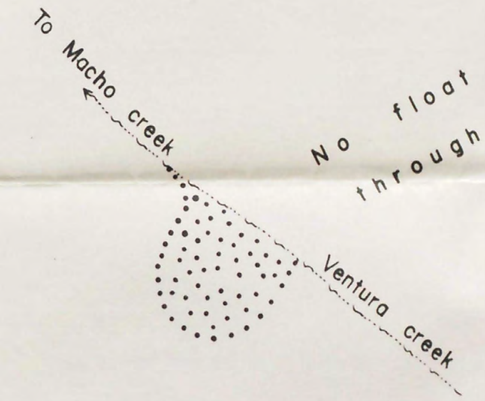
All the deposits examined, with the exception of the Mariana, are in the watersheds of the Fató and Nombre de Dios rivers, and will be described under the corresponding headings.

Fig. 8

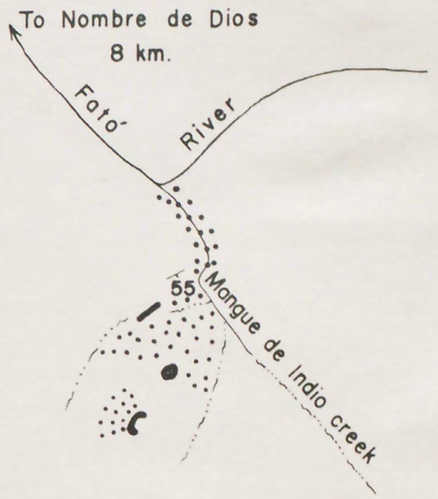


BLAQUE DEPOSIT

0 10 20 30 40 50 m.
Scale



PANAMA (VENTURA) DEPOSIT

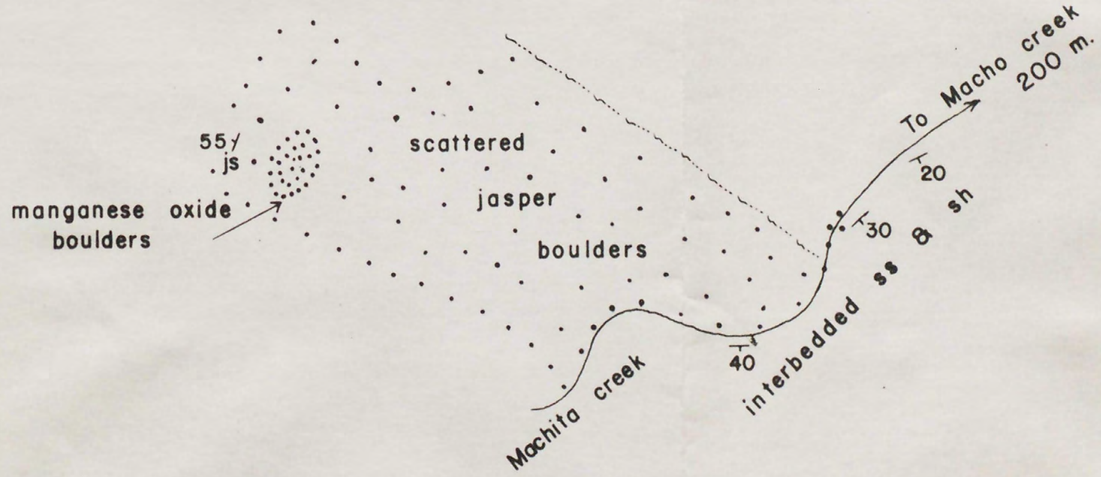


MANGUE DE INDIO DEPOSIT

0 50 100 200 300 m.
Scale

Boulders of manganese silicate or manganiferous jasper, slightly oxidized

N



MACHITA DEPOSIT

0 10 20 30 40 50 m.
Scale

SKETCH MAPS OF MANGANESE DEPOSITS ALONG THE FATO RIVER

Nombre de Dios, Province of Colon, Republic of Panama

EXPLANATION

js	jasper
ss	sandstone
sh	shale
60	Strike and dip of beds
	Trench or pit
	Open cut
	Manganese silicate or manganiferous jasper in place

April, 1943

Deposits along the Fató River

Mostroncosa

The Mostroncosa deposit is on the steep hill between Mostroncosa and Mostroncosita creeks about one kilometer south of the confluence of Mostroncosa creek and the Fató river, and 5 kilometers south of Nombre de Dios. It is covered by three claims of five hectares each, Juan Miguel Nos. 1, 2, & 3, which trend west-northwest. (See fig. 8.)

The hill is blanketed with angular boulders of jasper and chert some of which contain a small amount of partially oxidized manganese silicate. The boulders rest in clay. No rock in place was found but the source of the boulders must be near the hilltop, as the entire north and east slopes are boulder-covered. The area of float is roughly 200 meters in diameter and the boulders contain 10-15 percent of manganese. Not more than 20 percent of the manganese is present as oxide.

The writer was told by his guide that a similar deposit lies farther south, but bad weather prevented an examination. The Mostronocosa deposit is considered to have little or no value because of the extremely low grade of material available.

Mangue de Indio deposit

The Mangue de Indio deposit is in the low hills along Mangue de Indio creek about 8 kilometers south of Nombre de Dios. It is covered by one claim, Consuelo No. 3, of 5 hectares area.

A body of very siliceous manganese oxide crops out along the bank of a small fork of Mangue de Indio creek. The outcrop is 25 meters long and averages two meters in thickness. It strikes N. 70° E. and dips 55° SE. The wall rock is rusty-colored clay containing fragments of tuff or shale. The manganese occurs as thin veins of soft oxide and numerous

small rosettes of crystalline pyrolusite. Remnants of tuff in the jasper indicate that the original tuff has been replaced by jasper. The manganiferous rock averages perhaps 15-20 percent of manganese.

The hill to the south is covered with boulders which are imbedded in clay. The boulders are composed of rock varying from a coarse-grained quartzite-like mixture of manganese silicate and quartz to fine-grained chert of similar composition. Many of the boulders are nearly pure chert. A number of the boulders carry small rosettes of pyrolusite and the more manganiferous ones are coated with manganese oxide to depths up to 4 or 5 cm. The average boulder contains only about 15 percent of manganese.

