

The deposits of iron in Mexico are sufficient to supply the universe for centuries to come. There is but one thing lacking, and that thing is—cheap fuel. Nature never works by halves; those immense deposits of iron never were put where they are without the means near at hand for their utilization. Coal exists, but it has not been mined yet on a large scale, as it will be hereafter.

But even at the present time the principal supply of pig-iron comes from native ore, the output being consumed by the producers in the manufacture of iron goods. The main iron mines now being worked are located at Durango, Zimapán, Zacualtipán, Tulancingo, and Leon. For the most part these mines are found in the midst of great forests, in consequence of which cheap fuel is found in the form of charcoal, the iron made from which being of very superior quality, free from phosphorous, and, price and other things being equal, is always preferred to the imported pig. It is manufactured in charcoal furnaces exclusively.

There is, however, quite a considerable amount of pig imported, principally from Alabama, and Scotch pig from England. The great drawback to importations heretofore has been the immense quantity of scrap iron, which, during the lapse of centuries, had accumulated, unused, throughout the Republic. This, however, is becoming well-nigh exhausted; and for that reason the demand for imported pig is increasing, the native output not keeping pace with the need for it. Much scrap iron also has come from railroads, another source of supply which is not increasing with the demand.

Imported pig ranges in price in the City of Mexico from \$50 to \$60 silver per ton, the native producers aiming to keep their price just about the same.

Iron Foundries.—There are in the City of Mexico, in addition to several small ones, seven large foundries, as follows: the Mexican Central Railroad foundry, the Mexican National Railroad foundry, the Artistic, the Delicias, Charreton Bros., V. Elcoro & Co., and Hipolito David. There are also large foundries at Pachuca, Puebla, Chihuahua, Durango, and Monterey, as well as smaller ones at Irapuato, Guanajuato, Zacatecas, Veracruz, Guadalajara, Mazatlán, Oaxaca, and Morelia.

Copper.—Copper is now quite an important product of Mexico, and is used to a certain extent in the country, but as the supply far exceeds the home demand, it is exported to the United States and Europe. That which finds its way to this country enters chiefly in the form of matte, and is refined into casting or electrolytic copper. What goes to Europe is blister copper, or approximately so, from the Boleo mine in Lower California, where a French company is working a large group of copper mines. The point of most activity is Santa Rosalia, on the

Gulf of California, where the company treats the ore in its own smelting plant adjoining. The matte, or black copper, is sent to Europe in the same vessels that bring out coke. The company gives employment to thousands of hands directly and indirectly, owns its own steamers, and solicits workmen all along the coast. But this enterprise, large as it is, shows the progress that has been made and the difficulties overcome by individuals. The country itself is arid and sterile, and there is little encouragement for others to prospect, or even develop, when found, apparently good prospects, owing to the natural difficulties to be overcome and the vast capital necessary to successfully carry on mining operations; as success is hardly to be obtained except by treating the ores on the ground, as the Boleo Company has done.

At the same time the enterprising firm of Guggenheim has established its works at Aguas Calientes, adding very considerably to the copper product, and the increase of matte shipments from San Luis Potosi and Monterey makes a large difference from former returns. To judge from the official figures, the amount of copper produced in 1896 was not less than 22,000 metric tons, the greater production being from the Boleo mines.

Quicksilver.—The production of quicksilver can only be approximated from imports, as the native production is far short of the requirements of the country. In 1895 the amount imported was 818,704 kilos, with a value of \$541,664, while during the past year the amount imported was 854,526 kilos, with a value of \$574,153. The only inference to be drawn from these figures is that the production in Mexico in the past year as compared with 1895 has not increased, and the figures of production given in the *Engineering and Mining Journal* of 1895 may be accepted as correct for 1896.

Coal.—Fuel is perhaps the greatest and most pressing need of Mexico. For centuries the population of the whole country has used wood for fuel, until the most thickly inhabited portions of the country are completely destitute of trees. This condition of things is a very serious objection to the increase of manufacturing, as it is impossible to manufacture cheaply when fuel commands a very high figure. Coal, which has to be transported sometimes for thousands of miles before it reaches the centre of the country, becomes very expensive. At present rates the cost of wood in the City of Mexico is equal to \$14 a cord, while coal ranges from \$16 to \$22 per ton according to grade, and one source of supply is the artificial fuel of compressed coal dust brought from England, and in use not alone on the Veracruz Railway, but in various local industries, while coal also comes from West Virginia, Alabama, etc. The distances of the sources of coal supply and its consequent cost led to the attempt of utilizing the peat deposits which

are of great extent and practically inexhaustible within ten miles of the City of Mexico.

