INVESTIGATIONS OF SOME OF THE MINERAL RESOURCES OF PORTO RICO.

By H. B. C. Nitze.

INTRODUCTION.

The mineral resources of Porto Rico are practically entirely undeveloped. With the exception of some primitive alluvial gold washing by the natives and the abortive attempts to work certain phosphate deposits, no mining operations of any kind have ever been prosecuted. It may be said that the mineral resources of the island have not even been fairly explored.

Passing over the many causes of this lack of development in the past, it may be pointed out that one serious factor among them still remains, and that is the limited means of transportation. The total length of the railroad lines is about 135 miles; these are disconnected, and being confined to the coast are of little value for the development of the interior of the island. There are about 170 miles of graded macadamized roads. Outside of these the only means of travel and transportation are horse trails, and during the wet season these are well-nigh impassable.

The harbor facilities of Porto Rico are extremely poor. With few exceptions the coast is a shallow, sandy beach, affording few opportunities for close anchorage and little shelter from storms. The exceptions are at Guanica and Jobos, on the south coast; Fajardo, Ensenada-Honda, and Naguabo, on the east coast, and San Juan on the north coast. The latter is the only port that has dock facilities, and these are very limited.

Timber for mine and fuel purposes is very scarce. There are few large forest tracts, and the majority of the woods are too valuable for the above purposes, being of the hard-wood varieties.

Charcoal, in small quantities, is worth 37 to 75 cents per 100 pounds. Coal is imported at a cost of $6 to $8 per ton delivered; the present import duty being 20 cents per 1,000 kilograms.

There are abundant water powers on the island, though entirely undeveloped as yet.

Native labor is plentiful. Ordinary farm or road labor is paid 30 cents a day of ten hours. Fair mining labor will cost 40 to 50 cents a day.

The mining laws are favorable to the mine owner. All mineral deposits are originally the property of the Government, and are acquired by private owners by concession. In order to take up a mining claim the following steps are necessary: A petition must be filed in the bureau of the insular secretary of the interior, containing a general description of the claim, the proper name by which known, the location (specifying the barrio and jurisdiction), the approximate bearings and measurements of the boundary lines, the approximate area in hectares, the name or names of the surface land owners, and the character of the mineral. This petition is advertised for sixty days in the Official Gazette, at the expiration of which time the claim is granted, provided there has been no valid protest from others claiming prior rights. At the time that the above petition is filed a deposit of 5 pesos must be made for every hectare up to 12, and 2 pesos for every hectare in excess, this money being the fee of the Government engineer who is detailed to make an accurate survey and plat after the claim is granted. In case the claim be not granted, the amount of the deposit is refunded. At the time that the claim is granted an additional fee must be paid for the title of concession. This, in the case of the more valuable minerals, such as gold, silver, lead, nickel, copper, etc., amounts to 1 peso per hectare, and in the case of such minerals as iron ore, coal, etc., to 6 pesos for the first 15 hectares, and 50 centavos for every hectare in excess.

The land owner is compelled to sell the necessary surface for mining purposes, the value of which may be appraised by a court.

The size of a mining claim is a square of 100 meters, called a "pertenencia," equal to 1 hectare. There is no limit to the number of claims which may be granted to any one person, but it can not be less than four.

According to the records of the bureau of public works in San Juan, the following mining claims were granted from August, 1894, to May, 1899:

Date.	Name of mine.	To whom granted.	Mineral.	Area in hectares.	Location.
Aug. 7, 1894	El Trabajo	Joaquin de Alarcon	Phosphate of lime		Barrio of Arenales-bajo; municipal of Isabella.
Aug. 18, 1894	La Confianza	Miguel Arzuaga	do		Municipal of Manati; mado of las Boquellas.
Feb. 6, 1896	La Esperanza	Pedro Santisteban y Chiavarri.	Iron	96	Barrio of Ceiba Norte; jurisdiction of Juncos.
Sept., 1896	Joachin y San Jose	Jose Sanchez y Valdes	Phosphate of lime		Municipal of Ponce.
Oct., 1898	Buena Suerte	Periandro Serram and Jose A. Menendez.	Bituminous clay		Barrio of Cidral; municipal of San Sebastian.
Do	Santa Teresa	M. Argueso and L. Miner	Copper, etc	64	Barrio of Rio Blanco; jurisdiction of Naguabo.
Do	Ernestita	do	Gold and nickel	100	Do.
Do	Sta. Amalia	do	Copper, etc	100	Do.
Nov., 1898	Reina del Cobre	Jas. A. Pearce	Copper		Barrio of Dos Bocas; jurisdiction of Bayamon.
Do	Momernate	Pedro Santisteban y Chiavarri.	Salt		Jurisdiction of Salinas.
Do	Union	J. R. Latimer y Fernandez	Gold		Barrio of Mameyes; jurisdiction of Rio Grande.
Dec., 1898	Brijida	do	Silver, etc		Barrio of Gurmengribe; jurisdiction of Rio Grande.
Dec. 12, 1898	Eloisa	Pedro Santisteban y Chiavarri.	Iron	25	Barrio of Collores; jurisdiction of Las Piedras.