A flat bed of manganiferous jasper or cherty manganese silicate crops out on top of the hill. The bed is about 2 meters thick and the outcrop covers an area of some 25 sq. meters. The rock is filmed with manganese oxide along joints and on the surface, but very little oxide was seen. Fifty meters south is a similar flat bed cropping out along a canyon wall for 20 meters. The bed is about 2 meters thick and consists entirely of very low-grade manganiferous jasper. It has been explored by several trenches which have uncovered no good ore. Most of the material seen contains about 15-20 percent of manganese.

Panama (Ventura) deposit

The Panama deposit is on the southwest bank of Ventura creek, a small tributary of Macho creek, about 500 meters southwest of the Mangue de Indio deposit. It is covered by one claim of five hectares, Consuelo No. 2.

An area about 100 meters in diameter is blanketed with boulders of siliceous rock which is either manganiferous jasper or a mixture of jasper and manganese silicate. Several shallow trenches show a mantle of boulders

over a meter thick, resting in clay. No rock in place was seen. The boulders are cut by veins of manganese oxide. None of the boulders carries more than 20 percent manganese, the average being about 15 percent, largely in the form of manganiferous jasper or manganese silicate.

Machita deposit

The Machita deposit is on a small branch of Macho creek 1500 meters from the Fató River and about 700 meters southwest of the Panama deposit. It lies on the south flank of Macho Peak and is covered by one claim of 5 hectares, Consuelo No. 3.

Interbedded shale and sandstone are exposed along the stream course. The strike varies from northeast to east, the dip from 20 to 40 degrees south and southeast. An area of about 3000 sq. meters on the northwest side of the creek is sparsely covered with boulders of manganese oxide, jaspe , and jasper cut by veinlets of manganese oxide. Some of the jasper is cut by quartz veins up to 3 cm. thick. Near the top of the float area is an outcrop of jasper which strikes N. 2 5° E. and dips 55° NW. Just below the outcrop is an area of about 100 sq. meters showing some float of fairly good oxide.

The best material is a manganese oxide-jasper rock in which the jasper has been partly replaced by manganese oxide, leaving isolated patches of jasper surrounded by oxide. The jasper has probably formed by replacement of shale or sandstone. No manganese silicate has been definitely identified at this deposit. A partial analysis of the Machita rock, taken from a report by Stuart St. Clair written in 1940, gives the following:

Mn	20.81
Fe	10.61
SiO_2	53.09

No boulders seen carry more than 40 percent of manganese. The outcrop of the oxide has not been found, but is probably concealed near the small area of float mentioned above.

Blaque Deposit

The Blaque deposit is on a low ridge between Blaque creek and the Fató river 13 kilometers southeast of Nombre de Dios. It is covered by three claims of 5 hectares each, Blaque Nos. 1, 2, and 3.

Two shallow pits 5 meters apart have been dug on the ridge about 50 meters above the Fató river. The pits show small outcrops of jasper cut by veinlets of manganese oxide. The rocks strike NE and dip 35° SE. Some of the rock exposed in the east pit carries about 40 percent manganese, but the amount in sight is very small. The wall rock is clay. Fifteen meters southwest another pit shows a small boulder of siliceous oxide, and the slope below toward the Fató river shows a few small boulders of similar rock. A few pieces of diorite were found near the base of the hill.

Seventy meters southwest, on the northwest side of Blaque creek, an area of about 500 sq. meters is covered with boulders of brown chert imbedded in clay. Some of the chert is banded with thin quartz veins. There are a few small pieces of mixed manganese oxide and clay, but most of the rock carries little or no manganese.

Just south of the float area, Blaque creek has cut through a bed of coarse grained arkosic sandstone which strikes N. 60° E. and dips 45° SE. The sandstone contains plates of chlorite up to 2 cm. across along bedding surfaces. It has been replaced by a vein of jasper at least 2 1/2 meters thick. The contact between jasper and sandstone is sharp and very irregular, and dips in an opposite direction to the sandstone.

SKETCH MAPS OF MANGANESE DEPOSITS ALONG THE NOMBRE DE DIOS RIVER

Nombre de Dios, Province of Colon, Republic of Panama

EXPLANATION

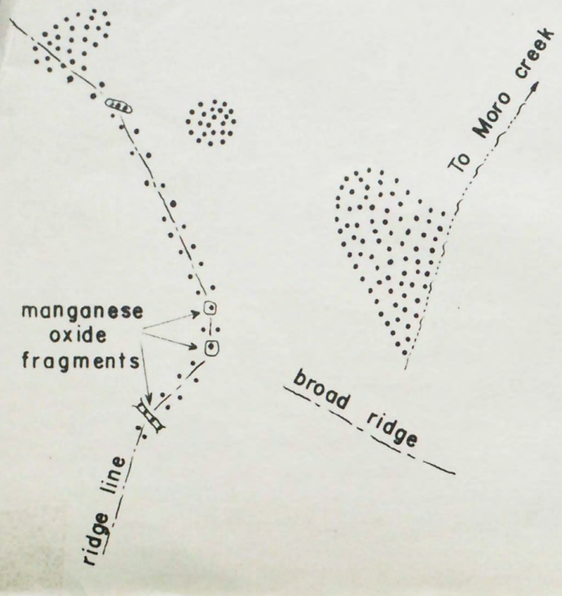
35 Strike and dip of beds

Trench or pit

Open cut

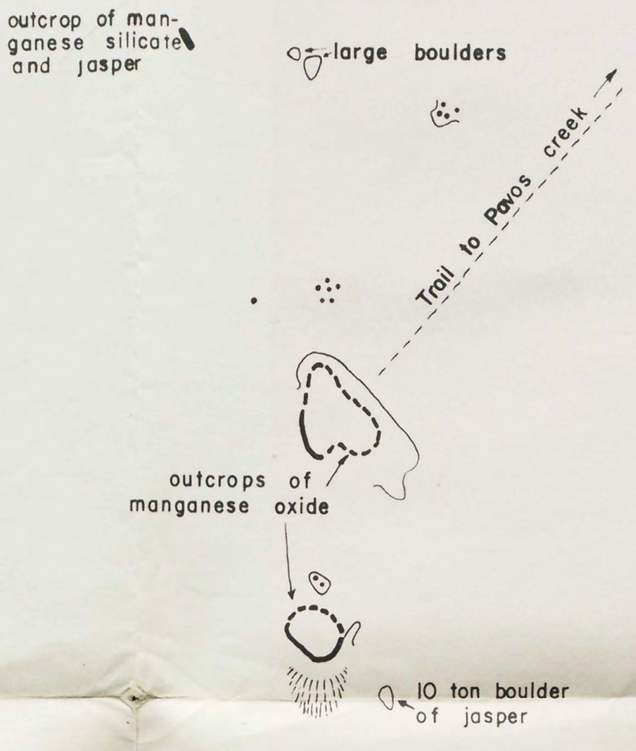
Boulders of partially oxidized manganese silicate or manganiferous jasper (unless otherwise noted)