In the Tlahualilo district of the State of Coahuila, for instance, owing to the distance from the nearest coal mines, the question of fuel is very important, as there are at present more than three hundred horse-power in constant use, and the amount is steadily increasing. The main supply is from the mesquite brush, which is cleared from the new lands as the work of ditching and preparation advances. The hulls of the cotton seed also make a hot but quick fuel for some of the larger stationary engines. The wheat, straw and cotton bushes are utilized for brick-burning and for the domestic purposes of the laboring population.

Those acquainted with industrial conditions in Mexico and making investigations with a view to the establishment of new industries in that Republic, are consequently impressed with the fact that, in spite of the cheap labor, favorable climatic conditions, and good home markets, the lack of cheap fuel is exceedingly detrimental to a large proportion of the industries of this country; but fortunately large deposits of coal are now being discovered in the Republic. At Salinas, in the State of Coahuila, a large bed of coal is being worked by the International Railroad Company, which furnishes fuel for that road and even for a portion of the Southern Pacific Railroad and for some of the manufactories in Monterey. In the district of Tlaxiaco, in the State of Oaxaca, a very rich coal-field has been discovered, but for the present it is inaccessible and before a railroad can be built to tap it it cannot be used, as the expense of transportation would be exceedingly high. Sonora contains a carboniferous area, several miles in extent, with innumerable veins from five to sixteen feet in thickness, of hard, clean, anthracite coal, carrying as high a percentage in fixed carbon as the best coal mined in Wales. The ledge is thirty miles in length and averages sixteen feet in width, showing a quantity sufficient to supply the entire Pacific coast with anthracite coal of the first quality for years to come. The configuration of that State and the proximity of the sea make it comparatively easy to work it.

At Jiquilpan, State of Michoacan, almost immediately south from Negrete station on the Guadalajara branch of the Mexican Central Railroad, a large coal-field has been discovered. While it is not probable that either anthracite or first-class bituminous coal will be found in these fields, still the great value of even an ordinary class of coal will be appreciated by those acquainted with industrial conditions in Mexico. The coal measures of the Chapala district probably belong to the tertiary period, and lie in stratified rock overlaid by an outflow of basalt or lava, at an elevation of 250 or 300 feet above Lake Chapala. The general series of rocks has been examined and pronounced

as coal-bearing by an eminent geologist. The measures are quite extensive, being easily traced from Yurecuaro to near Ameca with occasional interruptions through volcanic intrusion. The developments already made, show that the coal or lignite veins extend over perhaps thirty square miles. How much beyond these limits, it would be impossible to state. It exists in considerable quantities. There are a number of veins overlying each other, and varying from two inches to fifty inches in width; but, as the explorations have not yet found the veins in place, it is impossible to say exactly what their condition will be. A feature which adds considerably to the value of these deposits is an extensive deposit of bog iron in the immediate vicinity. If further exploration discovers considerable quantities of commercially valuable coal, it is easy to estimate the results to the industries. Other beds of coal have been discovered but of less consequence, and in several of the northern states of Mexico there are known to exist large deposits.

Mexican industries will be completely revolutionized when they can use cheap coal instead of wood for all purposes, thus cheapening the cost of manufacturing by using cheaper fuel, which is so important an item of expense in manufacturing.

Mexican Miners.—While the laborers employed in Mexico will not compare in efficiency with the labor of the miner in the United States, it must be borne in mind that the American miner works eight hours and receives \$3 per day, or \$6 in Mexican money, and \$6 in Mexican money will employ from eight to twelve Mexicans, wages varying from 50c. to 75c. per day. As for the climatic conditions, it is only necessary to say that in all the mining districts of Mexico a miner can work 365 days in the year. There is never any snow or cold weather in winter, and the heat in the summer is not so extreme as in St. Louis, Chicago, or New York, and never enervating. A pair of blankets at night are indispensable every night in the year.

Mining Laws.—The mining laws of Mexico issued during the Spanish rule, which were kept in force until 1884, were both liberal and wise, and were intended to encourage mining. The domain of the mines remained in the Government and it gave temporary titles to anybody who discovered one, and who was willing to work it, but only as long as work was done in the mine. When the discoverer or owner could not for any reason continue to work it, and allowed a certain time to elapse without doing any work, the mine reverted to the Government and anybody else willing to work it could obtain a temporary title over it. This system was changed, by our Mining Code of 1884, to the effect of giving the mines in fee simple to the discoverers of the same, whether they were worked or not by those who denounced them, and the only cause for forfeiting the title is the failure to pay a

tax of \$10 per pertenencia, a "pertenencia" being our unit of a mining property and consisting of a hectare or a square 100 metres on each side, equivalent to 2.47 acres. The rights of the owner of the land are not interfered with, and in case anybody discovers a mine upon another man's property, the landlord continues to own the surface, and all the discoverer is entitled to is the mineral underground and so much of the surface as is necessary to work it, for buildings and other mining requirements, and for that the owner of the ground is compensated by agreement, or, if no amicable agreement can be reached, by arbitration.