Date.	Name of mine.	To whom granted.	Mineral.	Area in hectares.	Location.
Dec., 1898	Labina	Pedro Santisteban y Chiavarri.	Iron and silver	120	Barrio of Duque; jurisdiction of Nagnabo.
Do	Maria	M. Argueso and L. Miner	Iron, etc		Barrio of Mariana; jurisdiction of Humacao.
Do	America	do	Silver, etc		Barrio of Mameyes; jurisdictions of Fajardo and Rio Grande.
Do	Borinquen	do	Copper, etc	12	Barrio of Mabu; jurisdiction of Humacao.
Do	Washington	Antony F. Dignowitz	Gold and silver		Barrio of Dos Bocas; municipal of Corozal.
Do	Puerto Rico	Daniel Hogan	Silver, platinum, etc		Do.
Jan., 1899	Santa Agueda	Pedro Santisteban y Chiavarri.	Copper, silver, etc		Barrio of Lajas-arriba.
Do	La Fe	do	Iron		Barrio of Ceiba; jurisdiction of Juncos.
Do	Sta. Olalla	M. Argueso and L. Miner	Iron, etc	12	Barrio of La Barbera; jurisdiction of Humacao.
Do	Purificacion	do	do	12	Barrios of La Barbera and Buenavista; jurisdiction of Humacao.
Do	Elena y Eugenia	Pedro Santisteban y Chiavarri.	Copper, etc	15	Barrio of Lajas-arriba; jurisdiction of Lajas.
Jan. 16, 1899	Capron	do	do	15	Do.
Jan. 20, 1899	La Esperanza	Daniel Hogan and A. Dignowitz.	Iron, silver, gold, copper, etc.	30	Barrio of Padilla; municipal of Corozal.
Jan. 23, 1899	Finita	M. Argueso and L. Miner	do	30	Barrio of Mabu; jurisdiction of Humacao.
Jan. 24, 1899	Maria	do	do	30	Barrio of Dos Bocas; municipal of Corozal.
Jan. 25, 1899	Panchita	Antonio Rotger	Iron, etc	4	Barrio of Collores; jurisdiction of Las Piedras.

Date.	Name of mine.	To whom granted.	Mineral.	Area in hectares.	Location.
Jan. 30, 1899	Valentina	Pedro Santisteban y Chiavarri.	Copper, etc	12	Barrio of Rio; jurisdiction of Las Piedras.
Feb. 7, 1899	Caranzana	do	Iron	20	Barrio of Collores; jurisdiction of Juncos.
Do	Caridad	do	do	21	Barrio of Mamey; jurisdiction of Gurabo.
Do	Polonia	do	do	40	Barrio of Boqueron; jurisdiction of Las Piedras.
Feb. 8, 1899	San Miguel	do	do	21	Barrio of Collores; jurisdiction of Las Piedras.
Feb. 13, 1899	San Anton	do	do	12	Barrio of Collores; jurisdiction of Humacao.
Apr. 1, 1899	Corcega	Arthur H. Noble	Copper	12	Barrio of Guilarte; jurisdiction of Adjuntas.
Apr. 20, 1899	Begonia	Pedro Santisteban y Chiavarri.	Iron	21	Barrio of Collores; jurisdiction of Las Piedras.
Do	Luisa	do	do	30	Do.
Do	Buen Suceso	do	do	71	Barrio of Mamey; jurisdiction of Gurabo.
Apr. 26, 1899	La Esperanza	Francisco Sato Amador	Graphite	50	Barrios of Capaez and Juan Gonzalez; jurisdiction of Adjuntas.
May 1, 1899	Providencia	Pedro Santisteban y Chiavarri.	Iron	50	Jurisdiction of Patillas.
May 3, 1899	Borinquen	Nicanor Fernandez Cuadra.	Silver, etc	12	Barrio of Rio; jurisdiction of Las Piedras.
May 8, 1899	San Pedro	Pedro Santisteban y Chiavarri.	Iron	39	Barrio of Boqueron; jurisdiction of Las Piedras.
Do	San Ramon	do	do	47	Do.