April, 1943



MESA DEPOSIT

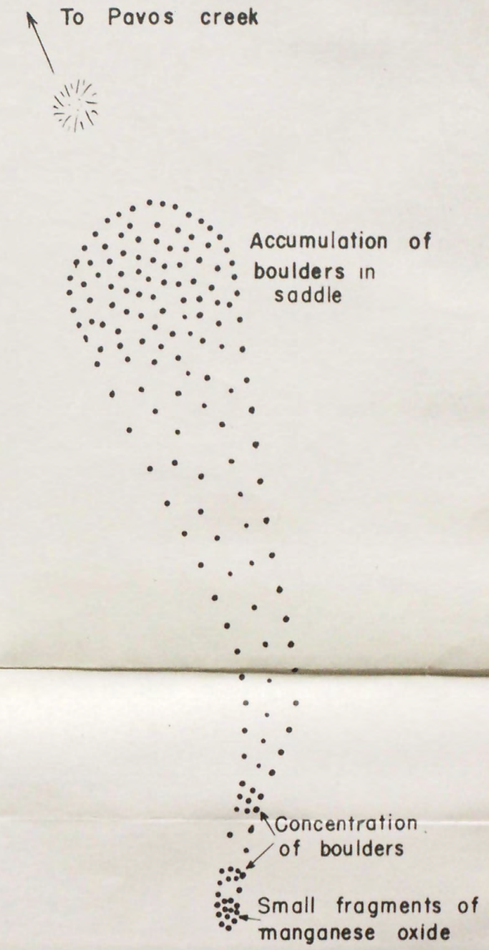
0 10 20 30 40 50 m.
Scale

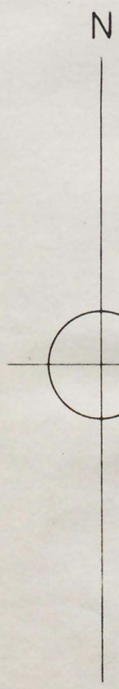


MARIA-DEFENSE DEPOSIT

0 5 10 20 m.
Scale

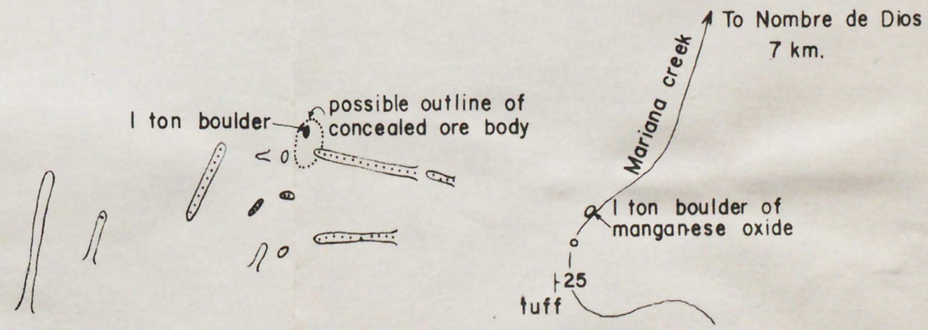
Dump





AMERICA DEPOSIT

0 10 20 30 40 50 m.
Scale



MARIANA DEPOSIT

0 10 20 30 40 50 m.
Scale

Trench showing pebbles of manganese oxide

Practically no ore is exposed anywhere on the Blaque claims and the lack of float indicates that there are probably no deposits of any size in the area.

Deposits along the Nombre de Dios River

Mariana

The Mariana deposit is on Mariana creek, which flows into Indio Bay 6 km. west of Nombre de Dios. It is most easily reached from Nombre de Dios by way of the Hyatt railroad and Marianito creek, a distance of 7 kilometers. The deposit is covered by three claims of five hectares each, Mariana Nos. 1, 2, and 3. (See fig. 9.)

Numerous small fragments of manganese oxide are found on a low ridge west of Mariana creek, and a boulder weighing about 1 ton lies in the creek bottom. This boulder is mentioned in several earlier reports, and evidently has furnished material for several assays. Sheared tuff which strikes north and dips 25° east crops out along a bend of the creek. Float is found over an area about 70 meters long and 30 meters wide but at only one place, near the west end of the area, was oxide seen which may be in place. Several trenches show fragments of oxide in clay which contains small pieces of decomposed shale. The fragments are found to depths up to one meter, but in no great concentration. Near the center of the area a concentration of small boulders suggests an undiscovered ore body nearby.

The oxide is a massive finely crystalline hard black mineral of the psilomelane type, cut by thin veins of pyrolusite. The massive oxide has numerous small vugs filled with tiny striated prisms of pyrolusite, and much of the float shows leached pockets of clay. The average grade of the

oxide is about 45 percent of manganese. The deposit has been explored sufficiently to indicate that it is unpromising because of lack of tonnage. An assay of the boulders, taken from a report by Stuart St. Clair written in 1940, gives the following result:

Mn	55.18
SiO_2	6.65
Fe_2O_3	.76
P	.049

Cerro Viejo deposits

Three deposits are found near the summit of Cerro Viejo (Viejo Peak), a prominent hill 8 kilometers airline southwest of Nombre de Dios. Cerro Viejo is 7 kilometers by trail from the nearest part of the Hyatt railroad and 14 kilometers by trail from Nombre de Dios. It is reached by travelling south along the railroad to a point just south of the junction of Pavos and Brazo de Cedro creeks, from which a trail leads over a low divide back to Pavos creek and thence to the foot of Cerro Viejo. Pavos creek is not used as a trail for the first few kilometers above its mouth because of steep canyon walls and a rocky stream bed.

Cerro Viejo may also be reached from Garote by taking the Ferrari banana railroad to the Indio river, from where a trail is said to lead to Pavos creek. This route is longer and perhaps more difficult than the one mentioned above.

Just downstream from the old Pavos camp is an outcrop of thick-bedded purplish shaly limestone which strikes N. 70° W. and dips 25° SW. Near the camp is a 5-ton boulder of very siliceous rock which has probably come from the América deposit on the ridge above the camp.