Mining litigation is quite rare in Mexico, and it does not take long to get a final decision, as mining cases are tried before a single judge, and appeals lie to the Supreme Courts of the different states, and to the Federal Supreme Court in Mexico. To the honor of the courts in Mexico be it said, as may also be said of the judiciary in the States and the United States Federal Courts, they are above reproach.

A concise statement of the provisions of the present mining laws of Mexico will not be out of place here.

The law grants to all inhabitants of the country the right to acquire and work mines. He has to denounce a new mine. A denouncement means making a location. When the location of a claim has been determined upon, all possible data are obtained concerning it before the denouncement is made. It may be a rich old mine, and yet if the law has not been complied with it is subject to relocation. The law grants to any inhabitant of the Republic the right to explore for mineral. All districts have their mining agents and all the prospector has to do is to have the regular form of petition used in making out a denouncement, as it is called, made out and submitted to the mining agent of the district. If there does not happen to be a mining agent in the district, the petition is presented to the local postmaster. The expense of registering the petition is \$1. After registering the petition, the mining agent has thirty days in which to appoint an expert to examine the property, who has eight days in which to reply to the summons, and if he accepts the service, the mining agent issues in duplicate a document stating that the claim has been denounced and directing objecting parties to make known their prior claims within a period of four months from the date of the denouncement, or forfeit any right to the property.

The charge of the expert for making a report upon the claim, together with the plans, is about \$15 per claim and travelling expenses. The expert has sixty days in which to send in his plans and report. The notification that the property has been denounced is published in the official journal of the district, the cost of which varies in the different states, from \$2 to \$4 being the usual fee.

The cost of making up a mining title is from \$10 to \$12. Titles, when once granted, unless fraud is shown, are irrevocable so long as the taxes are paid, which are ten dollars per year on each "pertenencia," and no work or manual labor is necessary to hold the same. The taxes may be paid quarterly or annually, at the discretion of the holder, to the mining agent of the district in which the property is denounced, or by special arrangement they may be paid at the office of the Federal Treasury in the City of Mexico. After the title is granted, it must be registered in the district where the denouncement is made, and also entered upon the books of the stamp office, for which no fees are charged.

MINTS AND DUTIES ON SILVER.

Under the Spanish laws all silver paid a duty; and as most of it was coined, that duty was levied on coinage, and the exportation of bullion was prohibited; but of course a great deal was smuggled, both during the Spanish rule and still more when Mexico was opened to foreign trade after our Independence. When I occupied for the first time the Treasury Department of Mexico in 1868, it seemed to me an outrage against the mining industry of the country to require the miners—especially those who were far removed from the mints—to take their bullion from the mints, at a heavy expense and risk, coin it there and take it back to the mines, and from there to the ports to be exported to London, where it was often again turned into bullion; and as the contracts made with the lessees of the mints did not allow the free exportation of bullion, I proposed and succeeded in having enacted a law for the purpose of allowing bullion to be exported, provided that it paid the coinage duty at the respective custom-houses for the benefit of the mint's lessees; and this condition of things, extraordinary as it may seem, was a great relief to the silver producers, and continued until the Mexican Government could recover all the mints and be free to legislate on the subject, which it was able to do partially during my last incumbency of the Treasury Department; they all since having been recovered.

We had thirteen mints in the country to coin the silver extracted from our mines, which, in the precarious condition of the Mexican Treasury, were sometimes rented to private parties who advanced a sum that seemed large at that time, although it was a trifle in comparison to their profits, as they collected a duty of nearly $4\frac{1}{2}$ per cent. upon the amount of bullion coined, and they credited to the Government only $1\frac{1}{2}$ per cent. of the same, the laws requiring that only coined silver could be exported. But now that silver can be transported easily from the mine to the mint, since a railway system has been built, the mints have been reduced to four,—one in the City of Mexico, which

is the principal one; one at each of the cities of Guanajuato, Zacatecas, and Culiacan, the last being the capital of Sinaloa.

Besides the mint or coinage duties, silver was taxed in Mexico with an export duty which sometimes was as high as twelve per cent. on the value of the silver, which, together with the mint duty, amounted to seventeen per cent., not taking into account other taxes and local duties. Only the rich character of the Mexican mines could stand that burden.