GOLD.

So far as known, the chief occurrence of gold is confined to the placer deposits of the northern drainage basins of the Luquillo and the Corozal Mountains. The former district is situated in the extreme northeastern part of the island, and comprises the rivers Loiza, Canóvanas, Herrera, Grande, Espiritu-Santo, Mameyes, Sabana, and their affluents. The Corozal district is situated in the northern central part of the island, and comprises the rivers Mabille, Corozal, Negros, Cibuco, and their affluents.

There are no reliable records regarding these deposits, and until they are intelligently prospected little can be said on the subject. Auriferous quartz veins appear to be very scarce on the island. The occurrence of iron pyrites in the igneous rocks, of which the mountains are largely composed, is very common, and I am inclined to believe that this mineral will be found to be the chief source of the gold.

LEAD.

Galena-bearing quartz veins have been found in the barrio of Carmen, a short distance north of the town of Guayama, in the southeastern part of the island. They have been prospected by shallow diggings, which are, however, caved in and inaccessible at present. It is doubtful whether these veins have any considerable thickness. The ores are said to be argentiferous. Similar ores are reported from the barrio of Guadiana, in the jurisdiction of Naranjito, about 15 miles southwest of San Juan.

COPPER.

The copper minerals appear to have a fairly wide distribution in the rocks of Porto Rico, and more attention has perhaps been paid to prospecting for copper than for any other mineral. It will, however, require much more extended exploratory work to determine whether there are deposits of value.

One of the most important localities is the Santa Amalia claim, situated on the south slope of the Luquillo Mountain range, at an elevation of 2,200 feet above the Naguabo Valley, in the barrio of Rio Blanco, jurisdiction of Naguabo, about 7½ miles northwest of the harbor of Naguabo. The ore body appears in a large and prominent outcrop of pyrrhotite, resting at an angle of 20° to 25° on a floor of white crystalline limestone.

This outcrop has been exposed by stripping for a distance of over 100 feet, and by a tunnel extending at right angles 40 feet into the hillside. The total thickness of the ore body is 5 to 10 feet. The lower portion (8 to 15 inches) is heavily mineralized with copper pyrites, grading insensibly into the more or less homogeneous pyrrhotite mass above, which is slightly copper bearing throughout. The lower chalcopyrite zone should average from 10 to 15 per cent metallic copper.

Several analyses, made by Ricketts and Banks, of New York, show:

Copper	per cent	11.77	13.60
Gold	do	0.21	1.45
Silver	do	0.03	0.26

Active exploratory work is now in progress. The tunnel will be extended 200 feet, and the mine put in shape to produce, if the present promising prospects continue.

Several miles south of this place is the Santa Teresa copper claim, which was at one time worked in a very small way. It is now so inaccessible that it could not be examined.

Immediately to the west of the town of Humacao, in the barrio of Mabu, is a series of low hills composed of altered rhyolitic rocks, stained and impregnated with copper carbonates. The Borinquen and Finita claims are located here, but no development work has yet been done.

In the vicinity of Corozal, about 17 miles in a straight line southwest of San Juan, is situated the Reina del Cobre copper-mining claim, owned by the Porto Rico Mining and Development Company, of Boston. There are numerous signs here of former workings, said to have been abandoned about thirty years ago. The present company is sinking a shaft, which at the time of my visit was down 30 feet, and from the bottom of which about 50 feet of drifting had been done.

The country rock is a siliceous conglomerate tuff and a basic ferromagnesian rock, in which the copper minerals, carbonates, and oxides occur in thin irregular streaks and seams. Several tons of such material, which probably carries 10 to 15 per cent copper, had been taken from this prospect. The company proposes sinking to 100 feet, and then drifting in search of the supposed main ore body under the old workings.

The Esperanza and Maria copper claims are located in the same district.

Other copper claims have been located in the barrio of Guamani, jurisdiction of Guayama; in the barrio of Jayuya-arriba, jurisdiction of Jayuya; in the barrio of Guilarte, jurisdiction of Adjuntas; in the barrio of Lajas-arriba, jurisdiction of Lajas; in the barrio of Rio, jurisdiction of Las Piedras, etc.

IRON PYRITES.

The common occurrence of iron pyrites in the igneous granites, diorites, syenites, etc., of Porto Rico has been alluded to. In only one instance, however, was a notable deposit of this mineral observed. On the coffee plantation of Mr. Simon Pierluissi, about 4 miles southeast of Adjuntas, on the Ponce-Adjuntas road, a heavy gossan outcrop may be seen on the immediate banks of the Portuguese River. The width of this body of highly oxidized, coarse, granular pyrites appears to be from 5 to 10 feet. No development work has been done. According to Mr. Pierluissi assays have shown traces of gold, silver, and arsenic.