América deposit

The América deposit is on Cerro Viejo ridge about 125 meters southeast of the camp. The camp is at an altitude of 80 meters. The deposit lies at an altitude ranging from 140 meters at the north end to 175 meters at the south end. The América is covered by a mining claim of 400 hectares, with title in the perpetuity, held by the Pinel-Ami interests of Panama. The area has been cleared, but no other prospecting is in evidence.

The deposit consists of boulders of very siliceous manganiferous rock found along the steep narrow crest of Cerro Viejo ridge. Wherever seen, the country rock is clay. As the ridge is very steep, there has been little opportunity for the accumulation of large amounts of float, if such has been available. The north end of the boulder area is in a small saddle, and here an area about 15 meters in diameter is sparsely covered with boulders weighing up to 10 tons. These boulders are largely a quartzite-like rock composed of an intimate mixture of jasper and manganese silicate or manganiferous jasper. Most of the boulders are coated with a thin film of manganese oxide. No good oxide was seen, the average grade being around 10 to 15 percent of manganese.

The train of boulders can be traced southeast and south along the ridge crest for 120 meters. Near the upper (south) end are two concentrations of boulders which probably mark the site of a concealed body of manganiferous jasper. At the extreme south end is a small area of float composed of soft crystalline oxide averaging about 45 percent of manganese. No outcrop of this material was found.

Although the deposit is nearly completely unexplored, the very low grade of material seen does not appear to justify any further work. The owners of the deposit are evidently of the same opinion.

María-Defense deposit

The María-Defense deposit is about one kilometer south of the América on the crest of Cerro Viejo ridge at an altitude of 1000 feet. It lies about halfway between Viejo Peak and a slightly lower summit to the north. The deposit is covered by six claims of five hectares each: María Nos. 1, 2, and 3 and Defense Nos. 1,2, and 3, from east to west. The main deposit lies on the boundary between María No. 3 and Defense No. 1.

An area about 30 meters long and 20 meters wide has been thoroughly cleared and scraped. Two outcrops of manganese oxide are exposed, the north outcrop having an area of 17 sq. meters, the south outcrop an area of 12 sq. meters. The centers of the outcrops are 18 meters apart, and the intervening ground shows a light mantle of float but no outcrops. A shallow trench just north of the south outcrop shows numerous small fragments of oxide in clay, and a trench along the east side of the outcrop shows a thin irregular layer of jasper between oxide and clay. The jasper is cut by quartz veins and ranges in thickness from a few centimeters to 30 cm. An open cut below the outcrop shows a 2.5 meter vertical face of oxide containing some admixed clay and a few small pockets of brown jasper. Just below the cut is a 10-ton boulder of jasper which may have rolled down from the hill 100 meters north. This boulder, as well as other smaller ones nearby, is cut by many quartz veinlets.

The manganese oxide is largely soft crystalline material which shows a variety of forms. Most of the oxide is finely crystalline, usually containing bundles of radiating prisms of pyrolusite up to 1.5 cm. in length. Some of the material is finely banded, the bands being alternate thin layers of quartz and manganese oxide. At the south end of the north outcrop the rock is a hard mixture of crystalline oxide and quartz full of small vugs lined

with tiny quartz crystals and striated cubes or short prisms of some manganese oxide, probably pyrolusite. The oxide in general appears to carry considerable silica, largely free. Some of the pebbles of oxide found in the clay appear to have formed in place. They have the typical irregular rounded shapes of small concretions and a rough concentric structure with the centers often crystalline and the rims massive.

Little can be said about the origin of the manganese oxide, as there are few rocks other than oxide and clay exposed. The south outcrop, which shows isolated irregular pockets of jasper surrounded by oxide, as well as a belt of jasper along the east contact with clay, suggests that the jasper has been replaced, in part at least, by manganese oxide. The origin of the jasper is not known but, analagous to other similar deposits in Panama, it may have replaced shale or tuff which is now altered to clay.

Assuming that the two outcrops are connected together underground (though there is little evidence that they are) about 100 tons of oxide per foot of depth may be expected if the surface area, including the now barren area between the outcrops, remains constant. If the two outcrops are unconnected, this estimate must be revised downward. The ore contains 45-50 percent of manganese.

On the steep slope north and west of the main outcrops are several boulders and one outcrop of purplish manganese silicate or manganiferous chert. Some of the rock has been brecciated, and fragments are cemented by veinlets of quartz and chalcedony. A few boulders in the open cut northwest of the north outcrop have been well oxidized, but most of the boulders carry little manganese.

Analyses of oxide from the María-Defense deposit are given below:

No.	Location	Mn	MnO_2	MnO	Fe_2O_3	SiO_2	CuO	P	BaO
1	Ridge, etc.	42.91	65.07	2.38	2.40	22.32	.33	.044	-
2	Composite	51.63		2.78	2.78	3.82		.059	4.39*
3	West side	47.48			2.35	12.36		.070	3.61*
4	Composite	47.82	72.87	1.87	.67	21.40	.13	.039	.66

Note: Assays 1-3 from report by Stuart St. Clair, 1940
Assay 4 from report by Reginald Laxton, 1943
* Indicative of psilomelane or hollandite?

The María-Defense deposit is considered the best of the deposits examined in the Nombre de Dios area, as it shows the only appreciable amount of good oxide seen. However, inadequate exploration makes any estimate of tonnage of doubtful value. The area between the two outcrops as well as to the north of them should be deeply trenched to establish whether or not the outcrops are connected or whether there is an extension of the orebody northward. Until this is done, the deposit must be considered as no more than a fair prospect.

June deposit

The June deposit is on a bench high above Luis creek on a small tributary of that creek. It is covered by three claims of five hectares each, June Nos. 1, 2, and 3.

The deposit is on the east side of a small creek, where an area about 75 meters long and 50 meters wide has been cleared. Well bedded shale and sandstone striking north and dipping 25° W. crop out in the west wall of the canyon. The area is covered with numerous large and small boulders of red and brown jasper, cut by quartz veinlets. One outcrop of jasper

15 meters long and several meters thick is found in the cleared area. The jasper strikes north, but the dip is uncertain. Some of the jasper is manganiferous, as boulders are often coated with manganese oxide, but all material in sight is very low-grade.