The duties on silver have been readjusted and reduced considerably, until now they only amount, as established by the law of March 27, 1897, to a coinage duty of two per cent. and a stamp duty of three per cent., which are paid at the Assay Office of the Mint when coined, or at the custom-house when exported in bullion, ores, or other compounds. When exported in ores in their crude condition, the duty has a rebate of ten per cent. A small duty representing the cost of the operation is also charged for assaying, refining, smelting, and separating the metals.

SMELTING PLANTS.

The Tariff Act of October 1, 1890, having levied a duty upon lead ore, which prevented that Mexican product from coming into the United States in the shape it had come before, the American companies, who had been developing the lead ore in Mexico, established smelting plants in the country for the purpose of treating there the lead ore, and sending it as pig-lead to the United States.

The smelting plants that have been established in Mexico, and their capacity and output, taken from official data received from the Mexican Government, up to December 31, 1896, are the following:

Mexican Metallurgical Company.—This company, of which Mr. Robert S. Towne is president, obtained a charter from the Mexican Government on March 20, 1890, to establish five smelting plants in Mexico, two with the minimum capacity of 200 tons a day, two of 150 tons, and one of 100 tons. The first one is located at Morales, five kilometres west of the city of San Luis Potosi. During the fiscal year 1895 to 1896, this plant received 62,370 and 020/1000 metric tons of ore from the States of Chihuahua, Coahuila, Durango, Guanajuato, Jalisco, Mexico, Michoacan, Nuevo Leon, Queretaro, San Luis Potosi, and Zacatecas. This plant yielded during the same year 16,019 and 070/1000 metric tons of base lead bullion, with 3,198,924.14 troy ounces of silver, valued at \$4,882,177.50; and 8268 and 37/100 troy ounces of gold, valued at \$161,338.63.

National Mexican Smelter at Monterey.—This company, whose president is Mr. Daniel Guggenheim, obtained a charter from the Mexican Government on October 9, 1890, to establish three smelting plants in Mexico, two with a minimum capacity of 300 tons per day,

and one with 100 tons. The first plant is located in the outskirts of the city of Monterey, has ten furnaces of the water-jacket system, and seven smelting furnaces for lead ore. From July, 1892, to June, 1896, this plant has smelted 521,809 and 769/1000 metric tons of ore, yielding 78,067 and 141/1000 tons of lead, with 515,382 kilograms of silver, with a value of \$21,824,597.93, having used foreign coke to the value of \$1,474,385.81, and Mexican coke to the value of \$73,268.08.

Central Mexican Smelter.—The second smelter of the Guggenheim Company is located at Aguascalientes. It has a department for concentrating copper ores, one for smelting the same ores, consisting of three furnaces, and another with four furnaces for smelting lead ores. This plant smelted from the 26th of December, 1895, 606 and 190/1000 tons of lead, containing 6502 kilograms of silver and 28 and 71/100 kilograms of gold, with a value of \$341,091.

Velardeña Mining Company.—This company, whose president is Mr. Edward W. Nash, obtained a charter from the Mexican Government on May 15, 1893, for the construction of two smelting plants in Mexico, with a capacity of 200 tons a day each. From November 30, 1893, to June 30, 1896, this plant smelted 110,000 tons of ore, yielding 9069 and 680/1000 tons of lead containing 1,850,685 troy ounces of silver and 6192 ounces of gold.

The Chihuahua Mining Company.—This company, whose president is Mr. John B. Shaw, obtained a charter from the Mexican Government May 26, 1893, and is located near the city of Chihuahua. Up to July 28, 1896, it had smelted 28,555 tons of lead ore, yielding 3761 tons of lead and 529,450 troy ounces of silver.

The Mazapil Copper Company, Limited.—This company established a plant at Concepcion del Oro, Zacatecas, and has smelted 5000 tons of lead ore containing silver.

Sabinal Mining and Smelting Company, Chihuahua.—This company owns the mines of Santa Juliana and Santa Inez, which yield 30 per cent. of lead, with a mixture of silver, and smelts their ore, notwithstanding that the cost of a ton of coke amounts to \$37.50.

La Preciosa.—A smelter under that name has been established at Tepeyahualco, State of Puebla, but I do not have any data about the company owning it, and the date of its contract with the Mexican Government, nor the amount of ore smelted there.

The Boleo Smelter.—I have already spoken of this plant, which smelts copper ores at Santa Rosalia, Lower California.

OROGRAPHY.

Mexico is traversed by two cordilleras or high ranges of mountains running almost parallel to the coast, one along the Gulf of Mexico and the other along the Pacific Ocean. The former runs from ten to