IRON.

The iron ores form the most important of the mineral resources of Porto Rico. Ores of excellent quality were seen in many parts of the island; but when quantity and quality both are to be considered, the only deposits of value, so far as present discoveries have shown, are situated in the jurisdictions of Gurabo, Juncos, Las Piedras, and Humacao, in the eastern part of the island.

The ores are massive magnetites, partially altered to red hematite in places. In structure they are very fine grained and homogeneous, and almost entirely free from gangue matter, which, when it does occur, is white, glassy quartz. In one instance the presence of copper minerals was observed in the ores, but in no case was iron pyrites seen. These are high-grade Bessemer ores, extremely low in phosphorus and sulphur, and free from titanic acid. A shipping product averaging above 60 per cent—probably nearer to 65 per cent—of metallic iron can be depended upon. The following analysis by Patterson and Strad, of Middleborough, England, taken from Mr. R. T. Hill's report on the mineral resources of Porto Rico, may be considered typical of these ores as a class:

Analysis of iron ore from Porto Rico.

Constituent.	Per cent.
Metallic iron	65.050
Silica	5.300
Phosphorus	0.024
Sulphur	0.008

The country rocks are of igneous effusive types, largely porphyritic in structure, and usually basic in composition. I saw no evidence of replacement of limestone by ore, and consider the ore bodies as magmatic segregations and concentrations in the original igneous rocks.

These ore deposits occur in a broken line of ridges, which extend along the south bank of the Gurabo River, from a point about midway between Gurabo and Juncos, in an easterly direction, to the divide between the waters of the Gurabo and Naguabo, a total distance of some 8 or 10 miles. The ridges rise to an altitude of 300 to 1,000 feet above the river, with steep slopes and sharp and narrow crests. Their continuity is interrupted by frequent transverse valleys, some of which are several miles wide.

There is no regularity about the ore occurrence. Some of the hills are ore bearing, others are not. In some localities the ore occurs in apparently large masses, the solid outcrops being clearly visible; in others the quantity is unimportant and only small amounts of surface float ore can be seen.

There are no developments whatever, but the prominence and magnitude of the outcrops indicate that there are extensive bodies of ore here that can largely be worked in open quarries.

The principal mining claims in this district are the Esperanza, Eloisa, Polonia, La Fe, Panchita, Caranzana, Caridad, San Miguel, San Anton, Begonia, Luisa, Buen-Suceso, San Pedro, and San Ramon. These have recently been acquired by an American company, which proposes an early and active development of the resources.

As to the accessibility of the ore deposits of this district, it may be said that the valleys of the Naguabo and Gurabo rivers will furnish a very favorable railroad route to the port of Naguabo. Seventeen miles of road will reach the farthest deposit. Seven additional miles will connect with the harbor of Ensenada-Hondo, which has some advantages over Naguabo, being the deepest and best sheltered harbor on the east coast.

Of the other iron-ore deposits in Porto Rico none that I saw have any commercial value. The Maria, Santa Olalla, and Purificacion claims, situated about 2 miles southwest of the town of Humacao, are massive hornblende-diorite bodies containing only a small percentage of disseminated magnetite, and hence of no value aside from the fact that the magnetite contains from 4 to 6 per cent of titanic acid.

A report that there was a large deposit of ore on the plantation of Mr. Ramon Cortado, about 7 miles north of Ponce, proved to be entirely erroneous. The ore is of excellent quality, very similar to the eastern ores, but the quantity is very small.

Specular hematites occur in various parts of the island, and such were visited at several localities near Utuado, and at Pozo-Hondo, near Guayama, but they may be said to exist merely as mineral specimens.

PEAT AND LIGNITE.

The only mineral fuels found in Porto Rico are peat and lignite. The former occurs in the marshy region along the north coast, and covers considerable areas, though the deposits have never been developed.

The lignites, so far as they came to my attention, are of inferior quality, being freely impregnated with iron pyrites. They are found in the western part of the island, some of the principal localities being Utuado, Moca, Lares, San Sebastian, San German, and Caba-Rojo.

PHOSPHATE OF LIME.

Deposits of phosphate of lime exist on the islands of Mona and Monita, off the west coast; on the island of Caja de Muertos, off Ponce, and in the northwest corner of the main island, near the town of Isabella. These deposits have been repeatedly explored and partially developed without commercial success, and it is probable either that the extent of the beds is too limited or that the quantity of phosphate that the rock contains is small.