La Mesa deposit

La Mesa deposit is on a braod ridge on the west flank of Mesa Peak between Mesa and Moro creeks about 8 kilometers airline and 15 kilometers by trail south of Nombre de Dios. It lies about 3 kilometers southeast of and 150 meters above the junction of the two creeks, and is covered by three claims of 5 hectares each, Salvavida Nos. 1, 2, and 3. The trail from the creek junction follows a steep narrow ridge. Limestone boulders were seen along the ridge at three places, 450, 750 and 780 meters northwest of the deposit, and tightly folded shale crops out in a small canyon to the southwest; these were the only rocks except clay seen in the vicinity of the deposit.

Manganiferous rock is found near the junction of a broad ridge, which trends southeast, and two narrow ridges which trend northwest and south, respectively. At the junction two pits one meter deep reveal fragments of manganese oxide and jasper up to one meter in diameter imbedded in clay. A trench 8 meters southwest shows a mantle of manganese oxide fragments about 30 cm. thick lying in and on clay. About 10 percent of the clay mantle is oxide. The manganiferous-bearing rock is largely sugary brown manganiferous jasper or manganese silicate, of which the smaller fragments have well oxidized. The larger boulders have cores of unaltered siliceous material. The best material seen carries about 35 percent of manganese, but very little is in sight.

On the northwest ridge 40 meters from the pits a shallow trench shows a few boulders of siliceous oxide and jasper in clay. Fragments up to 30 cm. in diameter make up about 10 percent of the surface cover to a depth of 1/2 meter. A few pieces of float are found in the area between the pits and the trench. Just northwest of the trench are a few boulders of siliceous oxide, and to the east is an area of about 100 sq. meters covered with similar boulders.

The largest area of float is about 30 meters east of the pits on the west side of a small canyon. Here a narrow bench is covered with boulders over an area 35 meters long and 20 meters wide. The float is mostly jasper and slightly oxidized manganese silicate or manganiferous jasper, in boulders weighing up to several tons. No rock definitely in place was seen, and the area is completely unexplored. The ground between this float area and the ridge top is practically devoid of float. The average grade of the float is about 15 percent of manganese.

The deposit has not been explored adequately, perhaps because the total lack of outcrops gives no indication of suitable areas for prospecting. However, the low grade of material seen here together with the great distance from transportation do not warrant any further expenditure of time and money for development.

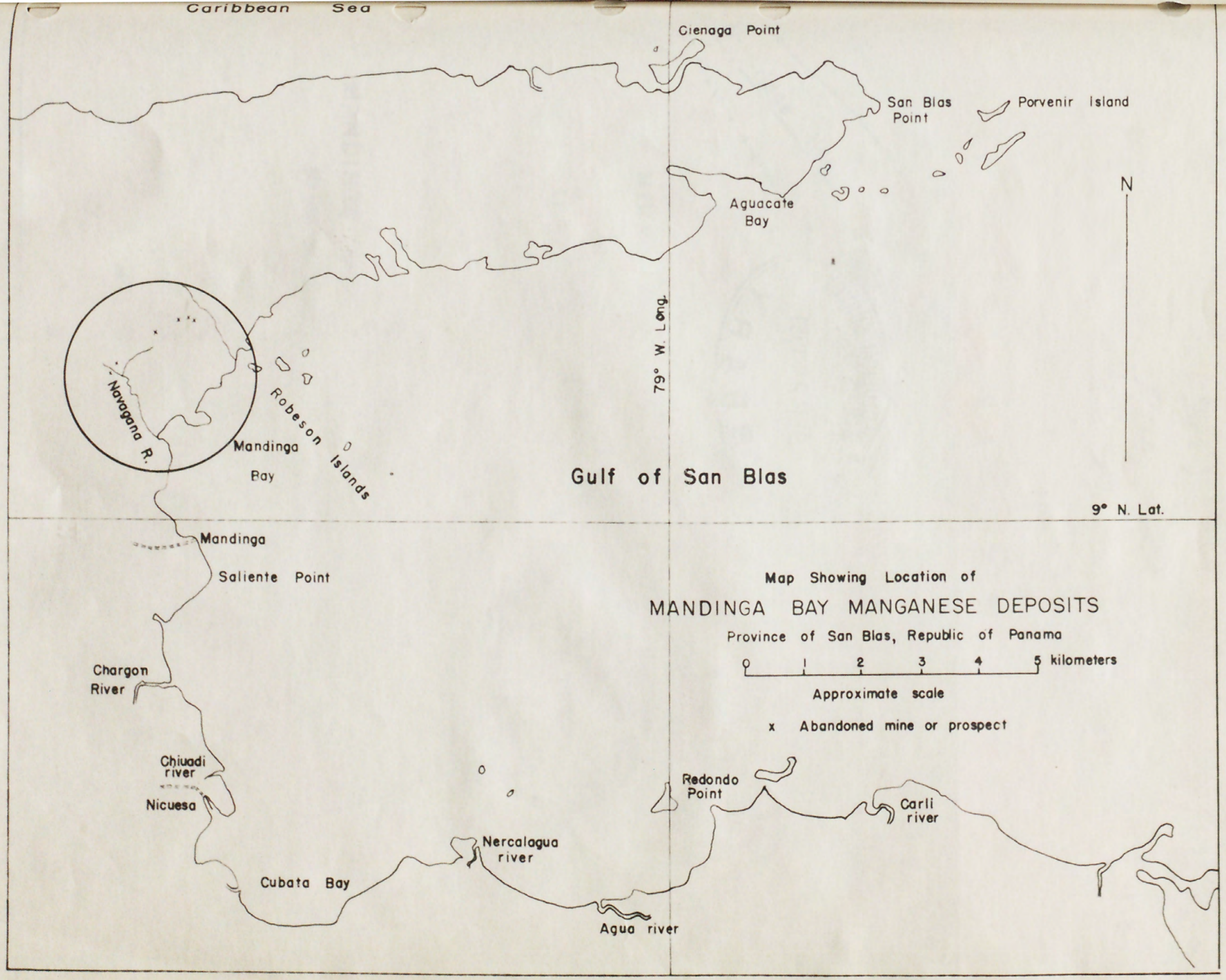
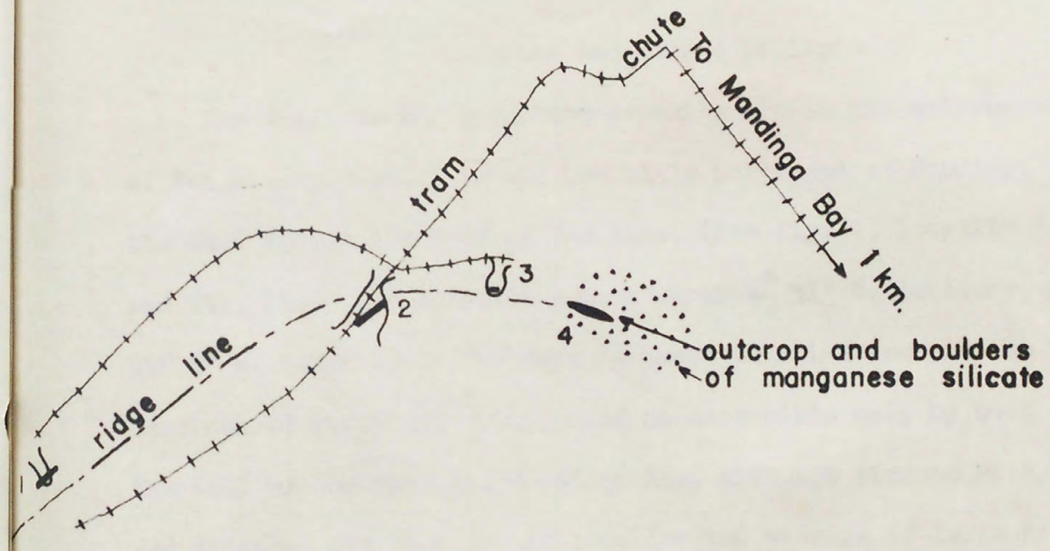

Caribbean Sea
Cienaga Point
San Blas Point
Porvenir Island
Aguacate Bay
N
79° W. Long.
Navagana R.
Robeson Islands
Mandinga Bay
Gulf of San Blas
9° N. Lat.
Mandinga
Saliente Point
Chargon River
Chiuadi river
Nicuesa
Cubata Bay
Nercalagua river
Agua river
Redondo Point
Carli river
Map Showing Location of
MANDINGA BAY MANGANESE DEPOSITS
Province of San Blas, Republic of Panama
0 1 2 3 4 5 kilometers
Approximate scale
x Abandoned mine or prospect

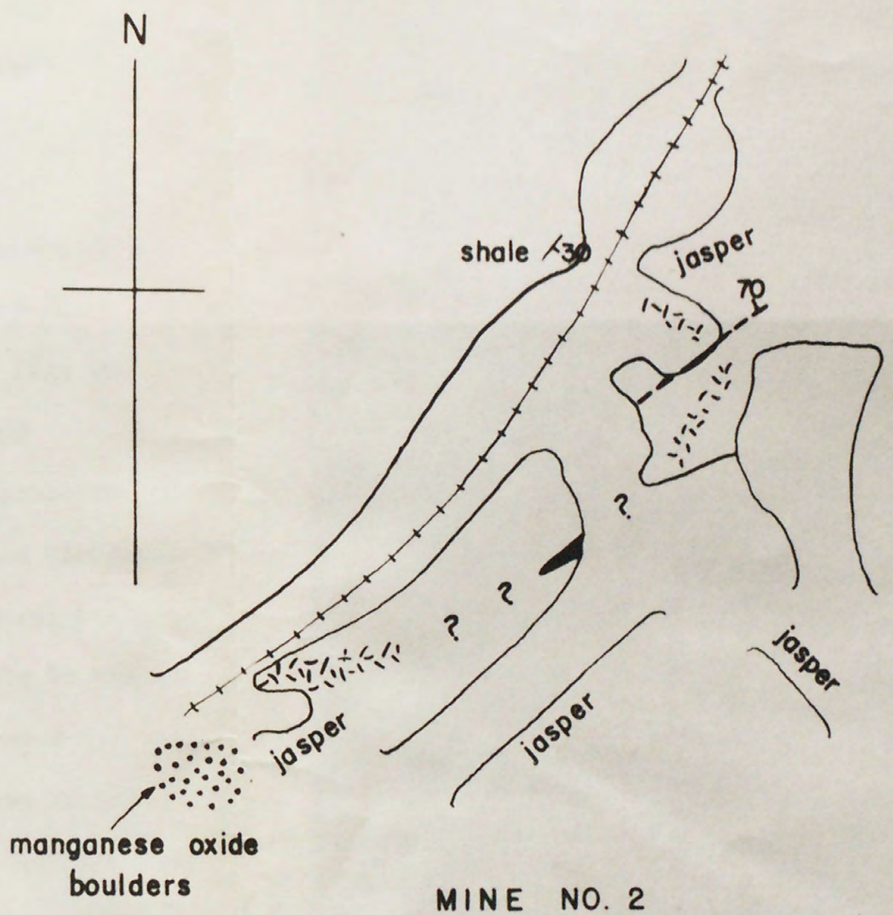
Fig. 10



MINES AND RAILROAD

0 100 200 300 400 500 meters

Scale



MINE NO. 2

0 10 20 30 40 50 m.

Scale

30 Strike and dip of beds

70 Strike and dip of shear zone

Small manganese oxide bodies

Sketch Maps of

MANDINGA BAY MANGANESE DEPOSITS

Province of San Blas, Republic of Panama

Open cut

Railroad (abandoned)

Manganese oxide outcrop

January, 1943

Deposits in the vicinity of Mandinga Bay, Province of San Blas

Location and accessibility

The Mandinga Bay manganese deposits are in the extreme western part of San Blas province, in the low hills northwest of Mandinga Bay at the west end of the Gulf of San Blas. (See fig. 1, locality 5, fig. 10, and fig. 11.) The deposits are at about 9° 31' N. Latitude, and 79° 5' W. Longitude. The area is about 60 miles east of the Caribbean terminus of the Panama Canal, and is accessible only by boat and airplane. The Gulf of San Blas and Mandinga Bay, although studded with coral reefs and islands, are deep enough to allow the passage of large boats to within a few hundred meters of the shore in the vicinity of the manganese deposits. The surrounding country is sparsely settled, but most of the islands in the gulf are inhabited by the San Blas Indians who operate small plantations on the nearby mainland. There are small native settlements at Nicuesa and Mandinga.

Climate and vegetation

The Mandinga Bay area, situated on the Caribbean side of Panama, receives a heavy rainfall. To the writer's knowledge no records have been kept, but the average annual rainfall is probably about 140 inches, nearly all in the period from April to December. During the dry season, from January to March, the area is swept by the trade winds, and the Caribbean is so rough that small boats have difficulty in making the voyage between Colón and Mandinga Bay.

The country is covered by dense jungle, traversed by a few Indian trails which do not penetrate more than a few kilometers inland. Cross-

country travel is very slow because of the necessity of almost continuous trail-cutting.

Ownership, history, and production

The deposits are owned jointly by the Huertematte family of Panama and by Colombian interests for which the Huertemattes have power of attorney. The Huertemattes control 60 percent of the property.

During 1916 and 1917 the deposits were leased to James Hyatt and William Powellson for $25,000 per year, and these men exported to the United States 21,309 tons of ore with a value of $691,488. Some of the ore is said to have brought a price of $104 per ton. Statistics on imports of manganese ore from Panama by the United States during the years 1916-1919 are given below. All this ore was produced from the Mandinga mines.

Year	Tons	Value
1916	10,498	$265,772
1917	5,202	163,120
1918	5,608	262,520
1919	2	76
	21,309	$691,488

The ore was mined from numerous open pits in 4 general areas, and was hand sorted. It was then carried by a tram from the mines down to a railroad which took the ore to a short-pier where it was loaded on boats for shipment. The tramline, railroad, and pier are now nearly completely destroyed, and a few rusty rails and remnants

of ore cars are the only evidences of former activity. The mines have been inactive since 1919. The Huertemattes are willing to lease the deposits for mining but are not planning to do any further work themselves.

Geology and ore deposits

General

The manganese deposits are located on the crest of a low ridge which trends about north-northeast, roughly parallel to the shoreline of Mandinga Bay. The deposits are all about one kilometer inland, and lie at altitudes ranging from 50 to 100 meters.

The predominant country rock is a soft, deeply weathered shale or mudstone which crops out in a few places along stream courses. Nearly everywhere a thick mantle of clay obscures the bed rock, but along the crest of the ridge there are numerous prominent outcrops of red and yellow jasper. There is very little information available to indicate the origin of the jasper belt and its roughly linear trend, although shale is exposed near the jasper at a few places, mainly in prospect pits. The jasper probably represents a silicification of shale either along bedding or shear zones. The origin of the jasper will be discussed later in connection with the origin of the manganese ore.

Description of mines and prospects

The manganese deposits will be described in order of their occurrence from southwest to northeast.

Navagana river

Manganese ore crops out on both sides of a small tributary of the Navagana River, about 1 1/2 kilometers from the river's mouth. On the northeast side of the stream the outcrop is about 40 meters long and ranges in thickness from three to five meters. The strike is about N. 50° E., the dip vertical. Sixty meters southwest across the creek there is a small outcrop of ore lying approximately along the strike of the main outcrop. There are no exposures between the two outcrops, and the ore body is probably not continuous. The wall rock, exposed in three shallow pits, is shale, the attitude of which is indeterminate.

The manganiferous material is almost entirely a brown manganese silicate, slightly oxidized on the surface. A very small amount of oxide ore, which appears to be entirely superficial, is also present. The ore will average not more than 30 percent of manganese and not less than 50 percent of silica. The low grade of the ore and the predominance of manganese silicate as the ore mineral make the deposit valueless.

Mine No. 1

Mine No. 1 is on the southeast side of the ridge about one kilometer northeast of the Navagana River deposits. Development work consists of an open cut 50 meters long and 25 meters deep, now heavily overgrown with jungle. The walls of the cut are so steep that they are nearly entirely inaccessible.

Most of the rock exposed is red or brown jasper traversed by numerous small quartz veins. The only ore in sight at present is a seam of high grade hard manganese oxide in the face of the cut near the bottom. The seam is flay-lying and ranges in thickness from one-half to one meter. The wall rocks are considerably sheared, and the ore

has perhaps been deposited along a shear zone. The deposit appears to have no economic value, as the amount of ore in sight is negligible.

Mine No. 2

Mine No. 2 lies on the crest of the ridge about 500 meters northeast of Mine No. 1, and is the largest of the Mandinga Bay mines. Although some of the cuts are completely overgrown with jungle, the mine affords by far the best exposures seen in the area. The workings, as shown on the sketch map, cover an area 120 meters long and 75 meters wide, and reach a maximum depth of 25 meters. (See fig. 11.)

The rock exposed in the cuts is largely red and yellow jasper which in places is considerably sheared and brecciated. In the northwest part of the mine area there is an outcrop of shale or mudstone. Deep weathering has nearly completely obliterated the bedding, but the rock appears to strike about northeast and dip about 30° southeast. It is highly jointed and weathers into tiny irregular columns and pinnacles of red, yellow, gray color. The jasper has probably been formed by silicification of a similar rock, in this locality apparently along the bedding of the shale.

The ore consists largely of hard blue-black manganese oxide of the psilomelane type, but there is also a small amount of soft coarser-grained material. The oxide occurs as thin veins in jasper and as irregular lenticular bodies replacing jasper. One lens of ore contains some brown manganese silicate that is partly replaced by manganese oxide.

The predominant shearing in the jasper has a northeast trend, and the general northeast direction of the workings indicates that this is also the trend of the ore zones. There is very little ore in sight at present, most of it occurring in a belt with a rough northeast trend. It appears likely that the ore deposition was controlled, in part at least, by these shear zones, but post-mineralization shearing has occurred to such an extent that any pre-mineralization structures are effectively concealed.

The deposit appears to have been nearly mined out and offers little promise of future production.

Mine No. 3

Mine No. 3 is on the north side of the ridge about 200 meters east of Mine No. 2. Development work consists of a semicircular open cut about 50 meters in diameter and 20 meters deep. The rock exposed is jasper, which is red, orange, or yellow in color, and is commonly weathered yellow. The only ore in sight is a seam of hard manganese oxide about 15 cm. thick occupying a brecciated zone in jasper. The ore has partly replaced the breccia fragments, some of which are completely surrounded by manganese oxide. The deposit has been completely mined out.

Mine No. 4

Mine No. 4 lies on the crest of the ridge about 150 meters southeast of Mine No. 3. Very little mining has been done, and development work consists of a few shallow prospect pits. The deposit is a lens of manganese ore nearly 100 meters long and ranging in thickness from five to eight meters. The lens strikes about N. 70° W. and dips vertically. There are no other rocks exposed in the vicinity.

The ore is largely brown manganese silicate, oxidized on the surface to depths up to two cm. It is cut by numerous quartz veins up to a centimeter in thickness, and is somewhat faulted and brecciated. Some of the ore contains small fragments of jasper surrounded by manganese silicate which appears to have replaced the jasper.

The ore contains about 25 percent of manganese and about 50 percent of silica. The deposit has little economic value because of the low grade of the ore and the predominance of manganese silicate as the ore mineral.

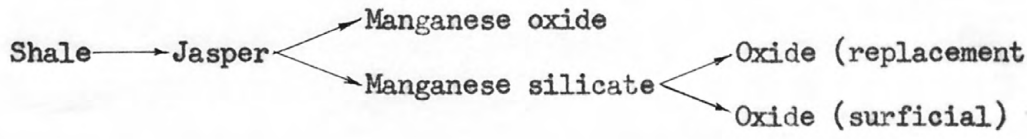
Origin of the deposits

The manganese ore in the Mandinga Bay area is closely associated with red and yellow jasper. This rock is fine-grained and massive, and entirely devoid of bedding. It is considerably jointed and faulted, and the few visible contacts of shale and jasper appear to be fault contacts. It is probable that the jasper has been produced by silicification of shale or mudstone, either along bedding or along shear zones.

Most of the manganese oxide is of the psilomelane type, very hard and heavy, but there is a small amount of soft, powdery oxide. The manganese oxides appear to have replaced the jasper along faults and fractures, as the ore bodies are elongate and irregular, and they often contain masses of jasper surrounded by oxide. The writer was told by men who had worked in the mines that the ore bodies mined were usually small and difficult to separate from the jasper.

At Mine No. 4, manganese silicate, either bementite or neotocite, has replaced jasper and has been slightly oxidized where exposed at the surface. No replacement bodies of manganese oxide were seen at Mine No. 4, but at Mine No. 2 the oxide has replaced the silicate to a small

degree. The complete paragenesis is not shown at any one locality, but the sequence appears to be:



Wherever manganese oxide and manganese silicate are both present, the oxide appears to be later than the silicate.

Reserves

The Mandinga Bay deposits examined by the writer are estimated to contain about 20,000 tons of manganese ore averaging from 25 to 30 percent manganese and 40 to 50 percent silica. This ore is largely in the form of the hydrous manganese silicates bementite or neotocite. The writer has heard vague reports of additional deposits further inland in the same general area, but could find no one who had any accurate knowledge of them.

Sketch map of the

CALZADA LARGA MANGANESE DEPOSIT

Province of Panama, Republic of Panama

0 5 10 20 meters

Scale

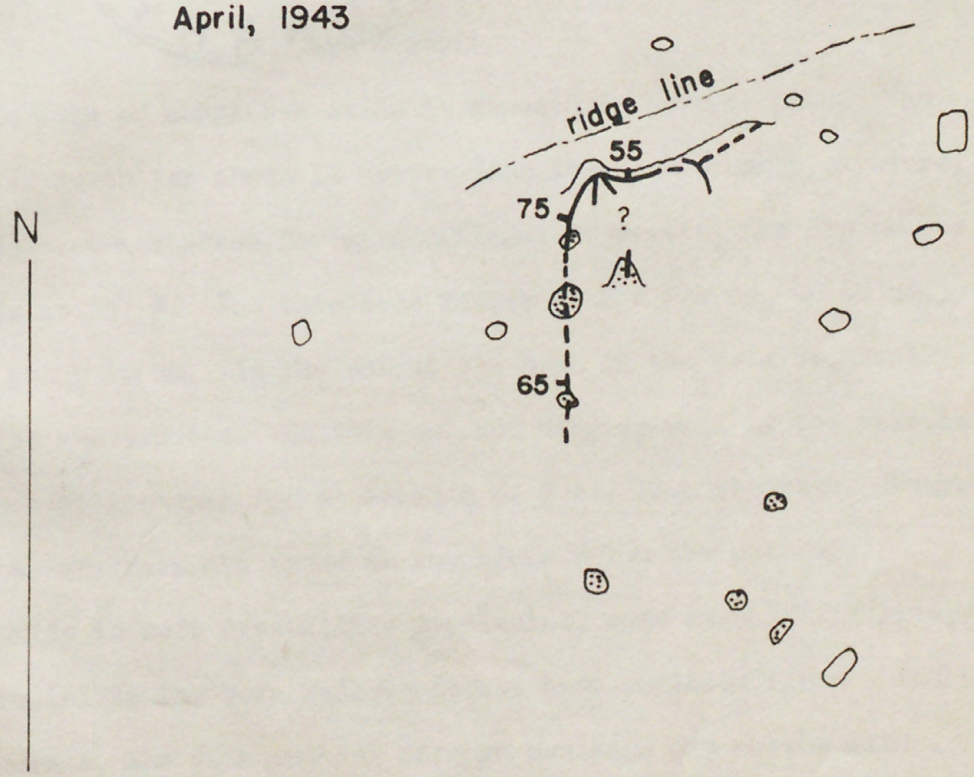
Pit in agglomerate

Open cut

Pit, showing manganese oxide float

65 Vein of manganese oxide, showing dip

April, 1943



Calzada Larga deposit, Province of Panama

General

The Calzada Larga deposit is in the low hills south of Calzada Larga about 4 kilometers south of Madden Lake and 23 kilometers north of Panama City. It can be reached by road from Panama City via Chilibre, a distance of 42 km.

The deposit lies on the south flank of a low ridge between the Chilibrillo river and a small creek (See fig. 12). The ridge is composed of deeply weathered agglomerate and tuff, probably andesitic. Fragments of the agglomerate run up to 40 cm. in diameter.

Ore deposit

A thin vein of manganese oxide is exposed in several pits. The vein strikes north for about 12 meters from its southernmost exposure, then swings east-northeast for an additional 10 meters; the dip ranges from 75° E. to 55° N. The thickness rnages from a few cm. to 40 cm., averaging about 10 cm. In the cut at the bend in the vein two small branch veins are exposed. In this cut the hanging-wall of the vein is altered to a yellow clay for a distance of 5 cm. from the vein. Numerous small pieces of float are found on the slope below the outcrop.

The oxide is soft crystalline pyrolusite, some of which is finely banded parallel to the vein walls. It has been emplaced along a fault in the agglomerate, the vein cutting through boulders and matrix alike. No other manganese mineral was seen, and it is thought that oxide is primary.

About two tons of oxide have been removed from the vein and from

pits in the float area below the vein. The average grade is about 50 percent of manganese. It is probable that only a small amount of oxide will be found here, as the vein has been well explored and is shown to be too narrow to provide much tonnage.